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The Impact of Technological Turbulence on SMEs Business Model Innovation Performance: The Contingent Role of Entry Order

Francisco-Jose Molina-Castillo, Michael A. Stanko, Nazrul Islam, and Mark de Reuver

***Abstract*—In this study, we investigate how small and medium-sized enterprises (SMEs) engage in business model innovation in response to technology shifts, and the ensuing impact of this innovation on performance. Using structural equation modeling, we analyze data from a survey of 1328 European SMEs and find that technological turbulence affects the scope and novelty of business model innovation, and that these dimensions of innovation in turn affect firm performance. We show that these relationships are doubly contingent: both SME size (micro, small, or medium) and time since market entry are relevant. Early entrant firms are more responsive to technological turbulence through both dimensions of business model innovation, as the learning accruing in these SMEs since market entry motivates and informs business model innovation. There are meaningful differences in these relationships for micro, small, and medium-sized enterprises. Our findings advance the theoretical understanding of the relationships between technology, entry order, business model innovation, and performance and also serve to inform managers' estimations of the implications of technology turbulence and business model innovation for performance.**

***Index Terms*—Business model innovation, business model novelty, business model scope, entry order, SMEs, technological turbulence.**

I. Introduction

BUSINESS model innovation, which can profitably "break the existing rules" of a market [1], has been a topic of growing research interest during the last 20 years [2], [3]. This work has spanned disciplines, such as strategic management [4], entrepreneurship [5], marketing [6], knowledge management [7], and information systems [8]. Business models are central to open innovation research [9], which has itself experienced tremendous growth [10]. As would be expected in a fast-expanding topical domain, several definitions of business models have been applied [11], though there has been convergence [12] around Teece's [13] viewpoint of a business model as the underlying logic of the firm, the "design or architecture of the value creation, delivery, and capture mechanisms" (p. 172).

Business model innovation is an even faster growing subsegment of the business model literature [14], closely connected to entrepreneurial vision and creativity [11]. Business model innovation is thought to be more critical to competitive advantage than product invention [15], as products do not capture value without business models [16]. Technological progress is lionized, yet business model innovation offers as much, or more [17], in terms of rewards to the firm and society [18]: business model innovation represents the tools by which business opportunities are realized [19]. While research suggests that business model innovation typically helps firms' performance [20], research in two critically important areas remains sparse: 1) the antecedents of business model change and 2) the conditions under which business model innovation leads to performance improvement. In this article, we set out to address these gaps.

Foss and Saebi [21] described two main components of business model innovation: scope and novelty. Business model scope refers to the extent to which firm resources and components are renewed or reconfigured. The second dimension, business model novelty, refers to the degree to which changes in the business model are new to the industry [22]. Although developing business models outside of the familiar can be challenging [23], a novel business model can improve the competitive position of a firm [24]. Distinguishing the multiple dimensions of business model innovation helps to disentangle its antecedents and consequences [25].

Technological turbulence, the rate of technological change in a particular market [26], is thought to encourage business model innovation [27], though the boundary conditions of this presumption remain to be understood [12]. Technology shifts [17] often require a business model response to unlock the technologies' potential value [28], [29]. The ability to deploy business model innovation in response to turbulence is a critical dynamic capability [22], [30], and supply chain adjustments are one potential mechanism that may drive business model innovation [31]. Changing technologies also enable new business models to be deployed, as seen with digitalization [4], [32]

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and sustainable technologies [33], [34]. Hence, technological turbulence 1) requires new business models, which are necessary to commercialize technological inventions, and 2) enables new business models, which become possible thanks to supporting technologies. External factors, such as technological turbulence, have long been thought to be influential in bringing about business model innovation [35]. It marks another gap in the literature that this relationship has not been systematically explored.

We posit that the rewards from business model innovation differ between early entrants, who pioneer innovative products and develop the accompanying business models, and late entrants, who enter a sphere of already-established business models. The entry order literature shows that, generally, technological turbulence affects early and late entrants in different ways [36], [37], while also influencing innovation [38]. Surprisingly, the business model innovation literature only sparsely considers entry order [39], though authors have acknowledged that business model innovation relies on complementary assets and capabilities, such as channel relationships and brands, which early entrants have had more opportunity to establish [13], [19]. Given that early and late entrants are in different positions with regard to these complementary assets, which can enable the success of business model innovation [39], we view entry order as a critical consideration when examining the antecedents and performance implications of business model innovation. Entry order effects have not yet been thoroughly studied, beyond the conceptual argument that being first to market helps firms more effectively integrate new technology into business models [16], [38]. One noteworthy exception is Zott and Amit [40], who find an interaction between having a novel business model and early market entry in determining the value of publicly traded firms.

Understanding the type of business model innovation needed in a specific situation is even more critical for small and medium-sized enterprises (SMEs) [41]. SMEs have fewer resources available to overhaul their business models, as compared to large corporations [42]. Very few studies [43] have investigated differences in business model innovation across subcategories of SMEs (micro, small, and medium firms). Business model innovation may not have identical performance implications for all firms: research on the legitimacy threshold of organizations (the point below which a venture struggles for existence) Zimmerman and Zeitz [44] pointed to reasons to expect meaningful differences in how SMEs innovate their business models, and are able to reap rewards from doing so. Such entrepreneurial actions do not happen in isolation; these tactics build upon the resources and legitimacy established by the organization's previous efforts [45]. For instance, channel relationships are often crucial to business model innovation, as the firm must "persuade its prospective partner that the risk is a good one" [46, p. 294], which relates directly to the firm's legitimacy. Meaningful differences in complementary resources and flexibility across micro, small, and medium enterprises impose the logical necessity to examine size effects on business model innovation [15]. Given SMEs' leading contributions to virtually all nations' economies, their impact on innovation, and the expectation of boundary conditions to the performance benefits of business model innovation, it marks a substantial blind spot that business model researchers have largely treated SMEs as a monolith. Thus, this article aims to address the following questions: 1) Does entry order alter the impact of technological turbulence and business model innovation on a company's performance? 2) Are there meaningful differences across size categories of SMEs (micro, small, and medium)?

This study develops a contingent view, exploring the antecedents and performance implications of business model innovation for SMEs by connecting theoretically relevant external market dynamics (technological turbulence) and firm characteristics (entry order, size). We test a structural model using data gathered from a European Union–sponsored survey of 1328 SMEs that distinguishes between micro, small, and medium-sized firms—which too often are amalgamated. We find important differences in incumbent (i.e., early entrant) firms' ability to deploy complementary resources (e.g., channel relationships, brand) to support business model innovation [43]. Additionally, we show that the flexibility inherent to small organizations is relevant to the drivers of business model innovation [47]. Thus, the nature of these relationships is doubly contingent (see Fig. 1): both firm size and experience play meaningful roles in this network of effects. These findings are consistent with the strategic entrepreneurship perspective [48], focusing on the entrepreneurial actions of firms addressing uncertainty [5].

