# How Do Non-R&D-based Innovations Affect SMEs' Performance? The Mediating Role of Dynamic Capabilities

Guo Yanting, Chen Xiao, Zheng Gang
Zhejiang University, School of Management, Hangzhou, China

***Abstract*--Non-R&D-based innovations as effective ways to promote firms' growth and performance have gradually been recognized in recent years. However, the reason why those innovations generate benefits is still underexplored and mixed, particularly for small and medium enterprises (SMEs) in the context of emerging economies like China. Using quantitative data from 506 SMEs in China, we analyze five kinds of non-R&D-based innovative activities and explore how those non-R&D-based innovations contribute to SMEs' performance from dynamic capabilities view. Our results provide evident support that SMEs' dynamic capabilities mediate the relationships between three kinds of non-R&D-based innovations, namely product and service customization, marketing innovation and organizational innovation, and business performance. We contribute to enriching dynamic capabilities research in non-R&D-based innovation context, on one hand, which is relatively neglected in previous research. On the other hand, we call for more attention on non-R&D-based innovative activities, which could complement the picture of innovation processes in SMEs in emerging economies.**

## I. INTRODUCTION

During the past decades, research and development (R&D) has always been regarded as considerably important factor in explaining firms' innovativeness, survival or growth. However, demonstrated by the third and fourth Europe-wide Community Innovation Survey, non-R&D innovation activities are also critical to firm performance but receive much less attention [1]. It hints that not all innovations come from R&D-related investments [2], and firms may conduct non-R&D-based innovations regardless of their size, technological capabilities or located industry [3]. Nevertheless, evidence also shows that non-R&D-based innovative activities are pertinent to the growth of SMEs. R&D is often associated with high costs and risk. While many SMEs suffer from limited financial and technological resources [4], they depend on innovative activities without R&D to survive.

In this study, non-R&D-based innovations refer to innovative activities beyond the intramural or extramural R&D, where R&D activities refer to the organized, systematic creative activity conducted by R&D personnel or department. Extant research has identified some specific non-R&D-based innovations, as well as their relations with business performance. However, there is a scarcity of reasonable category incorporating different non-R&D-based activities. In light of prior work [1, 3, 5] and OECD survey, we investigate both technical non-R&D-based activities, namely product/service customization, imitation and design, and technological adoption, and non-technical non-R&D activities, say organizational innovation and marketing innovation.

In explaining why those non-R&D-based innovations affect firm performance, scholars have found clues from several perspectives, such as resources-based view, organizational learning theory and open innovation theory [6, 7, 8]. Nevertheless, existing mechanisms are not reflective on the turbulent and high-dynamic environment in emerging economies like China, while dynamic capabilities view pertains closely to answering how SMEs cope with such complex by conditions by virtue of non-R&D-based innovations. Therefore, in order to adding evidence of SMEs in emerging economies, our research question is whether and to what extent can SMEs' dynamic capabilities bridge the relations between non-R&D-based innovations and business performance?

In the next section, we review the literature on the mechanisms why non-R&D-based innovations have a bearing on business performance, and the framework of dynamic capabilities. Then we propose the research hypotheses. In section 3, the methodology and measure scale are presented. In section 4, the analysis results are given. Finally, section 5 concludes the study.

## II. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The mechanisms through which non-R&D-based innovations promote business performance have long been discussed. There are several streams in literature history. The first stream seeks evidence in resources-based view. Teece's [9] emphasized that the returns from innovation usually accrue to organizations that hold valuable and rare complementary assets. Sterlacchini's [6] revealed that innovation in small firms does not necessarily require heavy R&D investments. In the non-R&D-intensive industries, there was a positive relationship between innovation beyond R&D and firm export performance. Although they didn't make much R&D investments, they devoted lots of *financial and human resources* to design, engineering and trial production. Thus, their products still improved with little R&D expenditure.

The second stream uses organizational learning theory for explanation. Cohen and Levinthal's [10] found that minor modification and incremental changes can help firms reduce cost. It can depend on *learning by doing*, as a firm gets better at what it already does. According to Barge-Gil and Modrego's [7], the capability to identify pertinent knowledge can be relevant to explain innovation results that

non-R&D-based-innovation activities bring about. Furthermore, using of advanced technology can be seen as a process of *flows of knowledge* from R&D intensive sectors. It helps SMEs improve the ability to cope with uncertainty and change in dynamic environments. In addition, Barge-Gil and Modrego's [7] pointed that design activities were kind of daily routines and important to integrate and synthesize different pieces of knowledge. Arundel's [1] highlighted that combing existing knowledge in new ways are systems build on *tacit knowledge*, *engineering skills* and *cumulative learning process*. As for marketing innovation, Chen's [11] explored several forms of marketing innovation. Marketing innovation not only can acquire consumer information more effectively, but it can also reduce the consumer transaction costs. Furthermore, marketing innovation emphasized sales growth by shifting consumer demand from elastic to more inelastic market segments through the *delivery of better value* (actual or perceived) to the consumer [12, 13, 14].

