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Product innovation in entrepreneurial firms: How business model design influences disruptive and adoptive innovation

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A R T I C L E I N F O

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A B S T R A C T

Blockchain technology has the potential to drive product innovation in various industries. This emerging technology is an important enabler of the next generation of new ventures. Our study examines the effects of the business model designs of blockchain-based entrepreneurial firms on the scope of product innovation, including disruptive innovation and adoptive innovation. To test this relationship, we conduct a survey to collect data from 159 blockchain-based ventures. The findings indicate that the novel business model strongly entices disruptive innovation but does not influence adoptive product innovation. The results also indicate that the efficient business model strongly encourages adoptive product innovation, but strongly discourages disruptive product innovation. Further, our analysis shows that the firm's disruptive technological capability strengthens the positive relationship between the novel business model and disruptive product innovation but weakens the positive relationship of design efficiency with adoptive innovation. Additionally, we found that the disruptive technological capability strongly entices blockchain-based entrepreneurial firms to favor disruptive product innovation over adoptive product innovation.

1. Introduction

Recently, as a disruptive technology, blockchain technology has had a significant effect on the facilitation of business development and industry revolution (Abdel-Basset et al., 2020; Chang, 2018; Chang et al., 2020a; Choi et al., 2019; Dolgui et al., 2020; Frizzo-Barker et al., 2020; Kaur et al., 2018; Saberi et al., 2019; Zhu and Kouhizadeh, 2019). Blockchain technology is often defined as a platform that is used to execute smart contracts, cryptocurrencies, and other elements of supply chain management, marketing, and finance (Ahluwalia et al., 2020; Baym et al., 2019; Ma et al., 2020). Applications of blockchain technologies have the potential to revolutionize various industries through driving product transformations, such as disruptive and adoptive product innovations (Ahluwalia et al., 2020; de Soto, 2017; Chang et al, 2020b; Kimani et al., 2020; Larson and Chang, 2016).

Scholars suggest that blockchain technologies represent actor-independent, external enablers that attract and facilitate entrepreneurs to develop their business ideas and to exploit those ideas to create new blockchain ventures (Chalmers et al., 2021; Chen et al., 2020; Davidsson, 2015; Davidsson et al., 2020). The emergence of blockchain technologies has facilitated entrepreneurial firms to create innovative business models that enable those firms to identify new business logics and opportunities to deliver propositions about the superior value of their products to customers (Chen and Bellavitis, 2020; Foss and Saebi, 2017; McDonald and Eisenhardt, 2020). Research on business model designs has predominately assumed that they are important for large or mature firms (e.g.; Bocken and Geradts, 2020). We believe that it is valuable to examine the impact of business models on new ventures, particularly blockchain ventures. The business model designs of blockchain ventures are an important priming process, which further drives firms to develop their innovative products (Chang, Chen, and Lu, 2019; Morkunas et al., 2019; Nowiński and Kozma, 2017). The literature has assumed and/or suggested that business model designs influence new product development (e.g., Foss and Saebi, 2017; Zott and Amit, 2007;

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Zhu et al., 2019); however, until now, little research has been conducted to examine how they influence product innovation in entrepreneurial firms. Therefore, we aim to examine how the business model designs of blockchain ventures influence the firms' disruptive product innovation and adoptive product innovation.

We examine our research question using the data collected from 159 blockchain entrepreneurial firms and we advance the literature by offering the following contributions. First, we examine the effects of business model designs on product development by emphasizing the scope of innovation: disruptive and adoptive innovation. The literature has previously investigated the impacts of business models on the speed of new product development without considering the heterogeneity of product innovation—either disruptive or adoptive. We link the dual nature of business model designs (design novelty and design efficiency) with the dual nature of product innovation activities: products that are "new to the world" (disruptive innovation) as well as those that are "new to the ventures" (adoptive innovation). Second, we advance the literature on the performance consequences of business model designs by focusing on a specific type of innovation outcome for the business model design. The literature has assumed two important mechanisms through which business model designs can influence firms' financial performance: introducing new products and accessing new markets (Foss and Saebi, 2017). We go further to explain how business model designs can influence both the disruptive product innovation and adoptive product innovation in entrepreneurial firms. We test these two specific mechanisms, discussed in the literature. Third, we examine the effects of business model designs in blockchain-based entrepreneurial firms. It will be necessary to investigate the issue of boundary conditions in future research, which could provide valuable insights for the advancement of the theory (Foss and Saebi, 2017). We test our framework in the context of a single (blockchain-based) industry and consider the entrepreneurial stages of firms.

We structure the paper as follows. After the introduction, the theoretical background and hypothesis development are discussed. We then present the research method, analyses, and results. Last, we offer insights for business practice and discuss the research limitations and potential opportunities for future studies.

2. Theory background and hypotheses development

2.1. *An integrative perspective: the resource-based view and transaction cost economics theory*

2.1.1. *The resource-based view*

The resource-based view posits that a firm's sustainable competitive advantage stems from resources that are rare; valuable; difficult, or impossible, to imitate or duplicate; and hard to substitute (Barney, 1991). The design of a firm's business model often aims to enhance the internal capabilities that help firms shape their competitive advantage (Zott and Amit, 2007). Supporting research highlights that business model design incorporates multiple organizational characteristics (i.e., the elements of structure and governance and the contents of transactions) and alignments among the elements (Doty et al., 1993; Miller, 1996; Misangyi et al., 2017). The underlying logic of a firm's business model design is consistent with the resource-based view, which depicts the firm as a unique collection of resources and capabilities, enabling effective development and deployment to achieve and sustain a competitive advantage. According to the resource-based theory, the design of the business influences entrepreneurial firms' performance (Zott and Amit, 2007). There are two main streams associated with the core mechanisms. One is that business model design helps entrepreneurial firms enhance their total value creation for all stakeholders through reducing operational costs. The other is that business model design enables firms to shape and develop their capabilities appropriate to the values desired by their business models.

The resource-based view provides a theoretical foundation to explain how firms deploy and aggregate a bundle of resources to achieve competitive advantage. For example, resources (i.e., blockchain technology) enable entrepreneurial firms to generate new products for the market. If firms aim to better deliver value to customers through producing and introducing different types of products, they are required to deploy their resources through transactions that create value for all stakeholders (i.e., customers) (DaSilva and Trkman, 2014). Therefore, management scholars (e.g., DaSilva and Trkman, 2014) highlight the importance of integrating the resource-based view and transaction cost economics theory to explain the performance outcomes of firms.