Once hypotheses for our entire sample of SMEs are tested, we explore each individual size category, finding evidence to support our reasoning that legitimacy, resource, and flexibility differences across these subgroups impact the outcomes of business model innovation. This advances the recently begun exploration of the distinct roles of newness and smallness in impacting innovation [49] and furthers researchers' knowledge pertaining to the boundary conditions of the performance benefits of business model innovation [2]. From a theoretical point of view, our findings address the current gap in the understanding of the relationships between technology, entry order, business model innovation, and performance. Our findings will also help managers to make more accurate estimations of technology and business model innovation implications for performance. The balance of this article is organized as follows: Section II develops our theoretical background and describes key constructs. Following this, Section III puts forward hypotheses, and the study's methodology (Section IV) and results (Section V) are reported. The final section discusses our implications for research and practice.

II. Theoretical Framework

A. Business Model Innovation—Scope and Novelty

Ambiguity persists with regard to what, conceptually, constitutes both a business model [2], [14] and a business model innovation [29], [50]. Amit and Zott [51] related business model innovation to the resource-based view of the firm, as well as to transaction cost theory. They find that it is crucial to understand how different resources of a firm combine. This has resonated with more recent authors [52], who describe business model innovation based on how core elements or key components create or capture value. While there has been tremendous growth

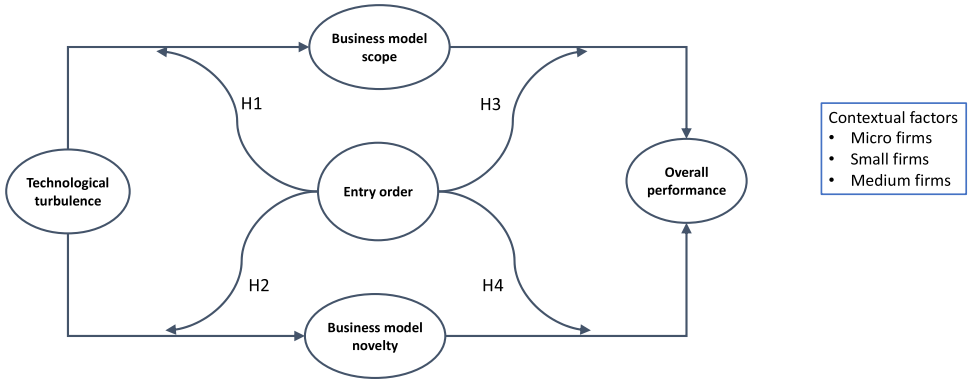

Fig. 1. Theoretical model.

in the analysis of business models [2], much of this literature borrows from long-established work related to profiting from technological advances (e.g., 46) before the term business model was widely used.

Foss and Saebi [12] advocated for distinguishing two dimensions of business model innovation: business model scope (the degree of change or combinations in the components of the firm's business model) and business model novelty (the degree of novelty of these changes in relation to the industry). Business model scope refers to the notion that business models are built on the connections of different components within the company and how they are connected to each other [21]. The challenge for any firm is to find the proper arrangement of these components [6]. Hence, the scope of business model innovation captures changes in any element(s) of the business model (modular innovation), as well as changes in the interrelationships between the model's components (architectural innovation). This conceptualization aligns with related work (e.g., 53) that distinguishes between modular and architectural innovation. The second dimension proposed by Foss and Saebi [12], business model novelty, pertains to the newness of a business model compared to others in the industry. With differentiated business models, firms can avoid directly competing with each other [54] by identifying a "blue ocean strategy" [55]. A novel business model can improve the competitive position of a firm against its rivals [24]. Most firms innovating their business model strive to find distinctions from competitors [56] to realize a strong market position [57]. Amit and Zott [51] found empirical support for this notion, bifurcating small but meaningful business model improvements from revolutionary changes. We define business model novelty as the degree to which the outcome of business model innovation is new to the industry [21].

B. Technological Turbulence

The notion that innovation is particularly imperative in turbulent (i.e., fast-changing) environments is well established [48], [58]. Turbulence in the environment can originate from within the industry (e.g., competitors introducing new products) and outside (e.g., new regulation) and relates to the rate and magnitude of change. Environmental turbulence involves both market turbulence (e.g., competitor behavior) and technological turbulence, of which the latter is our focus here. The impact of technological turbulence on business model innovation has hardly been examined, similar to antecedents to business model innovation in a broader sense [22], [59]. The few existing studies largely focus on market turbulence [60], but little attention has yet been paid to the ways a changing technological environment drives firms to rethink their business models. From a theoretical perspective, the relationship between technological turbulence and business model innovation is twofold. First, business models are seen as a way to unlock the hidden potential of inventions [16]: technological inventions are only valuable when accompanied by suitable business models [61]. Hence, we view business model innovation as an important driver of performance. Second, technology shifts can enable new business models [17], as they may constitute channels for delivering value [62] by for instance, providing interfaces and platforms for digital services and the development of technological architectures [63].

C. Entry Order

The relationship between entry order and performance is complex and the subject of much debate [64]. The entry order literature brings forward several reasons why early entrants enjoy advantages [65], often referred to as first (or early) mover advantages [38]. Consumers may prefer a first-entrant offering because they consider it the "original" version [38], because it has become a de facto standard, or because of switching costs once they have committed to an early entrant. Also, the firm itself may benefit from learning effects and economies of scale, which create entry barriers for others [66]. The ability to acquire and assimilate knowledge from the environment has been connected to business model innovation [67]. Early entrants may also benefit from pre-emption of scarce assets, such as suppliers or locations [68], which may become particularly critical if these complementary assets are invoked as part of a later business model innovation [19]. Even under threat from new entrants, incumbents may sustain their position thanks to the advantages accumulated while they were still the only player in the market [69].

However, early market entrance has not always been viewed by researchers as an advantage. Market pioneers often succumb to followers [70]. Lieberman and Montgomery [68] suggested that early entrants face disadvantages: free-rider effects (i.e.,

later entrants can benefit from mistakes made by early entrants), uncertainties about technologies and markets, shifts in technologies and customer needs, and inertia as incumbents become victims of their own routines and rigidity. With respect to learning, some authors argue that early entrants' initial learning creates barriers to later competitive entry [66]. Others argue that late entrants have more time to observe the market [71] and can learn from evolving customer segments and incumbents' mistakes [72].

The business model innovation literature scantly intersects with this discussion on entry order [23]. Business model innovation has been observed to enable late entrants to overcome disadvantages from late entry, as evidenced in the case of Apple's iTunes with regard to MP3 technology [73], despite Apple's entering the market much later than other firms such as Sony and Napster. Similarly, Tesla, a late entrant to the automotive market, has benefited from business model innovation, particularly in terms of product distribution and the charging network [3], [74]. Markides and Sosa [39] argued that business models that are fundamentally different from those in the industry allow late entrants to overcome early mover advantages as well as explaining why early mover advantages do or do not sustain. While late entrants are thought to benefit from novel business models, early entrants are also poised to benefit from them. Complementary assets logically connect the entry order and business model innovation literatures, though research at this intersection is in its infancy, and we set out here to address this deficit.