The third stream points to open innovation theory in SMEs. SMEs were agreed to have sufficient capacity to manage the whole innovation process by themselves, which encouraged them to *collaborate* with other firms [15]. Hervas-Oliver et al. also hold the view that University and suppliers were important sources of external knowledge for SMEs' product innovation. Non-R&D variables would become much more important in low-tech sectors and SMEs [8]. Open innovation normally focused more on the early stages of innovation, addressing external *technology sourcing* and networking with technology providers and innovative, upstream companies [16]. Additionally, Huang et al.'s [3] revealed that firms that source innovation and information from suppliers tent to do non-R&D-based innovation activities.

As has been stated, lots of research has explored the mechanisms between non-R&D-based innovative activities and business performance, based on resource-based view, organizational learning and open innovation perspectives. Comparatively, dynamic capabilities view can add our knowledge toward this issue by providing a more integrated framework. This is because existing mechanism are not reflective on the turbulent and high-dynamic environment in emerging economies, while dynamic capabilities view is more pertain to answering how SMEs cope with such complex by virtue of non-R&D-based innovations.

Dynamic capabilities are defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment" [17]. Dynamic capabilities provide a mechanism to cope with highly-changed environment using exploiting and exploring competencies [18, 19]. Such capabilities embrace both change and routines, and how constantly refreshing them through organizational learning is vital for organizational success in radically changing environments [20]. The relations between dynamic capabilities and performance have been discussed a lot. Firms with effective dynamic capabilities have more competitive advantages over others [21]. It can benefit business performance in several ways. For example, by allowing the firm to identify and respond to opportunities lied in new processes/services development, it has the potential to increase revenue [22]. Similarly, improved response speed, effectiveness, and efficiency of dealing with environmental changes can positively affect firm performance by allowing the firm to take advantage of revenue enhancing opportunities and adjust its operations to reduce costs [23].

*A. Product and service customization*

Product and service customization is a customer-centric strategy to provide individually designed products and services to customers [24, 25]. In markets with mass customization, larger firms may no longer automatically have greater efficiencies because of their larger production capabilities. SMEs often are able to utilize technology to achieve significant economies as well [26].

SMEs performing customization need to interact with targeted customers and understand their real demand [18]. Understanding customers' heterogeneous needs and changing preferences are essential processes of value creation and capture, through better reconfiguring SMEs' limited resource [27]. Besides, customization motivates SMEs to assimilate and exchange customers' knowledge through joint problem-solving activities. Processes to identify target market segments and change customer needs are vital components of sensing market and technical opportunities [28].

***Hypothesis 1. The effect of product and service customization on business performance is mediated by dynamic capabilities.***

*B. Imitation and design*

Imitation is the capacity of recognizing and reproducing others' behaviors [29]. It is also a common strategy in latecomer countries. Design includes "activities that can transform a set of product requirement into a configuration of materials, elements and components". Since product design is of great importance to a product's success and competitive advantages [30], SMEs can survive by providing similar product appearance or package and much lower price to attract customers' eyes.

On the one hand, imitation enable SMEs to identify a superior position and introduce mainstream products to serve the customers better with a much lower cost. In this vein, imitators do not need to invest in plenty of resources on exploring, but can still make a living because of similarity [31]. Imitating design can add better financial performance in some cases [32]. For example, the use of "shanzhai" (In Chinese:山寨) becomes popular with the outstanding sale performance of "shanzhai" cell phones. Nowadays, their products are no longer poor-quality, and firms' chances of survival may depend on the size of segmented markets.

On the other hand, imitators can learn new knowledge and develop new skills in the process of imitation [29]. Imitation in design help SMEs gain active reactions and match

customer requirements in many aspects, such as a product's performance and quality [33]. In this case, imitators can better adapt to environment and react to the market dynamically [34].

***Hypothesis 2. The effect of imitation and design on business performance is mediated by dynamic capabilities.***

*C. Technological adoption and modification*

According to Huang et al.'s [3], technology adopters are defined as firms which perform innovation only through buying advanced machinery, computer hardware and software or licenses from other firms or organization. Modification signals that technology adopters may perform modification activities to suit their unique conditions.

Technologies often encompass managerial practices, production methods or other tacit knowledge and know-how [35]. Many SMEs in emerging economy choose technology adoption strategy. SMEs can get benefits from adopting a new technology throughout the life of the innovation and the cost is just at the time of adoption. In addition, comparing to the large benefits, the cost is a small hurdle [36].

Furthermore, since adoption is a process of the absorbing [35], SMEs can thus assimilate new knowledge and seize the opportunities by virtue of their flexibility to better meet demand in segmented markets. Modification according to customers' characteristics enable SMEs dynamically adapt to local environment. Thus, SMEs will play to their strengths serving the markets and create competitive edges.

***Hypothesis 3. The effect of technology adoption and modification on business performance is mediated by dynamic capabilities.***

*D. Organizational innovation*

An organizational innovation in this paper means a new organizational method in a firm's business practices, workplace organization and external relations [37], regarded as "fertile ground for innovation" [38].

