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ORIGINAL EMPIRICAL RESEARCH

Firm capabilities and growth: the moderating role of market conditions

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Abstract Using a contingency theory lens, this study explores the impact of multiple firm-level capabilities and their interactions on firm growth under different market conditions, using panel data from 612 U.S. public firms across 16 years in 60 industries. Specifically, this study empirically examines how three key firm capabilities (marketing, R&D, operations) interact to impact firms' revenue growth and profit growth over time, and how external boundary conditions (market munificence and competitive dynamism) influence the interactive growth effects of these capabilities. The results indicate that firms' R&D (operations) capabilities positively (negatively) influence the effects of marketing capabilities on firm growth and that such effects vary across different market conditions. This study provides insights to researchers and managers regarding how to manage and deploy resources across multiple capabilities simultaneously under different market conditions to drive firm growth.

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Introduction

Capabilities are complex bundles of skills and knowledge embedded in organizational processes that a firm performs well relative to rivals and which transform the firm's available resources into valuable outputs (Day 1994; Morgan 2012). Past research on firm capabilities has mainly focused on the impact of individual capabilities (e.g., marketing, R&D or operations) on performance over short time spans (see Krasnikov and Jayachandran 2008). However, in practice, different capabilities coexist within a firm and are often intertwined. They are also developed over long time periods and are embedded within the firm (Grewal and Slotegraaf 2007), regardless of what markets and sectors the firm operates in. Thus, investigating individual capabilities in isolation over short time frames and ignoring their interrelatedness may lead to an incomplete and potentially inaccurate understanding of firm capabilities (Krasnikov and Jayachandran 2008; Levinthal 2000). In addition, past research has mostly focused on exploring the direct performance impact of firm capabilities, neglecting the likely existence and potential importance of boundary conditions. Therefore, many researchers have called for more context-based explorations of variations in the capability–performance relationship (e.g., Eisenhardt and Martin 2000; Krasnikov and Jayachandran 2008).

In addition, growth, as one of the primary drivers of a firm's stock price, is of central importance to both investors and managers (Day et al. 2009). Although revenue and profit growth are important indicators of marketing

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effectiveness as well as vital parts of marketers' requirements to gain a "seat at the top table" (Lehmann and Winer 2009), long-term growth is an infrequently studied performance measure in marketing (Katsikeas et al. 2016).[1] We therefore have relatively little knowledge concerning the drivers of firm growth, and in particular the impact of interactions among various firm capabilities on firms' growth performance (Morgan et al. 2009).

To address these important knowledge gaps, this study uses a cross-industry sample of 612 public firms across 60 industries in the U.S. from 1993–2008 to examine two important questions. First, how do different firm capabilities (marketing, R&D, operations) interact and impact firm revenue and profit growth over an extended time? Second, how do external marketplace boundary conditions (e.g., market munificence and competitive dynamism) influence the interactive effects (i.e., complementarity versus substitution) of firm capabilities on growth?

In addressing these key questions, this study offers several contributions to the literature on firm capabilities. First, it provides the first comprehensive picture of how the three most important firm-level capabilities identified in the literature interact to drive growth, by simultaneously exploring marketing, R&D, and operations capabilities and their interactions. This is important because in practice all three capabilities coexist within firms, yet our empirical knowledge of how this coexistence may affect firm performance outcomes has been absent. From this perspective, our results show that marketing and R&D capabilities complement each other in enhancing firms' revenue and profit growth, whereas operations capabilities decrease marketing capabilities' positive impact on profit growth.

Second, this study identifies market munificence and competitive dynamism as new boundary conditions that affect capability–performance relationships. This is important because the value of firms' capabilities has been theorized as being dependent on the characteristics of the marketplace environments in which they are deployed (e.g., Morgan 2012). Empirically we show that this is true, and we identify specific marketplace characteristics that are important factors to consider when making resource deployments and capability development investment decisions, as they have a significant impact on the value of firm capability–performance relationships.

Third, using a large, representative panel of U.S. firms over an extended time period, this study provides the strongest, most comprehensive, and most generalizable evidence to date to establish the performance benefits of marketing capabilities in the presence of other key firm-level capabilities. This greatly enhances confidence in the performance-enhancing value of marketing capabilities, and it reveals an important new mechanism by which that value is created and captured—via firms' ability to grow their top and bottom line performance. As a result, the findings presented in this study provide new guidance for marketing scholars and managers concerning whether and when investments in building firm-level marketing (and other) capabilities are most likely to pay off. Table 1 summarizes the major contributions of this study, relative to representative research on firm capability interactions.

In the next section, we present the theoretical basis and conceptual model for our study. This is followed by descriptions of the research method adopted, measures of key constructs and variables, dataset assembled, and analysis approach. We then present and discuss the results of the analyses and consider their implications. Finally, we examine the study's limitations and present ideas for future research.

Conceptual framework

Both the resource-based view (RBV) and dynamic capability (DC) theories have pointed to the importance of firm capabilities as they enable firms to effectively and efficiently perform value-creating tasks, and also reside in firm processes and routines that may be difficult to observe and imitate, thereby enabling firms to enjoy sustainable competitive advantage and superior performance over time (Teece et al. 1997; Kozlenkova et al. 2014). Prior research examining individual (occasionally two) capabilities generally supports this position and shows that: (1) individual firm capabilities (e.g., marketing, R&D and operations) are generally positively associated with firms' market performance and efficiency (e.g., Day 1994; Dutta et al. 1999), and (2) marketing and R&D capabilities mainly drive market performance, while operations capability primarily drives efficiency performance (e.g., Krasnikov and Jayachandran 2008). Given these prior findings, it may be expected that marketing, R&D, and operations capabilities should all drive both revenue growth and profits growth.

However, we currently know little about the interactive effect of different capabilities. Among the few studies that have examined two-way interactions between different capabilities, some report complementary effects of different capabilities on firm performance (e.g., Dutta et al. 1999; Luo and Donthu 2006; Moorman and Slotegraaf 1999; Song et al. 2005), whereas others find substitutive effects—especially when the capabilities have opposing underlying goals (e.g., maximization versus minimization, effectiveness versus efficiency) (Grewal and Slotegraaf

[1] We tested our models on revenue and profit levels as well as growth and found a similar pattern of results. However, as the focus of this paper is on firm growth, we do not include these additional results in the paper.

Table 1 Representative research on firm capability interactions

Study	Number of capability interactions	Number of boundary conditions	Interaction type	Panel data	Findings generalizability	Performance measure
Dutta et al. (1999)	Two (marketing and R&D, R&D and operations capabilities)	None	Single: complementary	Yes	Context –specific (semi-conductor)	Secondary: Profitability (Tobin's q)
Moorman and Slotegraaf (1999)	Single (marketing and technology capabilities)	Single (external information presence)	Single: complementary	Yes	Context –specific (food)	Secondary: Level and speed of product quality increase
Song et al. (2005)	Single (marketing and technology capabilities)	Single (technology turbulence)	Single: complementary	No	Yes (466 firms from 7 industries)	Primary: Profit, sales and ROI
Luo and Donthu (2006)	None (marketing communication capability and R&D resources)	Single (competitive intensity)	Single: complementary	Yes	Context –specific (89 firms)	Secondary: ROA, Tobin's Q and stock return
Grewal and Slotegraaf (2007)	Single (store management capability and merchandize management capability)	None	Single: substitution	No	Context –specific (retail)	Primary: Store and merchandise management performance
King et al. (2008)	None (acquirer marketing resources and target firm R&D resources)	None	Single: complementary	No	Context –specific (high-tech)	Secondary: Abnormal return
Ramaswami et al. (2009)	None (interactions among new product development performance, supply-chain management performance and customer management performance)	Two (size and age)	Multiple: complementary and substitution	No	Context –specific (88 firms)	Primary: Financial performance Secondary: Growth in revenue, profit and market value, and price-to-book
Krush et al. (2015)	Single (inter-organizational and intra-organizational dispersed marketing capabilities)	None	Single: complementary	No	Yes (152 firms from 4 industries)	Primary: Marketing's influence and business unit performance
This study	Three (marketing and R&D, marketing and operations, and R&D and operations capabilities)	Two (munificence and competitive dynamism)	Multiple: complementary and substitution	Yes	Yes (612 firms from 60 industries across 16 years)	Secondary: Revenue and profit growth

2007). As a result, researchers have called for more investigation into the interactive effects of different capabilities (e.g., Kozlenkova et al. 2014; Krasnikov and Jayachandran 2008; Newbert 2007).