D. Business Model Innovation and SMEs

SMEs represent more than half of all economic activity in most countries [75]. In contrast, business model innovation research has thus far focused predominantly on large businesses [4], with some attention to start-ups [5]. The handful of studies focused on SMEs find that business model innovation helps them to find market opportunities [25] and has positive performance implications [19], [62]. Aspara et al. [43] showed that small firms focusing more on business model innovation than replication show stronger performance. On the other hand, business model innovation is not easy for SMEs [75], which have fewer resources to engage in such innovation than large firms [76]. Relatedly, Cucculelli and Bettinelli [19] found that the presence of intangible assets (which likely are relatively scarce for SMEs) increase SMEs' ability to profit from business model change. Similarly, Del Giudice et al. [15] explored the effect on digital innovation for SMEs. There may be instances in which the flexibility and speed advantages of smallness [47], [77] prove advantageous for business model innovation. For example, Scuotto et al. [41] showed how individual digital skills are crucial for innovation performance and SME growth. Thus, the context of SMEs is an economically important, managerially practical, and theoretically interesting context within which to examine business model innovation. Surprisingly, very few studies [43] have considered the differences that may arise based on the size of SMEs. Given that the resource, flexibility, and legitimacy differences across the micro, small, and medium subgroupings are crucial to both undertaking and profiting from business model innovation, and that entry order allows for meaningful differences in market learning and experience across these SMEs, this intersection offers a meaningful context for our research.

III. Hypotheses

Hypothesis development focuses on the moderating role of entry order in affecting both technological turbulence's impact on business model innovation and the performance implications of this business model innovation (see Fig. 1), as well as on differences across subcategories of SMEs.

A. Technological Turbulence and Business Model Scope/Novelty

Linder and Williander [78] and Yuan et al. [79] argued for the need to better understand business model innovation in relation to environmental volatility. Essentially, following strategic alignment logic, firms should pursue an appropriate fit between the technological environment and their business [80], [81]. Especially under technological change, early entrants are more likely to ambitiously reformulate their business model, given their inherent entrepreneurial orientation and demonstrated lack of risk aversion. Their deep understanding of the marketplace enables the detection of technological threats as well as the motivation to take action based on these threats. Learning and experience accruing since market entry have been observed to promote business model innovation, shifting how managers perceive the landscape [12]. Interfirm networks [3] and other complementary resources (for instance, brands) built up over time by early entrants can be redeployed by iterating with a business model in response to technological turbulence [13]. In contrast, late entrants have not developed assets and relationships to the same extent and thus have fewer options in terms of how wide their scope of business model innovation might be. Resource availability has been noted as an impediment for late entrants to respond to technological shifts (e.g., [82]); this marks another reason we expect early entrants to be more responsive to technological turbulence through business model shifts.

> H1: Technological turbulence is more positively related to a wider scope of business model innovation for early entrants than for late entrants into a market.

Previous studies have brought attention to technology's role in prodding the development of business models that are new to the world [48], [83]. Following Teece's [13] logic, when technologies change, companies should pursue new business models to protect their current businesses and find avenues for growth. In general, early entry to a market creates several advantages for firms [65], which we argue alters the ways that these early entering firms will respond to later technological turbulence. The ability to deploy long-established complementary assets (e.g., channel relationships, brands) to a new-to-the-world business model renders early entrants more willing to shoulder this risk, unlike later entrants who face the uncertainty imposed by technological turbulence without the benefits of extensive

experiential learning in a market, long-established relationships, or relevant complementary assets.

The pursuit of novel business models constitutes a substantial risk for SMEs [43]. Early entering firms, who have built a deeper market understanding, will be more apt to take on the risk inherent to a novel business model innovation. The thinking patterns of managers and founders within SMEs are central to business model innovation, particularly for very novel business models [12]. In a study of small ventures over a decade, Snihur and Zott [22, p. 573] found that one cognitive practice closely connected to novel business model innovation is a complex thinking style, occurring "when the founders, and subsequently other members of the organization, display exceptional awareness of their industry structure and functioning" that involves "deep reflections about the different types of participants in their industries and their interactions." This practice appears to be common to serial entrepreneurs and innovators [22], [84]. We argue that this practice, enabled by reflection on industry experience and grows over time since market entry and thus will be more pronounced in early entrants.

H2: Technological turbulence is more positively related to novel business model innovation for early entrants than for late entrants into a market.

B. Business Model Scope/Novelty and Organizational Performance

As stated by Chesbrough [61], the same technology marketed in different ways can have different results. Late entrants need to overcome more entrenched notions of the status quo [61] and challenge accepted business models [85]. Yet incumbents' long-established market presence may imply a larger number of opportunities to create additional value through shifts in their business model [81] and outperform competitors that entered the market later [23]. Early entrants may also leverage the trust built over time with customers [86] to support customer-informed business model innovation. Early entrants' relationships with customers can be harnessed to more deeply understand customer preferences and shape business model changes to optimize performance. The performance implications of uncovering customer needs and responding with an appropriate business model alteration can sustain long term [87] (refer to the related concept of the need-solution pairing). The ability to profit from a variety of modifications to the business model relies to a great extent on the leveraging of complementary resources. That is, business models rely on assets, such as brands, capabilities, such as customer service, and also relationships with channel partners and suppliers to generate profit [13], [19], [22], [46]. Since early entrants have had more time in the industry to develop these complementary resources, it logically follows that these firms should more effectively deploy them to profit from iterations within their business models. In many cases, these early entrants have pre-empted access to these resources [39], making it more complicated for later-entering firms to profit from changes in their business model scope. Further, since a wider scope of business model innovation tends to produce a more complex business model, early entrants are in a better position to communicate the relevant aspects of their complex and evolving business models to customers who are further along in the customer journey. Shifts in the business model scope may present the chance to profit from customers with already-established switching costs, as early entrants have had a greater chance to achieve customer lock-in [72].

H3: A wider scope of business model innovation is more positively related to performance for early entrants than for late entrants into a market.

Markides and Sosa [39] argued that a novel business model helps late entrants to overcome the first-mover advantages of early entrants. We contend that a more developed competitive environment favors performance for late entrants, which develop novel business models as a form of differentiation in a crowded marketplace [88]. In the parlance of Kim and Mauborgne [55], late entrants are better poised to reap the benefits of a "blue ocean strategy," finding niches ignored by incumbents. Market latecomers with a novel business model are in a position to capture emerging segments with distinct needs that may be overlooked by incumbents reluctant to abandon an existing customer base [89].