2.1.2. *Transaction cost economics theory*

Transaction cost economics theory is concerned with how to reach an optimal governance structure that enables firms to minimize the total cost of organizational transactions (Ghoshal, and Moran, 1996). Such transaction is the theory's unit of analysis, which concerns the exchange of information, products, or services across the different, subsequent stages of a production process (Cuypers et al., 2021; Schmidt and Wagner, 2019). In the case of business model design, entrepreneurial firms orchestrate and connect the contents, structures, and governances of the firm to help create the themes of model novelty and model efficiency. Specifically, the novelty-centered business model design is concerned with creating new transaction mechanisms, which highlights the importance of marketing concepts (customer-driven, build-to-order business models) rather than selling concepts (the build-to-stock model of selling). In contrast, the efficiency-centered business model is aimed at achieving transaction efficiency through reducing transaction costs. For example, firms use efficiency-centered designs to reduce information asymmetry among transaction participants and to increase the reliability and simplicity of transactions.

Taken together, the resource-based view recognizes that the unique combination of resources creates value for firms, while transaction cost theory highlights that transaction efficiency is a source of value (DaSilva and Trkman, 2014). Based on the underlying assumptions of these two theories (DaSilva and Trkman, 2014), we argue that entrepreneurial firms cannot deliver any value to customers through using their resources alone; however, value for customers can be delivered through products made with the use of resources.

2.2. *Business model design and product development*

Blockchain-based product development is particularly important for blockchain ventures, which need to improve innovation performance for firm survival and growth (Nuscheler et al., 2019). As a disruptive mechanism, the application of blockchain technology in new product development is an important component that directly influences the success of new product development (Adams et al., 2017), helping ventures to shape a competitive advantage via product differentiation, to establish entry barriers, and to explore new markets in blockchain industries (Zhu et al., 2019). However, for blockchain entrepreneurial firms, the process of new product development can be influenced by the business model of the ventures. Business model designs help blockchain entrepreneurial firms to shape and use unique combinations of resources together with optimal governance structures to search for, identify, and assimilate resources and to minimize the total cost of organizational transactions—which, in turn, determines blockchain firms' product innovation outcomes (Zott and Amit, 2007; Zott et al., 2011; Zhu et al., 2019).

Recently, scholars have tried to investigate how business models influence new product development (e.g., Zhu et al., 2019). The literature has argued that the business model is a system that is designed to manage boundary-spanning activities and transactions (e.g., Zott and Amit, 2010) and to control interactions with external partners (Zott and Amit, 2007, 2008, 2010; Zhu et al., 2019). Therefore, these management activities can help firms to identify entrepreneurial opportunities and facilitate their exploitation of innovations (Teece, 2010; Zott and Amit, 2010). Studies have recently explored the effects of business model designs on new product development (e.g., Zhu et al., 2019); however, the literature has predominately investigated the effects of business model design on the speed of new product development. When considering time-based competition, the speed of new product development has been identified as a key component that determines the success of new product development (Thakur-Wernz et al., 2020; Wu, Liu and Su, 2020; Zhu et al., 2019).

However, it is not only speed that matters to new product development; the quality of the new product is also important for blockchain firms' survival and growth a competitive marketplace (Jin et al., 2019). This is especially true for emerging blockchain technological firms in highly competitive environments, such as China (Cooper, 2019; Jin et al., 2019; Wang et al., 2020; Wu, Liu, and Zhang, 2017; Wu, Lui and Su, 2020). Therefore, based on the integration of the resource-based view and transaction cost theory, we aim to investigate how business model designs influence blockchain entrepreneurial firms' product innovation. We argue that the efficient and novel business model design contains different mechanisms of transactions produced using different combinations of resources, which may generate distinctive effects on blockchain-based disruptive and adoptive product innovation.

2.3. Design novelty and disruptive and adoptive product innovation

The novel business model aims to introduce new ways to conduct economic exchange, through which firms can often connect to new participants (Zott and Amit, 2007, 2008). Scholars have assumed that the novel business model design can influence product innovation through the approaches of production and products (Zott and Amit, 2008; Zhu et al., 2019). The literature has suggested that the novel business model can help firms to build a new market or expand their existing markets through innovation (e.g., Bocken and Snihur, 2020; Foss and Saebi, 2017; Zott and Amit, 2007, 2008, 2010). We propose that a higher level of novel business model design will drive the blockchain venture to accelerate disruptive blockchain-based product innovation but will result in a lower level of adoptive blockchain-based products.

Novel business model designs facilitate disruptive blockchain-based product generation by entrepreneurial firms via three important mechanisms. First, novelty-centered business model designs increase the proactiveness of blockchain entrepreneurial firms to acquire unique resources that help design novel transaction mechanisms. Proactiveness may be described as:

> proactive behavior in relation to participation in emerging industries, continuous search for market opportunities and experimentation with potential responses to changing environmental trends (Miles et al., 1978). It is expected to be manifested in terms of seeking new opportunities, which may or may not be related to the present line of operations, [and the] introduction of new products and brands ahead of competition, strategically eliminating operations which are in the mature or declining stages of life cycles. (Pérez-Luño et al., 2011:558; Venkatraman, 1989: 949)

To develop and maintain novel business model designs, blockchain ventures tend to proactively innovate the business model itself and develop novel ways for unique resource-based development. With such a proactive attitude, blockchain entrepreneurial firms are more likely to fully examine their internal and external environments, build unique resource bases, and identify disruptive innovation opportunities to defeat their competitors (Miller, 1983; Pérez-Luño et al., 2011; Zobel et al., 2017); therefore, such firms tend to become pioneers in disruptive blockchain-based product generation (Brege and Kindström, 2020; Karimi and Walter, 2016; Lindsay and Hopkins, 2010; Mahto et al., 2020; Pérez-Luño et al., 2011; Roper and Tapinos, 2016).

