MIDWESTERN BUSINESS AND ECONOMIC REVIEW

Number 43
Spring 2009

In This Issue ....

BBGR

Bureau of Business and Government Research
Midwestern State University
Wichita Falls, Texas

Midwestern State University
Wichita Falls, Texas
http://www.mwsu.edu

Please direct all comments to:

Editor:
Midwestern Business
and Economic Review

Bureau of Business and
Government Research

Dillard College of
Business Administration

Midwestern State University
3410 Taft Boulevard
Wichita Falls, Texas 76308-2099

Telephone: (940) 397-4661
Fax: (940) 397-4693

MIDWESTERN BUSINESS AND ECONOMIC REVIEW

The *Midwestern Business and Economic Review* is published twice a year, in the fall and spring, by the Bureau of Business and Government Research. The articles published present the points of view of the individual authors and do not necessarily reflect those of the Bureau of Business and Government Research, the Dillard College of Business Administration, or Midwestern State University. The authors assume responsibility for the accuracy of facts published in the articles.

The *Midwestern Business and Economic Review* invites submission of original manuscripts and research by individuals in the public and private sector in the areas of economics and business administration. Of particular interest are topics dealing with issues relevant to Texas and the Southwestern United States. Submission requirements may be found inside the back cover.

Additional copies of this issue are available upon request for $5.00.

MIDWESTERN BUSINESS AND ECONOMIC REVIEW

No. 43 .....Spring 2009

Table of Contents

ABSTRACTS

BOND RATING AND CONVEXITY: COMPARISON BETWEEN UPGRADES AND DOWNGRADES

Convexity is a measure of a bond's inherent capability to resist price decline as interest rates rise and promote price increase as interest rates fall. Obviously, convexity is a desirable characteristic of bonds, and yet it has not been included in the set of attributes used by bond rating agencies. Upgrading or downgrading of a bond's rating imparts a rating agency's changed view on the quality of bond. We compare the effect of change in bond rating and change in yield on bond convexity between two groups: upgrades and downgrades. It is found that the two groups are significantly different in rating change and yield change, but not significantly different in convexity change.

THE RELATIONSHIPS AMONG GENDER, WORK EXPERIENCE, AND LEADERSHIP EXPERIENCE IN TRANSFORMATIONAL LEADERSHIP

The transformational leadership style—with its emphasis on participation, sharing power and information, and individual consideration to employees—is often described as a feminine leadership style. Numerous authors have speculated that gender differences existed in transformational leadership. The purpose of this study is to examine the relationships among gender, working experience, supervisor experience, and six transformational leadership dimensions by analyzing 992 (495 males and 493 females) valid and usable questionnaires. The factorial ANOVA results show that females rated themselves significantly higher than males in: 1) overall transformational leadership style, and 2) five of the six transformational leadership dimensions: vision, communication, trust, sensitivity to self and others, and management of feelings. No significant link was established between working experience and transformational leadership. However, supervising experience did affect transformational leadership. This suggested that leadership skills could be acquired from leadership experience but not from working experience.

THE IMPACT OF REGULATION ON RESEARCH AND THE FORMATION OF RESEARCH JOINT VENTURES

This paper considers the impact of two forms of regulation, price-cap and rate-of-return, on the incentive of firms to produce R&D and form research joint ventures. We find that price-cap regulation dominates rate-of-return regulation in a variety of research cooperation scenarios. Outside of a full research information sharing agreement, we find that the advantages of cooperation versus noncooperation under both types of regulation are dictated largely by the appropriability problem. As a result, noncooperation is superior only when the natural rate of knowledge spillover is low and the production output of firms is relatively substitutable. With higher rates of information spillover, however, cooperation in research production is more beneficial than noncooperation.

THE INTERNET'S IMPACT ON INTER-BRAND COMPETITION IN NEW CAR MARKETS

The internet has dramatically impacted competition in new car markets. Yet while the impact on intra-brand competition is well documented, the impact on inter-brand competition has been largely ignored. This paper specifically addresses the impact on inter-brand competition by examining the internet's role in the search process. The model is a two-equation simultaneous system with one continuous and one dichotomous dependent variable. Equation one explains the overall amount of inter-brand search while equation two explains the decision to utilize the internet in the search process. The confirmation of an increase in inter-brand competition has important implications as dealers, manufacturers and regulators grapple to adjust the spatial distribution of dealerships in the age of the internet.

A NOTE ON INFLATION AND STOCK RETURNS: AN EXAMINATION OF EQUITY MARKET PERFORMANCE IN EIGHT MAJOR ECONOMIES

This paper analyzes the impact of the level of inflation and changes in the rate of inflation on the stock markets of 8 major economies. We find that increases in both variables are negatively associated with real stock returns, but only the change in inflation variable showed statistical significance in diversified portfolios linked to those 8 nations. The effect of creating such globally diversified portfolios not only increased the significance of the change in inflation coefficient compared to single country results, but it also improved the R^2. The results suggest that by increasing global diversification, one may become more vulnerable to the forces of systematic risk inherent in global inflation.

EXAMINING RETIREMENT PLANNING OF UNIVERSITY STUDENTS – ARE THEY BEING REALISTIC?

We examine whether university students have false sense of financial security with respect to one key element of personal finance, the retirement planning. Are they realistic in their understanding of this important aspect of life? Employing survey data of university students and using realistic assumptions of financial variables, we find that there is statistically significant difference between the actual and perceived retirement needs of the students. Similarly, there is a significant difference in the actual and perceived monthly savings needed to build sufficient retirement fund by these students. Students who maintain a financial plan; save regularly; spend less on credit cards and carry less debt are more financially literate. Similarly, individuals with less college education; with greater credit card usage; who do not make timely payments on credit card liabilities; carry greater credit card and student loans; and do not save on a regular basis are the ones with greater financial illiteracy. We argue that there is a systematic lack of personal finance education in our society.

BOND RATING AND CONVEXITY: COMPARISON BETWEEN UPGRADES AND DOWNGRADES

Minje Jung, University of Central Oklahoma
Stephen M. Black,University of Central Oklahoma

INTRODUCTION

Convexity is a measure of bond's inherent capability to resist price decline as interest rates rise. It is also a measure of bond's natural quality to promote price increase as interest rates fall. Obviously, convexity is a desirable characteristic of bond, and yet it has not been included in the set of attributes used by bond rating agencies. It is well documented that bond ratings have a significant effect on bond price. However, it has not been investigated whether bond ratings do have some positive effect on convexity, thus enhancing a bond's characteristic such that it reduces its interest rate risk.

Changes in bond ratings are the direct results of the financial market's reevaluation of the bond's default risk that is perceived to be the most significant financial risk in bond market. Upgrading or downgrading of the bond ratings imparts a rating agency's changed view on the quality of bonds to the markets. Rating agencies' reevaluation of bond quality is taken as an impartial, unbiased reassessment of issuing firms' financial risk, and it well reflects the changes in market participants' views and opinions on the quality and risk of the bond. Improvement in a bond rating (i.e., upgrading) conveys positive information about the quality of bond due to lower level of default risk, whereas deterioration in bond ratings (i.e., downgrading) transmits negative information to the markets.

The main purpose of this paper is to examine the relationship between bond ratings and convexity for two types of bond: upgrades and downgrades. We are going to explore the relationship between the change in bond ratings and change in bond convexity. We will also examine whether there exists a statistically significant difference in the relationship between upgraded bonds and downgraded bonds. The paper proceeds as follows: Section II reviews the literature on bond convexity and bond ratings; Section III describes the data and sample statistics; Section IV presents results of regression analysis; and conclusions are in Section V.

LITERATURE REVIEW

Convexity

The convexity of bond's price-yield function is the curvature of the function. The more convex (i.e., bent) the price-yield curve is, the more favorable is the effect of interest rate changes on bond prices. That is, as interest rates fall, the prices of high convexity bonds rise more than those of low convexity bonds. As interest rates rise, the prices of high convexity bonds fall less than those of low convexity bonds. Convexity is the bend, or curvature, of the price-yield function, and it is defined as the change in duration for a change in yield. Duration is equal to the slope of the bond's price-yield curve, and it is, in fact, the first-order derivative of the convex bond price-yield function. Convexity is, therefore, the second-order derivative of the convex bond price-yield function. Thus, a higher convexity bond's price will increase more as rates drop. As interest rates rise, its price drops less than a lower convexity bond (Grantier, 1988).

This relationship translates into better defense against rising interest rates, and greater price appreciation when interest rates fall. Thus, convexity is often cited as a desirable characteristic of a bond because of its favorable effect on bond price (Kritzman, 1992). The magnitude of convexity indicates the strength of resistance of the bond price decline as interest rate rises. The larger the magnitude (i.e., the more convex the curve is), the less the decline in the value of bond as interest rates increase. As interpreted by Dunetz and Mahoney (1988), as interest rates fall, high-convexity bond prices rise faster than the price of low-convexity bonds. High-convexity bonds outperform low-convexity bonds in an environment of falling interest rates. Conversely, high-convexity bond prices decline less than low-convexity bond prices when rates rise. Therefore, high convexity bonds also outperform low convexity bonds in an environment of rising interest rates. These performance characteristics of bond prices due to convexity should be positively related to bond rating. The formula for the convexity of a bond with a maturity of n years and annual coupon payments is:

$$Convexity = \frac{1}{P \times (1+y)^2} \sum_{t=1}^{n} \left[\frac{CF_t}{(1+y)^t} \left(t^2 + t \right) \right]$$

Where, CF_t is the cash flow, and P and y denote price and yield to maturity, respectively.

Bond rating

Bond rating agencies, such as Standard and Poor's Corporation and Moody's Investor Services, analyze various features of bonds and indicators of the issuing corporations' financial soundness before assigning quality ratings. Market participants want ratings to be a view of an issuer's relative fundamental credit risk, which they perceive to be a stable measure of intrinsic financial strength (Moody's Investors Service, 2002). Bond ratings are an indicator of default risk, and prices of corporate bonds generally respond to the announcement change in bond ratings that are based on careful and deliberate analysis of long-term financial risks.

Despite empirical findings that changes in bond and stock prices precede rating changes (Weinstein, 1977, Griffin & Sanvicente, 1982), bond ratings appear to have significant impact on the market prices of both bonds and stocks (Hand, Holthausen, and Leftwich, 1992). Previous studies on the relationship between bond ratings and default rates in each category of bond ratings show that the percentage of firms that defaulted was higher in the lower rated group than in the higher rated group (Pye, 1974; Wood & Wood, 1985). Bond ratings are based on the level and trend of the issuer's financial ratios and the significance and size of business of the issuing firms (Pinches & Mingo, 1973; Kaplan & Urwitz, 1979).

DATA DESCRIPTION

For those bonds whose ratings changed during year 2001, data on bond rating, market price, coupon, maturity, and yield were collected one month before and after the day of rating changes from the Mergent Annual Bond Report. Also calculated is convexity one month before and after a rating change using the price, yield, and remaining time until maturity before and after, respectively. For group comparison and the following regression analysis, qualitative bond ratings were quantified following the scale shown below:

Aaa3=27, Aaa2=26, Aaa1=25, Aa3=24, Aa2=23, Aa1=22, A3=21, A2=20,
A1=19, Baa3=18, Baa2=17, Baa1=16, Ba3=15, Ba2=14, Ba1=13, B3=12,
B2=11, B1=10, Caa3=9, Caa2=8, Caa1=7, Ca3=6, Ca2=5, Ca1=4, C3=3, C2=2, C1=1.

There were in total 217 bonds whose ratings changed during the year of 2001. The sample includes mortgage bonds, subordinate notes, superior notes, guaranteed notes, and debentures. It is divided into two groups: 99 upgrades and 118 downgrades. Statistics of three variables are reported in Table 1 and Table 2 for two groups: upgrades and downgrades. For upgrades, average rating change is a 17.66 percent increase from 15.37 to 17.56 which is an equivalent change from Ba3 to Baa3. Average rate of change in yield to maturity is a 0.025 percent increase, while the average rate of change in convexity is a 0.119 percent decline, and the results are consistent with the negative relationship between yield and convexity. For downgrades, average rating change is a 27.17 percent decrease from 15.13 to 11.69 which is equivalent to a downgrade from Ba3 to B3. Average rate of change in yield to maturity and convexity are 26.02 percent and -1.11 percent, respectively, and the results are also consistent with the negative relationship between yield and convexity. Overall, changes in bond rating, and the resulting changes in yield and convexity appear to be more conspicuous in downgrades than in upgrades.

The results of *t*-tests for the difference between the two groups are reported in Tables 3-5. Tables 3 and 4 show that the two groups are significantly different in rating change and yield change, with *p*-values of 4.26E-40 and 0.002, respectively. However, the upgraded and downgraded bonds are not significantly different in convexity change as seen in Table 5. The extent of change in yield due to change in bond rating is found to be significantly different between two groups. Change in yield due to price decline with downgrading exceeds change in yield due to price rise with upgrading. In other words, downgraded bonds price and yield have a higher degree of sensitivity to rating change than upgraded bonds. Convexity change in response to the announcement of bond rating change is found to be a negligible -0.011 percent for upgrades and -1.113 percent for downgrades. Again, decline in convexity as bonds are downgraded appears to be more severe than the convexity decline in upgraded bonds. However, the difference in convexity change between two groups is statistically insignificant.

Table 1
Sample Statistics- Upgrades

	rating change	yield change	convexity change
Mean	0.176	0.000	-0.001
Standard Error	0.019	0.016	0.003
Median	0.090	-0.005	0.001
Mode	0.058	0	0
Standard Deviation	0.187	0.165	0.034
Sample Variance	0.035	0.027	0.001
Kurtosis	2.858	7.275	10.379
Skewness	1.878	0.906	-1.040
Range	0.754	1.330	0.296
Minimum	0.045	-0.582	-0.156
Maximum	0.800	0.748	0.139
Sum	17.132	0.024	-0.115
Count	97	97	97

Table 2
Sample Statistics- Downgrades

	rating change	yield change	convexity change
Mean	-0.271	0.260	-0.011
Standard Error	0.019	0.087	0.033
Median	-0.236	0.019	-0.001
Mode	-0.055	#N/A	#N/A
Standard Deviation	0.211	0.949	0.368
Sample Variance	0.044	0.902	0.135
Kurtosis	1.263	40.122	48.966
Skewness	-1.274	5.607	5.531
Range	0.847	8.922	4.132
Minimum	-0.888	-0.927	-0.957
Maximum	-0.041	7.994	3.174
Sum	-32.065	30.705	-1.313
Count	118	118	118

Table 3
t-Test: Two-Sample Assuming Unequal Variances-Rating Change

	upgrades	*downgrades*
Mean	0.176	-0.271
Variance	0.035	0.044
Observations	97	118
Hypothesized Mean Difference	0	
df	212	
t Stat	16.469	
P(T<=t) one-tail	4.26E-40	
t Critical one-tail	1.652	
P(T<=t) two-tail	8.52E-40	
t Critical two-tail	1.971	

Table 4
t-Test: Two-Sample Assuming Unequal Variances- Yield Change

	upgrades	*downgrades*
Mean	0.000	0.260
Variance	0.027	0.902
Observations	97	118
Hypothesized Mean Difference	0	
df	126	
t Stat	-2.919	
P(T<=t) one-tail	0.002	
t Critical one-tail	1.657	
P(T<=t) two-tail	0.004	
t Critical two-tail	1.978	

Table 5
t-Test: Two-Sample Assuming Unequal Variances- Convexity Change

	upgrades	downgrades
Mean	-0.001	-0.011
Variance	0.001	0.135
Observations	97	118
Hypothesized Mean Difference	0	
df	119	
t Stat	0.291	
P(T<=t) one-tail	0.385	
t Critical one-tail	1.657	
P(T<=t) two-tail	0.771	
t Critical two-tail	1.980	

RESULTS

To examine how convexity change is related to changes bond rating and yield, an empirical regression analysis is performed: $\Delta(\text{Convexity}) = \alpha + \beta_1 \cdot \Delta(\text{Rating}) + \beta_2 \cdot \Delta(\text{Yield}) + \varepsilon$ where Δ represents change in each variable.

Table 6 reports the results of the regression analysis for upgrades. Change in convexity is regressed on two independent variables: bond rating change and yield change. Change in bond rating (i.e., upgrading), that is the reflection of market's favorable reassessment of the financial risk of the bonds, is negatively related to convexity change. This negative relationship is consistent with theoretical relationship between convexity and bond upgrading which results in rise in price. The coefficient of the variable is -0.08, and it is yet statistically insignificant, with a *p*-value 0.93. Change in yield appears to be significantly negatively related to change in convexity with *p*-value 9.93-E-19 which is almost zero. This result is consistent with the negative relationship between yield and convexity as shown in convexity equation. Also, the result is an indication of tremendously significant impact of rising yield (i.e., falling price) on convexity. An R-Square of 0.58 indicates sufficient explanatory power of the independent variables (i.e., changes in bond rating and yield) for convexity change. The regression model appears to be robust enough with an F-Statistic score of 64.93 that is statistically significant with a *p*-value 1.94E-18.

Table 7 presents results of the regression analysis for downgrades. Change in yield is negatively related to convexity change with coefficient -7.35 that is statistically significant with a *p*-value of 3.11E-11. This result is consistent with the negative relationship between yield and convexity as shown in the convexity equation. Rating change for this group is negative (i.e., downgrading), and, in the regression, it appears to be negatively related to convexity change. As rating change increases (i.e., less downgraded), the price of the bond rises, thus convexity falls. This negative relationship is consistent with the theoretical relation between bond price and convexity as shown in the convexity equation. Unlike the case of upgraded bonds, this negative relationship for downgraded bonds is statistically significant with a coefficient of -2.34 that has a *p*-value of 0.02.

Viewed overall, yield is negatively related to convexity for both upgraded and downgraded bonds. It is also found that bond rating is negatively related to convexity. As bond ratings change, the ensuing change in price causes the convexity to decline for both upgrades and downgrades, as predicted by theoretical convexity equation.

Table 6
Bond Rating Upgrades: Regression Analysis

Regression Statistics	
Multiple R	0.761
R Square	0.580
Adj. R Square	0.571
Standard Error	0.022
Observations	97

	df	SS	MS	F	Significance F
Regression	2	0.065	0.032	64.93	1.94E-18
Residual	94	0.047	0.000		
Total	96	0.113			

	Coefficients	Standard Error	t Stat	P-value
Intercept	0.000	0.003	-0.299	0.765
Rating Chg	-0.001	0.013	-0.085	0.931
YTM Chg	-0.158	0.014	-11.071	9.93E-19

Table 7
Bond Rating Downgrades: Regression Analysis

Regression Statistics	
Multiple R	0.565
R Square	0.319
Adj. R Square	0.307
Standard Error	0.306
Observations	118

	df	SS	MS	F	Significance F
Regression	2	5.084	2.542	27.027	2.39E-10
Residual	115	10.817	0.094		
Total	117	15.902			

	Coefficients	Standard Error	t Stat	P-value
Intercept	-0.040	0.046	-0.881	0.379
Rating Chg	-0.329	0.140	-2.341	0.020
YTM Chg	-0.229	0.031	-7.350	3.11E-11

CONCLUSION

We compared the effect of change in bond rating and change in yield on bond convexity between two groups: upgrades and downgrades. It is found that the two groups are significantly different in rating change and yield change, but not significantly different in convexity change. With change in bond rating, downgraded bonds experience a higher degree of decline in bond rating and also a higher degree of rise in yield than upgrades do. Downgrading and ensuing rise in yield is more conspicuous than upgrading and ensuing fall in yield. However, the decline in convexity caused by rating change is not distinguishable between two groups. Both upgrades and downgrades experience decline in convexity, but the differential decline between two groups is not statistically significant. Results of regression analysis show that bond rating and yield are negatively related to convexity for both upgraded and downgraded bonds.

REFERENCES

Dunetz, M.L., & Mahoney, J..M. (1988). Using duration and convexity in the analysis of callable bonds. *Financial Analyst Journal, 44* (3), 53-73.

Grantier, B.J. (1988). Convexity and bond performance: The benter, the better. *Financial Analyst Journal, 44* (6), 79-81.

Griffin, P.A., & Sanvicente, A.Z. (1982). Common stock returns and rating changes: A methodological comparison. *Journal of Finance, 47* (1), 103-119.

Hand, J R., Holthausen, R.W, & Leftwich, R.W. (1992). The effect of bond rating agency announcements on bond and stock prices. *The Journal of Finance*, *47* (2), 733-752.

Kaplan, R.S., & Urwitz, G. (1979). Statistical models of bond rating: A methodological inquiry. *Journal of Business*, *52* (2), 231-262.

Kritzman, M, (1992). What practitioners need to know about duration and convexity. *Financial Analyst Journal, 48* (6), 17-20.

Mergent, Inc. (2002). *Mergent Bond Record 69* (1-12). Mergent FIS: New York, NY.

Moody's Investors Service, (May 2002). *Special comment: Understanding Moody's corporate bond ratings and rating process*. Moody's Investor Service: New York, NY.

Pinches, G.E., & Mingo, K.A. (1973). A multivariate analysis of industrial bond ratings. *Journal of Finance, 28* (1), 1-31.

Pye, G. (1974). Gauging the default premium. *Financial Analyst Journal, 30* (1), 49-52.

Weinstein, M.I. (1977). The effect of a rating change announcement on bond prices. *Journal of Financial Economics, 5* (3), 329-350.

Wood, J.H., & Wood N.L. (1985). *Financial Markets*, (pp. 293). Harcour Brace Jovanovich: Orlando, Fla.

THE RELATIONSHIPS AMONG GENDER, WORK EXPERIENCE, AND LEADERSHIP EXPERIENCE IN TRANSFORMATIONAL LEADERSHIP

Jennifer Y. Mak, Marshall University
Chong W. Kim, Marshall University

INTRODUCTION

Transformational leadership is an organizational leadership theory centered around "the ability to inspire and motivate followers to achieve results greater than originally planned and for internal reward" (Gibson, Ivancevich, & Donnelly, 2000). The investigation into transformational leadership began in the mid-1980s with a number of influential publications by Bass (1985), Bennis and Nanus (1985), Kouzes and Posner (1987) and Tichy and Devanna (1986). In the 1980s, the study of transformational leadership was focused on case-based research (Conger, 1999). By the late 1990s, a substantial body of empirical investigations on transformational leadership had been conducted (Conger, 1999).

