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JOURNAL OF MANAGEMENT STUDIES

Journal of Management Studies ••:•• 2022
doi:10.1111/joms.12869

Speed and Scaling: An Investigation of Accelerated Firm Growth

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ABSTRACT While most firms do not grow, a small number of firms are able to maintain and accelerate their growth over time. Researchers, practitioners, and policymakers continue to question the factors which increase a firm's chances of growing rapidly and becoming a more powerful economic driver. Using a robust longitudinal data set from the United Kingdom (UK) during the period from 2000 to 2017, we investigate the propensity of firms to accelerate growth in sales, employment, market share, and productivity. We report varying effects of firm characteristics, industry competitive factors, and regional factors as drivers of accelerated growth. This study will help policymakers and firm managers understand the forces behind different types of acceleration, and it provides a foundation for future research on the speed of firm growth.

Keywords: employment growth, firm acceleration, firm scaling, market share growth, productivity growth, sales growth

INTRODUCTION

The ability of some firms to exponentially increase the pace of their growth – known as 'acceleration' – has drawn the attention of practitioners and researchers, as well as the wider business community. Although most firms[1] do not grow or intend to grow (Acs et al., 2008), a few maintain growth over time. Some even increase the speed of their growth, demonstrating accelerated growth. Acceleration is a characteristic of firm growth and is beneficial for job creation, economic development, increased investor returns, and expedited diffusion

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of innovation (Coad, 2009; Lockett et al., 2011; Nason and Wiklund, 2018). However, most studies of firm growth dynamics rely on cumulative and comparative growth indicators to produce insights into the mechanisms and conditions required for rapid growth (Hoffman and Yeh, 2018; Singh and Mitchell, 2005), and few consider the pace of growth (e.g., Bennett and Levinthal, 2017). This study conceptualizes firm acceleration as related to, yet distinct from, traditional notions of high growth (Demir et al., 2017) and scalability (Piaskowska et al., 2021). A number of prior studies have described why firms grow and expand in size by focusing on their managerial capabilities (Helfat and Martin, 2015) and the reconfiguration of resources (Penrose, 1959), as well as market dynamics and industry effects (Porter, 1980). However, these studies do not specify how firms grow, or whether firms do so at an *increasing* pace over time. This study addresses these issues by distinguishing between three concepts of growth: absolute growth, benchmarked growth, and accelerated growth. We further point out that extant conceptualizations of growth may obscure such distinctions. Overarching strategic questions and manifestations of the three types of growth are summarized in Table I.

All three conceptualizations emphasize the rate at which firms grow. However, traditional studies of high growth, whether absolute (e.g., relative to the firm's own past performance) or benchmarked (e.g., relative to competitors), have not considered *variability* in the speed of growth. A theoretical opportunity exists to explore the phenomenon of an *acceleration* in firm growth which occurs among a subset of high-growth firms. From a methodological perspective, such growth acceleration has not been detectable using traditional additive or comparative measures of firm growth. This is regrettable given how critical firm acceleration is to attracting talent, investors, and media attention by nurturing firm growth in the form of a 'flywheel' that continues to gain momentum once in motion by virtue of synergistic, compounding effects (Collins, 2001; Jansen, 2004). This study fills the theoretical gap by examining firms' accelerated growth, which manifests as a continuous *increase* in growth rate, with each succeeding year's growth rate exceeding the previous year's growth.

Our work on firm growth acceleration invites scholars to expand their thinking about various types of firm growth. Examining the phenomenon of accelerated firm growth has the potential to shed new light on the compounding factors that trigger continual *periods* (rather than cumulative instances) of progressive firm expansion. Moreover, we suggest that these periods are likely to coincide with or precede the emergence of several different types of firms, such as 'scale-ups', firms with annualized growth of at least 20% in sales and employment over a three-year period (Eurostat-OECD, 2007); 'blitzscalers', firms which prioritize growth rate over efficiency (Hoffman and Yeh, 2018; Kuratko et al., 2020); or even 'unicorns', startup firms valued at more than US$1 billion (Piaskowska et al., 2021). Growth acceleration is a phenomenon which can be used to describe the emergence of today's exceptionally large and successful firms in industries which represent outliers in the overall population of business firms (Hoffman and Yeh, 2018), as well as to predict and create the conditions required for future flywheel firms to emerge. As such, this study aims to examine firm acceleration among a wide sample of firms, ranging from startups to mature enterprises, within a variety of industries.