This study focuses on the interactions among firms' marketing, R&D, and operations capabilities, because these are the core functional capabilities that contribute the most to firms' ability to deliver value to customers and thereby create sustainable competitive advantage (Krasnikov and Jayachandran 2008). *Marketing capability* concerns a firm's ability to use available resources to perform marketing tasks in ways that achieve desired outcomes better than rivals do (Morgan et al. 2012). *R&D capability* is a firm's ability to use its available resources to create useful technological knowledge for product and process innovations better than rivals can (Dutta et al. 1999). *Operations capability* is a firm's ability to use its available resources to efficiently deliver products or services of a required quality better than rivals do (Krasnikov and Jayachandran 2008).

Complementarity versus substitution effects in firm capabilities interactions

Our main research question—whether these three key firm capabilities are complements or substitutes in driving firm growth under different market conditions—is empirical because prior research has found evidence in support of both alternatives (see Table 1 for a review), and both complementarity and substitution have their supporting theories. For example, theoretically, both the RBV and DC theories suggest that different firm capabilities may be complementary assets (i.e., the presence of one capability enhances the returns of another), as their synergistic interactions can increase a firm's effectiveness and/or efficiency in deploying resources (Teece et al. 1997; Kozlenkova et al. 2014). In addition such capability synergies are due to asset interconnectedness and create greater causal ambiguity and thus deliver complementary rents that are difficult for rivals to imitate (Helfat et al. 2007). Empirically, both Dutta et al. (1999) and Moorman and Slotegraaf (1999) have found complementary effects between marketing and R&D/technology capabilities in single industry samples.

However, theoretically, it is also possible that these capabilities could attenuate one another's effectiveness and/or efficiency, because firm resource constraints and capability goal conflicts may create inter-capability tradeoffs and inefficiency (King et al. 2008). For example, in a study of retailers, Grewal and Slotegraaf (2007) found that developing multiple capabilities could be counterproductive when these capabilities have opposing objectives (e.g., maximization versus minimization, effectiveness versus efficiency).

From this perspective, marketing, R&D and operations capabilities represent different functional area–related capabilities, each with its own objectives and priorities. For example, marketing is generally tasked with goals related to demand creation and satisfying customers, while R&D is rewarded for creating new products and processes, and operations is charged with the efficient use of resources, cost minimization, and meeting objective quality standards. Thus, marketing generally seeks a wide mix of products to more closely match customer needs and enough inventory to enable rapid product delivery to satisfy every customer, R&D wants to develop a continuous stream of break-through (patentable), revolutionary new products, whereas operations typically prefers just-in-time production and delivery systems that minimize inventory, as well as narrower product lines with static product design specifications, to gain economies of scale and minimize changeover problems. However, few studies have investigated the interactive effects among the three capabilities simultaneously.

Therefore, we examine the interactive effects and propose that, in general, marketing and R&D capabilities should complement each other, as they both focus more on effectiveness (building stronger brands/customer relationships and creating better and more innovative products) than efficiency (minimizing the costs involved in doing so) (Dutta et al. 1999; Kozlenkova et al. 2014). We also propose that both marketing and R&D may have substitutive effects with operations, which has contradictory goals focusing more on cost minimization and efficiency (with an acceptable quality level) than on effectiveness (Piercy 2007; Ramaswami et al. 2009).

The moderating role of market conditions

Contingency theory posits that the environment in which a firm operates is important in determining the returns to a firm's resource and capability investments (Ruekert et al. 1985; Song et al. 2005), because different market conditions imply different importance of and value impact of capabilities (Meyer et al. 1993; Levinthal 2000; Penrose 1959). As a result, both marketing and economics scholars have suggested that capabilities should have greater value when deployed in ways that are consistent with the external environment (Moorman and Slotegraaf 1999; Penrose 1959). DC theory also posits that the ability to acquire, integrate, and deploy resources and capabilities in ways that match the marketplace conditions is the most significant and enduring source of competitive advantage (Eisenhardt and Martin 2000; Teece et al. 1997).

A number of other theories across disciplines likewise support the importance of a firm's environment in affecting the returns to investments in different capabilities.

Managerial cognition scholars suggest that cognition about the applicability of existing capabilities to new environments affects growth (Taylor and Helfat 2009; Danneels 2011). Economics and finance theories also contend that firms may make investments in different combinations of firm capabilities as their "options" to respond to current market conditions and future threats and opportunities (Dixit and Pindyck 1994; Tirole 1988). Other theorists suggest that firms should deploy their capabilities to exploit current or emerging environmental trends to find the best fit between a firm and its environmental conditions (Porter 1985). The literature therefore suggests that a fundamental problem facing managers is how to best deploy the range of different capabilities to best fit the current external conditions the firm faces and to deal with future threats and opportunities (Morgan 2012).

Thus, whether marketing, R&D, and operations capabilities are more complementary versus substitutes could be affected by market conditions, which can affect the interactive effects of capabilities through changing (1) the extent of their goal congruence (similar vs. pulling in different directions) and/or (2) the firm's resource constraints (more resources allocated to one capability diminish those available for another).

Here, we focus on market munificence and competitive dynamism as key marketplace conditions that affect a firm's capability–growth relationship, because both environmental characteristics have been shown to have important effects on firm conduct and growth (Penrose 1959). Munificence refers to the abundance of resources and opportunities in the market that can support sustained growth (Dess and Beard 1984). Competitive dynamism refers to changes in the heterogeneity and concentration of competitors (Aldrich 1979) and reflects variation in the number of firms in an industry and the disparities in the market share of these firms (Porter 1980). Both munificence and competitive dynamism are linked with marketplace uncertainty, characterizing markets where managers may face the greatest challenges in making resource allocation and capability development investment decisions and thus need the most guidance. By examining how the different capabilities interact with one another under such conditions, we seek to gain a better understanding of how firms should invest in and manage multiple capabilities to facilitate growth in uncertain markets.

However, we do not develop formal hypotheses for the effects of the interactions among the three firm capabilities and two market conditions because existing theory either points in different (equally plausible) directions or is insufficiently clear with respect to how specific marketplace characteristics impact the value of coexisting firm capabilities. Thus we treat these effects as empirical issues.

Research methodology

Data

We drew an initial random sample of 1000 public firms for the years 1993 through 2008 from the COMPUSTAT Database, and we collected the financial and operating information needed to compute firm-level revenue and profit growth metrics, along with several firm- and industry-specific control variables. Additionally, we collected patent and trademark data from the U.S. Patent and Trademark Office (USPTO) Database, which we used to calibrate and estimate firm-level marketing, R&D, and operations capabilities.

After merging data from various sources, and removing observations with missing data and firms with fewer than four consecutive years of observations, our final sample contains 612 firms over 16 years (1993–2008), for a total of 8049 firm-year observations.[2] We lose one additional year of data for these 612 firms due to the use of first-differencing in our estimation procedure, resulting in a total of 7437 firm-year observations. In order to estimate these firms' future growth performance, we augmented our dataset by including financial information for the years 2009–2011. Because these were future observations of our dependent variables, they did not impact sample size. The 612 firms in our sample represent 60 Standard Industrial Classification (SIC) two-digit industries (165 SIC three-digit) (see Appendix 1). The average firm in our sample has $8 billion in assets.

Measures

Firm capabilities Following prior research, *marketing capability* was measured using a stochastic frontier estimation (SFE) input–output approach in which the resource inputs were a firm's current and previous year SG&A and advertising investments and the number of trademarks owned, with the firm's sales revenue as the output (e.g., Bahadir et al. 2008; Narasimhan et al. 2006). Similarly, we followed Dutta et al. (1999, 2005) to operationalize *R&D capability*, calibrated as an input–output equation using the number of patents as the output and a set of R&D-related resources (e.g., R&D expenditures, R&D and patent stock in the previous year) as the inputs. Finally, *operations capability* was measured using costs of goods sold (a proxy for costs of production) as the output, and cost of labor and capital (total interest and

[2] Such reductions in the number of observations are common when several secondary sources are merged. However, excluding these 388 firms due to missing data, etc. does not affect the generalizability of our sample. A two-sample mean difference t-test shows that the missing firms are not statistically different from the remaining sample in terms of total assets, number of employees, firm age, ROA, and sales volume. Moreover, a two-stage Heckman sample selection model further confirms that there is no selection bias in our sample due to missing data.

