Market Expansion and R&D Externality Effect

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ABSTRACT

I examine the externality effects of R&D investments. I find that firms' future operating performance is positively related to industry peers' R&D expenditures. Firms also tend to experience positive abnormal returns following industry peers' high R&D expenditures. This suggests that the market not only underreact to a firm's own R&D investments, but also to industry peers' R&D investments. Consistent with this notion, the market is surprised by firms' earnings performance following high peer R&D investments. Finally, I present evidence that the positive externalities of R&D investments may be due to the market expansion caused by technology advances.

JEL Classifications: O3, G1, G02

Keywords: R&D externality; market expansion; stock return predictability

I.   INTRODUCTION

An extensive literature in finance studies the valuation effects of corporate decisions/actions such as investing, financing or payout decisions, and whether the stock market immediately incorporates these effects. Little attention, however, has been paid to the externality effects of these decisions, i.e., how one firm's action affects the valuations of its peer companies. This is an important gap to be filled due to the significance of the topic. Studying externality effects enhances our understanding of the economy-wide benefits or costs of a certain corporate action and is therefore useful to regulators in forming regulatory decisions. It is also useful to investors and managers because they need to understand how (and how much) their peer companies' actions will affect the valuation of their firms and thus make more informed trading or managerial decisions.

Externalities of corporate decisions are plausible because peer companies (typically those in the same industry) employ similar or related raw materials and technologies/methods, and interact with same groups of customers and suppliers. In different situations, externality can be negative due to competition or positive if one firm's action can benefit or damage the whole industry. There has been some (albeit limited) evidence of such externalities. Hsu et al. (2010) and Braun and Larrain (2009) show that peer companies experience negative stock price reactions to IPOs in their industry, which is consistent with IPO-induced competitive advantages. Lang and Stulz (1992) documents both contagion and competitive effects for firms in the same industry upon bankruptcy announcements.

In this study, I analyze the cross-firm valuation effect of an important type of corporate investments in intangible assets – firms' R&D spending. More specifically, I focus on the intra-industry effect, i.e., how a firm's stock return is affected by the R&D investments of firms in the same industry. A large body of literature in economics (e.g., Hall (1993), Griliches (2002)) has shown that R&D investments by private-sector firms generate positive spillovers on the output growth and productivity increase within the same industry, in the downstream industries, as well as across regions and countries. Such spillovers are believed to be an important source of endogenous economic growth (e.g., Romer (1990a; 1990b); Griliches (1992)), and form the basic rationale for public policies on private-sector R&D investments.

I add to this literature by studying the valuation impact of firms' R&D expenditures on their peer companies in the same industry. My focus on R&D expenditures offers several advantages. Unlike the studies aforementioned that investigate firms' capital market transactions, I study externalities of firms' internal investments, which have no obvious market-timing motives. In addition, Eberhart et al. (2004) argue that R&D investments are distinctive from other long-term investments due to the stark contrast between its tangible costs and intangible benefits. Since the market tends to misreact to intangible information but not to tangible information (Daniel and Titman (2001)), it is interesting to examine the market's ability to incorporate the valuation impact of R&D's intangible benefits, both on the investment firm itself and on its peers.

Existing studies have documented that high R&D expenditures or large R&D increases are associated with subsequent positive abnormal stock returns as well as positive abnormal operating performance (see Chan et al. (2001), Eberhart et al. (2004),

Lev and Sougiannis (1996), and Lev et al. (2005)). These findings suggest that the market tends to underreact to the benefits of R&D expenditure. If R&D investments have positive externalities and the market also underreacts to such effects, then economists as well as investors may have underestimated the social benefits of R&D expenditures. Such social benefits should be taken into account in determining how to treat R&D in accounting rules, e.g., whether to require firms to fully expense their R&D expenditures or allow them to capitalize them in financial statements. Such discussion is timely when lawmakers are debating whether to extend certain tax cuts/benefits including R&D credits.

Using a sample of Compustat firms for the period of 1975-2012, I document evidence for positive externalities of R&D investments. I find that firms' future operating performance is positively related to peer firms' R&D investments. The results hold after I control for a firm's own R&D expenditures. This suggests that firms benefit from peers' R&D investments.

I then examine whether the stock market efficiently incorporates such value implication. I find that firms tend to experience positive abnormal returns in the year subsequent to high peer R&D investments, suggesting that the market underreacts to the externalities of R&D. Given that the valuation impact of the R&D externalities has not been documented before, regulators, economists as well as investors may have underestimated the benefits of R&D investments.

Consistent with the notion that the market underreacts to the externality effects of R&D, I also find that the market is surprised by firms' earnings performance following high peer R&D investments. Specifically, future earnings surprises and abnormal stock returns around earnings announcements are significantly positive where industry peers have high R&D investments, whereas these measures are insignificantly different from zero where industry peers have low R&D investments.

Finally, I identify a channel through which the benefits of R&D investments can spill over to other firms in the industry: advances in technology expand the market demand. Consistent with this hypothesis, I find that industry sales and employment grow faster when industry R&D intensity is high; and that the positive externality effect on operating performance is stronger where the market expands more.

II.   DATA AND DESCRIPTIVE STATISTICS

The sample includes Compustat firms for the period from 1975 through 2012. I impose the following sample criteria. (1) I require that the stock return data and financial statement data are available from CRSP and COMPUSTAT. (In some subsample analysis I also require analysts' earnings forecasts data are available from IBES.) (2) I exclude any firm-year observations for which total assets (Compustat variable AT) or sales (Compustat variable SALE) are either zero or negative. (3) Following Fama and French (1993), I exclude firms with negative book values of equity. (4) I also exclude firms with stock price less than $5. (5) Utility firms (SIC=4900-4999) and financial firms (SIC=6000-6999) are excluded since they operate in a regulated environment and their characteristics differ substantially from nonregulated firms. (6) For a firm-year (or industry-year) observation to be included in the sample, I require the number of firms in the industry to be at least ten in that year. Firms are classified into 48 industries based on Fama-French (1997). (7) I require that firms have nonnegative R&D expenditures.

Missing R&D expenditures are coded as zero. The resulting full sample consists of 89,782 firm-year observations for the period of 1975-2012. For the subsample analysis that further requires analyst earnings forecast data from IBES, the sub-sample consists of 47,053 firm-year observations.

I use three operating performance measures: gross profit margin measured sales minus costs of goods sold, divided by sale; gross ROA as sales minus costs of goods sold, divided by lagged assets; and sales growth rate.[1] I also use three variables to measure market expansion: industry sales growth as the growth rate of the aggregate industry sales, Industry employment growth as growth rate of the aggregate industry employment, and new firm entry as the number of new firms relative to the number of all firms at the end of last year. R&D expenditures are scaled by lagged sales (RDS), lagged assets (RDA), or by lagged market value of equity (RDE).