The ability to effectively enter completely new niches [90] and to execute drastically different business models may be stifled for early entrants (i.e., incumbent's inertia), which pursue novel business models through an embedded network of relationships and assets [3], conscious of the risk of cannibalizing existing customer relationships. The performance of early entrants pursuing novel business models may be hampered, given that the preferences of their established customer base are entrenched and likely less responsive to truly novel change [91]. Late entering SMEs are less likely to face these limitations. For example, late entrant spacecraft manufacturer SpaceX chose to rely more heavily on internal production and nontraditional suppliers, avoiding traditional aerospace contractors' lengthy timelines and prohibitive costs and garnering cost and speed advantages compared to incumbents [92]. While new market entrants may face network disadvantages, they may have flexibility advantages, which we view as being more relevant to the performance of a truly novel business model. Ultimately, the heightened ability of the latecomer to engage emerging segments through novel business models, coupled with the incumbent's performance concerns (stemming from the entrenched relationships and customers) leads us to hypothesize:

H4: Novel business model innovation is more positively related to performance for late entrants than for early entrants into a market.

IV. Methodology

A. Population and Sampling

Our research draws on data collected through a wide-scale European research project funded by the European Commission. The data collection was carried out by a market research firm, which followed a documented process when contacting potential respondents through telephone interviews. The population under study is composed of European SMEs involved in business model innovation that are listed in the Dun and Bradstreet

TABLE I
DISTRIBUTION OF SMES BY INDUSTRY

Industry	Frequency	%
Manufacturing	198	14,9
Electricity, gas, steam and air conditioning supply	31	2,3
Water supply; sewerage, waste and recycling	20	1,5
Construction	141	10,6
Distributive trades	198	14,9
Transportation and storage	38	2,9
Accommodation and food services	99	7,5
Information and communication	55	4,1
Financial and insurance activities	47	3,5
Real estate activities	26	2,0
Professional, scientific and technical activities	35	2,6
Administrative and support service activities	29	2,2
Education	58	4,4
Human health and social work activities	64	4,8
Arts, entertainment and recreation	31	2,3
Other service activities	258	19,4
Total	**1328**	**100%**

TABLE II
SUMMARY OF SME CATEGORIES

	Micro firms (461 firms)	Small firms (455 firms)	Medium firms (412 firms)
Number of employees	1-10	11-50	51-249
Age of the firm (years)*	27	35	54
Sales volume per year (K€)*	14353	323374	141801
Percentage share controlled by family*	89	88	88
Percentage of women in management*	47	41	38
*Average values are provided for each type of firm			

directory of companies (17 914 potential entries). A series of screening questions was used to ensure that respondent companies were involved in some form of business model innovation. The first question explored whether the firms had made any changes to their business model in the previous 24 months. Firms reporting that they had made a change were then asked whether their firm had made changes related to any of the following four broad categories of business model changes [13]: value proposition; the ecosystem of the firm's role in value creation; the enabling role of technology; and/or revenue models in value capture and distribution. Firms indicating that they had implemented a change in at least one category were included in the survey. Based on this filtering, a total of 4692 companies were approached to participate in the full survey; usable responses were obtained from 1328 firms (28% response rate), distributed across industries as shown in Table I.

Cluster sampling was used to ensure representation of firms from all European countries. Data collection was managed to ensure an approximately equal sampling of each size subgroup (micro, small, and medium). Per European Commission guidelines, micro firms had 1–10 employees, small firms 11–50 employees, and medium-sized firms 51–249 employees. The survey also collected firm size and industry sector, which confirm that these companies were indeed part of our intended population. A detailed summary can be found in Table II.

Nonresponse bias was assessed using Armstrong and Overton's (1977) procedure. A comparison of early and late respondents indicated no significant threat of nonresponse bias. Prior to quantitative data collection, 120 in-depth case studies with representation in each country and subgroup of SMEs were conducted. First, a case study protocol was prepared containing the interview instrument and procedures. This protocol is an essential tool for interviewers when conducting a multiple-case study, to reduce bias and increase the reliability of results [130]. The average interview duration was 90 min; interviewees typically were CEOs and/or founders. These case studies helped refine the inclusion of key constructs in the survey and indicated the possibility of differences across size categories as well as between early and late entrants.

B. Measures

For this study, we used the scales the Horizon 2020 Project (available on request). All scales are reflective in nature [93]. Technological turbulence was measured with a two-item scale adapted from Jaworski and Kohli [26], which has been used by other researchers (e.g., [94], [95]). The first item focuses on rapid technological change, while the second item concerns improvement. Business model scope was measured using a scale drawing on the work of de Reuver et al. [96] and Philipp et al. [97]. Business model novelty was assessed with a three-item scale based on Bock et al. [98] and Christensen and Raynor [27], with items assessing novelty in the industry, among direct competitors, and in the dominant business models. Both the scope and novelty measures take an expert-informant approach, relying on the respondents' professional expertise as to what constitutes a business model. In line with Robinson and Chiang [99], we assessed entry order via a variable that measures whether the firm was one of the first to introduce an innovation to the market. The use of a single item to measure entry order has also been used by other researchers in this field such as Zott and Amit [40] and Molina-Castillo et al. [100], similar to the Strategic Planning Institute databases STR2 and STR4 [101]. Competitive pressure (a control variable) was measured using a single item adapted from Jaworski and Kohli [26]. Finally, overall performance was measured using a four-item scale assessing financial performance and growth, in line with recent work on SMEs (see [102]). The questionnaire was written in English and translated into 11 official languages in Europe. The traditional back-translation process was used for accuracy. Before collecting data, we pretested the survey with a small number of companies in each language to ensure clarity.

C. Common Method Bias

Because the responses were obtained from a single source, techniques were used to assess common method bias. The Harman one factor tests fit worse (χ 2 (54) = 4663.07, CFI = 0.68, RMSEA = 0.25) than the measurement model (χ 2 (45) = 101.60, CFI = 0.99, RMSEA = 0.03). Next, the common latent factor test [103] was conducted. The results showed a worse fit (χ 2 (12) = 9155.28, CFI = 0.26, RMSEA = 0.69) compared with the measurement model (χ 2 (45) = 101.60, CFI = 0.99, RMSEA = 0.03). Additionally, we also employed the marker variable technique [104]. No significant differences ($p > 0.05$) were found.

D. Persistence of Effects

One tactic to addresses potential causation and endogeneity concerns is to employ data gathered at different points in time.