Second, novelty-centered business model designs encourage blockchain entrepreneurial firms to test their unique combinations of resources, which support the development of original business ideas and assumptions, enabling the blockchain firms to iterate their disruptive innovation opportunities. Disruptive generations require blockchain entrepreneurs to intensively refine and iterate their blockchain-based technologies (resources) and products before execution and scaling (Bocken and Snihur, 2020). Novel business model designs require an intensive experimentation process that encourages blockchain entrepreneurs to fully engage with various stakeholders, helping them to overcome organizational inertia and deploy their resources and, therefore, driving radical innovation (Berends et al., 2016; Bocken and Snihur, 2020). Third, novel business models enable blockchain firms to link various new participants together (Zott and Amit, 2007, 2008, 2010). Such interactive activities allow blockchain firms to develop themselves as novel structural holes in which the network resources occupy a central position (Andrews and Burt, 1995; Bocken and Snihur, 2020; Gargiulo and Benassi, 2000; Gilsing et al., 2008). The natural advantages of structural holes increase blockchain firms' capabilities to gain access to various new stakeholders and fresh external knowledge for the identification of disruptive opportunities and the formation of disruptive ideas (Grosser et al., 2018). Therefore, novelty-centered business model designs provide blockchain firms with a novel structural hole through which to identify new opportunities and obtain necessary knowledge and resources for the exploitation of opportunities. Taken together, the above three mechanisms—proactiveness in learning, the testing and iteration of novel business ideas, and structural holes—generated by novel business model designs facilitate disruptive blockchain-based product generations. Therefore, we propose that:

Hypothesis 1a: The more novelty-centered an entrepreneurial firm's business model design, the greater the firm's disruptive product innovation.

While novel designs facilitate disruptive blockchain-based product generation by entrepreneurial firms, they may harm blockchain-based product adoptions. Innovative product adoptions require the blockchain entrepreneurial firms to rely on and leverage existing resources to continually select, refine, and execute innovation for current product upgrades (March, 1991; Raffaelli et al., 2019; van Oorschot et al., 2018). The substance of novel designs is the conceptualization of new approaches that interact with various new participants (Zott and Amit, 2007, 2008). Because of the nature of novel design and innovation adoptions, novelty-centered business model designs may damage the innovative product adoptions of blockchain entrepreneurial firms by the following significant mechanisms.

First, novel designs require connections with previously unconnected participants, which may disrupt the attention and focus required by blockchain entrepreneurial firms to continually maintain well-established relationships with current partners and collaborators (Berghman et al., 2006; Zhu et al., 2019). This reduction of the focus on current well-established relationships affects blockchain entrepreneurial firms' abilities to absorb resources consistently and continually from the current relationship for current product iterations and adoptions. In addition, the activities and practices of blockchain entrepreneurial firms are often constrained by their limited resources (i.e., human capital, the time and energy of entrepreneurs, and financial capital) (Tran and Santarelli, 2014). When focal firms or entrepreneurs allocate more resources to develop connections with new participants, the resources allocated to established relationships will be dramatically weakened. Therefore, the refinement and development processes of pre-existing knowledge will be shortened and impaired, which, in turn, will erode blockchain entrepreneurial firms' abilities to adapt and iterate current products. Therefore, we propose that:

Hypothesis1b: The more novelty-centered an entrepreneurial firm's business model design, the weaker the firm's adoptive product innovation.

2.4. Design efficiency and disruptive and adoptive product innovation

The substance of efficient designs is to reduce transaction costs and improve transaction efficiency (Zott and Amit, 2007, 2008). The attention on such reductions and improvements drives blockchain firms' focus and ability to reduce uncertainty, complexity, and information asymmetry in more efficient ways (de Vasconcelos et al., 2018; Zott, 2003). The pursuit of efficient improvement led by efficiency-centered business model designs may decrease the disruptive blockchain-based product generations of blockchain firms but increase the possibilities for focal firms to produce blockchain-based product adoptions.

An efficient design decreases the blockchain firms' disruptive product generations using two key mechanisms. First, with a focus on efficiency improvement, entrepreneurial firms are often required to follow their organizational routines to interact with current participants, which, in turn, influences the firms' capacity to absorb externally fresh information and resources for future disruptive innovation. Firms or entrepreneurs can simplify the devotion of knowledge and resources to an interacting and negotiating process with current participants to further enrich their existing knowledge for the improvement of efficiency (Mu, 2015). Repeated processes and organizational routines situate the firms' intention to acquire fresh knowledge beyond the current participants, constraining the creation and application of new knowledge required for disruptive innovation processes.

Second, an efficiency-centered business model design may cultivate the risk-avoiding attitudes and behaviors of focal entrepreneurial firms. An efficient design encourages firms to reduce uncertainties and risks through focusing on revising and leveraging their pre-existing knowledge, which harms the identification and exploitation of disruptive innovation ideas (Zott and Amit, 2007, 2008). Risk-avoiding attitudes and behaviors would prevent blockchain entrepreneurial firms from allocating important resources in high-risk investments, such as entirely new product categories. With a risk-avoiding attitude, firms would cease to move from known to unknown ventures (Globocnik, 2019). Consequently, ventures tend to circumvent disruptive innovation that is without the likelihood of success and reduce their resource allocations for high-risk and uncertain innovations; thus, they are less willing to escape from the familiar into the unknown. These mechanisms indicate that a blockchain entrepreneurial firm with an efficient deign is less likely to devote resources and efforts toward the pursuit, identification, and exploitation of disruptive innovation ideas. We therefore hypothesize the following:

Hypothesis 2a: The more efficiency-centered an entrepreneurial firm's business model design, the weaker the firm's disruptive product innovation.

In contrast, to enhance the efficiency of business model designs, entrepreneurial firms should focus on rigid and standardized routines throughout their entire business development and operation processes (Zhu et al., 2019). Such designs and processes facilitate blockchain entrepreneurial firms to develop blockchain-based product adoption for two reasons. First, an efficient design and development process requires the persistence and consistency of business operations that drive firms to reinforce their existing resources through in-depth interactions with current participants (Zott and Amit, 2007, 2010). The reinforcement of pre-existing knowledge through interactions with relatively fixed groups of participants means that firms can further identify opportunities for future technology and product iterations. In addition, the firms will be guided by their pursuit of efficiency and the patterns of knowledge absorption will become reinforced through repeated modes of learning during the processes of efficiency improvement. Consequently, the firms will be able to fully understand the needs of their current participants and continually and consistently reinforce existing knowledge for product adoption.

Second, the pursuit of an efficient design facilitates the development of operational standardization in blockchain entrepreneurial firms. Such a development process necessitates firms to enhance the dependability and simplicity of business transactions. To achieve such standardization, firms are required to rely more on the selection, refinement, and execution of characteristics possessed by one or several participants in the marketplace. This standardization could stimulate firms to identify adoptive opportunities and exploit them to adapt to the needs of their participants and customers. Thus, we hypothesize that:

Hypothesis 2b: The more efficiency-centered an entrepreneurial firm's business model design, the greater the firm's adoptive product innovation.