When computing industry peers' R&D expenditures for firm i, I use the mean RDS (or RDA, or RDE) for firms in the same industry excluding firm i: the corresponding industry variables are IRDS (or IRDA, or IRDE). In robustness checks, I use just industry R&D leaders as the peer group, where leaders are those whose RDS (or RDA or RDE) are among the top 30%. Results are robust.

In studying the impact of peer R&D investments, I also control for a firm' own characteristics in addition to its own R&D expenditures, including the firm size as the natural logarithm of market value of equity (ln(size)), the leverage ratio (LEV), the book-to-market ratio (ln(B/M)) and the average monthly stock return in the previous 12 month (PrRET). Variable definitions are also listed below. All variables except for PrRET are winsorized at the 1% and 99% percentiles.[2] All dollar values are in 2012 constant dollars.

Table 1
Variable definition

Operating performance measures:	
Gross profit margin	(sales – costs of goods sold)/sales
Gross ROA	(sales – costs of goods sold)/lag assets
Sales growth	(sales-lag sales)/lag sales
Market expansion measures:	
Industry sales growth	industry aggregate sales growth
Industry employment growth	percentage change in total employees
New entry	number of new firms scaled by the total number of firms in prior year
Firm Characteristics:	
RDE	R&D expenditure scaled by lagged market equity
RDS	R&D expenditure scaled by lagged sales
RDA	R&D expenditure scaled by lagged assets
IRDE	Industry mean (exclude firm i) RDE
IRDS	Industry mean (exclude firm i) RDS
IRDA	Industry mean (exclude firm i) RDA
LEV	Sum of long term debt and debt in current liabilities, all divided by total assets
Ln(SIZE)	log market capitalization
Ln(B/M)	log book-to-market ratio
PrRET	average monthly return during the past 12 months (Momentum)

Table 2 presents the summary statistics of these variables. I report the mean, median, min, max and standard deviation of main firm characteristics, market expansion variables, and operating performance variables. The mean (median) gross profit margin, gross ROA, and sales growth are 0.34(0.33), 0.47(0.42), 0.17(0.11). The mean (median) aggregate sales growth rate is 14% (13%). The mean (median) industry employment growth rate is 8% (6%). On average, 5% of new firms will enter the industry each year. The mean (median) RDE, RDS and RDA are 0.06(0), 0.06(0) and 0.04 (0), respectively.

Table 2
Summary statistics

	N	Mean	Median	Min	Max	STD
Panel A: Operating Performance Measures						
Gross profit margin	89782	0.34	0.33	-0.47	0.84	0.22
Gross ROA	74171	0.47	0.42	-0.01	1.33	0.30
Sales growth	74171	0.17	0.11	-0.32	1.31	0.29
Panel B: Market expansion Measures						
Industry sales growth	87853	0.14	0.13	-0.02	0.44	0.10
Industry employment growth	87853	0.08	0.06	-0.06	0.34	0.08
New entry	87853	0.05	0.03	0.00	0.22	0.05
Panel C: Firm Characteristics						
RDE	74171	0.06	0.00	0.00	0.50	0.11
RDS	89782	0.06	0.00	0.00	1.23	0.20
RDA	74171	0.04	0.00	0.00	0.30	0.07
IRDE	86585	0.08	0.05	0.00	0.45	0.09
IRDS	88764	0.05	0.03	0.00	9.25	1.69
IRDA	86585	0.04	0.02	0.00	0.22	0.05
LEV	89553	0.22	0.20	0.00	0.64	0.18
Ln(SIZE)	89782	12.14	12.00	8.86	16.47	1.82
Ln(B/M)	81915	-0.59	-0.54	-2.62	0.98	0.82
PrRET	85143	0.26	0.12	-0.95	27.77	0.71

The table reports summary statistics of main firm characteristics, market expansion variables, and operating performance variables for sample firms over 1975-2012. Gross profit margin= (sales − costs of goods sold)/sales. Gross ROA= (sales − costs of goods sold)/lag total assets. Sales growth= (sales-lag sales)/lag sales. Industry sales growth= (industry aggregate sales-lag industry aggregate sales)/lag industry aggregate sales. Industry employment growth is the percentage change in industry total employees ((industry total employees-lag industry total employees)/lag industry total employees). New entry is the number of new firms scaled by the total number of firms in prior year. RDE is R&D expenditure scaled by lag market equity. RDS is R&D expenditure scaled by lag sales. RDA is R&D expenditure scaled by lag total assets. IRDE is firm i's industry peers' mean RDE. IRDS is firm i's industry peers' mean RDS. IRDA is firm i's industry peers' mean RDA. LEV is the sum of long term debt and debt in current liabilities, all divided by total assets. Ln(SIZE) is the log of market capitalization. Ln(B/M) is the log book-to-market ratio. Momentum (PrRET) is the average monthly return during the past 12 months. All variables (except for Momentum PrRET) are winsorized at the 1th and 99th percentiles.

III.   RESULTS

In this section I examine the R&D spillover effects. I analyze the externality of R&D on corporate operating performance, stock returns, and future earnings news. I also examine a possible channel for the spillover effect.

A.   Industry Peer's R&D Expenditures And Future Operating Performance

I first examine the externality of R&D investments on corporate operating performance. I hypothesize that a firm's operating performance not only depends on its own R&D investments but also the industry's R&D investments. To test the hypothesis, I estimate the following regressions:

$$\text{Operating Performance}_{i,t+k} = b_0 + b_1 \times R\&D_{peer,t} + b_2 \times R\&D_{i,t} + \beta \times \text{Controls} + e_{it} \quad (1)$$

where operating performance measures are gross profit margin, gross ROA or sales growth; k=1, 2 or 3 years; and peer firms include firms in the same industry excluding firm i. Firm's own R&D intensity measures are RDE, RDS, and RDA. Industry peer's R&D intensity measures are IRDE, IRDA and IRDS, respectively. The control variables are log of market capitalization (lnSIZE) and firm leverage (LEV). If the competitive effect dominates the spillover effect, then $b_1<0$; if the spillover dominates the competitive effect, then $b_1>0$.

