

The mediating role of ambidexterity between R&D and marketing with performance

The case of semiconductor industry in Taiwan

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Abstract— This paper examines the mediating effects of ambidexterity in the relations between resource employments of R&D and marketing with performance from financial perspective. With the data from the semiconductor industry in Taiwan in 2015, the present paper studied resource employment through the lens of research and development (R&D) and marketing to examine how ambidexterity mediates the effects of resource employment on firm performance. The results of the empirical study showed that: (1) both R&D and marketing resource employments have direct positive effects on performance; (2) while the employment of marketing resources has a positive effect on exploitation, the R&D resources has a negative effect on exploration; (3) the mediating role of the exploitation between the employment of marketing resources and the performance is not supported; and (4) the mediating effects of exploration reduce the effects of the R&D resource employment on performance. Most semiconductor companies that provide intermediate inputs adopt a business-to-business (B2B) model without emphasizing marketing capacity. The results of the paper indicated that these companies have problems with balancing the exploitation and exploration. They are weak in building exploitation to generate short-term profitability and in accumulating exploration to create long-term value at current time.

Keywords- *ambidexterity; exploration; exploitation; resource-based theory*

I. INTRODUCTION

Much has been researched and written, both theoretical and empirical, on organizational ambidexterity. They include what (sequential, simultaneous or contextual), how (intra-organization and inter-organizational), the tension between exploitation and exploration (short-term over longer term) and its impacts on performance [1]. Ambidexterity refers to the firm's ability to allocate scarce resources among competing objectives such as short-term outputs against long-term new value [2]. While the notion of ambidexterity has various definitions, there are studies focused on the top managers' decision of how sources could be allocated to build exploration

and exploitation capabilities so as to survive and obtain long term sustainability in the changing environment [3].

Organizational ambidexterity is reflected in a complex set of decisions and routines that enable the organization to sense and seize new opportunities through the reallocation of organizational assets [1]. This paper focuses on one single aspect of ambidexterity from the perspectives of managerial employment of resources to research and development (R&D) vis-a-vis marketing. Firms make R&D and marketing expenditures with the objective to generate value to the shareholders [4]. Whether R&D or marketing functions should be empowered more to achieve management objectives, such as new-product development, has been a subject of debate [5]. although both R&D and marketing employments generate current profits and enhance future growth simultaneously, marketing usually represents a significant aspect of exploitation of assisting assets of a firm with relatively certainty of proven benefits [6] while R&D represents exploration to secure new yet uncertain business opportunity over a longer period, be it innovation, technology, new market, and the like [7]. Essentially, there is an inherent tension between marketing and R&D given scarce resources. A senior manager must decide how to allocate of resources to and between two different types of activities, which are seen as essential to the firm's immediate profitability and long-term sustainability.

Ambidexterity as used in this paper refers to a firm's activity in structuring exploitation and exploration to pursue performance. The management may or may not put equal emphasis on both. Even when they are equal, one may be more equal than the other. It is important for the manager to know the impacts of resource employment to concurrent activities for marketing and to R&D so that the manager can weigh the actual deployment with a view to producing the desired results.

This paper proposes a causal model from resource employment to firm performance with exploration and exploitation as the mediators. The data of the semiconductor industry collected from the Taiwan Economic Journal (TEJ) Database for 2015 was used to test the hypotheses. The managerial decision on resource employment, the

ambidexterity, and their impacts on performance cannot be comprehended or imitated by outsiders due to ambiguity among complicated resource bundles and the causal relations between inputs and outputs [8][9]. However, it could be observed and measured from the financial statements of the firm [10]. In this paper, the resource employment of R&D and marketing is measured by the respective percentage change from the previous year. The exploration and exploitation are defined as the firm's ability to create sales from utilization of R&D and marketing resources. The performance is measured by return on investment (ROI), a performance indicator representing the effectiveness of resource utilization.