2.5. Moderating effects of disruptive technological capability

To develop blockchain-based disruptive product innovation and adoptive product innovation, blockchain entrepreneurial firms often engage in developing blockchain disruptive technological capabilities (Hughes et al., 2019; Kewell et al., 2017). This enhances the entrepreneurial firms' innovative aptitudes for allocation as well as their orchestration of accumulated knowledge and skill (Kang et al., 2017; Markard, 2020; Peerally et al., 2019; Zhang, Wang, Duan, & Zheng, 2021). We argue that when a blockchain venture develops its blockchain disruptive technological capabilities, its foundation of disruptive technological resources and skills is enriched, and its disruptive technological application capability is enhanced. This, in turn, facilitates entrepreneurial firms' abilities to exploit their accumulated disruptive technological capabilities and to simultaneously explore fundamentally new disruptive technological capabilities (Levinthal and March, 1993; March, 1991; Raisch et al., 2009; Wu, Wang and Evans, 2019).

With strong blockchain-based disruptive technological capabilities, a blockchain venture with a novel design is more capable of exploring possibilities. The supporting research has found that as firms build disruptive technologies and become more innovative, they identify new resources and skills, resulting in an enlarged pool of knowledge (Li, 2019; Zhang et al., 2019). Therefore, such firms have enhanced opportunities to identify and create new possibilities for more explorative activities (March, 1991; Raisch et al., 2009). A firm with a stronger disruptive technological capability is equipped with a richer foundation of disruptive skill through which it can search for and create new expertise. In addition, such a rich foundation provides the firm with varied disruptive technological resources for discovery and experimentation, which have been identified as appropriate channels for the generation of disruptive ideas (He et al., 2020). Importantly, a strong disruptive technological capacity reflects the entrepreneurial firm's ability to apply its existing technological capabilities to further technological development. Such developmental processes and progress encourage the development of the blockchain firm's experimentation capability, which is critical for disruptive product innovation. Therefore, this exploitation process, from the search for and creation of novel blockchain expertise, to the discovery of new ideas, to the experimentation with those ideas, amplifies the positive effects of novel design on disruptive blockchain-based product innovation. Thus:

Hypothesis 3a: The positive effect of novelty-centered business model design on disruptive product innovation will depend on the disruptive technological capability, such that the effect will be stronger with greater disruptive technological capability.

Organizational research has suggested that a greater level of a particular type of organizational capability cultivates a higher level of exploitation in that area (Levinthal and March; 1993). When blockchain entrepreneurial firms continue to build their technological capabilities for blockchain disruption, the firms tend to become more self-reinforcing during the entire technological learning process, which encourages them to be more exploitive (Gupta et al., 2006; Luger et al., 2018; Zhou and Wu, 2010). With a strong disruptive technology, a blockchain entrepreneurial firm has a significant foundation of blockchain disruptive technologies from which to choose and refine its existing technologies. However, as an entrepreneurial firm, a continuous process of new blockchain disruptive technology building may induce firms to move beyond their current technological trajectories (Cohen and Levinthal, 1990; Zhou and Wu, 2009). Consequently, the accumulation of new disruptive technological knowledge may not be used for current product adoptions, which are often based on the revision of existing technological knowledge. Further, entrepreneurial firms may face difficulties in integrating new disruptive technological knowledge into their existing knowledge bases or find that the process of such integration is time consuming. Further, new disruptive technological knowledge may require different resources or operational processes to allow it to be commercialized. Therefore, we suggest that a strongly disruptive technological capability discourages firms from undertaking blockchain-based adoptive product innovation. Thus, we propose the following:

Hypothesis 3b: The positive effect of efficiency-centered business design on adoptive product innovation will depend on the disruptive technological capability, such that the effect will be weaker with a greater disruptive technological capability.

The above suggests that blockchain disruptive technological capability provides either exploration or exploitation benefits that facilitate blockchain-based disruptive product innovation and adoptive product innovation. We further argue that a blockchain entrepreneurial firm with strong blockchain disruptive technological capabilities tends to focus on more exploitative activities that facilitate adoptive innovations (Zhou and Wu, 2009). Blockchain entrepreneurial firms are often constrained by limited resources, such as financial capitals for research and development investment (Tran and Santarelli, 2014); therefore, a strong level of disruptive technological capability may facilitate exploitation. This exploitation during the early stages of a firm's life cycle allows the firm to fully leverage their current technological knowledge for survival and growth, such as by adapting more products to market expansion based on the success of current items. In addition, entrepreneurial firms with strong blockchain disruptive technological capabilities may face challenges in realizing the commercialization of new technologies in the short term, which could encourage them to become more capable of adapting technological knowledge in current product portfolios in the short term. This is because, for an entrepreneurial firm, especially in its early stages of life, the nature of self-reinforcing facilitates efficiency in integrating and adapting newly disruptive technologies into existing categories (Levinthal and March, 1993; Zhou and Wu, 2009). Therefore, for blockchain entrepreneurial firms, we hypothesize the following:

Hypothesis 3c: Disruptive technological capability influences the tendency for product innovation. That is, it will strengthen the tendency toward disruptive product innovation.

3. Research method

3.1. Research setting and sample

To test the proposed hypotheses, we collected data from blockchain-based entrepreneurial firms from the cities of Beijing, Shanghai, Shenzhen, and Guangzhou, the most commonly known first tier cities in China, through surveys. Entrepreneurs in these cities are strongly encouraged to advance emerging technologies under the "Made in China 2025" initiative (Industry 4.0), which seeks to transform China from a manufacturing giant into a world manufacturing power (innovation) (Hemmert et al., 2019). The data were collected from May to August 2020. The survey questionnaires were sent to the various technological and innovative parks or incubators in Beijing, Shanghai, Shenzhen, and Guangzhou, from which we identified our potential target participants. The entrepreneurial founders (Chief Executive Officers or Chief Technology Officers) were invited to complete the survey questionnaires.

To increase the response rate, the researcher and hired research assistants (two master's graduate students from the University of Sydney and the University of Warwick, respectively) contacted the identified entrepreneurial firms two weeks after the survey was distributed. In total, we approached 367 blockchain-based entrepreneurial firms that were founded in 2016 or the previous year; finally, 235 firms (a response rate of 64.03%) returned the completed questionnaires to us. We checked the returned questionnaires and ensured that the firms belonged to the sample selection criteria: 1) that they could be categorized as blockchain-based, 2) that they were officially founded between 2010 and 2016 (entrepreneurial firms), and 3) that they were involved in innovation activities or the launch of new products/services. Those firms founded between 2017 and 2020 (36 firms), that did not belong to the blockchain-based category (31), or that were not involved in innovative activities (5) were excluded from the sample. In total, we obtained 163 responses that met our sample frame and, of those, 159 were considered valid. Eventually, we obtained the data of 159 blockchain-based entrepreneurial firms to comprise the dataset (a response rate of 43.32%).

