

## On the R&D/Marketing interface in knowledge intensive entrepreneurial firms

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### **Abstract:**

In this paper we focus on the performance impact associated with whether R&D or marketing takes the lead in product innovations and/or product development. We examine empirically the performance of a sample of entrepreneurial firms across 10 European Union countries for which we can identify alternative regimes in which R&D, or in which marketing, is viewed as being relatively more important in creating and sustaining the firm’s competitive advantage. We find that when R&D is the dominant strategy, firms realize greater growth in sales, other factors held constant.

**Keywords:** R&D | marketing | entrepreneurial firms | innovation

### **Article:**

#### **Introduction**

Since the pioneering work by Souder (1977) and Souder and Chakrabarti (1978), scholars from a number of disciplines have investigated the interface between R&D and marketing. These more recent studies have examined a variety of topics including, but not limited to, power asymmetry between R&D and marketing (Auh and Merlo 2012); the relative value of marketing efforts versus R&D innovation in a firm (Srinivasan et al. 2009); a firm’s overall market orientation (Zhou et al. 2005); and the nature and degree of communication between marketing and R&D (Gupta et al. 1985; Song and Dyer 1995). For the most part, however, the literature as a whole has focused on extending Souder (1977) and thus has been based on the following premise (Souder and Chakrabarti 1978, p. 88)<sup>1</sup>:

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<sup>1</sup> Surprisingly, much of the R&D/marketing interface literature has ignored the early work of Mansfield. Mansfield and Wagner (1975, p. 184) noted that one might expect the probability of technical completion of an R&D project, the probability of commercialization of the resulting technology, and the economic success of the innovation in the market to be influenced by “the extent to which the firm’s R&D portfolio is based on ideas coming from the R&D department, as distinct from the marketing department and other parts of the firm.”

[T]he degree of collaboration/integration between functional units, such as marketing and R&D, has a profound influence on the success/failure outcomes of innovation projects in industrial settings.

Generally, the R&D/marketing interface literature has focused on two general areas. The first area relates to why there are integration issues between the R&D group and the marketing group. Recent research suggests that when R&D has too much power in the innovation process that marketing's role in launching the innovation gets lost and, too often, the importance of marketing in determining commercial success of the innovation is minimized hindering future marketing efforts (Stock and Reiferscheid 2014). Likewise, unsuccessful marketing efforts can minimize the financial success of a useful R&D innovation (Pauwels et al. 2004). As Gupta et al. (1985, p. 12) point out:

Too often R&D becomes exuberant about a new technical idea without sufficient regard for its commercial significance. Similarly, marketing misreads the customer needs and scarce resources are wasted on products that fail to satisfy real market needs.

The second area relates to organizational issues or strategies to mitigate what Gupta et al. (1986, p.8) refers to as the "integration gap." Evidence from research examining this critical area has determined that there may be a number of issues that hinder maximization of R&D/marketing communication. For example, Gupta et al. (1985) conclude that one issue in the R&D/marketing interface involves disagreement about how they should interface and work together. Other research suggests that socio-cultural differences between R&D and marketing influence the degree of integration that these two functions can achieve within an organization (Gupta et al. 1986). Wang and Montaguti (2002, p. 84) conclude<sup>2</sup>:

The desired level of the R&D/marketing interface is defined [to exist] when: communication intensity is high; information credibility is high for both parties; and influence is mutual and consistent with the level of information credibility.

From an empirical perspective, the extant literature, especially that literature that is focused on the performance consequences associated with whether R&D or marketing takes the lead in product innovations and/or product development (e.g., Mansfield and Wagner 1975), has focused on small samples of large industrial firms that are country or industry specific. And, there is also a conspicuous void of analyses of such consequences in entrepreneurial firms, knowledge intensive entrepreneurial (KIE) firms in particular.<sup>3</sup> This paper attempts to begin to fill these voids. In particular, in this paper we examine, in an exploratory manner, the performance of entrepreneurial firms under alternative regimes in which R&D, or in which marketing, is viewed as being relatively more important in creating and sustaining the firm's competitive advantage. Our premise is that when R&D (marketing) is viewed as relatively more important than

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<sup>2</sup> See also Moenaert et al. (1994), Song and Dyer (1995), and Stock and Reiferscheid (2014).