Because SMEs have fewer layers of bureaucracy, more participatory decision making, and have shorter communication lines [39, 40]. Once deciding to introduce new technology, SMEs managers often bring about changes more quickly and reap the reward of reorganization than that in larger firms [41]. Moreover, compared with large firms, collaboration is a key source of legitimacy for smaller firms, since their resource limitations require them to use social capital from relationships with partners [40]. It maybe also influential for acquiring useful information from multiple sources, such as suppliers, competitors, universities, or industrial associations [42]. Consequently, developing external relations as one manifestation of organizational innovation can enhance SMEs' power and speed up innovations [40, 43], leading to better adaptation.

***Hypothesis 4. The effect of organizational innovation on business performance is mediated by dynamic capabilities.***

*E. Marketing innovation*

A marketing innovation is the implementation of a new marketing concept or strategy that differs significantly from enterprise's existing marketing methods or which has not been used before Mortensen and Bloch's [37].

In practice, using new media or techniques for product promotion allows SMEs to enhance market (structure) asset through quickly gaining influence or legitimacy. Since novel social media platforms may quickly go viral among customer communities, by obtaining endorsements from celebrities or core individuals in customer's network [26]. In addition, building new channels (e.g., online selling) enables SMEs to lower operational cost, establish links with target customers, and influence their buying decisions. They are more likely to achieve evolutionary fit on account of responding actively to new trend. Furthermore, by virtue of specialization in certain segmented market, SMEs can often bring about changes more quickly than is generally possible in larger firms, leading to 'behavioral advantage' [44].

***Hypothesis 5. The effect of marketing innovation on business performance is mediated by dynamic capabilities.***

## III. RESEARCH METHODOLOGY

*A. Data and sample*

Taking into consideration the lack of non-R&D-based innovation evidence from emerging countries, this study chose Chinese SMEs[1] for empirical analysis, where the number of SMEs took up more than 99 percent. Among them, only 17.5 percent conducted internal R&D activities,[2] But about 29 percent of Chinese SMEs were recorded having innovation activities.

Survey is suitable here because our research objects are non-R&D-based innovations in SMEs, which have scarcely any public information available. Given the convenience and availability of data collection, the authors collaborated with Small and Medium Enterprises Bureau (SMEB) of Zhejiang Province, a government agency responsible for the management of small and medium enterprises in Zhejiang Province. Zhejiang is regarded as very representative in China in terms of SMEs' innovation and development, owing to the following reasons. Firstly, Zhejiang is famous for its energetic and innovative private economy in China, which well represents the status quo of Chinese SMEs to some extent. For another, a quantity of SMEs in Zhejiang engaged in manufacturing have strong innovativeness, even though they are in a low or medium–low tech industry and do not have enough resources and capacity to perform formal R&D. Target respondents were middle or senior managers who were familiar with the company's activities. The questionnaires were offered with a

[1] Classification standard of Chinese small and medium enterprises. http://www.gov.cn/zwgk/2011-07/04/content_1898747.htm

[2] See: http://www.stats.gov.cn/tjsj/qtsj/2006cxdc/t20080222_402464447.htm.

cover letter that briefly introduced the project, guaranteed confidentiality and an expected research report.

After distributing 1500 questionnaires by cooperating with Zhejiang SME Bureau, we received 506 valid responses and the recovery rate was 33.73%.

*B. Measures*

All items, unless specified otherwise, were measured with a five-point Likert scale (1=strongly disagree, 5=strongly agree).

***1) Business performance***

Performance was a multi-dimension concept [45] and we approached it from two dimensions: innovation performance and financial performance, adapting from Baker and Sinkula's [46]. Specifically, innovation performance was assumed to be high when a firm declared that it had increasing number of new product/process and patent application, as well as improved speed of developing new innovations. We assumed financial performance to be high when the operational cost is reducing, the sales and profit are increasing. The Cronbach's alpha coefficients of this construct was 0.839.

***2) Non-R&D-based innovations***

*Product and service customization* (Cronbach's alpha coefficients=0.772). We followed Arundel et al.'s [1] to measure customization by three proxies. The first item stressed firms' activity to "partly modify the characteristics of products according to the customer needs." The second item gauged whether firms "develop new products according to customers' special requirements. The last item appraised customization in terms of "providing new services to customers that we have never do before or competitor never do before".

*Imitation and design* (Cronbach's alpha coefficients＝0.654). We used two items to measure the construct according to Arundel et al.'s [1]. The first item stressed if firms "imitate extant products, for instance in design, packaging, component, reverse engineering. The second item regarded if they "design product functions, appearance or packaging".

*Technology adoption and modification* (Cronbach's alpha coefficients＝0.664). We adapted from Arundel et al.'s [1] to measure the construct by four proxies. They tried to measure if *firms* "introduce international-or-domestic advanced production technologies, advanced equipment, production line"; "produce or adopt the introduced products or processes after making minor modifications or incremental changes"; "introduce new logistics, delivery or distribution methods to cut costs"; "introduce new office management systems".