3.2. Measures

The measurements employed in this study were checked using important steps to guarantee the data's reliability and validity. First, the survey questionnaire and the measurements of all the constructs were checked through six in-depth interviews with blockchain entrepreneurs and industry experts (angel and venture capital financing investors, and leading experts in the field). Their comments and suggestions were considered and integrated into the questionnaires (i.e., the measures of R&D expenditure and incubator experience). Second, we sent out the initial version of our questions to 15 blockchain-based entrepreneurs for the pilot study. We then addressed the potential confusion regarding the items and questions, as proposed by the pilot participants, and revised the questionnaire before the data collection.

3.3. Dependent variables

3.3.1. Blockchain-based disruptive product innovation and adoptive product innovation

We used two dependent variables in this study to measure the innovative performance of blockchain-based entrepreneurial firms, namely, disruptive product innovation and adoptive product innovation. We asked the entrepreneurs to indicate the number of "new to the world" products introduced to the market in the last three years, which was used to measure the firms' *blockchain-based disruptive product innovation*. We also invited the entrepreneurs to indicate the count number of "new to the firm" and "new to the market" products to reflect the firms' *blockchain-based adoptive product innovation*. The *product innovation tendency* was computed by the percentage of blockchain-based disruptive product innovations in the total number of blockchain-based disruptive and adoptive product innovations. Measuring the number of new products for innovation is a method widely employed in the existing innovation studies (e.g., Pérez-Luño et al., 2011).

3.4. Independent variables

3.4.1. Business model design

Following the studies of Zott and Amit (2007, 2008), we used two independent variables to capture the *business model designs* of the blockchain-based entrepreneurial firms: design novelty and design efficiency. There were 13 items used to measure the design novelty and 13 items used to measure design efficiency. Likert-type scales were adapted to measure the strength of each item in terms of design novelty and design efficiency. The strength of each item was then coded into a standardized score, whereby 1 indicated "strongly agree," 0.75 connoted "agree," 0.25 designated "disagree," and 0 stipulated "strongly disagree." "Radically" was coded as 1, "substantially" as 0.66, "a bit" as 0.33, and "not at all" as 0. Further, "yes" was indicated by 1 and "no" by 0. The measurements for the design novelty and design efficiency were captured by an overall score using equal weights for each design theme (Zott and Amit, 2007, 2008, 2010).

To check the consistency and reliability of the measures of design novelty and design efficiency, we computed standardized Cronbach alpha coefficients for each design theme. The coefficient for design novelty was 0.749 and the coefficient for design efficiency was 0.742. Both measures for design novelty and design efficiency sufficiently satisfied the guideline of Nunnally (1978), whose study suggests 0.70 as a benchmark for the reliability test.

We also operated confirmatory factor analysis (CFA), which can be utilized to test how data follow a predetermined theoretical structure in each design theme (Bollen, 1989; Cole, 1987); therefore, we used CFA to test the convergent validity of each design theme. When the values of the CFI (comparative fit index) as well as the TEI (Tucker-Lewis index) are all larger than the threshold value of 0.90, when the value of the SRMR (standardized root mean squared residual) is less than 0.09, and when the RMSEA (root mean square error of approximation) value is less than 0.08, the measures of the variables have good model fits (Byrne, 2001; MacCallum et al., 1996). The CFA results for the design novelty suggest that the values of the CFI and the TLI are 0.986 and 0.983, respectively. The SRMR captured a value of 0.053 and the RMSEA obtained a value of 0.019. These CFA results for design novelty indicate a sufficient set of fit indices. The CFA results for design efficiency were 0.990 for CFI, 0.988 for TLI, 0.054 for SRMR, and 0.017 for RMSEA, which also suggests a good convergent validity. The above results provide sufficient support for the construct validity of the design—considering design novelty and design efficiency.

3.5. Moderating variables

3.5.1. Disruptive technological capability

Invention patent grants have been widely used to measure the technological capability of firms in previous studies (e.g., Kang et al., 2017; Rothaermel and Alexandre, 2009; Stuart, 2000). This is because the number of patented invention grants can capture a firm's disruptive technological capability to integrate and build existing technological skills into new ones. The number of patented invention grants has been theoretically constructed as a key indicator of disruptive technological ability (Rothaermel and Alexandre, 2009). Further, invention patents have been proven by the government authorities and their numbers are closely related to other indicators of disruptive technology capability, such as technology licensing (Hagedoorn, and Cloodt, 2003).We, therefore, used the number of granted invention patents in the blockchain category to measure the blockchain-based disruptive technological capability of the entrepreneurial firms.

3.6. Control variables

We controlled for further considerations that may affect the new product development of blockchain-based entrepreneurial firms. The entrepreneur-level controls included founder–CEO educational background, founder–CEO gender, and the size of the founding team. Firm size was captured by a logarithm for the number of total employees. Founder–CEO educational background was measured using a five-point ordinal scale adopted from Karaevli and Zajac (2013), with a value of 1 for high school, 2 for college, 3 for undergraduate degrees, 4 for graduate degrees, and 5 for doctoral degrees. The founder–CEO gender was given by the value of 1 for male and 0 for female. The founding team size was measured by the number of founders and co-founders.

We also controlled some important firm-level factors, comprising firm age, firm size, R&D expenditure, firm strategic alliance, incubator, financing experience, and prior sales growth. Firm age was measured by the number of years since the firm was officially established. Firm size was captured as a logarithm of the number of employees. R&D expenditure was measured as the average percentage of R&D expenditure in the total sales turnover of the firm for the last three years. Firm strategic alliance was measured as the number of strategic alliances with external organizations. Incubator was given the value of 1 if the firm was an incubator and was otherwise 0. Financing experience was measured as the number of financing rounds. Prior sales growth was measured as the average sales growth rate for the last three years.

