# An Integration of Antecedents and Outcomes of Business Model Innovation: A Meta-Analytic Review

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## Abstract

Despite the existence of a large body of literature on the business model innovation (BMI) research, there has been no comprehensive empirical review of antecedents of BMI and its outcomes. This study develops a theoretical framework and carries out a meta-analysis of empirical studies to investigate the relationships among BMI, its antecedents and firm performance. The results validate a significant positive association between external and internal antecedents and BMI. Likewise, BMI is positively associated with firm performance. In addition, BMI and firm performance measurement and environmental uncertainty reveal borderline significant moderating effects on the relationship between BMI and firm performance. However, the moderating effect of BMI measurement on the antecedents-BMI relationship is not confirmed during the subgroup analyses. This study not only contributes to research on BMI, but also assists practitioners in interpreting and developing BMI strategies for organizations.

**Keywords**: Business model innovation, efficiency-centered BM, novelty-centered BM, meta-analysis, firm performance

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## 1.Introduction

The business model (BM), as a unit of analysis (Zott, Amit, & Massa, 2011), has become increasingly prevalent in management literature in recent years (Demil, Lecocq, Ricart, & Zott, 2015; Foss & Saebi, 2017; Spieth, Schneckenberg, & Ricart, 2014). It has also emerged as key focus in different research fields, such as strategy management (e.g., Teece, 2010; Zott & Amit, 2008), marketing (e.g., Storbacka, Windahl, Nenonen, & Salonen, 2013), entrepreneurship (e.g., George & Bock, 2011), and innovation management (e.g., Henry Chesbrough, 2010; Wei, Yang, Sun, & Gu, 2014). Given the emphasis that researchers place on the importance of BM in management studies, scholars believe that an in-depth investigation of BM is vital for progress in BM research (Foss & Saebi, 2017; Spieth, Tidd, Matzler, Schneckenberg, & Vanhaverbeke, 2013). Past BM literature has laid stress on the design (e.g., elements, styles, and design process) (R. Amit & Zott, 2001; Charles Baden-Fuller & Mangematin, 2013), and implementation of BM (e.g., types selection, implementation, and performing process) (Casadesus-Masanell & Enric Ricart, 2010; Zott & Amit, 2007, 2008). However, the recent emphasis on how to create innovative BMs has also caught the attention of a wide range of scholars (Casadesus-Masanell & Zhu, 2013; Clauss, 2017; Velu & Stiles, 2013). Many researchers are keen on focusing on the elements, outcomes, and contingency in the process of BM innovation that affect a firm's strategic intents through new value-creation and value-capturing activities. Theoretically, research on BMI serves as an informative framework for enterprises' growth and success. Besides, the need for considerable attention from practitioners is emphasized in international business by the successful use of BMI by Apple, Amazon, Google, Alibaba, and many other players (McGrath, 2010). These enterprises have not only achieved success, but also influenced others to implement innovative BMs. Hence, it is evident that the ability to create innovative BMs has become the keystone for successful enterprises (Gassmann, Frankenberger, & Sauer, 2016) and BMI has established its significance in different disciplines.

With regard to existing research on BMI, we found that most of the studies on BMI emphasized its benefits, such as competitive advantage (e.g.,Casadesus-Masanell & Enric Ricart, 2010; Henry Chesbrough, 2010), superior firm performance (e.g.,Aspara, Hietanen, & Tikkanen, 2010; Cucculelli & Bettinelli, 2015; Kim & Min, 2015), and adaptive agility (e.g.,Battistella, De Toni, De Zan, & Pessot, 2017; Yves L Doz & Mikko Kosonen, 2010). Moreover, some attempts have been made to investigate the possible antecedents of BMI, such as trial-and-error learning (Sosna, Trevinyo-Rodriguez, & Velamuri, 2010), technological developments (e.g.,Teece, 2010; Wirtz, Schilke, & Ullrich, 2010), market opportunity (e.g.,R. Amit & Zott, 2001; George & Bock, 2011), value network (e.g.,Henry Chesbrough, 2013; Guo, Tang, Su, & Katz, 2017; Wang, Guo, & Liu, 2017), managerial recognition (e.g.,Aspara, Lamberg, Laukia, & Tikkanen, 2013), and globalization (e.g.,Lee, Shin, & Park, 2012).

These studies have functionally analyzed the antecedents of BMI from multiple perspectives. However, in understanding the antecedents of BMI, there exists a basic and crucial question: what kind of factors motivate enterprises' BMI? Moreover, despite the remarkable progress made in understanding the antecedents of BMI, relatively few studies have systematically identified the antecedents of BMI and provided integrative frameworks to depict the comprehensive motivators of BMI. As noted by Foss and Saebi (2017), there can be many antecedents of BMI. These could differ in their nature and levels at which they are placed; further, they could be firm-specific or external. Following their opinions, this study believes that it is necessary to classify the antecedents of BMI into two categories—external and internal—by using a comprehensive framework for comparison.

In addition, among the endeavors that the literature has made on the benefits of BMI (i.e., innovativeness, competitive advantage and profitability, or other aspects of outcomes) (Foss & Saebi, 2017), the majority of existing research has explained in detail how BMI improves firm performance, one of the most important outcomes that gains a lot of attentions and deserves always attentions. However, prior research has yielded inconsistent findings regarding the effects of BMI on firm performance. Most scholars have proposed that BMI positively influences the performance of established and starts-up firms (Aspara et al., 2010; A. J. Bock, Opsahl, George, & Gann, 2012; Futterer, Schmidt, & Heidenreich, 2018; Kim & Min, 2015; Wei et al., 2014; Zott & Amit, 2007). For example, Cucculelli and Bettinelli (2015), in their study of the Italian clothing industry over a 10-year period, find that BMI firms showed a significantly higher performance than non-BMI firms, especially when BMI is combined with investment in intangibles. However, some scholars have stressed that although BMI can result in superior value creation, it does not necessarily improve firm performance (Desyllas & Sako, 2013; Visnjic Kastalli & Van Looy, 2013). For instance, Casadesus-Masanell and Zhu (2013), focusing on sponsor-based BMI, provide a game-theoretic framework to examine how firms strategically conceal or reveal new business models. Their results suggest that an entrant needs to strategically choose whether to conceal its innovation by adopting a traditional business model, or reveal it by competing through its new business model.

Given the literature insights quoted above, the question about how BMI is causally linked to its antecedents and firm performance is still ambiguous and poorly understood (Foss & Saebi, 2017). There are a number of systematic literature reviews on BM literature that are qualitative (e.g.,Foss & Saebi, 2017; George & Bock, 2011; Schneider & Spieth, 2013; Spieth et al., 2014; Wirtz, Pistoia, Ullrich, & Goettel, 2016; Zott et al., 2011). However, to the best of our knowledge, no comprehensive empirical review regarding the antecedents of BMI and firm performance has been conducted. In addition, the magnitudes of the correlation coefficients in existing empirical studies show different magnitudes of the effects of BMI with its antecedents and firm performance; this could be result of the different measuring tools used and the presence of some contingency variables. However, few studies have explored the boundary factors, such as the measuring tool, that may have a significant impact on these

links (i.e., antecedents-BMI and BMI-firm performance).

Hence, based on the research arguments on BMI outlined above, this study poses the following research questions: (1) what are the antecedents of innovative BM?; (2) what is the true impact of BMI on firm performance?; and (3) what is the influence of measurement tools and contingency variables on the antecedents-BMI and BMI-firm performance relationships?

To address these questions, the current study attempts to conduct a meta-analytic review by quantitatively synthesizing the available empirical studies on BMI. To reconcile conflicting results in prior independent research, the study develops and validates an integrative framework of the antecedents of BMI and its consequences on firm performance. By researching the abovementioned objectives, the present study contributes to the extant literature in multiple ways. First, responding to the recent call for a research model for future BMI research (Foss & Saebi, 2017), the current study is, to the best of our knowledge, the first effort to provide an empirical synthesis of prior findings on the antecedents-BMI relationship. Specially, through extant literature review, the study identifies four external factors (i.e., market opportunity, contextual factors, value network, and technology innovation) and three internal factors (i.e., managerial cognition, internal resources and capabilities, and organization structure and activity). Second, the current study tests the magnitudes of the relationships between BMI and firm performance across multiple studies, thereby taking the initial steps to address the inconsistent conclusions among BMI-firm performance links. Finally, the conceptual integration proposed in this study promotes a more complete understanding of BMI by providing an analysis of the moderating effect of measurement and the contextual variables. Therefore, our findings can help to explain the inconsistent results of prior BMI empirical studies when exploring the relationships linking to its antecedents and firm performance by considering some boundary conditions.