Drawing on prior research on the dynamism of firm growth and the role of firm and industry characteristics in this process (Coad, 2018; Coad et al., 2013, 2014; Jansen, 2004), we formulate two research questions:

Table I. Conceptualizing growth

Growth concept	*Strategic question*	*Manifestation*	*Extreme archetypes*
Absolute growth	Are we growing?	A firm increases in *total* size.	Scale-up firms (e.g., at *least* a 10–40% increase in employment or sales growth annually).
Benchmarked growth	Are we growing faster than our competitors?	A firm grows larger *compared* with competitors.	Blitzscaling firms (e.g., market share growth prioritized over firm efficiency; monopolies and winner-take-all industries).
Accelerated growth	Are we growing faster over time?	A firm grows *faster* each year.	Flywheel firms (e.g., prior growth increases future gains when scaling or blitzscaling).

1. How do firms accelerate, and which firm, industry, and region-specific factors affect a firm's likelihood to accelerate?
2. How do the different types of firm acceleration (i.e., sales, market share, employment, productivity) relate to each other over time?

Our contribution to the entrepreneurship and management literature is threefold. First, in contrast to absolute and benchmarked concepts of growth, we distinguish firm accelerated growth as a unique characteristic of firm growth. We also consider how and why firms are able to achieve continuously higher levels of growth, where they can do so, and what and who enables them. Firm acceleration poses unique challenges for many organizations compared with an occasional increase in growth rate. The intersection of *why* and *how* in particular adds to the existing knowledge on firm growth factors (internal and external drivers of acceleration). Moreover, we note that theoretical contributions are possible in combining theories of firm growth previously considered separate (Penrose, 1959; Porter, 1980).

Second, we broaden scholarly understanding of what accelerated growth *is* by drawing on a population of business firms in a variety of industrial settings. We go beyond the factors which explain the success of blitzscalers or unicorns within a few specific industries (e.g., Piaskowska et al., 2021) using relatively few growth metrics (typically sales or employment). Instead, we emphasize that acceleration entails a continuous and exponential expansion of the firm and involves balancing several frequently unbalanced growth dimensions. Previous studies have predominantly focused on holistic indicators of growth, often suggesting a strong correlation between two (e.g., Delmar and Wiklund, 2008) or three measures of growth (e.g., Baysinger et al., 1982; Coad, 2007). However, we assess firm acceleration along four distinct yet intertwined dimensions: acceleration in sales, market share, employment, and productivity. We observe that the factors which explain one type of firm acceleration may differ from the factors that predict other types (i.e., factors which lead to an acceleration in employment may differ from those which drive productivity acceleration), and that acceleration may follow a sequence which starts with acceleration in sales and culminates in an acceleration in productivity.

Third, we demonstrate how specific internal and external factors influence various types of accelerated growth, expanding prior research on traditional firm growth (Baum et al., 2001; Delmar et al., 2013; Gilbert et al., 2006; Pereira et al., 2020). Indeed, our results suggest that a firm's accelerated growth depends on both endogenous factors, such as firm age and size, and exogenous factors, such as industry competition and regional dynamics. This multi-level consideration allows us to test additional acceleration hypotheses. In doing so, our work provides insights to practitioners on how and when firm growth acceleration may occur; to academics on how to study this phenomenon; and to policymakers on where and how to target interventions in order to increase both the likelihood and the desired type of firm acceleration.

THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

To describe the causal mechanisms underlying firm growth, researchers draw on a variety of frameworks and approaches. To summarize the factors that propel firm growth

and acceleration as a special type of firm growth, we rely on two perspectives: 'inside-out' and 'outside-in'[2] (Spanos and Lioukas, 2001). According to the first perspective, rooted in the work of Penrose (1959), managerial capabilities are critical for firm growth. The second perspective may be traced to the concepts of industrial economics, as well as Porter (1980), who suggested that firm growth is principally based on market dynamics and industry effects. While both perspectives acknowledge the importance of firm-specific (endogenous) and context-related (exogenous) characteristics, they place varying levels of emphasis on the criticality of these effects.

The study of firm growth has often emphasized intrafirm capabilities and the value of human capital. For example, Piaskowska et al.'s (2021) recent study identified four growth-enabling activities that scaling firms engage in: financing, innovation, digitalization, and acquisition. Similarly, Demir et al. (2017) analysed 33 articles on high-growth firms and summarized the key drivers of high growth as residing within the firm: human capital, human resource management, strategy, innovation, and capabilities. Notably, both Piaskowska et al. (2021) and Demir et al. (2017) conceptually ground their work in Penrose's (1959) seminal theory of firm growth. This theory considers the role of managerial capabilities in reconfiguring resources – technology, human, financial, and other types of capital – as critical for innovation and high growth (Helfat and Martin, 2015).

However, this perspective de-emphasizes the role of external forces in shaping growth environments – such as, for example, industry structure (Chrisman et al., 1998; Sandberg and Hofer, 1987), competition, and other market forces (Porter, 1980), or government support (Estrin et al., 2013). Indeed, as Pereira et al. (2020) observe, while growth depends on firm-specific factors, regional attributes, as well as economic, social, and institutional characteristics must also be accounted for. Table II includes a summary of the internal, external, and naturally bi-directional factors that promote (or inhibit) firm growth and have been mentioned in recent studies of high-growth firms (e.g., Piaskowska et al., 2021).

This study analyses how firm and environmental factors affect firm acceleration, defined as 'changing the speed of growth' (Foley, 2012). To illustrate the complexities of firm growth acceleration, we develop a 'funnel-shaped' model that combines regional, industrial, and firm-specific factors as predictors of a firm's likelihood to accelerate across four different types of acceleration – sales growth, market share growth, employment growth, and productivity growth. As Figure 1 illustrates, this funnel visualizes the stages of acceleration or acceleration 'architecture' that exist within firms and markets by linking an *oval-shaped* schematic representation of the external competitive environment with a *cone-shaped* schematic representation of the firm's internal environment. Internal and external factors affect the propensity of firms to accelerate, and each combination of factors may result in four different types of firm acceleration. As illustrated in Figure 1, an acceleration in organizational sales often provides a foundation for broader firm acceleration, enabling a company to move along a path towards accelerated market share growth, employment, and finally organizational productivity. The double-headed arrows represent interdependencies between the firm and environment within the inside-out and outside-in view of a firm.[3]

While Figure 1 conceptualizes and introduces the funnel of firm acceleration that exists within firms and markets by linking the factors from the external environment (industry,

Table II. Structuring firm growth factors

Perspective	*'Inside-out'*	*'Outside-in'*	*Combined*
Drivers of growth	Founder's attention and perception; growth aspirations; (human, founder) capital and capabilities; resources; strategy; reputation; firm size; firm age; etc.	Industry structure and competition; government support; economic, social, and institutional characteristics; population density; quality of the government; etc.	Technologies (in-house or acquired through partnerships); networks (social ties within and outside the organization); intellectual property (IP) rights protection of firm's innovation by an external organization
Exemplar studies	Gilbert et al. (2006); Chrisman et al. (1998); Demir et al. (2017); Joseph and Wilson (2018); Piaskowska et al. (2021)	Chrisman et al. (1998); Estrin et al. (2013); Pereira et al. (2020); Sandberg and Hofer (1987)	Autio and Acs (2010); Estrin et al. (2013); Piaskowska et al. (2021)

Source: Authors.