*Marketing innovation* (Cronbach's alpha coefficients=0.747). We adopted from Mortensen and Bloch's [37] to measure marketing innovation by three items. One was about the *implementation* of new media or techniques for product promotion (i.e. the first time use of a new advertising media, a new brand image, introduction of loyalty cards, etc). The second appraised to what extent the firm introduce new methods for product placement or sales channels (i.e. first time use of franchising or distribution licenses, direct selling, exclusive retailing, new concepts for product presentation, etc). The third one assessed using new methods of pricing goods or services (i.e. first time use of variable pricing by demand, discount systems, etc).

*Organizational innovation* (Cronbach's alpha coefficients=0.551). We used three items to measure organizational innovation according to Mortensen and Bloch 's [37]. The first item was about new business practices for organizing procedures (i.e. supply chain management, business re-engineering, knowledge management, lean production, quality management, etc). The second item concerned new methods of organizing work responsibilities and decision making (i.e. first use of a new system of employee responsibilities, team work, decentralization, integration or de-integration of departments, education/training systems, etc). The last item stressed new methods of organizing external relations with other firms or public institutions (i.e. first use of alliances, partnerships, outsourcing or sub-contracting, etc).

***3) Dynamic capabilities***

Since capabilities are behavior variables, it is better to use subjective measures because prior research has provided valid and reliable scales for such constructs [21, 47]. For instance, some scholars measured dynamic capabilities on the basis of Teece' s definition, directly from resource configuration, integration ability and other related aspects [48]. Cepeda and Vera 's [49] emphasized its role of changing firms' internal routines, indirectly measuring dynamic capabilities from knowledge management perspective. Consistent with Jiao et al.'s [50], we focused on three characteristics of dynamic capabilities, namely transformative, environment-perceiving and flexible, which capture how firms develop management capabilities and difficult-to-imitate skills. The Cronbach's alpha coefficients of this construct was 0.741.

***4) Control variables***

Referring to prior innovation studies, we controlled employee numbers as a proxy of *Firm Size.* It was processed as a categorical variable to differentiate small- and medium-sized firms. *Industry* was controlled to capture the difference between specific manufacturing sectors. Last but not least, we controlled SMEs' *R&D intensity* in this study, because some evidence shows that R&D activities and non-R&D activities may concurrently influence business performance [7]. We measured it by collecting as a categorical variable about firms' R&D intensity interval.

*C. Common method bias*

Since this study uses a single-information approach, we checked for the problem of common method bias. Ex ante,

we arranged the survey questions in an inconsequential order, which helped to reduce respondents' consistent motives to a certain degree. Anonymity and reverse retest items were adopted to lower the potential common method bias in advance. In the post hoc stage, we used Harman's one-factor test to check for the potential common method bias [51]. It revealed that the loading of all items in the first factor was 25.30%, suggesting no severe common method bias in this study.

*D. Construct validity*

We refined the measures and assessed their construct validity following the procedures recommended by Anderson et al.'s [52]. We ran exploratory factor analyses for each set of focal constructs and attained the theoretically expected factor solutions.

Furthermore, we assessed the convergent validity of the focal constructs by estimating a five-factor confirmatory measurement model using AMOS 21.0. All five constructs were latent variables, and each questionnaire item loaded only on its respective latent construct. The latent constructs were allowed to be correlated, whereas the measurement items and their error items were uncorrelated. The model provides a satisfactory fit to the data ($\chi 2/df=3.041$, $p<0.001$; GFI=0.866, confirmatory fit index [CFI]=0.846, incremental fit index [IFI]=0.847, Non–Normed index [NFI]=0.885; root mean square error of approximation [RMSEA]=0.064) and thus indicates the unidimensionality of the measures. Convergent validity can also be hinted from average variance extracted (AVE) and composite reliabilities in Table 1.

To assess the discriminant validity of the measures, we calculated the shared variance between all possible pairs of constructs to determine if they were lower than the square roots of AVE for the individual constructs (See numbers on the diagonal in Table 1). The results showed that for each construct, the square roots of average variance extracted was much higher than its highest shared variance with other constructs, which represented additional support for discriminant validity [53]. Overall, these results showed that the measures possess acceptable reliability and validity.

## IV. RESULTS

The respondent firms covered a wide range of industries, while 69 percent of all came from manufacturing, distributing evenly among districts. In light of employment number and annual sales, small-sized enterprises accounted for 72.1 percent. More notably, 71.7 percent of all were non-R&D intensive firms and among whom, 31.6 percent had no R&D inputs.

The descriptive statistics of variables, correlations and reliability coefficients of variables were shown in Table 1. Comparing the correlation coefficients given in Table 2, most independent variables, dependent variables and dynamic capabilities were positive related, which meant a preliminary evidence on hypothesized relationships.