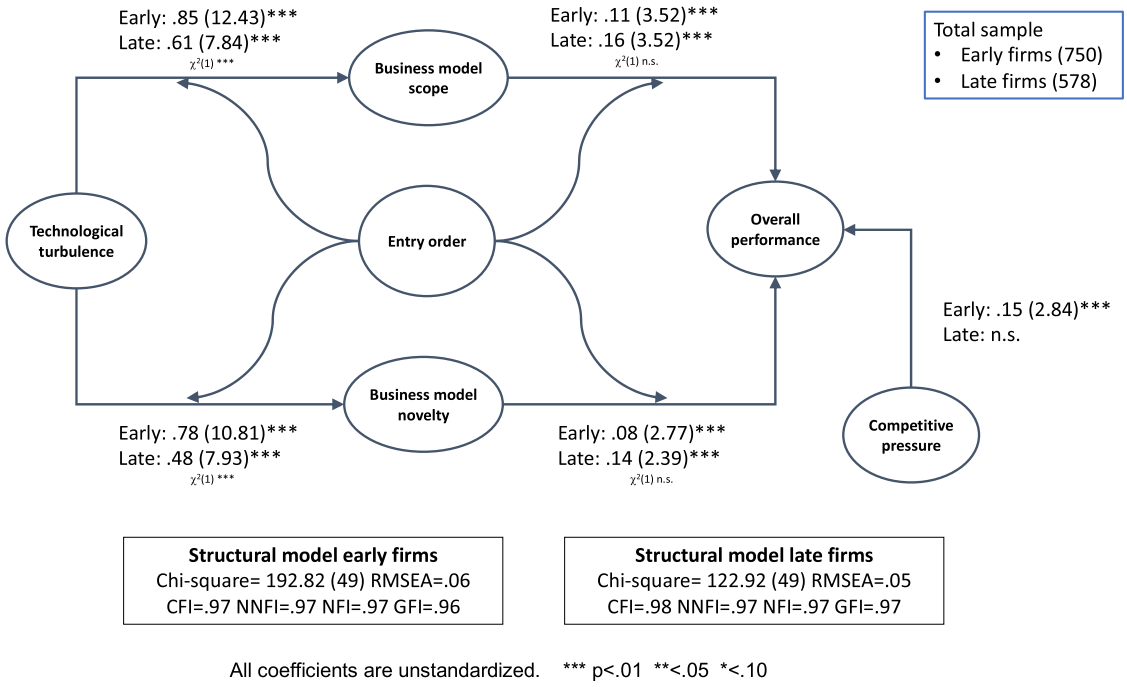

Fig. 2. Model results: Early and late entrants (overall sample).

This also provides further evidence against the existence of common method bias [103]. As part of the Horizon 2020 Project, a small portion of sampled firms were also sampled again the following year. This allows for a subsample examination of 185 firms where overall performance is measured one year after the original survey. A model was estimated using the first year response for all variables except overall performance, for which the following year's response was now included. The results of the measurement model of this subsample were adequate (χ^2 (45) = 122.52, CFI = 0.95, RMSEA = 0.08). The structural model tested using the lagged overall performance measure is compared with an unsplit version of the structural model with all data collected in the focal year ($n = 1328$). We found that the fit of the lagged structural model ($n = 185$) was acceptable (χ^2 (49) = 167.91, CFI = 0.91, RMSEA = 0.08) although not as good as the fit for the much larger overall sample (χ^2 (49) = 345.82, CFI = 0.98, RMSEA = 0.06). The structural results were also similar to our overall (unsplit) model results and indicate that business model scope and novelty each have a lasting impact on performance. For the subsample of 185 cases, business model scope (0.35, $p < 0.01$) and novelty (0.10, $p < 0.10$) each impact the lagged performance measure significantly. While the subsample of $n = 185$ does not allow us to split the data further (as done with the entire sample inSection V), these results indicate that causation flows in the hypothesized direction with respect to performance and persist over time.

E. Measurement Model and Discriminant Validity

To establish validity, we ran a confirmatory analysis of our measurement model. The results of the four-factor model were acceptable for each of the subsamples (micro firms, small firms, and medium firms) in each of the groups (early entrants and late entrants). In addition, each item had a significant loading on its construct ($p < 0.001$). Measurement invariance was tested by following Byrne [105] and configural invariance was also established by following Steenkamp and Baumgartner [106]. Additionally, both scale composite reliability as well as average variance extracted values proved to be satisfactory. Discriminant validity was tested both by square root comparison with AVE, as well as HTMT correlation ratio [107]. Both tests (see Table III) support discriminant validity of these scales.

TABLE III
DISCRIMINANT VALIDITY (AVE, CORRELATIONS, AND HTMT) FOR OVERALL SAMPLE

AVE Correlation Comparison	Mean	SD	SCR	AVE	1	2	3	4
1. Technological turbulence	4,01	1,89	.86	.78	.88			
2. Business model scope	3,62	1,81	.83	.72	.51***	.85		
3. Business model novelty	2,93	1,71	.86	.67	.48***	.63***	.82	
4. Overall performance	4,22	1,56	.88	.66	.24***	.33***	.31***	.85
SCR= Scale compose reliability, AVE= Average Variance Extracted Elements in the main diagonal are the square root of the AVE *** p<.01 **<.05 *<.10								
HTMT Test					1	2	3	4
1. Technological turbulence								
2. Business model scope					.51			
3. Business model novelty					.48	.63		
4. Overall performance					.24	.33	.31	

V. RESULTS

Next, a structural model for the overall sample as well as each of the subgroups was calculated. All proposed paths were significant, but further analysis was needed to examine the potential hypothesized differences between early and late entrants.

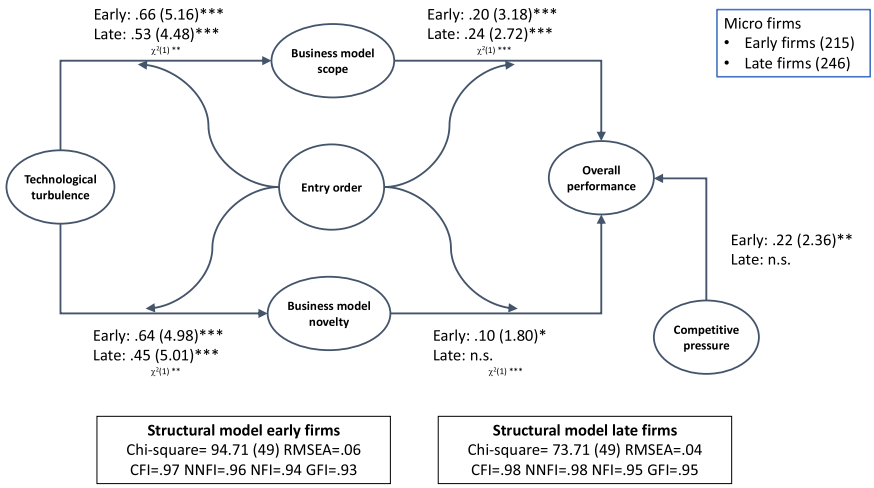

Fig. 3. Model results: Early and late entrants (micro firms).

