Business model evolution, contextual ambidexterity and the growth performance of high-tech start-ups

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Abstract

Focusing on the role of efficiency and novelty design themes, this paper examines how (a) the initial business model of a start-up, (b) the subsequent changes in the design themes and (c) the combinative effect of efficiency and novelty (contextual ambidexterity) impact a start-up's growth performance. The study is based on a survey involving 267 new ventures from high-tech industries. The results highlight the importance of pursuing higher efficiency over the life cycle of a start-up, although not at the moment of its establishment. In relation to business model ambidexterity, the findings highlight the different effect that contextual ambidexterity can have on the growth performance of a start-up firm in different stages of its life cycle. While initial ambidexterity is found to have a negative effect on growth performance, successive increases in the level of ambidexterity have a positive influence on growth.

Keywords: business model evolution; business model design; business model ambidexterity; growth; start-ups; high-tech

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1. Introduction

High-tech start-ups are often seen as engines of economic development and as effective vehicles for job creation (Adelino, Ma, & Robinson, 2017; Hathaway, 2013). Yet, although a handful of such firms do achieve incredible success, on average high-tech start-ups have a limited impact on employment and reach only moderate rates of growth, as confirmed by academic research (Pe'er, Vertinsky, & Keil, 2016; Song, Podoynitsyna, Van Der Bij, & Halman, 2008), and by an increasing amount of statistical data (European Commission, 2017; Kauffman Foundation, 2017; OECD, 2018). Such poor performance is caused by several limitations and weaknesses intrinsic to these firms, pertaining to entrepreneurial, strategic and organisational aspects (Pugliese, Bortoluzzi, & Zupic, 2016) and – ultimately – to their precarious business models (BMs). Indeed, it is anything but easy for a start-up to guess the 'right' (meaning scalable and profitable) BM since the very beginning (Andries & Debackere, 2007; Reymen, Berends, Oudehand, & Stultiëns, 2016). Most of the time, such firms must dynamically adapt and fine-tune their BMs, through flexibility (Bock, Opsahl, George, & Gann, 2012), experimentation (Andries, Debackere, & Van Looy, 2013) and the use of trial-and-error heuristics (Chesbrough, 2010; Sosna, Trevinyo-Rodríguez, & Velamuri, 2010). In general, the theme of BM dynamics (BM evolution in this paper) is attracting an increasing number of studies from manifold theoretical perspectives (Foss & Saebi, 2018; Gassmann, Frankenberger, & Sauer, 2016). The literature is devoting great attention to the antecedents of BM evolution – what triggers the changes in the BM and under what conditions (Schneider & Spieth, 2013). Much less has been said about the BM evolution process itself and on its implications for a firm's performance. Actually, as discussed by Foss and Saebi (2017), not

many studies have succeeded so far in linking BM evolution with increased competitiveness, innovativeness or other firm performance dimensions, with the result that the relationship between BM evolution and performance remains an open issue, both for managerial theory and practice.

This study contributes to this discussion by deepening our knowledge of the patterns of BM evolution in high-tech start-ups and by studying the impact that such dynamics have on the growth performance of the same firms. We focus on growth as a main performance measure for high-tech start-ups due to the uncertain and unstable levels of profitability these firms experience in the early stages. Our study is positioned within the 'activity system' literature stream on BM evolution (Amit & Zott, 2001; Gassmann et al., 2016; Zott & Amit, 2007, 2008). According with Amit and Zott (2001) and Zott and Amit (2007, 2008), we look at the dominant value-creation drivers of a BM, which they call BM *design themes*. In particular, in this study we focus on two contrasting design-themes – novelty and efficiency – and look at how such drivers, and the interplay between the two, impact the growth performance of high-tech start-ups over time. By looking at the interplay between the two design themes, we examine also the notion of *contextual ambidexterity* – the combinative effect of efficiency and novelty – within the domain of the BM evolution literature and look at the specific conditions under which BM ambidexterity favours the growth process of high-tech start-ups (Gerdoçi, Bortoluzzi, & Dibra, 2018; Hu & Chen, 2016; Liao, Liu, & Zhang, 2018; Markides, 2013).

Our study is quantitative in nature and is based on a sample of 267 high-tech start-ups. The results of our analyses do not show a significant impact by the initial design themes (novelty and efficiency) on the growth performance of start-ups. Further, BM efficiency matters only in the subsequent phases of a start-up's evolution. Our results also suggest that initial ambidexterity is not positively associated with the growth of start-ups and that its beneficial effects come only in a later period. Overall, our empirical results advance our

knowledge of the complex relationship between BM evolution and firm performance in two ways: first, by showing that the impact of BM design themes (novelty and efficiency) on performance may change over time. In doing so, our results corroborate some recent theoretical speculation by Christensen et al. (2016), who claim efficiency to come only in later stages of the evolutionary process of a start-up's BM. Second, by highlighting the different impact that BM ambidexterity can have on the growth performance of a start-up firm in the different phases of its evolution, this paper contributes to the debate on how separating or adopting a combination of different BM design themes might represent the optimal solution for the viability of new firms.

2. Background

2.1 Business model evolution

The academic literature dealing with BM dynamics has significantly increased over the last years (Saebi, Lien, & Foss, 2016), and related concepts have multiplied: from BM *innovation* (Amit, Zott, & Pearson, 2012) to BM *adaptation* (Saebi et al., 2016) and from BM *renewal* (Khanagha, Volberda, & Oshri, 2014) to BM *evolution* (Demil & Lecocq, 2010), to name a few. Foss and Saebi (2017: 201) define BM innovation as 'designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements'. This process is usually associated with a radical change in the configuration of an existing BM, aimed at disrupting current market conditions (Saebi et al., 2016), challenging industry-specific standards (Aspara, Hietanen, & Tikkanen, 2010) or discovering a 'fundamentally different business model in an existing business' (Markides, 2006: 20). Studies on BM dynamics have also pointed to less radical modifications. In this regard, Saebi et al. (2016:568-569) use the concept of BM adaptation to describe 'the process by which management actively aligns the firm's business model to a changing environment'. Yet, neither

the concept of BM innovation nor that of BM adaptation captures the entire spectrum of changes in BM design that a new venture experiences over its life cycle, specifically the nonradical changes that are neither a consequence of an environmental change (as in BM adaptation) nor a significant transformation of a firm's strategy and organisation (as in BM innovation).