The regression results of Equation (1) are reported in Table 3. Gross profit margin and Gross ROA are positively and significantly related to industry peer's R&D intensity measures IRDE/IRDA/IRDS for years t+1, t+2 and t+3, respectively (all of the coefficients are significant at the 10% level). Those results are also economically significant. For example, one standard deviation increase in IRDS causes Gross profit margin, Gross ROA, and Sales growth to increase by 2.5%, 3.6% and 3.3% in year t+1, respectively. In comparison, the mean Gross profit margin, mean Gross ROA and Sales growth are 0.34, 0.47 and 0.17, respectively in the full sample. Sales growth is always positively related to industry peers' R&D expenditures but most of the coefficients b_1 are not significant. In general, these results suggest that there is positive externality of R&D expenditures on industry peers' future operating performance. Table 2 also shows that a firm's own R&D intensity has positive effects on gross profit margin and sales growth in the next 3 years, but has insignificant effect on gross ROA.

The unique nature of corporate R&D activities suggest that the stock market may not be fully efficient in valuing the spillover effect of R&D investments. Indeed, the results documented above suggest that R&D investments by industry peers do not immediately result in tangible assets for the firms, and the cash flow benefit to firms may take years to materialize. The three operating performance measures I use reflect market expansion and productivity growth, the two possible channels through which the real effect of R&D spillover takes place. To capture the market expansion effect, I use a firm's annual sales growth rate. To capture productivity growth, I include gross profit margin and return on assets (ROA). The results are consistent with the notion that industry peers' R&D activities have real spillover effects on a firm's sales growth and profitability.

Table 3
Operating performance and industry peer's R&D expenditures

	Dependent variable: operating performance measures for Year t+1			Dependent variable: operating performance measures for Year t+2			Dependent variable: operating performance measures for Year t+3		
	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth
R&D measure: RDE(R&D/Market Cap)									
IRDE	1.49**	6.19***	4.88*	3.63***	7.30***	5.59	3.11***	9.12***	5.69
	(2.43)	(2.89)	(1.80)	(3.27)	(2.64)	(1.58)	(3.29)	(2.74)	(1.48)
RDE	1.92***	2.30	1.78	3.18***	0.74	2.45	3.82***	-0.25	4.49**
	(2.80)	(0.97)	(0.72)	(4.48)	(0.30)	(0.70)	(4.31)	(-0.12)	(2.21)
Ln(SIZE)	0.012	-0.61***	-1.08***	0.04	-0.87***	-1.96***	0.06	-0.99***	-1.48***
	(0.46)	(-6.11)	(-3.65)	(0.85)	(-6.89)	(-4.03)	(1.03)	(-8.16)	(-6.75)
LEV	-0.42	-9.63***	-1.68	-0.99	-6.59***	-9.13***	-0.94	-5.53***	-1.86
	(-1.46)	(-6.48)	(-0.85)	(-1.13)	(-4.52)	(-2.83)	(-1.04)	(-3.61)	(-0.87)
R&D measure: RDA (R&D/Assets)									
IRDA	2.41***	12.46***	0.55	5.57***	19.12***	5.51	5.20***	21.41***	6.43
	(2.86)	(4.02)	(0.12)	(3.43)	(3.88)	(0.94)	(3.45)	(3.69)	(0.99)
RDA	6.81***	0.04	24.98***	11.76***	-10.50	17.40*	12.98***	-11.38	22.89***
	(3.68)	(0.01)	(3.54)	(5.40)	(-1.39)	(1.90)	(4.18)	(-1.23)	(4.54)
Ln(SIZE)	0.01	-0.60***	-1.10***	0.04	-0.86***	-1.96***	0.06	-0.98***	-1.48***
	(0.44)	(-6.09)	(-3.70)	(0.84)	(-6.88)	(-4.04)	(1.07)	(-8.15)	(-6.78)
LEV	-0.16	-9.64***	-0.43	-0.52	-6.98***	-8.38**	-0.49	-5.76***	-1.14
	(-0.53)	(-6.87)	(-0.21)	(-0.64)	(-5.27)	(-2.44)	(-0.58)	(-4.03)	(-0.53)
R&D measure: RDS (R&D/Sales)									
IRDS	0.27**	0.79*	0.19	0.60*	1.35**	0.40	0.80***	1.86**	0.97
	(2.50)	(1.93)	(0.38)	(1.79)	(2.05)	(0.65)	(2.71)	(1.98)	(1.32)
RDS	12.76***	21.09***	43.50***	24.17***	24.34***	52.03***	21.81***	27.20***	56.02***
	(3.97)	(3.44)	(4.23)	(4.79)	(3.14)	(2.82)	(5.28)	(2.84)	(2.74)
Ln(SIZE)	0.03	-0.64***	-1.11***	0.01	-0.91***	-2.03***	0.04	-1.04***	-1.55***
	(0.12)	(-6.44)	(-3.86)	(0.19)	(-7.15)	(-4.22)	(0.64)	(-8.39)	(-7.08)
LEV	-0.02	-9.24***	0.07	0.17	-6.13***	-6.76*	-0.45	-4.93***	0.35
	(-0.07)	(-6.27)	(0.04)	(0.31)	(-4.29)	(-1.88)	(-0.55)	(-3.24)	(0.14)

The table reports operating performance regressions for sample firms over 1975-2012. The sample contains 89,782 firm-year observations. The dependent variables are operating performance measures (Gross profit margin, Gross ROA and Sales growth) for year t+1, t+2 and t+3, respectively. I rescale the dependent variable by a factor of 100. That is, I multiple the R&D measures by 100. The independent variables are R&D measures (R&D/Market Cap, R&D/Assets, R&D/Sales), LnSIZE, and LEV. All variables are defined as in Table 1. All variables are winsorized at the 1th and 99th percentiles. A ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. Numbers in parentheses are *t*-statistics.

B.   Industry peer's R&D expenditures and future stock returns

I next examine the externality of R&D investments on firm's stock returns. Specifically, I estimate the following regression:

$$\text{Stock Returns}_{i,t+k} = c_0 + c_1 \times R \& D_{peer,t} + c_2 \times R \& D_{i,t} + \beta \times \text{Controls} + e_{it} \quad (2)$$

where k=1, 2 or 3 years and control variables include log of market capitalization (LnSIZE); log of book-to-market (LnB/M) and Momentum (PrRET).

Existing studies show that a firm's future stock returns are positively related to its R&D intensity, suggesting the market tends to underreact to the information. If stock investors also tend to underreact to a firm's industry peers' R&D intensity, then the coefficient c_1 will be significantly different from zero: $c_1>0$ if the spillover effect dominates the competitive effect, or $c_1<0$ if the competitive effect dominates the spillover effect.

The regression results are reported in Table 4. The coefficient on IRDS is positive and significant for years t+1 and t+2, but is not significant for year t+3. The coefficient on IRDA is positive and significant for year t+1 and t+3 while the coefficient on IRDE is only significant for year t+1. Overall, the results show that companies experience positive abnormal returns in the first year after industry peers' R&D expenditures, but not significantly so after that. It suggests that the market underreact to the spillover effect for about one year's time. Industry peer's R&D expenditures have also a huge economic effect. In fact, a one standard deviation increase in IRDE, IRDA and IRDS causes stock returns to increase by 29%, 17% and 45% in year t+1, respectively.