TABLE 1
DESCRIPTIVE STATISTICS, CORRELATIONS AND RELIABILITY COEFFICIENTS OF STUDY VARIABLES

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Industry | | | | | | | | | | |
| 2. Firm size (employee) | 0.43 | | | | | | | | | |
| 3. R&D intensity | .041 | .199** | | | | | | | | |
| 4. Product and service customization | -.002 | .074 | .498** | ***0.701*** | | | | | | |
| 5. Imitation and design | -.058 | .128** | .217** | .338** | ***0.585*** | | | | | |
| 6. Technology adoption and incremental modification | -.008 | .220** | .340** | .393** | .207** | ***0.734*** | | | | |
| 7. Marketing innovation | .063 | .090* | .189** | .349** | .162** | .336** | ***0.707*** | | | |
| 8. Organizational innovation | .008 | -.020 | .231** | .323** | .297** | .356** | .307** | ***0.551*** | | |
| 9. Dynamic capability | .068 | .046 | .212** | .290** | -.004 | .314** | .353** | .289** | ***0.587*** | |
| 10. Business performance | .087 | .195** | .488** | .395** | .136** | .422** | .334** | .273** | .494** | ***0.677*** |
| Mean | 6.767 | 1.350 | 2.553 | 3.517 | 2.557 | 3.088 | 3.443 | 3.137 | 3.648 | 3.102 |
| S.D. | 4.848 | .568 | 1.381 | .891 | 1.029 | .791 | .768 | .923 | .429 | .631 |
| AVE | / | / | / | 0.491 | 0.342 | 0.539 | 0.500 | 0.304 | 0.345 | 0.458 |
| CR | / | / | / | 0.659 | 0.670 | 0.778 | 0.750 | 0.563 | 0.796 | 0.829 |

N = 506.
*Note:* Cronbach's alpha coefficients are displayed on the diagonal with bold.
Cronbach's alpha coefficients of non-R&D innovation as a whole is 0.812.
† p< .10 * p < .05 ** p< .01 *** p< .001

By multiple regression, control variables were included into Model 1. Model 2 was designed to test the relations

between independent and dependent variables. Model 3 and Model 4 were assigned to test mediating effects according to Baron and Kenny's [54] (see results in Table 2).

We adopted the procedures of examining mediating effect following Baron and Kenny's [54]. The first step was to unveil whether five kinds of non-R&D-based innovative activities were positively related with performance. As was shown in Model 2, the effects of "technology adoption and incremental modification", "product and service customization" and "organizational innovation" were significantly positive to business performance ($p<0.001$), while marketing innovation was also significant but at a level (at $p<0.05$). In contrast, the effect of imitation and design was not verified by the sample in this study. In this vein, the prerequisite of examining the mediating effect of dynamic capabilities was not satisfied for "imitation and design".

The next step was to ensure if positive relationships can be found between non-R&D-based innovative activities and dynamic capabilities. With regard to Model 3, there was significantly negative relation between "imitation and design" and dynamic capabilities (at $p<0.01$). In comparison, the other four types of non-R&D innovation patterns were all positively and significantly related to dynamic capabilities (at $p<0.01$).

Lastly, by entering both innovative activities and dynamic capabilities into model 4, mediating effects would be supported statistically if the relationships change significantly compared with those in Model 2. Model 4 had higher explanatory power than Model 2 in terms of R square value, signaling that the model with mediating is more explanatory than the original one. Specifically, the relationship between marketing innovation and SMEs' business performance decreased from 0.124 ($p<0.001$) to 0.064 ($p<0.05$), suggesting a partly mediation of dynamic capabilities. Besides, a total mediation was supported between customization and performance, owing to a change from significance ($p<0.05$) in Model 2 to non-significance in Model 4. In addition, there was weak evidence about dynamic capabilities mediating organizational innovation and performance. In a nutshell, dynamic capabilities fully mediated the hypothesized relationship between customization, organizational innovation and performance, while partially mediated the relationship between marketing innovation and business performance. As for technological adoption, the mediating effect was not supported. 'Imitation and design' was not analyzed because it did not meet the prerequisite of examination as aforementioned.

Put differently, although four among five non-R&D-based innovations have significantly positive effects on SMEs business performance, we rejected Hypotheses 2 and 3, but found supports for Hypotheses 1, 4 and 5.

Interestingly, results showed that R&D intensity as a control variable is significantly and positively related with performance. It differed from Arundel et al.'s [1]'s finding that no difference exists in the economic performance of R&D and non-R&D firms. It maybe owing to the development stages and context of different countries. Larger effects on revenue performance existed for firms located in emerging countries, where structural changes were possibly producing rapid revenue growth. Given China's fast-changing transition economies, it was not strange to expect the different effects of R&D activities on business performance.