4. Analyses and results

4.1. Econometric modeling and estimation models

We applied a hierarchical negative binomial regression analysis for the effect of independent variables testing. We had two dependent variables: the number of blockchain-based disruptive product innovations and the number of blockchain-based adoptive product innovations. Because both were numbers, Poisson and negative binomial regressions were suitable for the data analysis. However, our dependent variables were subject to overdispersion around the value of "0"; therefore, we used negative binomial regressions, given that we developed Hypotheses 3a, 3b and 3c to test the moderating effects of blockchain-based disruptive technological capability. Nonetheless, the coefficients of the interaction terms in the Poisson regressions and negative binomial regressions yield may not accurately capture the actual interaction effects (Wiersema and Bowenz, 2009). In addition, to capture the innovation tendencies of blockchain-based entrepreneurial firms for the testing of Hypothesis 3c, fractions (disruptive product innovation/disruptive product innovation + adoptive product innovation) were used, ranging from 0 to 1. Therefore, we employed hierarchical ordinary least squares (OLS) regressions by using "hireg" in Stata for the moderating effects analyses.

4.1.1. Statistical results of hierarchical negative binomial regressions

Table 1 offers an overview of the descriptive statistics of the data. We first tested the hypotheses correlated with blockchain-based disruptive product innovation. The results in Table 2 suggest that when the main effect variables—namely, design novelty and design efficiency—were entered into the independent model from the base model, there was a considerable improvement in model fit (Delta $Chi^2 = 17.180$; $p < 0.000$). The novel design was significantly and positively related to the blockchain-based disruptive product innovation (Beta = 2.021; $p < 0.00$), therefore, supporting Hypothesis 1a. However, the efficient design was significantly and negatively related to the blockchain-based disruptive product innovation (Beta = –0.476; $p < 0.05$), thus supporting Hypothesis 2a.

We then tested the hypotheses correlated with blockchain-based adoptive product innovation (see Table 3). We found no support for Hypothesis 1b, that the novel design had a negative association with the propensity for blockchain-based adoptive product innovation (Beta = –0.624; n.a.). However, the positive effect of the efficient design (Beta = 1.236; $p < 0.05$) supported Hypothesis 2b.

4.2. Statistical results of the hierarchical ordinary least square (OLS) regressions

We used hierarchical OLS regressions to test the moderating effects of blockchain-based technological capability. As shown in Table 4, the positive moderating effect of blockchain technological capability (Beta = 1.000; $p < 0.00$) supported Hypothesis 3a. The results shown in Table 5 are for the testing of the moderating effect of blockchain disruptive technological capability on the positive relationship between the efficiency-centered business model design and blockchain-based adoptive product innovation. The results indicate the negative moderating effect of blockchain disruptive technological capability on the relationship (Beta = –1.645; $p < 0.05$). This statistic result supports Hypothesis 3b.

Hypothesis 3c concerns the tendency of product innovation toward blockchain-based disruptive product innovation or adoptive product innovation. The analysis results are presented in Table 6. We ran the interaction between the novel design and blockchain disruptive

Table 1
Variable correlations.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Blockchain-based product generation	0.956	0.093	1														
2. Blockchain-based product adoption	2.314	0.186	−0.242*	1													
3. BMD efficiency	0.549	0.012	−0.285*	0.338*	1												
4. BMD novelty	0.387	0.012	0.294*	−0.027	0.077	1											
5. Firm age	4.535	0.058	−0.068	−0.083	0.009	−0.105	1										
6. Firm size	3.883	0.040	−0.037	−0.162*	0.027	−0.008	−0.149	1									
7. Founder–CEO education	3.868	0.071	0.152	−0.028	−0.143	0.023	−0.104	0.009	1								
8. Founder–CEO gender	0.528	0.040	0.040	0.063	−0.023	0.055	0.036	−0.065	0.213*	1							
9. Founding team size	3.094	0.068	0.074	−0.097	−0.045	0.006	0.121	0.122	−0.000	0.105	1						
10. R&D	0.478	0.017	0.166*	−0.087	−0.026	0.087	−0.040	0.051	0.382*	0.221*	−0.008	1					
11. Blockchain technological capability	2.170	0.130	0.349*	−0.440	−0.458*	−0.052	0.024	0.025	0.149	0.113	0.254*	0.105	1				
12. Strategic alliance	3.302	0.147	0.067	−0.009	−0.018	−0.041	0.025	0.058	0.139	−0.064	0.058	0.060	0.010	1			
13. Incubator experience	0.403	0.039	0.075	−0.006	−0.014	0.021	0.066	−0.072	0.107	−0.021	0.045	0.068	0.087	0.137	1		
14. Financing	1.138	0.088	0.267*	−0.070	−0.032	0.079	−0.045	0.078	0.235*	0.107	0.106	0.351*	0.157*	0.032	−0.033	1	
15. Sales growth	0.173	0.028	0.091	−0.034	−0.097	0.065	0.159*	0.044	0.048	0.097	0.050	0.047	0.080	−0.133	−0.030	0.060	1

Note: n = 159; * $p < 0.05$.

technological capability alone. We then entered the interaction between the efficient design and the blockchain disruptive technological capability into the model. We found consistent results for these two models. Because of limited space, we present only the full model results in Table 6. The results suggest that the blockchain disruptive technological capability strongly entices blockchain entrepreneurial firms with strong novel designs to favor blockchain-based disruptive product innovation over adoptive product innovation (Beta = 0.281; p < 0.00), thereby supporting Hypothesis 3c.

5. Discussion and conclusion

We have examined the effects of business model design, namely, design novelty and design efficiency, on blockchain entrepreneurial firms' blockchain-based disruptive product innovation and adoptive product innovation and we have made three significant theoretical contributions. First, we have advanced the literature on business model designs and firm innovation performance by specifically discussing the scope of product innovation newness. While the literature has previously discussed the contingent effects of design novelty and design efficiency on product development performance, such as the speed of new product development (e.g., Zhu et al., 2019), we have highlighted the importance of considering the heterogeneity of new product development (Pérez-Luño et al., 2011) by differentiating the effects of design novelty and design efficiency on disruptive product innovation and adoptive product innovation. This consideration of the dual nature of product innovation activities addresses the call from Pérez-Luño et al. (2011). We have linked the dual nature of product innovation (disruptive product innovation and adoptive product innovation) to the dual nature of business model designs (novelty and efficiency).

Second, we have advanced the literature in considering the effects of design on performance through highlighting the importance of focusing on a specific type of performance outcome in business model design. The literature has predominately focused on an aggregate performance outcome, such as financial performance (e.g., Foss and Saebi, 2017; Zott and Amit, 2007). Such studies have boldly assumed that business model designs can influence firms' financial performance through various mechanisms, including the introduction of new products, the accessing of new markets, and the optimization of operation processes (Foss and Saebi, 2017). We have enhanced the understanding of how designs influence firm product newness.