<sup>3</sup> Malerba (2010, p. 4) defines KIE as follows: "Knowledge-intensive entrepreneurship concerns new ventures that introduce innovations in the economic systems and that intensively use knowledge. From this broad definition, it follows that knowledge-intensive entrepreneurship may take place in various ways: through the foundation of new firms or through the display of entrepreneurial spirit with existing firms or through the action of single individuals within non-profit organizations such as universities or public laboratories."

marketing (R&D), it can be assumed that R&D (marketing) generally takes the lead over marketing (R&D) in product innovations and/or product development.

The remainder of the paper is outlined as follows. In “The AEGIS database of KIE firms” Section, we describe the data on KIE firms used in our analyses. In “Analysis of firm performance and the R&D/marketing interface” Section, we discuss an empirical framework of firm performance as a function of the R&D/marketing interface and other firm characteristics. Our empirical findings are presented and discussed in this section as well. Concluding remarks are offered in “Concluding remarks” Section.

### **The AEGIS database of KIE firms**

The AEGIS (Advancing knowledge-intensive entrepreneurship and innovation for growth and social well-being in Europe) project was funded by the European Commission under Theme 8 “Socio-Economic Sciences and Humanities” of the 7th Framework Programme (FP7) for Research and Technological Development (Caloghirou et al. 2011).<sup>4</sup> The project’s focus was on KIE under the implicit assumption that KIE is an important vehicle for obtaining economic growth and societal well-being.

Data collection was part of the AEGIS project. The AEGIS database contains information on 4004 KIE firms established between 2002 and 2007 across 10 European Union (EU) countries. The AEGIS survey was conducted from late-2010 into 2011, and thus a firm in the AEGIS sample had been active for a minimum of four years.<sup>5</sup>

**Table 1.** Distribution of aegis high-tech industrial sector firms, by country

Country	High-tech sector firms
Croatia	35
Czech Republic	25
Denmark	34
France	68
Germany	67
Greece	22
Italy	57
Portugal	31
Sweden	34
United Kingdom	47
Total	420

Source: Caloghirou et al. (2011) and the AEGIS database

The countries represented in the database are (alphabetically): Croatia, Czech Republic, Denmark, France, Germany, Greece, Italy, Portugal, Sweden, and the United Kingdom. And, across these countries a number of firms from the high-tech and low-tech industrial sectors, and from the knowledge-intensive business services sector, are represented in the database. Only the sample of high-tech industrial sector firms, that is those that are actually involved in R&D, are

<sup>4</sup> In Greek mythology the word *Aegis* refers to the powerful shield carried by Athena and Zeus.

<sup>5</sup> Other studies using the AEGIS database are, for example, Cunningham and Link (2016) and Link and Swann (2016).

considered in this paper. The distribution of the 420 high-tech industrial sector firms across the EU countries is shown in Table 1.<sup>6</sup>

### Analysis of firm performance and the R&D/marketing interface

The empirical analysis in this paper is limited by the availability of information in the AEGIS database on firm performance, the R&D/marketing interface, and firm control variables. Our measure of firm performance is the percentage growth in firm sales between 2009 and 2010, *Sales*. Table 2 shows the mean percentage growth in sales for the entire sample of 420 high-tech firms to have been 18.99%, with a range from -70% to 800%. Descriptive statistics on the other variables discussed below are also in Table 2.

**Table 2.** Descriptive statistics on the variables,  $n = 420$

Variable	Mean	Standard deviation	Range
<i>Sales</i>	18.990	62.12	-70-800
<i>RDDmy</i>	0.381	0.486	0/1
<i>RDGap</i>	0.136	1.510	-4-4
<i>Age</i>	7.124	2.077	4-10
<i>Emp</i>	13.901	33.760	1-530
<i>Commerc</i>	0.702	0.458	0/1
<i>Inter'101</i>	24.233	32.665	0-100
<i>Inter'102</i>	0.191	0.393	0/1

There is not a theoretical justification for how one measures the R&D/marketing interface, that is the extent to which R&D or marketing takes the lead in product innovations and/or product development, and the extant literature discussed above offers no specific guidelines for such quantification. The key question on the AEGIS survey from which we derive such a measure is:

Please indicate the contribution of each—R&D activities and marketing and promotion activities—in sustaining the competitive advantage of this firm using a 5-point scale where 1 is no impact and 5 is a huge impact.

The range of response values reported on the survey for both the R&D activities and the marketing and promotion activities variables was 1–5. We quantified, in an exploratory manner, the R&D/marketing interface in two ways. First,  $RDDmy = 1$  for a firm if the survey response for R&D activities by the firm was numerically greater than its response for marketing and promotion activities, and 0 otherwise. And second,  $RDGap = (\text{firm's response to R\&D activity} - \text{firm's response to marketing and promotion activities})$ .