TABLE 2
EFFECTS OF NON-R&D INNOVATIONS ON BUSINESS PERFORMANCE THROUGH DYNAMIC CAPABILITY

| Explanatory variables | Explained variables | | | |
|---|---|---|---|---|
| | Performance | | Dynamic capability | Performance |
| | Model 1 | Model 2 | Model 3 | Model 4 |
| Constant | 2.355*** | 1.360*** | 2.628*** | .090 |
| **Control Variable** | | | | |
| Industry | .008* | .008 | .004 | .006 |
| Firm size (employee) | .111 | .081 | -.002 | .083* |
| R&D intensity | .212*** | .148*** | .016 | .141*** |
| **Independent Variable** | | | | |
| Product and service customization | | .068* | .065** | .037 |
| Imitation and design | | -.036 | -.072*** | -.001 |
| Technology adoption and incremental modification | | .155*** | .080** | .117*** |
| Marketing innovation | | .124*** | .124*** | .064* |
| Organizational innovation | | .047† | .076*** | .011 |
| **Mediator Variable** | | | | |
| Dynamic capability | | | | .483*** |
| **Parameters** | | | | |
| F test | 56.287*** | 34.800*** | 18.095*** | 43.792*** |
| $R^2$ | 0.252 | 0.359 | 0.226 | 0.443 |
| Adjusted $R^2$ | 0.247 | 0.349 | 0.213 | 0.433 |

*Note:* * p < .05 ** p< .01 *** p< .001

## V. DISCUSSION AND CONCLUSION

*A. Discussion*

In this study, we explore whether and to what extent can SMEs benefit from non-R&D-based innovations through dynamic capabilities, since current mechanisms are not reflective on the turbulent and high-dynamic environment in emerging economies like China. We examine both technical non-R&D-based activities, namely product/service customization, imitation and design, and technological adoption, and non-technical non-R&D activities, say organizational innovation and marketing innovation.

Our findings suggest that most non-R&D-based activities can exert positive and significant effects on SMEs' performance. The unsupported effect of imitation and design on business performance may be attributed to the developing stage of Chinese SMEs, where duplicative imitation is still pervasive and detrimental to bring sustainable competitive advantages owing to price war [55]. More importantly, the role of dynamic capabilities as a 'bridge' is prominent on product/service customization, marketing innovation and organizational innovation, while fragile in mediating the relationship between technological adoption and SMEs' performance.

It can thus infer that when SMEs conduct customization, marketing innovation or organizational innovation activities, the ability to sense, seize and configure will be useful to facilitate performance improvement. We extend the micro-foundations of dynamic capabilities in non-R&D context. For example, the capabilities of 'sensing' market opportunities and 'seizing' customers' specific demand are critical to marketing innovation and customization. Besides, transformation as a component of dynamic capabilities will favor organizational innovative activities, because it enables SMEs to respond quickly and to allocate resource in time as 'behavior advantages' [44].

*B. Contributions and limitations*

For academic implications, on one hand, we contribute to broaden Arundel et al.'s [1]'s findings of four technological non-R&D-based innovative activities, by revealing the relationships between various non-R&D-based innovative activities and SMEs' performance. One the other hand, it deepens the understanding of how non-R&D-based innovation affect SMEs' performance, in terms of emphasizing the explanatory power of dynamic capabilities. Particularly for marketing innovation, this mediation enables evolutionary theory and dynamic capabilities view to set foundations for non-R&D-based research. For SMEs in emerging countries, dynamic capability could compensate for the liability of smallness to some extent. The ability to reconfigure their resource base due to greater nimbleness and agility is a considerable advantage of SMEs compared to large corporations [56]. In other word, SMEs are equipped with higher level of dynamic capabilities that can benefit more from non-R&D-based innovations.

For managerial implication, SMEs are encouraged to invest in diverse non-R&D-based innovations given their potential roles in performance promotion. The influences of technological non-R&D-based innovative activities are rather direct, while the innovations concerning organization and market function by virtue of dynamic capabilities. Therefore, when performing organizational change and new marketing campaign, it is better for SMEs to set clear goals and cultivate adaptive ability toward changing environment.

Last but not least, extant policies tend to overestimate R&D as the primary way for SMEs to enhance their innovative capabilities. We suggest that government should give more attention to support non-R&D-based innovative activities in SMEs, especially in low-tech or medium tech sectors where most firms do not have abundant R&D investment or capabilities.

This study is not free from limitations. Findings are waited to be further examined in other emerging economies to extent the generalization. Additionally, we did not divide SMEs into non-R&D and R&D groups according to their R&D status. Given the possible interaction effect (complementary vs. substitution) between R&D and non-R&D-based innovative activities, simultaneously comparing two groups may reveal more interesting findings.

## ACKNOWLEDGMENTS

This research is supported by Projects of National Natural Science Foundation of China (No. 71172112), (No. U1509221).

## REFERENCES

[1] A. Arundel, C. Bordoy, and M. Kanerva, "Neglected innovators: How do innovative firms that do not perform R&D innovate," Results of an analysis of the Innobarometer, vol. 9, 2007.

[2] L. Santamaría, M. J. Nieto, and A. Barge-Gil, "Beyond formal R&D: Taking advantage of other sources of innovation in low-and medium-technology industries," Research Policy, vol. 38, pp. 507-517, 2009.