Table 2 Descriptive statistics

Variables	Mean	Std. Dev.	Std. Err.	Min.	Median	Max.
Firm capabilities and strategy						
Marketing capabilities	54.725	16.167	.185	1.000	55.144	100.00
R&D capabilities	86.323	19.975	.229	1.000	97.779	100.00
Operations capabilities	58.504	14.924	.167	1.000	60.185	100.00
Firm performance						
Revenue growth	.117	.219	.002	−.731	.082	5.261
Profit growth	.123	1.986	.023	−39.644	.088	157.844
Controls						
Return on assets (ROA)	4.093%	18.373%	.206%	−584.485%	5.513%	132.775%
Firm size (Total assets)	7966.581	43,037.572	464.275	7.547	1055.056	1,020,934
Number of segments	2.832	2.353	.026	1.000	2.000	23.000
Strategic emphasis	.028	.431	.005	−5.241	.000	9.220
Moderators						
Munificence	6.154%	6.950%	.096%	−23.702%	5.329%	97.795%
Competitive dynamism	−.012	.097	.001	−.819	−.016	1.607

dividends paid) as inputs[3] in the input–output equation (e.g., Narasimhan et al. 2006).

The SFE method estimates an inefficiency score on the basis of how well each firm transforms its available resource inputs into the relevant desirable performance output relative to the best achievable in the primary industry in which they operate. Specifically, firm capabilities were estimated based on general least-squares random-effects and stochastic frontier models, following Kumbhakar et al. (2015). This method allows for the calibration of separate firm-specific time-invariant and firm-specific time-variant components of a firm's capability. Full details on model specifications and estimation are summarized in Appendix 2.

Market conditions Following Keats and Hitt (1988), we measured *market munificence* as the 5-year average industry growth in net sales. To calculate *competitive dynamism*, we used the 5-year change in Hirschmann-Herfindahl Index (HHI) (Grossack 1965; Keats and Hitt 1988).

Firm growth Since our focus is on predicting future growth performance, we used *future revenue growth* and *future profit growth* as firm performance metrics. By using forward performance measures, we also avoid simultaneity and reverse causality concerns. Specifically, we used data on future annual sales (*COMPUSTAT* item SALE) and future annual gross profit (*COMPUSTAT* items SALE- COGS)[4] and calculated future annual revenue growth as $(Sales_{(t+1)} - Sales_{(t)})/(Sales_{(t)})$ and future profit growth as $(Profit_{(t+1)} - Profit_{(t)})/(Profit_{(t)})$. We used future annual revenue and profit growth rates for time periods (t+1), (t+2), and (t+3) to estimate 3-year averages for both future revenue and profit growth.

Control variables We included a number of firm- and industry-specific covariates to control for other factors that are commonly known to also impact firm growth. We controlled for each firm's strategic emphasis (*(advertising expenditures-R&D expenditures)/total assets*) to account for heterogeneity in firms' strategies (Mizik and Jacobson 2003). Likewise, we controlled for return on assets (ROA), firm size (*dollar value of total assets*) and the number of business segments served (*from COMPUSTAT business segment database*) to control for possible economies of scale and scope.[5]

Descriptive statistics and correlations for each of the variables in our data set are summarized in Tables 2 and 3.

Model formulation

Preliminary tests confirmed that the panel data used to empirically examine our research questions introduced several econometric estimation concerns such as heteroskedasticity, serial correlation, unobserved firm-specific heterogeneity,

[3] We used labor costs and capital costs where both data were available; where labor costs were not available, we used capital costs only. The correlations between the measures including/not including labor costs is 0.91.

[4] COGS stands for costs of goods sold. Our findings are robust to alternative profit metric specifications, including versions based on income (*COMPUSTAT* items NI or IB), earnings (*COMPUSTAT* items EBIT or EBITDA), and operating income (*COMPUSTAT* item OIBDP).

[5] In addition to the multiple firm and industry controls included, we also controlled for competitors' marketing, R&D, and operations capabilities directly, in alternative model specifications. Substantively, the findings remained unchanged. For the purpose of parsimony, we opted to not include these additional estimates with the findings reported.

and endogeneity. This suggests that an error-component model is appropriate (Baltagi 2001). Seeking to address these concerns, we propose the following model specifications (Baltagi 2001):

$$\begin{aligned} RG_{i(t+1)} = {} & \beta_0 + \beta_1.RG_{i(t)} + \beta_2.MC_{i(t)} + \beta_3.RDC_{i(t)} + \beta_4.OC_{i(t)} + \beta_5.ENV_{i(t)} + \\ & \beta_6.\left(MC_{i(t)} \times RDC_{i(t)}\right) + \beta_7.\left(MC_{i(t)} \times OC_{i(t)}\right) + \beta_8.\left(RDC_{i(t)} \times OC_{i(t)}\right) + \\ & \beta_9.\left(MC_{i(t)} \times ENV_{i(t)}\right) + \beta_{10}.\left(RDC_{i(t)} \times ENV_{i(t)}\right) + \beta_{11}.\left(OC_{i(t)} \times ENV_{i(t)}\right) + \\ & \beta_{12}.\left(MC_{i(t)} \times RDC_{i(t)} \times ENV_{i(t)}\right) + \beta_{13}.\left(MC_{i(t)} \times OC_{i(t)} \times ENV_{i(t)}\right) + \\ & \beta_{14}.\left(RDC_{i(t)} \times OC_{i(t)} \times ENV_{i(t)}\right) + \beta_{15}ROA_{i(t)} + \beta_{16}.FirmSize_{i(t)} + \beta_{17}.Segments_{i(t)} + \\ & \beta_{18}.Strategic\ \ Emphasis_{i(t)} + \eta_i + \varepsilon_{i(t+1)} \end{aligned} \tag{1A}$$

$$\begin{aligned} PG_{i(t+1)} = {} & \beta_{r0} + \beta_{r1}.PG_{i(t)} + \beta_{r2}.MC_{i(t)} + \beta_{r3}.RDC_{i(t)} + \beta_{r4}.OC_{i(t)} + \beta_{r5}.ENV_{i(t)} + \\ & \beta_{r6}.\left(MC_{i(t)} \times RDC_{i(t)}\right) + \beta_{r7}.\left(MC_{i(t)} \times OC_{i(t)}\right) + \beta_{r8}.\left(RDC_{i(t)} \times OC_{i(t)}\right) + \\ & \beta_{r9}.\left(MC_{i(t)} \times ENV_{i(t)}\right) + \beta_{r10}.\left(RDC_{i(t)} \times ENV_{i(t)}\right) + \beta_{r11}.\left(OC_{i(t)} \times ENV_{i(t)}\right) + \\ & \beta_{r12}.\left(MC_{i(t)} \times RDC_{i(t)} \times ENV_{i(t)}\right) + \beta_{r13}.\left(MC_{i(t)} \times OC_{i(t)} \times ENV_{i(t)}\right) + \\ & \beta_{r14}.\left(RDC_{i(t)} \times OC_{i(t)} \times ENV_{i(t)}\right) + \beta_{r15}.FirmSize_{i(t)} + \beta_{r16}.Segments_{i(t)} + \\ & \beta_{r17}.Strategic\ \ Emphasis_{i(t\ )} + \varphi_i + \zeta_{i(t+1)} \end{aligned} \tag{1B}$$

where subscript i identifies each firm and t represents the year, $RG_{i(t+1)}$ and $PG_{i(t+1)}$ are the future 3-year average revenue and profit growth, and $RG_{i(t)}$ and $PG_{i(t)}$ are one period lags of $RG_{i(t+1)}$ and $PG_{i(t+1)}$. We include the one-period lagged dependent variable as it accounts for inertia, persistence, and various initial conditions and helps alleviate serial correlation (Wooldridge 2006). $MC_{i(t)}$ represents marketing capabilities, $RDC_{i(t)}$ represents R&D capabilities, and $OC_{i(t)}$ represents operations capabilities. $ENV_{i(t)}$ represents environment conditions such as market munificence (*MU*) or competitive dynamism (*COM*). Using the *current* firm capabilities to predict *future* firm growth also directly addresses endogeneity concerns and rules out reverse causality. *Firm Size*, *Segments*, and *Strategic Emphasis* represent the control variables described earlier, while η_i and φ_i are time-invariant unobservable factors; $\varepsilon_{i(t+1)}$ and $\zeta_{i(t+1)}$ are i.i.d errors. We include a time-invariant error component (η_i and φ_i) to control for industry fixed-effects and other unobserved firm-specific heterogeneity, and to lessen remaining heteroskedasticity concerns.