The remainder of this paper is structured as follows. A brief literature review of BMI and the relational hypotheses of antecedents-BMI and BMI-firm performance relationships are presented in section 2. Section 3 describes methodology, where the incorporated meta-analytic procedures are thoroughly discussed. Section 4 outlines our empirical results, whereas section 5 presents the discussion, followed by implications, limitations, and future research directions.

## 2. Theoretical Background and Hypotheses Development

This section outlines the theoretical foundation and expected relationships between BMI and its antecedents, as well as between it and firm performance. First, the following section briefly presents an overview of the literature on BMI, highlighting the background of the relationships of antecedents-BMI and BMI-firm performance. Then, the study specifically develops hypotheses concerning the main theoretical issues in this meta-analysis. Besides, it also delineates the moderating roles of BMI and firm performance measurement, as well as environmental uncertainty, on the main effects.

### *2.1 Business Model Innovation*

Owing to the complexity and diversity of BMs, different theories have been introduced to explain and analyze BM issues across disciplines; this has led to multiple understandings of the term BM (Wirtz et al., 2016). The majority of the definitions of BM proposed in the existing literature are based on the content/elements (R. Amit & Zott, 2001), process (Teece, 2018), and design theme (R. Amit & Zott, 2001); a few use some other considerations. The commonly accepted definitions consider the business model as the logic through which enterprises conduct business in markets (Zott et al., 2011), as well as the rationale used by organizations to create, deliver, and capture value (i.e., social, economic, or some other type) (Teece, 2010). Business models are not stable over time. The creation or even modification of an original BM by adapting or innovating one or several of its core elements is considered as BMI. BMI is an extension of the BM concept. Scholars have paid much attention to the dynamic and innovative BM and provided insights about how enterprises can improve the prototypes of BM and innovate their current BM; this is crucial for determining the success of enterprises (H. Chesbrough & Rosenbloom, 2002). However, there is no general agreement on the definition of BMI. Following Foss and Saebi (2017), this study conceptualizes BMI as "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements."

With very few exceptions (e.g.,Foss & Saebi, 2017; Schneider & Spieth, 2013), the antecedents of BMI that we reviewed remain under-examined. For example, in the systematic review of Foss and Saebi (2017), they distinguished the research stream of BMI as an organizational change process, and identified that leadership, learning mechanisms, and capabilities are needed for successful BMI. They also put forward the research gap in the antecedents of BMI that can be filled by testing the different antecedents in terms of external (e.g., network position, technologies) and internal factors (e.g., dynamic capabilities and change in strategy). Schneider and Spieth (2013) systematically reviewed the extant BMI literature, and identified the prerequisites of conducting BMI, such as: globalization (e.g.,Lee et al., 2012); technological and behavioral developments, such as Web 2.0 (e.g.,Wirtz et al., 2010); the role of inter-organizational cognitions (e.g.,Aspara et al., 2013); and strategic agility (e.g.,Yves L. Doz & Mikko Kosonen, 2010). In addition, there exist opposing views in the extant literature on the antecedents of BMI. Some argue that BMI is a passive change process in which the external factors drive internal factors and view it as an outcome of trial-and-error experimentation, and incrementally adapting to environmental changes (McGrath, 2010). Other researchers insist that BMI is a process involving active adjustment that is driven by the internal factors, and suggest that BMI starts with cognition by top management teams (Martins, Rindova, & Greenbaum, 2015). Despite the agreement in the BMI literature that these antecedents are crucial for innovative BM, the antecedents of BMI remain ambiguous and have not been synthesized; thus, it is a research issue that deserves further investigation. Following Foss and Saebi (2017), the antecedents of existing BMI literature are classified into two categories—external and internal (Table 1). External factors consist of market opportunity,

contextual factors, value network, and technology innovation, whereas internal factors include managerial cognition, internal resources and capabilities, and organizational structure and activity.

Being a complementary form of innovation (Raphael Amit & Zott, 2012), BMI can reshape the industry, generate new value growth, and help enterprises surpass their rivals (Matzler, Bailom, Eichen, & Kohler, 2013). It also creates new competitive advantages and improves enterprises' performance by restructuring the way they conduct resource transactions (Zott & Amit, 2007). Most research has insisted that BMI plays a significant role in the achievement of superior performance in dynamic markets (Casadesus-Masanell & Enric Ricart, 2010; Kim & Min, 2015). In particular, some studies have addressed the firm performance implications of BMI by directly exploring the impact of BMI on firm performance (e.g.,Cucculelli & Bettinelli, 2015; Guo et al., 2017; Kim & Min, 2015), or examining the effects of different BM designs (e.g., efficiency-centered and novelty-centered BMs) (e.g.,Wei et al., 2014; Zott & Amit, 2008). Efficiency-centered BMs refer to those that reduce transaction cost and redesign content, structure, and governance elements for value creation (Zott & Amit, 2008). Firms can redesign and optimize the interface among participants to reduce transaction asymmetry and complexity through standardization. Compared with efficiency-centered BMs, novelty-centered BMs essentially emphasize the promotion of new ways of conducting business. Accordingly, a theoretical framework for our meta-analysis is presented to enhance the understanding of the relationships between BMI, its antecedents, firm performance, as well as the possible moderating variables.

**Table 1 to be placed here**

### *2.2 Antecedents of Business Model Innovation*

Based on the above background, the following sections specifically delineate the expected relationships linking BMI and its antecedents. Consequently, the first four hypotheses focus on the external factors and their impacts on BMI. The next three hypotheses refer to the expected effects of internal factors and their direct effects on BMI. The hypotheses for these antecedents are as follows.

#### *2.2.1 External Factors*

External factors include market opportunity, contextual factors, value network, and technology innovation. Several studies on BMI have looked into market opportunity and found that it is closely linked to the BMI (R. Amit & Zott, 2001; George & Bock, 2011; Johnson, Christensen, & Kagermann, 2008). Market opportunity is time-based, and requires that enterprises integrate the internal and external resources to commercialize the opportunity as quickly as possible. The degree of opportunity development is closely related to the quantity and quality of resources that enterprises can integrate. In this regard, enterprises will optimize or redesign their current BMs to better transform their market opportunities into value creation activities, and deliver value to their target customers to achieve success. This is also consistent with the transaction cost theory. Enterprises can innovate their BM (e.g., by innovating transaction structures) by seizing market opportunity. BMI is considered an important way

to achieve market opportunity and, then, create value. Hence, we can conclude that BMI is driven by market opportunity. Therefore, this study postulates the following hypothesis:

*Hypothesis 1: There is a positive relationship between market opportunity and BMI.*

The contextual factors that enterprises face have been examined in prior research; they include environmental uncertainty and innovation legitimacy (e.g.,Najmaei, 2016; Osiyevskyy & Dewald, 2015). Environmental uncertainty (e.g., environmental dynamism, threat and competition) results from the dynamic change and unpredictability of the environment; this conflicts with the prototype of the BM (Ghezzi, Cortimiglia, & Frank, 2015; Wiprachtiger, Narayanamurthy, Moser, & Sengupta, 2019; Zott & Amit, 2013). Under uncertain circumstances, it is hard for enterprises to identify potential market demand (Teece, Pisano, & Shuen, 1997). Firms have to look for new opportunities to ensure sustainable development. Therefore, enterprises need to constantly improve their BMs to quickly react to the uncertainty by dynamically integrating, reconstructing, and acquiring resources. By doing these, enterprises could implement exactly what BMI requires. Extant literature also argues that environmental uncertainty plays a crucial role in BMI actions (Ricciardi, Zardini, & Rossignoli, 2016; Velu & Jacob, 2016).

With respect to innovation legitimacy, there exist explicit and implicit contract relationships between enterprises and stakeholders. The potential benefits for enterprises complying with these contracts include building reputations that help them engage with their stakeholders; thus, they can obtain government support, maintain customers, and attract investors. Therefore, innovation legitimacy is the prerequisite for obtaining the required resources, and the recipe for BMI's success. Therefore, the study predicts that innovation legitimacy is responsible for successful BMI. Hence, this leads to the following hypothesis:

*Hypothesis 2: Contextual factors, such as (a) environmental uncertainty and (b) innovation legitimacy, are positively associated with BMI.*

Enterprises are always embedded in a certain value network system that will influence the BM of an enterprise through other participating subjects. Several studies have looked into value network by focusing mainly on network embedding and inter-organizational learning (e.g.,Guo, Zhao, & Tang, 2013; Wang et al., 2017).

