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Disentangling the complex longitudinal relationships between business model innovation and firm performance

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ABSTRACT

Despite the increasing interest in business model innovation (BMI), the literature lacks solid empirical evidence about its impact over time. We address this gap by taking an element-based perspective, differentiating three core dimensions: value creation, value proposition, and value capture. We collected cross-industry data based on more than 35,000 press releases, capturing over 2,300 events of BMI from 60 German publicly traded corporations, and regressing them against firm performance measures. Our findings show that BMI has a positive, albeit lagged effect on firm performance. We further find substitutive as well as complementary effects of the different business model dimensions. Moreover, concentrated BMI activities outperform BMI activities dispersed across different business model dimensions when it comes to subsequent firm performance. Our findings contribute to the literature by stimulating a deeper reflection on the role of resource allocation, highlighting the need to carefully plan BMI activities at the level of strategic management.

1. Introduction

For more than a decade, business model innovation (BMI) has attracted ongoing attention in both academic research and management practice (Foss & Saebi, 2017; Massa & Tucci, 2014; Ritter & Lettl, 2018). Interpreting business models as attributes of real firms (Massa et al., 2017), BMI is defined as novel changes to one or more of the three core dimensions of a business model: value creation, value proposition, and value capture (Clauss, 2017; Foss & Saebi, 2017; Klein et al., 2021; Teece, 2010).

Despite the general assumption that BMI is key to firms' performance (Zott et al., 2011), this assumption relies on a rather inconclusive and ambiguous empirical foundation (Foss & Saebi, 2017; Hartmann et al., 2013; Latifi et al., 2021), and has only recently been challenged by findings identifying the potential negative performance effects of BMI (Clauss et al., 2019; Visnjic et al., 2016). Thus, the economic sense of investments in BMI should at the very least be questioned. The way in which resources should be allocated to BMI has to date hardly been explored (Lanzolla & Markides, 2021). In their comprehensive literature review on BMI, Foss and Saebi (2017) conclude that recent studies test how different business model designs are related to innovation performance, rather than directly linking BMI activities to firms' overall performance outcomes. The few existing studies on the direct BMI-performance relationship are either case-based and thus not generalizable in their findings, or cross-sectional and/or sector-specific, focusing e.g. on the U.S. newspaper industry (Karimi & Walter, 2016), U.S. retail (Kim & Min, 2015), Australian pension funds (Hartmann et al., 2013), the German electronics industry (Clauss et al., 2019), or Italian clothing SMEs (Cucculelli & Bettinelli, 2015).

Although these valuable contributions broaden our understanding of the general BMI-performance relationship in particular contexts, these studies treat BMI as a holistic construct (with Clauss et al. (2019) being the exemption) without accounting for the particular configurations of the innovated business model dimensions. This is an important omission, especially when considering how previous research has indicated that BMI can be constituted through different reconfigurations of particular business model dimensions (e.g., Clauss et al., 2020; Kulins et al., 2016; Leppänen et al., 2023). As the degree to which each business model dimension is innovated may vary across firms and contingencies, a deeper understanding of the BMI-performance relationship should consider the interaction effects of simultaneous innovation activities in each business model dimension. For example, while good solutions

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might fail in isolation, the connection between dimensions (e.g., the joint innovation of value creation and value capture) may yield superior results (Leppänen et al., 2023). We consider the investigation of these interaction effects to be theoretically and practically relevant. Scholars have called for empirical analyses of the interdependencies among business model dimensions and their effect on firm performance (e.g., Foss & Saebi, 2017; Ramdani et al., 2019; Sorescu et al., 2011). Spieth et al. (2014, p. 244) even state that "interaction processes and effects in business model innovation are important to the extent that good designs in isolation can fail." From the perspective of the resource-based view (RBV), investigating whether BMI activities in different dimensions of the business model yield complementary or substitutive effects (Sjödin et al., 2020) helps to provide a better understanding regarding whether changes in multiple dimensions of the business model will create synergies or conflicts in the allocation of resources (Lanzolla & Markides, 2021; Kohtamäki et al., 2019). In a similar vein, the question arises whether a greater focus on more homogenous innovation activities (i.e., innovating only one dimension of the business model), or a spreading of resources across more diverse innovation activities (i.e., simultaneously pursuing innovation in multiple dimensions of the business model) fosters firm performance.

From a practical perspective, BMI constitutes a decision problem for managers, as it requires the allocation of scarce resources for seizing emerging opportunities (Khanagha et al., 2014; Teece, 2018; Velu & Stiles, 2013). Each BMI activity displays a resource allocation in a certain direction, and a decision against alternative BMI foci. Here, the allocation of resources to BMI activities may or may not be concentrated on a certain dimension of the business model and/or benefit from complementarities of activities between BMI dimensions. Managers as a consequence benefit from a better knowledge about how the simultaneous pursuit of innovation activities in multiple business model dimensions will affect their firm performance.

However, so far little is known about how to innovate the business model to enhance subsequent firm performance. It remains unclear how these activities relate to each other and how companies pursuing multiple BMI activities should navigate through the process, especially when companies initiate multiple BMI activities. While scholars identify sharing and redeployment of resources as well as balancing resource allocations to be a crucial BMI capability (e.g., Achtenhagen et al., 2013; Ahuja & Novelli, 2016; Doz & Kosonen, 2010), research lacks more thorough comprehension of how resource allocations during BMI are related to firm performance (Massa et al., 2017; Sjödin et al., 2020), and scholars call for guidance to choose from a set of feasible BMI activity options (Lanzolla & Markides, 2021). In an effort to close this BMI-resource allocation gap, Lanzolla and Markides (2021, p. 551) call for business model research to investigate from a resource-based perspective "what activities should be connected" to achieve superior performance.

In addition to a lack of understanding about the effects of simultaneously innovating multiple business model dimensions, our research addresses a more methodological research gap. Previous research has primarily investigated the BMI-performance relationship without considering the important role of time. However, as BMI activities may require time to achieve full productivity, and customers may need time to recognize new opportunities stemming from new product and service offerings, performance effects may unfold over time. Hence, the time lag between the realization of BMI and performance outcomes "may be substantial" (Foss & Saebi, 2017, p. 212), questioning findings from cross-sectional studies as a result. To close this BMI-performance gap, scholars have called for cumulative empirical work to provide more generalizable results based on robust, large-scale, cross-industry investigations with a longitudinal research design (e.g., Aspara et al., 2010; Foss & Saebi, 2017; Sohl et al., 2020). Our study seeks to answer three research questions to address these research gaps: *(1) How do BMI activities in different business model dimensions affect firm performance over time? (2) How do simultaneous BMI activities among the different business model dimensions affect firm performance over time? (3) Do concentrated BMI activities outperform BMI activities dispersed across different business model dimensions?* We empirically examined the complex BMI-performance relationship in detail to find these answers while considering three important aspects. First, we investigated the effects of BMI in a longitudinal setting over a period of 11 years. Our longitudinal research design captured potential time lags between the three BMI dimensions and firm performance, which might have remained undetected in previous cross-sectional studies. Second, instead of treating BMI as a universal construct, we broke it down into its three core dimensions of value creation innovation, value proposition innovation, and value capture innovation (Clauss, 2017; Clauss et al., 2020; Klein et al., 2021; Osterwalder et al., 2005; Spieth & Schneider, 2016; Teece, 2018). Focusing on these dimensions of BMI (Foss & Saebi, 2017), we follow an element-based perspective[1] which assumes that BMI results from the separate yet interrelated innovation activities among the different dimensions (e.g., Bock et al., 2012; Foss & Saebi, 2017; Schrauder et al., 2018; Sorescu, 2017; Teece, 2010). To capture BMI events in these three dimensions, we adapted the measurement model developed by Clauss (2017), assembling a hand-collected cross-industry dataset based on more than 35,000 press releases, and capturing over 2,300 BMI activities in 60 German prime standard listed corporations between the years 2007–2017. Third, by building on theoretical arguments about the role of scarce recources for BMI activities (Lanzolla & Markides, 2021), we continue the qualitative work by Sjödin et al. (2020), investigating the interaction effects of simultaneous activities among the different business model dimensions. Thus, we obtain valuable insights into whether the simultaneous pursuit of BMI activities in the three core dimensions yields complementary or substitutive effects. Finally, and in a similar vein, we examine the role concentrated BMI activities across business model dimensions play for subsequent firm performance, collecting further evidence to provide guidance for the decision problem of resource allocation during BMI.

Our study contributes to the body of BMI literature in two ways. First, our study extends previous literature on the BMI-performance relationship by analyzing how simultaneous innovation activities in the different business model dimensions interact with each other. In line with Achtenhagen et al. (2013), Ahuja and Novelli (2016), and Lanzolla and Markides (2021), our study stimulates a deeper reflection on resource allocations in the context of BMI activities. More precisely, based on our results, decision-makers can derive implications regarding which BMI activities to choose among the multitude of options, while allocating resources accordingly. We find substitutive effects when two dimensions of the business model, value creation and value proposition, are simultaneously innovated. In contrast, value capture innovation tends to complement value proposition innovation. What is more, concentrated BMI activities outperform BMI activities dispersed across different BMI dimensions when it comes to subsequent firm performance. Hence, BMI does not appear to follow a logic of "the more, the better." Instead, BMI requires the careful strategic planning of systematic changes to prevent an uneconomic use of resources. Thus, this study provides initial guidance to the resource allocation problem during BMI, suggesting managerial implications regarding how to innovate the business model. Second, we extend the knowledge about the relationship between BMI and firm performance in a longitudinal, cross-industry setting. Our study shows that different BMI dimensions may require significantly different time spans before positive performance effects actually unfold, thereby providing a potential explanation for previous cross-sectional studies that found either no clear direct effects (e.g., Latifi et al., 2021), or even negative effects of BMI (e.g., Clauss et al., 2019).

[1] The terms "business model elements", "business model components", or "business model dimensions" are used in the literature. In this study, these terms are understood as synonymous, and we consistently refer to the latter.

The remainder of this study is structured as follows. Section 2 details the conceptual background and presents our research hypotheses. Section 3 explains our data and describes our research design. Section 4 presents our research results. Section 5 discusses our key findings and outlines our contribution to the literature and practice. A final section concludes.

2. Conceptual background and hypotheses

2.1. Business models and business model innovation

Business models explain "how firms do business" (Zott et al., 2011, p. 1020), and are further described as the logic a firm uses to operate and create value for stakeholders (Casadesus-Masanell & Ricart, 2010). While scholars long struggled to find a widely accepted definition (Shafer et al., 2005), Foss and Saebi (2017) observe a convergence of definitions toward that of Teece (2010, p. 172), who describes business models as "the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit.".

Despite the utilization of different terminologies, "the literature converges on the components that constitute a business model" (Foss & Saebi, 2017, p. 202). Scholars agree on three main dimensions of business models: value creation, value proposition, and value capture (e.g., Clauss, 2017; Johnson et al., 2008; Morris et al., 2005; Schrauder et al., 2018; Sorescu, 2017; Spieth & Schneider, 2016; von Delft et al., 2019).[2] The value creation dimension describes the structure of the value chain for creating customer offerings (Chesbrough, 2010). This requires the organization of key resources and assets following intra- and inter-organizational processes (Achtenhagen et al., 2013; Johnson et al., 2008; Teece, 2010). The value proposition dimension defines how products and services are offered and delivered to customers. This implies identifying customers' needs, and designing adequate offerings, channels, and relationships all targeted to raise a customers' willingness to pay (Johnson et al., 2008; Morris et al., 2005; Teece, 2010). The value capture dimension describes the blueprint of how a company creates value for itself, comprising its revenue model and cost structure; as Johnson et al. (2008, p. 58) put it, value capture describes the "profit formula" of a firm.