Table 3 Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Marketing capabilities	1.000										
2. R&D capabilities	.360	1.000									
3. Operations capabilities	.528	.224	1.000								
4. Revenue growth	.122	.049	.178	1.000							
5. Profit growth	.006	−.011	.013	.212	1.000						
6. ROA	−.054	.008	−.064	−.019	−.020	1.000					
7. Firm size	−.177	−.139	−.421	−.032	−.010	−.003	1.000				
8. Segments	−.159	−.127	−.332	−.106	−.010	−.006	.166	1.000			
9. Strategic emphasis	.033	.079	.101	.016	−.010	.017	−.014	−.012	1.000		
10. Munificence	.001	.168	−.083	.002	.008	.075	.041	.020	−.034	1.000	
11. Competitive dynamism	−.020	.091	−.051	.007	.004	.029	.002	.036	−.044	.500	1.00

Correlations with an absolute value greater than .021 are significant at $p < .05$ level

Next, we constructed first-differences model specifications equivalent to those detailed in Eqs. 1A and 1B (i.e., each variable is defined as the difference, or change, between two consecutive time-period observations) to remove the unobserved fixed effects (η_i and φ_i) and alleviate any residual autocorrelation (Arellano and Bond 1991; Mizik and Jacobson 2004).

Nonetheless, a few additional possible sources of endogeneity remain, such as (1) correlated lagged dependent variables and the error terms in the first-differences models and (2) firms' investments directed toward firm capabilities and growth, which may create endogeneity by simultaneously influencing firm capabilities and sales and profit growth. We addressed these potential concerns by jointly estimating the proposed level-level and changes-changes model specifications, using the dynamic system General Method of Moments (GMM) method. This yields unbiased and efficient estimates and empirically addresses all potential sources of endogeneity listed (Arellano and Bover 1995; Blundell and Bond 1998). Specifically, we used the first two-period (or earlier) lagged values of the endogenous variables, industry and year dummies, as instruments for their first differences (Mizik and Jacobson 2004; Tuli et al. 2010). These instruments were then used to generate unbiased and efficient parameter estimates (e.g., Arellano and Bond 1991). We used the AR(II) test for autocorrelation of the residuals to confirm that the second-order differenced error terms are not correlated, indicating that the transformed residuals are not serially correlated (Arellano and Bond 1991; Roodman 2009).

Results and discussion

We present the empirical results for market munificence and competitive dynamism in Tables 4 and 5, respectively. Consistent with other papers using system GMM (e.g., Angulo-Ruiz et al. 2014; Tuli et al. 2010), we report the changes-changes estimation results that are most robust to econometric concerns in analyzing panel data.[6] Consistent with Aiken and West (1991), we mean-centered all predictor variables before creating the interaction terms. Variance inflation statistics suggest that there are no multicolinearity issues in our models. In Tables 4 and 5, Model 1 shows the two-way interaction effects among the three firm capabilities on revenue and profit growth, and Model 2 adds three-way interactions with the environmental variables.

Results in Model 1 show a complementary interaction effect between marketing and R&D capabilities: R&D capability further reinforces the positive effects of marketing capability on future revenue growth (1.066, $p < .01$) and profit growth (.736, $p < .05$). However, marketing and operations capabilities have a negative interactive effect on profit growth (−.509, $p < .01$), but this is not significant in its effect on revenue growth (−.101, $p > .1$). This suggests substitution interaction effects between marketing and operations; that is, the positive effect of marketing capability on firms' future profit growth is weakened when operations capability is high. Moreover, R&D and operations capabilities have negative but non-significant interaction effects on both firms' revenue growth (−.387, $p > .1$) and profit growth (−.260, $p > .1$). Overall, these results indicate that marketing and R&D capabilities complement each other in enhancing revenue and profit growth, whereas operations capability decreases marketing capability's positive effect on profit growth.

These two-way capability interaction results generally support the theoretical notion discussed in our conceptual model that goal congruence between different functionally-related capabilities may be a source of positive asset interconnectedness that produces synergistic benefits. Linking these benefits with growth performance over a 3-year future period in our data provides some support for the sustainability of such capability synergies that are theoretically due to asset interconnectedness and causal ambiguity. Conversely, our results also provide support for the idea that conflicting capability goals such as those between operations, which is focused on efficiency, and marketing, which is focused on effectively generating demand, can result in "negative synergies" that significantly impact firm performance.

Regarding the moderating effects of market munificence, the three-way interaction results presented in Model 2 in Table 4 show that five out of the six three-way interactions of firm capabilities and market munificence are significant. This provides clear evidence that marketplace munificence is a significant boundary condition affecting the capabilities–performance relationship. First, regarding MC × RDC × MU, we find that in more munificent markets, the positive complementary effects between marketing and R&D capabilities become weaker for both firms' revenue growth (−.367, $p < .01$) and profit growth (−.274, $p < .1$). Thus, while in general, we find that the growth benefits of having strong marketing capability increases as the level of R&D capability increases, this complementary effect is stronger in less munificent markets than in highly munificent markets.

This suggests that firms with higher marketing capability appear to be able to more synergistically utilize strong R&D capability to drive growth in slower-growing markets. One explanation could be that that while being simultaneously able to create and maintain high levels of marketing and R&D capabilities is more difficult for rivals to imitate, this benefit is greatest in slow-growing environments where fewer rivals may be willing to make the investments necessary for such imitation. In addition, firms that are able to most efficiently translate available resources into desired marketing and R&D outputs (i.e., those with the strongest marketing and R&D capabilities) should also be at a greater cost advantage in

[6] The estimates we report are also consistent with those observed in less robust "levels-levels" models.

Table 4 Effect of environmental munificence on firm capabilities–growth relationship

	ΔRevenue growth $_{(t+1\sim3)}$		ΔProfit growth $_{(t+1\sim3)}$	
	Model 1: two-way interaction	Model 2: full model	Model 1: two-way interaction	Model 2: full model
Main effects				
ΔMarketing capability$_{(t)}$ (MC)	−.615	−.475	−.078	−.578
ΔR&D capability$_{(t)}$ (RDC)	.385**	.405	.332	.856**
ΔOperations capability$_{(t)}$ (OC)	.588***	.380**	.247	.736
ΔMunificence$_{(t)}$ (MU)		.118*		.105
Moderating effects				
$\Delta(MC_{(t)} \times RDC_{(t)})$	1.066***	.529*	.736**	.657*
$\Delta(MC_{(t)} \times OC_{(t)})$	−.101	.175	−.509***	−.594***
$\Delta(RDC_{(t)} \times OC_{(t)})$	−.387	−.183	−.260	−.075
$\Delta(MC_{(t)} \times MU_{(t)})$		.052		.210*
$\Delta(RDC_{(t)} \times MU_{(t)})$		−.016		−.007
$\Delta(OC_{(t)} \times MU_{(t)})$		−.065		−.012
Three-way interactions				
$\Delta(MC_{(t)} \times RDC_{(t)} \times MU_{(t)})$		−.367***		−.274*
$\Delta(MC_{(t)} \times OC_{(t)} \times MU_{(t)})$		−.136**		.065
$\Delta(RDC_{(t)} \times OC_{(t)} \times MU_{(t)})$		.338***		.309*
Controls				
ΔRevenue growth$_{(t)}$	.372***	.285***		
ΔProfit growth$_{(t)}$			.097	.035
ΔROA$_{(t)}$	−.072**	−.107**		
ΔFirm size$_{(t)}$	.079*	.033	.090	−.004
ΔNumber of segments$_{(t)}$	−.229***	−.118	−.012	.092
ΔStrategic emphasis$_{(t)}$	.209	.366	.104	.570**
Specification tests				
Number of observations	7437	7437	7437	7437
Wald χ^2(d.f.)	913.46$_{(11)}$***	559.47$_{(18)}$***	407.25$_{(10)}$***	128.39$_{(17)}$***
AR(II) test$_{(z\text{-score})}$	.70	.12	1.00	1.30

*** significant at $p < .01$; ** significant at $p < .05$; * significant at $p < .1$

slow-growing environments where price competition is generally greater, and lower prices may be needed to drive demand.