First, enterprises can effectively acquire and allocate their resources through the network embedding mechanism, and can gain competitive advantage by exchanging and sharing resources in their value network. Network embedding reduces the difficulty and cost of acquiring heterogeneous resources, and offers spillover resource support and advantages for the innovation of BM. Therefore, network embedding is the necessary premise for innovative BM, and the key factor in successful BMI. Second, inter-organizational learning helps to integrate and internalize the knowledge and capabilities acquired from outside for improving the innovative ability and further promoting enterprises' BMI (G. W. Bock,

Zmud, Kim, & Lee, 2005).

From what we discussed above, it emerges that network embedding and inter-organizational learning have the potential to promote BMI. According to social network theory, the value network: provides firms with access to various types of external knowledge and resources; enables them to recognize valuable business opportunities; and helps them to search for desired partners. In sum, value network is particularly essential for BMI (Henry Chesbrough, 2013; Guo et al., 2017). Thus, the study proposes the following hypothesis:

*Hypothesis 3: Value network components, such as (a) network embedding and (b) inter-organizational learning are positively associated with BMI.*

The capability for technology innovation can directly accelerate the process of BMI (Teece, 2010). Technology innovation creates the demand for technologies in the market, and opportunities to meet the potential needs of consumers. Of late, disruptive technologies, such as big data analytics, new hardware, and smart apps, have attracted greater consideration about incorporating innovation in the business model to enhance value creation (Alberti-Alhtaybat, Al-Htaybat, & Hutaibat, 2019). The marketization and commercialization of new technology must be matched by appropriate BMs, which will, thus, promote the formation of new BMs. Many BMIs come directly from technology innovation. This does not imply that introducing new technology innovation would require BMI; however, when a firm introduces technology innovation across a broad spectrum of business activities and processes, the firm will be much more likely to succeed through these innovations. Results of empirical research have also shown that there is a significant positive relationship between technology innovation and BMI (C. Baden-Fuller & Haefliger, 2013; Sousa-Zomer & Cauchick-Miguel, 2019). Hence, the following hypothesis is proposed:

*Hypothesis 4: Technology innovation has a positive relationship with BMI.*

### *2.2.2 Internal Factors*

Internal factors include managerial cognition, internal resources and capabilities, as well as organization structure and activity. Managerial cognition, which is thought to influence BMI through leader-related factor and opportunity recognition, has been discussed in extant literature. Consistent with upper echelon theory, recent studies have shown that diversity in the top management teams' biographies and social features have impacts on BMI (Dunford, Palmer, & Benveniste, 2010). As outlined above, some scholars insist that BMI, which is driven by internal factors, starts with cognition by top management teams (Martins et al., 2015). In this regard, leader-related factor (e.g., diversity of top management teams) may increase the efficiency of the internal information process of BMI (Boone & Hendriks, 2009) and help in accessing diverse external resources—something conducive to BMI.

Regarding opportunity recognition, Zott and Amit (2010) suggested that under a highly volatile external

environment, the ability of opportunity recognition can help enterprises to grasp the latest trends in market development, and then create a new innovative BM based on the market demand. According to transaction cost theory, enterprises need to innovate their extant BMs via innovating the content, structure, and governance of transactions to take advantage of recognized opportunities (George & Bock, 2011). Thus, enterprises can innovate BMs by recognizing and capturing opportunities (Henry Chesbrough, 2010; McGrath, 2010; Sosna et al., 2010). Hence, the following hypothesis is proposed:

*Hypothesis 5: Managerial cognition, such as (a) leader-related factor and (b) opportunity recognition, is positively associated with BMI.*

Internal resources and capabilities have received considerable attention in the extant literature and include employee-level capabilities, enterprise-level capabilities, as well as enterprises' internal resources. Few researchers have explained the antecedents of BMI by using the employee-level perspective, which mainly focus on entrepreneurship (Foss & Saebi, 2017) and absorptive capacity. Entrepreneurship, in the form of an innovative or adventurous spirit, is considered as pursuing uncertain opportunities and having the willingness to face the consequences of innovation and change. Entrepreneurship means the choice of a new BM for start-ups and innovating the current components or the architecture of BM in established firms (Foss & Saebi, 2017). Further, BMI intrinsically reflects the idea of entrepreneurial vision. Related studies have also shown that entrepreneurship is closely and positively related to innovation (McAdam & Galloway, 2005). Thus, entrepreneurship is intrinsically related to BMI (Foss & Saebi, 2017). Absorptive capacity helps employees to identify, acquire, digest, and apply useful external knowledge for further improvement in cognition. Hence, they can gradually cope with the current BM by developing a broader vision; it is much easier for them to identify problems, which is undoubtedly conducive to BMI.

With respect to the enterprise-level capabilities, this study mainly focuses on dynamic capability, which refers to a comprehensive ability to dynamically acquire, integrate, reconstruct internal and external resources, as well as competitiveness, when facing environmental changes (Teece, 2007). Dynamic capability helps enterprises to grasp market dynamics and opportunity in the wake of environmental change to meet the changing market demands. It is likely to promote new technology, bring changes in organizational structure, and lead to improvement in management processes. This, in turn, changes the BM elements and stimulates innovative BM. Therefore, dynamic capability plays an important role in promoting BMI (Sousa-Zomer & Cauchick-Miguel, 2019).

As far as internal resources are concerned, they can help enterprises to expand the boundaries and capital of transactions, thus making BMI possible. BM is a tool for the enterprise to transform resources into customer value. According to the resource-based view, the employee-level capabilities, enterprise-level capabilities, and internal resources can serve as the heterogeneous resources that lead to the difference in competitiveness and performance (Sousa-Zomer & Cauchick-Miguel, 2019). Therefore, the study

proposes the following hypothesis:

*Hypothesis 6: Internal resources and capabilities, such as (a) employee-level capabilities, (b) enterprise-level capabilities, and (c) internal resources, are positively associated with BMI.*

BMI often starts from the organizational structure. Organizational structure, being the basic component of BM, reflects the comprehensive relationships among different management levels, and inevitably affects the innovative BM. Changes in the organizational structure can help enterprises to enhance strategic sensitivity and flexibility, which determines whether enterprises can respond to external shocks in time (Yves L. Doz & Mikko Kosonen, 2010). With respect to the organization activity (e.g., organizational orientations and learning), it constantly improves the governance structure in practice and drives enterprises to innovate their BMs in a certain direction (Sinkovics, Sinkovics, & Mo, 2014). From the perspective of strategy, BMI is a process in which enterprises constantly make decisions (Casadesus-Masanell & Enric Ricart, 2010). Results have also shown that organizational structure (e.g.,Najmaei, 2016) and organization activity (e.g.,Wang et al., 2017) can promote BMI. Therefore, the study proposes the following hypothesis:

*Hypothesis 7: Organizational structure and activity, such as (a) organizational structure and (b) organizational activity, are positively associated with BMI.*

### *2.3 BMI and Firm Performance*

Extant qualitative reviews of the BMI literature have revealed a growing consensus about BMI playing a central role in explaining firm performance (Foss & Saebi, 2017; Zott et al., 2011). BMI, as a "key resource," allows firms to integrate internal and external resources, and make adjustments. Enterprises can optimize key processes, redesign and innovate a new profit model to reduce costs, ensure high efficiency in value creation and delivery, and ultimately bring about performance growth (Casadesus-Masanell & Zhu, 2013). Past empirical studies have also indicated that BMI shows a positive relationship with firm performance (e.g.,Henry Chesbrough, 2013; Cucculelli & Bettinelli, 2015; Guo et al., 2017; Johnson et al., 2008). In addition, some studies empirically test the effects of two main BM design themes (i.e., efficiency- and novelty-centered BMs) on firm performance. Efficiency-centered BMs not only improve the current BMs, but also emphasize efficiency and cost reduction. Novelty-centered BMs indicates firms recombine or recreate current BM elements to improve value creation and value acquisition. Both BMs can, thereby, affect performance. Existing literature has also indicated that efficiency-centered and novelty-centered BMs can significantly affect firm performance (Balboni, Bortoluzzi, Pugliese, & Tracogna, 2019; Wei et al., 2014; Zott & Amit, 2008). As discussed above, this study proposes the following hypothesis:

*Hypothesis 8: BMI, such as that based on (a) efficiency-centered, and (b) novelty-centered BM, is positively associated with firm performance.*

### *2.4 Moderators of Antecedents-BMI and BMI-Firm Performance Links*

In addition to resolving inconsistent empirical results, this research also investigates whether measurement and contextual variables affect the relationships between BMI and its antecedents, and between it and firm performance. The study identified three potential moderators (i.e., measurement of BMI, firm performance, and environmental uncertainty) of the relationships between antecedents-BMI and BMI-firm performance.