Companies commercialize innovative ideas and technologies through their business models (Chesbrough, 2010). However, because some innovations need to be matched with the business model to capture value (Wei et al., 2014), the business model itself can be the subject of innovation (Calia et al., 2007; Chesbrough, 2010; Teece, 2010; Zott et al., 2011). As markets change with the introduction of innovations, new competitors and entrants, changing regulations, and so on, business models may face the threat of becoming less profitable, or even obsolete. BMI as a result can be seen as an approach for maintaining a competitive position (Bucherer et al., 2012; Casadesus-Masanell & Ricart, 2010).

In this view, the business model becomes a new, powerful unit of innovation. Whereas product innovation refers to introducing new products and services, and process innovation refers to the implementation of new processes, manufacturing methods, or operations (Snihur & Wiklund, 2019), BMI complements product and process innovation through a holistic perspective on innovation potentials in the elements of an organization (Hock-Doepgen et al., 2021). Therefore, BMI may involve elements of product and process innovation, e.g., establishing a new business model to commercialize a new product (Chesbrough & Rosenbloom, 2002) or adapting processes and operations to new business model ideas (Clauss et al., 2019). However, in line with our definition, BMI is a more fundamental change of the elements of the business model and its connections. Thus, it does usually not follow internal innovation processes, but instead relies on external knowledge (Snihur & Wiklund, 2019) and capabilities (Bouncken & Fredrich, 2016), and is driven by external factors such as technology turbulence and market-related forces (Bouwman et al., 2018; De Reuver et al., 2009b). Although the nature of BMI is more systemic, its scope does not necessarily require radical changes in one or all business model elements; it can also be the result of more incremental reconfigurations of these (Foss & Saebi, 2017). We as a result take the perspective that BMI might involve different foci of innovation activities, and does not necessarily involve simultaneous innovation within all three business model dimensions (Clauss et al., 2020; Foss & Saebi, 2018; Massa & Tucci, 2014).

2.2. Business model innovation and firm performance

Research has devoted considerable effort to testing the role of business models in explaining differences in firm performance (Massa et al., 2017). Zott and Amit (2008) demonstrate that certain business model topics augment competitive advantages and enhance market capitalization. Regarding innovations to the business model, scholars argue that BMI is a key source of competitive advantage and therefore among the keys to firm performance (e.g., Casadesus-Masanell & Ricart, 2010; Morris et al., 2005; Sosna et al., 2010; Spieth & Schneider, 2016; Teece, 2010). The capability to innovate an established business model is considered crucial for any firm, especially in dynamic business environments (Doz & Kosonen, 2010), and important to the ability to counter threats for success in the long run (Sosna et al., 2010) and harness new technologies (Chesbrough & Rosenbloom, 2002). Moreover, studies reveal that technological developments only promote firm performance when aligned with adequate business models (Chesbrough, 2010; Wei et al., 2014). With this in mind, of important note is that many attempts to innovate a business model fail (Koen et al., 2011).

In terms of empirical evidence, industry-specific studies that treat BMI as a holistic construct have predominantly suggested its positive performance effects. Based on a survey of Finnish firms, Aspara et al. (2010) find a positive relationship between a strategic emphasis on BMI and firm performance. Their findings are in line with those of Heij et al. (2014) who focus on the Dutch market. Also, Hartmann et al. (2013) find that BMI has a positive effect on firm performance. Karimi and Walter (2016) identify a positive, non-linear relationship between BMI adoption and business model performance in the newspaper industry. In addition to direct BMI-performance relationships, further empirical studies identify a mediating role of BMI in the relationship between specific organizational factors such as entrepreneurial orientation, opportunity recognition, organizational agility, and firm performance (e.g., Bhatti et al., 2021; Ferreras-Méndez et al., 2021; Guo et al., 2017). Positive correlations between BMI and firm performance have also been observed within correlation reports (e.g., Nunes & Pereira, 2021; Zhang et al., 2021). Latifi et al. (2021) within a sample of European SMEs find that the path between BMI and a firm's overall performance is mediated through efficiency growth, revenue growth, and organizational capabilities. However, while current literature continues to focus on studying the relationship between BMI and firm performance (e.g., Khaddam et al., 2021; Moradi et al., 2021), as mentioned above, most of these studies treat BMI as a holistic construct and measure performance outcomes in a cross-sectional setting. Nevertheless, other studies taking an element-based perspective on BMI show more differentiated results. Clauss et al. (2019) find that the different dimensions of BMI yield different effects on firm performance: positive effects for value creation

[2] Some of these dimensions are referred to differently in other studies. Commonly used different terms for "value proposition" are "value delivery" (e.g., Teece, 2010) or "value offering" (e.g., Schrauder et al., 2018). Despite the terminological differences, looking into each definition, authors agree that this dimension captures the question regarding what is offered to whom through which channel. Hence, we consistently use the term "value proposition" in this study, which presents the superset, while "value delivery" depicts a subset of "value proposition." This was the result of a review of existing conceptualizations by Clauss (2017).

innovation and value proposition innovation, but negative effects for value capture innovation. Giesen et al. (2007) find that BMI efforts targeted at disrupting the industry chain, revenue model, or organizational boundaries are not associated with significant variations in financial performance across the different types of BMI.

Our study aims to solve this puzzle of the unclear BMI-performance relationship by taking an element-based perspective, which allows the underlying resource allocation decisions that firms conduct when engaging in BMI activities to be taken into account. Here, and reflecting upon the nature of BMI, we argue that resources allocated to single business model dimensions always yield positive performance effects, as each dimension facilitates different mechanisms, which in turn lead to performance increases: (1) value creation innovation is a key to firm performance, because new configurations of its constituent elements, including activities, resources, key processes, structures, and technologies/capabilities determine the efficiency of the organizational system and can produce greater economic results (Casadesus-Masanell & Ricart, 2010; Clauss et al., 2019; Zott & Amit, 2010). For example, a new configuration might involve enhancing efficiency and effectiveness via new digital technologies (Klos et al., 2023). Moreover, value creation innovation is an instrument for adapting to a dynamic environment (Hartmann et al., 2013). Value creation innovation may also stem from leveraging sources which lie outside the firm's present boundaries, or from changes in the firm's ecosystem. For example, increased stakeholder engagement enables co-creation and knowledge gathering (Herrera, 2016), selecting appropriate partners creates access to required resources and capabilities (de Reuver et al., 2009a), and BMI in alliances enhances firm performance (Bouncken & Fredrich, 2016). (2) Innovation in a firm's value proposition dimension is also associated with improved performance. It enables firms to "satisfy a perceived need" (Amit & Zott, 2010, p. 8) and create value for customers, such as by solving a fundamental customer problem (Johnson et al., 2008). Beyond that, firms may explore or exploit markets, for example through addressing novel customer segments and chosing distinct distribution strategies, or by developing completely new regions. Value proposition innovation helps generate profit by creating a high willingness to pay and exploiting new revenue sources (Clauss et al., 2019; Foss & Saebi, 2017; Hartmann et al., 2013; Karimi & Walter, 2016). (3) Value capture innovation affects performance because an appropriate revenue model is required to capture value from business activities (Amit & Zott, 2010). If value capture innovation allows for a shift to more sustainable revenue streams, or for the generation of additional revenue such as via cross-selling or integrating service contracts (Clauss, 2017), then the effect on performance is assumed to be positive. In addition, value capture innovation can lead to an optimized cost structure, for example when achieving economies of scale (Heij et al., 2014).

The related literature generally assumes that the effects of innovations will not fully or instantly materialize; the full performance effect of innovation will instead take time. For innovations adopted by organizations for internal improvements (Damanpour et al., 2009), time may be required for new processes, activities, and/or technologies to unfold their full productivity. Innovations that firms externally commercialize typically follow an adoption process (Rogers, 1976) that requires time until a critical mass of customers is reached (Artz et al., 2010; Belderbos et al., 2004). Because BMI combines innovation both internally and externally to organizations, and because of the often complex nature of changes, mechanisms among all dimensions of BMI are assumed to necessitate time to materialize (Clauss et al., 2019; Foss & Saebi, 2017). Furthermore, like any other innovation process, BMI is a costly endeavor. Although investments in BMI tend to yield satisfactory outcomes, it may take time until organizational and monetary costs are outweighed by their resulting benefits.

Summarizing, this study postulates the following hypotheses describing a positive yet lagged effect of each of the three core dimensions of BMI on firm performance:

H1.1: Value creation innovation activities induce a lagged positive effect on firm performance.

H1.2: Value proposition innovation activities induce a lagged positive effect on firm performance.

H1.3: Value capture innovation activities induce a lagged positive effect on firm performance.

2.3. (Combinatory) effects of multiple BMI activities

Companies simultaneously commence different BMI activities to create value for their customers while capturing value for themselves (Snihur & Tarzijan, 2018). The deployment of resources for these initiatives is critical to seizing the full potential of BMI (Teece, 2018). Scholars have identified the crucial role of managing resource fluidity (Doz & Kosonen, 2010) and resource co– and re-deployment (Ahuja & Novelli, 2016), and have emphasized a balanced use of the resource base (Achtenhagen et al., 2013) for BMI. Simultaneous engagement in BMI activities is a complex endeavor, raising the question of how firms should effectively allocate resources in order to realize positive performance outcomes (e.g., Achtenhagen et al., 2013). The question that arises here is whether the activities and resources dedicated to innovation in the different dimensions of the business model are complementary or substitutive. In light of the perspective of the supermodularity theory (Milgrom & Roberts, 1990, 1995; Topkis, 1995), organizational change in one area will only generate increased performance effects if this fits the other choices of the firm (e.g., if the decision to integrate a new revenue model is aligned with choices about target segments and the skills of the sales people). In this case, the activities are complementary (substitutive) and the joint contribution of these activities may be higher (lower) compared to their marginal contributions in isolation.

As a theoretical basis for reflecting upon the complementarity and substitutability of simultaneous BMI activities, we refer to the theoretical premises of the resource-based view of the firm (Barney, 1991). Engaging in BMI requires the (re-)deployment of resources for related new applications (Doz & Kosonen, 2010). From this perspective, four main arguments arise, suggesting that the simultaneous pursuit of activities in more than one BMI dimension may yield substitutive rather than complementary effects.

First, resource redeployment should be evaluated with consideration for the potential to create economies of scope: "Economies of scope arise from inputs that are shared, or utilized jointly without complete congestion" (Teece, 1980, p. 226). Hence, economies of scope occur when resources such as proprietary knowledge or indivisible physical assets can be applied to different tasks. Economies of scope can lead to cost reductions and positively affect firms' overall performance as a result (Sakhartov, 2017). In the case of BMI, this would imply that the relative costs associated with BMI activities would decrease as more initiatives are simultaneously pursued. However, as BMI dimensions fundamentally differ, applicability of the required resources across BMI dimensions might be restricted (Sakhartov & Folta, 2014; Sakhartov, 2017). To illustrate, value creation innovation tends to be inward-oriented toward internal resources and processes, whereas value proposition innovation is outward-oriented toward connecting products and services to new markets and customers. These distinct directions of orientation and relationships might require different resource specificities and thus diminish the possibility for sharing and synchronizing resources, consequently reducing possible benefits from economies of scope.

Second, resources that are redeployed should be distinguished into either scale-free or non-scale-free resources (e.g., Bryce & Winter, 2009; Sakhartov, 2017). Non-scale-free resources such as plants, machinery, and employees are tangible and indivisible. Scale-free resources, such as explicit information or knowledge, can be leveraged almost infinitely with zero opportunity costs, as they do not need to be withdrawn from one use to be applied to another (Winter & Szulanski, 2001). Kang and

Kim (2020) show that non-scale-free resources are critical to achieving the performance effects of BMI. The resources required to achieve BMI are mostly non-scale-free, including financial resources, tangible assets, and employees with specific skills and knowledge. While scale-free resources always have "excess" capacity and can therefore be shared among applications, non-scale-free resources are subject to opportunity costs (Levinthal & Wu, 2010) and must be strategically allocated between alternative activities; this can even lead to competition (Rawley & Simcoe, 2010). For example, human capital is not available in excess, because the "people who embody the resource can be in only one place at a time" (Wernerfelt, 1984, p. 175). Moreover, the redeployment of non-scale-free resources involves transfer costs (Helfat & Eisenhardt, 2004). Following this argument, the nature of substantial changes such as BMI creates situations in which scarce resources need to be strategically reallocated, and in which some activities may be better equipped than others. Therefore, the simultaneous pursuit of BMI in more than one core dimension may create inherent conflicts among BMI activities.