A. Multigroup Analysis

Moderating effect of entry order was tested by using multigroup analyses. Early and late entrants firms were separated into two subsamples via median split [108]. The fit of this overall model for the 1328 cases (see Fig. 2) was strong for both early entrants [$n = 750$, $\chi^2(49) = 192.82$, CFI $= 0.97$, NNFI $= 0.97$, NFI $= 0.97$, GFI $= 0.96$, RMSEA $= 0.06$] and late entrants [$n = 578$, $\chi^2(49) = 122.92$, CFI $= 0.98$, NNFI $= 0.97$, NFI $= 0.97$, GFI $= 0.97$, RMSEA $= 0.05$]. As can be observed in Fig. 2, there were differences between early and late entrants firms. Technological turbulence had a stronger (χ^2 difference $p < 0.01$) positive effect on business model scope for early entrants (0.85) than for late entrants (0.61). Similarly, the impact on business model novelty was stronger (χ^2 difference $p < 0.01$) for early entrants (0.78) than for late entrants (0.48). These significant differences support H1 and H2. In contrast, examining the effects of business model scope and novelty on overall performance, the differences are nonsignificant, failing to support H3 and H4. Differences within size subgroups will be investigated next.

B. Exploring Firm Size

To further explore the contingent effects of size and entry order, we run a series of structural models for each subsample (micro firms, small firms, and medium firms). The authors divided the 1328 firms into micro firms (461 micro firms), small firms (455 small firms), and medium firms (412 medium firms) using the same multigroup approach to test the differences between early and late entrants within each of the size subsamples. The first subsample, 461 micro firms, was divided into two groups, early entrants (215 firms) and late entrants (246 firms). The structural model showed strong fit for early entrants [$\chi^2(49) = 94.71$, CFI $= 0.97$, NNFI $= 0.96$, NFI $= 0.94$, GFI $= 0.93$, RMSEA $= 0.06$] and late entrants [$\chi^2(49) = 73.71$, CFI $= 0.98$, NNFI $= 0.98$, NFI $= 0.95$, GFI $= 0.95$, RMSEA $= 0.04$]. As can be observed in Fig. 3, the impact of technological turbulence on business model scope is stronger (χ^2 difference $p < 0.05$) for early entrants (0.66) than for late entrants (0.53). Similarly, a stronger effect (χ^2 difference $p < 0.05$) of technological turbulence on business model novelty was found for early entrants (0.64) than for late entrants (0.45). These results are consistent with H1 and H2 for microfirms. With regard to the impact of business model scope on overall performance, we found a significantly (χ^2 difference $p < 0.01$) higher effect for late entrants (0.24) when compared to early entrants (0.20). For microfirms, this functions counter to H3. The impact of business model novelty on overall performance was stronger (χ^2 difference $p < 0.01$) for early entrants (0.10) than for early entrants (NS) contradicting H4 for this subsample.

Next, we compared structural models (258 early entrants firms and 197 late entrants firms) within the small firms subsample. The fit of the structural model was good for early entrants [χ^2 (49) $= 133.65$, CFI $= 0.96$, NNFI $= 0.94$, NFI $= 0.93$, GFI $= 0.93$, RMSEA $= 0.08$] and late entrants [χ^2 (49) $= 78.36$, CFI $= 0.98$, NNFI $= 0.97$, NFI $= 0.94$, GFI $= 0.94$, RMSEA $= 0.07$]. As can be observed in Fig. 4, we again found significant differences in the relative effects. The impact of technological turbulence was stronger (χ^2 difference $p < 0.01$) for early entrants (82) than for late entrants (0.65). Similarly, the impact of technological turbulence on business model novelty was stronger (χ^2 difference $p < 0.05$) for early entrants (0.75) than for late entrants (0.53). Again, this is consistent with H1 and H2 for small firms. Concerning the impact of business model scope on overall performance, the effect was nonsignificant for both early entrants and late entrants, failing to support H3 for this subgroup. The impact of business model scope on overall performance was stronger (χ^2 difference $p < 0.01$) for late entrants (0.26) than for early entrants (0.12), supporting H4 for this subgroup.

Finally, we compared two different structural models (227 early entrants firms and 135 late entrants firms) within the medium firms subgroup. Structural models showed good fit for early entrants [$\chi^2(49) = 103.72$, CFI $= 0.98$, NNFI $= 0.97$, NFI $= 0.96$, GFI $= 0.94$, RMSEA $= 0.06$] and late entrants [$\chi^2(49) = 75.59$, CFI $= 0.96$, NNFI $= 0.95$, NFI $= 0.90$, GFI $= 0.91$, RMSEA $= 0.06$]. As can be observed in Fig. 5, we found that the impact of technological turbulence on business model

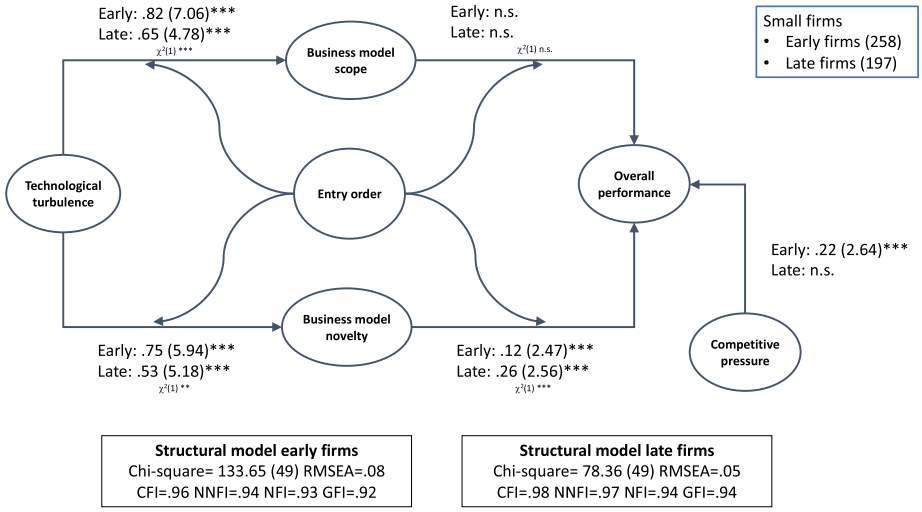

Fig. 4. Model results: Early and late entrants (small firms).