A transformational leader "articulates a vision, uses lateral or nontraditional thinking, encourages individual development, gives regular feedback, uses participative decision-making and promotes a cooperative and trusting work environment" (Carless, 1998: 888). This leadership style is often "depicted as a feminine leadership style because of its emphasis on the manager's intellectual stimulation of, and the individual consideration given to employees" (van Engen, van der Leeden & Willemsen, 2001: 582). The handling of employees in this manner seems to be more passive and relationship oriented. Such management attributes seem to "resemble those stereotypically attributed to women." (van Engen et al., 2001). Numerous authors have speculated on possible gender differences in transformational leadership (Avolio & Bass, 1988; Bycio, Hackett, & Allen, 1995; Carless, 1998). However, some other results could be conflicting (Eagly and Johnson, 1990). The purpose of this study is to examine the web of relationships among gender, working experience, supervisor experience, and transformational leadership.

THEORETICAL RATIONALE FOR EXAMINING GENDER DIFFERENCES IN LEADERSHIP STYLE

Individuals behave according to societal gender-role expectations (Eagly, 1987). Under the gender-role spillover concept (Eagly & Johnson, 1990), gender-based expectations for behavior would carry over into the workplace (Nieva & Gutek, 1981; Gutek & Morasch, 1982). "The spillover concept suggests that gender roles may contaminate organizational roles to some extent and cause participants to have different expectations for female and male managers" (Eagly & Johnson, 1990: 235).

On the other hand, Kanter (1977) and Eagly, Karau & Makhijani (1995) disagreed on gender differences in leadership style. Kanter (1977) argued that organizational roles should override gender roles under a structural interpretation of organizational behavior. Male and female managers who occupied the same organizational role, went through the same socialization process into their leadership roles, and were selected under the same set of organizational criteria, should manifest no significant differences in leadership style (Eagly & Johnson, 1990). Eagly et al. (1995) further argued that if women and men were at the same hierarchy level within the organizations they should have comparable positions and their defining roles would be the same.

With a gender-centered approach toward the transformational theory, studies have tried to prove that individual attributes vary by gender (Carless, 1998). This approach proposed that charisma, caring, and nurturance characterized a feminine leadership style, while a male leadership style was associated with instrumental, dominating, and task-oriented qualities (Carless, 1998; Klenke, 1996; van Engen et al., 2001). Rosener (1990) stated that the feminine leadership style has developed beyond the command-and-control style of managing that may have influenced the first female leaders. Today, female leaders have drifted away from styles and habits that have traditionally proven effective for men. Females demonstrate gender differences in their leadership styles by making use of skills and abilities they have developed through interacting and sharing with other females. Female leaders are using their unique socialization attributes as a means of leading. Women are succeeding with the aid of their feminine characteristics, the same characteristics that were considered to be inappropriate for leaders. The success of women leaders has proven that their nontraditional style functions well in many different organizational environments. Rosener (1990) specifically stated that women encourage participation, share power and information, enhance other participants' self-worth and get others excited about their works. Yoder (2001) further supported that the transformational leadership style and characteristics establish a congenial atmosphere that allows women to actualize their leadership effectiveness.

Eagly and Johannesen-Schmidt (2001) determined that women exceeded men in three transformational attributes: idealized influence, inspiration motivation, and individualized consideration. Their findings suggested that female managers are more able than male managers to:

1. display attributes that motivated their subordinates to feel respect and pride;
2. show enthusiasm about future goals;

3. develop and mentor subordinates according to individual needs.

A survey in 2000, sponsored by the International Women's Forum, demonstrated that men and women differ in how they describe their leadership performance and how they influence those with whom they work. Men were found to describe themselves in terms corresponding with the transactional leadership style; they utilized the power that came from their positions and formal authority. In contrast, women would use characteristics that were more in line with the transformational leadership style; they were able to influence their subordinates to transform their own self-interest into the group interest, and their power came from personal characteristics such as charisma, interpersonal skills, hard work, or personal contacts rather than organizational status (Rosener, 1999).

Research on gender differences in transformational leadership showed divergent findings. Carless (1998), Komives (1991a, 1991b) and Maher (1997) found no difference between male and female in transformational leadership, whereas Doherty (1997) and Druskat (1994) reported significant differences in the expected gender stereotypic direction. Bass, Avolio and Atwater (1996) noted inconsistent findings for gender differences in transformational leadership in three studies with different samples of managers.

HYPOTHESIS

In summary, the investigators suggest that transformational leadership theory is a feminine leadership style. Therefore, females score higher in transformational leadership and its indicators than males. The investigators also agree that working and supervising experiences will enhance the transformational leadership skills. Thus,

Hypothesis 1: Females score higher than males in transformational leadership.

Hypothesis 2: People with working experience score higher than people without working experience in transformational leadership.

Hypothesis 3: People with supervising experience score higher than people without supervising experience in transformational leadership.

METHODS

Procedures and measures

Stratified random sampling and the Salant & Dillman (1994) survey methodology were adopted for data collection. The Transformational Leadership Scale (Hellriegel & Slocum 2004) was used as the instrument to measure the variables. Part I of the survey instrument consisted of twenty-four questions related to transformational leadership. It was designed and scaled to elicit responses on the six transformational leadership indicators:

1. Management of attention – Paying special "attention to outcomes" through a clear vision conveyed to coworkers (Gaillour, 2002). This idea stresses the importance of detail to the successful leader.
2. Management of meaning – This concept alludes to an ability to "take the abstract and convey what it means experientially" (Gaillour, 2002). Defining meanings will require the leader to communicate effectively with followers.
3. Management of trust – How high is your trust rating among employees and colleagues? Followers will base their decisions on the leader's track record such as commitments and clear business stances. A good leader must gain the trust and respect of his/her followers to be successful (Hellriegel, & Slocum 2004).
4. Management of self – Related to "general attitudes toward yourself" and regard for the well being of others. Specifically, the ability to place positive value on how the leader and coworkers feel about themselves (Hellriegel & Slocum 2004).
5. Management of risk – This type of manager would assume risks, but only after assessing alternatives and consequences from several angles. A transformational leader would certainly "not spend excessive time or energy on plans to 'protect' themselves against failure". Actions such as this are negative in nature, and would waste the time of the transformational leader (Hellriegel & Slocum 2004).
6. Management of feelings – The placing of importance on making coworkers feel more "competent" about their performances, and making their subsequent works more "meaningful." This skill would have a great impact on morale and efficiency (Hellriegel & Slocum 2004).

Each indicator consisted of 4 questions and was based on a 5-point Likert-type scale with the following options: "5" – to a very great extent; "4" – to a considerable extent "3" – to a moderate extent; "2" – to a slight extent; and "1" – to little or no extent. Part II of the survey instrument consisted of participants' demographic characteristics such as gender, age, race, and education, etc. The pilot instrument was tested on 91 participants from Mid-Atlantic Area, consisting of 30 males and 59 females, mainly graduate students (56%), white (85.7%), and between the ages of 18-24 (56%). The Cronbach Alpha Coefficient was 0.91 and it was concluded that the Transformational Leadership Scale was internally consistent and reliable.

Analysis of data

Upon completion of the pilot study, the Salant & Dillman (1994) survey methodology was implemented. First, in late March a personalized advance-notice letter was sent to the faculty members who administer the data collection. About one week later, another personalized cover letter, a package of questionnaires and study information sheets were mailed to faculty members. Eight days after these mailings, follow-up postcards were sent to the faculty. The follow-up postcards expressed thanks to those who had responded and requested a response from those who had not yet responded. Three weeks after the first questionnaire package was mailed, another personalized cover letter, a package of questionnaires, and study information sheets were sent to those who had not responded. The entire procedure yielded a total of 992 valid and usable questionnaires.

Table 1 *Demographic Information to Participants*

Demographic	n	%
Gender		
Male	495	50.1
Female	493	49.9
Total	988	100.0
Missing	4	
Race		
Caucasian	839	86.9
Other	126	13.1
Total	965	100.0
Missing	27	
College		
College of Business	576	58.1
College of Education and Human Service	416	41.9
Total	992	100.0
Full-Time Working Experience		
No Full-time working experience	434	43.8
1-5 years Full-time working experience	372	37.5
More than 5 years Full time working experience	186	18.8
Total	992	100.0
Supervising Experience		
Yes	334	33.7
No	658	66.3
Total	992	100.0

Table 2 *Descriptive Information of the Six Indicators of Transformational Leadership*

Indicators	Mean	SD
Management of Trust	17.07	1.80
Management of Self	17.02	2.02
Management of Attention	16.66	1.93
Management of Feelings	16.37	2.30
Management of Meaning	16.10	2.26
Management of Risk	15.03	2.38
Transformational Leadership Total	98.28	9.69

[a] N = 992.

Table 3 *Factorial (2X2X3) ANOVA of Transformational Leadership*

Source of Variation	SS	df	MS	*F*	p
Main Effects					
Gender	1009.30	1	1009.30	10.92	.00*
Supervising Experience	555.67	1	555.67	6.01	.01*
Working Experience	109.59	2	54.80	0.59	.55
2 Way Interactions					
Gender/Supervising Experience	33.73	1	33.73	0.37	.55
Gender/Working Experience	17.04	2	8.52	0.09	.91
Supervising Experience/Working Experience	418.88	2	209.44	2.27	.10
3 Way Interactions					
Gender/Supervising Experience/ Working Experience	169.34	2	84.67	.92	.40
Residual	86529.99	936	92.45		
Total	89087.14	947			

[a] N = 992.
*p <.05

The data were analyzed using three statistical techniques. An analysis of frequency distribution was used to describe the participants' demographic information and the indicators of transformational leadership. The Cronbach Coefficient Alpha test was used to establish reliability and internal consistency for the questionnaire. Factorial Analysis of Variance (ANOVA) was used to identify significant relationships among gender, supervising experience, working experience, and transformational leadership.

RESULTS AND DISCUSSION

Participants

Data were collected from undergraduate and graduate students enrolled in the College of Business and College of Education and Human Services. A total of nine hundred ninety two (992) usable responses—which consisted of 495 males and 493 females students, mainly white (86.9%), and between the ages of 18-22 (51.6%)—were collected from a Mid-Atlantic University (See table 1). More than half of the participants (56.3%; n=541) with full-time working experience and over one-third of participants have supervising experience (34.5%; n=320) (See table 1). The Cronbach Alpha Coefficient was 0.87, indicating that the Transformational Leadership Scale was internally consistent and reliable.

Transformational leadership

The descriptive information of the six transformational leadership indicators is presented in Table 2. The six indicator means ranged from 15.03 to 17.07 out of a possible score of 20 with standard deviations ranged from 1.80 to 2.38. Five out of six indicator means were higher than 16. This suggests that almost all participants responded with a "4—to a considerable extent," thus illustrating the importance of these indicators to participants. These results support the notion that participants focus on key issues and are able to prioritize those issues. On the other hand, the management of risk indicator had the lowest mean of 15.03, which suggested the participants are moderate risk takers and tend to take more calculated risks (Hellriegel & Slocum, 2004).

Factorial (2X2X3) ANOVA of transformational leadership

The Factorial (2X2X3) ANOVA was used to identify the differences among gender, supervising experience, working experience and transformational leadership (see table 3). Hypothesis 1 stated that females score higher than males in transformational leadership and Hypothesis 3 stated that people with supervising experience score higher than people without supervising experience in transformational leadership. Results indicate that there were significant differences in transformational leadership based on gender [F (948) = 10.92, p<.05; power = .91; R^2 = .012], and supervising experience [F (948) = 6.01, p<.05; power = .69; R^2 = .006] (see table 3), thus, Hypothesis 1 and Hypothesis 3 are supported. Females (M=99.19) received significantly higher score than males (M=97.34) in transformational leadership (see table 4). These findings are consistent with earlier studies (Bass et al., 1996; Druskat, 1994). In addition, participants with supervising experience (M=99.21) scored significantly higher than

participants without supervising experience (M=97.80) in transformational leadership (see table 5). Hypothesis 2 stated that people with working experience score higher than people without working experience in transformational leadership. However, results indicate that there was no significant difference in transformational leadership based on working experience [F (948) = 0.59, p<.05; power = .15; R^2 = .001], thus, Hypothesis 2 is rejected.

Factorial (2X2X3) ANOVA of transformational leadership indicators

Significant differences were found between males and females across five indicators: management of trust; management of self; management of attention; management of feelings; and management of meaning (see table 4). On the other hand, management of risk was the only indicator that showed no significant difference between males and females [F **(948) =** 0.21, p<.05] (see table 4).

Significant differences were found between participants with supervising experience and without supervising experience in three indicators: management of trust; management of attention; and management of risk (see table 5). On the other hand, management of self, management of feelings, and management of meaning revealed no significant difference between participants with supervising experience and those without supervising experience (see table 5). Moreover, there were no significant differences in the six transformational leadership indicators based on working experience.

Table 4 *Descriptive Information of the Six Indicators of Transformational Leadership between Male and Female* [a]

Indicators	Male		Female	
	Mean	SD	Mean	SD
Transformational Leadership*	97.34	9.17	99.19	10.11
Management of Trust*	16.89	1.81	17.24	1.77
Management of Self*	16.83	1.96	17.21	2.07
Management of Attention*	16.49	1.88	16.82	1.98
Management of Feelings*	16.13	2.28	16.60	2.30
Management of Meaning*	15.75	2.26	16.46	2.20
Management of Risk	15.22	2.19	14.84	2.57

[a] N = 992.
*p <.05

Table 5 *Descriptive Information of the Six Indicators of Transformational Leadership between with supervising and without supervising experience* [a]

Indicators	Supervising		Non-Supervising	
	Mean	SD	Mean	SD
Transformational Leadership*	99.21	9.08	97.80	9.97
Management of Trust*	17.28	1.62	16.95	1.87
Management of Self	17.17	1.88	16.94	2.09
Management of Attention*	16.84	1.91	16.56	1.94
Management of Feelings	16.45	2.16	16.32	2.37
Management of Meaning	16.14	2.23	16.07	2.28
Management of Risk*	15.38	2.17	14.85	2.47

[a] N = 992.
*p <.05

Management of trust

Females (M=17.24) received significantly higher scores than males (M=16.89) in the management of trust (see table 4). These findings supported the Eagly and Johannesen-Schmidt (2001) research findings that female leaders motivate their followers to feel respect and pride. Moreover, participants with supervising experience (M=17.28) scored significantly higher than participants without supervising experience (M=16.95) in management of trust. On the other hand, there was no significant difference in transformational leadership based on working experience [F (948) = 0.59, p<.05].

Management of self

Females (M=17.21) received significantly higher scores than males (M=16.83) in the management of self (see table 4). Females sought to develop and mentor followers and attend to their individual needs more than men (Eagly & Johannesen-Schmidt, 2001). However, there were no significant differences in transformational leadership based on working experience and supervising experience.

Management of attention

Females (M=16.82) received significantly higher scores than males (M=16.49) in the management of attention (see table 4). This finding is consistent with the literature; females are more focused on task accomplishment than males and show more optimism and excitement regarding future goals (Eagly & Johannesen-Schmidt, 2001; Eagly & Johnson, 1990; Gardiner & Tiggemann, 1999). Participants with supervising experience (M=16.84) scored significantly higher than participants without supervising experience (M=16.56) in management of attention. However, there was no significant difference in transformational leadership based on working experience [F (982) = 0.14, p<.05].

Management of feelings

Females (M=16.60) received significantly higher scores than males (M=16.13) in the management of feelings (see table 4). This finding is consistent with findings by Gardiner and Tiggemann (1999), Eagly and Johannesen-Schmidt (2001), and Eagly and Johnson, (1990). Females are interpersonally oriented (Gardiner & Tiggemann, 1999) and place more importance on interpersonal relations than males (Eagly & Johannesen-Schmidt, 2001; Eagly & Johnson, 1990). Nonetheless, there were no significant differences in transformational leadership based on working experience and supervising experience.

Management of meaning and management of risk

Regarding the management of meaning, females (M=16.49) have a higher ability to convey messages and better overall communication skills than males (M=15.75) (see table 4). The findings of this study support prior research (Carless, 1998; Davidson & Burke, 2000; Gardiner & Tiggemann, 1999; Helgesen, 1990; Panopoulos, 1998; Rosener, 1990; van Engen et al., 2001; Yammarino & Bass, 1990; Yammarino, Dubinsky, Comer & Jolson, 1997; Yoder, 2001). Compared to men, women are more inclined to collectively distribute credit for success, ask questions, offer feedback with tact by incorporating praise into criticism, and indirectly give others orders. Whereas men are prone to boastfulness, offering

bluntly critical feedback, withholding compliments, and asking fewer questions (Kinicki & Kreitner, 2003). However, there were no significant differences in transformational leadership based on working experience and supervising experience (see table 5). Participants with supervising experience (M=15.38) received significantly higher score than participants without supervising experience (M=14.85) in management of risk (see table 5). Conversely, there were no significant differences in management of risk based on gender and working experience.

CONCLUSION

Numerous researchers (Carless, 1998; Gardiner & Tiggemann, 1999; Helgesen, 1990; Yammarino et al., 1997) refer to transformational leadership as a specifically 'feminine' leadership style. The results of the factorial ANOVA showed that differences in leadership style existed between males and females. Females rated themselves significantly higher than males in the transformational leadership style. Under close inspection, females are more interpersonally oriented than males. For instance, females have better communication skills: they possess a superior ability to communicate ideas and get their message across to coworkers. Females attempt to develop and mentor followers more than men; they display high levels of trust and respect on the part of their subordinates and have a higher ability to instill positive attitude in coworkers. In addition, females are more task-oriented and have a clearer vision of goals and higher attention to outcomes than males. These finding are supported by the results of past studies (Bass et al., 1996; Doherty, 1997; Druskat, 1994; Eagly & Johannesen-Schmidt, 2001).

The effect size of the significant gender differences is very small ($R^2 = .012$). Some researchers have argued that there is no practical difference between female and male leaders (Carless, 1998; Yammarino et al., 1997). On the other hand, the investigators agree with other scholars (e.g. Martell, Lane & Emrich, 1996) that small but frequently recurring differences across numerous individuals and occasions could produce large consequences.

The investigators are aware of the limitations of this study and interpret the results with caution. Some readers may argue that participants in this study are students rather than leaders. Also, the adoption of the self-ratings method may elicit mere gender-stereotypic expectations. However, a high percentage of participants with full-time working experience (56.3%; n=541) and supervising experience (34.5%; n=320) might regulate some of the effects.

This study discovers a very interesting relationship in transformational leadership based on working experience and supervising experience. No significant differences in the transformational leadership skills were established based on working experience. There were no differences among someone without working experience, someone with one to four years working experience, and someone with more than four years working experience. Working experience is therefore not a factor that affects transformational leadership skills.

Interestingly, supervising experience was found to affect transformational leadership skills. Someone with supervising experience had better transformational leadership skills than someone without supervising experience. Leadership opportunity and leadership experience are therefore important for acquiring transformational leadership skills. In addition, leadership skills are obtained through leadership experience and not through working experience. This indicates the leadership opportunity is a key factor in nurturing leaders, whereas working experience is not. If we believe that leadership skills might be imparted through training, then we need to provide leadership opportunities to future leaders. In other words, we need to allow future leaders to lead.

REFERENCES

Avolio, B., & Bass, B. M. (1988) Transformational Leadership, Charisma and Beyond. In J. G. Hunt, B. R. Baliga, H. P. Dachler, & C. A. Schriesheim, (eds), *Emerging Leadership Vistas,* pp. 267-308. Lexington, MA: D.C. Heath-Jossey-Bass.

Bartol, K. & Martin, D. (1986) Women and Men in Task Groups. In R. Ashmore & F. Del Boca (eds), *The Social Psychology of Male-Female Relations: A Critical Analysis of Central: pp.*259-310. Orlando, FL: Academic Press.

Bass, B. M. (1985) *Leadership and Performance Beyond Expectations*. New York: Free Press.

Bass, B. M. (1990) *Bass and Stogdill's Handbook of Leadership*. New York: Free Press.

Bass, B. M., Avolio, B. J., & Atwater, L. (1996) The Transformational and Transactional Leadership of Men and Women, *Applied Psychology, An International Review* 45: 5-34.

Bennis, W. G., & Nanus, B. (1985) *Leaders: The Strategies for Taking Charge*. New York: Harper & Row.

Bycio, P., Hackett, R. D., & Allen, J. S. (1995) Further Assessments of Bass's 1985 Conceptualization of Transactional and Transformational Leadership, *Journal of Applied Psychology* 80(4): 468-478.

Conger, J. A. (1999) Charismatic and Transformational Leadership in Organizations: An Insider's Perspective on these Developing Streams of Research, *Leadership Quarterly* 10: 145-169

Davidson, M. J. & Burke, R. J. (eds) (2000) *Women in Management*. London: Sage Publications.

Doherty, A. J. (1997) The Effect of Leader Characteristics on the Perceived Transformational/ Transactional Leadership and Impact of Interuniversity Athletic Administrators, *Journal of Sport Management* 11: 275-285.

Druskat, V. U. (1994) Gender And Leadership Style: Transformational and Transactional Leadership in the Roman Catholic Church, *Leadership Quarterly* 5(2): 99-119.

Eagly, A. H. & Johannesen-Schmidt M. C. (2001) The Leadership Styles of Women and Men, *Journal of Social Issues* 57(4): 781-797.

Eagly, A. H. (1987) *Sex Differences in Social Behavior: A Social-role Interpretation*. Hillsdale, NJ: Erlbaum.

Eagly, A. H., & Johnson, B. T. (1990) Gender and Leadership Style: A Meta-analysis, *Psychological Bulletin* 108: 233-256.

Eagly, A. H., Karau, S. J., & Makhijani, M. G. (1995) Gender and the Effectiveness of Leaders: A Meta-analysis, *Psychological Bulletin* 177: 125-145.

Gaillour, F. R. (2002, July) *Do You Embody the Four Strategies of a Transformational Leader? Dr. G's Leadership Edge*. Available at :http://www.kihealth.com/ezine_transformational_leader.htm

Gardiner, M., & Tiggemann, M. (1999) Gender Differences in Leadership Style, Job Stress and Mental Health in Male – and Female Dominated Industries, *Journal of Occupational and Organizational Psychology* 72: 301-315.

Gibson, J. L., Ivancevich, J. M., & Donnelly, J. H. Jr. (2000) *Organizations: Behavior, Structure, Processes*. Boston, Massachusetts: Irwin McGraw-Hill.

Gutek, B. A., & Morasch, B. (1982) Sex-ratios, Sex-role Spillover, and Sexual Harassment of Women at Work, *Journal of Social Issues* 38(4): 55-74.

Helgesen, S. (1990) *The Female Advantage: Women's Way of Leadership*. New York: Doubleday.

Hellriegel D., & Slocum, J. W. (2004) *Organizational Behavior*. Thomson South-western.