The empirical study examined two causal paths, yielding several findings. For the marketing-exploitation-performance path, marketing had positive and accelerated direct effects on performance. However, the indirect effect of marketing on performance via exploitation was negative. For the R&D-exploration-performance path, both the direct effect and the indirect effect via exploration of R&D resources on performance were positive. In addition, the increase of R&D resource employments accelerated exploration, which in turn increased the performance. These results indicate that Taiwanese semiconductor companies have leveraged more profits from R&D than from marketing resource employments.

Prior literature has indicated how the ambidexterity could be achieved and its association with firm performance but leaves fundamental questions in theory and practice unanswered. First, the perspective of dynamic capabilities indicates the top managers' decision to reallocate and reconfigure organizational resources to build ambidexterity [11][12]. How the allocation of organizational assets affects the ambidexterity building needs to examine. Second, a number of studies verified the positive relationship between the ambidexterity and the performance of the firms. They did not answer the question of how ambidexterity transforms the resource employments to performance. This paper contributes to the knowledge of ambidexterity by answering these questions.

Furthermore, unlike previous studies that used subjective measurements for ambidexterity this paper estimated exploration and exploitation with financial variables, the objective measurements that are easy to assess and allow long-term analysis. The rationales for this approach are as follows. First, although resource competition may arise within individual functional units including marketing [13] and R&D [14], it also exists inter-functional units for annual budgeting [15] and the power to influence innovation [5]. In specific, there are trade-off relations between exploring in R&D functions versus exploiting in marketing functions [16]. R&D and marketing are the appropriate measurement to approximate exploration and exploitation [6]. Second, conceptual ambidexterity, which can be across different organizational units, is measured following a bottom-up procedure where corporate culture is embedded. However, there are gaps from people's intention or knowing to actual action taken [17]. Alternatively, the accounting statements record the outcome of how financial resources distributed to functional units to recruit

human resources or to acquire external services. These records disclose the realization of the managers' strategies and the individual units' actual actions that generated the performance [10]. Finally, the effects of market-oriented and R&D-oriented on firm performance depend on at which stage the business cycle the firm is [18]. The dynamic ambidexterity paradigm between exploitation and exploration for long-term survival and response to environmental changes refers to a long-term trajectory of organizational activities and performances. The financial measuring approach allows us to trace the variations of resource allocation/reallocation and the corresponding firm performance with longitudinal data.

II. THEORETICAL MODEL AND HYPOTHESES

Strategy making refers to iterated processes of resource allocation [19]. The resource-based view perceives the firm as a *unique bundle of idiosyncratic resources and capabilities* where management consists of two simultaneous tasks involving maximizing the value through the optimal employment of existing resources and capabilities and developing the firm's resource base for the future [20]. Organizational ambidexterity is reflected in a complex set of decisions and routines that enable the organization to sense and seize new opportunities through the reallocation of organizational assets [1]. Given limited resources, the transformation of resources to performance is an iterated process of strategic choice between short-term performance and long-term growth. The resource allocation not only affects the performance directly but also enhances the capacity building of functional activities, which further, affect the final performance. This paper proposes a theoretical model to explain performance differences among firms within industry with two classes of paths of effects as shown in Figure 1.

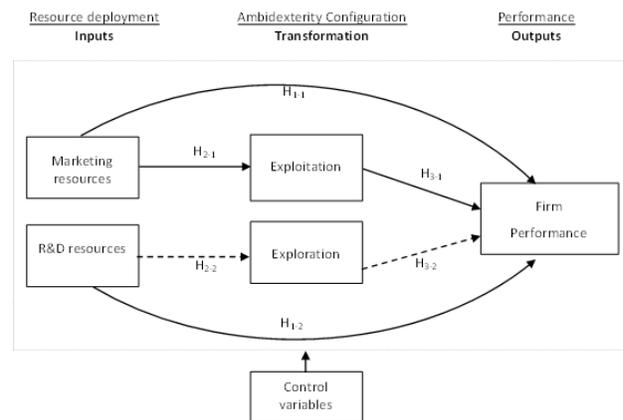


Figure 1. Theoretical model

The first class of paths, denoted as direct effects, attributes the performance to the resource configuration, which is measured by the deployments between R&D and marketing resources. The second class of paths, consists of a causal series of resource employment- exploration/exploitation-

performance, measuring the indirect effects of resource employments on performance via ambidexterity.