Great differences exist in the BMI measurement used in extant research; this may influence the direction or magnitude of the correlations between BMI and its antecedents. Most studies measure BMI by using Zott and Amit's (2007, 2008) scale, which was originally developed with 26 items to measure two types of BM design—efficiency-centered and novelty-centered. Items, such as "Inventory costs for participants in the BM" measures the efficiency-centered BMs. Items, such as "The BM provides new combinations of products, services, and information" measure novelty-centered BMs.

Some studies, however, use other scales (e.g.,Velu & Jacob, 2016; Wang et al., 2017). There are also some studies that use self-developed scales of prior literatures (e.g.,Hock, Clauss, & Schulz, 2016). The current study classified all of these, except for Zott and Amit's (2007; 2008) scale, into the "other" category. Because the theoretical basis and contents of different scales are not consistent, the connotation and extension of BMI are also different. The study assumes that the influence of different BMI measurements on the relationships between BMI and antecedents may be different. Therefore, the following assumption is proposed:

*Hypothesis 9: The type of BMI measurement used moderates the relationships between (a) contextual factors, (b)value network, (c)managerial cognition, (d) internal resource and capabilities, and (e) organization structure and activity, on the one hand, and BMI, on the other.*

As with the earlier argument, we propose that the influence of different BMI measurement on the relationship between BMI and firm performance may vary. With respect to the firm performance measurement, the extant BMI literature reveals two streams of firm performance measurement. One stream employs objective measures representing enterprises growth and profitability, such as sales growth rate, profit margin, and return on assets (ROA). The second stream employs perceptive measurements, which can be obtained through questionnaires or interviews capturing the perception of senior managers or supervisors about firm performance. Compared to the objective measurements, the accuracy of subjective evaluation is much more likely to be influenced by social desirability and common method bias; this may lead to an overestimation of the results.

In addition, contingency variable (e.g., environmental uncertainty) is generally regarded as an important moderating factor that influences the relationship between enterprises behavior and firm performance. Environmental uncertainty describes the degree of change and unpredictability of external environment, which is regarded as an important moderator in existing studies (Najmaei, 2016). When facing high rate

of environmental uncertainty, enterprises confront more uncertain factors, and it becomes very difficult to build and maintain competitive advantage via BMI; this affects enterprises performance. We therefore assume the moderating effect of environmental uncertainty. Thus,

*Hypothesis 10: The type of (a) BMI measurement, (b) firm performance measurement, and (c) environmental uncertainty will moderate the relationship between BMI and firm performance.*

A theoretical framework for our meta-analysis is presented in Figure 1.

**Figure 1 to be placed here**

## 3. Methodology

In this section, we describe how we assembled the sample via literature search, operationalization choices to exclude samples, coding procedures, and our meta-analytic procedures. We also explain our strategies for addressing the potential biases in our sample.

### *3.1 Literature Search*

To identify relevant BMI studies for our meta-analysis, we conducted a computer-based search of literature published between 2007 and October 2017 by using the Web of Science, EBSCO business source premier database, Wiley inter-science, and Google Scholar for articles containing the term "business model innovation" in the title, abstract, or keywords (Boolean phrase, English, limited to the field of business and management, limited to the types of article or review, that is, peer-reviewed work in academic journals). Other concepts, such as "innov* business model" and "business model evolution/ reinvention/ adaption/ dynamics" were also used to identify additional articles in the abovementioned databases (Foss & Saebi, 2017). Second, we conducted manual searches of special issues published on studies of business model (innovation) in some well-known journals, such as Long Range Planning (2010, 2013), International Journal of Innovation Management (2013), Industrial Marketing Management (2013), International Journal of Product Development (2013), R&D Management (2014), and Strategic Entrepreneurship Journal (2015). Third, we searched for articles (limited to CSSCI articles) in Chinese containing the terms "BMI" in title, abstract, or keywords in the database of the China National Knowledge Infrastructure. Finally, we examined the reference lists of recently published BMI studies to further identify any studies that we might have overlooked.

### *3.2 Inclusion Criteria*

We adopted three criteria to include studies in our meta-analysis. First, we included only those empirical studies on BMI that examine a correlation between BMI and its antecedents, or between it and firm performance. Second, studies have to report the reliability values of focal variables and zero-order correlation coefficient between BMI and its antecedents or between it and firm performance, together with the sample sizes. However, data obtained by structural equation models, regression analysis, or other statistical methods are not included. Third, the sample was limited to variables reported with

sufficient frequency (N≥3) to permit meta-analyses from independent studies. Ultimately, 74 published studies containing the information necessary to calculate effect sizes met the inclusion criteria and were employed for final analysis; among these, 19 studies had examined both the antecedents of BMI and its effect on firm performance. We divided the meta-analysis dataset into two subsets. The one focused on antecedents reported the correlations and sample sizes from 86 independent samples ($k$ = 86, $N$ = 23,917). The other focused on the firm performance, which formed the raw effect sizes from 42 independent studies ($k$ = 42, $N$ = 10,435).

### *3.3 Coding Procedures*

The first 15 studies from the two data sets are separately coded as a calibration sample by the authors. The authors reached an agreement on over 90% of the initial codes. The remaining discrepancies were resolved through subsequent discussion among authors until 100% agreement was reached, especially for some judgment-based codes. A coding scheme was then developed and the remaining studies are coded independently on the basis of the abovementioned criteria. Some discrepancy issues about the specific coding are resolved by referring to the original source or other relevant literature, which is also discussed until a consensus is achieved. Following statistics were coded: 1) the publication information; 2) the reliability values of focal variables; 3) the correlation coefficients between BMI and its antecedents or between it and firm performance; 4) the sample size ($N$); and 5) other sample information (e.g., response rate of the sample, nature and age of the enterprise).

It should be noted that when a study provides reliability values and correlations between multiple dimensions, the reliability values or correlations are averaged to yield a single estimate. For studies that do not report reliabilities, such as the objective variable of return on assets, mean reliability across the studies of the same construct that do report reliabilities are used. The correlation coefficients were weighted by the sample sizes, relative to the cumulative sample size for that specific relationship. We ensure that no single sample was included twice for a single correlation (Hunter & Schmidt, 2006). Two authors checked for errors and discrepancies, compiled the final coding results, and then ran the data.

### *3.4 Meta-Analytic Procedures*

A total of 87 effect sizes are computed for the antecedents-BMI relations (i.e., 45 for external and 42 for internal factors) and 42 for the BMI-firm performance relations. In addition, effect size estimates are calculated by the mean value of sample size weighted correlations from the primary studies; these offer more accuracy than estimates obtained from any study. During the process of correcting weighted mean correlations, positive and negative sampling errors canceled out. To control the measurement error, the formula $r_{x_t y_t} = \frac{r_{xy}}{\sqrt{r_{xx}}\sqrt{r_{yy}}}$, which represents the true correlation coefficient, is used to correct the correlation coefficients; $r_{xy}$ is used for observed correlation; $r_{xx}$ for the reliability of BMI; and $r_{yy}$ for the reliability of relevant variables (i.e., antecedents or firm performance). According to Borenstein,

Hedges, Higgins, and Rothstein (2011), we use CMA2.0 to estimate the effect value, taking advantage of $r_{x_t y_t}$, the sample size N, and the coding information of the related moderation effects. Specifically, fail-safe N (Rosenthal, 1979) and Egger's regression intercept (Egger, Smith, Schneider, & Minder, 1997) are used in this study to determine whether publication bias existed in our meta-analysis. Second, following the process of correcting measurement error and sampling error, homogeneity test is used to identify fixed- or random-effects model to test the hypothesis for examining the mean true-score relationships between BMI and antecedents (or between BMI and firm performance). Finally, we test the potential moderating effects using subgroup meta-analysis and regression (Hunter & Schmidt, 2006). In addition to reporting the true correlations, it is also vital to describe variance in meta-analysis. Accordingly, we report 95% confidence intervals around the estimated population correlations.