Third, the more dimensions involved in changing a business model, the more substantial the disruption of the existing activity system and the need to reallocate resources will be. This will have a considerable impact on the productivity of each resource, as a given resource's advantages related to specificity in the previous BMI application may be lost. Furthermore, such disruptive system-level changes may reduce the superior interdependencies within the activity system. In particular, if the required new activities in the revised business model are incompatible with the previous ones, compatibility conflicts arise (Lanzolla & Markides, 2021). Therefore, the increasing complexity – at least in the short term – creates diseconomies of scope and lower the firm's overall performance.

Fourth, and on a cognitive level, for simultaneous BMI activities the fundamentally different characteristics of the BMI dimensions may lead to managerial distraction. When business actors try to achieve too much at once, they might end up losing focus; confusing their customers; alienating their stakeholders; sub-optimally allocating resources; cannibalizing existing assets and organizational routines; or creating technological or organizational problems (Markides, 2013; Velu & Stiles, 2013; Zott & Amit, 2007). These diseconomies of scope arise from monitoring and influence costs (Rawley & Simcoe, 2010), ultimately causing a decline in productivity (Schoar, 2002). Monitoring costs occur when managers are distracted due to task complexity (Penrose, 1959), or when incomplete information results in moral hazards presenting challenges in handling relationships with all involved stakeholders (Rawley & Simcoe, 2010). Influence costs thereby describe conflicts over shared corporate resources.

In conclusion, the four related arguments above lead to the following hypotheses:

H2.1: The combination of value creation innovation and value proposition innovation activities induces a lagged substitutive effect on firm performance.

H2.2: The combination of value creation innovation and value capture innovation activities induces a lagged substitutive effect on firm performance.

H2.3: The combination of value proposition innovation and value capture innovation activities induces a lagged substitutive effect on firm performance.

Based on our line of argument concerning the existence of substitutive effects between activities in different business model dimensions, and following our considerations of sharing and redeployment of resources and associated costs, we further propose that concentrated BMI activities induce significantly better firm performance subsequent to BMI than BMI activities dispersed across different business model dimensions. First, with activities concentrated on a single business model dimension, the changes to the activity system of the business model are expected to be less disruptive (e.g., Foss & Saebi, 2017; Taran et al., 2015). Fewer compatibility conflicts will thus occur compared to the more disruptive changes induced by the simultaneous innovation of several business model dimensions. What is more, with BMI activities concentrating on one dimension of the business model only, managerial distraction as well as monitoring and influence costs will be moderate as the complexity and scope of innovations are reduced. Second, activities within one business model dimension feature more homogenous tasks. For example, BMI activities addressing the value creation dimension are very inward-oriented and focus on resources and processes, sharing a similar orientation direction. The increased relatedness of simultaneous activities within one business model dimension is expected to allow for applicability of scale-free resources across activities (Bryce & Winter, 2009). The created economies are likely to exceed the costs of sharing, e.g., effort required to transfer explicit information or tacit knowledge (Sakhartov, 2017). Moreover, with respect to non-scale free resources, relatedness of tasks increases expected returns from the redeployment of resources (Montgomery & Wernerfelt, 1988). Consequently, the possibility of sharing and redeploying resources creates economies of scope, ultimately enhancing firm performance after BMI.

From a corporate perspective, it could be argued that resources are located in functional organizations and as a result are controlled by and designed for a functional hierarchy (e.g., Gupta & Kohli, 2006). Value creation innovation would therefore tend to be located in the functional areas of production or procurement, while value proposition innovation would tend to be located in the functional areas of sales and central strategy. Within functional areas (and thus within the business model dimensions), the fungibility – the capability of a resource to interchangeably be applied to several purposes (Levinthal & Wu, 2010) – and thus the redeployment of non-scale-free resources and sharing of scale-free resources such as knowledge or tacit information are significantly increased. Between functional areas (and thus between the BMI dimensions), these synergies might be relatively hampered.

The line of argument elaborated upon above more formally leads to Hypothesis 3:

H3: Concentrated BMI activities induce a lagged positive effect on firm performance.

3. Methodology

3.1. Data and sample selection

3.1.1. Sample

Our sample exclusively captured publicly traded companies listed on the German DAX, MDAX, and SDAX stock exchanges. To be included on these exchanges, firms had to fulfill the prime standard requirements of the Frankfurt Stock Exchange, which holds the highest international transparency standards, requires inter alia comprehensive quarterly reporting, international accounting standards (IFRS/IAS or US-GAAP), and ad hoc disclosures. In other words, all BMI-relevant activities had to be disclosed and made publicly available.

Out of 160 firms listed on the German DAX, MDAX, or SDAX stock exchanges, 60 firms offered either online access to their press and financial report archives from 2007 to 2017, or provided them to us upon our request, comprising the base of our sample as a result.[3] We analyzed more than 35,000 press releases, ad hoc disclosures, and financial statements concerning BMI-relevant activities over a span of 11 years (2007–2017). This allowed us to obtain data for more than 2,300 BMI activities, achieving a large-scale longitudinal research design.

[3] The selection of the 60 companies out of the 160 listed firms is based solely on data availability and accessibility (disclosures and firm-level variables) and is thus arbitrary, suggesting that our sample is representative and not biased.

3.1.2. Measurement/coding

Studies have indicated that BMI is not a holistic universal construct, and that it may be undertaken by modifying and innovating the three BMI core dimensions (Clauss et al., 2020; Kulins et al., 2016). Therefore, from an element-based view, BMI can be captured by the separate measurement of innovation activities in these dimensions, which allows for large-scale quantitative measurement (Clauss, 2017; Klein et al., 2021; Spieth & Schneider, 2016; von Delft et al., 2019). The heterogeneity of previous operationalizations emphasizes the valuable contributions from Clauss (2017) who developed a formative measurement scale based on the three-dimensional structure of BMI, and assigned appropriate sub-elements to each dimension. Striving for cumulativeness in research, we apply the measurement scale developed by Clauss (2017) to operationalize BMI. Fig. 1 presents the scale, which constitutes the basis for our BMI scoring model. Appendix 1 elaborates the three core dimensions and their underlying sub-elements in greater detail.

Prior to coding, the authors of this study (who were also the raters) jointly agreed on a coding procedure, developing the coding tools such as a codebook and coding spreadsheets based on the measurement scale developed by Clauss (2017). To connect BMI activities to discrete years, prevent double counting of BMI activities, and cater for inter-rater bias, we decided to apply a manual coding process comprising three steps: (1) baseline determination, (2) BMI scoring, and (3) discussion of borderline cases. Here, exclusively original disclosures from the companies' websites (or disclosures provided to us from the public relations department upon our explicit request) were considered. To avoid biases from individual keywords and search engines' algorithms, we decided against a search engine approach.

To define a firm's business model baseline, we determined the initial business model characteristics of each firm to be able to identify relevant BMI activities in the forthcoming periods. In doing this, we considered industry-level and firm-level specifics, containing among other aspects the starting product portfolio, global footprint, value creation, markets and customer groups addressed, and cost structure specifics. A point score was assigned to the dimension and year, respectively, for each BMI-relevant activity affecting one or more of the business model dimensions and underlying sub-elements. We here followed a two-step approach to cater for bias between raters. First, we pre-selected potential BMI-relevant releases. As many of the press releases did not report on BMI-relevant activities,[4] we achieved almost perfect accordance among the raters (K greater than 0.8). Second, for each identified BMI-relevant activity fundamentally affecting one or more of the business model dimensions (overall, we identified 2,300 BMI-relevant disclosures), we achieved lower but still substantial agreement between the raters (K greater than 0.6). To cater for the lower inter-rater reliability and to be able to draw conclusions from our assessment, we applied the third step of our coding procedure to settle the final annual BMI scores within the entire research team. Whenever mismatches between raters in the interpretation of the pre-selected potential BMI activities occurred, we discussed the facts of the cases and agreed on the interpretation as a team of authors. The high number of disclosures that firms tend to effectuate per year, as well as the introduction of the third process step, led to the coding process taking several months. To prepare the data structure for our longitudinal, cross-industry regressions, we created a panel data structure by adding up the score points per dimension and year for each firm. One score point here represented one identified firm-level BMI activity affecting the respective BMI dimension.

[4] Most of the firms publish numerous disclosures per year, reporting not only on BMI-relevant information, but also on financial topics, personnel changes to their top management, marketing campaigns, public affairs, human resource management, etc.

3.1.3. Dependent variable

Firm performance has been at the nucleus of management thinking for both practitioners and scholars for approximately a century (Haggège et al., 2017), and research literature has assigned a multidimensional character to this construct (e.g., Venkatraman & Ramanujam, 1986). In our study, we focused on the level of financial performance while considering a firm's *market capitalization* as a relevant and valid performance measurement because it reflects economic returns (Ho et al., 2011), or to restate, reflects the market's expectations of future cash flows to shareholders (Zott & Amit, 2008). Kelm et al. (1995) argue that the shareholder value should be a major criterion to apply in the context of innovation projects. This is why, particularly within our setting of publicly traded companies, we considered *market capitalization* as the most important performance indicator for stock-listed corporations, as we utilized the annual average market capitalization to avoid distortions caused by short-term reactions from shareholders to firms' announcements. We refrained from applying ratios as a performance measurement due to the resulting production of inaccurate parameter estimates and lower levels of statistical power (see Certo et al., 2020). We obtain the data on *market capitalization* from the *Thomson Reuters Datastream*. Further, because *profitability* appears to be a recurrently applied performance indicator (see Aspara et al., 2010; Kastalli & van Looy, 2013; Visnjic et al., 2016), we considered *earnings before interest and taxes (EBIT)* as an appropriate alternative dependent variable for our robustness tests. We obtained the annual EBIT per firm from the *S&P Capital IQ* database.

3.1.4. Independent variables

Based on our calculated scores, the concept of BMI entered our regression analyses via its three dimensions – (1) *value creation innovation*, (2) *value proposition innovation*, and (3) *value capture innovation* (first set of hypotheses) – and their pair-wise interaction terms – *value creation innovation X value proposition innovation*, *value creation innovation X value capture innovation*, and *value proposition innovation X value capture innovation* – to analyze their complementarity and substitutability (second set of hypotheses). The variable *BMI concentration* furthermore entered the regression as the range of BMI activities in the three dimensions within one period to analyze the role of concentrated BMI activities targeted to single dimensions (third hypothesis). This variable is calculated as the difference between the maximum of BMI activities across all three dimensions and the minimum of BMI activities across all three dimensions. The variable describes whether a firm concentrates its simultaneous BMI activities within one period rather than a single business model dimension, or to multiple dimensions in parallel.

3.1.5. Control variables

As suggested by previous studies, we included as control variables further factors that might influence a firm's performance. At the firm level, we followed the common practice of BMI scholars, controlling for *firm age* and *firm size* (e.g., Clauss et al., 2019; Heij et al., 2014; Patzelt et al., 2008; Sood & Tellis, 2009; Wei et al., 2014; Zott & Amit, 2008). Scholars apply *firm age* as a proxy for performance-favoring capabilities that firms have accumulated over time, such as experience, learning ability, and managerial competencies (e.g., Cucculelli & Bettinelli, 2015). For example, Hartmann et al. (2013) find a firm's experience and size to be positively related to performance, all while noting that both firm specifics might create inertia (Hannan & Freeman, 1984). Because further studies indicate a non-linear relationship between firm age and performance (Coad et al., 2013; Grund & Westergaard-Nielsen, 2008; Serrasqueiro et al., 2010), we also applied the *quadratic term of firm age* as a control to assess the inverse relation.