A more comprehensive description of BM dynamics, which we also adopt in this paper, is reflected in the concept of BM evolution (BME), which Demil and Lecocq (2010: 239) define as a 'fine-tuning process involving voluntary and emergent changes, *in* and *between* permanently linked core components' in response to both external and internal factors. Consistent with this definition, in the rest of this paper, with BME we refer to the entire spectrum of BM dynamics, including incremental or radical, voluntary or emergent, endogenous or exogenous changes, and also the cases of BM innovation and adaptation.

While empirical studies on the antecedents of BME – the internal/external stimuli (or barriers) that could trigger (or hamper) this process – are frequent in the literature (see Schneider & Spieth, 2013 for a review), studies dealing with the patterns of BME are scarcer, especially quantitative ones. Among the few exceptions, Willemstein, Van Der Valk and Meeus (2007) carried out a longitudinal study on biotech firms, finding that they tend to be more product-focused at the outset and become more 'hybrid' (mixing up products and services) in the later stages of their development. Kranz, Hanelt and Kolbe, (2016) apply a case-study method to study the BME process of six incumbent vendors of enterprise resource-planning software to investigate the role played by absorptive capacity and organisational ambidexterity in the process. Similarly, the qualitative study by Berends, Smits, Reymen and Podoynitsyna (2016) uses organisational learning literature to analyse the process of BM reconfiguration in established firms. According to Foss and Saebi (2018), the lack of empirical research can be attributed to the complexity of operationalising and measuring BME, as well

as the time lag between the changes in BM and their (potential) performance outcomes. Given the lack of empirical evidence, it is thus not clear whether BM dynamics is beneficial to firms at all and whether different types of BM modifications can result in different outcomes.

2.2 Business model ambidexterity

Following Markides (2013), here we posit that ideas developed in the ambidexterity literature can be a natural theoretical anchor for academic researchers exploring BME. Organisational ambidexterity refers to firms' capacity to address two organisationally incompatible objectives equally well (Raisch, Birkinshaw, Probst, & Tushman, 2009; Tushman & O'Reilly III, 1996). It can have different dimensions, as the pursuit of incompatible objectives (which are often described with the terms exploration and exploitation) may take place sequentially (Simsek, Heavey, Veiga, & Souder, 2009) or simultaneously. This latter type of ambidexterity, which is also called 'contextual ambidexterity' (Gibson & Birkinshaw, 2004), is a necessity to business success, especially, as posited by Wang and Rafiq (2014), in high-tech firms that often have no choice but to exploit existing competences for short-term commercial benefits while simultaneously exploring new competences for long-term success.

According to Amit and Zott (2001; 2007, 2008), two specific BM design themes shall be managed by firms to address such duality: BM novelty and BM efficiency. BM novelty refers to BM designs that innovate a firm's products, services, production and distribution methods and the management of business transactions; BM efficiency refers to BM designs that increase the productivity of a new firm's methods of running and managing the nexus of transactions in which it is embedded. Zott and Amit (2007) empirically apply the novelty-efficiency dichotomy to determine whether and how a BM design affects a firm's performance. In their view, novelty and efficiency work not only independently but also complementarily. In this regard, Zott and Amit (2007: 182) first advanced an 'ambidexterity' hypothesis,

contending that 'efficiency- and novelty-centered designs are neither orthogonal, nor are they mutually exclusive'. More specifically, they advance the argument that 'by emphasizing business model novelty, the focal firm may be better positioned to appropriate some of the value it creates through increased efficiency', while 'increasing the emphasis on efficiency-centered design may enhance the return on design novelty' (*ibidem*: 186). However, contrary to this argument, the authors have found indications of potential diseconomies of scope in BM design; that is, entrepreneurs' attempts to incorporate both efficiency- and novelty-centred design elements into their BMs may be counterproductive.

Significant progress in the contextual BM ambidexterity perspective has been made recently at the empirical level. In a study conducted on a sample of 176 Chinese firms, Wei, Yang, Sun and Gu (2014) disconfirm the ambidexterity hypothesis, finding that novelty-centred BMs weaken the negative effect of exploitative innovation on firm growth, contrary to efficiency-centred BMs, which enhance this effect (while weakening the positive effect of exploratory innovation). In another study, Hu and Chen (2016) reach opposite results: the authors adopt two dimensions of BM ambidexterity: the 'balanced dimension' (BD) and the 'combined dimension' (CD), showing that efficiency and novelty do not function independently. In particular, they find that the CD has a direct impact on technological innovation performance and that the BD acts as a moderator variable. Further, in the study by Gerdoçi et al. (2018), BM ambidexterity is grounded in the moderating role of BM efficiency within the relationship between BM novelty and firm performance.

3. Hypotheses formulation

Based on the above background, in this paper we test six hypotheses referring to the patterns of BME and their impact on a firm's performance. To better capture the full dynamics of BME, we focus on two distinct moments in a new high-tech venture's life: an initial moment,

right after the start-up's inception, and a subsequent moment, when the start-up can be considered established. Consequently, our first three hypotheses focus on the initial levels of BM novelty and efficiency and BM ambidexterity and on their impact on firms' growth performance. The next three hypotheses refer to the expected effect on performance of the subsequent increases of BM novelty and efficiency and of BM ambidexterity. As mentioned in the introduction, we use growth as a main performance measure for high-tech start-ups due to their unstable levels of profitability in their early stages.