Third, we have progressed the understanding of the designs by highlighting the importance of the issue of boundary conditions. Such a consideration addresses the call from a review paper by Foss and Saebi (2017), published in the *Journal of Management*, which observes that the business model design literature does not explicitly grapple with the boundary issues that might influence research findings and the advancement of the literature. This is because these boundary conditions, such as the stages of a venture's life cycle (for entrepreneurial or established firms) and the types of industry (single or diversified), must be considered (Foss and Saebi, 2017; McDonald and Eisenhardt, 2020; Zott and Amit, 2007; 2008). Therefore, we have developed our study by focusing on a single (blockchain-based) industry and the entrepreneurial stages of firms. This has enabled us to clearly investigate the effects of business model designs on firm innovation outcomes in a specific context. The literature has suggested that the performance consequences of business model designs are more prominent in established firms, yet little attention has been given to entrepreneurial firms. Although the initial empirical context for the study of business model design was new ventures (e.g., Zott and Amit, 2007, 2008), the setting for the research was diversified industries.

Finally, we have integrated the resource-based view with transaction cost theory to explain the effects of business model design on the product innovation of entrepreneurial firms. We argue that entrepreneurial firms cannot deliver any value to customers using their resources alone; however, value can be delivered to customers through transactions

Table 2
Hierarchical negative binomial regression analysis for blockchain-based disruptive product innovation.

DV	Base model			Independent model		
	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*
Control						
Firm age	–0.152	0.138	0.269	–0.065	0.129	0.615
Firm size	–0.305	0.195	0.117	–0.246	0.195	0.208
Founder–CEO education	0.070	0.12	0.562	0.037	0.116	0.747
Founder–CEO gender	–0.125	0.205	0.543	–0.145	0.202	0.474
Founding team size	–0.048	0.121	0.690	0.009	0.118	0.941
R&D	0.378	0.453	0.405	0.142	0.473	0.764
Blockchain technological capability	0.205***	0.055	0.000	0.159***	0.06	0.008
Strategic alliance	0.017	0.055	0.761	0.041	0.054	0.448
Incubator experience	0.039	0.191	0.838	–0.015	0.186	0.935
Financing	0.186**	0.087	0.032	0.157*	0.085	0.063
Sales growth	0.379	0.283	0.181	0.286	0.270	0.29
constant	0.665	1.152	0.564	0.171	1.166	0.884
Main effect variables						
BMD efficiency				–1.476**	0.671	0.028
BMD novelty				2.021***	0.573	0.000
Model						
Log likelihood	–197.592			–189.002		
χ^2	32.86***			50.04***		
Delta χ^2				17.180		
Pseudo R^2	0.077			0.117		

Note: n = 159; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3
Hierarchical negative binomial regression analysis for blockchain-based adoptive product innovation.

DV	Base model			Independent model		
	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*
Control						
Firm age	–0.081	0.099	0.409	–0.091	0.100	0.361
Firm size	–0.325**	0.138	0.019	–0.340**	0.135	0.012
Founder–CEO education	0.103	0.085	0.227	0.118	0.086	0.172
Founder–CEO gender	–0.187	0.082	0.186	0.188	0.138	0.173
Founding team size	–0.027	0.081	0.737	0.025	0.080	0.753
R&D	0.229	0.365	0.530	–0.238	0.355	0.503
Blockchain technological capability	–0.390***	0.058	0.000	–0.328***	0.063	0.000
Strategic alliance	0.006	0.039	0.875	–0.004	0.038	0.926
Incubator experience	0.004	0.142	0.977	–0.012	0.142	0.932
Financing	0.018	0.067	0.791	0.013	0.066	0.847
Sales growth	0.042	0.198	0.831	0.108	0.197	0.582
Constant	2.656***	0.812	0.001	2.127**	0.931	0.022
Main effect variables						
BMD efficiency				1.236**	0.569	0.030
BMD novelty				–0.624	0.470	0.184
Model						
Log likelihood	–290.874			–287.828		
χ^2	58.44***			64.53***		
Delta χ^2				6.09		
Pseudo R^2	0.092			0.101		

Note: n = 159; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

made with the use of resources. Our research informs the intersection of these two theories in the effects of the business model designs of entrepreneurial firms on product innovation. The literature with a resource-based view has argued that firm value is generated through a unique combination of resources (e.g., DaSilva and Trkman, 2014), and the literature based on transaction cost theory has argued that the efficiency of transactions is a source of value creation (e.g., Zott et al., 2011). However, we have highlighted that it is important for entrepreneurial firms to combine the resource-based view with transaction cost logics in their product development processes. This will help entrepreneurial firms to develop innovative boundary-spanning organization designs, which may enable them to deliver true value to customers through disruptive or adoptive product innovation.

Our findings also produce some valuable insights with practical implications. Ahluwalia et al. (2020) emphasized that “as for the underlying blockchain technology, there are still massive obstacles standing in its way.” Our findings may provide value to blockchain-based entrepreneurial firms for their business model designs in the very early stages of the ventures’ life cycles, which may help ventures to design their business models in line with their new product development strategies and objectives. Our findings could remind blockchain entrepreneurs to channel their product development toward innovation generation or adoption and to integrate their innovation objectives into their business model design processes. This also provides valuable insights for entrepreneurs by highlighting the significant effects of business model design on the scope of product newness for blockchain-based entrepreneurial firms. Blockchain entrepreneurs might need to pay attention to their initial business model designs and

Table 4
Hierarchical OLS regression analysis for blockchain-based disruptive product innovation.

DV	Base model			Independent model			Contingent model		
	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*
Control									
Firm age	–0.119	0.121	0.330	–0.078	0.117	0.508	–0.099	0.113	0382
Firm size	–0.176	0.178	0.326	–0.151	0.168	0.370	–0.168	0.162	0.301
Founder–CEO education	0.033	0.109	0.764	0.015	0.103	0.888	–0.047	0.101	0.644
Founder–CEO gender	–0.074	0.183	0.685	–0.096	0.172	0.577	–0.080	0.166	0.632
Founding team size	–0.014	0.108	0.898	–0.013	0.102	0.901	0.028	0.099	0.774
R&D	0.299	0.458	0.514	0.221	0.431	0.609	0.261	0.416	0.531
Blockchain technological capability	–0.224***	0.056	0.000	0.179***	0.059	0.003	–0.166	0.114	0.147
Strategic alliance	0.032	0.048	0.509	0.043	0.046	0.347	0.053	0.044	0.231
Incubator experience	0.095	0.181	0.600	0.088	0.170	0.608	0.108	0.164	0.512
Financing	0.210**	0.085	0.015	0.196**	0.080	0.016	0.156**	0.078	0.048
Sales growth	0.042	0.198	0.831	0.154	0.240	0.523	0.240	0.232	0.304
Constant	1.120	1.042	0.285	0.930	1.086	0.393	1.974*	1.088	0.072
Main effect variables									
BMD efficiency				–1.429**	0.640	0.027	–1.091*	0.624	0.082
BMD novelty				2.227***	0.530	0.000	–0.534	0.942	0.572
Interactions									
BMD novelty × blockchain technological capability							0.100***	0.286	0.001
Model									
R^2	0.188			0.299			0.354		
Adj. R^2	0.134			0.237			0.291		
F	3.44***			4.76***			5.63***		

Note: n = 159; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5
Hierarchical OLS regression analysis for blockchain-based adoptive product innovation.