As shown in Table 2, 38.1% of the high-tech firms responded that R&D activities made a greater contribution than marketing and promotion activities in sustaining the competitive advantage of the firm, *RDDmy*; 61.9% responded that marketing and promotion activities were equal to or

<sup>6</sup> The high-tech industrial sector is defined in the AEGIS database to include aerospace; computers and office machinery; radio-television communication equipment; manufacture of medical, precision and optional instruments; pharmaceuticals; manufacturer of electrical machinery and apparatus, manufacturer of machinery and equipment, chemical industry.

greater than R&D activities in sustaining the competitive advantage of the firm. Also, on average, the mean of the difference in firm responses to R&D and to marketing and promotion, *RDGap*, was positive and only slightly greater than 0. We offer no hypothesis about the relationship between the percentage growth in sales and either one of the R&D/marketing interface variables.

The academic literature has focused on describing organizational issues associated with R&D versus marketing taking the lead in product innovations and/or product development. As we noted in the Introduction, the literature is void of a systematic study of the performance consequences so associated with this interface. That said, even in KIE firms, it might be the case that for some projects R&D takes the lead while marketing assumes that role for other projects. Our measures of the R&D/marketing interface are at the firm level so any inter-project differences in the interface are lost. But, our performance variables, *Sales*, is also at the firm level.

Regarding control variables, firm age, *Age*, is measured by the year of the AEGIS survey less the year that the firm was founded. As shown in Table 2, the mean age of the high-tech KIE firms is just over 7 years. Firm size is measured by the number of employees, *Emp*, at the time of the survey. The mean employment size of the high-tech KIE firm is nearly 14 employees, with a range of 1 to 530 employees.<sup>7</sup> On the one hand, older and/or larger firms might realize greater sales growth—especially during a post-recessionary period, and the EU countries were experiencing a recession in late-2007 and 2009—due to their experience and established presence in the market. On the other hand, older and/or larger firms might realize less sales growth compared to younger and smaller entrepreneurial enterprises that have entered the market with a new and innovative product. Thus, we offer no prediction on the relationship between growth in *Sales* and either *Age* or *Emp*.

The dichotomous variable *Commerc* accounts for how the firm responded to the following survey question:

Did your firm introduce new or significantly improved goods or services during the past three years? (Exclude the simple resale of new products purchased from other enterprises and changes that are solely of an aesthetic nature.)

Just over 70% of the high-tech KIE firms responded to this question in the affirmative. We hypothesize a positive relationship between *Commerc* and *Sales*. Recall that the period late-2007 to 2009 was one of recession among EU countries; thus, an entrepreneurial advance in terms of a new or significantly improved good or service is hypothesized to be a necessary condition for sales growth from 2009 to 2010.

We also hypothesize that those firms whose market is international, as opposed to local or even national, will have greater sales growth during the post-recessionary period. Our argument is that the more international the firm's market presence, the more diverse its market base and thus the greater the opportunity to realize sales growth. We quantify the international nature of a firm in two ways. First, *Inter01* represents the percent of firm sales in the period late-2007 to 2009 that

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<sup>7</sup> Two part-time employees are assumed to equal one full-time employee.

were in the international market as opposed to in the local and national markets. Second, *Inter02* equals 1 if the firm's percent sales in the international market was greater than its combined sales in the local and national market, and 0 otherwise. On average, just over 24% of the sales of the high-tech KIE firms went to international markets. And, in 19.1% of this sample of firms, international sales were greater than combined sales to the local and national markets.

A correlation matrix with all of the relevant variables is in Table 3. The correlations do not suggest any troublesome collinearities among the independent variables.<sup>8</sup> Of particular note is the positive and statistically significant correlations between *Commerc* and both *RDDmy* and *RDGap*. Recall from the Introduction section of this paper the proposition that we posited, namely that when R&D (marketing) is viewed as relatively more important than marketing (R&D), we assume that R&D (marketing) takes the lead over marketing (R&D) in product innovations and/or product development. When *RDDmy* = 0 ( $n = 260$ ), the mean value of *Commerc* is 0.658; when *RDDmy* = 1 ( $n = 160$ ), the mean value of *Commerc* is 0.775. In other words, in those firms where R&D is assumed to take the lead (*RDDmy* = 1), the likelihood that the firm will have introduced new or significantly improved goods and services in the period late-2007 to 2009 is 11.7 percentage points greater, other factors not held constant.