To derive the first two hypotheses, we observe that new ventures do not face the same cognitive constraints and do not suffer from the same significant inertia and sunk cost effects which force established firms to fit products, technologies, investments and resources into their existing BMs. On the contrary, high-tech start-ups are constantly pursuing different sources of value creation and appropriation (Sosna et al., 2010). Thus, these ventures are inclined to adopt, since the very beginning, novel BM designs aimed at capturing latent customer needs, identifying and connecting multi-sided markets and acquiring new sets of competences to enrich their value offer (Amit & Zott, 2001; Casadesus-Masanell & Zhu, 2013; Chesbrough, 2007; Demil & Lecocq, 2010). By emphasizing BM novelty, a new venture may increase switching costs for stakeholders and customers because there are fewer comparable alternatives (Zott & Amit, 2007). Further, new ventures can create new markets which were previously untapped and increase their value appropriation capacity in the long run (Gerdoçi, Bortoluzzi, & Dibra, 2018). Therefore, we expect a positive effect of the initial level of BM novelty on the growth performance of new ventures.

On the other hand, an equally important role in performance is played, in these firms, by BM efficiency, which includes the efficient management of business transactions and the adoption of governance structures and operating mechanisms that reduce market uncertainty and transaction complexity. The 'efficiency' argumentation is grounded in Williamson's

theory of transaction costs (Williamson, 1981), which include search, contracting, negotiation, monitoring and enforcement costs. Although limited empirical evidence is available on the relation between BM efficiency, BM novelty and business performance, Zott and Amit (2007) provide partial support to the hypothesis that efficiency matters in driving entrepreneurial firms' performance, while Hu and Chen (2016) find that efficiency has a significant positive effect on the innovation performance of manufacturing firms, giving them access to new customers (who will be drawn to transact with the firm) and enhancing transaction frequency as a result of lower transactional friction. Extending such argumentations to the growth performance of start-up firms, we posit that efficiency matters in the first phases of their life. Thus, our first two research hypotheses are formulated as follows:

H1: Initial BM novelty has a positive effect on growth performance.
H2: Initial BM efficiency has a positive effect on growth performance.

The third hypothesis is directly derived from our ambidexterity assumption. Indeed, Zott and Amit (2008) empirically demonstrated that BMs emphasizing novelty (typical for new ventures), when coupled with a cost leadership strategy (i.e. high efficiency), may have a positive impact on a firm's performance. Other empirical studies (Casadesus-Masanell & Tarzijan, 2012) show that efficiency and novelty themes can achieve different advantages, such as reduced threat of entry by other firms (through efficiency) and diversification of potential sources of revenue (through novelty). In addition to such evidence, here we can consider that – in high-tech industries – the pursuit of novel business ideas can be positively coupled with the search for efficiency, typically through an extensive use of digital technologies. For example, the study carried out by Wang and Rafiq (2014) on two samples of high-tech British and Chinese firms show that contextual ambidexterity exerts a positive influence on innovation

outcomes (e.g. radical innovations, incremental innovation and time-to-market). In another study carried out by Kranz et al. (2016) on the software industry, it is shown that, in periods of turbulent change, ambidexterity supports the process of BME of high-tech firms. Hence, based on the previous findings and argumentations, we claim that an initial BM that emphasizes both novelty and efficiency favours the growth performance of start-up firms. In more formal terms:

H3: The initial BM ambidexterity has a positive effect on growth performance.

The next three hypotheses are aimed at capturing the true essence and impact of BME on high-tech start-up performance. Such hypotheses are formulated with respect to the changes that occurred at the BM level from an initial time (a time very close to the inception of the start-up) to a later time (when the BM has been subject to a significant evolution and can be considered 'established'). Indeed, in the context of this study, BME is seen as an ongoing process of fine-tuning the initial levels of novelty and efficiency. Such changes may lead firms to revise significant parts of their BM or even redesign it fully (Demil & Lecocq, 2010; Morris, Schindehutte, & Allen, 2005). In other words, a new firm's BM is subject to typical patterns of evolution, where after an initial period in which a start-up's BM is more fluid, and often tangled in terms of internal coherence and consistency, comes a period in which the BM is gradually refined and reinforced (Morris et al., 2005; Siggelkow, 2002). This is true both for BM novelty and BM efficiency. With reference to BM novelty, in their original contribution, Amit and Zott (2001) focused mainly on new ways for bringing together and offering incentives to the participants in a BM (clients, suppliers, intermediaries). In fact, firms can increase the levels of novelty of their BM in many other ways, such as by offering new combinations of products, services and information; by revising and refining the target market; by fine-tuning the revenue model; and by creating new synergies and improving the

interdependencies among the building blocks of an existing BM. Increasing the levels of novelty should enable a firm to cope with current competitors (incumbents), face new entrants and discourage clients from purchasing substitute products, thus putting the firm in an ideal position to gain additional market share over its competitors. On the contrary, a lack of change or a decrease in the levels of BM novelty may result in a loss of competitiveness, lower attractiveness for clients and, ultimately, a contraction of revenues and market share. The above argumentations are perfectly in line with the empirical findings by Zott and Amit (2008) and in particular with their conclusion that novelty-centred business models – coupled with product market strategies that emphasize differentiation, cost leadership or early market entry – can enhance firm performance.