[3] C. Huang, A. Arundel, and H. Hollanders, "How firms innovate: R&D, non-R&D, and technology adoption," 2010.

[4] R. Ortega-Argilés, M. Vivarelli, and P. Voigt, "R&D in SMEs: a paradox?" Small Business Economics, vol. 33, pp. 3-11, 2009.

[5] Y. Meng, G. Zheng, and F. Liu, "Non-R&D innovation in SMEs: An empirical study from China," in Technology Management in the IT-Driven Services (PICMET), 2013 Proceedings of PICMET'13: pp. 768-772, 2013.

[6] A. Sterlacchini, "Do innovative activities matter to small firms in non-R&D-intensive industries? An application to export performance," Research Policy, vol. 28, pp. 819-832, 1999.

[7] A. Barge-Gil and A. Modrego, "The impact of research and technology organizations on firm competitiveness. Measurement and determinants," The Journal of Technology Transfer, vol. 36, pp. 61-83, 2011.

[8] J.-L. Hervas-Oliver, J. A. Garrigos, and I. Gil-Pechuan, "Making sense of innovation by R&D and non-R&D innovators in low technology contexts: A forgotten lesson for policymakers," Technovation, vol. 31, pp. 427-446, 2011.

[9] D. J. Teece, "Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy," Research Policy, vol. 15, pp. 285-305, 1986.

[10] W. M. Cohen and D. A. Levinthal, "Innovation and learning: the two faces of R & D," The Economic Journal, vol. 99, pp. 569-596, 1989.

[11] Y. Chen, "Marketing innovation," Journal of Economics & Management Strategy, vol. 15, pp. 101-123, 2006.