Consistent with prior studies (Chan, et al., 2001; Eberhart et al., 2004; Lev and Sougiannis, 1996), I also find that a firm's own R&D intensity has a positive impact on subsequent stock returns. The impact of firm's own R&D intensity is also economically important. A standard deviation increase in RDE, RDA and RDS causes stock returns to increase by 7%, 36% and 8% in year t+1, respectively. The signs and statistical significance for the coefficients of Ln(Size), Ln(B/M), and PrRet are generally consistent with prior literature.

Particularly noteworthy is that the coefficient for peer's R&D expenditures is significantly positive even after controlling for firm's own R&D intensity. Thus, the economic benefit to firms is stronger when there is an industry-wide R&D increase. This reflects an industry-wide spillover effect. Whether industry peer's R&D spending positively predict stock returns of a firm depends not only on the significance of the real spillover effect mentioned above, but also on the efficiency of inter-firm information transmission in the financial market, i.e., on the efficiency of the financial market to incorporate information about one firm's action on the cash flows and risks of another. Specifically, in the valuation of a stock, investors may underreact to the information that its industry peers' increase in R&D investments; hence the stock may subsequently experience positive abnormal returns. Indeed, the documented results have shown that investors under-react to the industry-wide R&D spillover effect: the intensity of peer's R&D investments is positively related to subsequent abnormal stock returns. Thus, understanding the cross-firm valuation consequences of corporate R&D investments may be an important challenge for investors.

Table 4
Stock returns and industry peer's R&D expenditures

	Dependent variable: stock return for Year t+1	Dependent variable: stock return for Year t+2	Dependent variable: stock return for Year t+3
R&D measure: RDE(R&D/Market Cap)			
IRDE	0.33*	0.28	0.22
	(1.93)	(1.53)	(1.37)
RDE	0.20***	0.18**	0.07
	(3.21)	(2.56)	(1.54)
LnSIZE	-0.04***	-0.03***	-0.01**
	(-5.11)	(-3.66)	(-2.26)
LnB/M	0.03**	0.02	0.03**
	(2.15)	(1.41)	(2.02)
PrRET	0.05**	-0.01	-0.01
	(2.23)	(-0.53)	(-0.67)
R&D measure: RDA(R&D/Assets)			
IRDA	0.24*	0.18	0.20*
	(1.87)	(1.52)	(1.67)
RDA	0.46***	0.40**	0.12
	(2.88)	(2.54)	(1.07)
LnSIZE	-0.04***	-0.03***	-0.01**
	(-5.41)	(-3.84)	(-2.39)
LnB/M	0.03**	0.02*	0.03**
	(2.27)	(1.90)	(2.03)
PrRET	0.04**	-0.01	-0.01
	(2.12)	(-0.48)	(-0.53)
R&D measure: RDS(R&D/Sales)			
IRDS	0.44**	0.38*	0.24
	(1.98)	(1.80)	(1.34)
RDS	0.15	0.23*	0.09
	(1.52)	(1.70)	(1.05)
LnSIZE	-0.05***	-0.03***	-0.02**
	(-5.01)	(-3.53)	(-2.39)
LnB/M	0.01	0.01	0.02
	(0.53)	(0.29)	(0.87)
PrRET	0.06***	-0.01	-0.01
	(2.49)	(-0.42)	(-0.37)

The table reports stock returns regressions for sample firms over 1975-2012. The sample contains 89,782 firm-year observations. The dependent variables are stock returns for year t+1, t+2 and t+3, respectively. The independent variables are R&D measures (R&D/Market Cap, R&D/Assets, R&D/Sales), LnSIZE, LnB.M, and Momentum (PrRET). I rescale the industry R&D measures by a factor of 100. That is, I multiple the industry R&D measures by 100. All variables are defined as in Table 1. All variables (except for Momentum (PrRET)) are winsorized at the 1th and 99th percentiles. A ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. Numbers in parentheses are *t*-statistics.

C.   Industry Peer's R&D Expenditures And Future Earnings News

I have shown that firms experience positive abnormal returns following their industry peers' high R&D investments. This implies that the market does not fully incorporate

the valuation implications of industry peers' R&D expenditures immediately. This further implies that investors may be surprised by their firm's performance in the future. Since I can reasonably measure market expectation and surprises with earnings, I test whether future earnings surprises and market reactions to earnings announcements are more positive for firms with higher peers' R&D investments.

I obtain actual earnings and analyst forecast data from IBES. I examine earnings surprises and abnormal stock returns around annual earnings announcements for three years. Earnings surprise is calculated as the difference between actual earnings and mean analyst forecast divided by the stock price five days prior to the announcement date.[3] Earnings announcement abnormal return is the market-adjusted returns calculated for the three days around the annual earnings announcement.[4]

I divide sample firms into quintiles based on the industry peers' R&D expenditures. For each quintile, I first compute the cross-sectional mean of earnings surprise and earnings announcement abnormal returns for each year, and then I compute the time-series average of the annual cross-sectional means (the standard error of the time-series average is based on the times-series standard deviation of the annual cross-sectional means).

Table 5 presents these time-series averages of cross-sectional means. Panel A reports the average earnings surprise for each peer R&D quintile, as well as the difference between Quintile 5 and Quintile 1. I find that for low peer R&D quintiles, the average earnings surprises are not significantly different from zero. They become significantly positive as I move to higher peer R&D quintiles, and most strongly so for the Quintile 5: all earnings surprises are significantly positive for quintile 5.

The difference between Quintiles 5 and 1 is significantly positive for all the three industry R&D measures (IRDA/IRDE/IRDS) for year t+2 and t+3, but is not insignificant for year t+1. The magnitudes of the differences also increase from year t+1 to t+3. This seems to suggest the benefits to a firm's earnings from peers' R&D investments tend to surprise the market starting two years after the R&D expenditures.

Results in Panel B of Table 4 indicate that firms' future earnings abnormal returns tend to be positively related to industry peers' R&D investments. Similar as the pattern in Panel A, abnormal returns tend to be insignificantly zero in low peer R&D quintiles but become significantly positive in high quintiles. The differences in the abnormal returns between quintiles 5 and 1 are significantly positive in most cases. In terms of the magnitude of the difference, taking IRDS for example, the difference is a significant 36 basis point for year t+2 and a significant 79 basis point for year t+3. In comparison, the average abnormal return for the sample is 22 basis point for year t+2 and 7 basis points for year t+3.