Regarding BM efficiency, start-ups aimed at getting fully established in their target markets must streamline their initial BM and make the overall organisation and its transaction system more efficient. These efficiency-seeking changes focus on reducing transaction costs and exploiting interdependencies among BM components (Christensen et al., 2016; Demil & Lecocq, 2010; Dmitriev, Simmons, Truong, Palmer, & Schneckenberg, 2014). Christensen et al. (2016: 38) write that after their establishment, start-ups cannot just pursue innovation but must also concentrate on reducing costs by 'eliminating labour or by redesigning products to eliminate components or replace them with cheaper alternatives'. Such improvements have positive consequences for growth performance: as transactions become faster and cheaper, existing customers might increase their purchases, while new customers might be motivated to start transacting with the firm. Based on the above, we speculate that by increasing, over time, their levels of BM novelty and efficiency, start-ups can sustain their competitiveness and improve their performance. Thus, we advance our fourth and fifth hypotheses as follows:

H4: In the process of BME, increases in BM novelty have a positive effect on growth performance.

H5: In the process of BME, increases in BM efficiency have a positive effect on growth performance.

In general, quantitative empirical evidence of the temporal dynamics of BM ambidexterity and its impact on performance is scarce, if not absent. However, the few studies focused on the firms operating in high-tech industries suggest a positive role for ambidexterity. For example, the longitudinal study carried out by Khanagha et al. (2014) on a single ICT firm highlights the various benefits coming from the recursive iteration between separated and integrated structures in high-turbulence periods. The study by Tongur and Engwall (2014) applies a similar research methodology and comes to similar conclusions. Further, the already cited work by Hu and Chen (2016), in the context of Chinese manufacturing firms, shows that the 'combined dimension' of BM ambidexterity has a direct impact on technological innovation performance while the 'balanced dimension' acts as a moderator. Further, Ricciardi, Zardini and Rossignoli (2016) posit ambidexterity to be a key enabler of BME and, in turn, of the performance of established firms. In sum, although the limited amount of studies focused on start-ups cannot fully support the formulation of specific hypotheses on the role of BM ambidexterity during the evolution of a start-up, in light of the above discussion we speculate that start-ups can continue to benefit from their capacity to combine incremental changes in both BM efficiency and novelty. In other words, continuous improvements in the initial content, structure and/or governance of transactions – i.e. the novelty theme – and the further reduction of information asymmetry and/or transaction complexity – i.e. the efficiency theme – can have synergistic effects on the firm's performance. In sum, we hypothesise that start-ups that over time are able to generate combined increases in novelty and efficiency will

outperform their competitors. We thus advance our sixth and final research hypothesis as follows:

H6: In the process of BME, increases in BM ambidexterity have positive effects on growth performance.

Figure 1 summarises our set of research hypotheses.

Figure 1 here

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4. Research design and methodology

4.1 Data collection and sample

To test our hypotheses, we conducted a cross-sectional survey of Italian start-ups operating in high-technology industries. A stratified random sample of 2,500 units was drawn from the population of start-ups. The Aida database (Bureau Van Dijk) was used to randomly select the sample. Firm size, firm age and industry were used as strata, consistent with other research on new ventures' performance (Farhat & Robb, 2018). With the goal of analysing their BME process over a sufficiently extended period of time, firms six to nine years old – all incorporated between 2006 and 2009 – were selected for this study. The firms' age range also allowed for an adequate level of heterogeneity in the sample (McDougall, Covin, Robinson, & Herron, 1994). The survey participants consisted of chief executive officers and members of the founding teams who were presumed to possess complete knowledge about the issues investigated in this study (Simsek, Veiga, Lubatkin, & Dino, 2005). The questionnaire was submitted between January 2016 and March 2016. It was originally developed in English and later translated into Italian. Back translation was employed to ensure comparability of the

original and translated versions of the questionnaire. Items included in the questionnaire were focused on BM changes and the firms' growth performance. The length of the questionnaire was designed to keep the interview under 20 minutes so to assure a high response rate (Hansen, 2006).

Data was collected using the computer-assisted telephone interviewing (CATI) method. This method ensures a good balance of (a) confidence in the identity of respondents, (b) control of the quality of the answers provided and (c) acceptable return rates. To ensure data validity, respondents' profiles were checked, with interviewees asked how long they had been involved in their start-up's strategic decision making. Generally, the key informant was the start-up's founder (87% of cases). Two hundred and eighty completed questionnaires were received (an 11.2% response rate). Thirteen firms were excluded from the final sample because their age was lower than the minimum threshold (six years). Thus, the final sample consisted of 267 start-ups, belonging to four different industries (Table 1): electronics and automation (39.6%), information and communication technologies (49.8%), pharma and biotech (3.3%) and knowledge-intensive business services (7.3%). The average firm size in 2011 (our 'initial' year) was just above four full-time equivalent employees, while in 2015 (our 'final' year) it reached a level of eight employees, representing an annual employment growth rate (from 2011 to 2015) close to 20%.

To address the potential for common method bias, we followed recommendations for both ex ante survey design choices and ex post analyses (Conway & Lance, 2010; Podsakoff, MacKenzie, Podsakoff, & Lee, 2003). Regarding ex ante research design, we followed the recommendations of Conway and Lance (2010) in addressing the questionnaire to a single respondent in each firm, rather than to multiple respondents, as our study concerns mainly small- and medium-sized firms where typically only one person fits the key informant criteria. Regarding ex post research design (Podsakoff et al., 2003), the potential for nonresponse bias

was checked by comparing the characteristics of the respondents with those of the original population sample. T-statistics for the number of employees and age of the company were all statistically insignificant, suggesting that there are no significant differences between the respondent and non-respondent groups. Further, as all measures were collected via the same questionnaire, we used Harman's single-factor test to check for the possibility of common method bias (Podsakoff et al., 2003). This test required that we load all items into a single exploratory factor analysis. The single factor accounts for only 24% of the variance, accounting against the risk of common method bias (Scott & Bruce, 1994).