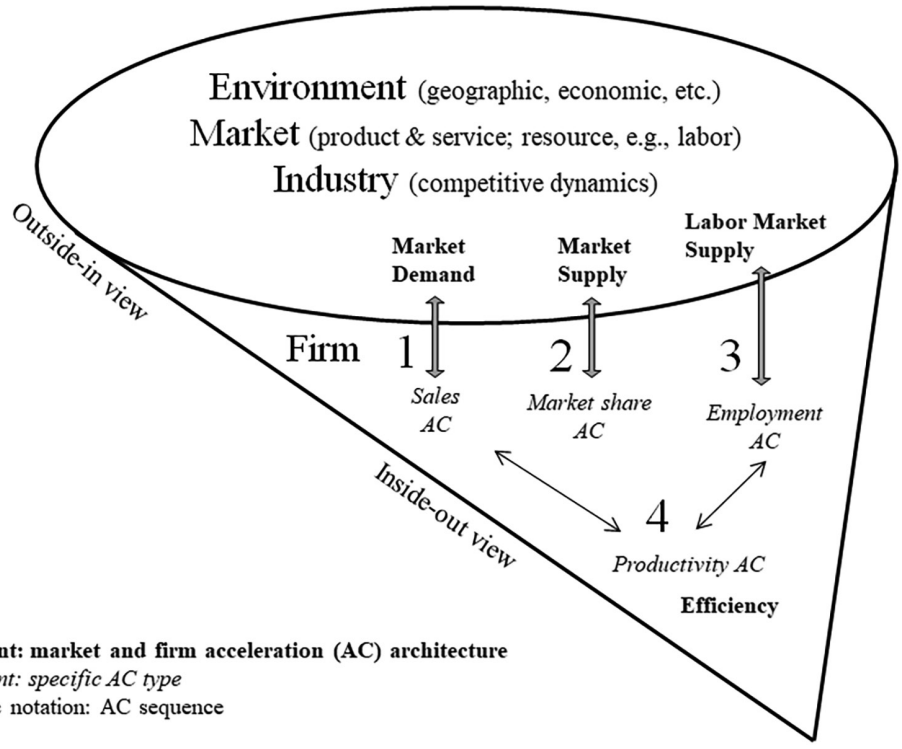

Figure 1. Conceptual model of the firm acceleration typology

region) to organizational characteristics (firm age, size), Figure 2 demonstrates four different pathways of firm acceleration. For example, Figure 2 (upper left) introduces sequential firm acceleration, which means that a firm begins with an acceleration in sales, followed by accelerated market share, job creation, and finally productivity. Figure 2 (upper right) illustrates simultaneous firm acceleration, which occurs when a firm experiences two or more types of growth acceleration at once (e.g., sales and productivity). Figure 2 (bottom left) visualizes the case of firm acceleration in a growing market, while Figure 2 (bottom right) demonstrates firm acceleration in a shrinking or declining market. While the upper right and left panels of Figure 2 represent the firm acceleration pathway which is endogenous to a firm, the bottom left and right panels of Figure 2 demonstrate the external forces that can facilitate or impede the acceleration process.

To further conceptualize firm acceleration and its effects, we describe each of the four types of firm growth acceleration (e.g., employment, sales, market share, and productivity acceleration). We thereby create a foundation for the combined 'inside-out' and 'outside-in' view of firm growth acceleration, and for formulating testable hypotheses.