Kanter, R. M. (1977) *Men and Women of the Corporation*. New York: Basic Books.

Klenke, K. (1996) *Women and Leadership: A Contextual Perspective*. New York: Springer.

Komives, S. R. (1991a) Gender Differences in the Relationship Of Hall-Directors' Transformational and Transactional Leadership and Achieving Styles, *Journal of College Student Development* 32: 155-165.

Komives, S. R. (1991b) The Relationship of Same- and Cross-Gender Work Pairs ao Staff Performance and Supervisor Leadership in Residence Hall Units, *Sex Roles* 24: 355-363.

Maher, K. J. (1997) Gender-Related Stereotypes of Transformational and Transactional Leadership, *Sex Roles* 37: 209-225.

Martell, R. F., Lane, D. M., & Emrich, C. G. (1996) Male-Female Differences: A Computer Simulation, *American Psychologist* 51: 157-158.

Nieva, V. F., & Guteck, B. A. (1981)*Women and Work: A Psychological Perspective*. New York: Warner Books.

Pawar, B. S., & Eastman, K. K. (1997) The Nature and Implications of Contextual Influences on Transformational Leadership: A Conceptual, *Academy of Management Review* 22(1): 80-109.

Rosener, J. B. (1990) Ways Women Lead, *Harvard Business Review* 68(6), 119-126.

Salant, P., & Dillman, D. A. (1994). *How To Conduct Your Own Survey*. New York, NY: John Wiley & Sons, Inc.

Tichy, N., & Devanna, M. A. (1986). *The Transformational Leader*. New York: Wiley.

Van Engen, M. L., van der Leeden, R, & Willemsen, T. M. (2001) Gender, Context and Leadership Styles: A Field Study, *Journal of Occupational and Organizational Psychology* 74: 581-598.

Yammarino, F. J., Dubinsky, A. J., Corner, I. B., & Jolson, M. A. (1997) Women and Transformational and Contingent Reward Leadership: a Multiple-levels of Analysis Perspective , *Academy of Management Journal* 40: 205 – 222.

Yoder, J. D. (2001) Making Leadership Work More Effectively for Women, *Journal of Social Sciences* 57(4): 815-828.

THE IMPACT OF REGULATION ON RESEARCH AND THE FORMATION OF RESEARCH JOINT VENTURES

Mark W. Frank,[1] Sam Houston State University

1. INTRODUCTION

During the 1990s the telecommunications industry, along with other traditionally regulated industries, replaced rate-of-return forms of regulation with price-cap and other incentive-based types of regulation. Before the divestiture of AT&T in 1984, for example, all 50 states employed rate-of-return regulation to regulate interstate telecommunication operations. Following the divestiture, however, several states began experimenting with alternative forms of incentive-based regulations (e.g. earnings sharing regulation, rate case moratoria, and price-cap regulation). By 1996, price-cap regulation had emerged as the most common form of these new regulations. By the time of the new millennium, only twelve states retained the use of rate-of-return regulation, while thirty-five utilized price-cap regulation (see Al and Sappington, 2002).

The rise of price-cap regulation can be attributed to its potential of providing stronger incentives for innovation than traditional rate-of-return regulation (see Vogelsang, 2002; Clemenz, 1991; Cabral and Riordan, 1989).[2] Empirical support for this view has gained considerable ground in recent years. Studies by Ai and Sappington (2002), Prieger (2002; 2001), and Resende (2000) have all found price-caps to be associated with greater innovation and greater productive efficiency, while Uri (2001a) and Lehman and Weisman (2000) have found qualified support.

The potential of price-cap regulation to encourage greater innovation has special importance in industries such as telecommunications, where innovations play a critical role in the industry's growth. Uri (2001b), for example, finds that productivity in telecommunications increased nearly 5% per year in the 1990s, with much of this growth primarily due to the development of new production technologies. The practice of developing these innovations, however, has increasingly involved firms cooperating with other firms. Duysters and Hagedoorn (2000) find that joint research partnerships in telecommunications during the 1989 to 1996 period were up 317% over the 1980 to 1988 period.[3] The emerging practice of regulated firms increasing R&D through R&D cooperation with other firms, however, remains largely ignored in the theoretical and empirical literatures.

The purpose of this paper is to explore the impact of rate-of-return and price-cap regulation in an environment where firms may choose to cooperate in the development of research. Our analysis relies on a symmetric two-stage duopoly model to compare R&D and output levels both with and without regulation. In the initial stage, firms must choose to either compete in the production of R&D, form a research joint venture by cooperating in the production of R&D, or cooperate in the production of R&D and fully share all cost-reducing research information. Table 1 presents a summary description of these three research cooperation scenarios. In the second stage of our model, firms compete in the output market.[4] The results are then compared based on the substitutability of the firm's products, the presence and efficacy of regulation, and the degree to which new knowledge can spillover to rival firms.

Our findings indicate that the intersection between regulatory policies and research cooperation matters. R&D is greatest when firms cooperate in the production of research, fully share all research information, and are unregulated. Production output, however, is greatest when firms cooperate in the production of research, fully share all research information, but are subject to price-cap regulation. With respect to the three research

Table 1. Research Cooperation Scenarios

Research Scenario	R&D Production	R&D Spillovers
N	Firms are noncooperative in the production of R&D.	Firms do not fully share cost reducing research information, although some information may become public ($0 \leq \sigma < 1$).
C	Firms cooperate in the production of R&D.	Firms do not fully share cost reducing research information, although some information may become public ($0 \leq \sigma < 1$).
CS	Firms cooperate in the production of R&D.	Firms fully share all cost reducing research information ($\sigma = 1$).

scenarios, research production cooperation coupled with full research information sharing (CS) consistently dominates noncooperative research production (N) and cooperative research production (C). When R&D information has a low rate of spillover to other firms, noncooperative research production dominates cooperative research production. When the information spillover rate is high, however, cooperative research production dominates noncooperative research production.

The following section presents the initial postulations and the subgame-perfect Nash equilibrium outcomes from within each of the three regulatory scenarios (unregulated, rate-of-return regulated, and price-cap regulated). Section 3 presents a comparative analysis across the three research cooperation scenarios. Section 4 provides a brief summary of our main findings and suggests directions for further research. Proofs are included in the Appendix.

2. THE MODELS

Consider an industry of two firms with the linear inverse demand:

$$P = a - q_i - \beta q_j, \quad \beta \in (0,1) \tag{1}$$

where P is market price, q_i is output from the i^{th} firm, q_j is output from the j^{th} firm, and β is a substitutability parameter. If $\beta = 1$, then q_i and q_j are perfectly substitutable. If $\beta = 0$, then q_i and q_j are perfectly unsubstitutable (i.e. each firm is a monopoly).

Assume that per unit production cost in the absence of R&D is $rk_i + wl_i$, where k_i and l_i are the capital and labor required to produce one unit of output. Production cost may be lowered through cost reducing R&D:

$$c_i = rk_i + wl_i - x_i - \sigma x_j, \quad \sigma \in (0,1) \tag{2}$$

where x_i is cost reducing R&D from the i^{th} firm and x_j is cost reducing R&D from the j^{th} firm. We assume that $rk_i + wl_i > x_i + \sigma x_j$, since costs cannot be negative. The parameter σ represents exogenous R&D spillovers. If both firms agree to fully share all cost-reducing research information, then the spillover is internalized, and $\sigma = 1$. In the absence of a research information sharing agreement, some research knowledge may still spillover given the public good nature of knowledge, hence $0 \leq \sigma < 1$. Knowledge spillovers may also arise by deliberate disclosures or involuntary leaking, for example. The case of $\sigma = 0$ would imply that all cost-reducing research information remains private to the innovating firm.

Following from d'Aspremont and Jacquemin (1988), De Bondt, Slaets, and Cassiman (1992), and Poyago-Theotoky (1995), it is assumed that the total cost of firm i's own R&D reflects the existence of decreasing returns to scale:

$$\gamma \frac{x_i^2}{2}, \tag{3}$$

where γ is the price of R&D.

2.1. Unregulated Duopoly

In the absence of regulation (U), profit for the i^{th} firm in the second stage is

$$\Pi_i^U = \left(a - q_i - \beta q_j - rk_i - wl_i + x_i + \sigma x_j\right) q_i - \gamma \frac{x_i^2}{2}, \tag{4}$$

where $j \neq i$ and $i = 1, 2$.

Proposition 1. *If* $\sigma > \frac{\beta}{2}$, *then* $x_i^{CS,U} > x_i^{C,U} > x_i^{N,U}$, $q_i^{CS} > q_i^{C} > q_i^{N}$, *and* $W_i^{CS,U} > W_i^{C,U} > W_i^{N,U}$.

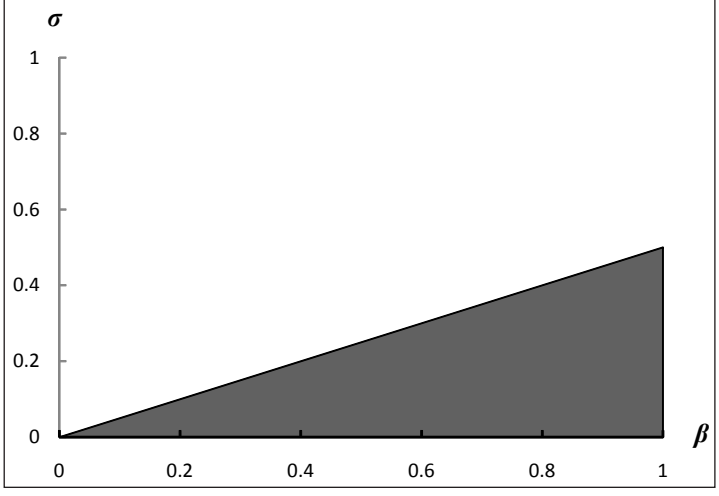
If $\sigma < \frac{\beta}{2}$, *however,* $x_i^{CS,U} > x_i^{N,U} > x_i^{C,U}$, $q_i^{CS,U} > q_i^{N,U} > q_i^{C,U}$, *and* $W_i^{CS,U} > W_i^{N,U} > W_i^{C,U}$.[5]

(Proof provided in Appendix.)

Proposition 1 tells us that R&D is greatest under research production cooperation coupled with full research information sharing $\left(x_i^{CS,U}\right)$. Noncooperative research production $\left(x_i^{N,U}\right)$, by contrast, suffers from an appropriability problem. When spillovers of research information are greater than 0.5 and product substitutability is sufficiently low, then noncooperative research production is inferior to cooperative research production, *ceteris paribus*. This relationship is plotted in Figure 1. The shaded area represents values of σ and β that result in $\left(x_i^{N,U}\right)$ being greater than $x_i^{C,U}$.

This relationship between $\left(x_i^{N,U}\right)$ and $x_i^{C,U}$ occurs because noncooperative research suffers from an appropriability problem; when research information becomes public at a high rate, and rival products are relatively unsubstitutable (the non-shaded area of Figure 1), the firm finds it profit maximizing to reduce their own production of R&D and free ride off the research efforts of the rival firm. In this case, the firm can overcome this appropriability problem by agreeing to cooperate in the production of R&D (hence,) $x_i^{C,U} > x_i^{N,U}$.

Figure 1. The Appropriability Problem



Note: In the shaded area, $x_i^N > x_i^C$; in the non-shaded area $x_i^N < x_i^C$.

Production output and total welfare follow similarly. If $\sigma > 0.5\beta$, then $q_i^{CS,U} > q_i^{C,U} > q_i^{N,U}$ and $W_i^{CS,U} > W_i^{C,U} > W_i^{N,U}$. If $\sigma < 0.5\beta$, however, $q_i^{CS,U} > q_i^{N,U} > q_i^{C,U}$ and $W_i^{CS,U} > W_i^{N,U} > W_i^{C,U}$. That is, cooperative research production coupled with full information sharing (CS) dominates the noncooperative and cooperative research production. The noncooperative research scenario outperforms the cooperative research scenario, so long as information spillovers are less than 0.5 and product substitutability is sufficiently high. Otherwise, the appropriability problem causes noncooperative research production to underperform cooperative research production.

2.2. RATE-OF-RETURN REGULATION

Under rate-of-return regulation (RR), the objective of the regulatory commission is to determine the appropriate cost of capital to force zero total profits. From equation (4), this means that

$$\left(a - q_i - \beta q_j - sk_i - wl_i + x_i + \sigma x_j\right)\ q_i - \gamma \frac{x_i^2}{2} = 0\,, \qquad (5)$$

where s is the allowed cost of capital (see, Averch and Johnson, 1962; Takayama, 1969; Bailey and Malone, 1970). Consequently, the problem for the RR regulated firm is to maximize profits subject to the regulatory constraint:

$$L^{RR} = \left(a - q_i - \beta q_j - rk_i - wl_i + x_i + \sigma x_j\right)\ q_i - \gamma \frac{x_i^2}{2}$$
$$-\lambda\left[\left(a - q_i - \beta q_j - sk_i - wl_i + x_i + \sigma x_j\right)\ q_i - \gamma \frac{x_i^2}{2}\right]. \qquad (6)$$

This is the second stage payoff function for the i^{th} firm. The Lagrangian multiplier (λ) represents the efficacy of regulation. As λ approaches one, the regulator more effectively imposes the regulatory constraint (5). As λ falls towards zero, regulation becomes less effective. In the absence of regulation, λ equals zero, and (6) reduces to the unregulated profit function (4) from the previous section. We follow the rate-of-return literature in assuming that if $0 > \lambda > 1$, then $r > s\lambda$ (see Smith, 1974, 1975; Okuguchi, 1975; Baumol and Klevorick, 1970).

Proposition 2: *If* $\sigma > \frac{\beta}{2}$, *then* $x_i^{CS,RR} > x_i^{C,RR} > x_i^{N,RR}$, $q_i^{CS,RR} > q_i^{C,RR} > q_i^{N,RR}$, *and* $W_i^{CS,RR} > W_i^{C,RR} > W_i^{N,RR}$. *If* $\sigma < \frac{\beta}{2}$, *however,* $x_i^{CS,RR} > x_i^{N,RR} > x_i^{C,RR}$, $q_i^{CS,RR} > q_i^{N,RR} > q_i^{C,RR}$, *and* $W_i^{CS,RR} > W_i^{N,RR} > W_i^{C,RR}$. (Proof provided in Appendix.)

Proposition 2 shows that R&D is greatest under research production cooperation coupled with full sharing of research information $\left(x_i^{CS,RR}\right)$. As in the unregulated case before, noncooperative research production in the presence of rate-of-return regulation $\left(x_i^{N,RR}\right)$ suffers from an appropriability problem. When spillovers of research information are greater than 0.5, noncooperative research production is inferior to cooperative research production, *ceteris paribus* (see Figure 1).

Production output and total welfare follow similarly. If $\sigma > 0.5\beta$, then $q_i^{CS,RR} > q_i^{C,RR} > q_i^{N,RR}$ and $W_i^{CS,RR} > W_i^{C,RR} > W_i^{N,RR}$. If $\sigma < 0.5\beta$, then $q_i^{CS,RR} > q_i^{N,RR} > q_i^{C,RR}$ and $W_i^{CS,RR} > W_i^{N,RR} > W_i^{C,RR}$. Firms subject to RR regulation respond to the research cooperation scenarios in much the same way as unregulated firms. R&D, production output, and total welfare are greatest when firms cooperate in the production of R&D and fully share research information (CS). The noncooperative research scenario outperforms the cooperative research scenario, so long as information spillovers are less than 0.5 and product substitutability is sufficiently high. Otherwise, the appropriability problem forces noncooperative research production under cooperative research production.

Lemma 1: *R&D, production output, and total welfare in each of the three research scenarios are decreasing functions of the RR regulatory parameter, λ. When regulation is perfectly enforced (λ = 1), then the profit maximizing firm will no longer produce output.*

More effective enforcement of RR causes the profit maximizing firm to reduce R&D. There is empirical support for this occurrence. Frank (2003) and Granderson (1999) have found that the presence of RR regulation led to reductions in the rate of technical change in the electric power and natural gas industries, respectively. In their seminal work on RR regulation, Averch and Johnson (1962) found that RR regulation caused an overuse of capital and underuse of other production inputs. A similar effect is occurring here; RR regulation is enticing the profit maximizing firm to reduce its use of cost-reducing R&D.

2.3. PRICE-CAP REGULATION

Price-cap regulation (PC) involves the imposition of a binding price ceiling that is periodically adjusted downwards by a preannounced productivity factor. In the literature on PC regulation, it is common to assume that the regulated price is initially set equal to the firm's per unit production costs, thus enabling the firm to make normal profits (see Heyes and Liston-Heyes, 1997; Clemenz, 1991; Carbral and Riordan, 1989). This price-cap is then periodically adjusted downwards by some factor X (often referred to as the $RPI - X$ factor, where RPI is the retail price index). This adjustment lowers the price-cap to account for changes in projected industry-wide technological improvement.[6] Firms can make greater than normal profits if they produce cost-reducing innovations in excess of X. If firms produce innovations amounting to less than X, however, they may request a rate hearing. The result of this rate hearing will be that the regulator adjusts the price-cap so that the firm is again making normal profits.[7]

It is assumed that the firm never chooses a price below the PC (hence, the PC is binding). The regulator initially sets the price-cap equal to the firm's per unit production costs. This cap is subsequently adjusted downwards by X:

$$\overline{P} = rk_i + wl_i - X\,. \qquad (7)$$

The objective of the regulator is to anticipate future cost-reducing innovations by the firm, meaning $\overline{P} = rk_i + wl_i - x_i - \sigma x_j$.

Table 2. Rankings of the Regulatory Scenarios

Regulatory Scenario	R&D Ranking		Output Ranking	
	$\beta > 2\sigma$	$\beta < 2\sigma$	$\beta > 2\sigma$	$\beta < 2\sigma$
U	$x_i^{CS,U} > x_i^{C,U} > x_i^{N,U}$	$x_i^{CS,U} > x_i^{N,U} > x_i^{C,U}$	$q_i^{CS,U} > q_i^{C,U} > q_i^{N,U}$	$q_i^{CS,U} > q_i^{N,U} > q_i^{C,U}$
RR	$x_i^{CS,RR} > x_i^{C,RR} > x_i^{U,RR}$	$x_i^{CS,RR} > x_i^{N,RR} > x_i^{C,RR}$	$q_i^{CS,RR} > q_i^{C,RR} > q_i^{N,RR}$	$q_i^{CS,RR} > q_i^{N,RR} > q_i^{C,RR}$
PC	$x_i^{CS,PC} > x_i^{C,PC} > x_i^{N,PC}$	$x_i^{CS,PC} > x_i^{N,PC} > x_i^{C,PC}$	$q_i^{CS,PC} > q_i^{C,PC} > q_i^{N,PC}$	$q_i^{CS,PC} > q_i^{N,PC} > q_i^{C,PC}$

Figure 2. R&D Comparisons from the Regulatory Scenarios

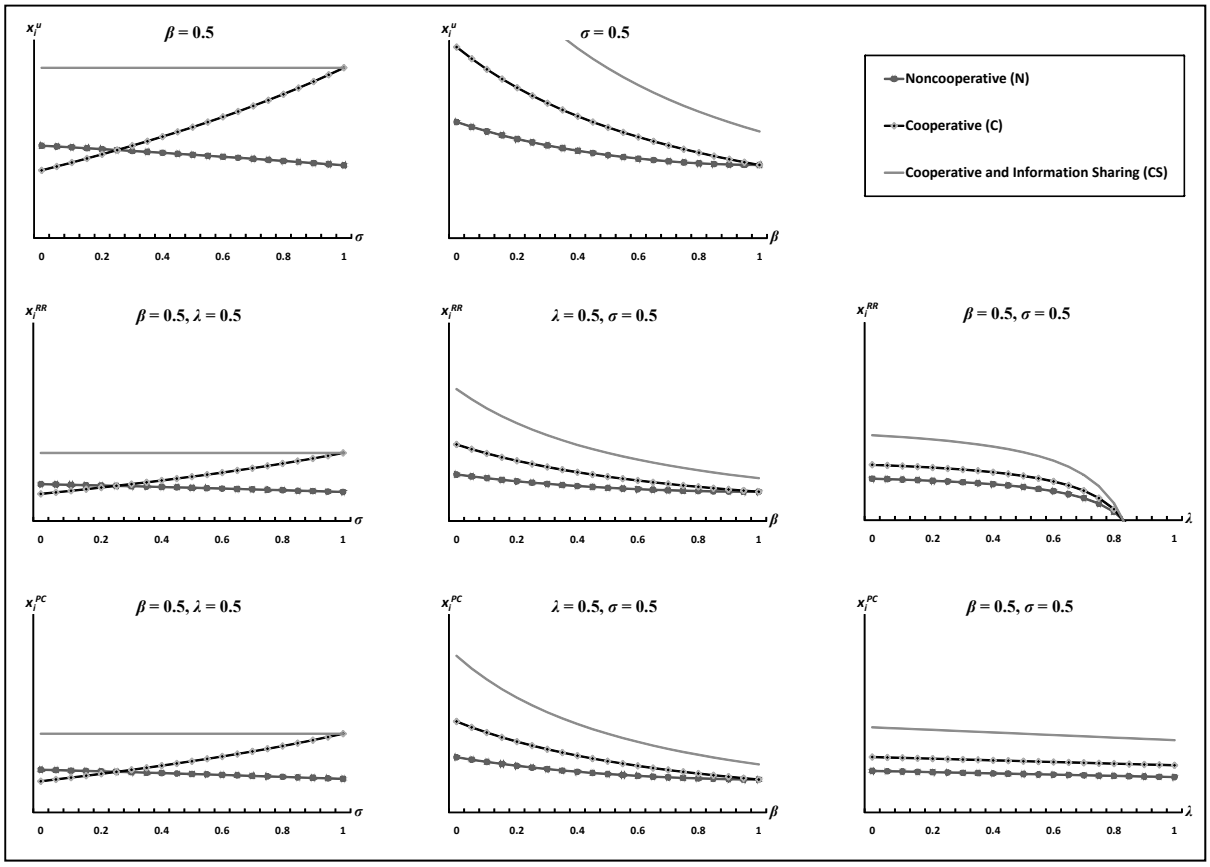


Table 3. Rankings of the Research Cooperation Scenarios

Research Scenario	R&D Ranking	Output Ranking
N	$x_i^{N,U} > x_i^{N,PC} > x_i^{N,RR}$	$q_i^{N,PC} > q_i^{N,U} > q_i^{N,RR}$
C	$x_i^{C,U} > x_i^{C,PC} > x_i^{C,RR}$	$q_i^{C,PC} > q_i^{C,U} > q_i^{C,RR}$
CS	$x_i^{CS,U} > x_i^{CS,PC} > x_i^{CS,RR}$	$q_i^{CS,PC} > q_i^{CS,U} > q_i^{CS,RR}$

The firm will be able to gain financially if actual cost reductions $(x_i + \sigma x_j)$ are greater than the adjustment factor (X). If $X > x_i + \sigma x_j$, however, the firm requests a rate hearing and forces the regulator to set $X = x_i + \sigma x_j$.