[12] R. C. Bennett and R. G. Cooper, "The misuse of marketing: an American tragedy," Business Horizons, vol. 24, pp. 51-61, 1981.
[13] R. F. Hurley and G. T. M. Hult, "Innovation, market orientation, and organizational learning: an integration and empirical examination," The Journal of Marketing, pp. 42-54, 1998.
[14] V. Naidoo, "Firm survival through a crisis: The influence of market orientation, marketing innovation and business strategy," Industrial Marketing Management, vol. 39, pp. 1311-1320, 2010.
[15] T. Edwards, R. Delbridge, and M. Munday, "Understanding innovation in small and medium-sized enterprises: a process manifest," Technovation, vol. 25, pp. 1119-1127, 2005.
[16] W. Vanhaverbeke and M. Cloodt, "Open innovation in value networks," Open innovation: Researching a new paradigm, pp. 258-281, 2006.
[17] D. J. Teece, G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management," Strategic Management Journal, vol. 18, pp. 509-533, 1997.
[18] J. Schmidt and T. Keil, "What makes a resource valuable? Identifying the drivers of firm-idiosyncratic resource value," Academy of Management Review, vol. 38, pp. 206-228, 2013.
[19] J.-P. Vergne and R. Durand, "The path of most persistence: An evolutionary perspective on path dependence and dynamic capabilities," Organization Studies, vol. 32, pp. 365-382, 2011.
[20] S. E. Dixon, K. E. Meyer, and M. Day, "Stages of organizational transformation in transition economies: A dynamic capabilities approach," Journal of Management Studies, vol. 47, pp. 416-436, 2010.
[21] K. M. Eisenhardt and J. A. Martin, "Dynamic capabilities: what are they?" Strategic Management Journal, vol. 21, pp. 1105-1121, 2000.
[22] R. Makadok, "The four theories of profit and their joint effects," Journal of Management, vol.37, pp.1316-1334, 2010.
[23] P. L. Drnevich and A. P. Kriauciunas, "Clarifying the conditions and limits of the contributions of ordinary and dynamic capabilities to relative firm performance," Strategic Management Journal, vol. 32, pp. 254-279, 2011.
[24] F. Salvador, P. M. De Holan, and F. T. Piller, "Cracking the code of mass customization," MIT Sloan Management Review, vol. 50, p. 71, 2009.
[25] R. McIntosh, J. Matthews, G. Mullineux, and A. Medland, "Late customisation: issues of mass customisation in the food industry," International Journal of Production Research, vol. 48, pp. 1557-1574, 2010.
[26] M. Josefy, S. Kuban, R. D. Ireland, and M. A. Hitt, "All Things Great and Small: Organizational Size, Boundaries of the Firm, and a Changing Environment," The Academy of Management Annals, vol. 9, pp. 715-802, 2015.
[27] R. L. Priem and M. Swink, "A demand-side perspective on supply chain management," Journal of Supply Chain Management, vol. 48, pp. 7-13, 2012.
[28] D. J. Teece, "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance," Strategic management journal, vol. 28, pp. 1319-1350, 2007.
[29] A. Billard and M. Arbib, "Imitation," MIT Press2002.
[30] G. Gemser and N. M. Wijnberg, "Effects of reputational sanctions on the competitive imitation of design innovations," Organization Studies, vol. 22, pp. 563-591, 2001.
[31] K. Z. Zhou, "Innovation, imitation, and new product performance: The case of China," Industrial Marketing Management, vol. 35, pp. 394-402, 2006.
[32] M. B. Beverland, "Managing the Design Innovation–Brand Marketing Interface: Resolving the Tension between Artistic Creation and Commercial Imperatives*," Journal of Product Innovation Management, vol. 22, pp. 193-207, 2005.
[33] P. Micheli, J. Jaina, K. Goffin, F. Lemke, and R. Verganti, "Perceptions of industrial design: The “means” and the “ends”," Journal of Product Innovation Management, vol. 29, pp. 687-704, 2012.
[34] F. K. Pil and S. K. Cohen, "Modularity: implications for imitation, innovation, and sustained advantage," Academy of Management Review, vol. 31, pp. 995-1011, 2006.
[35] G. Blalock and P. J. Gertler, "Firm capabilities and technology adoption: Evidence from foreign direct investment in Indonesia," Unpublished Paper, 2004.
[36] B. H. Hall and B. Khan, "Adoption of new technology," National bureau of economic research2003.
[37] P. S. Mortensen and C. W. Bloch, Oslo Manual-Guidelines for collecting and interpreting innovation data: Organisation for Economic Cooporation and Development, OECD, 2005.
[38] H. W. Volberda, F. A. Van Den Bosch, and C. V. Heij, "Management innovation: Management as fertile ground for innovation," European Management Review, vol. 10, pp. 1-15, 2013.
[39] S. Lee, G. Park, B. Yoon, and J. Park, "Open innovation in SMEs—An intermediated network model," Research Policy, vol. 39, pp. 290-300, 2010.
[40] V. Van de Vrande, J. P. De Jong, W. Vanhaverbeke, and M. De Rochemont, "Open innovation in SMEs: Trends, motives and management challenges," Technovation, vol. 29, pp. 423-437, 2009.
[41] G. Schreyögg and J. Sydow, "Organizational path dependence: A process view," Organization Studies, vol. 32, pp. 321-335, 2011.
[42] A. Leiponen and C. E. Helfat, "Innovation objectives, knowledge sources, and the benefits of breadth," Strategic Management Journal, vol. 31, pp. 224-236, 2010.
[43] M. Perkmann, A. Neely, and K. Walsh, "How should firms evaluate success in university–industry alliances? A performance measurement system," R&D Management, vol. 41, pp. 202-216, 2011.
[44] N. Hewitt-Dundas, "Resource and capability constraints to innovation in small and large plants," Small Business Economics, vol. 26, pp. 257-277, 2006.
[45] A. Rauch, J. Wiklund, G. T. Lumpkin, and M. Frese, "Entrepreneurial orientation and business performance: An assessment of past research and suggestions for the future," Entrepreneurship Theory and Practice, vol. 33, pp. 761-787, 2009.
[46] W. E. Baker and J. M. Sinkula, "Learning orientation, market orientation, and innovation: Integrating and extending models of organizational performance," Journal of Market-focused Management, vol. 4, pp. 295-308, 1999.
[47] V. Govindarajan and P. K. Kopalle, "Disruptiveness of innovations: measurement and an assessment of reliability and validity," Strategic Management Journal, vol. 27, pp. 189-199, 2006.
[48] L.-Y. Wu, "Entrepreneurial resources, dynamic capabilities and start-up performance of Taiwan's high-tech firms," Journal of Business research, vol. 60, pp. 549-555, 2007.
[49] G. Cepeda and D. Vera, "Dynamic capabilities and operational capabilities: A knowledge management perspective," Journal of Business Research, vol. 60, pp. 426-437, 2007.
[50] H. Jiao, J. Wei, and Y. Cui, "An empirical study on paths to develop dynamic capabilities: From the perspectives of entrepreneurial orientation and organizational learning," Frontiers of Literary Studies in China, vol. 4, pp. 47-72, 2010.
[51] P. M. Podsakoff, S. B. MacKenzie, J.-Y. Lee, and N. P. Podsakoff, "Common method biases in behavioral research: a critical review of the literature and recommended remedies," Journal of Applied Psychology, vol. 88, p. 879, 2003.
[52] J. C. Anderson and D. W. Gerbing, "Structural equation modeling in practice: A review and recommended two-step approach," Psychological Bulletin, vol. 103, p. 411, 1988.
[53] C. Fornell and D. F. Larcker, "Structural equation models with unobservable variables and measurement error: Algebra and statistics," Journal of marketing research, pp. 382-388, 1981.
[54] R. M. Baron and D. A. Kenny, "The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations," Journal of Personality and Social Psychology, vol. 51, p. 1173, 1986.
[55] Y. Luo, J. Sun, and S. L. Wang, "Emerging economy copycats: Capability, environment, and strategy," The Academy of Management Perspectives, vol. 25, pp. 37-56, 2011.
[56] N. Rosenbusch, J. Brinckmann, and A. Bausch, "Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs," Journal of Business Venturing, vol. 26, pp. 441-457, 2011.