A. *The direct effect of resources on performance*

Among the business resource bundles, R&D and marketing have drawn much attention of strategic management research. R&D expenditure is generally believed to drive technological advancements and firms' growth. The relationship between R&D expenditure and firm performance is unclear. While some studies found a positive relationship between R&D and firm performance (e.g., [21], [22], [23]), others found a negative relationship [24] or insignificant relationship [25].

Reference [21] suggested that R&D develops new products or improves existed products to satisfy customers' needs and increased firm performance. The cross-sectional analyses in [22] also showed that higher R&D ratio than the industry average lead to larger stock-price increases for firms in high-technology industries but not for low-technology industries. For the European region, [23] found that R&D was positively and significantly associated with Tobin's q. On the contrary, [24] found that although R&D spending was positively related to patents, the relationships between patents with both return on assets (ROA) and sales growth were negative. Similarly, Chan et al. (2001) presented that R&D ratio had little influence on stock price performance however it was positively associated with return volatility.

Similarly, marketing spending strengthens product differentiation, enhances consumer recognition [26], and creates brand equity and market-based assets [27], which all contribute to the profitability. A number of studies signified the positive relationships between marketing or advertising spending and performance (e.g., [28], [29], [30], [31]). The research of [28] also presented the positive effects of deploying marketing resources on ROA through marketing capabilities. They concluded that market orientation and marketing capabilities are complementary assets that contribute to superior firm performance. Another article, to study the impacts of marketing resources on financial performance, [29] used SG&A ratio to measure marketing density of firms and found that cutting marketing expenses reduced stock market performance. Another article, [30] carried out a large-scale, cross-industry study and found that firms' pre-IPO marketing spending boost initial public offering trading in the stock market. Similarly, [31] found that although unexpected expenditure in marketing expenditure was negatively related to firm value, the unexpected increase in advertising spending advertising response threshold increased firm value. [32] also selected SG&A ratio and advertising ratio to measure marketing resource utilization and found that they are positively associated with financial performance including Tobin's q and cash flow related indicators.

Based on prior research, the present paper proposed the following:

Proposition 1: *The employments of R&D and marketing resources have direct effects on the financial performance.*

B. *The mediating effects of exploration and exploitation on the relations between resources and performance*

Ambidexterity suggests that firms have to be aligned and efficient in managing their current business demands while simultaneously being adaptive to changes in the environment [33]. To achieve the concurrent and future goals, ambidextrous firms not only allocate resources to maintain the mature part of the business but also devote the existing assets and capabilities to new sectors for sustainability [1][34]. The dynamic capability stream also draws attention to the firm's ability to reconfigure resources to sustain the superior performance in the changing environment [35]. The key responsibility for managers is not only to allocate resources to various functions in their firms [8], [15], but also, to be sustained, they have to maintain routines and make decisions to sense and seize new opportunities through the reallocation of organizational assets [1]. For any point of time with limited resources, managers have to make strategic choice between exploration-exploitation buildings. It is a challenge to the manager to balance the exploitation and exploration to ensure short-term viability and long-term sustainability simultaneously [33].

The exploration of innovations such as new products, new markets, or new technologies often confront negative returns and are associated with high uncertainties in the short run [6]. However, enhancing exploration enables the firm to sustain over environmental changes. Competing resources between exploration and exploitation strategies exist especially in emerging companies with vast growth opportunities such as high-tech industries [36]. For example, according to a Nielson's survey on the new product purchase intentions, 64% interviewees prefer branded products on the one hand, 63% of them also prefer the suppliers provide new product for choices (Nelson 2013). The product providers have to make advertisement and sales expenditure to keep customers' loyalty and to confront the pressure of introducing innovative products to meet consumers' expectations at the same time [38]. The dual demands in the product market push the firms to manage short-term alignment to meet the market needs and to allocate resources to adapt the possible change in the industry. Ambidextrous firms must have *the capacity to take the resources out of their short-term best use and transform them, through various methods, into outputs that in the long term have the potential to create new value* [39].