From (1), the inverse demand is $P = a - q_i - \beta q_j$. Hence, the per unit regulatory objective is

$$\left(a - q_i - \beta q_j\right) - rk_i - wl_i + x_i + \sigma x_j = 0. \quad (8)$$

The problem for the PC regulated firm is then to maximize profits subject to the regulatory constraint:

$$L^{PC} = \left(a - q_i - \beta q_j - rk_i - wl_i + x_i + \sigma x_j\right) q_i - \gamma \frac{x_i^2}{2}$$
$$-\lambda\left(a - q_i - \beta q_j - rk_i - wl_i + x_i + \sigma x_j\right), \quad (9)$$

where $0 \le \lambda \le 1$. This is the second stage payoff function for the i^{th} firm. As in the RR case, λ again reflects the efficacy of regulation. As λ approaches one, regulation converges to the regulator's objective (8). As λ falls towards zero, regulation diverges from the regulator's objective (X falls increasingly below the actual amount of cost-reducing innovation, $x_i + \sigma x_j$).[8]

Proposition 3: *If* $\sigma > \frac{\beta}{2}$, *then* $x_i^{CS,PC} > x_i^{C,PC} > x_i^{N,PC}$, $q_i^{CS,PC} > q_i^{C,PC} > q_i^{N,PC}$, *and* $W_i^{CS,PC} > W_i^{C,PC} > W_i^{N,PC}$. *If* $\sigma < \frac{\beta}{2}$, *however,* $x_i^{CS,PC} > x_i^{N,PC} > x_i^{C,PC}$, $q_i^{CS,PC} > q_i^{N,PC} > q_i^{C,PC}$, *and* $W_i^{CS,PC} > W_i^{N,PC} > W_i^{C,PC}$. (Proof provided in Appendix.)

These results are similar to the two prior regulatory scenarios. R&D is greatest under research production cooperation coupled with full sharing of all cost reducing R&D information $\left(x_i^{CS,PC}\right)$. As with the U and RR cases before, noncooperative research production in the presence of price-cap regulation $\left(x_i^{N,PC}\right)$ suffers from an appropriability problem. When spillovers of research information are greater than 0.5 and product substitutability is sufficiently low, noncooperative research production is inferior to cooperative research production, *ceteris paribus* (see Figure 1).

With respect to production output and total welfare, if $\sigma > 0.5\beta$, then $q_i^{CS,PC} > q_i^{C,PC} > q_i^{N,PC}$ and $W_i^{CS,PC} > W_i^{C,PC} > W_i^{N,PC}$. If $\sigma < 0.5\beta$, however, $q_i^{CS,PC} > q_i^{N,PC} > q_i^{C,PC}$ and $W_i^{CS,PC} > W_i^{N,PC} > W_i^{C,PC}$. Cooperative research production coupled with full information sharing dominates the noncooperative and cooperative research production. The noncooperative research scenario outperforms the cooperative research scenario, so long as information spillovers are less than 0.5 and product substitutability is sufficiently high. Otherwise, the appropriability problem forces noncooperative research production under cooperative research production.

Lemma 2: *R&D and total welfare from each of the three research scenarios are decreasing functions of the PC regulatory parameter, λ. Production output, however, is an increasing function of the PC regulatory parameter.*

As the regulatory parameter approaches unity, R&D falls, *ceteris paribus*. Whenever $\lambda < 1$, this implies that the regulator is not able to fully enforce its regulatory objective (8). This would occur when the price-cap is not lowered by the full amount of the firm's cost-reducing R&D (hence, $X < x_i + \sigma x_j$), thus enabling the firm to earn greater than normal profits. When the enforcement of PC regulation improves (i.e. $\lambda \to 1$), the firm receives less of the benefits from cost-reducing innovation. As a result, R&D decreases.

In contrast to RR regulation, production output under PC regulation is an *increasing* function of the regulatory parameter in each of the three research scenarios. As $\lambda \to 1$, the profit maximizing firm is induced to increase production output. This effect has important welfare implications. Better enforcement of PC regulation forces the firm to transfer the benefits from cost-reducing innovations to consumers in the form of increased output (recall that if $\lambda = 1$, then $X = x_i + \sigma x_j$). Consumer surplus, therefore, is increasing in λ.

What is good for consumers is not, in the case of PC regulation, good for producers. Total profit for the firm under each of the three research scenarios *decreases* as $\lambda \to 1$. Lax regulation means the firm can gain greater profits because actual cost-reducing innovations ($x_i + \sigma x_j$) are greater than the regulatory productivity-adjustment factor (X). The impact of regulation on total profit within each of the three research scenarios, however, is greater that than the impact on consumer surplus. Hence, as λ approaches unity, total welfare decreases.

3. COMPARISON OF MODELS

Table 2 presents a summary of the R&D and production output rankings across the three regulatory scenarios (U, RR, and PC). Figure 2 provides a graphical comparison of R&D across the three regulatory scenarios. Each row presents a different regulatory scenario (U, RR, and PC, respectively). Each column presents variations of a different parameter (σ, β, and λ, respectively) while keeping the remaining two constant at 0.5. Within each scenario, R&D and production output are greatest when firms cooperate in the production of research and fully share research information (CS). Noncooperative research production (N) performs better than cooperative research production (C) in terms of R&D and production output only when research spillovers are less than 0.5 and product substitutability is sufficiently high (when $\sigma < 0.5\beta$). Otherwise, noncooperative research production suffers from an appropriability problem and is inferior to cooperative research production.

Comparisons across the three research cooperation scenarios (CS, C, and N) are summarized in Table 3 and Figure 3. Within each scenario, R&D is greatest when the firm is unregulated (U), and least when the firm is subject to RR regulation. Production output does not follow this pattern, however. Instead, output is greatest when the firm is subject to PC regulation, and least when subject to RR regulation.

Notice that PC regulation consistently outperforms RR regulation. More effective administration of RR regulation (meaning, $\lambda \rightarrow 1$) causes production output to decrease. More effective administration of PC regulation, by contrast, causes output to *increase*. In terms of R&D, both RR and PC regulation lead to lower levels of R&D, though the decrease is greater under RR regulation. With PR regulation, firm is forced to transfer the benefits of cost-reducing innovations to the consumer in the form of increased output (recall that if $\lambda = 1$, then $X = x_i + \sigma x_j$).

PC regulation is mixed when paired against the unregulated case, however. The profit maximizing unregulated firm will produce more R&D than the PC regulated firm, but less production output. Consequently, greater total profit occurs in the unregulated case, but greater consumer surplus is generated when PC regulation is present. In the unregulated case, firms are able to set R&D and output at profit maximizing levels. Under PC regulation, however, the regulator alters the choice of the firm by, in effect, requiring them to transfer a portion of the benefits from cost-reducing R&D to consumers.

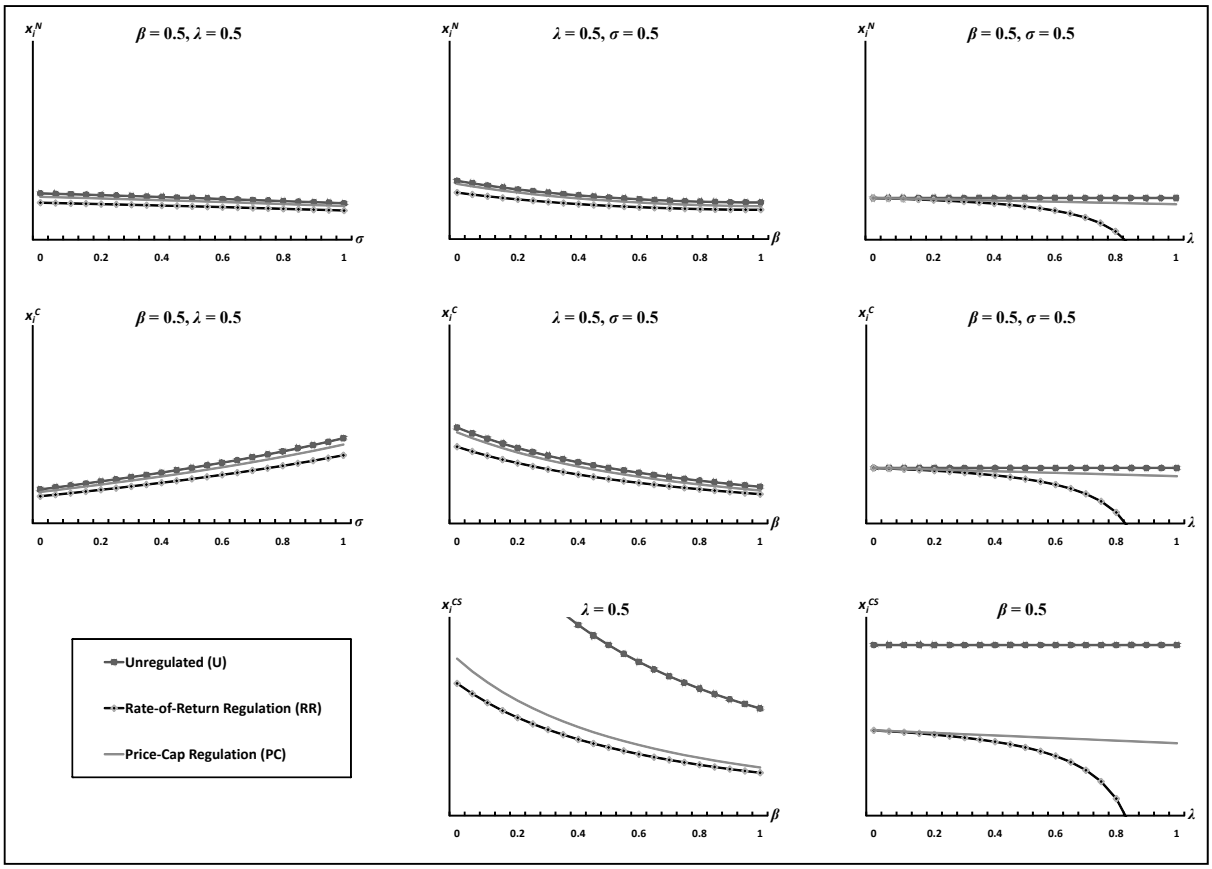
4. CONCLUSION

This article has considered the impact of rate-of-return and price-cap regulation on the incentive to cooperate in research. Our findings are based on a symmetric two-stage duopoly framework in which firms choose to either compete in the production of R&D, cooperate in R&D production, or cooperate in R&D production and share all research information. The findings have relevance to industries such as telecommunications, where the replacement of rate-of-return with price-cap regulation has occurred alongside the increasing use of inter-firm research partnerships.

We find that price-cap regulation dominates rate-of-return regulation in a variety of research cooperation scenarios. Compared to the unregulated case, however, price-cap regulation does not dominate. In terms of R&D production, we have shown that the unregulated case provides a greater incentive for innovation than does price-cap regulation. With respect to inter-firm research partnerships, the advantages of cooperation versus noncooperation are dictated largely by the appropriability problem. Noncooperation is superior only when the natural rate of knowledge spillover is low (less than 50 percent), and output is relatively substitutable. With higher rates of information spillover, however, cooperation in research production is more beneficial to firms than noncooperation. Hence, full research information sharing coupled with research cooperation dominates all other types of research partnerships.

It remains an open question, however, how robust these findings would be in a more dynamic setting, or what insights empirical testing may provide. Given the ongoing coexistence of price-cap regulation in industries with firms engaging in cooperative research agreements, our findings may prove suggestive for future research.

Figure 3. R&D Comparisons from the Research Cooperation Scenarios



APPENDIX

Proof of Proposition 1: The Nash-Cournot symmetric equilibrium level of output in the second stage is

$$q_i^U = \frac{(2-\beta)(a-rk_i-wl_i+x_i)+x_j(2\sigma-\beta)}{4-\beta^2}. \quad \text{(A1)}$$

If q_i^u were negative, the firm would not produce. It is therefore assumed that q_i^u positive. This in turn requires that $a-rk_i-wk_i>0$. The first stage payoff for the *i*th firm is found by substituting the profit maximizing output from the second stage (A1) into the second stage profit (4):

$$\Pi_i^U = \left[\frac{(a-rk_i-wl_i)(\beta-2)+x_i(\beta\sigma-2)+x_j(\beta-2\sigma)}{(\beta^2-4)^2}\right]\left\{(\beta^2-4)(-rk_i-wl_i+x_i+x_j\sigma)\right.$$
$$\left.+\left[a+(rk_i+wl_i)(1+\beta)\right](\beta-2)+x_i(2-\beta\sigma+\beta^2)+x_j(\beta-2\sigma+\beta^2\sigma)\right\}-\gamma\frac{x_i^2}{2}. \quad \text{(A2)}$$

Under noncooperative research production, the symmetric profit maximizing level of R&D $(x_i^{N,U})$ is found by differentiating (A2) with respect to x_i:

$$x_i^{N,U} = \frac{2(2-\beta\sigma)(a-rk_i-wl_i)}{\gamma(2-\beta)(2+\beta)^2-2(1+\sigma)(2-\beta\sigma)}. \quad \text{(A3)}$$

Substituting $x_i^{N,U}$ into (A1) yields the profit maximizing level of production output for the game:

$$q_i^{N,U} = \frac{\gamma(4-\beta^2)(a-rk_i-wl_i)}{\gamma(2-\beta)(2+\beta)^2-2(1+\sigma)(2-\beta\sigma)}. \quad \text{(A4)}$$

Substituting $x_i^{N,U}$ and $q_i^{N,U}$ into second stage profits (4), reveals firm *i*'s total profits for the game:

$$\Pi_i^{N,U} = \frac{\gamma(a-rk_i-wl_i)^2\left[\gamma(4-\beta^2)^2-2(2-\beta\sigma)^2\right]}{\left[-\gamma(2-\beta)(2+\beta)^2+2(1+\sigma)(2-\beta\sigma)\right]^2}. \quad \text{(A5)}$$

With linear inverse demand (1), consumer surplus is $q_i^{N,U}(1+\beta)$. Total welfare is the sum of consumer surplus plus profit:

$$W_i^{N,U} = \frac{\gamma(a-rk_i-wl_i)^2\left[\gamma(2-\beta)^2(2+\beta)^3-2(2-\beta\sigma)^2\right]}{\left[-\gamma(2-\beta)(2+\beta)^2+2(1+\sigma)(2-\beta\sigma)\right]^2}. \quad \text{(A6)}$$

When firms cooperate in the production of R&D, the profit maximizing symmetric level of R&D $(x_i^{C,U})$ is found by adding both profit functions (A2) together and differentiating with respect to R&D:

$$x_i^{C,U} = \frac{2(a-rk_i-wl_i)(1+\sigma)}{\gamma(2+\beta)^2-2(1+\sigma)^2}. \quad \text{(A7)}$$

Substituting $x_i^{C,U}$ into (A1) yields the profit maximizing level of production output for the game:

$$q_i^{C,U} = \frac{\gamma(2+\beta)(a-rk_i-wl_i)}{\gamma(2+\beta)^2-2(1+\sigma)^2}. \quad \text{(A8)}$$

Substituting $x_i^{C,U}$ and $q_i^{C,U}$ into second stage profits (4), reveal firm *i*'s total profits:

$$\Pi_i^{C,U} = \frac{\gamma(a-rk_i-wl_i)^2}{-\gamma(2+\beta)^2+2(1+\sigma)^2}. \quad \text{(A9)}$$

With linear inverse demand (1), consumer surplus is $q_i^{C,U}(1+\beta)$. Total welfare is the sum of consumer surplus plus profit:

$$W_i^{C,U} = \frac{\gamma(a-rk_i-wl_i)^2\left[\gamma(2+\beta)^3-2(1+\sigma)^2\right]}{\left[-\gamma(2+\beta)^2+2(1+\sigma)^2\right]^2} \quad \text{(A10)}$$

When firms cooperate in the production of R&D and fully share all cost-reducing research information, $\sigma = 1$. Consequently,

$$x_i^{CS,U} = \frac{4(a-rk_i-wl_i)}{\gamma(2+\beta)^2-8},\ q_i^{CS,U} = \frac{\gamma(2+\beta)(a-rk_i-wl_i)}{\gamma(2+\beta)^2-8},$$

$$\Pi_i^{CS,U} = \frac{\gamma(a-rk_i-wl_i)^2}{-\gamma(2+\beta)^2+8},$$

and $W_i^{CS,U} = \frac{\gamma(a-rk_i-wl_i)^2\left[\gamma(2+\beta)^3-8\right]}{\left[-\gamma(2+\beta)^2+8\right]^2}.$ (A11)

The second order conditions for each of the three research scenarios (N, C, and CS) are as follows:

$$\gamma > \frac{2(1+\sigma)(2-\beta\sigma)}{(2-\beta)(2+\beta)^2},\quad \gamma > \frac{2(1+\sigma)^2}{(2+\beta)^2}, \text{ and } \quad \gamma > \frac{8}{(2+\beta)^2}, \quad \text{(A12)}$$

respectively. Note that each ensures that the dominator is always positive.

Consequently, $x_i^{CS,U}$ is greater than $x_i^{C,U}$ for all σ and β because

$$\frac{4(a-rk_i-wl_i)}{\gamma(2+\beta)^2-8} > \frac{2(a-rk_i-wl_i)(1+\sigma)}{\gamma(2+\beta)^2-2(1+\sigma)^2}. \quad \text{(A13)}$$

Likewise, $x_i^{CS,U}$ is greater than $x_i^{N,U}$ for all σ and β because

$$\frac{4(a-rk_i-wl_i)}{\gamma(2+\beta)^2-8} > \frac{2(2-\beta\sigma)(a-rk_i-wl_i)}{\gamma(2-\beta)(2+\beta)^2-2(1+\sigma)(2-\beta\sigma)}, \quad \text{(A14)}$$

and $x_i^{C,U}$ is greater than $x_i^{N,U}$ only if $\sigma > 0.5\beta$. For small research spillover rates, $\sigma < 0.5\beta$, $x_i^{C,U}$ is less than $x_i^{N,U}$. Production output, total profit, and total welfare follow similarly. *Q.E.D.*

Proof of Proposition 2: From (6), the Nash-Cournot symmetric equilibrium level of output in the second stage is

$$q_i^{RR} = \frac{2-\beta}{4-\beta^2}\left(a-wl_i-k_i\frac{r-s\lambda}{1-\lambda}+x_i+\sigma x_j\right). \quad \text{(A15)}$$

If q_i^{RR} were negative, the firm would not produce. Therefore, it is assumed that q_i^{RR} is positive. This requires that

$$a-wl_i-k_i\frac{(r-s\lambda)}{1-\lambda}>0. \quad \text{(A16)}$$

The first stage payoff for the *i*th firm is found by substituting the profit maximizing output from the second stage (A15) into the second stage profit (6):

$$\Pi_i^{RR} = \frac{1}{2(\beta^2-4)^2}\left\{-4x_i(\beta\sigma-2)(\beta-2)(\lambda-1)\left[a+wl_i+k_i\left(\frac{r-s\lambda}{\lambda-1}\right)+x_j\left(\frac{\beta-2\sigma}{\beta-2}\right)\right]\right.$$
$$-\frac{2}{\lambda-1}\left\{(\beta-2)(\lambda-1)\left[a+wl_i+k_i\left(\frac{r-s\lambda}{\lambda-1}\right)+x_j\left(\frac{\beta-2\sigma}{\beta-2}\right)\right]\right\}^2$$
$$\left.+x_i^2(\lambda-1)\left[\gamma(\beta^2-4)^2-2(\beta\sigma-2)^2\right]\right\} \quad \text{(A17)}$$

Under noncooperative research production, the symmetric profit maximizing level of R&D $\left(x_i^{N,RR}\right)$ is found by differentiating (A17) with respect to R&D:

$$x_i^{N,RR} = \frac{2(2-\beta\sigma)\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2-\beta)(2+\beta)^2 - (1+\sigma)(2-\beta\sigma)}. \quad \text{(A18)}$$

Substituting $x_i^{N,RR}$ into (A15) yields the profit maximizing level of production output for the game:

$$q_i^{N,RR} = \frac{\gamma\left(4-\beta^2\right)\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2-\beta)(2+\beta)^2 - 2(1+\sigma)(2-\beta\sigma)}. \quad \text{(A19)}$$

Substituting $x_i^{N,RR}$ and $q_i^{N,RR}$ into second stage profits (6), reveals firm *i*'s total profits for the game:

$$\Pi_i^{N,RR} = \frac{\gamma\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)^2\left[\gamma\left(4-\beta^2\right)^2 - 2(2-\beta\sigma)^2\right]}{\left[-\gamma(2-\beta)(2+\beta)^2 + 2(1+\sigma)(2-\beta\sigma)\right]^2}. \quad \text{(A20)}$$

With linear inverse demand (1), consumer surplus is $q_i^{N,RR}(1+\beta)$. Total welfare is the sum of consumer surplus plus profit:

$$W_i^{N,RR} = \frac{\gamma\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)^2\left[\gamma(2-\beta)^2(2+\beta)^3 - 2(2-\beta\sigma)^2\right]}{\left[-\gamma(2-\beta)(2+\beta)^2 + 2(1+\sigma)(2-\beta\sigma)\right]^2}. \quad \text{(A21)}$$

When firms cooperate in the production of R&D, the profit maximizing symmetric level of R&D $\left(x_i^{C,RR}\right)$ is found by adding both profit functions (A17) together and differentiating with respect to R&D:

$$x_i^{C,RR} = \frac{2(1+\sigma)\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2+\beta)^2 - 2(1+\sigma)^2} \quad \text{(A22)}$$

Substituting $x_i^{C,RR}$ into (A15) yields the profit maximizing level of production output for the game:

$$q_i^{C,RR} = \frac{\gamma(2+\beta)\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2+\beta)^2 - 2(1+\sigma)^2}. \quad \text{(A23)}$$

Substituting $x_i^{C,RR}$ and $q_i^{C,RR}$ into second stage profits (6), reveal firm *i*'s total profits:

$$\Pi_i^{C,RR} = \frac{\gamma\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)^2}{-\gamma(2+\beta)^2 + 2(1+\sigma)^2}. \quad \text{(A24)}$$

Consumer surplus is $q_i^{C,RR}(1+\beta)$. Total welfare is the sum of consumer surplus plus profit:

$$W_i^{C,RR} = \frac{\gamma\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)^2\left[\gamma(2+\beta)^3 - 2(1+\sigma)^2\right]}{\left[-\gamma(2+\beta)^2 + 2(1+\sigma)^2\right]^2}. \quad \text{(A25)}$$

When firms cooperate in the production of R&D *and* fully share all cost-reducing research information, $\sigma = 1$. Consequently,

$$x_i^{CS,RR} = \frac{4\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2+\beta)^2 - 8}, \quad q_i^{CS,RR} = \frac{\gamma(2+\beta)\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2+\beta)^2 - 8},$$

$$\Pi_i^{CS,RR} = \frac{\gamma\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)^2}{-\gamma(2+\beta)^2 + 8}, \text{ and}$$

$$W_i^{CS,RR} = \frac{\gamma\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)^2\left[\gamma(2+\beta)^3 - 8\right]}{\left[-\gamma(2+\beta)^2 + 8\right]^2}. \quad \text{(A26)}$$

The second order conditions for each of the three research scenarios (N, C, and CS) are identical to the unregulated case. Each ensures that the dominators remain positive.