Clauss (2017) further argues that size matters; small firms are more likely to be flexible in decision-making and resource allocation, but lack financial resources and have limited access to market or technology information. On the contrary, large firms might possess more abundant

Value creation innovation				Value proposition innovation				Value capture innovation	
New capabilities	New technology & equipment	New partnerships	New processes & structures	New product & service offering	New customer segments & markets	New customer relationship	New product & service delivery	New logic of earnings	New logic of costs

Fig. 1. Business model innovation scoring model: own representation based on Clauss (2017).

resources for costly trial-and-error learning. Further, large firms have greater bargaining power at their disposal (Zott & Amit, 2010), and may leverage scale and scope advantages as needed (Bouncken & Fredrich, 2016). Next, following common practice in the BMI literature, we measured *firm age* by calculating the number of years since the firm was founded, and *firm size* by calculating the natural logarithm of the number of full-time employees. Furthermore, prior research recommends *firm R&D expenditure* as a control for the relationship between BMI, innovative outcomes, and firm performance (Artz et al., 2010). Kelm et al. (1995) argue that investors incorporate expectations from R&D activities into their assessments of market value. This is why we applied the logarithm of firms' *R&D expenditure* as a third control variable. We obtained data for all control variables from the *S&P Capital IQ* database. Table 1 summarizes our main variables of interest, indicating the respective operationalization and data sources.

3.2. Descriptive statistics

Table 2 provides descriptive statistics, revealing large differences among some variables. *Market capitalization* ranges from a minimum of 8 million EUR to a maximum of 113 billion EUR, and *profitability* (*EBIT*) ranges from a loss of 6.1 billion EUR to earnings of 15.6 billion EUR. This heterogeneity and skewness to the left illustrates that our dataset represents both large multinationals and a surplus of small- and medium-sized enterprises. Moreover, *firm age* ranges from 1 to 170 years, with an average of 82 years, revealing that German stock market indices contain long-established incumbents, which is typical within the nation's industrial landscape. Due to the logarithmic transformation, *firm size* and *R&D expenditures* are almost normally distributed. With regard to the BMI dimensions, value creation innovation averages 2.77 events per year; value proposition innovation averages 1.43 events per year; and value capture innovation averages 0.30 events per year, revealing that the first two dimensions are more frequently applied in practice. The rare occurrences of value capture innovation confirm that changes in this dimension constitute a more systematic change, requiring additional effort (Clauss et al., 2019).

As Table 3 shows, there were no worrying correlations present within our dataset ($r < 0.7$ for all variables[5]). The correlation matrix unveiled some insight into the interconnectedness of firm performance and firm specifics: somewhat high bivariate correlations could be found between *market capitalization* and *profitability* ($r = 0.79$), indicating that *market capitalization* and *profitability* were strongly linked to one another. Furthermore, *firm size* was highly correlated to *market capitalization* ($r = 0.66$) and *profitability* ($r = 0.62$), reinforcing its importance as a control variable, and *R&D expenditure* ($r = 0.67$), indicating that large enterprises tend to invest more in R&D. We observed that the variance inflation factors (VIF) were all<5, indicating the absence of multicollinearity issues.

3.3. Data analysis

Based on our longitudinal dataset, we used a fixed-effects panel regression approach,[6] controlling for industry- and time-invariant effects (Baltagi, 2021). Case studies indicate that it can take multiple years until BMI fully unfolds (Frankenberger et al., 2013) because the pertaining process is more iterative than linear. Sosna et al. (2010, p. 392) stress the importance of trial-and-error learning, observing that the "intelligent failures" in the phase of experimentation and exploration can take up to five years before delivering expected results. However, the phase of experimentation and exploration can be costly, and can steadily require resources (Achtenhagen et al., 2013; Sánchez & Ricart, 2010). Because of the importance of time, scholars encourage the utilization of a longitudinal research design (e.g., Clauss et al., 2019; Foss & Saebi, 2017). We applied time lags for the independent variables from 0 to 5 years in our regression models to observe potential delays, allowing us to run the following estimations to test our hypotheses:

$$Y_{i,t} = \gamma_0 + \gamma_1 Businessmodelinnovation_{i,t-n} + \gamma_2 Businessmodelcombination_{i,t-n} + \gamma_3 Businessmodelinnovationconcentration_{i,t-n} + \gamma_4 Firmspecifics_{i,t} + \varepsilon$$

where $Y_{i,t}$ is the performance of firm i in year t, and n constitutes the time lag for the independent variables with $n \in [0, 5]$ years. *Business model innovation* is a vector containing all three core dimensions of a BMI: value creation innovation, value proposition innovation, and value capture innovation. The vector *Business model combination* includes the two-way interaction terms of the three dimensions: value creation innovation and value proposition innovation; value creation innovation and value capture innovation; and value proposition innovation and value capture innovation. *Business model innovation concentration* presents the range of activities in different BMI dimensions. The vector *Firm specifics* contains the control variable *firm age* and the quadratic term *firm age*, *firm size*, and *R&D expenditure*, which are assumed to affect firm performance independent of BMI.

We conducted a modified Wald test to test for group-wise heteroscedasticity in our fixed effect model (Greene, 2003). Following

[5] *Market capitalization* and *profitability (EBIT)* did not enter the same regression models.

[6] The Hausman test suggests using fixed effects (FE) (see Hoechle, 2007; Wooldridge, 2010). With $p < 0.05$, we reject the null hypothesis, which is that the unique errors are not correlated with the regressors, concluding that an FE model is most appropriate for our regression approach. This result aligns with our theoretical anticipation, as the cross-industry character of our data expectedly entails industry-specific and macroeconomic effects (our selected time period covers phases of both economic prosperity and fundamental crises, such as the 2007/2008 financial crisis). FE models control for both.

Table 1
Variables and Operationalization.

Type	Variable	Measurement	Data source	Time frame	Literature Source (extract)
Dependent Variable	Market capitalization	Annual mean of number of shares times share price per trading day in million € per year	Thomson Reuters DataStream	2007–2017	Zott & Amit, 2008;***Ho et al., 2011;Sood & Tellis, 2009***
	Profitability	Annual earnings before interest and taxes (EBIT) in million € per year	S&P Capital IQ	2007–2017	Aspara et al., 2010;***Kastalli and Van Looy, 2013; Visnjic et al., 2016
Independent Variable	Value creation innovation	Annual score of value creation innovation events	Press Releases; Annual Reports	2007–2017	Morris et al., 2005; Johnson et al., 2008; Spieth et al., 2014; Spieth & Schneider, 2016; Clauss, 2017
	Value proposition innovation	Annual score of value proposition innovation events	Press Releases; Annual Reports	2007–2017	
	Value capture innovation	Annual score of value capture innovation events	Press Releases; Annual Reports	2007–2017	
Control Variable	Firm size	Logarithm of number of full-time employees per year	S&P Capital IQ	2007–2017	Zott & Amit, 2008; Patzelt et al., 2008;***Heij et al., 2014;***Wei et al., 2014;Clauss et al., 2019
	Firm age	Number of years since firm's founding per year	S&P Capital IQ	2007–2017	Zott & Amit, 2008; Patzelt et al., 2008; Heij et al., 2014;***Wei et al., 2014;Clauss et al., 2019
	R&D expenditure	Total amount of money spent in R&D in million € per year	S&P Capital IQ	2007–2017	Artz et al., 2010; Belderbos et al., 2004; Kelm et al., 1996;

Note: This table shows the variables of interest, operationalization and data sources.

Hartmann et al. (2013), we further conducted a Wooldridge test for autocorrelation in the panel data; both heteroscedasticity and autocorrelation were present. Therefore, we apply Rogers standard errors, which extend the Huber/White/sandwich VCE estimators to control for both heteroscedasticity and clustering of data points on the firm ID (Hoechle, 2007; Rogers, 1993) to obtain robust standard errors.

4. Results

Table 4 provides the results of our panel regressions focusing on the single BMI dimensions. *H1.1* and *H1.2* are confirmed. Value creation innovation ($\beta = 563.0; p < 0.05$) and value proposition innovation ($\beta = 684.5; p < 0.05$) show lagged significant performance effects. *H1.3* cannot be confirmed based on this model. Table 5 shows the results of the panel regressions applying the full model, including the two-way interaction terms of the BMI dimensions. Again, *H1.1* and *H1.2* are confirmed, as the first two dimensions display lagged, sustained performance effects. Moreover, *H1.3* is indicatively confirmed: value capture innovation starts with a short-term positive effect, then turns to negative but not significant coefficients for three years, and eventually positively enhances firm performance after four years. The effect of value capture innovation thereby is supported by weaker evidence ($\beta = 1{,}375; p < 0.10$).

Regarding the assessment of complementarity and substitutability,

Table 2
Descriptive statistics.

Variable	Mean	Std. dev.	Min	Max	Observations
Market capitalization					
Overall	12257.14	19331.69	8.129313	112632.8	N = 608
Between		17,608	151.2213	75943.69	n = 60
Within		6865.041	−14905.58	60543.41	T-bar = 10.1333
Profitability					
Overall	1395.36	2766.28	−6097	15,595	N = 643
Between		2467.67	−278.5	9968	n = 59
Within		1242.81	−5.409	22.21764	T-bar = 10.72
Value creation innovation					
Overall	2.773196	3.219471	0	27	N = 582
Between		3.026182	0.0909091	19.33333	n = 59
Within		2.143673	−5.408622	22.21764	T-bar = 9.86441
Value proposition innovation					
Overall	1.426117	1.747545	0	12	N = 582
Between		1.092143	0	5.375	n = 59
Within		1.404121	−2.948883	9.15339	T-bar = 9.86441
Value capture innovation					
Overall	0.3006873	0.6186707	0	5	N = 582
Between		0.3160566	0	1.272727	n = 59
Within		0.5342128	-0.97204	4.209778	T-bar = 9.86441
Firm size					
Overall	51679.69	96982.89	100	6,642,292	N = 635
Between		94595.58	452.5455	496928.1	n = 60
Within		17587.94	−115943.4	197043.6	T-bar = 10.5833
Firm age					
Overall	81.55335	49.71498	1	170	N = 656
Between		50.21185	4	165	n = 60
Within		3.154544	76.55335	86.55335	T-bar = 10.9333
R&D Expenditure					
Overall	534.7676	1542.64	0	11,853	N = 615
Between		1471.328	0	8682.636	n = 58
Within		419.6975	−3045.869	3705.131	T-bar = 10.6034

Note: This table shows descriptive data on 60 German Prime Standard listed firms from 2007 to 2017.

Table 3
Correlation matrix.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Market capitalization	1.000							
(2)	Profitability (EBIT)	0.792**	1.000						
(3)	Value creation innovation	0.439**	0.450**	1.000					
(4)	Value proposition innovation	0.286**	0.263**	0.455**	1.000				
(5)	Value capture innovation	0.231**	0.243*	0.401**	0.357**	1.000			
(6)	Firm size	0.660**	0.622**	0.402**	0.250**	0.173*	1.000		
(7)	Firm age	0.255*	0.189*	0.054	−0.008	−0.017	0.531**	1.000	
(8)	R&D expenditure	0.525**	0.482**	0.373**	0.167*	0.197**	0.672**	0.347**	1.000

Note: This table reports the correlation coefficients among the dependent and independent variables employed in our regressions.
†0.05 ≤ p < 0.1, *0.01 ≤ p < 0.05, **0.001 ≤ p < 0.01, ***p < 0.001.

Table 4
Panel regression model assessing performance implications of single BMI dimensions.