The results documented above suggest that investors fail to appreciate the positive implications of peer's current R&D investment on future earnings. Specifically, investors underestimate future earnings because they do not understand that R&D costs incurred in the current period function more like an investment which produces future revenue rather than an expense (which is matched against current revenue). Then, investors reassess their earnings expectations in future periods when the benefits are unexpectedly realized, leading to a positive relation between future returns and current R&D (see Lev and Sougiannis (1996), Eberhart et al. (2004), Lev et al. (2005)). I confirm this relation and show that peer's current R&D investment is positively associated with future earnings over several subsequent years.

Table 5
Industry peer's R&D expenditures and future earnings news

	R&D measure: RDE(R&D/Market Cap)			R&D measure: RDA(R&D/Assets)			R&D measure: RDS(R&D/Sales)		
	Year t+1	Year t+2	Year t+3	Year t+1	Year t+2	Year t+3	Year t+1	Year t+2	Year t+3
Panel A. Earnings Surprise (%):									
Quintile1	0.05	-0.05	-0.29	0.03	-0.03	-0.07	0.07	-0.01	-0.07
	(0.47)	(-0.36)	(-1.29)	(0.30)	(-0.24)	(-0.59)	(0.69)	(-0.08)	(-0.69)
Quintile2	0.01	0.13	0.03	-0.02	0.08	-0.41	0.03	0.12	-0.10
	(0.01)	(1.00)	(0.22)	(-0.16)	(0.62)	(-1.04)	(0.32)	(1.12)	(-0.50)
Quintile3	0.20	0.41*	-0.08	0.16	0.36**	0.20	0.26	0.39	-0.06
	(0.67)	(1.71)	(-0.23)	(0.66)	(2.16)	(1.02)	(1.16)	(1.57)	(-0.12)
Quintile4	0.19*	0.29**	-0.51	0.15*	0.20	-0.13	-0.09	0.14	-0.31
	(1.64)	(2.13)	(-1.09)	(1.79)	(1.29)	(-0.34)	(-0.51)	(0.92)	(-1.15)
Quintile5	0.33**	0.36**	0.67**	0.32**	0.43**	0.54**	0.37**	0.39**	0.56**
	(2.19)	(2.07)	(2.21)	(2.09)	(2.08)	(2.18)	(2.23)	(2.25)	(2.31)
Quintile5-1	0.28	0.41**	0.96***	0.28	0.46**	0.61**	0.30	0.39**	0.63***
	(1.56)	(2.28)	(2.72)	(1.63)	(2.11)	(2.39)	(1.55)	(2.19)	(2.61)
Panel B. Earnings announcement abnormal returns (%):									
Quintile1	-0.01	0.11	-0.14	0.04	0.01	-0.12	0.11	-0.04	-0.29**
	(-0.02)	(0.95)	(-0.84)	(0.27)	(0.07)	(-0.88)	(0.86)	(-0.35)	(-1.99)
Quintile2	0.26**	0.12	-0.00	0.11	-0.02	-0.07	0.33	0.19	0.07
	(2.05)	(0.75)	(-0.01)	(1.03)	(-0.13)	(-0.38)	(2.05)	(1.27)	(0.42)
Quintile3	0.42**	0.22	-0.06	0.33*	0.20	0.07	0.32	0.41	-0.11
	(2.18)	(1.37)	(-0.38)	(1.75)	(1.08)	(0.43)	(1.48)	(1.62)	(-0.56)
Quintile4	0.26*	0.46*	-0.05	0.51***	0.27**	0.07	0.19	0.41***	-0.20
	(1.74)	(1.73)	(-0.24)	(2.64)	(2.32)	(0.50)	(1.02)	(2.65)	(-1.15)
Quintile5	0.58***	0.43***	0.35**	0.54***	0.37**	0.38**	0.31**	0.32**	0.50***
	(2.98)	(2.76)	(2.39)	(2.75)	(2.42)	(2.18)	(2.32)	(2.56)	(3.44)
Quintile5-1	0.58*	0.32*	0.50**	0.50*	0.37**	0.50**	0.20	0.36**	0.79***
	(1.79)	(1.74)	(1.98)	(1.73)	(2.01)	(2.25)	(1.35)	(2.15)	(4.89)

This table reports the earnings announcement abnormal returns and earnings surprises by industry peer's R&D expenditures portfolios for years t+1, t+2 and t+3. The sample contains 47,053 firm-year observations. The earnings announcement abnormal return is market-adjusted returns (differences between firm returns and returns on the value-weighted NYSE/AMEX) calculated for the three days around the annual earnings announcement date. The earnings surprise is calculated as the difference between actual earnings and consensus analyst mean forecast divided by the stock price five days prior to the announcement date. Earnings data are from I/B/E/S. Earnings announcement dates are obtained from COMPUSTAT. I divide sample firms into quintile portfolios based on the industry peer's R&D expenditures. Portfolio Quintile 5 contains highest industry peer's R&D expenditures (IRDE, IRDA, or IRDS). Portfolio Quintile 1 contains lowest industry peer's R&D expenditures (IRDE, IRDA, or IRDS). I report the time-series mean of cross-sectional mean values for these portfolios. Panel A reports the results for earnings announcement abnormal returns, and Panel B reports those for earnings surprises. A ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. Numbers in parentheses are t-statistics.

In summary, I show evidence in this subsection that investors are surprised by firms' earnings performance following their peer firms' R&D investments. This is consistent with the notion that the market fails to immediately incorporate the externality effects of R&D expenditures.

D.   Industry Peer's R&D Expenditures And Market Expansion

I are also interested to explore what might drive this R&D spillover effect. One plausible channel is that the industry investments in R&D lead to innovations that expand the market and increase market demand for the whole industry. For example, the success of iPhone reignites the market interest in smart phones in general, and also opens up an extended market that provides software for these smart phones. I thus hypothesize that the market expands when industry peer's R&D increases. To test the hypotheses, I estimate the following regressions:

$$\text{Market Expansion}_{i,t+1} = \alpha_0 + \alpha_1 \times R\&D_{peer,t} + \beta \times \text{Control variables} + e_{i,r} \quad (3)$$

I measure market expansion in terms of industry sales growth, industry employment growth, and the percentage of new firms enters the industry. The regression results of Equation (3) are reported in Table 6. Industries with higher IRDE tend to have higher subsequent total sales growth, total employment growth, and larger percentage of new firms enter the industry. The coefficients on IRDA and IRDS are positive and significantly associated with industry employment growth and new firms entry, but are not significant for industry sales growth. In general, the results are consistent with my prediction: the market for an industry expands more when its R&D intensity is higher.