Consequently, $x_i^{CS,RR}$ is greater than $x_i^{C,RR}$ for all σ and β because

$$\frac{4\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2+\beta)^2 - 8} > \frac{2(1+\sigma)\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2+\beta)^2 - 2(1+\sigma)^2}. \quad \text{(A27)}$$

Likewise, $x_i^{CS,RR}$ is greater than $x_i^{N,RR}$ for all σ and β because

$$\frac{4\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2+\beta)^2 - 8}, > \frac{2(2-\beta\sigma)\left(a - wl_i - k_i\frac{r-s\lambda}{1-\lambda}\right)}{\gamma(2-\beta)(2+\beta)^2 - (1+\sigma)(2-\beta\sigma)} \quad \text{(A28)}$$

and $x_i^{C,RR}$ is greater than $x_i^{N,RR}$ only if $\sigma > 0.5\beta$. For small research spillover rates, $\sigma < 0.5\beta$, $x_i^{C,RR}$ is less than $x_i^{N,RR}$. Production output, total profit, and total welfare follow similarly. *Q.E.D.*

Proof of Lemma 1: From (A16), it is clear that as the RR regulatory parameter approaches unity ($\lambda \to 1$), the firm will no longer produce. The same occurs with R&D production. Since it is assumed $r > s\lambda$, then

$$\lim_{\lambda \to 1}\left(\frac{r-s\lambda}{1-\lambda}\right) = \infty. \quad \text{(A29)}$$

In the presence of perfect RR regulation ($\lambda = 1$), $x_i^{CS,RR} = x_i^{C,RR} = x_i^{N,RR} = 0$. The precise level of λ at which R&D expenditures equal zero depends on the size of *a* relative to $wl_i + k_i(r-s\lambda)/(1-\lambda)$. *Q.E.D.*

Proof of Proposition 3: The Nash-Cournot symmetric equilibrium for the second stage is:

$$q_i^{PC} = \frac{(a - rk_i - wl_i - \lambda)(\beta-2) + x_i(\beta\sigma - 2) + x_j(\beta - 2\sigma)}{\beta^2 - 4}. \quad \text{(A30)}$$

If q_i^{PC} were negative, the firm would not produce. Therefore, it is assumed that q_i^{PC} positive. This in turn requires that $a - rk_i - wk_i - \lambda > 0$. The first stage payoff function for the i^{th} firm is found by substituting (A30) into the second stage profit function (9):

$$\Pi_i = \left[\frac{\left[a - rk_i - wl_i - \lambda(\beta+1)\right](\beta-2) + x_i(\beta\sigma-2) + x_j(\beta-2\sigma)}{(\beta^2-4)^2}\right]\left\{-\lambda(\beta^2-4)\right.$$
$$\left.+\left[(a - rk_i - wl_i + \lambda)(\beta-2) + x_i(\beta\sigma-2) + x_j(\beta-2\sigma)\right]\right\} - \gamma\frac{x_i^2}{2} \quad \text{(A31)}$$

Under noncooperative research production, the symmetric profit maximizing level of R&D $\left(x_i^{N,PC}\right)$ is found by differentiating (A31) with respect to x_i:

$$x_i^{N,PC} = \frac{2(a - rk_i - wl_i - \lambda - \lambda\beta)(2-\beta\sigma)}{\gamma(2-\beta)(2+\beta)^2 - 2(1+\sigma)(2-\beta\sigma)}. \quad \text{(A32)}$$

Substituting $x_i^{N,PC}$ into (A30) yields the profit maximizing level of production output for the game:

$$q_i^{N,PC} = \frac{\gamma(4-\beta^2)(a - rk_i - wl_i + \lambda) - 2\lambda(1+\sigma)(2-\beta\sigma)}{\gamma(2-\beta)(2+\beta)^2 - 2(1+\sigma)(2-\beta\sigma)}. \quad \text{(A33)}$$

Substituting $x_i^{N,PC}$ and $q_i^{N,PC}$ into second stage profits (9), reveals firm *i*'s total profits for the game:

$$\Pi_i^{N,PC} = \frac{\gamma(-a + rk_i + wl_i + \lambda + \lambda\beta)^2\left[\gamma(4-\beta^2)^2 - 2(2-\beta\sigma)^2\right]}{\left[\gamma(2-\beta)(2+\beta)^2 - 2(1+\sigma)(2-\beta\sigma)\right]^2}. \quad \text{(A34)}$$

With linear inverse demand (1), consumer surplus is $q_i^{N,PC}(1+\beta)$. Total welfare is the sum of consumer surplus plus profit:

$$W_i^{N,PC} = \frac{\gamma(-a + rk_i + wl_i + \lambda + \beta\lambda)^2\left[\gamma(\beta^2-4)^2 - 2(\beta\sigma-2)^2\right]}{\left[\gamma(\beta-2)(2+\beta)^2 - 2(1+\sigma)(\beta\sigma-2)\right]^2}.$$
$$+\frac{(1+\beta)\left[\gamma(\beta^2-4)(a - rk_i - wl_i + \lambda) + 2\lambda(2 - 2\sigma + \beta\sigma - \beta\sigma^2)\right]^2}{\left[\gamma(\beta-2)(2+\beta)^2 - 2(1+\sigma)(\beta\sigma-2)\right]^2} \quad \text{(A35)}$$

When firms cooperate in the production of R&D, the profit maximizing symmetric level of R&D $\left(x_i^{C,PC}\right)$ is found by adding both profit functions (A31) together and differentiating with respect to R&D:

$$x_i^{C,PC} = \frac{2(a - rk_i - wl_i - \lambda - \lambda\beta)(1+\sigma)}{\gamma(2+\beta)^2 - 2(1+\sigma)^2}. \quad \text{(A36)}$$

Substituting $x_i^{C,PC}$ into (A30) yields the profit maximizing level of production output for the game:

$$q_i^{C,PC} = \frac{\gamma(2+\beta)(a - rk_i - wl_i + \lambda) - 2\lambda(1+\sigma)^2}{\gamma(2+\beta)^2 - 2(1+\sigma)^2}. \quad \text{(A37)}$$

Substituting $x_i^{C,PC}$ and $q_i^{C,PC}$ into second stage profits (9), reveal firm *i*'s total profits:

$$\Pi_i^{C,PC} = \frac{\gamma(-a + rk_i + wl_i + \lambda + \lambda\beta)^2}{\gamma(2+\beta)^2 - 2(1+\sigma)^2}. \quad \text{(A38)}$$

With linear inverse demand (1), consumer surplus is $q_i^{C,PC}(1+\beta)$. Total welfare is the sum of consumer surplus plus profit:

$$W_i^{C,PC} = \left[\gamma(2+\beta)^2 - 2(1+\sigma)^2\right]^2\left\{\gamma\left[\gamma(2+\beta)^2 - 2(1+\sigma)^2\right](-a + rk_i + wl_i + \lambda + \lambda\beta)^2\right.$$
$$\left.+(1+\beta)\left[2\lambda(1+\sigma)^2 - \gamma(2+\beta)(a - rk_i - wl_i + \lambda)\right]^2\right\}. \quad \text{(A39)}$$

When firms cooperate in the production of R&D *and* fully share all cost-reducing research information, $\sigma = 1$. Consequently,

$$x_i^{CS,PC} = \frac{4(a - rk_i - wl_i - \lambda - \lambda\beta)}{\gamma(2+\beta)^2 - 8}, \; q_i^{CS,PC} = \frac{\gamma(2+\beta)(a - rk_i - wl_i + \lambda) - 8\lambda}{\gamma(2+\beta)^2 - 8},$$
$$\Pi_i^{CS,PC} = \frac{\gamma(-a + rk_i + wl_i + \lambda + \lambda\beta)^2}{\gamma(2+\beta)^2 - 8}, \text{ and}$$
$$W_i^{CS,PC} = \left(\gamma(2+\beta)^2 - 8\right)^{-2}\left\{\gamma\left[\gamma(2+\beta)^2 - 8\right](-a + rk_i + wl_i + \lambda + \lambda\beta)^2\right.$$
$$\left.+(1+\beta)\left[\gamma(2+\beta)(a - rk_i - wl_i + \lambda) - 8\lambda\right]^2\right\} \quad \text{(A40)}$$

The second order conditions for each of the three research scenarios (N, C, and CS) are identical to the U and RR cases. Each ensures that the dominators remain positive.

Consequently, $x_i^{CS,PC}$ is greater than $x_i^{C,PC}$ for all σ and β because

$$\frac{4(a - rk_i - wl_i - \lambda - \lambda\beta)}{\gamma(2+\beta)^2 - 8} > \frac{2(a - rk_i - wl_i - \lambda - \lambda\beta)(1+\sigma)}{\gamma(2+\beta)^2 - 2(1+\sigma)^2}. \quad \text{(A41)}$$

Likewise, $x_i^{CS,PC}$ is greater than $x_i^{N,PC}$ for all σ and β because

$$\frac{4(a - rk_i - wl_i - \lambda - \lambda\beta)}{\gamma(2+\beta)^2 - 8} > \frac{2(a - rk_i - wl_i - \lambda - \lambda\beta)(2-\beta\sigma)}{\gamma(2-\beta)(2+\beta)^2 - 2(1+\sigma)(2-\beta\sigma)}, \quad \text{(A42)}$$

and $x_i^{C,PC}$ is greater than $x_i^{N,PC}$ only if $\sigma > 0.5\beta$. For small research spillover rates, $\sigma < 0.5\beta$, $x_i^{C,PC}$ is less than $x_i^{N,PC}$. Production output, total profit, and total welfare follow similarly. *Q.E.D.*

Proof of Lemma 2: In each of the three research scenarios, R&D output under PC regulation is decreasing in λ. This follows because

$$x_i^{N,PC} = \frac{2(a - rk_i - wl_i - \lambda - \lambda\beta)(2-\beta\sigma)}{\gamma(2-\beta)(2+\beta)^2 - 2(1+\sigma)(2-\beta\sigma)}, \; x_i^{C,PC} = \frac{2(a - rk_i - wl_i - \lambda - \lambda\beta)(1+\sigma)}{\gamma(2+\beta)^2 - 2(1+\sigma)^2},$$
$$\text{and } x_i^{CS,PC} = \frac{4(a - rk_i - wl_i - \lambda - \lambda\beta)}{\gamma(2+\beta)^2 - 8}. \quad \text{(A43)}$$

Production output is increasing in λ, because the second order conditions (defined in Proof of Proposition 1) place a minimum level on γ. In the noncooperative case $\left(q_i^{N,PC}\right)$, this follows because

$$\frac{2(1+\sigma)(2-\beta\sigma)}{4+\beta^2} > \frac{2(1+\sigma)(2-\beta\sigma)}{(2-\beta)(2+\beta)^2} \quad \text{(A44)}$$

for all relevant values of β and σ. In the case of $q_i^{C,PC}$,

$$\frac{2(1+\sigma)^2}{2+\beta} > \frac{2(1+\sigma)^2}{(2+\beta)^2}, \quad \text{(A45)}$$

and in the case of $q_i^{CS,PC}$,

$$\frac{8}{2+\beta} > \frac{8}{(2+\beta)^2}. \quad \text{(A46)}$$

The profit maximizing firm will produce a positive amount of R&D under PC regulation so long as $a - rk_i - wl_i - \lambda - \beta\lambda > 0$.

PC regulation reduces R&D by less than RR regulation, *ceteris paribus*, because

$$k\frac{r - s\lambda}{1-\lambda} > \lambda + \lambda\beta. \quad \text{(A47)}$$

In RR regulation, it is assumed $r > s\lambda$, thus

$$\lim_{\lambda \to 1}\left(\frac{r - s\lambda}{1-\lambda}\right) = \infty. \quad \text{(A48)}$$

For PC regulation, however,

$$\lim_{\lambda \to 1}\left(\lambda + \lambda\beta\right) = 1 + \beta. \quad \text{(A49)}$$

Thus, R&D output does not remain positive under perfect enforcement of RR regulation, but may remain positive under perfect enforcement of PC regulation. *Q.E.D.*

REFERENCES

Ai, Chunrong, and David E. Sappington, M. 2002. The Impact of State Incentive Regulation on the U.S. Telecommunications Industry. *Journal of Regulatory Economics* 22 (2, September):133-60.

Averch, Harvey, and Leland L. Johnson. 1962. Behavior of the Firm Under Regulatory Constraint. *American Economic Review* 52 (5, December):1052-69.

Bailey, Elizabeth E., and John C. Malone. 1970. Resource Allocation and the Regulated Firm. *Bell Journal of Economics and Management Science* 1 (1, Spring):129-42.

Baumol, William J., and Alvin K. Klevorick. 1970. Input Choices and Rate-of-Return Regulation: An Overview of the Discussion. *Bell Journal of Economics and Management Science* 1 (1):162-90.

Beesley, M. E., and S. C. Littlechild. 1989. The Regulation of Privatized Monopolies in the United Kingdom. *RAND Journal of Economics* 20 (3, Autumn):454-72.

Bernstein, Jeffrey I., and David E. Sappington, M. 1999. Setting the X Factor in Price Cap Regulation Plans. *Journal of Regulatory Economics* 16 (1, July):5-25.

Cabral, Luis M., B., and Michael H. Riordan. 1989. Incentives for Cost Reduction Under Price Cap Regulation. *Journal of Regulatory Economics* 1 (2, June):93-102.

Clemenz, Gerhard. 1991. Optimal Price-Cap Regulation. *The Journal of Industrial Economics* 39 (4, June):391-408.

De Bondt, Raymond, Patrick Slaets, and Bruno Cassiman. 1992. The Degree of Spillovers and the Number of Rivals for Maximum Effective R&D. *International Journal of Industrial Organization* 10:35-54.

Duysters, Geert, and John Hagedoorn. 2000. A Note on Organizational Modes of Strategic Technology Partnering. *Journal of Scientific & Industrial Research* 58 (August-September):640-49.

D'Aspremont, Claude, and Alexis Jacquemin. 1988. Cooperative and Noncooperative R&D in Duopoly with Spillovers. *American Economic Review* 78 (5, December):1133-37.

Federal Communications Commission. 1992. *Price Cap Performance Review for AT&T*. notice of inquiry filed in CC Docket 92-134, 7 FCC Rcd 5322.

Frank, Mark W. 2003. An Empirical Analysis of Electricity Regulation on Technical Change in Texas. *Review of Industrial Organization* 22 (4): 313-331.

Granderson, Gerald. 1999. The Impact of Regulation on Technical Change. *Southern Economic Journal* 65 (4):807-22.

Hagedoorn, John, and Hans van Kranenburg. 2003. Growth Patterns in R&D Partnerships: An Exploratory Statistical Study. *International Journal of Industrial Organization* 21 (4, April):517-31.

Heyes, Anthony G., and Catherine Liston-Heyes. 1998. Price-Cap Regulation and Technical Change. *Journal of Public Economics* 68 (1, April):137-51.

Laffont, Jean-Jacques, and Jean Tirole. 2002. *Competition in Telecommunications*. Cambridge, Massachusetts: MIT Press.

Lehman, Dale E., , and Dennis L. Weisman. 2000. The Political Economy of Price Cap Regulation. *Review of Industrial Organization* 16 (4, June):343-56.

Okuguchi, Koji. 1975. The Implications of Regulation for Induced Technical Change: Comment. *Bell Journal of Economics* 6 (2, Autumn):703-05.

Poyago-Theotoky, Joanna. 1995. Equilibrium and Optimal Size of a Research Joint Venture in an Oligopoly with Spillovers. *The Journal of Industrial Economics* 63 (2, June):209-26.

Prieger, James E. 2001. Telecommunications Regulation and New Services: A Case Study at the State Level. *Journal of Regulatory Economics* 20 (3, November):285-305.

Prieger, James E. 2002. A Model for Regulated Product Innovation and Introduction with Application to Telecommunications. *Applied Economics Letters* 9 (10, August):625-29.

Resende, Marcelo. 2000. Regulatory Regimes and Efficiency in US Local Telephony. *Oxford Economic Papers* 52 (3, July):447-70.

Scott, John T. 1989. Historical and Economic Perspectives of the National Cooperative Research Act. In *Cooperative Research and Development: The Industry-University-Government Relationship*, ed. Albert N. Link and Gregory Tassey. Norwell, Massachusetts: Kluwer Academic Publishers.

Smith, V. Kerry. 1974. The Implications of Regulation for Induced Technical Change. *Bell Journal of Economics and Management Science* 5 (2, Autumn):623-36.

Smith, V. Kerry. 1975. The Implications of Regulation for Induced Technical Change: Reply. *Bell Journal of Economics* 6 (2, Autumn):706-07.

Takayama, Akira. 1969. Behavior of the Firm Under Regulatory Constraint. *American Economic Review* 59 (3):255-60.

Uri, Noel D. 2001a. Technical Efficiency, Allocative Efficiency, and the Implementation of a Price Cap Plan in Telecommunications in the United States. *Journal of Applied Economics* 4 (1, May):163-86.

Uri, Noel D. 2001b. Telecommunications in the United States and Changing Productive Efficiency. *Journal of Industry, Competition and Trade* 1 (3, September):321-335.

Vogelsang, Ingo. 2002. Incentive Regulation and Competition in Public Utility Markets: A 20-Year Perspective. *Journal of Regulatory Economics* 22 (1, July):5-27.

ENDNOTES

1. Thanks to Barry J. Seldon and Donald G. Freeman for helpful comments. Sam Houston State University's Research Enhancement Fund provided financial support for this research project. All errors remain my responsibility.

2. In its performance review of AT&T, the FCC justified its change to price-cap regulation because rate-of-return regulation offered "little incentive to innovate new and innovative services" (FCC 1992, 5322).

3. Duysters and Hagedoorn also report joint formations of separate research corporations are up 87% between the two periods, while large company investments in small innovative companies (what they term "minority investments") are up 89%. Their findings are from the MERIT-CATI database on inter-firm partnerships, which is maintained by the University of Maastricht (see also, Hagedoorn and Kranenburg, 2003).

4. The possibility of production cooperation is set aside because anti-trust enforcement of production cooperation is a dissimilar policy instrument from price-cap regulation. Moreover, through government policies such as the National Cooperative Research Act (NCRA), R&D cooperation is actively encouraged by offering antitrust protection to firms who cooperate in the production of R&D (see Scott, 1989). The same is not true for production cooperation.

5. For the superscript notation, the first position refers to the research scenario (CS, C, or N), the second position refers to the regulatory scenario (U, RR, or PC).

6. Bernstein and Sappington (1999) provide an analysis of how this adjustment factor should be set under varying market conditions. Note also that our model drops the *RPI* aspect of the *X* factor. This is done merely for simplicity, though it has the benefit of avoiding the occurrence of a rising price-cap, which would occur when *RPI* becomes greater than *X*.

7. In its regulation of AT&T, the FCC set this adjustment factor (*X*) at 3% per year. The FCC argued that AT&T had historically achieved 2.5% productivity growth under rate-of-return regulation, and 0.5% was added as a Consumer Productivity Dividend (CPD) (FCC 1992, 5323). Similarly, in its regulation of British Telecom, the British government initially set *X* at 3% (Beesley and Littlechild, 1989).

8. Laffont and Tirole (2002) argue that imperfections in the administration of price-cap regulation are common. Reasons for this include the practice by regulators of using price averages in the monitoring of price-caps, the unsystematic treatment of new services and phasing out of existing services, the lack of an intertemporal price-cap adjustment, and lack of incentives for service quality (see section 2.3 in chapter 2).

THE INTERNET'S IMPACT ON INTER-BRAND COMPETITION IN NEW CAR MARKETS

Ellen Sewell, The University of North Carolina at Charlotte
Charles Bodkin, The University of North Carolina at Charlotte

The authors gratefully acknowledge financial support for this study through a Childress Klein research award.

INTRODUCTION

With the emergence of the internet, competition in many markets has dramatically intensified. New car markets are certainly no exception. But for this industry, the literature has focused almost exclusively on the internet's impact on intra-brand competition—competition among dealers selling the same make. Because dealership information, often including the price of a vehicle, can now be obtained online without the need for a visit, consumers are willing to search more distant dealers, expanding the geographic dimension of new car markets and intra-brand competition. The emergence of several popular on-line referral services further reduces the cost of search and further intensifies intra-brand competition.

Scott Morton, Zettelmeyer and Silva-Risso (2001) examine the impact of one on-line referral service on new car prices in California. After carefully adjusting for differences in product attributes (make, model, trim line, body type, engine size, transmission type, etcetera), the authors compare the prices paid by Autobytel customers with non-Autobytel customers. (Prices are transaction prices net of any rebates paid to the customer and adjusted for any difference between the trade-in price paid by the dealer and the estimated market value of the trade.) They find an average savings of $451, which they decompose into two sources. According to their analysis, $72 in savings arise from the referral of customers to low-price dealerships and the other $379 results from those dealers selling at lower prices to Autobytel customers (the buying power of the referral agency combined with any cost savings from serving its customers). Since the product must be selected before using a referral service, these services increase only intra-brand competition.

Sewell and Bodkin (2009) study the impact of the internet directly on intra-brand search using survey data. They find that internet shoppers receive a significantly higher number of price quotes on the model purchased in comparison to traditional (off-line) shoppers. This increase in intra-brand competition would, of course, be expected to somewhat reduce consumer prices with or without the involvement of a referral service in the search process.