Second, the three-way interaction of MC × OC × MU is negative and significant for revenue growth (−.136, $p < .05$), but not significant for profit growth (.065, $p > .1$). This suggests that the non-significant effect of marketing and operations capability interactions on firms' revenue growth in Model 1 become significantly negative in more munificent environments. At one level this result may appear counter-intuitive, since munificent markets should offer greater opportunities and ultimately more resources to firms serving them. However, there are two possible explanations for such a finding. First, growing a firm's revenue is often expensive and generally consumes firm resources in the short and medium term. This is consistent with the negative correlations often observed between firms' revenue and profit growth (e.g., Morgan et al. 2009) and may explain why we do not find a significant benefit of munificence on the profit growth outcomes of interactions between marketing and operations capabilities. Second, price competition is likely to be greater in slow growing markets with scant opportunities. In such conditions operations' ability to lower costs is more likely to be better aligned with marketing's need to offer lower prices than rivals in order to sell a greater number of products. In addition, when external resources are scarce, operations' ability to enhance efficiency may be more valuable in freeing up resources to fund sales growth efforts. Therefore, firms with higher operations capability are likely to be better able to leverage benefits from superior marketing capability to achieve higher growth in low munificent markets.

Finally, Model 2 in Table 4 shows that the three-way interactions of RDC × OC × MU are positive and significant for both revenue and profit growth (.338, $p < .01$ and .309, $p < .01$ respectively). This indicates that the interaction effects between R&D and operations capabilities on firm growth are stronger and positive when market munificence is high. This may be due to the greater resources freed up by the efficiency

Table 5 Effect of competitive dynamism on firm capabilities–growth relationship

	ΔRevenue growth$_{(t+1\sim3)}$		ΔProfit growth $_{(t+1\sim3)}$	
	Model 1: two-way interaction	Model 2: full model	Model 1: two-way interaction	Model 2: full model
Main effects				
ΔMarketing capability$_{(t)}$ (MC)	−.615	−.584	−.078	−.327
ΔR&D capability$_{(t)}$ (RDC)	.385**	.391	.332	−1.024***
ΔOperations capability$_{(t)}$ (OC)	.588***	.485**	.247	1.850***
ΔCompetitive dynamism$_{(t)}$ (COM)		.350***		.044
Moderating effects				
Δ(MC$_{(t)}$ × RDC$_{(t)}$)	1.066***	.735*	.736**	.802**
Δ(MC$_{(t)}$ × OC$_{(t)}$)	−.101	−.149	−.509***	−.715***
Δ(RDC$_{(t)}$ × OC$_{(t)}$)	−.387	−.112	−.260	.065
Δ(MC$_{(t)}$ × COM$_{(t)}$)		−.089		.136**
Δ(RDC$_{(t)}$ × COM$_{(t)}$)		−.075		−.024
Δ(OC$_{(t)}$ × COM$_{(t)}$)		.034		−.093
Three-way interactions				
Δ(MC$_{(t)}$ × RDC$_{(t)}$ × COM$_{(t)}$)		−.262**		−.172**
Δ(MC$_{(t)}$ × OC$_{(t}$ × COM$_{(t))}$)		−.161**		−.062
Δ(RDC$_{(t)}$ × OC$_{(t)}$ × COM$_{(t)}$)		.115		.223**
Controls				
ΔRevenue growth$_{(t)}$	.372***	.255***		
ΔProfit growth$_{(t)}$			.097	.077
ΔROA$_{(t)}$	−.072**	−.119**		
ΔFirm size$_{(t)}$	.079*	.106**	.090	−.235**
ΔNumber of segments$_{(t)}$	−.229***	−.284**	−.012	.197
ΔStrategic emphasis$_{(t)}$	.209	.323*	.104	2.106***
Specification tests				
Number of observations	7437	7437	7437	7437
Wald χ^2(d.f.)	913.46$_{(11)}$***	483.29$_{(18)}$***	407.25$_{(10)}$***	69.36$_{(17)}$***
AR(II) test$_{(z\text{-score})}$	.70	−.22	1.00	−.88

*** significant at $p < .01$; ** significant at $p < .05$; * significant at $p < .1$

benefits of strong operations capabilities being more valuable in funding R&D efforts in rapidly growing environments where firms often seek to create product and service innovation to allow them to capture greater volume and share in such attractive marketplaces.

Regarding the moderating effects of competitive dynamism, the three-way interaction results presented in Model 2 in Table 5 show that four out of the six three-way interactions of firm capabilities and competitive dynamism are significant. In line with our theorizing, this provides evidence of competitive dynamism being an important boundary condition affecting the capability-performance relationship. First, regarding MC × RDC × COM, we find a negative three-way interaction for both revenue growth (−.262, $p < .05$) and profit growth (−.172, $p < .05$). Thus, the baseline positive interaction effects of marketing and R&D capabilities on both sales and profit growth (Model 1) become negative and significant in more competitively dynamic markets. This indicates that while firms with strong marketing capabilities may be better able to leverage R&D investments, this is more difficult when competition is highly dynamic and therefore more difficult to predict. Indeed, these results show that absent such predictive ability, these generally synergistic capabilities can become substitutes. Interestingly, this suggests that the ability to predict competitive moves and responses may be a key part of the growth value associated with firms' marketing capabilities.

Second, the three-way interaction of MC × OC × COM is negative and significant for revenue growth (−.161, $p < .05$), but not significant for profit growth (−.062, $p > .1$). Thus, the directionally negative (but insignificant) interaction between marketing and operations capability on firms' revenue growth strengthens and becomes significantly negative in more competitively dynamic markets. Competitive dynamism creates greater difficulties for marketers in predicting rival moves and competitive responses, which makes it more difficult to accurately plan future product and service requirements needed to match or exceed rivals' offerings. Firms with strong operations capabilities built on most efficiently delivering products and

services of a given quality value the standardization benefits of less customized offerings and fewer product and service changes. This may offer less flexibility in allowing a firm to quickly adjust its product and service offerings. The need for and revenue growth impact of such product and service changes is likely to be greatest in more competitively dynamic markets.

Finally, for Model 2 in Table 5, the three-way interaction of RDC × OC × COM is positive and significant for profit growth (.223, $p < .05$), but not significant for revenue growth (.115, $p > .1$). This means that the generally directionally negative interactive effects of R&D and operations capabilities on profit growth are reversed in more competitively dynamic markets. This may be a result of the benefit of being able to both create and efficiently build innovative new products and services, providing a proactive means to combat the greater difficulty of predicting future competitive moves and reactions in more competitively dynamic markets. For example, such capabilities may enable a pioneering first-mover business strategy in such markets, by which the firm may reduce the competitive uncertainty in its marketplace by acting proactively, forcing rivals to respond to its marketplace moves. Alternatively, greater cost certainty and the ability to develop and build innovative products in response to rapidly changing competitive circumstances may simply be rarer and more valuable than in markets where competitor moves are easier to predict (and therefore accurately plan for).

Post hoc analyses

The findings reported in Tables 4 and 5 offer unequivocal evidence about the complex relationship between the firm's marketing, R&D, and operational capabilities and its future financial performance. However, from a manager's perspective, understanding how available resources should be allocated to develop or improve specific capabilities, under different competitive contexts, is a much more relevant question to address. Seeking to gain additional managerial insights on efficient capability investments, we estimated the incremental percentage of revenues and profit growth (i.e., relative to the average revenue and profit growth), under a variety of different competitive contexts. These post-hoc analyses are visually summarized in Fig. 1,[7] which we use to identify and discuss efficient combinations of firm capabilities investments under different competitive scenarios.

Low munificence–high competitive dynamism In low munificence–high competitive dynamism markets, two capability combinations yielded the greatest revenue and profit growth in our sample: (1) high marketing capability combined with low R&D and low operations capabilities and (2) a combination of high marketing capability, high R&D capability, and high operations capability. Therefore, our data suggest that superior marketing capability and aligned levels of R&D/operation capabilities (e.g., high-high, or low-low) are the key to firms' growth performance in slow-growing and more competitively dynamic markets.

High munificence–high competitive dynamism Overall, in high munificence–high competitive dynamism markets, firms that are high in all three capabilities (marketing, R&D, and operations) grow fastest in both revenue and profits. We also find that firms low in R&D and operations capabilities, but high in marketing capability, yield the second best revenue and profit growth in such markets. Therefore, again, we find that strong marketing and aligned levels of R&D/operation capabilities (e.g., high-high, or low-low) are important for firm growth in fast-growing and more competitively dynamic markets.