	Model I (0 Lags)	Model II (1 Lag)	Model III (2 Lags)	Model IV (3 Lags)	Model V (4 Lags)	Model VI (5 Lags)
Value creation innovation	220.0	353.3	**563.0***	**684.9***	142.5	116.2
	(265.2)	(251.1)	**(244.3)**	**(262.8)**	(256.7)	(157.9)
Value proposition innovation	371.4	525.9	419.4	259.0	744.8	**684.5***
	(369.0)	(431.1)	(614.8)	(447.2)	(476.4)	**(344.5)**
Value capture innovation	−424.0	−572.3	−359.4	−811.0	114.2	207.4
	(769.4)	(696.1)	(901.2)	(759.1)	(816.6)	(691.8)
Firm age	560.3	820.0	975.8	909.5	1,160	1,357
	(467.9)	(547.7)	(628.6)	(657.7)	(851.2)	(916.4)
Firm age (sq.)	3.292	3.475	4.172	4.649	4.148	3.647
	(2.213)	(2.346)	(2.709)	(2.970)	(3.409.)	(3.623)
Firm size	1,312	187.3	−643.8	−654.8	−2,023	−2,496
	(1,797)	(2,315)	(2,827)	(3,236)	(3, 875)	(3,777)
R&D expenditure	−688.4	−422.4	152.1	512.1	1,219	1,221
	(497.0)	(581.5)	(673.5)	(732.3)	(1,246)	(1,024)
N	438	396	353	309	266	224
R^2	0.240	0.300	0.332	0.338	0.325	0.310

Note: This table reports the results of our panel regression. We rely on a sample of 60 German Prime Standard listed firms for the years 2007 to 2017. The dependent variable is market capitalization.
†0.05 ≤ p < 0.1, *0.01 ≤ p < 0.05, **p < 0.01, *** p < 0.001. Robust standard errors in parentheses.

Table 5
Full model assessing complementarity and substitutability of pairwise BMI interactions.

	Model VII (0 Lags)	Model VIII (1 Lag)	Model IX (2 Lags)	Model X (3 Lags)	Model XI (4 Lags)	Model XII (5 Lags)
Value creation innovation	340.4	**701.1***	**847.2***	**1,187****	**655.1†**	307.7
	(318.7)	**(334.8)**	**(365.0)**	**(437.6)**	**(339.4)**	(258.2)
Value proposition innovation	546.3	**1,275***	**1,543***	**1,159****	**1,520***	534.9
	(580.2)	**(489.9)**	**(728.6)**	**(421.5)**	**(606.0)**	(410.1)
Value capture innovation	**998.2†**	−773.7	−444.5	−38.94	**1,376†**	1,539
	(546.0)	(945.9)	(972.2)	(866.0)	**(788.4)**	(1,012)
Value creation innovation X value proposition innovation	4.334	−181.9	**−216.5***	**−202.6***	−133.2	80.28
	(90.33)	(123.3)	**(90.40)**	**(95.73)**	(103.3)	(95.90)
Value proposition innovation X value capture innovation	–223.7	136.3	**440.3***	23.87	−45.90	−337.1
	(303.5)	(164.3)	**(189.1)**	(338.9)	(183.6)	(219.1)
Value creation innovation X value capture innovation	−106.2	124.7	−461.8	145.4	−50.49	−4.643
	(181.9)	(440.8)	(337.2)	(464.7)	(610.4)	(664.7)
Firm age	523.9	752.5	931.0	874.5	1,033	1,336
	(422.4)	(492.1)	(568.5)	(580.0)	(767.9)	(883.3)
Firm age (sq.)	**3.391†**	**3.759†**	**4.406†**	**5.015†**	5.049	3.758
	(2.014)	**(2.231)**	**(2.579)**	**(2.685)**	(3.095)	(3.608)
Firm size	1,588	460.5	−229.9	18.30	−1,150	−2,047
	(1,749)	(2,192)	(2,472)	(2,546)	(3,157)	(3,719)
R&D expenditure	−622.2	−198.5	134.0	492.5	1,209	1,085
	(497.0)	(545.2)	(644.2)	(748.8)	(1,087)	(1,044)
N	438	396	353	309	266	224
R^2	0.255	0.324	0.381	0.404	0.400	0.337

Note: This table reports the results of our panel regression including the interaction terms of the BMI dimensions. We rely on a sample of 60 German Prime Standard listed firms for the years 2007 to 2017. The dependent variable is market capitalization.
†0.05 ≤ p < 0.1, *0.01 ≤ p < 0.05, **p < 0.01, *** p < 0.001. Robust standard errors in parentheses.

our study confirms *H2.1*. We find statistically significant substitutive effects of simultaneously pursued innovation in value creation and value proposition after two and three years ($\beta = -216.5; p < 0.05$). Our study rejects *H2.2* and *H2.3*, because no significant substitutive effects are observed in the longitudinal setting. Conversely, the results indicatively reveal complementary effects of value capture innovation and value proposition innovation after two years ($\beta = 440.3; p < 0.05$). We however lack empirical evidence showing the linear positive effect of value capture innovation in the respective year. Our results also do not deliver strong significant support for the effects of our control variables *firm age*, *firm size*, or *R&D expenditure*. However, the quadratic term of *firm age* ($\beta = 4.406; p < 0.10$) indicates a positive inverse relationship regarding *firm performance*. All six models are statistically highly significant ($p < 0.001$), and we find the variance considerably explained, with R^2 values ranging from $R^2 = 0.255$ to $R^2 = 0.404$.

To improve the understanding of the underlying mechanisms of the substitutive character of value creation innovation and value proposition innovation, Fig. 2 illustrates the predictive margins and the contour plot of the respective interaction terms. When keeping one of the two dimensions constant at a low level (10% quantile) while altering the other dimension (50% quantile and 90% quantile), predicted performance increases, in alignment with the single positive effects of each dimension (*H1.1* and *H1.2*). This effect is also shown in the contour plot, in which the color-coding supports increasing performance for increasing activities in one dimension, while keeping the other at a low level. However, when both dimensions are increased, the predicted performance increases at lower rates, resulting in flatter gradients for the lines representing the 50% and 90% quantiles, explaining the confirmation of *H2.1* as a result. The contour plot, as indicated by the color-coding moving into the upper right corner, further reveals that for very high levels of innovation activities in both dimensions, the predicted performance decreases.

Table 6 shows the results of the panel regressions applying the full model extended for *BMI concentration* applied for different time lags. Empirical findings regarding hypotheses *H1.1* through *H1.3* as well as findings regarding complementary and substitutive effects of BMI activities in different dimensions are analogously confirmed to Tables 4 and 5. Regarding the assessment of simultaneous, concentrated BMI activities, *H3* is confirmed as we find statistically significant positive lagged effects of BMI patterns with activities concentrated on single dimensions ($\beta = 382.0$; $p < 0.05$). Fig. 3 illustrates the predictive margins of the *BMI concentration*. For higher values of the variable, the range of BMI activities increases, which means that the BMI activities' concentration on a single business model dimension increases. Complementary to the regression tables and in line with *H3*, the predictive margins plot presents higher residual firm performance values for higher levels of the *BMI concentration* variable, illustrating that concentrated BMI activities drive firm performance.

4.1. Robustness checks

To assess the robustness of our results, we re-ran our models with an alternative dependent variable capturing a different facet of firms' performance. In these models, we replaced the dependent variable *market capitalization* with *profitability (EBIT)*. The regressions yielded the same observations: the results confirm our findings regarding the impact of BMI dimensions on firm performance (see Appendix 2). *H1.1* through *H1.3* are confirmed, with all single dimensions positively and significantly affecting *profitability*. The full model including the two-way interaction terms further supports *H2.1*, confirming the substitutive

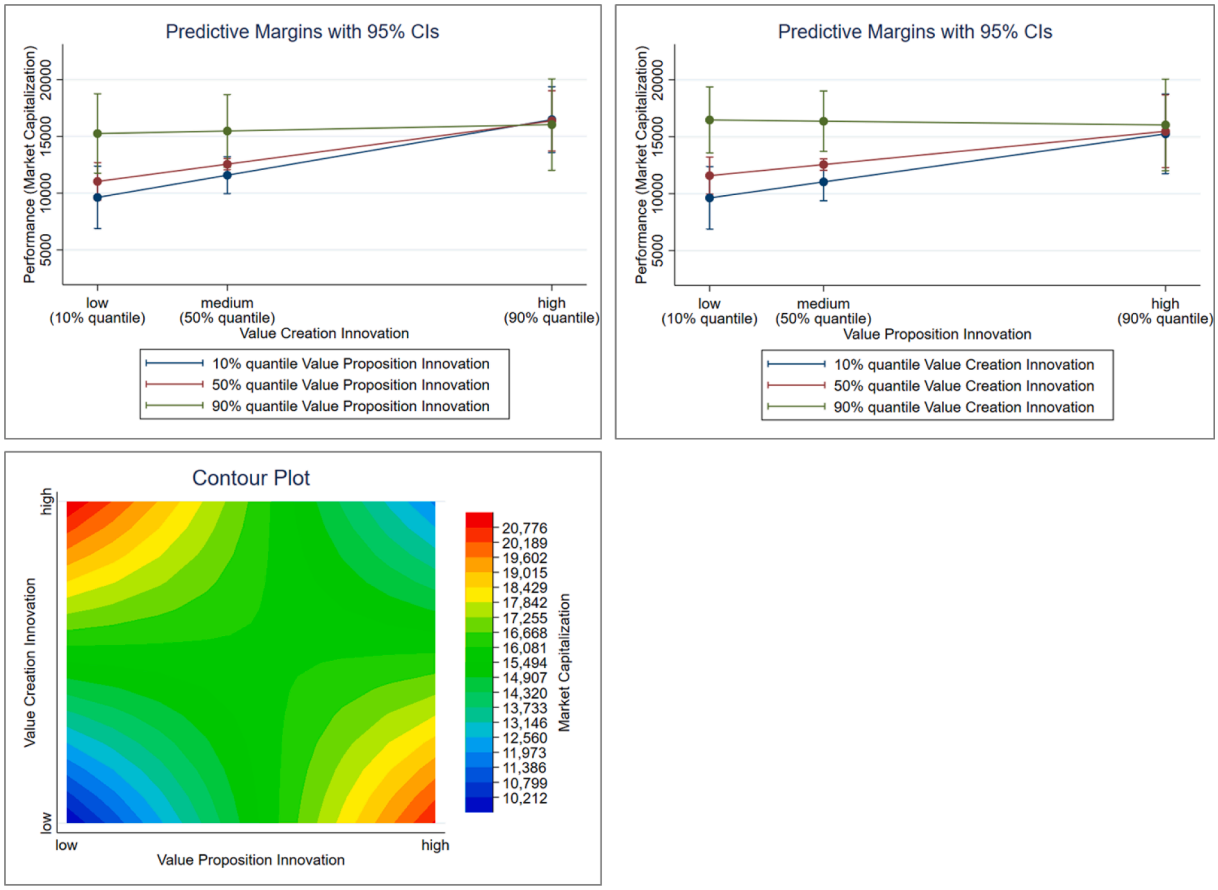

Fig. 2. Predictive margins plots for the interaction term value creation innovation with value proposition innovation and contour plot.

Table 6
Full model (TABLE 5) extended for the BMI concentration to assess the implications of simultaneous, concentrated BMI activities.