Along with the documented increase in intra-brand competition, competition across makes, or inter-brand competition, is likely to be impacted by the internet as well. Detailed information on new car attributes, including even virtual test drives, is readily provided by manufacturers on line. If this information effectively reduces the cost of comparing different makes, it would be expected to induce consumers to consider more makes, increasing the product dimension of new car markets and inter-brand competition.

In a recent paper, Zettelmeyer, Scott Morton and Silva-Risso (2006) report that internet shoppers collected information for more " types of cars" than traditional shoppers. Similarly, Ratchford et al. (2001) found that internet users considered more models than traditional shoppers. But these results do not indicate whether more competing makes were investigated or whether more like-make models were considered, or possibly both. So the impact on inter-brand competition, or competition across makes, is unclear.

Furthermore, even if internet shoppers consider more makes than traditional shoppers, it is not clear that inter-brand competition has increased with the advent of the internet. Does the internet actually increase competition or does it merely attract consumers with larger consideration sets who would have searched more intensely even without the internet? It is quite plausible that the latter could be the case. The demographics of those shoppers with larger consideration sets might well match with the demographics of customers who have the access, skills and preferences that are conducive to internet use. Younger customers, for example, because of lower search costs (due to lower wages) and less experience in purchasing cars, might have larger consideration sets. And because they grew up with the internet they might also be more comfortable and possess the skills necessary to effectively search online.

There has been little work done on the choice of the internet as a search tool. Ratchford et al. (2001) modeled the amounts of time spent with various information sources in automobile shopping as functions of consumer time cost, importance of attributes and price, prior information, skill at using each source and income. They found that internet buyers spent more time searching (in total number of hours) and considered more models than non-internet buyers. Internet buyers also spent more time with every other source of information except for reading and listening to ads, when compared to traditional (non-internet) buyers. While that study failed to conclusively establish whether the internet led to greater search or whether those with a greater incentive to search were simply drawn to the internet, it does suggest the real possibility that the latter might be the case. In evaluating its impact on competition, it would seem prudent to treat the decision to use the internet as endogenous.

This paper specifically examines the impact of the internet on inter-brand competition. If consumers investigate more makes as the result of the internet, then previous studies likely understate

its real impact on competition and retail prices, perhaps dramatically. By examining only cross-sectional differences among dealership prices for given makes, these studies capture only the reduction in consumer prices for a given wholesale price distribution. They fail to capture the internet's impact on prices at the wholesale level which would be expected to fall with an increase in inter-brand competition.

A full understanding of the internet's impact on both forms of competition is important from an academic perspective as well as for the crafting of policy. Automobile manufacturers, dealers and regulators have long debated the need for managed competition in retail automobile markets. The consequence of too little competition is well known. The dealership with substantial market power could choose to increase price, reducing sales and the manufacturer's profits but increasing its own profit.[1] Consumers, too, would be harmfully impacted by the higher price. Both inter-brand competition and intra-brand competition serve to limit the dealer's market power, effectively constraining price. But too much intra-brand competition, it has been argued, could have a harmful impact because the retail (and hence the wholesale) demand for the product is sensitive to the quality of brand-specific sales service provided at the dealership as well as the product price.[2] As intra-brand competition increases, retailers have an incentive not to offer the services and instead to reduce price . They are able to increase profits at the reduced price by avoiding the cost of providing the services. In this way, retailers who do not provide the services receive a free ride.[3] The optimal distribution of dealerships thus requires a balance between inter-brand and intra-brand competition to restrain prices while preserving sales service.

Recognizing a need to manage competition, many states regulate the placement of like-make dealerships. The first such law was enacted by Colorado in 1963. By 1984, thirty six states had similar laws [Rogers, 1986]. These laws, often known as RMA (Relevant Market Area) Laws, restrict the establishment of a new dealership or the relocation of an existing dealership into another dealer's relevant market area, the size definition of which varies across states.[4] Supporters of the RMA laws argued that they would provide greater protection from excessive intra-brand competition which might depress price to the point that service-conscious dealers would be unable to earn normal rates of return [Smith 1982, Rogers 1986].

Even if the RMA Laws once provided an optimal spatial distribution of dealerships, changes in both inter-brand and intra-brand competition in the age of the internet would likely render that distribution sub-optimal today. The increase in intra-brand competition might well put sales service at risk, justifying an increase in the size of the protected market area. And an increase in inter-brand competition would allow for a greater dispersion of like-make dealers without a significant increase in market power.

Furthermore, if , as expected, buyers substitute visits to web sites for traditional dealership visits then the importance of geographic proximity among competing brands diminishes. Brand representation on an auto row may no longer be critical. Less agglomeration among dealers and a greater focus on a more disperse distribution to improve post-purchase service accessibility could be justified.

Many of the leading manufacturers have announced plans to reduce the numbers of franchised dealerships and common ownership of like-make dealerships, within or across geographic markets, has intensified. The impact of the reduction in intra-brand competition will have a smaller adverse impact on consumer prices if it is adequately balanced by an increase in inter-brand competition. But that increase remains undocumented. This paper will begin to fill that void.

DATA

To understand the impact of the internet on competition, one must examine its impact on the search process. In order to compare behavior between internet and non-internet shoppers, a survey instrument was mailed to 5000 residents of North Carolina and South Carolina who had purchased a new car or light truck during the preceding 60 days (See appendix for detailed content). Survey instruments were filled out and returned by 750 consumers, though some contained only part of the requested information. The number of consumers responding to individual questions is indicated in the appendix.

The original source for the purchased addresses was vehicle registration records, which are virtually complete.[5] The sample of addresses purchased was randomly chosen except that fleet and commercial registrations were excluded. Thus we are confident that the group of consumers receiving survey instruments was representative of the study population (new car buyers in North and South Carolina). However, only fifteen percent of those receiving surveys returned them, introducing a real risk of non-response bias, which is always present, to some degree, when using survey data.

Differences in response rates based on age, income, race and education, were investigated. In order to encourage participation, no individual identifiers were included in the survey. However, county of residence was provided by respondents and could be determined for most (all but six) survey recipients from the mailing addresses. Thus a response rate (number returned/ number sent) could be calculated for each of the 146 counties in the study. And county level demographic data are readily available from the U.S. Census Bureau.

The first potential source of bias investigated was income. Counties were ranked from low to high on the basis of estimated median household income. The mean response rate for the poorest 37 counties (approximately 25 percent of counties) was compared to the mean response rate for the richest 37 counties. The difference was not significant at the 5% level. The procedure was repeated using median age, percent of the population over age 25 with a bachelor's degree or higher, and percent white. In each case, there was no significant difference at the 5% level.

A non-response bias based on gender was not investigated for two reasons. First, the variance in gender mix across counties is extremely small for the study population so that the

procedure used to investigate bias for the other demographic variables could not be used. Gender could be determined for most recipients by the salutation provided with the mailing address. And respondents were asked their genders. However, the cover letter instructed the recipient (the individual to whom the vehicle is registered) to pass the survey on to the member of the household who was the primary decision maker for this purchase. It was anticipated that the individual most influential in the purchase decision would provide the best quality data.. But it is no longer clear what gender mix for respondents would be indicative of a non-response bias. In other words, the gender mix for primary decision makers could be quite different than for registered owners.

The finding that response rates do not differ significantly across common demographic subgroups does not, unfortunately, allow us to rule out non-response bias since the observable and unobservable influences on the propensity to respond are virtually limitless. The use of survey data, even with high response rates, always introduces the risk of non-response bias.

Because this study compares traditional (off-line) to internet shoppers, systematic under-representation of either group would be troublesome. While one could reasonably expect that traditional shoppers would be more or less inclined to complete the survey, there is some evidence that any such systematic bias is small. Respondents were asked to indicate whether they had "used the internet to search for automotive information when purchasing your new car." The number of respondents indicating that they had used the internet in the search process was 430 or 57% of respondents. A study by J.D. Powers [2000], found that 54% of new car buyers nationwide used the internet in the search process.[6]

To assess the impact of the internet on inter-brand competition separately, one must determine where in the search process the internet was used. Those who indicated that they had used the internet when searching for their new car were then asked, "which makes did you research on-line using the internet?" Thirty check-boxes with the names of popular makes as well as an "other" category with a space to write in an additional make followed. Respondents who indicated that they had not researched any makes on-line were defined to be non-users in choosing the product. Those who indicated that they had used the internet in the search process were also asked, "How many websites did you visit that sold the same make you purchased?" Those who indicated that they had not visited any such sites were deemed to be non-users in the choice of dealership. The majority (384) of those who indicated that they had used the internet, used it in choosing both the product and the dealership. Forty two used the internet only in researching the product while two used the internet only in choosing the dealership. Finally, only two consumers responded that they had used the internet but then indicated that they had neither investigated any makes on-line nor visited any dealer sites for the model purchased.

Inter-brand competition is competition across different makes. To measure the extent of inter-brand competition all subjects were asked, "Which makes did you seriously consider purchasing?" Again, thirty check-boxes with the names of popular makes as well as an "other" category with a space to write in an additional make followed. The average response was 2.941 different makes for internet shoppers and 2.344 for traditional (non-internet) shoppers.[7] At first glance the significantly higher number for the internet-shopper appears to support the a-priori expectation that the internet, by reducing the costs of scrutinizing additional makes, models and options, increases the number of products considered and inter-brand competition. But again, the question is not that simple. Can we be sure that the internet is increasing inter-brand competition rather than merely attracting those who would have search more intensely even without it?

THE MODEL

The model used here is a two-equation simultaneous system. Equation one is intended to explain the overall amount of inter-brand search while equation two is designed to explain the decision to utilize the internet for all or part of that search.

Equation One:

$$makes = \gamma_1 internet + \beta_0 + \beta_1 dispersion + \beta_2 enjoy\ search + \beta_3 metro + \beta_4 loyalty + \beta_5 importance + \beta_6 experience + \beta_7 time\ value + \beta_8 location + \varepsilon_1$$

The dependent variable for this equation is the number of makes considered. The value of makes is observed and the variable is continuous.

Equation Two:

$$Internet^* = \gamma_2 makes + B_0 + B_1 access + B_2 skill + B_3 enjoy\ internet + B_4 enjoy\ traditional\ search + B_5 internet\ experience + B_6 metro + B_7 time\ value + B_8 location + \varepsilon_2$$

For this equation the observed value of the dependent variable is equal to one if $internet^* > 0$ and is equal to zero otherwise. A value of one indicates that the consumer used the internet while a value of zero indicates that the consumer did not use the internet in choosing the product.

Equation One derives from the basic optimal search framework originally proposed by George Stigler (1961) and extended numerous times. While Stigler's original paper focused on price search, the extension to a product search process is straightforward. The number of makes investigated (*makes*) is specified to be a function of internet use, perceived product dispersion, search enjoyment, whether the consumer lives in a metropolitan area, product loyalty, the importance of the choice of make, car purchase experience, the consumer's time value and the importance of a convenient location.

The dependent variable, *makes,* is the number of makes indicated in response to the question, "Which makes did you seriously consider purchasing?" as discussed above. *Internet* is a dichotomous variable with a value of one for a consumer who used the internet in choosing the product, as discussed above, and zero for a consumer who did not. The variable *dispersion* measures perceived product dispersion, or variation,

as indicated by agreement with the statement, "The quality of automobiles varies a lot in my price range." Agreement was measured using a seven point Likert scale with one designated as "strongly disagree" and seven designated as "strongly agree." With greater perceived variability, there is an increase in the probability of locating a product that would be sufficiently preferred to offset the additional search cost. The coefficient is expected to be positive. The variable *enjoy search* captures search enjoyment as gauged by the respondent's indicated agreement with the statement, "Overall, I really enjoy shopping for a new car." The same seven-point Likert scale discussed above was used to indicate and code agreement. The coefficient is expected to be positive. *Metro* is a dichotomous variable with a value of one if the respondent resides in a county which is a component of a metropolitan area, as defined by the U.S. Office of Management and Budget. Since a greater variety of dealerships can be found in metropolitan areas, the cost of traditional search would be lower in these locations. The coefficient is expected to be positive. The variable *loyalty* is a dichotomous variable with a value of one if the respondent answered yes to the question, "Have you previously owned the make of car that you recently purchased?" A consumer who repeat purchases the same make demonstrates a high level of satisfaction with the previous purchase. According to Sambandam and Lord [1995] and others, this high level of satisfaction, or loyalty, reduces the consumer's incentive to investigate competing brands. The coefficient on this variable is expected to be negative. The variable *importance* is the buyer's indicated agreement with the statement, "Careful comparison is required to choose the best make and model of car." The same seven-point Likert scale discussed above was used to indicate agreement. The coefficient is expected to be positive. The variable *experience* is the consumer's response to the question, "How many new cars have you purchased?" Because of a greater accumulated knowledge of market conditions, an experienced buyer is expected to engage in less search for a subsequent purchase, making the expected sign of the coefficient on this variable negative. This inverse relationship has been empirically supported by Srinivasan and Ratchford [1991], Kiel and Layton [1981] and others. The variable *time value* is intended to pick up the value of the respondent's time. It is the response to the question , "How many miles would you be willing to drive to save $300 off the price of your recently purchased car?" This variable is continuous. Since a high response is indicative of a low time value and lower search cost, the coefficient is expected to be positive. The variable *location* is the respondent's agreement with the statement, "A convenient service location is important in choosing the make." Again, the same seven-point Likert scale discussed above was used to indicate agreement. A greater emphasis on location would render fewer makes acceptable so the coefficient is expected to be negative.

The decision to use the internet in choosing the product is specified to be a function of access, skill, enjoyment of the internet, enjoyment of traditional search, experience using the internet, whether the consumer lives in an urban area, the consumer's value of time, and the importance of location in choosing the product.

The variable *access* is dichotomous with a value of one if a respondent answered yes to the question, "Do you have access to the internet in your home?" The variable *skill* is also dichotomous with a value of one if the consumer answered yes to the question, "Do you know how to use the internet to search for information?" A positive response to either question is expected to increase the likelihood of internet usage in the search process by reducing the cost of usage. Two survey questions were used to measure the enjoyment of alternative search options: internet search or traditional search. Participants were asked to "indicate the degree to which you agree or disagree with the following statements." The same seven point Likert scale was used to indicate and code agreement, with a higher value indicating greater agreement. *Enjoy internet* is the indicated agreement with the statement, "I really enjoy using the internet." *Enjoy traditional search* is the indicated agreement with the statement, "I really enjoy visiting dealerships and looking at new cars before I make a purchase." The coefficient on the first variable is expected to be positive while the coefficient on the second is expected to be negative. The variable *internet experience* is the buyer's indicated agreement with the statement, "I purchase a lot of products through the internet." The same seven point Likert scale was used to indicate agreement. This variable was designed to capture experience and comfort in evaluating product characteristics on-line. The coefficient is expected to be positive. The variable *metro* appears again in this equation. For rural customers, the distance to a dealership is greater so that the savings from searching online are greater if internet search can replace dealership visits. The coefficient on this variable, in this equation, is thus expected to be negative. The variable *time value* appears in this equation as well. If the internet reduces the time required to search, then those with higher time values (lower responses) should be more likely to search online. The expected coefficient is thus negative. The variable *location* appears again in this equation. The coefficient is expected to be negative. A convenient location is, presumably, one near the consumer. Cost savings are greatest when internet search can substitute for distant dealer visits. If the respondent places greater emphasis on proximity, then makes located only at some distance would not be considered and the savings from internet search would be smaller.

Because *internet* and *makes* are mutually dependent or endogenous, the individual estimation of the two equations would result in the familiar problem of simultaneous-equations bias. The resulting estimators would be inconsistent.

The appropriate procedures for estimation of a simultaneous system of equations with one continuous and one dichotomous variable have been discussed extensively in the econometrics literature [Maddala 1983; Amemiya 1978]. The *access* and *skill* variables as well as *internet experience* and *enjoy internet* should impact the dependent variable for equation one only through their impact on the decision to use the internet, making them solid instrumental variables. Consistent estimators can be obtained following a standard two stage process using ordinary least squares and probit.[8]

THE RESULTS

Table I presents the simultaneous equations estimates for the inter-brand model. The internet is found to have a positive and significant impact on inter-brand competition. The size of the consideration set does not, however, significantly influence the decision to use the internet. This would suggest that the internet is increasing inter-brand competition rather than merely attracting those with larger consideration sets. Only three other independent variables in the first equation, *loyalty, importance and location* are significant at the .05 level or higher. All of the coefficients have the expected signs.

In the second equation, both the *access* and *skill* variables have the expected positive coefficients and are significant at the .01 and .05 levels, respectively. These two variables are of particular interest because the number of consumers with internet access and search skills will both likely increase over time as computer-savvy younger consumers replace older consumers in the marketplace, suggesting that inter-brand competition will increase. Both of the enjoyment variables are highly significant. The coefficient on *enjoy traditional search* is negative. Those who enjoy visiting dealerships and looking at cars are significantly less likely to turn to the internet. And those who enjoy using the internet are more likely to include its usage in the search process for their new car, explaining the positive coefficient on *enjoy internet*.

CONCLUSIONS

This study tentatively confirms that on-line shoppers do, in fact, consider more makes than traditional shoppers and that this is not merely the result of the gravitation of shoppers with larger consideration sets to the internet. This finding, combined with past research, suggests that both competition across like-make dealers as well as competition across makes has intensified with the introduction of the internet.

The confirmation of an increase in inter-brand competition has important implications as dealers, manufacturers and regulators grapple with the need to adjust the spatial distribution of dealerships in the age of the internet. The increase in inter-brand competition allows for a more disperse distribution of like-make dealerships with a smaller associated increase in market power. And because on-line consumers can be induced to consider more makes, the importance of representation on an auto row is no longer as critical, again supporting a more disperse distribution with improved access to post purchase service. This suggests that the manufacturers' intent to reduce the number of dealerships could be accomplished without significant adverse impacts on consumers when compared to pre-internet days.

Table I Simultaneous Equation Estimates for Inter-brand Competition

Dependent Variable: # makes use		Dependent Variable: internet	
constant	2.4943**	constant	- 2.2659**
	(.4345)		(.5899)
internet	.1136*	makes	-.0181
	(.0554)		(.1685)
dispersion	.0376	access	.6285**
	(.0446)		(.1848)
enjoy search	.0695	skill	.7973*
	(.0364)		(.3641)
metro	-.0401	enjoy internet	.3990**
	(.1506)		(.0429)
loyalty	-.5903**	enjoy traditional search	-.0834*
	(.1333)		(.0363)
importance	.1335*	internet experience	.0306
	(.0573)		(.0454)
experience	-.0167	metro	.2174
	(.0147)		(.1429)
time value	.0001	time value	.0002
	(.0002)		(.0002)
location	-.1152*	location	-.0641
	(.0476)		(.0457)
R^2	0.0814		
corrected standard errors in parentheses		Pseudo R^2	0.3903
n=629		corrected z values in parentheses	
**significant at the .01 level			
* significant at the .05 level			

REFERENCES

Amemiya, Takeshi. 1978. The Estimation of a Simultaneous Equation Generalized Probit Model. *Econometrica*, 46(5): 1193-1205.

J.D. Power and Associates.2000. *New Autoshopper.com Study,* Aguora Hills, CA: J.D. Power and Associates.

Keshk, Omar M.G. 2003. CDSIMEQ: A Program to Implement Two-stage Probit Least Squares. *The Stata Journal*, 3(2): 1-11.

Kiel, Geoffrey C. and Roger A. Layton. 1981. Dimensions of Consumer Information Seeking Behavior. *Journal of Marketing Research*,18(2): 233-239.

Maddala, G.S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge: Cambridge University Press.

Ratchford, Brian T., Debabrata Talukdar and Myung-Soo Lee. 2001. A Model of Consumer Choice of the Internet as an Information Source. *International Journal of Electronic Commerce,* 5(3): 7-21.

Rogers, Robert P. 1986. The Effect of State Entry Regulation on Retail Automobile Markets. Bureau of Economics Staff Report to the Federal Trade Commission, (January).

Scott Morton, Fiona M., Florian Zettelmeyer and Jorge Silva-Risso. 2001. Internet Car Retailing. *The Journal of Industrial Economics*, 4(December): 501-519.

Sewell, Ellen and Charles Bodkin. 2009. The Internet's Impact on Competition, Free Riding and the Future of Sales Service in Retail Automobile Markets. *Eastern Economic Journal*, 35(1): 96-114.

Smith, R.1982. Franchise Regulation: An Economic Analysis of State Restrictions on Automobile Distribution. *Journal of Law and Economics*, 25(1): 125-157.

Stigler, George J.1961. The Economics of Information. *The Journal of Political Economy*, 69(3): 213-225.

Srinivasan, Narasimhan and Brian T. Ratchford. 1991. An Empirical Test of a Model of External Search for Automobiles. *Journal of Consumer Research*, 18(2): 233-242.

Telser, Lester G. 1960.Why Should Manufacturers Want Fair Trade Laws? *Journal of Law and Economics,* 3 (October): 86-105.

Walden, Michael L. 2004. Car Prices and State Entry Restrictions Revisited. unpublished working paper, Department of Agricultural and Resource Economics, North Carolina State University.

Zettelmeyer, Florian, Fiona M. Scott Morton, and Jorge Silva-Risso. 2006. How the Internet Lowers Prices: Evidence from Matched Survey and Automobile Transaction Data. *Journal of Marketing Research*, 43(2): 168-181.

ENDNOTES

1. In the United States, new cars are sold most commonly through a straight product distribution franchise system with more than 20,000 franchised dealerships. Franchises are allocated by each manufacturer to independent dealers.

2. This argument refers to service provided in the sales process rather than post-purchase maintenance or repair services.

3. Telser [1960] was one of the first to formally recognize that a free rider problem might arise in the absence of resale price maintenance for products requiring special services.

4. For definitions of the RMA's for all states, see Walden [2004]. The data used in this study are from North Carolina and South Carolina, making these definitions particularly relevant.

5. Customer addresses were purchased from Polk Company.

6. In a study by Zettelmeyer et al. [2006], 72% of respondents reported using the internet in some way in searching for their new vehicle. This study focused exclusively on buyers of eight popular models. It is quite plausible that the customer demographics for these models would favor heavier internet use.

7. Standard deviations were .0835 and .0849, respectively. 423 internet users responded to this question while 304 traditional shoppers answered.

8. Recently, a user-friendly statistical procedure for fitting such a model, without the need for additional programming, has become available [Keshk 2003].

APPENDIX

The data for this study were collected as part of a broader study into the behavior of new car purchasers. This appendix is intended to provide the general layout, the wording of questions, and summary responses for items related to this paper.

New Vehicle Purchase Survey

Section 1
Questions about your recent vehicle purchase

Make
The "make" of a car refers to the name of the Company that manufactured the car
Examples include:

Ford
Chevrolet
Honda
Dodge

Question 1. Please write in the make of the car you recently purchased.