## 4.Results

Before assessing the hypothesized relationships between BMI and its antecedents and that between it and firm performance, the following sections briefly discuss the results of publication bias analysis shown in Table 2, as well as the homogeneity test shown in Tables 3 and 4. To examine the ten hypotheses and their subparts, the full lists of meta-analytic findings are shown in Table 3-7 for each category (e.g., main effect analysis of correlations for the antecedents-BMI and BMI-performance relationships, and the moderation analysis). The overall result of all the analyses is summarized below.

### *4.1 Publication Bias Analysis*

Publication bias, considered as the file drawer problem, is a common issue in meta-analysis. Non-significant or smaller effect sizes locked in the "drawer" were not selected in meta-analysis; this resulted in sample selection bias. The study dealt with potential publication bias by employing the Fail-Safe N (Rosenthal, 1979) and Egger's regression intercept (Egger et al., 1997) methods. Rosenthal's fail-safe N determines the number of unpublished studies with null results needed to reduce the cumulated effect across studies to the point of non-significance, while the coefficient of the Egger's regression intercept above 0.05 indicates that no bias can be identified in the meta-analysis. Table 2 reports the results of publication bias tests. Higher classic fail-safe N, which indicates a more stable result of the meta-analysis, is reported for all the relationships between BMI and its antecedents, and between it and firm performance. For instance, the fail-safe N for the overall effect size of market opportunity is 1,405; this means that it would take 1,405 non-significant studies to nullify these findings. As for Egger's regression intercept, the effect size is 18.91 with p-value of 0.73 (this is beyond the benchmark of 0.05), indicating that no bias can be identified. Except for the contextual factors, the rest of the Egger tests are not statistically significant, indicating that the issue of sample publication bias is not obvious.

**Table 2 to be placed here**

### *4.2 Homogeneity Test Analysis*

Commonly recommended approaches to assess heterogeneity are $Q$ statistics (the weighted sum of squares) and $I^2$ test (the proportion of dispersion that can be attributed to real differences in effect sizes, as opposed to within-study error). The random-effect model is suggested for a significant $Q$ statistic and an $I^2$ statistic more than 75%; otherwise, the fixed effect model is used.

Results in Tables 3 and 4 show that: (1) Apart from technology innovation, all the $Q$ values for the other variables are significant ($p$ <0 .05); this indicates that the effect size are heterogeneous to some extent. (2) All the $I^2$ values were greater than 75%, except for technology innovation, which showed non-negligible heterogeneity among various studies. Therefore, we adopted the random effect model to estimate the effect sizes, except for the relationship between technology innovation and BMI; this was estimated with a fixed effect model.

### *4.3 Main Effect Analysis*

Table 3 illustrates the meta-analytic results for the relationships between BMI and its antecedents. None of the 95% *CI* included zero for the relationships between external factors and BMI. Hypothesis 1 is supported because the estimated true-score correlation between market opportunity ($CI_{95}$= [0.36, 0.91], $Z$=3.27, $p$ <0.01) and BMI was 0.73. Consistent with Hypothesis 2, contextual factors ($r_c$ = 0.42, $CI_{95}$= [0.19, 0.61], $Z$=3.37, $p$ <0.01) have a significant positive relationship with BMI. Specifically, the environmental uncertainty ($CI_{95}$= [0.17, 0.73], $Z$=2.85, $p$ <0.01) and innovation legitimacy ($CI_{95}$= [0.04, 0.46], Z=2.28, $p$ <0.05) are both positively associated with BMI, with $r_c$ values of 0.50 and 0.26, respectively; therefore, Hypotheses 2a and 2b are supported. Value network ($r_c$=0.57, $CI_{95}$= [0.47, 0.66], $p$ <0.001), network embedding ($r_c$=0.54, $CI_{95}$= [0.43, 0.64], $p$ <0.001), and inter-organizational learning ($r_c$=0.67, $CI_{95}$ = [0.48, 0.79], $p$ <0.001) have a significantly positive association with BMI, providing support for Hypotheses 3, 3a, and 3b. According to the result of fixed effect test, Hypothesis 4 is supported because technology innovation ($r_c$=0.39, $CI_{95}$= [0.34, 0.45], $p$ <0.001) is moderately associated with BMI.

Regarding internal factors, all the effects are significant (i.e., none of the 95% *CI* included zero and $p$ <0.05). Managerial cognition ($r_c$=0.46), leader-related factor ($r_c$=0.43), opportunity recognition ($r_c$=0.51), inner resource and ability ($r_c$=0.45), employee-level capabilities($r_c$=0.37), enterprise-level capabilities ($r_c$=0.52), internal resources ($r_c$=0.33), organization structure and activity ($r_c$=0.52), and organizational structure ($r_c$=0.35), as well as organizational activity ($r_c$=0.64) are moderately to strongly associated with BMI. As presented in Table 3, and consistent with our expectations, Hypotheses 5-7 are supported.

**Table 3 to be placed here**

Table 4 presents our meta-analytic estimates for the relationship between BMI and firm performance. In support of Hypothesis 8, BMI is significantly associated with firm performance ($r_c$=0.48, $CI_{95}$= [0.37, 0.58], $Z$=7.38, $p$ <0.001). More specifically, hypothesis 8a posited a significant relationship between efficiency-centered BM and firm performance ($r_c$=0.34, $CI_{95}$= [0.20, 0.47], $p$ <0.001). Consistent with Hypothesis 8b, the results demonstrate a significant positive relationship between novelty-centered BM ($r_c$=0.27, $CI_{95}$= [0.12, 0.41], $p$ <0.001) and firm performance. Our findings support Hypothesis 8.

**Table 4 to be placed here**

### *4.4 Moderation Analysis*

Hypothesis 9 dealt with the possible moderating effects of BMI measurement (Zott & Amit [2007, 2008] vs. "other") on the antecedents-BMI relationships. As shown in Table 5, the results indicate that there are statistically non-significant mean differences between the effect sizes of the two categories. The relation between contextual factors and BMI is stronger when Zott & Amit (2007, 2008)'s measure is used ($r_c$ =0.58, $CI_{95}$= [0.39, 0.72]) than when "other" measures are used ($r_c$ = 0.33, $CI_{95}$= [0.02, 0.59]); however, there is a statistically non-significant between-group $Q$ statistic ($Q_b$ = 2.25, *ns.*). Contrary to our expectation, Hypothesis 9a is rejected. Contrary to what was proposed in Hypotheses 9b–9e, the measurement of BMI (Zott & Amit [2007, 2008] vs. "other") also failed to moderate the relationships between BMI and: value network ($Q_b$ = 0.06, *ns.*); managerial cognition ($Q_b$ = 1.13, *ns.*); inner resource and ability ($Q_b$ =0.23, *ns.*); and organization structure and activity ($Q_b$ = 1.78, *ns.*); all had statistically non-significant between-group $Q$ statistics. Therefore, Hypotheses 9b–9e are not supported. Overall, this suggests that the type of BMI measurement used does not moderate the antecedents-BMI relationship.

**Table 5 to be placed here**

Table 6 presents the results of the moderating effects of BMI measurement (Zott & Amit [2007, 2008] vs. "other"), and firm performance measurement (objective vs. perceptive measure) on the BMI-firm performance relationship. First, the results of BMI measurement (Zott & Amit [2007, 2008] show a weaker correlation than "other" ($r_c$ =0.38, $CI_{95}$= [0.29, 0.46] and $r_c$ =0.56, $CI_{95}$= [0.37, 0.71], respectively) with borderline significance for the between-group $Q$ statistic ($Q_b$ = 3.18, $p$ <0 .10). Second, the results indicate that the relation between BMI and firm performance is stronger when perception-based measure of firm performance is used ($r_c$ =0.51, $CI_{95}$= [0.38, 0.62]) than when objection-based measure is used ($r_c$ =0.31, $CI_{95}$= [0.09, 0.50]), with borderline significance for the between-group $Q$ statistic ($Q_b$ = 2.81, $p$ <0 .10). Consistent with our expectation, Hypotheses 10a–10b are supported.

**Table 6 to be placed here**

Table 7 presents the result of the moderating effect of contextual factor (i.e., environmental uncertainty) on the BMI-firm performance relationship. Consistent with what was proposed in Hypotheses 10c, environmental uncertainty exhibits a borderline significant moderating effect on the BMI-firm performance relationship ($\beta$ = -0.36, $p$ <0 .10). Therefore, Hypotheses 10c is supported.