	Model XIII (0 Lags)	Model XIV (1 Lag)	Model XV (2 Lags)	Model XVI (3 Lags)	Model XVII (4 Lags)	Model XVIII (5 Lags)
Value creation innovation	251.7	510.6	**604.7†**	**1,078***	426.1	252.9
	(351.4)	(398.0)	**(350.9)**	**(476.0)**	(318.7)	(249.8)
Value proposition innovation	573.9	**1,229***	**1,573†**	**1,102***	**1,630***	552.5
	(603.5)	**(512.9)**	**(798.8)**	**(424.0)**	**(611.7)**	(470.1)
Value capture innovation	**994.6†**	−778.8	−1,074	−406.2	1,407	1,892
	(556.9)	(946.7)	(1,140)	(972.9)	(997.9)	(1,185)
Value creation innovation X value proposition innovation	6.436	−176.8	**−240.5***	**−230.1****	−173.2	47.51
	(88.35)	(128.6)	**(90.80)**	**(84.18)**	(113.8)	(124.1)
Value proposition innovation X value capture innovation	−84.38	254.8	**626.1****	142.1	89.55	−286.9
	(184.4)	(154.7)	**(162.9)**	(348.8)	(210.5)	(206.9)
Value creation innovation X value capture innovation	−230.8	57.58	**−612.2†**	95.88	−96.71	18.13
	(318.1)	(412.8)	**(315.9)**	(523.0)	(688.2)	(769.0)
BMI concentration	286.0	383.0	**485.5†**	**382.0***	358.7	−60.47
	(197.8)	(240.2)	**(244.9)**	**(158.9)**	(262.8)	(137.1)
Firm age	660.7	815.7	**992.3†**	921.8	1,105	1,200
	(460.1)	(505.4)	**(566.8)**	(618.0)	(848.2)	(967.2)
Firm age (sq.)	3.468	**4.001†**	**4.643†**	**5.202†**	**5.334†**	5.052
	(2.091)	**(2.191)**	**(2.439)**	**(2.695)**	**(3.043)**	(3.958)
Firm size	532.6	−216.9	−561.6	−120.4	−1,408	−2,384
	(1,791)	(2,212)	(2,475)	(2,568)	(3,369)	(3,967)
R&D expenditure	−680.5	−241.6	−171.1	172.9	657.8	980.6
	(579.4)	(607.3)	(738.2)	(766.7)	(1,017)	(1,119)
N	438	396	353	309	266	224
R^2	0.293	0.337	0.394	0.417	0.415	0.326

Note: This table reports the results of our panel regression including the interaction terms of the BMI dimensions and the span of BMI activities across business model dimensions. We rely on a sample of 60 German Prime Standard listed firms for the years 2007 to 2017. The dependent variable is market capitalization.
†0.05 ≤ p < 0.1, *0.01 ≤ p < 0.05, **p < 0.01, *** p < 0.001. Robust standard errors in parentheses.

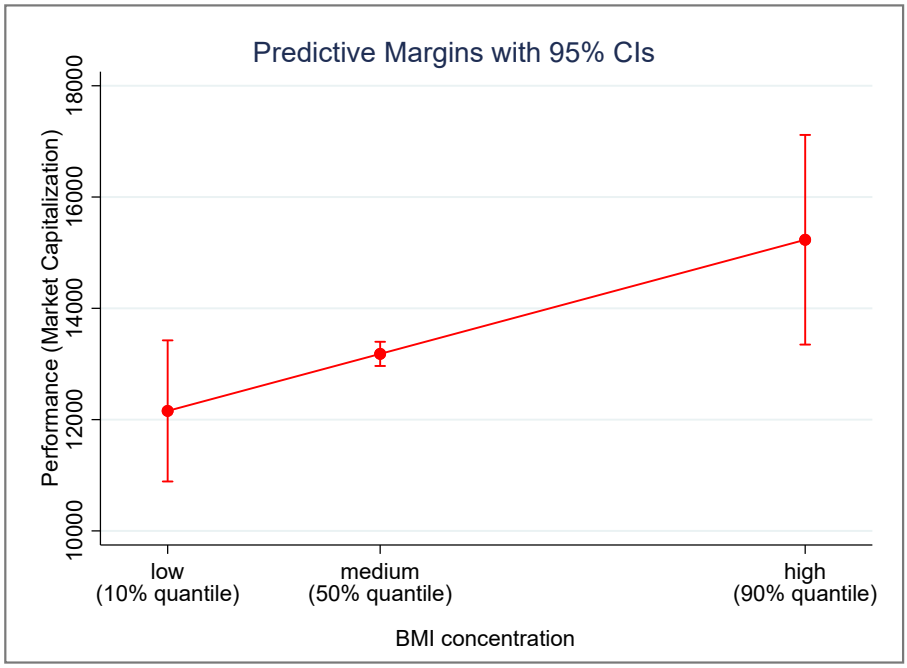

Fig. 3. Predictive margins plot for BMI concentration (span of BMI activities across business model dimensions).

effect of the combination of value creation innovation with value proposition innovation (see Appendix 3). Once again, *H2.2* is rejected, as the combination of value creation innovation and value capture innovation shows a complementary, albeit direct, not lagged, effect on firm performance. *H2.3* can indicatively be supported by our results. Appendix 4 supports *H3*, as the *BMI concentration* variable presents significant, lagged performance effects.

5. Discussion

5.1. Key findings

Our study aims to analyze the complex longitudinal relationships between BMI and firm performance. Although there has been consensus from a theoretical perspective that BMI is key to firm performance (Zott et al., 2011), our study delivers robust longitudinal empirical evidence

and allows the generalization of previous industry-specific findings (e.g., Brea-Solís et al., 2015; Clauss et al., 2019; Hartmann et al., 2013; Heij et al., 2014; Karimi & Walter, 2016; Sohl et al., 2020). Hypotheses H1.1-H1.3 are confirmed, as all BMI dimensions lead to lagged positive performance effects. Our study therefore empirically confirms the assumption of previous studies (e.g., Frankenberger et al., 2013; Sosna et al., 2010) that BMI activities may require time for their full performance effects to unfold. In addition to the temporal main effects of each BMI dimension, we have followed the call of previous scholars (e.g. Foss & Saebi, 2017; Ramdani et al., 2019) and unveiled the complex nature of simultaneous BMI activities in more than one dimension. This element-based perspective supports previous research arguing that BMI is not a universal procedure, but is instead characterized by simultaneously creating and modifying the three business model dimensions (Berends et al., 2016; Clauss et al., 2020).

Our analyses of the impact of simultaneous BMI activities in different business model dimensions (H2.1-H2.3) reveal interesting and partially unexpected results, finding only full support for H2.1. On the one hand, the simultaneous pursuit of value creation innovation and value proposition innovation yields a substitutive effect on firm performance. This effect could be related to previous arguments that firms undertaking organizational transformation and BMI might commence independent activities that compete for critical internal resources, suggesting that either mechanism should be strategically utilized separately. For these two fundamentally different BMI dimensions, innovation activities might be more decoupled and show fewer synergies. The "the more, the better" logic thus does not apply for simultaneous BMI in these two dimensions. On the other hand, contrary to our expectations, our findings indicate a complementary effect of a simultaneous deployment of value capture innovation with value proposition innovation. If firms pursue value capture innovation activities such as implementing a new revenue model, this change requires systemic adjustments in the value proposition dimension to create new, congruent organizational systems (Clauss et al., 2019). Thus, value capture innovation might be beneficially combined with value proposition innovation to produce superior firm performance results. In alignment with our findings, Kastalli and van Looy (2013), analyzing value capture innovation via servitization in the manufacturing industry, argue that newly launched service offerings with newly introduced value capture mechanisms require alignment with the existing value proposition portfolio to achieve complementary dynamics of additional sales and efficiency through economies of scope. Similarly, Björkdahl's (2009) case studies on the integration of information and communication technologies into established mechanical engineering products show how novel value propositions through "cross-fertilization" need to be accompanied by BMI, such as revenue model changes to achieve economic returns.

With respect to the combinatory effects of multiple BMI activities, our empirical findings suggest that simultaneous BMI activities concentrating on a single business model dimension within one period yield superior returns compared to activities dispersed across different business model dimensions, confirming H3. Arguing from an RBV perspective, the same direction of orientation as well as the focus on one dimension of the business model appear to enable economies of scope, as the benefits from sharing and redeployment of resources exceed the efforts in doing so, including monitoring and influence costs, complexity costs, and managerial distraction. Our differentiated findings on performance outcomes of different simultaneous BMI activities as well as of concentrated BMI activities emphasize the importance of the management and orchestration of BMI activities, and as a result make a call for a strategic perspective toward BMI.

5.2. Theoretical contributions

Our study makes two primary contributions to the BMI literature. First, it follows the recent call from Lanzolla and Markides (2021), discussing the implications of BMI from a resource perspective. While previous studies identified a positive relationship between resources allocated to BMI activities and firm performance (Bouwman et al., 2019), we stimulate a deeper reflection on the decision problem of resource allocations during BMI activities. Although the role of resources has been discussed for firms simultaneously engaging in multiple business models (e.g., Casadesus-Masanell & Tarzijan, 2012; Markides & Charitou, 2004), and resource allocation has been identified as a critical capability during BMI (e.g. Achtenhagen et al., 2013), a research gap with regard to the relationship between BMI and resource allocation has remained. Analyzing the impact of concentrated BMI activities directed to a specific core dimension of the business model, as well as the complementarity and substitutability of BMI activities in the three business model dimensions, are novel to the body of literature and contribute to the discussion regarding challenges firms face when changing their organization (e.g., Gilbert, 2005; Tripsas & Gavetti, 2000).

Our findings suggest that BMI requires the deliberate strategic planning of multiple related activities, and necessitates a clear idea of how the BMI dimensions and redeployed resources interact. Our empirical findings provide initial guidance to the resource allocation problem a firm faces during BMI. We show that simultaneous BMI activities directed to a single business model dimension within one period outperform non-concentrated BMI activity patterns. Simultaneous BMI activities within one business model dimension presumably benefit from economies of scope, i.e., from the sharing and redeployment of resources. In line with this finding, the simultaneous pursuit of value creation innovation and value proposition innovation weakens realized performance effects, supporting our argument that innovation in these two dimensions is a heterogeneous task which impedes the sharing/complementary use of resources (Snihur & Tarzijan, 2018), potentially yielding diseconomies of scope. Contrary to our assumptions, the simultaneous pursuit of value proposition innovation with value capture innovation creates complementary effects, indicating that these activities are less conflicting than other combinations, and can potentially benefit from economies of scope. Alternatively, it may be that for the alignment of these dimensions, the desirable effects of redeployment exceed the potential downsides, such as adjustment costs (Helfat & Eisenhardt, 2004), reduced organizational efficiency, or resistance and delay in processes due to path dependency and inertia (Kang & Kim, 2020; Sakhartov & Folta, 2014). Together, our findings also clearly support the assumptions made by Lanzolla and Markides (2021), suggesting that the interdependencies of activities in operating business models and BMI are a central determinant of firms' competitive advantages, and should thus play a central role in strategic planning processes.

Second, we refine the knowledge about the BMI-performance relationship by empirically reassessing this relationship in a longitudinal, cross-industry setting. We find that each of the three dimensions of BMI has a positive impact on firm performance. However, these effects do not occur immediately, but materialize over time. As expected, changes in value creation, such as alterations in processes and structures, require time to be implemented and may not immediately translate into financial returns (Clauss et al., 2019). Intra-organizational changes often face significant challenges in resource allocation, coordination costs, and goal alignment (Amit & Zott, 2010; Bock et al., 2012). Furthermore, new process logics may interrupt a firm's current operating model, requiring additional attention and control efforts (Damanpour, 1991). However, when successfully applied, value creation innovation enhances a system's efficiency (e.g., Casadesus-Masanell & Ricart, 2010) and consequentially improves the profitability of organizational value creation. The same logic can be applied to value proposition innovation, in which new products and services require time to achieve market acceptance (e.g., Bucherer et al., 2012). Successful market development may further require patience and knowledge of local circumstances. Although value capture innovation is associated with a significant immediate performance effect, which might be due to the direct effects of cost-cutting

efforts, the lagged performance effect sets in only after several years. Our study thereby supports previous findings arguing that value capture innovation comprises fundamental, systemic changes with a disruptive character, and thus calls for consideration in connection with amendments in other parts of the model. When applied in isolation, value capture innovation entails a temporal risk of local optimization, or possibly even provokes resistance from partners in the business ecosystem (Clauss et al., 2019).

In conclusion, we see that BMI activities require time to unfold their full performance potential. Consequently, research results on the impact of BMI that rely on cross-sectional data might not tell the full story, and should be critically reflected upon or replicated. For example, the reason Giesen et al. (2007) and Pedersen et al. (2018) do not find positive performance effects of BMI could potentially be explained by the absence of time considerations. Moreover, other consequences of BMI such as changes in customer behavior (Clauss et al., 2019) might not be fully understood in a cross-sectional setting.