_____

Model
The "model" of the car refers to the specific name given the car.
Examples include:

Escort
Camaro
Accord
Ram Truck

Question 2. Please write in the model of the car you recently purchased.

_____

Question. Please circle the number that indicates the degree to which you agree or disagree with the following statements.

	Strongly Disagree						Strongly Agree
Careful comparison is required to choose the best make.....	1	2	3	4	5	6	7
and model of car	n =746	Mean =5.95		Standard deviation = 1.26			
A convenient service location is important in choosing the make.....	1	2	3	4	5	6	7
	n = 726	Mean =4.20		Standard deviation =1.59			
The quality of automobiles varies a lot in my price range.....	1	2	3	4	5	6	7
	n = 732	Mean = 4.60		Standard deviation = 1.52			
I really enjoy visiting dealerships and looking at new cars.....	1	2	3	4	5	6	7
before I make a purchase							
	n=740	Mean =4.38		Standard deviation = 2.04			
I really enjoy using the internet	1	2	3	4	5	6	7
	n =721	Mean = 4.44		Standard deviation = 2.15			
I purchase a lot of products through the internet	1	2	3	4	5	6	7
	n =723	Mean = 2.79		Standard deviation = 1.90			
Overall, I really enjoy shopping for a new car	1	2	3	4	5	6	7
	n=742	Mean = 3.93		Standard deviation = 1.85			

Section II
Dealership Information

Question What was the name of the dealership where you purchased your new car? (If you don't know the name of the dealership, please describe the location

Name of dealership _____

Question. How many miles would you be willing to drive to save $300 off the price of your recently purchased car?..... _____ miles

n = 712 Mean = 67.14 Standard deviation = 162.48

Question. Do you have access to the internet in your home?..... _____No _____Yes

n = 746 yes = 562 no=184

Question. Do you know how to use the internet to search for information? ..... _____No _____Yes

n = 745 yes = 631 no=114

If you
USED THE INTERNET
to search for information when purchasing your new car please continue

If you
DID NOT USE THE INTERNET
to search for automotive information when purchasing your new car please
SKIP TO QUESTION 34
on the last page of the survey

Section III
Internet Use

Which makes did you research on-line using the Internet?

☐ Acura	☐ Dodge	☐ Infiniti	☐ Mercedes	☐ Saturn
☐ BMW	☐ Eagle	☐ Isuzu	☐ Mitsubishi	☐ Subaru
☐ Buick	☐ Ford	☐ Jeep	☐ Nissan	☐ Toyota
☐ Cadillac	☐ GMC	☐ Lexus	☐ Oldsmobile	☐ Volkswagen
☐ Chevrolet	☐ Honda	☐ Lincoln-Mercury	☐ Plymouth	☐ Volvo
☐ Chrysler	☐ Hyundai	☐ Mazda	☐ Pontiac	☐ Other (please write in) _____

Question . How many websites did you visit that sold the same make you purchased? ....._____

n = 429 Mean = 3.39 Standard deviation = 8.37

Section IV
Background Information

Question 34. Your zip code: _____ (please write in)

Question. County of Residence _____ (please write in)

Question: Gender _____ Male _____ Female

A NOTE ON INFLATION AND STOCK RETURNS: AN EXAMINATION OF EQUITY MARKET PERFORMANCE IN EIGHT MAJOR ECONOMIES

Maury R. Randall, Rider University
David Y. Suk, Rider University

The threat which inflation poses to equity markets remains a topic of both practitioner and academic interest. Fears of rising inflation, the impact on interest rates, and the ensuing reaction on stock prices are routinely reported to investors. News reports in the financial media frequently highlight how inflation is affecting underlying economic forces in global financial markets and how monetary authorities are likely to respond. Occasionally, such as in late 2008, fears of the combination of deflation and recession become the focus of attention. Given the broad interest in the linkages between the general price level and stock prices, there are many studies in academic-finance literature which examine various aspects of this subject.

In this paper we investigate a question which receives very little attention in the practitioner press and is rarely directly addressed in the academic literature. Specifically this paper focuses on the following question: Which is more important in explaining stock market returns, the level of inflation or changes in the rate of inflation? The answer to this question is not clear, for there are differing and conflicting theories on how inflation exerts its effects on stock markets.

The prevailing view has been that low, as opposed to high, rates of expected inflation will be a favorable influence on equity prices. Numerous studies on the United States stock market address this issue including those of Nelson (1976), Fama (1981), Geske and Roll (1983), Wahlroos and Bergland (1986), Park (1997), Murphy and Sahu (2001) and Al-Khazali and Chung (2004). In addition, international studies have been published which support the premise that higher rates of expected inflation are associated with lower real stock returns. These papers include Gultekin (1983), Lee (1998), Adrangi, Chatrath, and Raffiee(1999), and Adrangi, Chatrath, and Shank (1999).

There are, however, reasons to believe that changes in the rate of inflation are more important than the level of inflation in explaining stock returns. Would markets perform better in an environment where long-term inflationary expectations remained low, but rose from 2% to 3%, or would returns be superior if inflation had been stable at 5% but then dropped to 4%? One might argue that some of the reasons cited to explain the influence of inflation on stock prices are more closely linked to changes in inflation rather than to the prevailing level of inflation.

In the next section of this paper, we discuss two major theories on inflation and how they are linked to our premise that changes in inflation may be more significant in explaining variations of stock returns. Those two theories are the "tax effect" and "proxy effect" hypotheses. Subsequent sections of the paper describe the unique features of our analysis, the theoretical model employed, and the data utilized. The results of the empirical tests support the proposition that changes in inflation are more significant in explaining one-year stock returns than the level of inflation in the eight major economies and stock markets in our sample.

THE TAX-EFFECT AND PROXY-EFFECT HYPOTHESES

The tax-effect hypothesis describes how a higher rate of inflation has an adverse effect on free cash flows of corporations. [See Feldstein (1980), Ely and Robinson (1989), DeFina (1991), and Weigel (1994).] The hypothesis points out that the tax deduction for depreciation is based on historical costs and there is a disparity between historical-cost depreciation and current replacement costs. Higher inflation will, therefore, cause higher real corporate taxes, diminishing the availability of funds available to the corporation. Because capital expenditures needed to replace plant and equipment are linked to current costs, real free cash flows will tend to contract if there is an increase in the rate of inflation.

If, however, the rate of inflation stabilizes at the higher level, nominal free cash flow would eventually grow at the rate reflected in the higher rate of inflation. If physical capital retained its productivity, future stock returns could eventually be restored after the initial setback. [See Murphy and Sahu (2001) and Al-Khazali and Chung (2004).] The net effect is that stock prices might drop due to the increase in the rate of inflation, but over a longer period of time, the higher rate of inflation, if maintained would not be associated with lower stock returns.

The proxy-effect hypothesis provides a second explanation of an inverse relationship between inflation and returns on equities. [See Fama (1981 and 1990), Kaul (1987), McQueen and Roley (1993), and Park (1997).] Stock returns are assumed to be positively correlated to anticipated economic growth. However, anticipated economic growth is assumed to be negatively related to inflation. The latter relationship is attributable to the belief that the Federal Reserve will respond to higher inflation by raising interest rates with a tightened monetary policy. Such a policy would retard the expansion of the economy and decelerate or eliminate growth in profits. Again, the driving force appears to be changes in expected inflation which trigger the change in monetary policy.

In summary, both the proxy effect and tax-effect hypotheses support the notion that rising anticipated inflation would be associated with falling stock market returns. Similarly, declining inflationary expectations should be correlated with an improving stock market. At the same time both hypotheses are consistent with the premise that a stable rate of inflation, whether high or low, can be associated with either weakness or relative stability in stock returns.

UNIQUE FEATURES OF THE EMPIRICAL ANALYSIS

Most studies on the impact of inflation and stock returns utilize measures of expected inflation. In contrast, our study uses measures of actual inflation. While usage of expected inflation provides many useful insights, tests with actual inflation can also provide some interesting results and perspectives in understanding stock market movements. One advantage of using actual inflation versus expectations is that there are technical problems and the potential for significant errors in deriving an accurate measure of inflationary expectations. While there can also be measurement problems in actual inflation data, they are generally regarded to be more reliable than estimates of expected inflation.

The model utilized to estimate the relationship between inflation and stock returns is specified in equation (1):

(1) $R_t = a_0 + a_1 p_t + a_2 \Delta p_t + e_t$

R_t = total real return on the stock market during period t

p_t = level of inflation during period t

Δp_t = change in rate of inflation between period t-1 and t (i.e. $p_t - p_{t-1}$)

Two questions which we address in the empirical analysis are the following:

1. Is either inflation or changes in the rate of inflation significant in explaining one-year stock returns?
2. Is one of the two variables more robust in explaining movements in those returns?

DATA

The eight nations selected for this study were chosen because of their size and because data on total stock market returns and rates of inflation were available for an extended period of time. The names of the countries and their market indexes are shown in Table 1. According to the World Bank, the 8 countries rank among the 9 largest economies in the world based on statistics for the year 2006. The one large economy in the group of 9 which is not included in our sample is China (the fourth largest). The reason it was omitted is because its stock market developed relatively recently, and consequently, there is insufficient data for that nation. [There were also similar problems in adding other countries with relatively large economies.]

Data for the eight nations in the sample cover the 44-year period from 1961 to 2005. In all cases annual real stock returns and annual rates of inflation were utilized in the empirical analysis. The inflation data is based on each nation's consumer price index. Countries in Table 1 are listed in the order of the size of their economies in 2006.

ANALYSIS OF RESULTS

The findings for each of the individual nations are shown in Table 2. [To facilitate the analysis, the order of country listings was slightly altered. The 5 European nations are grouped together and are listed consecutively in Table 2.] The results may be summarized as follows:

1. In all 8 countries the coefficient of the change in inflation was negative. However, only in the cases of the United States and France was the relationship significant.
2. In 7 countries (except UK) the coefficient for the level of inflation was negative. It was significant only in Spain, and the UK was the one country in which the coefficient was slightly positive (but not significant).

Table I: Description of the Data (1961 – 2005)

Country	Stock Market Index	Average Annual Inflation	Average Annual Nominal Stock Return
United States	S&P 500	4.33%	11.87%
Japan	Japan Nikko Securities Composite	3.88%	11.72%
Germany	Germany CDAX	2.97%	9.18%
United Kingdom	UK FTA All-Share	6.05%	15.84%
France	France SBF-250	5.04%	12.91%
Italy	Italy BCI Global	7.29%	11.82%
Canada	Canada S&P/TSX-300	4.42%	11.64%
Spain	Barcelona SE-30	8.12%	17.15%
Average		5.31%	12.82%

Data source: Global Financial Data www.globalfinancialdata.com

Table II: Real Stock Returns vs. Levels and Changes of Inflation

Country	Constant	Coefficient of Level	Coefficient of Change	Adjusted R square
US	0.129 (3.09)***	-1.267 (-1.58)	-3.400 (-2.99)***	0.25
Canada	0.108 (2.49)**	-0.910 (-1.14)	-1.200 (-0.91)	0.02
Japan	0.132 (2.36)**	-1.381 (-1.40)	-1.228 (-0.91)	0.05
Germany	0.128 (1.79)*	-2.094 (-1.01)	-2.178 (-0.76)	0.01
UK	0.052 (0.77)	0.790 (0.93)	-0.964 (-0.68)	-0.02
France	0.115 (1.84)*	-0.803 (-0.82)	-4.640 (-2.21)**	0.10
Italy	0.086 (1.08)	-0.543 (-0.64)	-0.860 (-0.69)	-0.02
Spain	0.311 (4.64)***	-2.653 (-3.88)***	-0.646 (-0.57)	0.27
Portfolio of Five European Countries	0.136 (2.66)**	-1.015 (-1.43)	-4.700 (-2.79)***	0.19
Portfolio of Entire Group of Eight Countries	0.132 (2.98)***	-1.092 (-1.58)	-4.00 (-2.61)**	0.19

The numbers in the parentheses are t-statistics.
* significant at the 10%
** significant at the 5%
*** significant at the 1%

The results using nominal stock returns are not shown but those findings are basically the same as each of the results with real returns in Table 2.

In short, results for individual countries show a tendency for the two inflation coefficients to be negative, but in most of the cases there was no statistical significance and a relatively low R^2.

One possible reason why the results are relatively weak with respect to inflation is that country-specific factors and other "statistical noise" are obscuring the impact of the inflation variables. In other words is there something analogous to unsystematic risk that is muffling the impact of inflation? Some additional empirical analysis was performed to test this proposition.

For each of the 44 years the average rate of inflation was calculated for a sub-group of the nations and for each of those years the average real market return was also calculated for that sub-group. The sub-group selected consisted of the five European nations in the sample. In effect, an index of the rate of inflation for that group of 5 nations and an index of the collective real returns of those nations was computed. The results would be applicable to an investor who purchased an international mutual fund with equal weightings in each of the five stock markets. Another perspective would be an individual who invested an equal amount in 5 exchange traded funds, each fund representing one of the market indexes.

The findings for the group of 5 provide an interesting contrast to the outcome for the 5 individual countries discussed above. The coefficient for the level of inflation remains negative, but it is insignificant (only Spain of the 5 individual nations showed significance). However, the coefficient of the change in inflation is not only negative, but is now also significant, even though only one of the 5 nations (France) displayed significance in Table 2. The level of significance is also greater than each of the levels of significance for the individual countries. In addition, the adjusted R^2 is 0.19, which is greater than the average of the 5 individual values of R^2 (.07).

If an investor purchased a global mutual fund with equal weights in the entire group of 8 countries or if that individual purchased 8 country-index exchange-traded funds with equal weights, a similar set of findings occurred. In the portfolio of 8, the coefficient for the level of inflation again remains negative but not significant, and the coefficient of the change of inflation continues to be both negative and significant. In addition, the R^2 for the group of 8 (.19) is still greater than the average R^2 of the 8 individual countries (.08). However, while the coefficient for the change in the rate of inflation remains significant, the level of significance is .05 instead of .01.

SOME IMPLICATIONS AND APPLICATIONS

The results in Table 2 indicate that rising prices may be less detrimental for some nations, such as those with larger commodity-based industries. Another factor which relates to the results is that many nations may have encountered unique political and economic events on a year-to-year basis which overwhelmed the impact of inflation. Given that unsystematic country-risk factors are reduced through diversification, such investors may be more subject to market risk. Therefore, as one adopts a more diversified global investment strategy, forces such as international inflation may become more prominent and warrant greater attention.

The findings of the study may also be useful for the purpose of simulating and estimating the effect that actual inflation may exert in the context of international diversification. Using the results of the diversified portfolios in Table 2 [see coefficients for the change of inflation], one can observe that an increase in actual inflation of 1 percent generally reduced real stock returns between 4 and 5 percent. Similarly, if one expects a reduction in the rate of inflation, the impact, other things equal can also be simulated.

SUMMARY AND CONCLUSIONS

This paper has analyzed the impact of the level inflation and changes in the rate of inflation on the stock markets of 8 major economies. We find that increases in both variables are negatively associated with real stock returns but only the change in inflation variable showed statistical significance in the diversified portfolios. The effect of creating such globally diversified portfolios generally increased the significance of the change in inflation coefficient compared to single country results and also improved the R^2. The results suggest that by increasing global diversification, one may become more susceptible to the forces of systematic risk inherent in global inflation.

REFERENCES

Adrangi, Barham, Arjun Chatrath, and Kambiz Raffiee, "Inflation, Output, and Stock Prices: Evidence from Two Major Emerging Markets," *Journal of Economics and Finance*, 23, (Fall 1999), pp. 266-278.

Adrangi, Barham, Arjun Chatrath, and Todd Shank, "Inflation, Output, and Stock Prices: Evidence from Latin America," *Managerial and Decision Economics*, 20, (March 1999), pp. 63-74.

Al-Khazali, Osamah and Soo Pyun Chung, "Stock Prices and Inflation: New Evidence from the Pacific-Basin Countires," *Review of Quantitative Finance and Accounting*, 22, (March 2004), pp. 123-140.

DeFina, Robert, "Does Inflation Depress the Stock Market?" Federal Reserve Bank of Philadelphia, *Business Review*, (November/December 1991), pp. 3-11.

Ely, David, and Kenneth Robinson, "The Stock Market and Inflation: A Synthesis of the Theory and Evidence," Federal Reserve Bank of Dallas, *Economic Review*, (March 1989), pp. 17-29.

Fama, Eugene, "Stock Returns, Real Activity, Inflation, and Money," American *Economic Review*, 71, (September 1981), pp.545-565.

Fama, Eugene, “Stock Returns, Expected Returns, and Real Activity,” *Journal of Finance*, 45, (1990) pp.1089-1108.

Feldstein, Martin, “Inflation, Tax Rules and the Stock Market,” *Journal of Monetary Economics*, 6, (July 1980), pp. 309-331.

Geske, Robert, and Richard Roll, “The Fiscal and Monetary Linkage between Stock Returns and Inflation,” *Journal of Finance*, 38, (March 1983), pp. 1-33.

Gultekin, N., “Stock Market Returns and Inflation: Evidence from Other Countries,” *Journal of Finance*, 38, (March 1983), pp. 49-65.

Kaul, Gautam, “Stock Returns and Inflation: The Role of the Monetary Sector,” *Journal of Financial Economics*, 18, (1987), pp. 253-276.

Lee, Unro, “A Test of the Proxy-Effect Hypothesis: Evidence from the Pacific Basin Countries,” *Quarterly Journal of Business and Economics*, 37, (Summer 1998), pp. 40-52.

McQueen, G. and V. Roley, “Stock Returns and Business Conditions, *Review of Financial Studies*, 6, (September 1993), pp. 683-707.

Murphy, Austin and Anandi Sahu, “ Empirical Evidence of a Positive Inflation Premium Being Incorporated into Stock Prices,” *Atlantic Economic Journal*, 29, (June 2001), pp. 177-185.

Nelson, Charles, “Inflation and Rates of Reurn on Common Stocks,” *Journal of Finance*, 31, (May 1976), pp. 471-483.

Park, Sangkyun, “Rationality of Negative Stock Price Responses to Strong Economic Activity*” Financial Analysts Journal*, (September 1997), pp. 52-56.

Wahlroos, B. and T. Bergland, “Stock Returns, Inflationary Expectations, and Real Activity,” *Journal of Banking and Finance*, 10, (1986), pp. 377-389.

Weigel, Eric, “Dynamic Links between Risky Asset Returns and Inflation: The Case of Five Countries,” *The Journal of Investing*, 3, (Spring1994) pp. 41-51.

EXAMINING RETIREMENT PLANNING OF UNIVERSITY STUDENTS – ARE THEY BEING REALISTIC?

Rahul Verma, University of Houston – Downtown
Charles A. Smith, University of Houston – Downtown

1. INTRODUCTION

The need for financial education in the U.S is adequately manifested in the high level of consumer debt, alarming rates of bankruptcy, and low savings rate. Recent studies on Personal Financial Planning have also documented that an average American has poor knowledge of personal finances (see Vanguard Group/Money Magazine, 1997; PSRA, 1997; KPMG, 1995; Chen and Volpe, 1998). These studies have shown that financial illiteracy is prevalent in all stratum of our society.

CAF/Amex (1991) and Mandell (1997) find that high school students have poor knowledge of personal financial fundamentals. Similarly, PSRA (1997) and Oppenheimer Funds/ Girls Inc., (1997) suggest that household financial decision makers do not have a good grasp of basic finance concepts. The Institute of CFP (1993) find that financial illiteracy is a major problem when it comes to making individual financial decisions. Poor knowledge of investment fundamentals is the most common problem encountered by their clients. KPMG (1995) and Employee Benefit Research Institute (1995) surveys indicate that due to low savings rates and low returns from conservative investments, Americans do not have sufficient retirement funds and may have false senses of financial confidence and security.

Extending these studies on Personal Financial Planning, in this paper we examine whether university students also have false sense of financial security. Specifically, we investigate the awareness of university students with respect to one key element of personal finance, the retirement planning. Are they realistic in their understanding of this important aspect of life? Such examination of retirement planning is extremely important since one of the main goals of many individuals is long term financial security and independence.

Employing survey data of university students and using realistic assumptions of financial variables, the regression results suggests the following: first, there is a statistically significant difference between the actual and perceived retirement needs of the students. Similarly, there is a significant difference in the actual and perceived monthly savings needed to build sufficient retirement fund by these students. Secondly, we find that students who maintain a financial plan; save regularly; spend less on credit card and carry less debt are more likely to have better financial literacy about the retirement planning. Thirdly, regression results indicate that individuals with less college education; with greater credit card usage; who do not make timely payments on credit card liabilities; carry greater credit card and student loans; and do not save on regular basis are the ones with greater financial illiteracy.

These results have important implications, more so in the academia. Given these findings and results of previous studies we argue that there is a systematic lack of personal finance education in our society.

The remainder of this paper is organized as follows: Section two reviews the previous research while section three presents the data. Section four reveals the estimation results and section five concludes.

2. PREVIOUS RESEARCH

There is a growing body of literature on the financial literacy of college students. Armstrong and Craven (1993) examine the use of credit cards by college students, the number of credit cards possessed by college students, and their payment practices, as it relates to the subject's race and gender and find that women are more likely to possess credit cards than men. However, the balances on credit cards carried by women are lower than those of men. The argument was made that men do not have as firm a grasp on the understanding of personal finances and credit cards as women. They also discovered that white students were more likely to possess credit cards than black students.

Xiao, Noring, and Anderson (1995) focused on the attitudes of college students towards credit cards and credit card usage. Their studies indicated that students who were male, who lived on campus, and who were majoring in consumer affairs are likely to be more accepting of credit use. It is indicated that the same group of students was also likely to possess phone cards and credit cards, use credit cards on a more frequent basis, and have credit card accounts that were co-signed by a parent or guardian. They argue that students needed to be educated about credit and how to use credit responsibly.

Chen and Volpe (1998) examine the level of financial literacy among college students. They find that money management plans and personal finance budgets are concepts that college students are not familiar with. Chen and Volpe (1998) also hold colleges responsible for not providing students with adequate financial management courses.

In a study conducted by the Youth and Money Survey (1999) research indicated that few college students took advantage of the opportunity to take financial management courses while at

school. Statistical surveys indicated that only 21% of students elected to enroll in money management courses out of 65% of students who were offered the opportunity (Youth and Money Survey, 1999). In the same study, the Youth and Money Survey (1999) indicated that although it was the intention of most students to obtain a credit card for the purpose of establishing sound financial credit, 28% of the same students carried credit card debt.