The intuition behind the result is the following. R&D spillovers among firms have a positive market expansion effect. The positive market expansion effect is due to the fact that R&D investment performed by one firm will reduce costs of other firms, via spillovers. The cost reduction of the firms due to spillovers will then create new demand and translate in larger market shares, thus providing a positive externality effect for the industry. Indeed, the above results suggest that ideas and technology may spread from one firm to another, resulting in economic growth for an entire industry, creating new demand, and expanding the market.

E.   Industry Peers' R&D Expenditures, Market Expansion And Future Operating Performance

If the R&D expenditure benefits the whole industry through market expansion, I also expect to see that the spillover effect on firm performance is stronger when the market expands more. I therefore estimate the following regressions:

$$\begin{aligned}\text{Operating Performance}_{i,t+k} = d_0 &+ d_1 \times R\&D_{peer,t} \\ &+ d_2 \times (R\&D_{peer,t} \times \text{Market Expansion}_{t+k}) \quad (3) \\ &+ d_3 \times R\&D_{i,t} + \beta \times \text{Control variables} + e_{i,t}\end{aligned}$$

where operating performance measures are gross profit margin, gross ROA or sales growth; and k=1, 2 or 3 years. The control variables are log of market capitalization (LnSIZE) and firm leverage (LEV). If the market expansion hypothesis holds, then $d_2>0$.

Table 6
Market expansions and industry peer's R&D expenditures

	Industry Sales Growth	Industry Employment Growth	New Entry
R&D measure: RDE(R&D/Market Cap)			
IRDE	4.78*	6.18**	7.13***
	(1.82)	(2.26)	(3.33)
Ln(SIZE)	0.22***	0.17***	0.01
	(3.24)	(3.09)	(0.02)
LEV	0.25	0.43	0.04
	(0.79)	(1.09)	(0.16)
R&D measure: RDA(R&D/Assets)			
IRDA	5.34	6.99*	12.59***
	(1.23)	(1.65)	(3.46)
Ln(SIZE)	0.22***	0.17***	0.01
	(3.25)	(3.08)	(0.09)
LEV	0.09	0.19	0.11
	(0.28)	(0.47)	(0.44)
R&D measure: RDS(R&D/Sales)			
IRDS	0.75	1.77*	1.40*
	(1.05)	(2.5)	(2.31)
Ln(SIZE)	0.22***	0.16***	-0.01
	(3.21)	(3.03)	(-0.45)
LEV	0.08	0.21	-0.69
	(0.15)	(0.34)	(-1.45)

The table reports market expansion regression analysis for sample firms over 1975-2012. The sample contains 89,782 firm-year observations. The dependent variables are market expansion measures (Industry sales growth, Industry employment growth, and new firm entry). I rescale the dependent variable by a factor of 100. That is, I multiple the market expansion measures by 100. The independent variables are R&D measures (R&D/Market Cap, R&D/Assets, R&D/Sales), LnSIZE, and LEV. All variables are defined as in Table 1. All variables are winsorized at the 1th and 99th percentiles. A ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. Numbers in parentheses are *t*-statistics.

The regression results of Equation (4) are reported in Table 7. Taking IRDS for example (panel C), future operating performance is always positively related to the interaction term of (industry sales growth*IRDS) (8 out 9 coefficients are significant at the 10% level). The coefficients on (industry employment growth*IRDS) are also significantly positive in most cases. When the market expansion is measured as the percentage of new publicly traded firms, I find the results are relatively weaker: only future sales growth (but not profit margin or ROA) is positively associated with the (new entry*IRDS). Results are similar with IRDE (Panel A) and IRDA (Panel B). Those results are also statistically significant. For example, one standard deviation increase in (industry sales growth*IRDS) increases sales growth by 2.9%, 3.4% and 4.0% in year t+1, t+2 and t+3, respectively. As discussed previously, the positive

market expansion effect is due to the fact that spillovers among firms reduce their costs and increase their market shares. Therefore, I expect a stronger spillover effect when the market expands more. That is, I expect to see higher operating performance for firms in the industry that experience stronger productivity growth and larger market expansion. Overall, these results are consistent with the market expansion hypothesis: industry peers' R&D investments have a larger positive effect on a firm's operating performance where the market expands more.

IV.   CONCLUSIONS

In this study, I find evidence that R&D investments have positive externality effects. Firms' future operating performance is positively related to industry peers' (in terms of all peer firms, or leaders in the industry) R&D expenditures. Further, firms tend to experience positive abnormal returns following industry peers' high R&D expenditures. This suggests that the market not only underreact to a firm's own R&D investments (as suggested by both previous and my studies), but also to industry peers' R&D investments.

Consistent with the notion that the market underreacts to the externality effects of R&D, I also find that the market is surprised by firms' earnings performance following high peer R&D investments. Specifically, I find that future earnings surprises and abnormal stock returns around earnings announcements are significantly positive when industry peers have high R&D investments; and these measures are significantly higher than those firms whose industry peers have low R&D investments.

I also identify a channel through which the benefits of R&D investments can spill over to other firms in the industry: advances in technology expand the market demand. Consistent with this hypothesis, I find that industry sales and employment grow faster when industry R&D intensity is high; and that the positive externality effect on operating performance is stronger where the market expands more.

ENDNOTES

1.   In robust checks, I also use EBIT (earnings before interest and tax) margin and ROA. Results are robust. I choose to use gross profit margin and gross ROA because EBIT is influenced by R&D expenses.
2.   I do not wonsorize PrRet to conform to the convention. Results are robust if I do winsorize this variable as well.
3.   My results are robust to earnings surprise measured using the difference between reported earnings and consensus analysts' median earnings forecast divided by the stock price five days prior to the announcement date.
4.   Market-adjusted returns are the differences between firm returns and returns on the value-weighted NYSE/AMEX index, both compounded over the [-1, +1] earnings announcement window.