**Table 3.** Correlation matrix,  $n = 420$

	<i>Sales</i>	<i>RDDmy</i>	<i>RDGap</i>	<i>Age</i>	<i>Emp</i>	<i>Commerc</i>	<i>Inter'101</i>	<i>Inter'102</i>
<i>Sales</i>	1							
<i>RDDmy</i>	0.085	1						
<i>RDGap</i>	0.053	0.784 <sup>a</sup>	1					
<i>Age</i>	-0.092	0.112 <sup>a</sup>	0.130 <sup>a</sup>	1				
<i>Emp</i>	-0.005	-0.023	-0.010	0.086	1			
<i>Commerc</i>	0.117 <sup>a</sup>	0.125 <sup>a</sup>	0.145 <sup>a</sup>	-0.062	0.017	1		
<i>Inter'101</i>	0.131 <sup>a</sup>	0.052	0.052	0.032	0.216 <sup>a</sup>	0.153 <sup>a</sup>	1	
<i>Inter'102</i>	0.139 <sup>a</sup>	-0.006	0.001	0.015	0.199 <sup>a</sup>	0.077	0.889 <sup>a</sup>	1

<sup>a</sup> denotes significant at .05-level or better

Table 4 reports our regression results for various specifications using the above described independent variables.<sup>9</sup> We considered the possibility of a non-linear effect of *Age* and *Emp* on *Sales*, but in each of the eight specifications *Emp*<sup>2</sup> was not significantly different from zero and thus was deleted from the table.<sup>10</sup>

With reference to the theme of this paper, across each of the eight specifications in Table 4, both measures of the R&D/marketing interface are positive and statistically significant at either the .05-level or the .10-level. In other words, when R&D activities are viewed as more important than marketing and promotion activities in sustaining the firm's competitive growth advantage, the firm enjoys a greater growth in sales (i.e., it has a higher level of performance). With reference to the estimated coefficients on *RDDmy* in specification (1), (2), (5), and (6), that advantage is on the order of between 12 and 13 percentage points. If one interprets a firm's response that R&D activities are more important than marketing and promotion activities in

<sup>8</sup> Note that *Emp* is not correlated with either *RDDmy* or *RDGap*. This lack of correlation between firm size and the R&D/marketing interface complements the earlier findings of Link and Zmud (1986) described in footnote 2.

<sup>9</sup> Country fixed effects are controlled for in each specification in Table 4.

<sup>10</sup> The regression results that include *Emp*<sup>2</sup> are available on request from the authors.

sustaining the firm's competitive advantage to mean that within the firm its R&D strategy dominates or takes the lead over its marketing strategy, our findings might be viewed as providing the first systematic evidence among small, entrepreneurial firms of the economic impact associated with an R&D/marketing interface that is dominated by R&D. Our findings extend those of Auh and Merlo (2012) who indicate that, while the marketing function is very important for large and medium size firms, a power asymmetry between R&D and marketing is positively related to business performance.

**Table 4.** Regression results (standard errors),  $n = 420$

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>RDDmy</i>	11.968* (6.253)	12.424** (6.205)	–	–	12.571** (6.228)	12.968** (6.184)	–	–
<i>RDGap</i>	–	–	3.614* (2.066)	4.067** (2.055)	–	–	3.749* (2.058)	4.185** (2.048)
<i>Age</i>	–2.647* (1.459)	–36.048*** (12.244)	–2.618* (1.460)	–37.270*** (12.287)	–2.626* (1.457)	–34.794*** (12.298)	–2.591* (1.458)	–36.112*** (12.345)
<i>Age</i> <sup>2</sup>	–	2.319*** (0.844)	–	2.404*** (0.847)	–	2.234*** (0.848)	–	2.326*** (0.851)
<i>Emp</i>	–0.006 (0.091)	–0.014 (0.090)	–0.007 (0.091)	–0.015 (0.090)	–0.008 (0.091)	–0.013 (0.090)	–0.008 (0.091)	–0.014 (0.090)
<i>Commerc</i>	10.839 (6.641)	12.162* (6.606)	10.811 (6.660)	12.035* (6.617)	11.566* (6.579)	12.830** (6.549)	11.573* (6.599)	12.731* (6.561)
<i>Inter'101</i>	0.170* (0.097)	0.153 (0.097)	0.169* (0.097)	0.150 (0.097)	–	–	–	–
<i>Inter'102</i>	–	–	–	–	15.823** (7.868)	13.380* (7.865)	15.456** (7.882)	12.844 (7.878)
Intercept	16.417 (13.168)	124.960*** (41.613)	20.293 (13.308)	133.252*** (41.905)	16.686 (13.133)	121.291*** (41.800)	20.741 (13.265)	130.067*** (42.095)
Country	yes	yes	yes	yes	yes	yes	yes	yes
R <sup>2</sup>	10.12	11.76	9.98	11.74	10.33	11.85	10.17	11.80
F-level	3.26	3.59	3.21	3.58	3.33	3.62	3.27	3.60