Employment acceleration (EA) captures an exponential increase in the number of full-time employees hired by the firm. From an internal perspective, EA captures a firm's ability to fulfil its growth aspirations (Delmar and Wiklund, 2008) and succeed in new venture creation (Baum and Bird, 2010), and is often related to its competitive strategy (Lepak

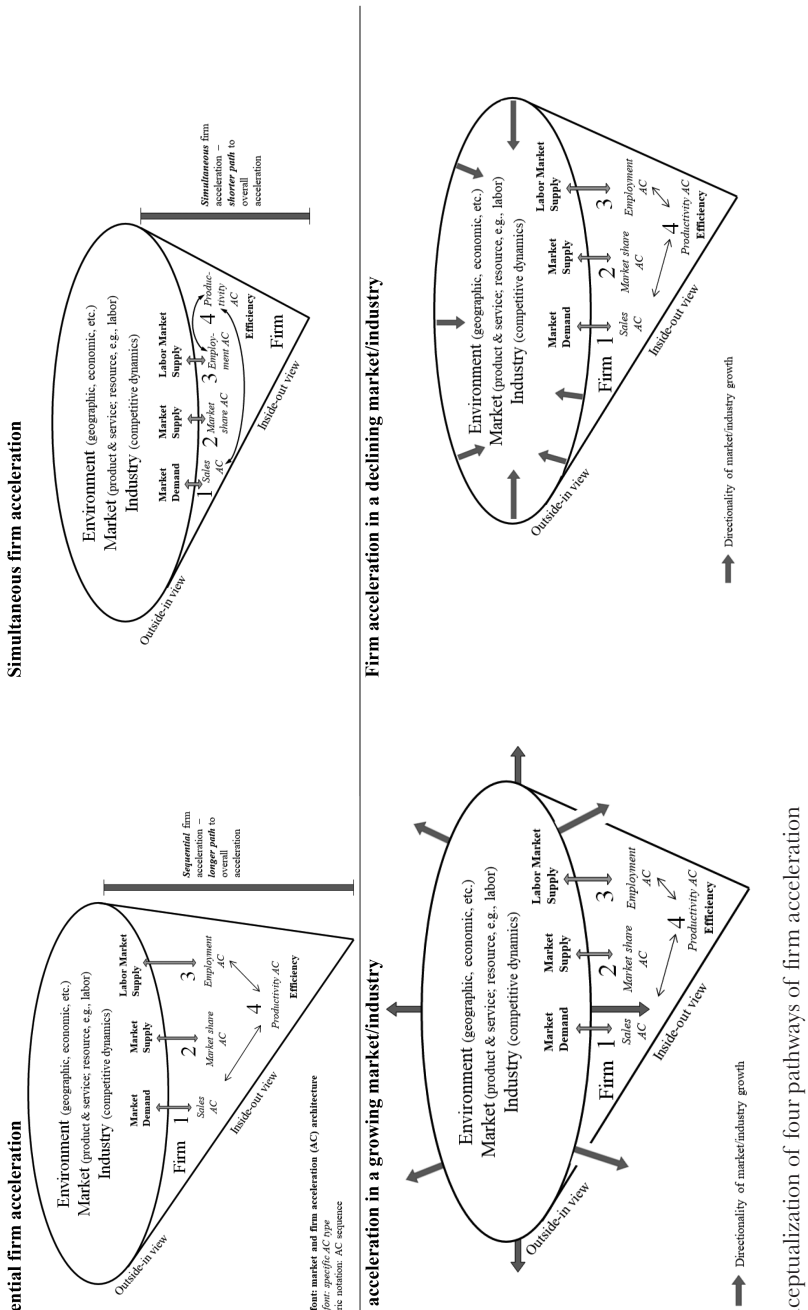

Figure 2. A conceptualization of four pathways of firm acceleration

and Snell, 2002). For instance, firms' outsourcing decisions may affect changes in employment growth rates, such as when Amazon or UPS choose between hiring drivers as full-time direct employees or as subcontractors. From an external perspective, changes in employment growth rates are affected by market and industry forces, as well as institutional, economic, and social factors (Pereira et al., 2020). High levels of technological development and automatization (robotization) in the industry reduce a firm's likelihood to accelerate in employment. Taken together, EA represents a firm's strategic choice regarding production factors made by taking product, technology, and labour market information into account.