Low munificence–low competitive dynamism Similarly, firms that enjoy the fastest revenue and profit growth in low munificence–low competitive dynamism markets are firms superior in all three core capabilities. However, firms with high marketing and operations capabilities, but low R&D capabilities, have the second highest revenue and profit growth in such markets. Therefore, both strong marketing and strong operations (regardless of R&D level) are required to enable the best growth performance in slow-growing and less competitively dynamic markets.

High munificence–low competitive dynamism Lastly, firms with high marketing capabilities but low R&D and operations capabilities experience the highest revenue and profit growth in high munificence–low competitive dynamism markets. In addition, firms that do well in marketing and R&D activities relative to rivals, but do not perform well in their operations capability, have the second best revenue and profit growth in such markets. Therefore, keeping a combination of a higher level of marketing capability and lower operations capability (regardless of R&D level) is desirable to enable growth success in fast-growing and less competitively dynamic markets.

Implications

This research represents the first comprehensive examination of the interactive effects of firm capabilities (marketing, R&D, and operations) on firm growth over time in a large, multi-industry sample. Overall, we find that marketing capabilities are generally complementary to R&D capabilities in driving firm growth, while operations capabilities lower the profit growth returns to firms' marketing capabilities. In addition, we find strong evidence that the growth outcomes of firms' capability

[7] In Fig. 1, dimmed and dashed lines represent non-significant slopes/effects.

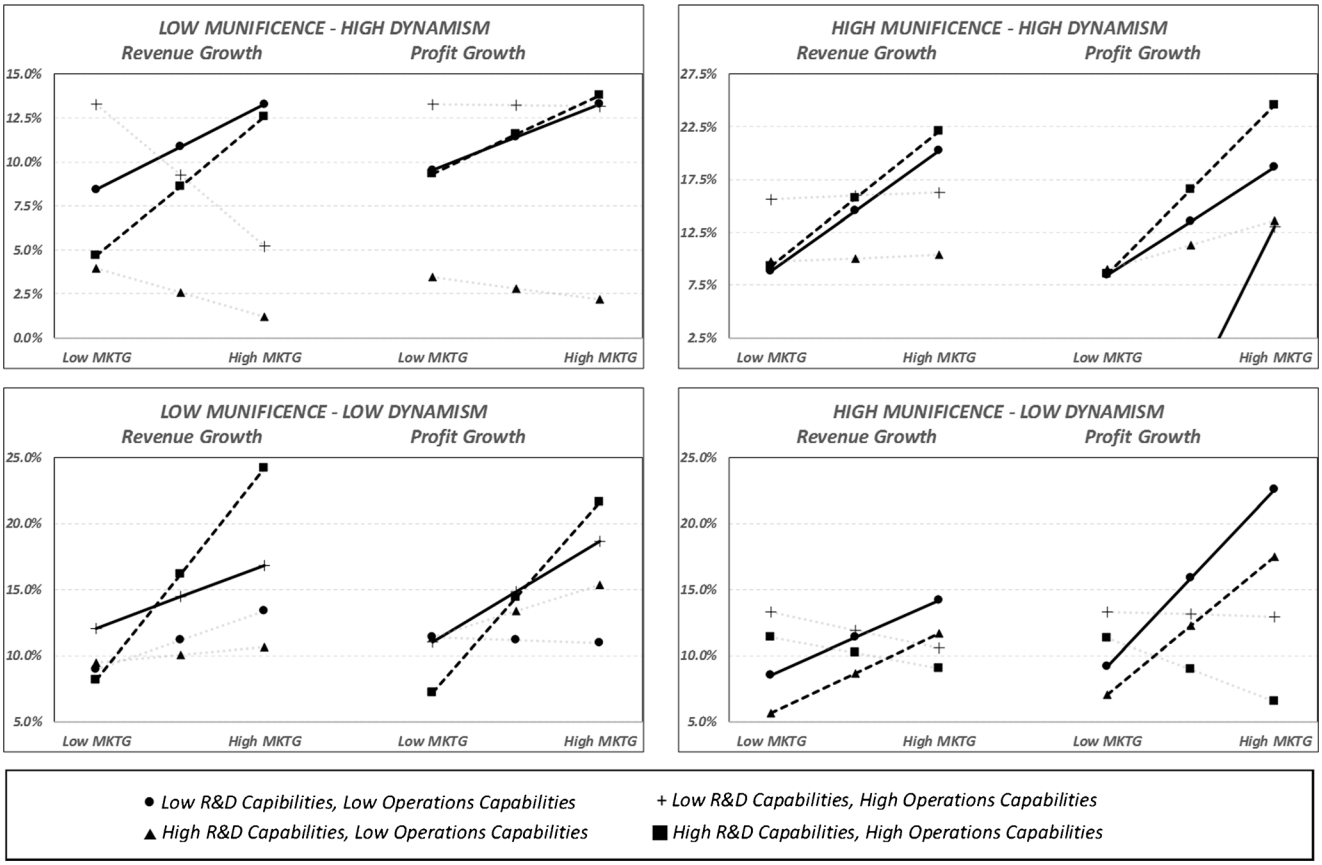

Fig. 1 Best combinations of firm capabilities under different market conditions

investments are contingent upon the munificence and competitive dynamism of the marketplace in which the firm operates.

Implications for theory

Four major implications for theory arise from our findings. First, capability research to date has mainly focused on the effects of individual capabilities on firm performance. By examining the joint effects of multiple capabilities and their interactions simultaneously, this study enriches the scant literature on interactive effects among multiple firm capabilities (Newbert 2007; Kozlenkova et al. 2014). It also provides empirical support for RBV and DC theory propositions that firms with superior *and* complementary capabilities should have more sustained competitive advantage by gaining economies of scope and creating complementary rents through these synergistic interactions (Teece et al. 1997; Kozlenkova et al. 2014).

Second, we provide the first evidence that whether capabilities are complements or substitutes and the impact this has on firms' growth depends on the market environment the firm faces. Based on two important market boundary conditions (market munificence and competitive dynamism), we provide evidence consistent with arguments that such capability complementarity versus substitution effects may be the result of resource availability tradeoffs. In addition, this research also contributes to the strategic management literature by providing strong evidence that the environment faced is important in determining the returns to a firm's capability investments and that the "fit" between capability combinations and market environment can change the value of each individual capability as well as their interactions.

Third, this study is the first to examine the organizational capabilities–firm growth linkage. In practice, growth is a key aspect of performance on which managers set goals and are assessed. Past research has identified certain specific marketing capabilities as drivers of firms' revenue and margin growth (Morgan et al. 2009). Our research enriches the scant knowledge on firm growth (Katsikeas et al. 2016) by identifying other key firm capabilities (R&D and operations) beyond marketing and their interactive joint effects (e.g., marketing–R&D interaction) as key drivers of firm growth. This is important because, in practice, organizational capabilities never exist alone. By using longitudinal data to examine the joint effects of multiple capabilities on firm growth in different market conditions, this research provides a more comprehensive—and realistic—view of how firm capabilities drive firm growth, and the market conditions under which these effects are more or less prominent.

Finally, our results provide the strongest evidence to date concerning the value of firms' marketing capabilities. Prior studies primarily either have been conducted in single

industries, which allow for greater control over industry contingent effects but limit generalizability, or have examined marketing capabilities in isolation, without observing or controlling for the impact of other capabilities that in practice exist simultaneously within firms. By looking at three capabilities simultaneously in a large sample of firms across industries and over time, our findings offer the most compelling evidence to date of the value of marketing capabilities.

Implications for managers

This research also has important implications for managers concerning the desirability of investments in building marketing capabilities and coordinating such investments in other key organizational capabilities to maximize firms' ability to grow under different market conditions. First, from a desirability perspective, this research clearly shows that managers should seek to build and maintain marketing capabilities that are superior to those of their rivals. Importantly, we find no circumstances in which having strong marketing capabilities significantly reduces firms' future growth performance. This is not the case for either R&D or operations capabilities. The clear message is that managers in firms seeking to grow need to invest in building stronger marketing capabilities.

Second, this research provides new insights into the interactive manner in which multiple capabilities can affect firm growth. Critically, for managers, this shows that it is not always optimal in terms of maximizing firms' growth performance to seek to achieve multiple strong capabilities simultaneously. Thus, to best improve business growth, managers need to be aware of these potential tradeoffs and take them into consideration when making decisions on investments in multiple capabilities.