Table 6
Operating performance, market expansion, and industry peer's R&D expenditures
Panel A
R&D Measure: RDE(R&D/Market Cap)

	Dependent variable: operating performance measures for Year t+1			Dependent variable: operating performance measures for Year t+2			Dependent variable: operating performance measures for Year t+3		
	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth
Market expansion measure: industry sales growth									
IRDE	2.39***	5.26**	13.82***	4.10**	10.05***	13.65***	6.10**	10.95***	11.02***
	(2.64)	(2.48)	(3.47)	(2.36)	(3.56)	(3.66)	(2.54)	(2.83)	(3.24)
Industry sales growth *IRDE	1.11	6.13***	16.76***	1.99**	7.55***	18.44***	2.75**	7.74**	20.63***
	(1.43)	(2.63)	(4.59)	(1.99)	(2.58)	(4.91)	(2.30)	(2.29)	(5.44)
RDE	1.87***	1.95	16.10***	2.56***	-2.32	16.49***	3.16***	6.42*	15.61***
	(3.42)	(0.74)	(4.18)	(3.10)	(-0.68)	(4.39)	(3.03)	(1.77)	(4.00)
Ln(SIZE)	0.01	-0.44***	-0.76***	0.04	-0.7***	-1.18***	0.11	-0.64***	-1.03***
	(0.34)	(-6.22)	(-5.31)	(0.65)	(-6.56)	(-7.46)	(1.33)	(-4.58)	(-6.63)
LEV	-0.41	-10.18***	-4.86***	-0.78	-4.63**	-6.10***	-0.77	-1.30	-2.41
	(-1.21)	(-6.59)	(-2.89)	(-1.38)	(-2.44)	(-2.63)	(-1.15)	(-0.58)	(-1.09)
Market expansion measure: industry employment growth									
IRDE	2.78***	6.72***	14.66***	4.36**	11.27***	14.97***	6.23***	12.16***	12.16***
	(2.98)	(2.75)	(3.22)	(2.44)	(3.58)	(3.35)	(2.62)	(3.12)	(2.91)
Industry employment growth *IRDE	0.35	3.97	17.81***	1.02	4.85*	18.44***	2.05	6.16*	20.24***
	(0.42)	(1.60)	(4.56)	(0.93)	(1.76)	(4.07)	(1.53)	(1.72)	(4.17)
RDE	1.85***	1.73	15.74***	2.49***	-2.67	16.23***	3.13***	6.47*	15.42***
	(3.46)	(0.65)	(4.03)	(3.14)	(-0.78)	(4.28)	(3.04)	(1.80)	(3.90)
Ln(SIZE)	0.01	-0.44***	-0.78***	0.04	-0.70***	-1.19***	0.11	-0.64***	-1.03***
	(0.31)	(-6.27)	(-5.43)	(0.64)	(-6.81)	(-7.52)	(1.31)	(-4.66)	(-6.53)
LEV	-0.40	-10.12***	-4.52***	-0.76	-4.55*	-5.89**	-0.77	-1.27	-2.24
	(-1.19)	(-6.48)	(-2.67)	(-1.34)	(-2.35)	(-2.50)	(-1.14)	(-0.56)	(-0.98)
Market expansion measure: new entry									
IRDE	3.52***	7.73**	13.54***	4.93**	11.55***	12.97***	6.66***	12.35***	10.30***
	(2.75)	(2.44)	(2.94)	(2.32)	(3.68)	(3.42)	(2.87)	(3.52)	(2.72)
New entry*IRDE	-2.20	1.27	24.37***	-0.19	5.09	30.74***	1.35	9.21	36.50**
	(-1.11)	(0.29)	(3.15)	(-0.10)	(1.05)	(2.73)	(0.57)	(1.42)	(2.33)
RDE	1.82***	1.43	15.68***	2.47***	-2.75	16.31***	3.22***	6.39*	15.69***
	(3.39)	(0.54)	(3.98)	(3.14)	(-0.80)	(4.25)	(3.17)	(1.76)	(3.97)
Ln(SIZE)	0.02	-0.44***	-0.81***	0.04	-0.72***	-1.26***	0.10	-0.68***	-1.11***
	(0.49)	(-6.34)	(-5.44)	(0.67)	(-7.10)	(-7.81)	(1.21)	(-5.11)	(-7.11)
LEV	-0.41	-10.14***	-4.94***	-0.8	-4.53**	-5.91**	-0.8	-1.25	-2.46
	(-1.22)	(-6.48)	(-2.94)	(-1.42)	(-2.33)	(-2.52)	(-1.18)	(-0.55)	(-1.09)

Panel B
R&D measure: RDA (R&D/Assets)

	Dependent variable: operating performance measures for Year t+1			Dependent variable: operating performance measures for Year t+2			Dependent variable: operating performance measures for Year t+3		
	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth
Market expansion measure: industry sales growth									
IRDA	4.33***	10.71**	15.52***	7.06***	17.96***	16.16***	10.30***	21.78***	15.33***
	(2.76)	(2.51)	(2.61)	(2.67)	(3.22)	(3.01)	(2.78)	(2.88)	(2.88)
Industry sales growth									
*IRDA	1.14	5.67***	16.28***	2.04*	7.37***	17.88***	2.34***	7.60**	19.72***
	(1.47)	(2.68)	(4.47)	(1.92)	(2.57)	(4.86)	(2.10)	(2.42)	(5.46)
RDA	6.02***	9.00	50.67***	9.40***	14.07*	47.94***	11.34***	23.40***	40.95***
	(3.49)	(1.50)	(6.40)	(3.38)	(1.68)	(6.43)	(3.64)	(2.61)	(4.77)
Ln(SIZE)	0.02	-0.42***	-0.76***	0.05	-0.67	-1.18***	0.12	-0.62***	-1.02***
	(0.51)	(-6.03)	(-5.58)	(0.79)	(-6.63)	(-7.76)	(1.47)	(-4.53)	(-6.71)
LEV	0.28	-10.53***	-0.22	0.29	-5.66***	-1.88	0.53	-2.96	1.09
	(0.94)	(-7.04)	(-0.12)	(0.58)	(-3.18)	(-0.80)	(0.86)	(-1.38)	(0.48)
Market expansion measure: industry employment growth									
IRDA	4.89***	12.31***	15.98**	7.46***	19.41***	17.83***	10.4***	23.26***	17.2***
	(3.04)	(2.66)	(2.36)	(2.76)	(3.26)	(2.69)	(2.81)	(3.10)	(2.73)
Market expansion measure: Industry employment growth									
*IRDA	0.19	3.84*	16.94***	0.91	4.77*	17.95***	1.79	6.39*	19.65***
	(0.24)	(1.66)	(4.62)	(0.82)	(1.75)	(4.11)	(1.33)	(1.88)	(4.16)
RDA	6.00***	9.30	50.04***	9.20***	14.75*	47.45***	11.25***	23.68***	40.65***
	(3.53)	(1.50)	(6.17)	(3.42)	(1.71)	(6.28)	(3.69)	(2.62)	(4.65)
Ln(SIZE)	0.02	-0.42***	-0.78***	0.05	-0.68***	-1.20***	0.12	-0.61***	-1.03***
	(0.48)	(-6.03)	(-5.68)	(0.78)	(-6.87)	(-7.85)	(1.46)	(-4.59)	(-6.64)
LEV	0.28	-10.49***	0.01	0.29	-5.69***	-1.76	0.49	-2.96	1.25
	(0.95)	(-6.95)	(0.01)	(0.57)	(-3.16)	(-0.74)	(0.80)	(-1.36)	(0.54)
Market expansion measure: new entry									
IRDA	6.70***	13.81**	14.43**	9.83***	20.55***	16.22***	12.52***	23.72***	15.02***
	(2.91)	(2.34)	(2.13)	(2.67)	(3.32)	(3.01)	(3.09)	(3.47)	(2.81)
New entry*IRDA	-4.05*	3.26	21.32***	-3.25	6.09	28.13**	-3.19	6.64	32.33**
	(-1.68)	(0.87)	(2.95)	(-1.61)	(1.03)	(2.49)	(-1.18)	(1.11)	(2.14)
RDA	6.00***	9.82	50.71***	9.15***	15.17*	47.16***	11.52***	23.76**	41.34***
	(3.45)	(1.56)	(6.22)	(3.41)	(1.76)	(6.13)	(3.86)	(2.60)	(4.71)
Ln(SIZE)	0.03	-0.41***	-0.81***	0.05	-0.69***	-1.27***	0.11	-0.65***	-1.11***
	(0.64)	(-6.09)	(-5.74)	(0.81)	(-7.12)	(-8.09)	(1.35)	(-5.00)	(-7.18)
LEV	0.28	-10.52***	-0.41	0.25	-5.65***	-1.87	0.50	-2.92	1.02
	(0.94)	(-6.99)	(-0.23)	(0.5)	(-3.14)	(-0.79)	(0.79)	(-1.36)	(0.45)