**Table 7 to be placed here**

## 5. Discussion

This study: provides a meta-analytic review of antecedents and outcomes of BMI (i.e., firm performance); integrates previous studies that took a segmented view; and establishes a framework for further research in the BMI field. We synthesized 74 studies during the past 10 years, including 128 independent samples, to obtain a total sample size of 34,352 and derive a relatively convincing and enlightening result. First, this study reviewed related literature to identify relevant antecedents of BMI to synthesize the antecedents of BMI. Second, this study meta-analyzed the BMI-firm performance links to resolve inconsistent findings and to obtain the true correlation between BMI and firm performance. Third, this study investigated the moderating effect of measurement and contingency variables on the relationships between BMI and its antecedents, as well as that between it and firm performance, by comparing the above relationships in terms of different types of BMI measurement (Zott & Amit [2007, 2008] vs. "others"), performance measurement (objective measure vs. perceptive measure), and environmental uncertainty.

Guided by the transaction cost, social network, upper echelon, and resource-based theories, the meta-analysis first confirmed the results of prior research and identified four external and three internal antecedents of BMI; these are market opportunity, contextual factors, value network, technology innovation, managerial cognition, internal resource and capabilities, as well as organization structure and activity (e.g.,R. Amit & Zott, 2001; Martins et al., 2015; Ricciardi et al., 2016). The results demonstrated significant positive effects of the antecedents (i.e., external and internal factors) on BMI. The results also indicated that the average magnitude of the correlations of external antecedents of market opportunity, contextual factors, value network, and technology innovation with BMI was 0.53. Specifically, the corrected correlation of market opportunity and value network were 0.74 and 0.57, respectively. However, the average magnitude of the correlations of internal antecedents was only 0.47.

In addition, some scholars believe that BMI plays a significant role in achieving of superior performance in dynamic markets (Casadesus-Masanell & Enric Ricart, 2010; Kim & Min, 2015). Others insist that BMI can create value, but enterprises are not necessarily able to benefit from it (Casadesus-Masanell & Zhu, 2013; Desyllas & Sako, 2013). The results of our meta-analysis have settled this dispute and shown that BMI has a moderate to strong and significant positive correlation with firm performance. Specifically, the average value of the correlations of BMI with firm performance was 0.48. The

magnitudes of the correlations of different BM design themes, that is, efficiency-centered and novelty-centered BM with performance were 0.34 and 0.27, respectively. Therefore, by integrating the results of existing empirical studies, our results demonstrate that BMI (including efficiency-centered and novelty-centered BMs) are likely to benefit organizations through an improvement in firm performance.

Moreover, the study examined the moderating effects of the measuring tool and contingency variables (environment uncertainty) on the antecedents-BMI and BMI-firm performance relationships. First, subgroup analyses did not reveal a significant effect of BMI measure on the antecedents-BMI relationship, indicating that we cannot reject the null hypothesis that no difference was identified in the antecedents-BMI relationship across different types of BMI measurements. Second, with respect to the BMI-firm performance relationship, a borderline statistically significant difference between subgroups (BMI measurements: Zott and Amit [2007, 2008[ vs. "other" and performance measurements: perceived vs. objective measure) was observed. Third, the results of regression analysis also reveal that environment uncertainty ($\beta$=-0.36, $p$ <0.10) has a borderline significant effect on the BMI-firm performance relationship. Taken together, the study does not reveal much difference in antecedents-BMI relationships across different types of BMI measurement; this indicates that the specific scales used to measure BMI are not a critical issue in the antecedents-BMI relationship.

### *5.1. Theoretical Implications*

Although a growing number of studies endeavor to explore the antecedents of BMI and the impacts of BMI on firm performance, there is a lack of a systematic and comprehensive empirical review. As such, this meta-analysis aims to address the call by Foss and Saebi (2017) to elaborate on the BMI model incorporating antecedents, consequences, and moderating variables. The current study develops an integrative framework regarding the antecedents and the specific impact of BMI on firm performance, besides exploring the moderating role of the measuring tool and environmental uncertainty on the above relationships. This study contributes to the BMI field by summarizing existing empirical findings and reconciling the conflicting results of prior research. Through a meta-analysis, we can obtain the true correlations of antecedents-BMI links and BMI-firm performance links with greater confidence and make broader generalizations about the validity of our results. Our findings offer important implications for understanding the relationships between BMI and its antecedents, and firm performance.

First, our meta-analysis clarifies the antecedents of BMI; specifically, it identifies four external and three internal factors, besides examining the influence of these antecedents on BMI. Existing studies (e.g.,R. Amit & Zott, 2001; Aspara et al., 2013; Henry Chesbrough, 2013; George & Bock, 2011; Guo et al., 2017; Sosna et al., 2010; Teece, 2010; Wang et al., 2017; Wirtz et al., 2010) attempt to explore the motivators of BMI from their own perspectives; this increases the cognitive burden while understanding the antecedents of BMI. Following Foss and Saebi (2017) we classify these antecedents into two categories and focus on the external and internal factors that significantly and positively

correlate with BMI.

Second, the study further clarifies the influence of BMI on firm performance and finds significant positive correlations in this link. Inconsistent conclusions have been reported in the prior studies; for example, some scholars have pointed out a discrepancy in understanding whether BMI will benefit firm performance (e.g.,Casadesus-Masanell & Zhu, 2013; Futterer et al., 2018) or whether BMI has the same impact once the correlations between it and firm performance are predicted to be positive(e.g., Bouncken & Fredrich, 2016versus; Najmaei, 2016). Through a meta-analysis, this study obtains relatively reliable correlations between the abovementioned relationships.

Third, this study identifies some contextual factors, such as the measuring tool and environmental uncertainty, that possibly influence the antecedents-BMI and BMI-firm performance links. Among numerous contextual factors, the measuring tool is the one that is more difficult to explore. By comparing the different results, through meta-analysis, we succeed in predicting the influence of measuring tool on antecedents-BMI and BMI-firm performance links. Although studies using the Zott and Amit (2007, 2008), and "other" scale obtain roughly the same results when exploring the same relationship between BMI and its antecedents, we find that the measurement of BMI (Zott and Amit (2007, 2008) vs. "other"), firm performance (perceived vs. objective measure), and environment uncertainty have borderline significant effects on the relationship between BMI and firm performance; this indicates the need to cautiously choose the measurement tool while attempting to explore this relationship in future.

In general, unlike narrative literature reviews, meta-analysis attempts to quantitatively summarize the findings across studies and establish the generalizability of reported relationships. Therefore, this study provides a systematic empirical synthesis and theoretical framework to address this issue by integrating the antecedents and outcomes of BMI. Specially, this quantitative review examines the magnitudes of the associations among antecedents-BMI and BMI-firm performance relationships. As a result, our conceptual integration advances the understanding of BMI, besides pointing out some problems that need to be addressed in future research.

### *5.2. Managerial Implications*

This study also has important managerial implications. First, it provides guidelines to business managers about the way to promote BMI. Because BMI is always a focus area for managers (Foss & Saebi, 2017), understanding the motivations of BMI helps practitioners to recognize the essential aspects of BMI required for firm performance. This study establishes that market opportunity, contextual factor, value network, and technology innovation are indeed the important external triggers, while managerial cognition, internal resources and capabilities, and organization structure and activity are the important internal motivators of BMI. Thus, the results help managers to locate the motivators, and allow them to determine the targets requiring attention, as well as how much of it, to achieve BMI.

Moreover, it is necessary for enterprises to understand the antecedents of BMI to ensure the realization of BMI using the ways suitable for different enterprise types and characteristics.

Second, as our findings have highlighted, BMIs (including efficiency-centered and novelty-centered BMIs) are positively correlated with firm performance; this further confirms the benefit that BMI confers to the organizations. Because BMI is a key factor that significantly contributes to competitive advantage and performance (Aspara et al., 2010; Henry Chesbrough, 2010), owners and managers should give considerable attention to BMI if their enterprises want to succeed in the competitive environment and survive the market forces. In addition, managers and owners are also required to keep an eye on the business activities related to value creation and delivery, and allocate sufficient resources to improve BMI (including efficiency-centered and novelty-centered BMs). This would not only help to improve the performance of their organizations, but also increase the competitive advantage over other firms.