5.3. Managerial implications

Our findings may help practitioners with their decision-making problem of resource allocation in different BMI activities, highlighting the importance of adequate strategic management regarding the BMI process and timing. First, BMI activities in single dimensions produce superior financial results. However, as concentrated BMI activities appear to outperform BMI activities dispersed across different business model dimensions, and due to the observed substitutability of the dimensions of value creation and value proposition innovation, we suggest that firms should desist from over-intensification of decoupled BMI efforts to avoid overstressing the organization, which might lead to a loss in focus, generate struggle over resources, and hamper decision-making and implementation (e.g., Ethiraj & Levinthal, 2004; Larsen et al., 2013).

Furthermore, complementary and substitutive performance effects of simultaneous BMI efforts with different foci on the respective BMI dimensions place new emphasis on the strategic role of BMI (Futterer et al., 2022). Our findings suggest that BMI activities should result from holistic strategic planning efforts, and that they should be aligned with firms' overarching strategies to prevent the negative consequences of unaligned innovation efforts in different dimensions of the business model. In line with the idea of business model roadmapping (De Reuver et al., 2013), managers should design a tiered transformation process that is linked to their firm's strategy, regulates innovation intensity and use of resources, and coordinates the appropriate combination of dimensions subject to change. This might also involve the intentional rejection of promising, substitutive BMI efforts. Regarding the positive performance implications of jointly deploying value capture innovation and value proposition innovation, findings from previous scholars highlight the importance of system thinking: for example, in the context of service-oriented BMI, Visnjic et al. (2016) recommend a coupling of the introduction of service business models with product innovation to achieve long-term competitive advantage.

Moreover, BMI requires time to materialize, and performance consequences are therefore time-delayed. Managers as a result need to consider the appropriate timing: because short-term results from BMI cannot be expected, their exertion might be inappropriate during times of poor liquidity or financial difficulties. Moreover, BMI might even cause short-dated additional effort (e.g., Achtenhagen et al., 2013; Sánchez & Ricart, 2010). Managers should therefore desist from further activities during times when critical resources are tied up in other ongoing strategic efforts.

5.4. Limitations and future research

This research is, as with all empirical studies, subject to a number of limitations. First, the set of BMI activities captured in our scoring models is limited to public, visible information. For publicly traded corporations complying with prime standard requisites, we argue that all BMI-relevant events are disclosed. However, invisible and intangible BMI favoring corporations' capabilities such as changes in culture and mindset are not covered. Moreover, the shareholder-value focus of listed enterprises might favor overreporting of activities that may not yet have been fully or successfully implemented. Second, our data is limited to publicly traded companies in the German market. A different logic may apply to alternative company structures such as privately owned firms, start-ups, or to distinct cultural and institutional settings. Third, our proxies for firm performance, *market capitalization* and *profitability (EBIT)*, involve financial performance indicators or investors' expectations of future profits. The effects of BMI on subjacent business performance or organizational effectiveness in areas such as innovation performance, product development, employee satisfaction, sustainability, quality, and social responsibility, are not directly investigated. For example, Menter et al. (2022) recently found that radical BMI decreases the congruence between employees and their organization. The previous arguments also lead to the fourth limitation of our study that stems from the choice to work with available secondary data to create a longitudinal research setting instead of e.g. applying survey-based primary data. While cross-sectional studies often attempt to measure fractions of time by asking perceptual questions that refer to larger periods (e.g., Bouwman et al., 2018), with respect to the use of time, survey research faces problems and pitfalls, such as relying on perception-based measures, issues related to key informant and common method bias, retrospective bias, or endogeneity (e.g., Hipp et al., 2020). Hence, while secondary data has its pitfalls, we are convinced that, for our specific purpose, longitudinal data outperform retrospective survey measures. Fifth, our operationalization of BMI activities in different business model dimensions does not capture a clear distinction between incremental or radical BMI. In line with Foss and Saebi's (2017) BMI typology, including scope and novelty, future research could pick up on our assessment of BMI activities in different dimensions while adding information regarding the novelty of BMI activities (new to the firms vs. new to the industry). Sixth, although we analyze the interactions of different business model dimensions in relation to firm performance, we do not analyze the relationships among BMI sub-elements. Clauss et al. (2019) argue that the successful implementation of value capture innovation may require subsequent adaptations of the firms' processes and operations (parts of the value creation). In particular, this intertemporal nature and the question regarding which other elements need to be reconfigured to implement BMI has yet to be studied. Future research could bring the resource-based interaction effect discussion to the evolving debate about digitalization and BMI (see for example Veile et al., 2022). From an ecosystem perspective, required resources may even lie outside the current organization's boundaries (e.g., Burström et al., 2021; Kohtamäki et al., 2019). Here, our managerial implications highlight the importance of work dedicated to the process of BMI for incumbents in the context of digitalization, such as Lamperti et al.'s (2023) model for digital servitization BMI, or, more generally, the discussion about a lean startup approach in digital entrepreneurship (Ghezzi & Cavallo, 2020).

6. Conclusion

Because existing studies lack generalizable evidence from cross-industry longitudinal research designs, this study examines the effect of BMI on firm performance. Our study enriches current BMI research by delivering empirical proof and generalizability regarding the positive time-delayed effects of the three BMI dimensions on performance. Furthermore, this study responds to recent calls for cumulativeness in the BMI literature by operationalizing a measurement construct developed by previous scholars in the field. Beyond these areas, our study contributes to the discourse on BMI as the creation and modification of various dimensions of the business model by assessing the

complementarity and substitutability of the underlying core BMI dimensions. Our study as a result stimulates a deeper strategic consideration regarding managing the BMI process, as well as the role of resource allocation during BMI activities. In addition, our findings have various practical implications for managers, helping them to better understand the mechanisms of BMI dimensions while enabling them to orchestrate BMI activities with different foci.

Our assessment opens up various directions for future research. Forthcoming studies should advance the assessment of the complementarity and substitutability of BMI dimensions, considering resource allocations for BMI activities and their underlying logic of economies of scope. Our findings suggest that resource allocation for BMI might follow certain episodes of alignment over time, while highlighting the role of strategy during BMI to create superior interdependencies (Lanzolla & Markides, 2021). While findings from innovation portfolio management suggest that the allocation of resources to a broader range of innovation projects increases product innovation performance (Klingebiel & Rammer, 2014), our differentiated findings on complementarity and substitutability of BMI dimensions furthermore raise the interesting question of how to successfully manage and select BMI activities. Hence, an in-depth analysis of these microfoundations can guide future research and managerial decision-making. This further involves prioritization of BMI dimensions and even the intentional choice against certain BMI activities, in particular joint value creation and value proposition innovation, at a particular time, opening avenues for research on the strategic selection and alignment of portfolios in BMI. Regarding the effects on performance outcomes, scholars should go beyond financial performance effects to examine the impact of BMI using a more holistic view of firm performance, assessing inter alia effects on business performance, innovation performance, and organizational effectiveness.

CRediT authorship contribution statement

Matthias Menter: Writing – original draft, Conceptualization. **Lutz Göcke:** Writing – original draft, Conceptualization. **Christopher Zeeb:** Writing – original draft, Conceptualization. **Thomas Clauss:** Writing – original draft, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1. Operationalization of business model innovation scoring model

Dimension	Sub-element	Source	Operationalization examples (extract)
Value creation innovation	New capabilities	When internal capabilities or skill sets are leveraged to perform relatively better than others, the term "core competency" can be applied (Morris et al., 2005). Capabilities therefore play an important role in building up competitive advantages, and acquiring new capabilities is part of value creation innovation. Most business models are based on playing leveraged core competencies as a competitive advantage. Some business models even limit their activities to one specific step of value creation and benefit from leveraged expertise, economies of scale, and high-quality processes (Gassmann et al., 2013). Internally, new capabilities can be developed through training, continuous learning, or knowledge integration (Clauss, 2017). The latter also requires managerial and organizational capabilities to identify and exploit opportunities that arise from the external environment (Teece et al., 1997; Achtenhagen et al, 2013; Clauss, 2017).	- Development of a core competency/ expertise by oneself, e.g. skill development; from outside sources, e.g. through mergers and acquisitions of firms with new, complementary capabilities; cooperation/partnership to jointly develop a competence.
	New technology & equipment	Technology is a key driver of business model change (Chesbrough & Rosenbloom, 2002; Chesbrough, 2007; Calia et al., 2008, Frankenberger et al., 2013). An adequate alignment of technological innovation and business model design is necessary for firms to grow successfully (Wei et al., 2014). In doing this, the required technologies differ: production technology and the corresponding equipment might be required for new product and service offerings, while new revenue models might require new technical systems for payment (Clauss, 2017).	- New technology in product/process with strategic relevance leading to competitive advantages developed/innovated by oneself, e.g. internal R&D department; acquired from outside sources, e.g. through mergers and acquisitions, new partnerships, license agreements, explicit purchase transactions. New equipment/infrastructure (in relevant size) developed internally/acquired externally.
	New partnerships	Since partners in value creation can be the source of assets that could not be developed by a firm on its own (Dyer & Singh, 1998), a holistic view of businesses calls for combining factors located both inside and outside the firm (Teece, 2010; Zott et al., 2011). Crowdfunding, open-source platforms, peer-to-peer businesses, shop-in-shop concepts, and ingredient branding are some examples of partnership-based business models (Gassmann et al., 2013). The management of the partner network displays an essential part for the business model to efficiently offer and commercialize value (Osterwalder et al., 2005) and exploit complementary assets to create a unique value proposition (Bohnsack et al., 2014).	- Cooperative agreement/ partnership/ strategic alliance with external partners/ institutions/ communities/ public bodies with strategic/ business model implications, e.g. realization of product and services, joint ventures, market entries, economies of scale/ scope, joint infrastructure/ innovation/ research. Development of a product and service ecosystem requiring new partner/ network configuration/ organizational partner integration.
	New processes & structures	A firm has to master several processes and activities and orchestrate its resources and capabilities to build and distribute the value proposition (Frankenberger et al., 2013). Processes and structures therefore define the connection of activities within a business model (Amit & Zott, 2001) and, contrastingly, new processes and organizational changes can be the basis for changes in the business model (Cavalcante et al., 2011; Clauss, 2017). As an example, some ventures in the catering industry have changed	- New core activity of firm's value creation Significant/substantial change in depth of added value/value creation network, e.g. via vertical integration Introduction of new & innovative processes, e.g. opening of development platform, open source, co-creation Extensive process improvement through synergies, technology, or efficiency increases Process-related integration of partners or customers, e.g.