Table 1 here

4.2 Measurements

Because we couldn't access longitudinal data, we collected data on the surveyed firms' BME retrospectively (Huber & Power, 1985). Marsden (1990) warns that retrospective data suffers from selection bias, in that recent events could be reported more prominently. Thus, we employed several interview techniques in order to minimize potential biases. First, key informants in our study were required to recall only the evolution of their venture's BM in terms of actual and initial BM design, preventing the informant from referring to other events and hence reducing the risk of informant fallibility. Second, the questionnaire focused on strategic changes, which are less likely to be affected by cognitive biases with respect to past beliefs or intentions. The salience of these strategic decisions shall increase their retrospective accuracy. Third, because our dependent variable is an objective data point (employment), available from secondary sources, it doesn't suffer from potential retrospective bias. Further, the use of this dependent variable reduces the risk of endogeneity problems. Fourth, our method

of measurement was consistent with several other studies published in strategic research journals analysing retrospective data (Eisenhardt & Schoonhoven, 1990; Golden, 1992; Huber & Power, 1985; Zapkau, Schwens, & Kabst, 2014).

4.2.1 Dependent variable

An important clarification shall be made on the measures of the dependent variable adopted in our study, i.e. growth performance. Unlike the works by Zott and Amit (2007), which focus on stock market value, we measure a new venture's performance in terms of the growth of full-time equivalent (FTE) workers (Delmar, Davidsson, & Gartner, 2003; McKelvie & Wiklund, 2010). This kind of operationalisation is a more objective measure of performance for entrepreneurial firms, which must rapidly achieve a minimum viable scale of operations (Shepherd & Wiklund, 2009). We decided not to consider other measures of performance, such as profitability, market value or sales revenue, because new technology-based firms may need a long time to break even. Indeed, profitability may vary consistently in the first phases of the life of a start-up, while market value is unknown – as only a negligible percentage of these firms are eventually listed on the stock exchange. In the same vein, the erratic evolution of sales revenue in the start-up period might engender an estimation bias on the measurement of growth. Further, sales growth rates depend on the availability of products and services that, in some high-tech industries, such as biotechnology, can take several years to be developed. Growth of FTE employees has been measured as the compound annual growth rate over a four-year period, from 2011 to 2015. This four-year period was considered sufficiently long in relation to the age of the sampled firms. A time lag from incorporation (2006 to 2009) to the initial measurement of the firm growth (2011) was introduced to better isolate the effective growth of the new venture after the very early stage, when founders are mainly focused on prototyping and market validation rather than on scaling up.

4.2.2 Independent variables

The initial BM efficiency and novelty were assessed using a multi-item scale adapted from Zott and Amit (2007), Hu (2014), Hu and Chen (2016) and Wei et al. (2014). Because several items on the scales developed by Zott and Amit (2007) seemed to be consistent only with e-business firms, we adopted purified scales. The four-item scale for efficiency reflects how the design of a BM enables fast and transparent transactions, reduced costs and the scaling up of the main market(s). BM novelty was also measured with a four-item scale, including the capacity to offer novel incentives to participants and novel ways of linking participants, as well as the capacity to generate new participants in transactions and exchange new solutions (Zott & Amit, 2007).

To describe the BM themes, the respondents were asked to evaluate the levels of novelty and efficiency, as compared with those of competitors, using a 7-point Likert scale (see Appendix A). Both multi-item scales showed reasonable internal consistency, with Cronbach's alpha coefficients higher than 0.800. The changes in BM novelty and efficiency were measured by comparing the levels of BM novelty and efficiency at the time of founding (T0) with those at the time of the interview (T1=beginning of 2016). As novelty and efficiency changes are formative constructs, composed of several variables, their reliability degrees were defined by assessing the assumption of non-multicollinearity (Diamantopoulos & Siguaw, 2006). Variance inflation factors (VIF) have been evaluated, and each indicator's tolerance value was higher than 0.20 and lower than 3.30 (Diamantopoulos & Siguaw, 2006).

Regarding initial BM ambidexterity, we must point out that the way ambidexterity is defined and measured may significantly impact the findings of empirical studies, as thoroughly discussed by Birkinshaw and Gupta (2013). While Hu and Chen (2016) split BM ambidexterity into a 'combined dimension' and a 'balanced dimension', for the purposes of our research and

in light of the interaction effects we have hypothesised between BM novelty and BM efficiency, our measure of BM ambidexterity consists only of the combined effect of the two BM design themes. This measure is consistent with most organisational ambidexterity studies (Cao, Gedajlovic, & Zhang, 2009; He & Wong, 2004) emphasizing how firms can integrate conflicting activities and achieve superior performance in dynamic environments (Gibson & Birkinshaw, 2004). In our analysis, BM ambidexterity is the result of the combination of efficiency and novelty themes and is measured as the product of them (BM novelty times BM efficiency). Before operationalising BM ambidexterity, efficiency and novelty were mean-centred to reduce the covariance between the linear and interaction terms (Echambadi & Hess, 2007). In accordance with the changes in BM design themes, the temporal dimension of BM ambidexterity was measured by the difference between BM ambidexterity at T1 (time of interview) and T0 (time of foundation).

The descriptive statistics shown in Table 2 provide a first account of our sample's BME. In particular, the results show that the initial levels of BM novelty (5.42 out of 7) are quite higher than the initial levels of BM efficiency (4.52 out of 7). Further, the magnitude of the changes from T0 and T1 is similar for novelty (+1.08) and efficiency (+1.05). Interestingly, no company declared a decrease in the levels of BM novelty and efficiency from T0 to T1.

4.2.3 Control variables

Our study includes several control variables which are meant to capture other determinants of a new firm's growth: (a) initial firm size (number of employees in 2011), which can be considered a proxy of the new firm's resource endowment (this measure was approximated by the number of FTE employees); (b) firm age (in 2011), which varied from two years for those firms incorporated in 2009 to five years for those ventures incorporated in 2006; (c) industry, which was introduced to control for industry-level forces and conditions,

such as the degree of competitive intensity and dynamism, and approximated by three dummy variables for the four investigated industries; and (d) external investors, which were measured by four dummy variables to account for start-ups raising equity from (1) venture capitalists, (2) business angels, (3) universities and (4) other enterprises.