\*\*\* significant at .01-level, \*\* significant at .05-level, \* significant at .10-level

Regarding firm age, *Age*, a comparison of the results for paired specifications, that is for specifications (1) and (2), for (3) and (4), and so forth, the regression coefficients clearly indicate that *Age* enters non-linearly and has an overall negative relationship with the growth in sales. Thus, younger firms enjoyed a greater percentage growth in sales over the 2009–2010 period. A finding of this nature may reflect newer, more innovative products being brought to market by the younger firms which would enhance relative sales growth compared to older firms whose product lines overall may not be as innovative and subject to growth. It is often the case that new firms spring into existence to meet some customer need(s) that is not being completely fulfilled. If that is the case, it would, at least in part, fit with previous research indicating that market-oriented firms tend to perform better in the marketplace (O'Cass and Ngo 2011).

The size of a firm, *Emp*, does not have a significant effect on sales growth in any specification.

As hypothesized, those firms that commercialized a new or improved product during the period late-2007 to 2009, *Commerc* = 1, accordingly realized growth in sales in the 2009–2010 period of nearly 11 to almost 13 percentage points over those firms that did not commercialize.

Finally, as hypothesized, firms with a greater presence in international markets experienced a greater growth in sales. With reference to the estimated coefficients on *Inter02*, for example, the growth in sales averaged nearly 13 to almost 16 percentage points greater among firms whose international sales dominated its local and national sales.

### **Concluding remarks**

Although our empirical analyses are exploratory in nature, our findings might be viewed as providing the first systematic evidence among small, entrepreneurial firms of the performance impact associated with an R&D/marketing interface that is dominated by R&D. Specifically, we show that among KIE firms in the high-tech manufacturing sectors of selected EU countries sales growth is greater when an R&D strategy dominates a marketing strategy. And, these findings are robust across alternative specifications.

However, our analysis does have limitations, and thus any generalizations from our findings should be made with these limitations in mind. First and foremost, our constructs for the R&D/marketing interface are based on the availability of data rather than on theoretical foundations. Due to data limitations, we are also unable to control for cross-firm differences in characteristics of products and processes being sold.

Our analyses did not include a measure of R&D innovation meaningfulness. While findings do indicate that R&D strategy results in relatively greater commercial results than does a firm that focuses more on marketing, including a measure of the meaningfulness of R&D innovation represents an area for future research (Szymanski et al. 2007). Another area for which our data could not address, but an area that merits additional study, involves measuring the effect of an entrepreneurial firm's market orientation on innovation success (Zhou et al. 2005; Homburg and Pflesser 2000) and the firm's ability to interface effectively between R&D and marketing functions (Song and Dyer 1995). Further research could also examine the degree of integration of R&D and marketing to see if there is an optimal level of integration within small, high-tech firms. O'Cass and Ngo (2011), in their study of business-to-business markets, indicate that a successful interaction between innovation and marketing capabilities significantly influences firms' marketplace performance more than they do individually. Findings from our current study do not completely address this issue.

Lastly, and from the perspective of dynamic entrepreneurship (Audretsch et al. 2016), the literature has yet to consider within the context of the R&D/marketing interface elements of uncertainty and risk in either activity, although risk is fundamental to both. As Amoroso et al. (2016, p.1) point out, uncertainty is fundamental to the "emergence of new opportunities." New opportunities emerge from successful R&D, and new opportunities become profitable opportunities as a result of successful marketing. Future research on the R&D/marketing interface might consider from either a theoretical perspective or an empirical perspective, or both, how to characterize the nature of R&D investments and activities and marketing investments and strategies in terms of elements of uncertainty. It might be, and this is conjecture on our part, that whether R&D or marketing dominates within a firm at a point in time is a function of how the entrepreneur perceives the uncertainty associated with each activity.

Additional research is certainly warranted on the relative importance of firms' R&D and marketing strategies, and perhaps our analyses herein will motivate that effort.

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