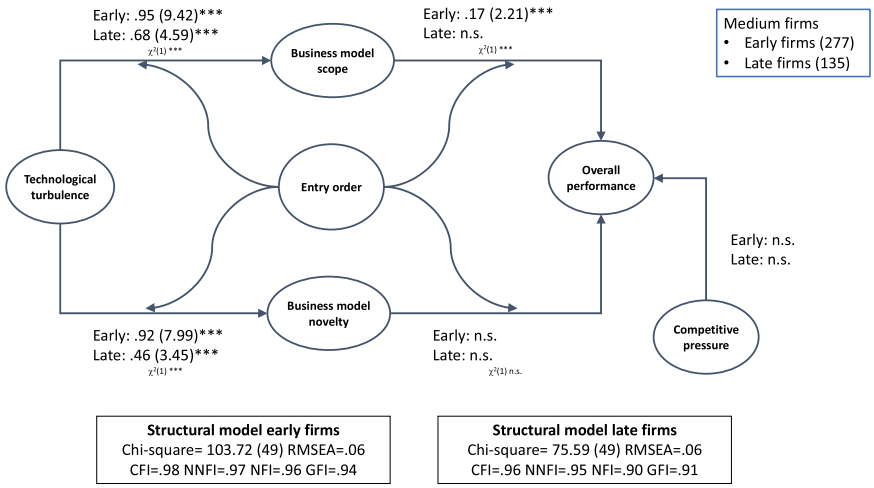

Fig. 5. Model results: Early and late entrants (medium firms).

scope was again stronger (χ^2 difference $p < 0.01$) for early entrants (0.95) than for late entrants (0.68). Also, technological turbulence's impact on business model novelty is significantly stronger (χ^2 difference $p < 0.01$) for early entrants (0.92) than for late entrants (0.46). These results are consistent with H1 and H2 for the medium subsample. With regard to the impact of business model scope on overall performance, the impact was stronger (χ^2 difference $p < 0.01$) for early entrants (0.17) than for late entrants (NS), which is consistent with H3 for this subgroup. Examining the impact of business model scope on overall performance, the paths were nonsignificant for both early and late entrants, failing to support H4 for this subgroup. When viewed together (see Table IV), these results reveal interesting patterns of contingency that will be more fully explored in the discussion section.

TABLE IV
HYPOTHESES TESTING AND SUBGROUP RESULTS

	Total sample ($n = 1328$)	Micro firms ($n = 461$)	Small firms ($n = 455$)	Medium firms ($n = 412$)
H1	Early Stronger	Early Stronger	Early Stronger	Early Stronger
H2	Early Stronger	Early Stronger	Early Stronger	Early Stronger
H3	NS	Late Stronger	NS	Early Stronger
H4	NS	Early Stronger	Late Stronger	NS

C. Alternative Model

The results obtained via the structural models showed that business model scope and business model novelty mediate the impact of technological turbulence on the overall performance for the overall sample as well as for each subgroup (micro, small, and medium). However, we acknowledge that testing alternative models is a best practice. In this case, we acknowledge that previous research in this field has suggested that technological turbulence could also directly impact performance [109]. Accordingly, we compared the structural model with another

model that also included the impact of technological turbulence on overall performance. We did not find any significant effect of technological turbulence on overall performance for all firms nor for each of the subsamples (micro, small, and medium). Additional tests were conducted to control for firm age with results consistent with the ones presented above. Potential confounds involving firm age were also investigated. An additional alternative model was specified that included firm age as an additional control. Firm age (time since firm founding) and entry order (time in a particular market) are related but distinct constructs. In a model otherwise identical to Fig. 2, paths were specified between firm age and each of business model scope, business model novelty and overall performance. All three of these paths were nonsignificant ($p > 0.10$), with paths related to hypothesis tests not meaningfully affected, providing further evidence of robustness.

VI. Discussion

Our findings (summarized in Table IV) show that entry order affects how SMEs respond to technological turbulence through business model innovation (H1 and H2), and that the performance implications of business model innovation (H3 and H4) differ across size subcategories. These findings offer important implications for scholarly work on business model innovation by emphasizing the importance of considering contingent factors such as size [15], [41] and entry order [110].

This study makes two noteworthy contributions to the growing literature on business model innovation. First, we show that technological turbulence acts as an antecedent of both the scope and novelty dimensions of business model innovation. This relationship is moderated by entry order consistently across all size subcategories. Evidence from this study that early entrants are more responsive to technological turbulence through business model innovation directly addresses calls to better understand the antecedents of business model innovation [22] and how contingencies are at play in these relationships [18], [21]. Second, while we confirm the prior presumption that business model innovation generally has a positive performance effect [9], [111], we add the missing but necessary nuance that the performance effects of the scope and novelty dimensions of business model innovation are contingent on both entry order and firm size (see Table IV). Plainly stated, it is inappropriate to treat SMEs as a monolith [15]. Firms reap the performance benefits of business model innovation differentially depending on entry order and size. This finding directly addresses Foss and Saebi's [12] call to understand the boundary conditions under which the performance benefits of business model innovation may or may not hold, as well as Schneider and Spieth's [48] call to deepen researchers' understanding of how business model innovation affects performance.

A. Theoretical Implications: Firm Size and Entry Order

As previous scholars have noted, the contextual factors at play within the network of relationships around business model innovation need to be better understood. First, with regard to the effect of technological turbulence on business model innovation, the role of these contextual factors is relatively straightforward. In terms of both the scope and novelty of business model innovation, early entrant firms are more responsive to technological turbulence. Early entrants' heightened awareness of market conditions, complex analysis by experienced founders/managers, and increased possibilities for business model innovation (given their complementary assets and interfirm relationships) make business model innovation more likely under technological turbulence [12], [112]. Rather than being prone to rigidity [113], the early entrant SMEs in our sample respond to technology shifts more decisively through both forms of business model innovation. This same pattern of heightened early entrant response to technological turbulence is observed for micro, small, and medium-sized firms. Next, with respect to the performance implications of business model innovation, the effects of firm size and entry order are doubly contingent. That is, an appropriate fit of the business model innovation dimensions with entry order and firm size can (in specific instances) predict superior performance. First, in terms of the scope of business model innovation, we observe a shift across the size range of firms studied here. Specifically, micro late entrant firms garner a performance premium from a wider scope of business model innovation [41], relative to micro early entrants. The late entering firms have flexibility and speed advantages [77], [114], given that they are not restrained by bureaucracy, industry norms, nor long-term customer relationships in their market. Their brand positioning is also less entrenched in the market [18], which may provide another advantage for these firms when making a business model change [46]. Thus, late entering microfirms are able to address new market niches more successfully with an appropriate focus [47] through a wider scope of business model innovation [7].