5. Results

Several studies on organisational ambidexterity (e.g. Cao et al., 2009; He & Wong, 2004) and BM ambidexterity (e.g. Hu, 2014; Hu & Chen, 2016; Wei et al., 2014) have applied hierarchical regression analysis to reveal both direct and moderating relationships between variables. In this vein, because our hypotheses involve both direct relationships (hypotheses 1, 2, 4 and 5) and interaction effects (hypotheses 3 and 6), a hierarchical multiple regression analysis was performed (Table 3). The reduced multicollinearity among variables (VIF<3.30) is also consistent with moderated multiple regressions (Echambadi & Hess, 2007).

Our first model considers only the control variables, while the second model includes the efficiency and novelty levels at T0, and the third includes the initial (at T0) BM ambidexterity. The fourth model also includes the increases in the BM design themes from T0 to T1, and the fifth and last model considers the increases in BM ambidexterity from T0 to T1.

Model 1 shows that the initial firm size, which can be considered a proxy of firms' available resources, has a significant positive impact on the growth performances. Model 2 shows that neither initial novelty nor initial efficiency are significantly correlated with new ventures' growth, thus not supporting H1 and H2. Model 3 introduces the initial combined ambidexterity into the regression. The findings indicate that BM ambidexterity has a negative and significant influence on the growth of a start-up. The negative coefficient reflects a substitutive effect of design themes rather than a combinative influence. Thus, H3 is not supported. Model 4 considers the successive changes in the levels of efficiency and novelty.

The results show that, while the incremental changes in BM novelty do not have a significant impact on growth, this same performance is, instead, positively impacted by the increases in BM efficiency. Therefore, H4 is rejected while H5 is supported. The full model (Model 5), including also the changes in BM ambidexterity, shows a significant positive impact of such changes on growth performance, providing support to H6. In summary, only H5 and H6 found empirical support in our sample.

Table 2 here

Table 3 here

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6. Discussion and conclusions

In competitive contexts characterised by accelerating dynamism such as high-tech industries, stable BMs hardly guarantee successful performance for start-up firms (Desyllas & Sako, 2013; Oe & Mitsuhashi, 2013). On the contrary, firms need to constantly revise their BMs and their strategies (Chesbrough, 2010; Spieth, Schneckenberg, & Matzler, 2016). What this research attempted to clarify is in which directions such changes should proceed. We adopted a quantitative research approach to advance specific research hypotheses on how (a) the initial BM of a start-up, (b) the subsequent changes in the design themes (novelty and efficiency) and (c) the interaction effect of efficiency and novelty and of their increases (which we call BM ambidexterity) impact a start-up's growth performance. To test our set of hypotheses, we conducted a survey on a sample of 267 start-ups in high-tech industries. Based on previous empirical evidence (Zott & Amit, 2007, 2008), we hypothesised that novelty matters, especially in the early phases of a new venture. This hypothesis, which sounded reasonable, especially for the investigated industries, where technological innovation is

frequent, was disconfirmed by the empirical findings. The same can be said for the initial levels of efficiency, which do not show, in our study, a significant impact on a new venture's performance. In sum, our results suggest that the initial BM has a limited impact on the future performance of a start-up firm and can thus be considered just a provisional foundation for such firm.

Overall, the data indicates a smaller-than-expected role for BM novelty in determining the growth performance of new firms, even after the inception phase. On the contrary, the data shows that in the subsequent stages of a new firm's life, efficiency does play a significant role in performance. A possible explanation is that a prolonged focus on novelty, rather than contributing to a firm's success, might generate greater challenges for new entrepreneurial ventures in finding customer acceptance (Aldrich & Fiol, 1994). Thus, in the search for legitimacy in the market, the start-up might limit the introduction of further novel components and decide not to pursue BM design themes (Bohnsack, Pinkse, & Kolk, 2014). At the same time, over its evolution, the start-up will implement a process of strategic and organisational imitation of the incumbents (DiMaggio & Powell, 1983; George & Bock, 2011; Kostova, Roth, & Dacin, 2008). This will favour BM convergence rather than its innovation and, as a consequence, novelty will not play a catalytic role in the evolution of start-up firms, in line with Teece's (2010: 179) contention that 'developing a successful business model (no matter how novel) is insufficient in and of itself to assure competitive advantage'. This conclusion suggests future avenues of research to test the hypotheses in different empirical settings, including start-ups that failed and start-ups that survived.

Our study also provides some new results on the effect of BM ambidexterity on start-ups' growth. In particular, we find that a high initial level of ambidexterity can harm the growth performance of a start-up. The negative coefficient of initial ambidexterity reveals that the two design themes should be considered, at the onset of a new firm's evolution, substitutive rather

than complementary. In our study, the same coefficient becomes positive at later times, thus suggesting that ambidexterity works differently at different stages of a start-up's evolution: initially, it negatively affects performance; later, it positively impacts a firm's growth.

This paper builds on and extends earlier work on BM dynamics by coming to a deeper understanding of BME, in particular by clarifying the different impact of novelty, efficiency and ambidexterity on the performance of high-tech start-ups at different moments in time (Schneider & Spieth, 2013). A first contribution of the paper is in relation to the role played by a novel BM design. In particular, contrary to previous studies focusing on more established firms (Gerdoçi et al., 2018; Zott & Amit, 2007), in our study we found BM novelty to have no effect on the growth performance of start-ups. This absence of effects does not vary over time, in open contradiction with Zott and Amit (2007: 184), who posit that the higher the degree of BM novelty, the 'higher the switching costs for the focal firm's customers [...] as there may not be readily available alternatives to doing business with the focal firm'. Despite being reasonable, such argumentation apparently does not hold in the case of start-up firms. Indeed, a high level of BM novelty, or a further increase of it, seems to have no impact on the ability of a start-up to *lock in* its customers and to increase its growth.