Panel C
R&D Measure: RDS(R&D/Sales)

	Dependent variable: operating performance measures for Year t+1			Dependent variable: operating performance measures for Year t+2			Dependent variable: operating performance measures for Year t+3		
	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth	Gross profit margin	Gross ROA	Sales Growth
Market expansion measure: industry sales growth									
IRDS	0.51**	1.46*	1.14	0.92**	3.05*	2.11	1.27**	3.99*	1.63
	(2.20)	(1.80)	(0.88)	(2.07)	(1.73)	(1.27)	(1.98)	(1.72)	(1.37)
Industry sales growth *IRDS	1.28	6.27***	16.91***	1.97*	6.61**	17.4***	2.09**	5.24*	18.53***
	(1.48)	(2.90)	(4.58)	(1.82)	(2.47)	(4.88)	(2.18)	(1.97)	(5.59)
RDS	8.75***	13.99*	77.59***	13.07**	21.09**	78.34***	17.98	17.98	66.15***
	(2.47)	(1.90)	(6.97)	(2.48)	(1.99)	(7.45)	(3.24)	(1.62)	(6.72)
Ln(SIZE)	-0.01	-0.46***	-0.86***	0.02	-0.75***	-1.29***	0.08	-0.72***	-1.13***
	(-0.01)	(-6.82)	(-6.56)	(0.34)	(-7.21)	(-8.56)	(1.00)	(-5.11)	(-7.85)
LEV	0.15	-9.62***	-0.10	0.01	-4.28**	-1.62	0.17	-1.20	1.08
	(0.49)	(-6.64)	(-0.06)	(0.01)	(-2.51)	(-0.72)	(0.28)	(-0.57)	(0.50)
Market expansion measure: industry employment growth									
IRDS	0.64**	1.64*	1.36	1.03*	3.24***	2.74	1.24**	4.02*	1.88
	(2.12)	(1.75)	(0.95)	(1.93)	(1.72)	(1.28)	(2.02)	(1.77)	(1.39)
Industry employment growth *IRDS	0.59	4.21**	17.11***	1.28	4.51**	17.64***	2.17*	4.30	18.49***
	(0.79)	(2.22)	(4.29)	(1.16)	(2.00)	(3.95)	(1.86)	(1.60)	(4.30)
RDS	8.75***	14.17*	77.76***	12.99**	20.66*	78.17***	17.44***	18.00	66.49***
	(2.51)	(1.90)	(6.95)	(2.49)	(1.92)	(7.33)	(3.24)	(1.61)	(6.59)
Ln(SIZE)	-0.01	-0.46***	-0.88***	0.02	-0.75***	-1.31***	0.08	-0.72***	-1.15***
	(-0.06)	(-6.80)	(-6.68)	(0.29)	(-7.45)	(-8.76)	(1.00)	(-5.22)	(-7.90)
LEV	0.15	-9.62***	0.08	0.03	-4.28**	-1.45	0.17	-1.22	1.20
	(0.49)	(-6.58)	(0.05)	(0.06)	(-2.47)	(-0.64)	(0.28)	(-0.58)	(0.55)
Market expansion measure: new entry									
IRDS	0.53	1.92*	0.11	1.92	3.59*	1.05	1.73*	5.05*	0.86
	(1.42)	(1.72)	(0.11)	(1.40)	(1.68)	(1.09)	(1.72)	(1.66)	(1.24)
New entry*IRDS	1.20	5.55	31.94***	0.76	6.17	35.00***	2.30	3.61	35.42**
	(0.95)	(1.48)	(3.10)	(0.27)	(0.84)	(2.78)	(0.78)	(0.55)	(2.37)
RDS	8.77**	14.03*	77.9***	13.24**	20.48*	77.01***	17.69***	17.46	66.20***
	(2.49)	(1.86)	(6.79)	(2.57)	(1.87)	(6.98)	(3.32)	(1.54)	(6.35)
Ln(SIZE)	-0.01	-0.47***	-0.91***	0.01	-0.78***	-1.38***	0.07	-0.74***	-1.22
	(-0.04)	(-6.84)	(-6.79)	(0.21)	(-7.68)	(-8.87)	(0.87)	(-5.56)	(-8.47)
LEV	0.15	-9.64***	-0.16	0.01	-4.30**	-1.49	0.12	-1.27	1.08
	(0.48)	(-6.69)	(-0.1)	(0.01)	(-2.47)	(-0.66)	(0.2)	(-0.61)	(0.51)

The sample contains 89,782 firm-year observations during 1975-2012. The dependent variables are operating performance measures (Gross profit margin, Gross ROA and Sales growth) for year t+1, t+2 and t+3, respectively. I rescale the dependent variable by a factor for 100. That is, I multiple the R&D measures by 100. The independent variables are industry R&D measures, the interaction of industry R&D measures and market expansion measures (Industry sales growth, Industry employment growth, New firm entry), LnSIZE, and LEV. In Panel A, R&D measure is RDE (R&D/Market Cap). In Panel B, R&D measure is RDE (R&D/Assets). In Panel C, R&D measure is RDS (R&D/Sales). All variables are defined as in Table 1. All variables are winsorized at the 1th and 99th percentiles. A ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. Numbers in parentheses are *t*-statistics.

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