Third, this research provides specific insights into how to deploy capabilities and their complementary rents to best fit external conditions. The post hoc analyses show that different market conditions require different combinations of firm capabilities to reach the highest revenue and profit growth. For example, superior marketing capability and aligned levels of R&D/operation capabilities (e.g., high-high, or low-low) are the key to continuous revenue and profit growth in more competitively dynamic markets regardless of market munificence. However, in slow-growing and less competitively dynamic markets, both strong marketing and strong operations capabilities (regardless of the R&D capability level) are required to enable growth. Last, a combination of a strong marketing capability and a weak operations capability (regardless of the R&D capability level) is the key to success in growth in fast-growing and less competitively dynamic markets. Therefore, this research should help managers make better investment decisions in developing the "right" capability combinations under different market environments to maximize the growth value of these capabilities.

Limitations and future research

A number of limitations in our study offer opportunities for future research. First, we focus on interactions among three key organizational capabilities (marketing, R&D, and operations) because these are core organizational activities that can result in sustained advantages (Krasnikov and Jayachandran 2008). However, we recognize that other types of capabilities (e.g., alliance management and merger and acquisition capabilities) also exist within firms and that these offer interesting possibilities for future research (Eisenhardt and Martin 2000). Future research could further explore how these capabilities interact with marketing, R&D, and operation capabilities. It may also be useful to explore other marketplace conditions and internal conditions (e.g., organizational slack, firm strategies, and governance structures) that may influence the effect of capability interactions.

Second, the capabilities studied in this research are measured at a relatively high level of abstraction due to the focus of our research questions and calibration method (input–output) used, relying on observable information from secondary data. This enabled us to examine the overall interactive impact of these three key firm-level capabilities without measuring the underlying dimensions or various components of each capability via repeated observations of the same firms in a large sample over a long period of time. However, this approach also has downsides in terms of the granularity of insights into each capability that can be gained. Future research should explore the use of more direct measures of these capabilities or use more fine-grained measures of each of these firm-level capabilities to further explore other types of specific marketing, R&D, and operations capabilities (e.g., brand management capability. product testing capability, quality management capability).

Third, while we empirically identify the best combinations of firm capabilities for firms' growth in different markets, we do not know how firms may be able to identify the need for and reconfigure their resources to create such functional capability configurations. Theoretically, this is a higher-order dynamic capability. Our research suggests that such a dynamic capability must comprise some marketplace scanning components to identify the types of characteristics in the market faced that must be accounted for in configuring firm capabilities. However, how such marketplace understanding leads firms to reconfigure capabilities to achieve better fit with the market conditions is empirically still largely unexplored, and it should be a focus of future research.

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Appendix 1

Table 6 SIC industries included in sample

SIC code	SIC industry label	SIC code	SIC industry label
01	Agriculture production – crops	45	Transportation by air
07	Agriculture services	47	Transportation services
10	Metal mining	48	Communications
12	Coal/lignite mining	49	Electric, gas & sanitary services
13	Oil and gas extraction	50	Durable goods
14	Forestry	51	Non-durable goods
15	General building contractors	52	Building materials, hardware, garden supplies and mobile home dealers
20	Food and kindred products	53	General merchandise stores
21	Tobacco manufacturing	54	Food stores
22	Textile mill products	55	Automobile dealers & gasoline service stations
23	Apparel and other textile products	56	Apparel & accessory stores
24	Lumber and wood products	57	Home furniture, furnishings and equipment stores
25	Furniture and fixtures	58	Eating & drinking places
26	Paper and allied products	59	Miscellaneous retail
27	Printing and publishing	60	Depository institutions
28	Chemicals and allied products	61	Non-depository credit institutions
29	Petroleum and coal products	62	Security & commodity brokers, dealers, exchanges & services
30	Rubber/misc. plastic products	63	Insurance carriers
31	Leather and leather products	64	Insurance agents, brokers and service
32	Stone, clay, glass and concrete prod.	67	Holding & other investment offices
33	Primary metal industries	70	Hotels, rooming houses, camps and other lodging places
34	Fabricated metal products	72	Personal services
35	Industrial and commercial machinery and computer equip	73	Business services
36	Electrical equipment and components	75	Automotive repair services & parking
37	Transportation equipment	78	Motion pictures
38	Measurement analyzing, control instrument and related products	79	Amusement and recreation services
39	Misc. manufacturing industries	80	Health services
40	Railroad transportation	82	Educational services
42	Motor freight transportation	87	Engineering, accounting, research management & related services
44	Water transportation	99	Non-classifiable establishments

Appendix 2

Stochastic frontier estimation of firm capabilities

Firm capabilities are estimated based on a general least squares random-effects model and stochastic frontier (SF) model, following Kumbhakar et al. (2015). Accordingly, firm capabilities are modeled via a persistent component, which is firm-specific time-invariant, and a residual component, which is firm- and time-specific. This approach allows us to separate firm capabilities into persistent and time-varying components (Kumbhakar et al., pp. 274–278).

The general SF function is : $\text{Output}_{it} = \alpha_0 + \alpha_1 \times input_{1it} + \alpha_2 \times input_{2it} + \ldots + \mu_i + \varepsilon_{it}$

Where μ_i is a firm-level unobserved random effect and ε_{it} is a firm and time specific error term. We further decomposed μ_i to estimate the firm-specific time-invariant persistent component and ε_{it} to estimate the firm- and time-specific component. Conceptually, both μ_i and ε_{it} are to be interpreted as inefficiency scores, capturing a firm's inefficiency in converting resources (i.e., inputs) into the output.

The firm-specific time-invariant persistent component and the firm-specific time-variant residual component are obtained based on the maximum likelihood estimates of the following equations:

$\mu_i = \vartheta_1 - \delta_i + \nu_i$

$\varepsilon_{it} = \vartheta_1 - \gamma_{it} + \omega_{it}$

The firm-specific time-invariant persistent capability is $Exp(-\delta_i)$, and the firm-specific time-variant residual capability is $Exp(-\gamma_{it})$. The overall firm capabilities are the product of persistent and residual capabilities (see Kumbhakar et al., chapter 10). This general method accommodates for several distributional assumptions on these error terms. Following Dutta et al. (1999, 2005), we assume $\mu_i \sim N(0, \sigma_\mu^2)$, $\varepsilon_{it} \sim N(\varepsilon, \sigma_\varepsilon^2)$ with $\varepsilon > 0$, $E[\mu_i \varepsilon_{it}] = 0$.

Specifically, to estimate marketing capabilities, for firm i in year t *in each industry*, we estimate:

$$ln(\text{Sales}_{it}) = \alpha_0 + \alpha_1 \cdot ln(\text{AD}_{it}) + \alpha_2 \cdot ln\left(\text{AD}_{i(t-1)}\right) + \alpha_3 \cdot ln(\text{SGA}_{it}) + \alpha_4 \cdot ln\left(\text{SGA}_{i(t-1)}\right) + \alpha_5 \cdot ln(\text{TRM}_{it}) + \alpha_6 \cdot \text{IND}_i + \mu_i + \varepsilon_{it}$$

where, μ_i and ε_{it} are as described above and used to compute marketing capabilities;

AD_{it} = advertising expenses of firm i in year t;
$\text{AD}_{i(t-1)}$ = advertising expenses of firm i in year t-1;
SGA_{it} = SG&A expenses of firm i in year t;
$\text{SGA}_{i(t-1)}$ = SG&A expenses of firm i in year t-1;
TRM_{it} = number of trademarks of firm i in year t;
IND_i = industry dummies (2-digit SIC code of firm i), and
Sales_{it} = sales revenue of firm i in year t

Similarly, to estimate R&D capabilities, for firm i in year t *in each industry*, we estimate:

$$ln(\text{PTS}_{it}) = \beta_0 + \beta_1 \cdot ln(\text{RD}_{it}) + \beta_2 \cdot ln\left(\text{RD}_{i(t-1)}\right) + \beta_3 \cdot ln\left(\text{PTS}_{i(t-1)}\right) + \beta_4 \cdot \text{IND}_i + \mu_i + \varepsilon_{it}$$

where, μ_i and ε_{it} are as described above and used to compute R&D capabilities;

PTS_{it} = number of patents of firm i in year t
RD_{it} = R&D expenses of firm i in year t
$\text{RD}_{i(t-1)}$ = R&D expenses of firm i in year t-1
$\text{PTS}_{i(t-1)}$ = patent stock of firm i in year t-1
IND_i = industry dummies (2-digit SIC code of firm i), and

Finally, to estimate operations capability, for firm i in year t *in each industry*, we estimate:

$$ln(\text{COGS}_{it}) = \gamma_0 + \gamma_1 \cdot ln(\text{XPR}_{it}) + \gamma_2 \cdot ln(\text{XCAP}_{it}) + \gamma_3 \cdot \text{IND}_i + \mu_i + \varepsilon_{it}$$

where, μ_i and ε_{it} are as described above and used to compute operations capabilities;

COGS_{it} = cost of goods of firm i in year t
XPR_{it} = labor costs of firm i in year t
XCAP_{it} = capital costs of firm i in year t, capital costs are total interest and dividends paid
IND_i = industry dummies (2-digit SIC code of firm i).