Henry, Weber, and Yarbrough (2001) investigated the income levels of college students with credit card debt. They find that the average student income was nearly $16,000, while the average student debt level hovered around $13,000. Henry, Weber, and Yarbrough (2001) were also able to establish through studies on reported yearly income, that 44% of the total number of students surveyed had more than a 31% debt ratio. They also found that of 42% percent of students reporting that they had a personal financial budget, 38% did not follow their budget all of the time, and 4% did not follow their budget any of the time.

In a study conducted by Hayhoe, Leach, and Turner (1999), a 1997 sample consisting of 426 college students from five state universities within the United States was used to establish students' reasoning for possessing four or more credit cards. Their research indicated that female students were more likely to possess four or more credit cards. The same students were likely to have already taken a course in personal finance, to have used money as a financial reward in their family, and to experience a type of emotional high when using credit cards.

Staten and Barron (2002) selected a sample of 300,000 active credit accounts from the top 15 general-purpose credit card issuers in the United States. The study analyzed the activity across three types of accounts: those initiated by student marketing programs, those opened by 18-24 year-olds through commercial marketing efforts, and those opened by 25 year-olds or older through commercial marketing efforts. They find that student accounts were delinquent more often, resulting in a charge-off, than were the other accounts. Their studies also indicate that college students carried lower balances than the other sample groups and that charge-off amounts for college students' credit card accounts were dramatically lower than those of the other accounts.

Angela Lyons (2004) used a random sample of college students to identify students who were more prone to financial risk and ways in which educators and professionals alike can address their financial education needs. Students who were financially at-risk, Lyons (2004) indicated, share the following characteristics: have credit card balances of $1,000 or more, are delinquent on their credit card payments by two months or more, have reached the limit on their credit cards, and only pay off their credit card balances some of the time or never.

Lyons' (2004) study indicated that students with other types of financial loans, i.e., car loan, mortgage, etc. were more likely to have credit card debt that exceeds $1,000. One characteristic of relevance of students with more than $1,000 in debt was being black. Research indicates that black students are more likely to hold substantial amounts of credit card debt as well as to not pay their balances in full each month. Lyons' (2004) research also indicated that those students struggling to make credit card payments were likely female, black, and/or Hispanic.

In a recent article focusing on the attitudes of Americans to retirement planning, Robert Powell (2007) concludes that the majority of Americans do not adequately plan for their retirement. According to research, only 25% percent of workers surveyed had more than $100,000 set aside for retirement. In addition, most workers tended to underestimate their life expectancy, which could lead a person to living out their final years of retirement at a standard lower than desired. Powell also points out that most Americans are not realistically planning for their medical expenses. Recent studies show that retiring couples will require approximately $300,000 to $500,000 for health expenses. Finally, Powell draws attention to the fact that more workers are succumbing to consumer advertising and putting less money away for retirement, which indicates that workers do not understand the value of a dollar saved.

3. DATA

The data for this analysis are obtained from 266 students attending the University of Houston-Downtown campus located in Houston, Texas. The students in the finance department of the University of Houston-Downtown randomly selected students at the same university. This random sample includes students of various ages, ethnicities, genders and different level of education. The college students were given a questionnaire about their lifestyles, future, and personal finances. The survey handlers made sure that the students responding to the survey knew that the study was an ongoing university effort to study college students and their personal finances and that the information compiled from the questionnaire would help determine how much college students knew about managing their finances.

The survey was done in an interview structure with limited interpretation differences to provide reliable and valuable responses. The data consisted of questions regarding the student's age, number of credit cards, amount of credit card debt, expected retirement age, and other related questions. A complete description of the responses is shown in appendix A. Before proceeding with the main estimation, we performed diagnosis for detecting and removing outliers. We followed the univariate detection method as suggested by Hair et al., (1998) by examining the distribution of observations. We identified those observations as outliers which fall at the outer ranges of the distribution.

The first step is to create additional variables based on the survey to analyze the financial literacy of business students, in the context of retirement planning. Accordingly, we followed the approach based on the "Basic-Planning-Annuity Method" as suggested by Dalton et al. (2005). Specifically, we carried out the following procedure:

Step 1: Based on the current age (Q2), and the expected retirement age (Q7) we calculate the number of months to retire next.

Step 2: We assume the life expectancy of an individual to be 85 years and calculate the number of years required to be funded during the post retirement period.

Step 3: Based on today's value of the expected monthly requirement during retirement (Q22) and assuming expected inflation rate of 3%, we calculate the expected monthly need for each individual during the first year of retirement. Specifically, we calculate the future value of today's value of expected monthly requirement at the time period obtained in step 1 compounded at the expected inflation of 3%. For example, the first respondent's current age is 26 years and plans to retire at 60. Also, his today's value of expected monthly requirement is $1000. Therefore, we calculate the future value of $1000 at 3% compounded on monthly basis for 34 years (60 years less 26 years) and obtain the requirement during the first month of post retirement period. This works out to approximately $2770.

Step 4: Assuming the expected rate of return of 8% i.e. real rate of return of approximately 5.04% (Fisher Effect), and using the data obtained from steps 2 and 3, we compute the capital required at the time of retirement to fund each individual's retirement. This is our first new variable (CAP_NEEDED). Specifically, we compute the present value of the monthly requirement obtained from step 3 discounted at the real rate of 5.04% for number of months based on step 2. For example, for the first respondent, we obtain the capital needed at retirement as $474,369 by computing the present value of $2770 for 25 years (life expectancy of 85 years less retirement age of 70 years) discounted at approximately 5.04 % on monthly basis.

Step 5: We create our second new variable by taking the difference between the CAP_NEEDED and the amount perceived by respondents as sufficient to fund retirement (Q12). This new variable (Δ CAP) represents the shortfall / (excess) in capital needed by each respondent to fund their retirement. For example, the first respondent perceives that $30,000 would be sufficient to fund the post retirement period and therefore Δ CAP works out to be $444,369 ($474,369 less $30,000).

Step 6: In the next step, we calculate the monthly savings (SAV_NEEDED) needed by each individual to accumulate CAP_NEEDED at the beginning of retirement. Specifically, based on the number of years to retire, the real rate of return and the CAP_NEEDED, we calculate the annuity required by each individual. For example, for the first respondent we calculate the monthly savings required as $445 based on the future value of $474,369 (CAP_NEEDED) discounted at 5.04% on monthly basis for 34 years. The interpretation of this number is that in order to accumulate $474,369 by the age of 70, the monthly savings needed is $445.

Step 7: We create our last variable (ΔSAV) by taking the difference between SAV_NEEDED and monthly savings sufficient to fund retirement capital as perceived by the respondents (Q13). The interpretation of this variable is the extra savings needed by each individual over and above what they perceive to be sufficient for retirement planning. For example, the first respondent perceives that $70 per month would be sufficient to build capital for retirement and therefore ΔSAV works out to be $375 ($445 less $70).

Table 1 reports the descriptive statistics of the following newly created variables: CAP_NEEDED, SAV_NEEDED, Δ CAP and ΔSAV. We also report the statistics of data on questions which we employed to calculate these new variables. Specifically, we include the descriptive statistics of Q2, 7, 12, 13 and 22 in table 1. The data based on the survey suggest that the average age of students involved in this study is 24 years. Similarly, the mean retirement age as indicated by these respondents is 56 years. A little less than $0.9 million is perceived to be sufficient to fund retirement. During the retirement period, approximately $3000 per month is sought by these students. However, the amount of current actual savings perceived to be important to accumulate such retirement nest is a little less than $800. The descriptive statistics of the newly created variables show that CAP_NEEDED which the actual capital needed based on the current age, and monthly requirement is close to $1.4 million. Consistent with the difference in CAP_NEEDED and Q12, we find that the shortfall in perceived sufficient capital required by respondents to the actual requirement is approximate $0.5 million. Similarly, the mean actual savings needed to accumulate CAP_NEEDED is approximately $1800 per month which is much larger than the actual savings (Q13) which is perceived to be sufficient to establish retirement nest. It is not surprising that this shortfall as measured by ΔSAV turns out on an average to be $970.

4. ESTIMATION RESULTS

Before proceeding with regression analysis, we first analyzed if there is significant difference between the capital perceived to be sufficient for retirement and the actual capital needed at retirement based on the monthly fund requirements. Accordingly, we performed two separate one-sample *t*-tests on the newly created variables, Δ CAP and ΔSAV. The one-sample t-test procedure tests whether the mean of a single variable is significantly different from a constant. In our case we analyzed whether the difference between capital required and capital perceived to be sufficient for retirement is significantly different from zero. Similarly, we tested if the difference between monthly savings required and monthly savings perceived is significantly different from zero. We report the results of *t*-tests in table 2. A low significance value (typically less than 0.05) indicates a significant difference. In our case the significance values are 0.001and 0.0015 suggesting that Δ CAP and ΔSAV

Table 1
Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
Q2	17	50	24	6
Q7	30	80	56	8
Q12	1,000	7,000,000	864,131	1,101,748
Q13	0	6,000	780	1,033
Q22	50	20,000	2,973	2,812
CAP_NEEDED	29,253	11,002,955	1,396,940	1,388,709
Δ CAP	-4,771,034	10,922,955	532,808	1,630,575
SAV_NEEDED	18	12,165	1,746	1,989
Δ SAV	-3,853	11,959	970	1,951

are different from zero at significant level of 1%. The confidence intervals for the mean differences are 532,808 and 970 which are consistent with the descriptive statistics presented in table 1.

In order to test our postulated relationships we estimated two separate ordinary least square (OLS) regressions with Δ CAP and ΔSAV as the dependent variables. We employed the data on 14 responses received from the respondents as a set of independent variables for both these regressions. Specifically, we used the responses on the following questions: 3, 5, 6, 15, 16, 17, 18, 19, 20, 21, 31, 34, 35, and 36. We chose these variables in our study since they are useful to analyze the financial literacy of the respondents.

Table 4 reports the OLS results for the difference in capital required and capital perceived to be sufficient for retirements regressed against a set of 14 independent variables. We find that variables related to questions 5, 17, 21 and 35 are significantly related to Δ CAP. The significant and positive coefficient for question 5 suggests that students who tend to use their credit cards more often during a month are more likely to have less knowledge about retirement planning i.e. there is greater difference between the capital required and capital perceived to be sufficient to fund their retirement. It is quite possible that since these students are less knowledgeable about the retirement funding requirement, they are more extravagant in their current spending.

Similarly, the positive and significant coefficient of question 17 indicates that students with higher credit card debt are more likely to misjudge the retirement funding requirement. As such there is a greater difference between their perception of capital required and actual capital needed for retirement. This result seems to be consistent with the finding related to question 5.

We find negative significant result for question 21 which is a dummy variable. This negative result suggests that students who have written a financial plan for the future have better perception of retirement funding. This finding is not surprising since individuals who are more focused and use the financial planning tools such as budgeting and planning tend to have better financial literacy.

Similarly, we find negative and significant coefficient related to question 35. This negative coefficient suggests that students who are currently saving for retirement have better knowledge about the capital needed for retirement. This finding is consistent with our earlier results that students with less usage of credit card and low debt are better aware of the retirement planning.

Overall, we find that students who maintain a financial plan; save regularly; spend less on credit card and carry less debt are more likely to have better financial literacy about the retirement funding requirements.

We report the results of the second regression in table 4. In addition to the three significant variables (questions 5, 17 and 35) obtained in the previous regression, we find that significant results related to three more variables. Specifically, we find significant results for the following six variables: questions 3,5,6,17,20 and 35.

Table 2
One sample test results

Test Value = 0	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence	
	Lower	Upper	Lower	Upper	Lower	Upper
Δ CAP	4.54	192	0.0010	532808.43	301305.53	764311.33
Δ SAV	6.91	192	0.0015	970.03	692.9966	124707

TABLE 3
Ordinary Least Square Regression results for the difference between capital required and capital perceived to be sufficient (Δ CAP)

Dependent Variable (Δ CAP)

Independent Variables	Unstandardized Coefficients	Std. Error	Sig.
(Constant)	-166794	789100	0.8329
Q3	-1386	4085	0.7350
Q5	40386*	20515	0.0512
Q6	-277174	309919	0.3728
Q15	-266777	348109	0.4449
Q16	164996	358675	0.6463
Q17	114*	59	0.0564
Q18	-36226	75492	0.6321
Q19	269686	316639	0.3960
Q20	30	31	0.3233
Q21	-669904*	362250	0.0667
Q31	496570	345556	0.1532
Q34	-271729	434204	0.5326
Q35	-798695**	353009	0.0253
Q36	469614	411420	0.2558

*, ** and ** denote significance at 10%, 5% and 1% respectively

TABLE 4
Ordinary Least Square Regression results for the difference between savings required and savings perceived to be sufficient (Δ SAV)

Dependent Variable (Δ CAP)

Independent Variables	Unstandardized Coefficients	Std. Error	Sig.
(Constant)	748.9535	809.2699	0.3565
Q3	-7.6607*	4.1897	0.0698
Q5	-16.4944*	10.0399	0.0735
Q6	-1032.4695***	317.8404	0.0015
Q15	-358.0052	357.0065	0.3179
Q16	201.4451	367.8434	0.5849
Q17	0.0212**	0.0105	0.0373
Q18	14.5275	77.4221	0.8515
Q19	-101.6286	324.7328	0.7548
Q20	0.0639**	0.0315	0.0448
Q21	477.8613	321.5088	0.2007
Q31	430.8479	354.3888	0.2263
Q34	-164.8037	445.3023	0.7119
Q35	-88.2950*	52.0320	0.0808
Q36	-39.8407	421.9357	0.9249

*, ** and ** denote significance at 10%, 5% and 1%respectively

The significant negative results for question 3 indicate that students with more hours of college credit seem to have a better understanding of the savings needed to accumulate sufficient capital for retirement. Accordingly, ΔSAV the difference between the actual savings needed and the savings perceived to be sufficient is lower for students with higher college education.

The significant positive result for question 5 suggests that students who use credit cards more often tend to be less aware of actual savings needed to accumulate capital. This result is consistent with the finding of our first regression where we find that individuals with greater credit card usage are more likely to be less financial literate when it comes to retirement planning.

We also find that students who only make the minimum payment each month rather than fully paying off their liability have perceptions about savings which are misaligned with reality. This is shown by the highly significant negative coefficient of question 6 over ΔSAV. This result is also in line with the findings of question 5 where we find that greater credit card usage and greater difference between the actual savings needed and savings perceived to be sufficient are significantly related to each other.

If individuals with greater credit card usage and the ones with greater instances of non payment of monthly liabilities in time are less literate about retirement planning, then it is natural to assume that people with higher credit card debt will have similar attributes. It is not surprising that the coefficient for question 17 is positive and significant. This result indicates that ΔSAV would be greater for individuals with greater credit card debt. This is also consistent with the findings of ΔCAP where question 17 is positive and significant.

In the similar lines we find that not only credit card debt but also other forms of debt are significantly related to ΔSAV. Specifically, we find significant positive results for question 20, indicating that individuals with greater student loans are less prepared for their retirement.

Lastly, individuals who are regularly saving seem to be more aware of the financial challenges related to retirement planning. There is a significant and negative relationship between question 35 and the difference between actual savings needed and the savings perceived to be sufficient to accumulate retirement capital.

Overall, the significant results for variables in the second regression indicate that individuals who have less college education; with greater credit card usage; do not make timely payments on credit card liabilities; carry greater credit card and student loans; and do not save on regular basis tend to have less financial literacy.

5. CONCLUSION

The focus of this paper is college students and their personal finances as they relate to retirement planning. Little research has been done regarding this particular area of study and our paper provides insight into the preparedness of college students for retirement. Employing survey data of university students and using realistic assumptions of financial variables, we find that there is a statistically significant difference between the actual and perceived retirement needs of the students. Similarly, there is a significant difference in the actual and perceived monthly savings needed to build sufficient retirement funds by these students. Students who maintain a financial plan; save regularly; spend less on credit card and carry less debt have more financial literacy. Similarly, individuals with less college education; with greater credit card usage; who do not make timely payments on credit card liabilities; carry greater credit card and student loans; and do not save on regular basis are the ones with greater financial illiteracy. We argue that there is a systematic lack of personal finance education in our society.

REFERENCES

Armstrong, Connie J. and M. Joyce Craven. (1993) Credit Card Use and Payment Practices Among College Students. *Proceedings of the 6th Annual Conference of the Association for Financial Counseling and Planning Education*, 148-159.

Chen, H. and R.P. Volpe. (1998) An Analysis of Personal Financial Literacy Among College Students. *Financial Services Review*, 7 (2), p107, 22p. Available: http://www.ehostvgw.8epnet.com

Hayhoe, Celia, Lauren Leach, Pamela Turner, Marilyn Bruin, and Frances Lawrence. (2000) Differences in Spending Habits and Credit Use of College Students. *Journal of Consumer Affairs*, 34: 113-133.

Henry, Reasie A., Janice G. Weber, David Yarbrough. (2001) Money Management Practices of College Students. *College Student Journal*, Vol. 35, Issue 2.

Lyons, Angela C. (2004) A Profile of Financially At-Risk College Students. *Journal of Consumer Affairs*, Summer2004, Vol. 38, Issue 1, 56-80.

Powell, Robert. (2007) Sunny Americans Refuse to Confront Dark Side of Retirement. *The Wall Street Journal* [Electronic Version]. Available: http://www.nasdaq.com/aspxcontent/NewsStory.aspx?cpath=20070412%5cACQDJON200704121946DOWJONESDJONLINE001228.htm&

Staten, Michael and John Barron. (2002) College Student Credit Card Usage. *Credit Research Center, Working Paper #65*, Georgetown University.

Xiao, Jing, Franziska Noring, and Joan Anderson. (1995) College Students' Attitudes Towards Credit Cards. *Journal of Consumer Studies and Home Economics*, 19: 155-174.

Youth and Money Survey. (1999) American Savings Education Council, 16p. Available: http://www.asec.org

APPENDIX A
QUESTIONNAIRE

Thank you for participating in this interview. We are trying to learn about college students and their personal finances. The person interviewing you is a student in Finance 1301, which is personal finance. By participating in this interview you are helping a fellow student at UH-D. Please give us your honest answer to each question. Your participation is voluntary and your results will remain anonymous. There is no right or wrong answer. Again, thank you for giving your time and information.

We would like your phone number, if you wish, because someone may try to call you to verify that this interview was conducted in a professional manner.

1. Your phone number is (_____) _____ -_____ (Optional).
2. Your age is _____ years.
3. You have _____ hours of college credit.
4. You have _____ credit cards.
5. You use a credit card _____ times a month.
6. If you have a credit card, you usually make the minimum payment each month. Y or N (Circle one)
7. You want to be _____ years old when you retire.
8. Do you live:
   At home with parents_____ With roommate_____ With spouse_____ Other_____
9. Do you have a savings account? Yes_____ No_____
10. Do you own any stocks or mutual funds? Yes_____ No_____
11. You are paying for college and other living expenses by (check all that apply):
    _____Help from relatives _____Work full time
    _____Work part time _____Other
12. How much money or wealth in dollars do you think you will need so that you can someday retire, i.e., how much money do you need to accumulate to retire? $_____
13. If you were graduating today and started saving for retirement this year, how much do you think you would need to save each month so that you could retire when you wanted to and live a comfortable life? $_____ Saved each month.
14. Do you write down goals at the beginning of each year or semester? Yes_____ No_____
15. Have you ever had a course or seminar on personal finance? Yes_____ No_____
16. Have you ever been depressed about your financial situation? Yes_____ No_____
17. How much credit card debt do you have, i.e., what is the total _____balance on all your credit cards added together? $_____ (Rounded to the nearest $1,000
18. On a scale of 1-10, please rate your knowledge about personal finance. If you think you know a lot about personal finance, put a 10, if only a little put a 3 or 4. If you think you know almost nothing about personal finance, put a 1. _____
19. You are _____Male _____Female
20. How much do you owe in student loans? $_____
21. Have you ever written a financial plan for your life? Yes_____ No_____
22. If you were retiring today, how much money in dollars would you want to receive each month so that you could have a comfortable retirement lifestyle? $_____/mo. income.
23. You have_____ children. 24. You have $_____ of life insurance.
25. Do you someday want own a home? Yes_____ No_____
26. Would you someday like to own some type of rental real estate? Yes_____ No_____
27. Do you own a car/truck? Yes_____ No_____
28. Do you have a checking or money market account? Yes_____ No_____
29. What percentage rate of return have stock investments earned on average over the last 50± years?
    _____ Rate of return; OR _____
30. Don't know_____
31. Your major or intended major is: Don't Know_____ Business_____ Other_____
32. You were born in the United States? Yes_____ No_____
33. At least one of your parents has a college degree? Yes_____ No_____
34. Do you think money in the bank is more important than driving a nice car? Yes_____ No_____
35. Do you have any credit cards that are "maxed out"? Yes_____ No_____
36. Are you saving for retirement now? Yes_____ No_____
37. Have either one of your parents ever talked to you about the importance of saving money? Yes_____ No_____

Midwestern Business and Economic Review

Manuscript Submission Guidelines

The *Midwestern Business and Economic Review* invites submission of original manuscripts and research by individuals in the public and private sector in the areas of economics and business administration. Of particular interest are topics dealing with issues relevant to Texas and the Southwestern United States. Each manuscript submitted is anonymously reviewed by members of the Editorial Review Board and *ad hoc* reviewers as needed. To meet the interest of a broad spectrum of the academic and business community, readability and expository clarity are considered essential in the review process.

All manuscripts submitted for review must meet the following guidelines

- The manuscript should be doubled spaced, 12 point Times New Roman, with 1" margins, and should not exceed fifteen pages, excluding tables, figures, and references
- The first page should include the title of the article and an abstract 50-75 words in length
- Endnotes are preferred over footnotes
- References should follow the *American Psychological Association* guidelines
- All tables and figures should be included on separate pages

A cover letter should be included with the submission containing the following:

- Title of the manuscript
- Name, degree, rank, and affiliation of each author
- Contact information for each author (mailing address, telephone number, and email address)

Four copies of each manuscript must be accompanied by a PC compatible electronic copy of the manuscript formatted in Microsoft® Word or rich-text (RTF) formats.

All manuscripts should be submitted to:

Editor, *Midwestern Business and Economic Review*
Bureau of Business and Government Research
Midwestern State University
3410 Taft Boulevard
Wichita Falls, Texas 76308-2099

Bureau of Business and Government Research
Midwestern State University
3410 Taft Boulevard
Wichita Falls, TX 76308-2099

ADDRESS SERVICE REQUESTED

Non-Profit Organization
U.S. POSTAGE
PAID
Permit No. 781
Wichita Falls, TX