For medium-sized firms, this effect shifts such that we observe early entrants to reap a performance premium from a wider scope of business model innovation. Increased resources enable these firms to deploy complementary assets more effectively, allowing them to profit from a wider scoped business model, consistent with the logic of H3. Given that these medium-sized firms have established their legitimacy (more so than, for instance, microfirms), they are also able to more effectively deploy interfirm relationships to ensure the success of alterations to their business model. A wide scope of business model innovation (given its iterative nature) likely relies on established capabilities and channel relationships to a greater degree than do truly novel business model innovations [9]. It logically follows that larger firms with longer market experience [15] are better able to convert innovation in business model scope into performance compared to later entrants of the same size. In contrast, late entry microfirms may lack the assets and legitimacy to pre-empt the critical resources needed to profit from iterations to the business model—one source of early mover advantage. Thus, the doubly contingent effect reported here is consistent with logic from the early mover advantage literature [68]. These findings also represent an interesting example of the distinctions between time since market entry (i.e., newness to market) and small firm size in determining innovative outcomes [49]. Finally, with respect to novel business model innovation, the performance implications

observed here are again nuanced. While the total sample shows positive direct effects of novel business model innovation for both early and late entering firms, significant performance implication differences only appear for specific size subcategories. Specifically, early entrant microfirms are able to drive performance from novel business model innovation to a greater extent than late entrant microfirms. This indicates that the founder learning accruing over the time in a market [7] and the complex thought processes that accompany this learning [7], [18]—which are critical to succeeding with novel business models—can be built up by early entrant firms, while their microsize provides rapidity and flexibility advantages. Business model innovation is not specific to start-ups [52]. On the contrary, whether a start-up or an established company, a firm may need to constantly adjust its business model to respond to opportunities and threats [115]. Larger firms have more resources to undertake business model innovation projects that can be implemented on a larger scale and become profitable through easier access to new markets [116]. But small businesses may transform their business model faster, because managers are closer to the operational levels [15], often making decisions more dynamically with flexible organizational routines [117], and thus facilitating the improvement of current or future strategic capabilities [118]. For small businesses, the routines for search, acquisition, and use of crucial knowledge for new business models [7] may take longer to develop than for larger entrepreneurial companies [8], [49]. If, in addition, these small firms are the first to enter the market, the barriers to implementing an innovative business model under technological turbulence are higher [119]. In contrast, late entrants can generate higher returns through novel business model innovation compared to early entrants [41]. This may imply that these later entrants do not suffer as much from the inertia caused by routines and rigidity compared to early entrants [113]. At the same time, as firm size increases, establishing legitimacy may be less a function of time since market entry. More generally, our findings related to entry order reinforce the recurring notion in the order-of-entry literature that early entrants do not perform better per se, but that their performance is contingent on decision making and environmental conditions [68].

B. Managerial Implications

The differences between early and late market entrants likely do not constitute the most practical managerial takeaway regarding business model innovation in SMEs, as both the scope and novelty of business model innovation are shown to be positively related to performance for the sample as a whole, and this performance benefit persists over time. Nevertheless, founders and managers of SMEs receive strong support from our findings to pursue a wide scope of business model innovation and truly novel business models [9], since both are shown here to result in lasting performance benefits. Especially in light of recent research that questions the revenue impact of R&D spending in small firms [49], business model innovation again seems advisable. While SMEs face resource constraints relative to their larger competitors [15], leveraging SME flexibility and rapidity advantages through business model innovation will help performance. Consciously developing innovation paths and roadmaps [120] may help in this regard, as will thinking ahead regarding complexities, firm capabilities, organizational readiness, and interfirm relationships that will enable business model innovation [8]. On the other hand, a heavy focus on internal efficiencies will tend to thwart business model innovation [22]. Managers may also benefit from understanding the differences between entry order and size subcategories in determining 1) how SMEs respond to technological turbulence through business model innovation and 2) how well business model innovation translates to superior performance. First, for all size categories, early entrant firms are more responsive to technological turbulence through pursuing both forms of business model innovation. Early entrant firms benefit from learning during their longer experience in a marketplace, which renders them more responsive to technology shifts through business model innovation. The deep market understanding developed over a firm's time since market entry fosters business model innovation; early entrant managers and founders should not underestimate the future value of their complex market understanding [9]. With regard to the performance implications of business model innovation, our results indicate that one-size-fits-all advice is inappropriate (see Table IV). Overall, an appropriate fit of a firm's size, experience since entering a market, and form of business model innovation is needed to yield the best performance.

VII. Limitations and Future Research

Limitations of this project point toward a number of promising future directions for research. First, while a subsample robustness test using future performance confirms that business model innovation affects performance in the causal order hypothesized, more could be done to disentangle these effects. Qualitative research could feasibly investigate this question over time. Snihur and Zott [22] recently used a multiple case methodology, following young business ventures over a decade. Extending the present investigation to consider multiple dimensions of business model innovation, as well as the components of entry order (experience, relationships, established routines) and size (assets, specialization, founder role), would likely prove worthwhile. While here, common method variance was statistically investigated, additional insights could be generated by examining multiple employees within each firm. Similarly, while we were able to control for the effect of firm age in an alternative model, we are not able to include this variable in each split-sample model due to sample size requirements. Future research that more completely disentangles the relationships between firms' market newness, age, and size will prove fruitful, where permissible (and in the rare case in which secondary data are available for SMEs), combining surveys of managers with secondary performance data could provide valuable nuance and confirm validity. Regulatory and privacy issues do not allow us here to combine survey data with secondary performance data (for instance, financial performance, patent data, or new product information). Similarly, given that changing business models poses challenges for customer retention, it would be intriguing to explore the connections between business model

innovation and customer-focused outcomes, such as satisfaction, loyalty, and customer lifetime value [29]. The COVID pandemic certainly prompted business model innovation as firms coped with an uncertain, dynamic environment [121]. During the pandemic, businesses providing essential services, such as healthcare, logistics, and food retailing, had to incorporate measures to protect employees and customers and change value delivery [122]. Undoubtedly, employee training was fundamental to achieve these objectives, particularly where open innovation was sought after [123]. In this way, the global pandemic has brought unpredictable socioeconomic consequences as well as impacted the technological capabilities of some companies and affected policy making [124]. It would be interesting to explore sustainable business models that could improve firms' response to adverse, unforeseen situations [34]. Although our data were collected before the COVID-19 crisis, we see two potential ways that the pandemic may affect our implications. First, the pandemic could be seen as a contextual condition that affects the generalizability of our findings. Future research could examine whether our findings hold in a global pandemic. Second, the pandemic could be seen as a trigger for business model innovation. In this case, one could conceptualize the pandemic as a direct driver of business model innovation, acting alongside the other drivers of our model.

Business model innovation researchers have commented that contextual factors are often ignored [25]. We challenge future scholars in this area to be conscious of contextual conditions in their research designs, either by holding them constant (e.g., only sampling medium-sized early entrants, or focusing on a specific sector) or by systematically sampling respondents (e.g., establishing quotas across categories, as done here). Neglecting these contextual factors can lead to substantial confounds; these factors contingently amplify the strength of key drivers and outcomes of business model innovation [23]. Our research raises a number of questions worthy of further investigation. What other factors enable SMEs to derive profit from novel business model innovation [125]? Does business model innovation function similarly in SMEs that are family firms versus nonfamily firms [126], or for minority businesses or female entrepreneurs [127]? Are there subdimensions of technology turbulence that play distinct roles on business model innovation or digitalization of business models [32], [128]? Do asset-intensive industries respond differently to technological turbulence than service-based industries [119]? And does business model innovation yield higher quality products [129]? While these and other interesting questions remain regarding business model innovation—particularly for SMEs—this study makes a start by advancing the understanding of how entry order and business model innovation relate, and the apparent differences in these relations for micro, small, and medium-sized enterprises.

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