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(*continued*)

Dimension	Sub-element	Source	Operationalization examples (extract)
		the logic of existing industry patterns by transferring part of the value creation to the customer (e.g., McDonalds, Vapiano; see Gassmann et al., 2013).	following mergers/acquisitions Significant change in organizational structure, e.g., creation of new business segments.
Value proposition innovation	New product & service offering	The bundle of products and services that is of value to the customer describes a firm's value proposition (Osterwalder, 2004; Frankenberger et al., 2013). New offerings comprise innovative solutions to customer problems and needs (Johnson et al., 2008), which are new to the firm or new to the industry itself, and complement, diversify, or restructure the company's product and service portfolio. New offerings arise from research and development activities (Cooper & Kleinschmidt, 1987), the exploitation of new technologies (Teece, 2010), or value creation innovation, e.g. when combining products and services in unique ways (Amit and Zott, 2001). A significant shift in a firm's offerings changes the underlying business model, e.g. when a company becomes a service provider instead of offering mere products, or when it refines its focus to profit generation via add-ons while providing the original business at a competitive price.	- New-to-the-firm or -industry products & services, addressing customer demand/ pain New-to-the-firm or -industry product & service innovations, e.g. in the context of internet/ digital platforms and ecosystems Complementary extension/ diversification/ significant change in product & service portfolio Development of new field of businesses, e.g. servitization.
	New customer segments & markets	Target customers and markets are paramount for business models (Osterwalder et al., 2005, Frankenberger et al., 2013, Clauss, 2017). Entering new markets or serving new customer segments presents a BMI (Clauss, 2017) which in this context allows a firm to expand its activities (Heij et al., 2014), target niches that are underserved by industry and competitors (Aspara et al., 2010), maintain salient points of difference (Morris et al., 2005), or even open up new markets (Zott & Amit, 2007; Hartmann et al., 2013). Some business models target the premium/luxury segment to open up and develop a new market, then drop down to less expensive segments with larger scale (Bohnsack et al., 2014). This positioning further includes decisions regarding stakeholders, visions, values, and networks and alliances (Morris et al., 2005), for example leading to business models where companies allow others to distribute goods under their brands (e.g. white label), or focus on delivering the core value proposition (e.g., no frills, see Gassmann et al., 2013).	- Addressing a new, currently not-served customer segment/ new customer group, e.g. customer tier, generation, price class Addressing a new, currently not-served market segment, e.g. new products or services Addressing / extending into a new, currently not-served market/ region of significant size, entailing substantial structural/ organizational changes or calling for new skills, e.g. entering the Asian/ Chinese market Significant change in positioning, e.g. new competitive strategy/ diversification.
	New customer relationship	Business models differ in the kind of relationships a firm establishes between itself and its customers, and the interaction with particular segments or accounts might even determine business success (Osterwalder et al., 2005; Morris et al., 2006). Customer relationships display a source of BMI, especially in mature or substitution markets (Clauss, 2017) where valuable customer links provide information about environmental changes and market needs (Chesbrough, 2006), help understand the customers' willingness-to-pay, and feedback serves as a source of improvement and innovation (Gambardella & McGahan, 2010; Wirtz et al., 2010; Spieth & Schneider, 2016). Some business models even center around customer relationships, for example by establishing lock-in effects (Amit & Zott, 2001; Johnson, 2010; Gassmann et al., 2013).	- Significant increase in customer loyalty/ retention/ repurchase rates, e.g. loyalty programs Significant increase in customer satisfaction, e.g. through enhancement of customer journey, feedback in consumer rankings Deliberate change in customer relationship, e.g. lock-in effects, razor and blade strategy Change in customer relation/ interaction, e.g. through inclusion in value creation via crowd sourcing/ open innovation; new delivery channels in the form of direct selling Increased and substantiated willingness-to-pay
	New product & service delivery	The distribution channels describe how a company gets in touch with its customers to deliver value (Osterwalder et al., 2005, Clauss, 2017) and affects a firm's value proposition (Morris et al., 2006). Digitalization often allows for new ways of delivery by turning existing products into digital variants and selling them via online channels (Gassmann et al., 2013).	- New distribution channels e.g. via introduction of online shop/ new store concept (flagship stores, shop-in-shop) Significant change in distribution structure, e.g., engagement of new distribution partners Significant change in the portfolio of deployed distribution channels Significant change in depth of value added in sales, e.g. via switching to direct sales
Value capture innovation	New logic of earnings	Value capturing describes the economic logic of a business model and points to the essential question of how to make money in the business (Frankenberger et al., 2013). New streams of revenue display a BMI, either generated by adding new to existing revenues, or by the substitution of less profitable ones (Amit & Zott, 2010). The introduction of new revenue models is about encouraging the customer to pay for the firm's value proposition (Afuah, 2014).	- Opening up/ generation of new sources of revenue, e.g. through cross-selling, affiliate products, complementary products, integrated service contracts, licenses - Change in payment system/ streams of revenue, e.g. rent instead of sale, subscription - New pricing strategy, e.g. flat rate, freemium, add-ons
	New logic of costs	Since a corporation's economic model provides a consistent logic for earning profits (Morris et al., 2005), emphasis on efficiency of existing transactions is a further way to innovate the business model and reinforces the focal firm's competitive position through cost leadership (Bohnsack et al., 2014). A new logic of costs, e.g., through leveraged operations, an optimized cost structure, or economies of scale might allow for higher margins (Morris et al., 2005; Heij et al., 2014).	- Realization of significant economies of scale, e.g. via bringing together business units/ partner integration/ joint use of infrastructure & resources Significant change in cost structure, e.g. in the context of a new product-to-market strategy Significant cost reduction/ synergies, e.g. through outsourcing, restructuring, or significant price-effects through enhanced sourcing strategy Efficiency-enhancing process innovation in context of IT/ digitalization/ automation/ organization

Appendix 2. Robustness test assessing performance implications of single BMI dimensions

	Model I (0 Lags)	Model II (1 Lag)	Model III (2 Lags)	Model IV (3 Lags)	Model V (4 Lags)	Model VI (5 Lags)
Value creation innovation	21.75	−2.769	**86.06†**	4.446	**58.83†**	57.20
	(30.01)	(28.27)	**(48.77)**	(29.95)	**(32.04)**	(38.53)
Value proposition innovation	40.86	**105.2†**	17.85	9.595	−4.013	12.22
	(50.12)	**(61.17)**	(50.59)	(152.82)	(49.30)	(80.41)
Value capture innovation	**189.8†**	−142.1	90.50	**226.0***	−172.2	−129.1
	(106.2)	(185.5)	(112.2)	**(91.96)**	(113.6)	(94.23)
Firm age	37.76	43.98	46.00	49.72	30.06	57.07
	(35.68)	(43.49)	(44.88)	(40.92)	(52.79)	(72.97)
Firm age (sq.)	**0.371†**	**0.495†**	**0.627***	**0.519†**	**0.652***	**0.756†**
	(0.211)	**(0.261)**	**(0.278)**	**(0.278)**	**(0.310)**	**(0.397)**
Firm size	163.3	−14.32	−138.4	−254.8	−458.1	**−556.2†**
	(216.5)	(217.3)	(227.7)	(250.6)	(285.0)	**(316.9)**
R&D expenditure	−83.23	−20.97	96.23	100.0	317.6	205.9
	(70.79)	(58.88)	(62.98)	(163.4)	(320.2)	(226.4)
N	460	416	370	323	277	186
R^2	0.10	0.121	0.156	0.162	0.182	0.206

Note: This table reports the results of our panel regression. We rely on a sample of 60 German Prime Standard listed firms for the years 2007 to 2017. The dependent variable is profitability (EBIT). †0.05 ≤ p < 0.1, *0.01 ≤ p < 0.05, **p < 0.01, *** p < 0.001. Robust standard errors in parentheses.

Appendix 3. Robustness test assessing complementarity and substitutability of pairwise BMI interactions

	Model VII (0 Lags)	Model VIII (1 Lag)	Model IX (2 Lags)	Model X (3 Lags)	Model XI (4 Lags)	Model XII (5 Lags)
Value creation innovation	1.574	19.32	**163.4***	27.87	57.50	87.52
	(29.94)	(38.58)	**(64.59)**	(49.08)	(35.30)	(55.39)
Value proposition innovation	**154.4***	**153.0***	**100.5***	**142.5***	102.9	−8.916
	(72.07)	**(431.1)**	**(228.3)**	**(189.7)**	(305.2)	(310.8)
Value capture innovation	31.58	−151.7	145.6	**183.8***	−95.13	123.4
	(129.5)	(243.8)	(137.6)	**(106.2)**	(127.5)	(95.89)
Value creation innovation X value proposition innovation	**−12.96***	−11.44	**−27.08***	**−25.40****	−9.743	11.28
	(6.327)	(22.50)	**(11.73)**	**(8.847)**	(6.513)	(9.297)
Value proposition innovation X value capture innovation	**103.2***	8.556	−29.73	**58.22†**	54.99	−50.33
	(44.91)	(37.76)	(35.98)	**(30.63)**	(40.63)	(40.38)
Value creation innovation X value capture innovation	**−144.4†**	6.522	98.19	−56.35	−114.6	0.859
	(82.03)	(98.58)	(78.43)	(62.92)	(69.49)	(53.28)
Firm age	30.19	41.03	46.11	52.28	28.05	56.35
	(34.89)	(41.99)	(42.30)	(37.39)	(48.25)	(65.95)
Firm age (sq.)	**0.431†**	**0.508 †**	**0.637***	**0.532***	**0.699***	**0.768***
	(0.220)	**(0.256)**	**(0.272)**	**(0.257)**	**(0.286)**	**(0.361)**
Firm size	213.9	−8.922	−154.9	−265.7	**−458.8†**	−500.4
	(217.5)	(212.3)	(225.4)	(230.5)	**(256.6)**	(301.9)
R&D expenditure	−87.40	−5.895	**123.1†**	121.9	344.5	184.7
	(67.55)	(64.18)	(72.37)	(153.3)	(294.8)	(221.6)
N	460	416	370	323	277	231
R^2	0.135	0.125	0.191	0.210	0.227	0.244

Note: This table reports the results of our panel regression including the interaction terms of the BMI dimensions. We rely on a sample of 60 German Prime Standard listed firms for the years 2007 to 2017. The dependent variable is profitability (EBIT). †0.05 ≤ p < 0.1, *0.01 ≤ p < 0.05, **p < 0.01, *** p < 0.001. Robust standard errors in parentheses.

Appendix 4. Robustness test assessing the implications of simultaneous, concentrated BMI activities

	Model XIII (0 Lags)	Model XIV (1 Lag)	Model XV (2 Lags)	Model XVI (3 Lags)	Model XVII (4 Lags)	Model XVIII (5 Lags)
Value creation innovation	−17.43	31.64	**87.49†**	27.88	25.35	75.56
	(29.51)	(38.51)	**(45.48)**	(40.03)	(26.16)	(55.01)
Value proposition innovation	**160.3***	**125.7***	**89.50†**	**126.1***	104.9	−30.83
	(67.59)	**(53.14)**	**(44.82)**	**(61.48)**	(68.23)	(102.5)
Value capture innovation	−15.16	−45.01	93.46	149.2	−161.6	136.5
	(125.8)	(230.6)	(145.7)	(120.0)	(161.3)	(133.6)
Value creation innovation X value proposition innovation	**−11.09***	−5.401	**−26.82***	**–32.51****	**−14.69***	4.559
	(6.412)	(24.03)	**(10.62)**	**(7.052)**	**(6.286)**	(6.278)
Value proposition innovation X value capture innovation	**110.7***	32.76	6.640	**69.92****	**85.32†**	−29.21
	(47.40)	(37.67)	(34.90)	**(24.66)**	**(47.82)**	(39.34)
Value creation innovation X value capture innovation	**−151.5†**	56.79	50.96	−44.22	−140.1	−8.110
	(84.46)	(92.11)	(61.46)	(61.12)	(84.91)	(58.66)

(*continued on next page*)

(*continued*)

	Model XIII (0 Lags)	Model XIV (1 Lag)	Model XV (2 Lags)	Model XVI (3 Lags)	Model XVII (4 Lags)	Model XVIII (5 Lags)
BMI concentration	44.13	**78.82***	**73.76†**	42.49	11.57	−44.01
	(32.97)	**(37.11)**	**(41.01)**	(31.00)	(22.36)	(32.15)
Firm age	41.55	48.34	47.10	43.64	10.10	−3.758
	(30.89)	(33.98)	(28.33)	(33.23)	(46.33)	(60.31)
Firm age (sq.)	**0.419†**	**0.495 †**	**0.603***	**0.566***	**0.723***	**0.966***
	(0.224)	**(0.257)**	**(0.274)**	**(0.267)**	**(0.279)**	**(0.386)**
Firm size	108.8	−88.17	−173.2	−248.0	**−424.5†**	−497.2
	(198.8)	(179.6)	(166.7)	(204.8)	**(248.4)**	(306.8)
R&D expenditure	−122.8	−40.67	51.93	120.9	385.6	263.1
	(63.47)	(38.05)	(83.88)	(160.7)	(325.3)	(277.2)
N	460	416	370	323	277	231
R^2	0.186	0.163	0.206	0.240	0.242	0.240

Note: This table reports the results of our panel regression including the interaction terms of the BMI dimensions and the span of BMI activities across business model dimensions. We rely on a sample of 60 German Prime Standard listed firms for the years 2007 to 2017. The dependent variable is profitability (EBIT). †$0.05 \leq p < 0.1$, *$0.01 \leq p < 0.05$, **$p < 0.01$, *** $p < 0.001$. Robust standard errors in parentheses.

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