Third, our results reveal that BMI and performance measurement have borderline significant moderating effects on BMI-firm performance relationship; this should remind the managers to focus on the way of assessment of BMI and performance when exploring the benefit of BMI. Our results further suggest that environmental uncertainty is a borderline moderator of the BMI-firm performance relationship. This result reinforces contingent arguments, and provides indirect validation of the tradeoffs inherent in adopting BMI. Despite the benefits of BMI, it is difficult for the enterprises to build and maintain competitive advantage via BMI when facing a high degree of environmental uncertainty (Najmaei, 2016). As such, the clear evidence of borderline moderating effects implies that managers should not pursue BMI without considering the context or contingency. More importantly, to cope with the fierce market competition, the ability to develop innovative BMs under uncertain environmental conditions has become the cornerstone for the competitiveness of many successful firms. Organizations should implement developmental programs that offer more opportunities for the managers to deal with the adverse effects of an uncertainty-filled environment.

### *5.3 Limitations and Future Research Directions*

The study has some limitations that need to be considered when interpreting its results. The first limitation of this meta-analysis is that the empirical literature on BMI is relatively recent and still growing; this means that a limited number of studies are available for examining the antecedents-BMI and BMI-firm performance relationships (Demil et al., 2015; Foss & Saebi, 2017). In addition, the studies that examine antecedents-BMI relationship cannot be meta-analyzed because a sufficient number of correlations (at least three) are unavailable. The limited number of studies on specific topics in the field may lower the robustness of the results. Therefore, it is expected that more empirical studies on BMI will be conducted in the near future. Second, the study fails to introduce other variables mediating or moderating the antecedents-BMI and BMI-firm performance relationships. Especially,

most of the previous heterogeneity tests of the main effect relationship are statistically significant, indicating the presence of situational moderators that deserve our attention. Further meta-analysis can be conducted with empirical studies as the field of BMI develops. Further, future research could also focus on the mediation and moderation mechanism when exploring the factors influencing BMI and their role; this would enrich the understanding of the research on BMI. Finally, there are differences across industries, incumbents, and startups in the antecedents and effects of BMI on firm performance (Foss & Saebi, 2017). Consequently, future meta-analytic examinations of BMI research could examine the moderating effects of different industries (i.e., manufacturing vs. non-manufacturing) and types of firms (i.e., incumbent vs. startup).

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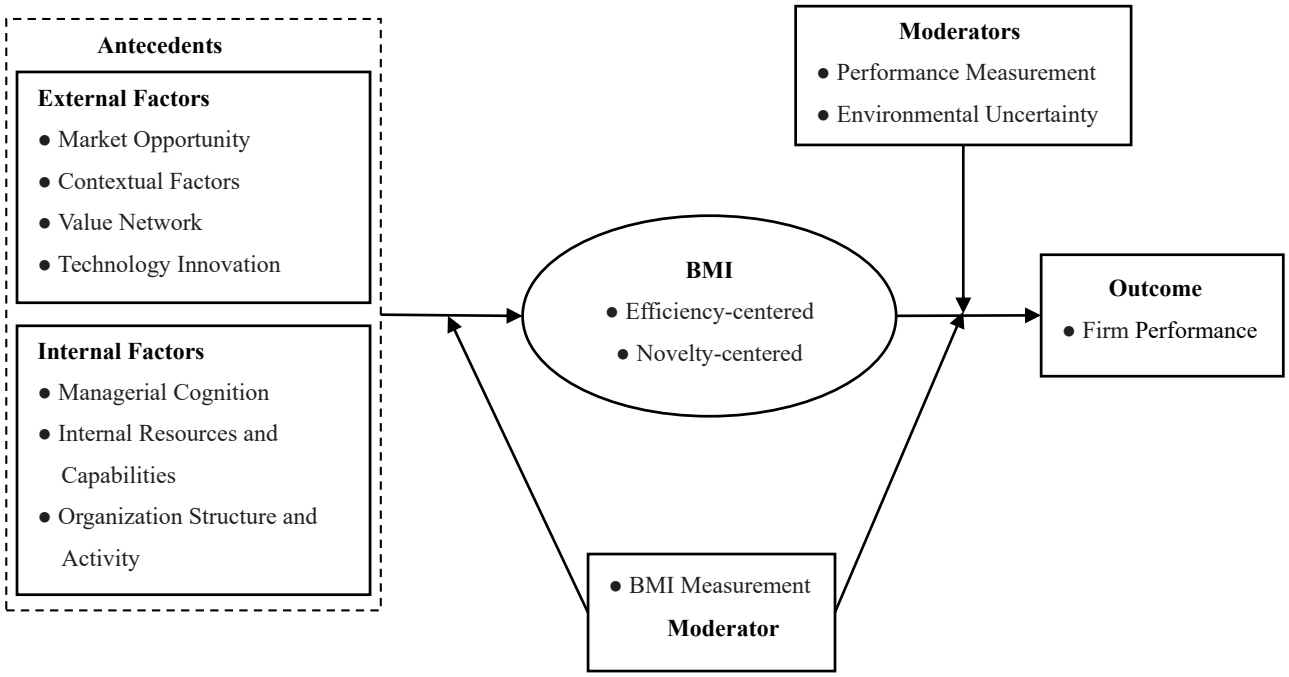


**Figure 1**: **Theoretical Framework of antecedents and outcome of BMI**

**Table 1. Categories used in the meta-analysis**

| Category | Sample concepts |
|---|---|
| ***External Factors*** | |
| Market opportunity | |
| Contextual factors | Environmental uncertainty (i.e., environmental uncertainty/dynamism, competition intensity, perceived critical threat); Innovation legitimacy |
| Value network | Network embedding (i.e., network embedding, managerial ties, corporate social ties, social capital); Inter-organizational learning (i.e., boundary-spanning search, knowledge sharing among organizations) |
| Technology innovation | |
| ***Internal Factors*** | |
| Managerial cognition | Leader-related factor (i.e., transformational leadership, top-manager proactive personality, top management team heterogeneity, entrepreneurs' background characteristics); Opportunity recognition |
| Internal resources and capabilities | Employee-level capabilities (i.e., employee entrepreneurship/absorptive capacity); Enterprise-level capabilities (i.e., firm capabilities/integrative capability/dynamic capability/absorptive Capacity); Internal resources (i.e., intangible assets, IT infrastructure) |
| Organization structure and activity | Organization structure (i.e., organization structure, organization modularity, governance structure), Organization activity (i.e., exploitative/explorative learning, entrepreneurial learning) |
| ***BMI*** | BM innovation/adaption, Efficiency-centered BM, Novelty-centered BM |
| ***Firm Performance*** | Firm performance, financial performance, return on equity, firm growth, stock market value, operating performance, innovation performance |

**Table 2. Results of Publication Bias Test**

| Relationship | K | N | Classic fail-safe N | Egger's Intercept | p |
|---|---|---|---|---|---|
| ***External Factors*** | | | | | |
| Market Opportunity→BMI | 5 | 1274 | 1405 | 18.91 | 0.73 |
| Contextual Factors→BMI | 18 | 5326 | 3112 | 14.92 | 0.03 |
| Value Network→BMI | 19 | 4788 | 8959 | 3.30 | 0.52 |
| Technology Innovation→BMI | 3 | 1019 | 134 | -50.63 | 0.78 |
| ***Internal Factors*** | | | | | |
| Managerial Cognition→BMI | 11 | 2252 | 1681 | -13.06 | 0.29 |
| Internal Resource and Capabilities→BMI | 17 | 4658 | 4503 | 2.45 | 0.70 |
| Organization Structure and Activity→BMI | 14 | 4719 | 4348 | 10.23 | 0.21 |
| ***Firm Performance*** | | | | | |
| BMI→Firm Performance | 42 | 10435 | 7265 | 3.63 | 0.38 |
| Efficiency-centered→Firm Performance | 15 | 3497 | 1376 | 5.10 | 0.20 |
| Novelty-centered→Firm Performance | 14 | 3389 | 696 | 7.89 | 0.05 |

***Note:*** *K = number of independent effect sizes in the analysis; N = total sample size; Classic fail-safe N = the number of unpublished studies with null results that is needed to reduce the cumulated effect across studies to the point of non-significance; Egger's Intercept= the intercept of Egger's regression;p = the p-value for Egger's Intercept.*