A second contribution of our study consists in providing a more fine-grained understanding of the role played by BM efficiency on the growth dynamics of start-ups. Indeed, our results show that previous contrasting empirical results (such as Hu & Chen, 2016; Zott & Amit, 2007) could depend on *when* the effects caused by BM efficiency were measured. Indeed, as speculated by Christensen et al. (2016), in their nascent phase, new ventures have not yet faced the recurrent tasks that create organisational routines, and their revenue models and cost structures have not yet been clearly defined. Thus, initial efficiency is not enough to deploy a BM's full potential, and only start-ups that pursue higher BM efficiency in later stages of their evolution will obtain significant advantages in terms of growth.

Finally, a third contribution of our paper is in clarifying different effects that the interaction of BM efficiency and BM novelty have on the performance of a start-up at different stages of its evolution. In this regard, our results challenge the belief that ambidexterity in BM design has positive effects on a firm's performance, whether that performance be market value (Zott & Amit, 2007), technological innovation (Hu & Chen, 2016) or just a generic performance (Ricciardi et al. 2016). Indeed, our results show that for a start-up firm, pursuing contrasting goals right after the establishment could inhibit its growth potential. That can be due to different causes, including an inefficient allocation of (scarce) initial resources and an unclear initial positioning in the market. Vice versa, in later phases, when start-ups have created the organisational routines needed, clarified their market positioning and tested their revenue models and cost structures, ambidexterity may release its full potential and encourage growth.

The managerial implications of our findings are straightforward: new ventures should focus not only on novelty but also on rapidly strengthening their BM with the required degree of efficiency. This ambidextrous approach should be carefully accomplished over time. Beginning with both themes may be too demanding of entrepreneurial and managerial attention and, thus, counterproductive in terms of performance. The initial BM focus shall be chosen very carefully: while novelty can typically be the focus in the early stages, successive evolution should instead be driven by the pursuit of progressive improvements in efficiency. This dynamic combination of novelty and efficiency appears to be a distinctive trait of a growing new venture. Together with Birkinshaw and Gupta (2013), we posit that superior business performance through ambidexterity shall leverage entrepreneurial and managerial capability: managing trade-offs among competing objectives (dualities) may imply actively pushing one objective (e.g. novelty) ahead of the other (e.g. efficiency) for a limited time or finding creative ways of delivering on two objectives (novelty and efficiency) at the same time.

As with every study, the present one has several limitations. First, it considers only the growth dimension of performance. Despite the limitations of this measure, which we have signalled in the methodology section, it is well known that the growth performance of high-tech start-ups is a multifaceted phenomenon, with several possible measures and dimensions (McKelvie & Wiklund, 2010), such as sales, market share, venture capital investments, innovation rates, internationalisation level and product variety. The use of different measures, such as the level of venture capital investments, could lead to different results and conclusions. Future studies could expand the analysis of growth performance by using different measurements or a combination of dimensions. Second, BME is a dynamic activity that unfolds over time, suggesting that longitudinal (rather than cross-sectional) research could more accurately capture the nature and degree of specific changes in the business architecture. In this vein, a follow-up investigation could address the limitation of a cross-sectional approach by adding a further measurement point to accurately approximate BM dynamics, in terms of both BM design themes and ambidexterity, for those firms included in the sample. This further step of analysis would also be relevant to better understand firm failure and relate it to BM dynamics. Third, regarding the subjective and retrospective measurement of our independent variables, our data may be contaminated by recall bias. Comparing subjective data with panel or objective data themes would have further validated our measurements (Chandler & Lyon, 2001). Fourth, although in our study we have controlled for the effect of firm age, future research should minimize the potential influence of age heterogeneity by selecting a sample of ventures incorporated in the same year. Moreover, due to the inadequate reliability of the available measurements, the present study does not consider the other BM design themes suggested by Amit & Zott (2001), such as lock-in and complementarity. In future research, it would be interesting to verify whether start-ups grow faster when attempting to retain their customers through contractual or technological bindings (lock-in) or when offering sets of

complementary products or services. Finally, future development of this research could also benefit by the use of PLS-SEM, a statistical approach that can work with relatively small samples and can readily incorporate formative as well as reflective constructs (Hair, Ringle, & Sarstedt, 2011).

Appendix A

Current efficiency-based BM (Likert scale 1-7: 1 fully disagree, 7 fully agree)
(1) The current business model of the firm enables fast transactions.
(2) Transactions are transparent: flows and use of information, services and goods can be easily verified.
(3) Costs for participants in the current business model are reduced (e.g. inventory, marketing and sales, transaction processing and communication costs).
(4) The current business model design, overall, offers high transaction efficiency.

Current novelty-based BM (Likert scale 1-7: 1 fully disagree, 7 fully agree)
(1) The current business model of the firm links participants to transactions in novel ways.
(2) Incentives offered to participants in transactions are novel.
(3) The current business model brings together new participants.
(4) Overall, the company's business model design is novel.

Initial efficiency-based BM (Likert scale 1-7: 1 fully disagree, 7 fully agree)
(1) The initial business model of the firm enabled fast transactions.
(2) Transactions were transparent: flows and use of information, services and goods could be easily verified.
(3) Costs for participants in the initial business model were reduced (e.g. inventory, marketing and sales, transaction processing and communication costs).
(4) The initial business model design, overall, offered high transaction efficiency.

Initial novelty-based BM (Likert scale 1-7: 1 fully disagree, 7 fully agree)
(1) The business model of the firm linked participants to transactions in novel ways.
(2) Incentives offered to participants in transactions were novel.
(3) The initial business model brought together new participants.
(4) Overall, the company's business model design was novel.