DV	Base model			Independent model			Contingent model		
	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*
Control									
Firm age	–0.350	0.239	0.146	–0.393	0.238	0.100	–0.332	0.235	0.160
Firm size	–0.748**	0.347	0.033	–0.795	0.342	0.021	–0.814	0.337	0.017
CEO education	0.069	0.212	0.747	0.114	0.210	0.588	0.185	0.209	0.378
CEO gender	0.534	0.355	0.135	0.512	0.350	0.146	0.451	0.346	0.194
Founding team size	0.096	0.209	0.648	0.070	0.207	0.736	0.014	0.205	0.944
R&D	–0.852	0.888	0.339	–0.875	0.877	0.320	–0.864	0.863	0.319
Blockchain technological capability	–0.652***	0.108	0.000	0.532***	0.120	0.000	0.295	0.369	0.425
Strategic alliance	0.015	0.094	0.875	0.017	0.093	0.857	0.008	0.091	0.928
Incubator experience	0.153	0.351	0.663	0.134	0.346	0.699	0.108	0.164	0.750
Financing	0.030**	0.165	0.856	0.022**	0.163	0.892	0.032**	0.161	0.845
Sales growth	0.125	0.493	0.800	0.258	0.488	0.599	0.306	0.481	0.526
Constant	7.618***	2.035	0.000	6.414	2.208	0.004	4.378*	2.338	0.063
Main effect variables									
BMD efficiency				3.088**	1.301	0.019	6.400*	1.897	0.001
BMD novelty				–1.184***	1.078	0.274	–1.334	1.063	0.211
Interactions									
BMD novelty × blockchain technological capability							–1.645***	0.695	0.019
Model									
R^2	0.244			0.277			0.304		
Adj. R^2	0.187			0.212			0.236		
F	4.31***			4.27***			4.49***		

Note: n = 159; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

initiatives if they wish to achieve relatively competitive differentiation advantages in their development of new products.

In addition, using an emerging technology, it is of significant value for entrepreneurs to build their blockchain technological capacities and to shape their competitive technological capabilities for future product development. However, in a blockchain entrepreneurial firm, the entrepreneur might need to be aware of the pace and rhythm in the development of blockchain technological capability, because a high level of blockchain technological capacity may harm their product adoption capability, and may, in turn, influence firm survival and growth. The abilities of blockchain-based entrepreneurial firms to adopt products are important for their early stages of development. Therefore, blockchain entrepreneurs must be aware of the drawbacks of their blockchain technological capabilities in product adoptions. For instance, blockchain-based ventures with strong technological capabilities might need to understand that although a strong technological capacity enhances product generation, it may trap them into pursuing technology building excessively and, therefore, may restrict them in maintaining current customers through consistently adapting existing products to satisfy their needs.

Our study has some shortcomings that offer potential opportunities for future studies. First, the mechanisms through which the business

Table 6
Hierarchical OLS regression analysis for blockchain-based product innovation tendency.

DV	Base model			Independent model			Contingent model		
	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*	Beta	Stand. error	*P-value*
Control									
Firm age	–0.024	0.038	0.533	–0.006	0.037	0.879	–0.011	0.036	0.754
Firm size	–0.043	0.055	0.441	–0.032	0.053	0.540	–0.037	0.051	0.470
CEO education	–0.012	0.034	0.719	–0.014	0.032	0.658	–0.031	0.032	0.335
CEO gender	–0.034	0.057	0.551	–0.038	0.054	0.487	–0.033	0.053	0.530
Founding team size	–0.021	0.033	0.536	–0.021	0.032	0.511	–0.010	0.032	0.759
R&D	0.074	0.142	0.601	0.051	0.135	0.708	0.062	0.132	0.639
Blockchain technological capability	0.103***	0.172	0.000	0.094***	0.018	0.000	0.001	0.065	0.987
Strategic alliance	–0.001	0.015	0.950	0.000	0.014	0.987	0.002	0.014	0.831
Incubator experience	0.004	0.056	0.939	–0.000	0.053	0.997	0.005	0.052	0.917
Financing	0.057**	0.026	0.033	0.053**	0.025	0.036	0.042*	0.025	0.095
Sales growth	0.128	0.079	0.104	0.096	0.075	0.203	0.121	0.074	0.104
Constant	0.373	0.324	0.252	0.234	0.340	0.494	0.518	0.370	0.164
Main effect variables									
BMD efficiency				–0.331	0.201	0.101	–0.220	0.291	0.451
BMD novelty				0.639***	0.166	0.000	–0.141	0.299	0.639
Interactions									
BMD novelty × blockchain technological capability							0.281***	0.091	0.002
BMD efficiency × blockchain technological capability							–0.008	0.106	0.940
Model									
R^2	0.266			0.342			0.383		
Adj. R^2	0.211			0.283			0.319		
F	4.83***			5.79***			5.93***		

Note: n = 159; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

model designs influence the generations and adoptions of blockchain-based products could be considered. We suggest that business model designs affect the propensity for product generation and adoption, highlighting the importance of how business model designs influence product newness in entrepreneurial firms. Future studies are needed to further explore this relationship by uncovering the paths by which the business model designs influence product generations and adoptions. To achieve this, more valuable insights could be given to entrepreneurs for business model design development and product development. Second, attention should be given to the generalizability of the findings of this study to other contexts. We investigated only the effect of designs on the product newness of blockchain-based ventures because we aimed to provide valuable insights for blockchain entrepreneurs in China. Future studies could attempt to test whether our findings work for firms in other industries or countries.

Appendix

Table 1, Table 2

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