Reference [2] introduced contractual ambidexterity and found that ambidexterity mediated the effects of contextual characteristics on performance at individual level. At the firm level, resources including tangible, intangible, and human resources, are productive creating firm value if they are harmonized via management capabilities [40]. The present paper proposed indirect effects of resources on performance via exploitation and exploitation as follows:

Proposition 2-1: *The exploitation mediates the effect of the employments of marketing resources on firm performance.*

Proposition 2-2: *The exploration mediates the effect of the employments of R&D resources on firm performance.*

III. EMPIRICAL STUDY

The research hypotheses are developed based on the propositions described above in two paths: the first path tests the resource employment-exploration-performance causal series while the second path examines the resource employment-exploitation-performance causal series.

A. Variables

Financial items are the provisions of the outcomes of the business strategy and the associated operational activities [10]. The present paper used financial variables to measure the resource employments, the exploration and exploitation, and the long-term and short-term performance at the firm level.

Resource employment. To measure resource employments or capabilities, R&D expenditure is a good proxy for R&D behavior of firms [41]. While the spending on technological development is recorded in R&D expenditure, it is not easy to find marketing expenses, the advertising and sales force spending are included in selling expenses. The selling expense that excludes R&D expenditure is commonly used as the proxy for marketing spending (e.g., [42], [43], [44], [45]). The deployments of resources are measured by the percentage of R&D expenditure and the selling spending or net sales. They are denoted as $rd (= \frac{R \& D}{Sales})$ and $m (= \frac{Selling \ expense}{Sales})$, respectively.

Exploration and exploitation. Exploitation is defined as the ability to generate short-term return, the net operating profits (NOP), with the employment of marketing resources. Exploration is defined as the ability to create long-term value, measured by the market-book ratio (PB ratio), with the employment of R&D resources. The exploitation and exploration are denoted as $EPI (= \frac{NOP}{m})$ and $EPR (= \frac{PB \ ratio}{rd})$, respectively.

Performance. Return on equity (ROE), a commonly used performance indicator, represents the effectiveness of resource utilization. ROE is measured as the net income divided by total equity.

Control variables. Financial ratios are the realization of the firm's resources and capabilities [10]. Scale, which is measured by the logarithm of total assets, and the equity multiplier, a financial leverage indicator, were incorporated in all models as control variables.

B. Data Source and Sample

The present paper collected semiconductor firms in the Taiwan Economic Journal Database, which provides expenses items including selling, R&D, and general management. The semiconductor industry is well developed in Taiwan. Very few of semiconductor companies have brand name, such as Taiwan Semiconductor Manufacturing Co. (TSMC), MediaTek (MTK), and AUO, etc. Most semiconductor players are business-to-business (B2B) manufacturers, which provide chips or services to the branded products.

C. Modeling procedure

The present paper used the EViews 7.0 object to perform panel regression models for the sample data. [44] pointed out for statistical testing that the residual of financial ratios is typically cross-sectional heteroskedastic, which may yield biased standard error estimation with ordinary least square approach. Therefore, we estimated the general least squared (GLS) models. The variation inflation factor (VIF) showed a value less 10, indicating that there is no collinearity problem with the regression model.

D. Testing the Mediation Effects

The mediation effects were tested with three steps [44] [45], as follows. The first step aimed to demonstrate that the independent variables (here, resource employments measured by the percentage of change of R&D expenditure and the marketing related expenses) influence the dependent variable (performance). The second step aimed to establish that the independent variables influence each of the mediators, exploitation and exploration, respectively. The last step demonstrates that the mediators (exploitation and exploration) influence the dependent variable, when controlling for the independent variables (marketing and R&D resource employments). If, in this final step, the effects of resource employments on performance turn to be insignificant, full mediation is indicated [44][45][46]; otherwise, partial mediation would be indicated.

This study examined the effects of two mediators of resource employments, specifically exploration and exploitation, on performance. Assuming that the effect of a mediator may change in the presence of the other mediator, the present paper built a full model to estimate these two mediators [30]. The fits of the models are given in Table 1 and Figure 2.