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Table 1. Composition of the sample firms

	Category	Percentage
Industries	Electronics/Automation	39,6
	ICT	49,8
	Pharma & Biotech	3,3
	KIBS	7,3
Firm Age (year of incorporation)	2006	20,8
	2007	21,3
	2008	28,5
	2009	29,4
Firm Size (n. of FTE employees in 2011)	<=5	58,5
	5-10	24,9
	10-50	16,2
	>50	0,4

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Table 2. Descriptive statistics and correlation matrix

		Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	**Growth Performance**	25.95	46.24	1.00																
2	**Age**	3.01	1.43	-0.09	1.00															
3	**Size**	7.94	10.47	0.26**	0.01	1.00														
4	**Industry1 (Pharma & Biotech)**	0.03	0.18	0.06	-0.10*	0.00	1.00													
5	**Industry2 (ICT)**	0.40	0.49	-0.03	0.05	0.05	-0.15	1.00												
6	**Industry3 (KIBS)**	0.50	0.50	0.02	-0.03	-0.02	-0.19**	-0.81**	1.00											
7	**Industry4 (Electr. & Automat.)**	0.07	0.25	-0.02	0.03	-0.05	-0.05	-0.22**	-0.27**	1.00										
8	**BA share**	0.02	0.14	-0.03	-0.02	-0.03	0.13*	-0.06	-0.03	0.07	1.00									
9	**VC share**	0.05	0.22	-0.04	0.05	0.23**	-0.04	-0.04	0.05	0.01	-0.03	1.00								
10	**CORP share**	0.22	0.42	0.01	-0.03	0.01	0.10	-0.04	-0.01	0.04	-0.01	-0.04	1.00							
11	**UNI share**	0.00	0.06	-0.03	-0.09	-0.03	-0.01	-0.05	-0.06	0.23**	-0.01	-0.01	0.12*	1.00						
12	**Initial BM Efficiency**	4.52	1.29	-0.11*	-0.04	0.00	0.03	-0.01	0.05	-0.09	0.05	0.03	-0.09	0.01	1.00					
13	**Initial BM Novelty**	5.42	1.35	-0.05	-0.05	0.04	-0.01	0.00	0.00	0.01	-0.06	0.06	-0.12*	0.04	0.45**	1.00				
14	**Initial BM Ambidexterity**	0.79	2.24	-0.14**	-0.03	-0.01	-0.04	0.03	-0.03	0.03	0.06	-0.06	0.04	-0.02	-0.16*	-0.10*	1.00			
15	**Increase in BM Efficiency**	1.05	1.09	0.22**	-0.03	0.05	0.04	-0.04	0.01	0.05	-0.03	0.03	0.19**	0.01	-0.52**	-0.26**	0.09	1.00		
16	**Increase in BM Novelty**	1.08	1.09	0.15**	-0.05	0.07	0.06	-0.09	0.06	0.03	0.16**	0.00	0.12*	-0.05	-0.28**	-0.36**	0.05	0.59**	1.00	
17	**Increase in BM Ambidexterity**	-0.08	1.87	0.11*	0.06	-0.02	0.04	0.01	-0.03	0.00	-0.09	0.04	-0.04	0.00	-0.19**	-0.25**	-0.34**	-0.20**	-0.09	1.00

* $\alpha < 0.05$; ** $\alpha < 0.01$

Table 3. Hierarchical multiple regression results

Dependent Variable	**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Growth Performance	St. Coeff.	t	St. Coeff.	t	St. Coeff.	t	St. Coeff.	t	St. Coeff.	t
(Costant)		2.043		1.947		2.280		2.325		2.296
Control Variables										
Age	-0.081	-1.346	-0.085	-1.421	-0.093	-1.573	-0.084	-1.428	-0.086	-1.476
Size	0.284**	4.618	0.283**	4.620	0.284**	4.705	0.274**	4.585	0.275**	4.631
Industry1 (Pharma & Biotech)	0.050	0.685	0.061	0.832	0.049	0.673	0.041	0.577	0.032	0.456
Industry2 (ICT)	-0.041	-0.324	-0.022	-0.173	-0.025	-0.201	-0.019	-0.154	-0.018	-0.147
Industry3 (KIBS)	0.000	0.001	0.023	0.179	0.013	0.108	0.011	0.088	0.014	0.113
BA share	-0.036	-0.601	-0.031	-0.516	-0.019	-0.324	-0.018	-0.300	-0.007	-0.113
VC share	-0.100	-1.627	-0.095	-1.555	-0.104*	-1.721	-0.113*	-1.895	-0.121*	-2.025
CORP share	0.000	0.001	-0.011	-0.187	-0.007	-0.112	-0.037	-0.622	-0.035	-0.594
UNI share	-0.036	-0.589	-0.031	-0.506	-0.036	-0.586	-0.034	-0.565	-0.035	-0.587
Independent Variables										
Initial BM Efficiency			-0.108	-1.598	-0.133*	-1.979	-0.028	-0.379	0.021	0.265
Initial BM Novelty			-0.013	-0.198	-0.017	-0.259	-0.011	-0.158	0.023	0.329
Initial BM Ambidexterity					-0.170**	-2.854	-0.172**	-2.921	-0.120*	-1.872
Increase in BM Efficiency							0.208**	2.524	0.265**	3.058
Increase in BM Novelty							0.006	0.083	0.008	0.098
Increase in BM Ambidexterity									0.142**	2.013
R^2	0.091		0.104		0.131		0.163		0.176	
Δ R^2	0.091		0.013		0.028		0.031		0.013	
Model F	2.852		1.852		8.145		4.724		4.052	
N	267		267		267		267		267	

* α <0.10; ** α <0.05; *** α < 0.01

Figure 1. Research hypotheses