**Table 3. Meta-Analytic Correlations for Antecedents-BMI Relationship**

| Variables | k | N | $r_c$ | 95% CI | | Z | p | Homogeneity Test | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | LL | UL | | | Q | $p_Q$ | $I^2$ |
| ***External Factors*** | | | | | | | | | | |
| Market Opportunity | 5 | 1274 | 0.73 | 0.36 | 0.91 | 3.27 | 0.00 | 411.08 | 0.00 | 99.03 |
| Contextual Factors | 18 | 5326 | 0.42 | 0.19 | 0.61 | 3.37 | 0.00 | 1527.06 | 0.00 | 98.89 |
| Environmental Uncertainty | 12 | 3676 | 0.50 | 0.17 | 0.73 | 2.85 | 0.00 | 1381.80 | 0.00 | 99.20 |
| Innovation Legitimacy | 4 | 1089 | 0.26 | 0.04 | 0.46 | 2.28 | 0.02 | 39.91 | 0.00 | 92.48 |
| Value Network | 19 | 4788 | 0.57 | 0.47 | 0.66 | 9.12 | 0.00 | 419.34 | 0.00 | 95.71 |
| Network Embedding | 15 | 3557 | 0.54 | 0.43 | 0.63 | 8.12 | 0.00 | 265.65 | 0.00 | 94.73 |
| Inter-organizational Learning | 4 | 1231 | 0.67 | 0.48 | 0.79 | 5.60 | 0.00 | 70.94 | 0.00 | 95.77 |
| Technology Innovation | 3 | 1019 | 0.39 | 0.34 | 0.45 | 13.23 | 0.00 | 5.60 | 0.06 | 64.31 |
| ***Internal Factors*** | | | | | | | | | | |
| Managerial Cognition | 11 | 2252 | 0.46 | 0.23 | 0.65 | 3.62 | 0.00 | 418.77 | 0.00 | 97.61 |
| Leader-related Factor | 7 | 1486 | 0.43 | 0.09 | 0.68 | 2.43 | 0.02 | 309.99 | 0.00 | 98.06 |
| Opportunity Recognition | 4 | 766 | 0.51 | 0.14 | 0.76 | 2.58 | 0.01 | 108.68 | 0.00 | 97.24 |
| Inner Resource and Ability | 17 | 4658 | 0.45 | 0.32 | 0.57 | 6.15 | 0.00 | 456.24 | 0.00 | 96.49 |
| Employee-Level Capabilities | 4 | 1205 | 0.37 | 0.12 | 0.57 | 2.90 | 0.00 | 57.16 | 0.00 | 94.75 |
| Enterprise-Level Capabilities | 10 | 2389 | 0.52 | 0.31 | 0.68 | 4.41 | 0.00 | 351.17 | 0.00 | 97.44 |
| Internal Resources | 3 | 1064 | 0.33 | 0.14 | 0.50 | 3.30 | 0.00 | 23.34 | 0.00 | 91.43 |
| Organization Structure and Activity | 14 | 4719 | 0.52 | 0.28 | 0.70 | 3.91 | 0.00 | 1261.63 | 0.00 | 98.97 |
| Organizational Structure | 4 | 1254 | 0.35 | 0.11 | 0.55 | 2.79 | 0.01 | 58.20 | 0.00 | 94.85 |
| Organizational Activity | 9 | 1092 | 0.64 | 0.34 | 0.82 | 3.69 | 0.00 | 1015.76 | 0.00 | 99.21 |

*Note: k= number of studies included in the analysis; N=total sample size; $r_c$= correlations controlling measurement and sampling error; 95%CI, LL-UL = the minimum and maximum limits of the 95% confidence interval; Z= the Z statistic; Q = statistical test used for the estimation of heterogeneity; $p_Q$ = the p-value for the Q statistic; $I^2$ = proportion of effect size variance that can be attributed to moderator variables (%).*

**Table 4. Meta-Analytic Correlations for BMI-Firm Performance Relationship**

| Variables | k | N | $r_c$ | 95% CI | | Z | p | Homogeneity Test | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | LL | UL | | | Q | $p_Q$ | $I^2$ |
| ***BMI*** | 42 | 10435 | 0.48 | 0.37 | 0.58 | 7.38 | 0.00 | 2074.40 | 0.00 | 98.02 |
| Efficiency-centered | 15 | 3497 | 0.34 | 0.20 | 0.47 | 4.53 | 0.00 | 274.29 | 0.00 | 94.90 |
| Novelty-centered | 14 | 3389 | 0.27 | 0.12 | 0.41 | 3.42 | 0.00 | 264.77 | 0.00 | 95.09 |

*Note: k= number of studies included in the analysis; N=total sample size; $r_c$ = correlations controlling measurement and sampling error; 95%CI, LL-UL = the minimum and maximum limits of the 95% confidence interval; Z= the Z statistic; Q = statistical test used for the estimation of heterogeneity; $p_Q$ = the p-value for the Q statistic; $I^2$ = proportion of effect size variance that can be attributed to moderator variables (%).*

**Table 5. Moderating Effects of BMI Measurement on the Antecedents-BMI Relationship**

| Relationships | Subgroups | k | N | $r_c$ | 95% CI | | $Q_b$ | p |
|---|---|---|---|---|---|---|---|---|
| | | | | | LL | UL | | |
| Contextual Factors→BMI | Zott & Amit(2007,2008) | 6 | 1157 | 0.58 | 0.39 | 0.72 | 2.25 | 0.13 |
| | other | 12 | 3985 | 0.33 | 0.02 | 0.59 | | |
| Value Network→BMI | Zott & Amit(2007,2008) | 12 | 2618 | 0.55 | 0.42 | 0.66 | 0.06 | 0.81 |
| | other | 6 | 1826 | 0.57 | 0.37 | 0.72 | | |
| Managerial Cognition→BMI | Zott & Amit(2007,2008) | 4 | 719 | 0.58 | 0.37 | 0.74 | 1.13 | 0.29 |
| | other | 7 | 1533 | 0.39 | 0.01 | 0.66 | | |
| Inner Resource and Ability→BMI | Zott & Amit(2007,2008) | 5 | 937 | 0.49 | 0.32 | 0.64 | 0.23 | 0.63 |
| | other | 12 | 3496 | 0.44 | 0.26 | 0.58 | | |
| Organization Structure and Activity→BMI | Zott & Amit(2007,2008) | 5 | 1125 | 0.66 | 0.43 | 0.82 | 1.78 | 0.18 |
| | other | 9 | 3594 | 0.43 | 0.08 | 0.68 | | |

*Note: k= number of studies included in the analysis; N=total sample size; $r_c$ = correlations controlling measurement and sampling error; 95%CI, LL-UL = the minimum and maximum limits of the 95% confidence interval; $Q_b$ = Q statistic of the between-group means; P= T value of the $Q_b$ statistic. "other" refers to scales that studies used other scales other than Zott & Amit (2007, 2008).*

**Table 6. Moderating Effects of Variable Measurement on BMI-Firm Performance Relationship**

| Relationship | Subgroups | k | N | $r_c$ | 95% CI | | $Q_b$ | p |
|---|---|---|---|---|---|---|---|---|
| | | | | | LL | UL | | |
| | ***BMI Measurement*** | | | | | | | |
| BMI→Firm Performance | Zott & Amit (2007,2008) | 22 | 5013 | 0.38 | 0.29 | 0.46 | 3.18 | 0.08† |
| | other | 21 | 5834 | 0.56 | 0.37 | 0.71 | | |
| | ***Performance Measurement*** | | | | | | | |
| BMI→Firm Performance | Perception Measurement | 32 | 7765 | 0.51 | 0.38 | 0.62 | 2.81 | 0.09† |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Objective Measurement | 12 | 2670 | 0.31 | 0.09 | 0.50 |

*Note: k= number of studies included in the analysis; N=total sample size; $r_c$ = correlations controlling measurement and sampling error; 95%CI, LL-UL = the minimum and maximum limits of the 95% confidence interval; $Q_b$= between-group test of homogeneity, with a significant value indicating moderator explains variability of effect sizes; p = p value of the $Q_b$ statistic.*

*"other" refers to scales that studies used scales other than Zott & Amit (2007, 2008), †p <0 .1.*

**Table 7. Moderating Effects of Environmental Uncertainty on BMI-Firm Performance Relationship**

| Relationship | Moderator | k | β | p |
|---|---|---|---|---|
| BMI→Firm Performance | Environmental Uncertainty | 4 | -0.36 | 0.07† |

*Note: k= number of studies included in the analysis; β= regression coefficient; p= p value of the regression coefficient. †p <0 .1.*