Model 1 shows that the direct effects of the employments of resources on the performance (ROE) is significantly positive (101.0^{*}) for marketing (m) but is negative for R&D (rd) (-48.74^{***}); H_1 is supported. Models 2-1 and 2-2 show that the effect of marketing resource employments on exploitation and the effect of R&D resource employments on exploration are negative (-5.25^{***}, -125.17^{***}). Model 3 shows that exploration is significantly positive related to the performance (0.06^{***}) but the relationship between exploitation and the performance is not significant. This result exhibits that the exploitation does not play a mediating role between marketing resources and performance. $H_{2,1}$ is not supported. Model 4, in which the variables of resource employments and the exploration and exploitation are incorporated together, shows similar results as Model 1 that the effects of the employments of resources on the performance (ROE) is significantly positive (82.68^{*}) for marketing but is negative for R&D (-30.32^{**}). In addition, the exploitation and exploration are significant and positive (3.79[†], 0.04[†]) at 0.1 level.

TABLE I. TABLE TYPE STYLES

Dependent Variables	Model 1	Model 2-1	Model 2-2	Model 3	Model 4
<i>Intercept</i>	-54.48**			-118.59***	-47.02***
<i>M</i>	101.00*	-5.25***			82.68*
<i>Rd</i>	-48.74***		-125.17***		-30.32**
<i>Exploitation (NOPLAT/m)</i>				2.78	3.79 [†]
<i>Exploration (mb/rd)</i>				0.06***	0.04 [†]
<i>Scale (log(TA))</i>	5.12***	0.05***	2.89***	5.30***	4.28***
<i>Equity multiplier</i>	-1135.48***	-5.21	976.64*	0.55***	-1073.47***
<i>Adjusted R square</i>	0.33	0.29	0.35	0.22	0.35
<i>Observations used</i>	178	173	172	167	167

*** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$; [†] $P < 0.1$; $p < 0.1$.

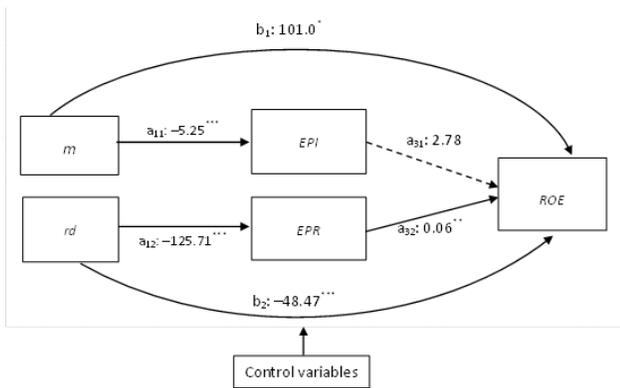


Figure 2. The results

The results of Model 4 support the mediating role of exploration between R&D resource employment and the performance; H_{2-2} is supported. The coefficient of the R&D resource employment in Model 4 is smaller than that in Model 1, indicating a partial effect.

IV. DISCUSSION AND CONCLUSIONS

The present study showed how the configuration of ambidexterity including exploration and exploitation mediate the effects of the deployments of R&D and marketing resources on the firm performance. The empirical studies generated several findings. For the effects of the employments of marketing and R&D resources on performance, the direct effects are positive. The effects of exploitation and exploration on performance are also positive. However, the linkage between the employment of marketing resources and capacity building of exploitation is not significant. Even more, the employment of R&D resources is negatively correlated with the exploration capacity. The negative indirect effects reduce the impact of the R&D resource employments on the performance. This causal path reveals that, for the semiconductor firms in Taiwan, the employment of marketing and R&D resources failed to build up the exploitation for short-term profitability and the exploration for long-term growth.

The shortage in ambidexterity building has reduced the firm performance at the current stage.

The constraints of this research associated mainly with data availability. The proxy variables, R&D and marketing, are expense items in accounting books, which do not include intangible resources; thus, they might underestimate resources actually employed.

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