All estimated firm capabilities are rescaled as a 1–100 indexes (Bahadir et al. 2008).

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. London: Sage.

Aldrich, H. (1979). *Organizations and environments*. NJ: Prentice Hall.

Angulo-Ruiz, F., Donthu, N., Prior, D., & Rialp, J. (2014). The financial contribution of customer-oriented marketing capability. *Journal of the Academy of Marketing Science, 42*(4), 380–399.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies, 58*(2), 277–297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics, 68*(1), 29–51.

Bahadir, S. C., Bharadwaj, S. G., & Srivastava, R. K. (2008). Financial value of brands in mergers and acquisitions: is value in the eye of the beholder? *Journal of Marketing, 72*(6), 49–64.

Baltagi, B. (2001). *Econometric analysis of panel data*. Chichester: John Wiley & Sons.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics, 87*(1), 115–143.

Danneels, E. (2011). Trying to become a different type of company: dynamic capability at Smith Corona. *Strategic Management Journal, 32*(1), 1–31.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing, 58*(4), 37–52.

Day, G. S., Reibstein, D., & Shankar, V. (2009). *Measuring innovation*. Wharton School of Business Working Paper. Philadelphia: University of Pennsylvania.

Dess, G. G., & Beard, D. W. (1984). Dimensions of organizational task environments. *Administrative Science Quarterly, 29*(1), 52–73.

Dixit, A. K., & Pindyck, R. S. (1994). *Investment under uncertainty*. Princeton: Princeton University Press.

Dutta, S., Narasimhan, O., & Rajiv, S. (1999). Success in high-technology markets: is marketing capability critical? *Marketing Science, 18*(4), 547–568.

Dutta, S., Narasimhan, O. M., & Rajiv, S. (2005). Conceptualizing and measuring capabilities: methodology and empirical application. *Strategic Management Journal, 26*(3), 277–285.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal, 21*(1), 1105–1121.

Grewal, R., & Slotegraaf, R. J. (2007). Embeddedness of organizational capabilities. *Decision Sciences, 38*(3), 451–488.

Grossack, I. M. (1965). Towards an integration of static and dynamic measures of industry concentration. *The Review of Economics and Statistics, 47*(3), 301–308.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., & Winter, S. G. (2007). *Dynamic capabilities: Understanding strategic change in organizations*. Malden: Wiley-Blackwell.

Katsikeas, C. S., Morgan, N. A., Leonidou, L. C., & Hult, G. T. M. (2016). Assessing performance outcomes in marketing. *Journal of Marketing*, *80*(2), forthcoming.

Keats, B. W., & Hitt, M. A. (1988). A causal model of linkages among environmental dimensions, macro organizational characteristics, and performance. *Academy of Management Journal, 31*(3), 570–598.

King, D. R., Slotegraaf, R. J., & Kesner, I. (2008). Performance implications of firm resource interactions in the acquisition of R&D-intensive firms. *Organization Science, 19*(2), 327–340.

Kozlenkova, I. V., Samaha, S. A., & Palmatier, R. W. (2014). Resource-based theory in marketing. *Journal of the Academy of Marketing Science, 42*(1), 1–21.

Krasnikov, A., & Jayachandran, S. (2008). The relative impact of marketing, research-and-development, and operations capabilities on firm performance. *Journal of Marketing, 72*(4), 1–11.

Krush, M. T., Sohi, R. S., & Saini, A. (2015). Dispersion of marketing capabilities: impact on marketing's influence and business unit outcomes. *Journal of the Academy of Marketing Science, 43*(1), 32–51.

Kumbhakar, S. C., Wang, H., & Horncastle, A. P. (2015). *A practitioner's guide to stochastic frontier analysis using Stata*. New York: Cambridge University Press.

Lehmann, D. R., & Winer, R. S. (2009). Editorial: introduction to special issue on marketing and organic growth. *International Journal of Research in Marketing, 26*(4), 261–262.

Levinthal, D. (2000). Organizational capabilities in complex worlds. In G. Dosi, R. Nelson, & S. Winter (Eds.), *The nature and dynamics of organizational capabilities* (pp. 363–379). Oxford: Oxford University Press.

Luo, X., & Donthu, N. (2006). Marketing's credibility: a longitudinal investigation of marketing communication productivity and shareholder value. *Journal of Marketing, 70*(4), 70–91.

Meyer, A. D., Tsui, A. S., & Hinings, C. R. (1993). Configurational approaches to organizational analysis. *Academy of Management Journal, 36*(6), 1175–1195.

Mizik, N., & Jacobson, R. (2003). Trading off between value creation and value appropriation: the financial implications of shifts in strategic emphasis. *Journal of Marketing, 67*(1), 63–76.

Mizik, N., & Jacobson, R. (2004). Are physicians "easy marks"? Quantifying the effects of detailing and sampling on new prescriptions. *Management Science, 50*(12), 1704–1715.

Moorman, C., & Slotegraaf, R. J. (1999). The contingency value of complementary capabilities in product development. *Journal of Marketing Research, 36*(2), 239–257.

Morgan, N. A. (2012). Marketing and business performance. *Journal of the Academy of Marketing Science, 40*(1), 102–119.

Morgan, N. A., Slotegraaf, R. J., & Vorhies, D. W. (2009). Linking marketing capabilities with profit growth. *International Journal of Research in Marketing, 26*(4), 284–293.

Morgan, N. A., Katsikeas, C. S., & Vorhies, D. W. (2012). Export marketing strategy implementation, export marketing capabilities, and export venture performance. *Journal of the Academy of Marketing Science, 40*(2), 271–289.

Narasimhan, O., Rajiv, S., & Dutta, S. (2006). Absorptive capacity in high-technology markets: the competitive advantage of the haves. *Marketing Science, 25*(5), 510–524.

Newbert, S. L. (2007). Empirical research on the resource-based view of the firm: an assessment and suggestions for future research. *Strategic Management Journal, 28*(2), 121–146.

Penrose, E. T. (1959). *The theory of the growth of the firm*. Oxford: Oxford University Press.

Piercy, N. (2007). Framing the problematic relationship between the marketing and operations functions. *Journal of Strategic Marketing, 15*(2–3), 185–207.

Porter, M. E. (1980). *Competitive strategy*. New York: The Free Press.

Porter, M. E. (1985). *The competitive advantage: Creating and sustaining superior performance*. New York: The Free Press.

Ramaswami, S. N., Srivastava, R. K., & Bhargava, M. (2009). Market-based capabilities and financial performance of firms: insights into marketing's contribution to firm value. *Journal of the Academy of Marketing Science, 37*(2), 97–116.

Roodman, D. (2009). How to do xtabond2: an introduction to difference and system GMM in Stata. *Stata Journal, 9*(1), 86–136.

Ruekert, R. W., Walker, O. C., Jr., & Roering, K. J. (1985). The organization of marketing activities: a contingency theory of structure and performance. *Journal of Marketing, 49*(1), 13–25.

Song, M., Droge, C., Hanvanich, S., & Calantone, R. (2005). Marketing and technology resource complementarity: an analysis of their interaction effect in two environmental contexts. *Strategic Management Journal, 26*(3), 259–276.

Taylor, A., & Helfat, C. E. (2009). Organizational linkages for surviving technological change: complementary assets, middle management, and ambidexterity. *Organization Science, 20*(4), 718–739.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509–533.

Tirole, J. (1988). *The theory of industrial organization*. Cambridge: MIT Press.

Tuli, K. R., Bharadwaj, S. G., & Kohli, A. K. (2010). Ties that bind: the impact of multiple types of ties with a customer on sales growth and sales volatility. *Journal of Marketing Research, 47*(1), 36–50.

Wooldridge, J. (2006). *Introductory econometrics*. Mason: Thompson Higher Education.