Sales acceleration (SA) captures an exponential increase in the quantity of goods and services sold by a firm, thereby indicating the comparative desirability of the firm's product/service offerings on the market. The quality and pricing of the available alternatives externally influence how likely a firm is to accelerate in sales. Firm operational capacity is a major internal inhibitor of SA. External hindrances of SA include a lack of demand (Pereira et al., 2020), industry decline (Coad et al., 2016), customers' high switching costs (Tanriverdi and Lee, 2008), and limited financing (Chan et al., 2003). SA represents an external market response in reaction to a firm's internal ability to supply/produce.

Market share acceleration (MSA) represents an exponential increase in the market space a firm occupies relative to other market participants. A firm's ability to exponentially grow its market share is constrained by other firms and their market positions, and an increase in the market share of 'fitter' firms reduces that of 'weaker' firms (Coad, 2007). Among the internal hindrances of MSA is a firm's strategic ability to find and maintain product-market fit and to expand the number of markets served. There are several major external inhibitors of MSA, including (a) the competitive prowess of other firms and their ability to satisfy demand (Porter, 1980); (b) industry structure (McGahan and Porter, 1997); and (c) policies and regulations (Audretsch et al., 2019), such as antitrust laws (Litan, 2016). A firm's opportunities to accelerate in market share are limited by the environment (i.e., industry, market, geographic factors) in which the firm competes. Moreover, in a growing market, a firm's market share may remain the same (no MSA), and yet the firm may still accelerate in sales, employment, and productivity. Like SA, MSA captures the external response in reaction to internal ability to supply/produce, but unlike an absolute measure of SA, MSA is a relative acceleration measure.

Productivity acceleration (PA) represents an exponential increase in a firm's total output (sales) divided by its total input relative to industry participants. The major driver of PA is a firm's ability to either (a) increase output from the same input or (b) reduce input while keeping output at the same level. Due to this dual nature, PA is closely related to SA and EA, and it also represents a clear indicator of organizational value creation. To be exponentially more productive, firms need to innovate (Kancs and Siliverstovs, 2016), absorb technological best practices (Cohen and Levinthal, 1990), and balance exploration and exploitation modes (March, 1991), among other factors. For this, firms need to overcome the internal constraints of PA that are linked to EA, such as overloading, multiloading, and perpetual loading of employees (Bruch and Menges, 2010). The external constraints of PA are linked to SA (and thereby indirectly to MSA), including the state of technology

and ability of other firms to increase their productivity via innovation and employee motivation (Coad and Teruel, 2013). Industry characteristics also play a role in PA as firms with greater market share are better positioned for productivity growth (Acs et al., 1999). PA serves as an indicator of a firm's efficiency in serving market demand factored by the internal resources used.

While a continuous increase in productivity is typically a related characteristic of growing firms, it is important to consider its independence from the other aspects of growth acceleration as well (Nason et al., 2015). In other words, firms may temporarily disregard growth efficiency when seeking to rapidly accelerate their gains in market share, typically within 'winner take all' industries (Hoffman and Yeh, 2018). The growth of 'blitzscalers' generally depends on a belief in substantial market demand forecasts by investors along with their willingness to unsustainably spend or 'burn' cash on innovation in the pursuit of market dominance and considerable future abnormal returns.

Inside-Out View of Firm Acceleration: The Effects of Firm Factors

Researchers have identified firm age (Coad et al., 2018; Haltiwanger et al., 2013), firm size (Achtenhagen et al., 2017; Chen and Hambrick, 1995; Cooper et al., 1989), and even aspirations of firm size (Greve, 2008) as among the most important determinants of firm growth. Prior research on firm scalability indicates that startups and small firms typically grow faster (Almus and Nerlinger, 1999; Daunfeldt and Halvarsson, 2015; Hamilton and Satterthwaite, 2019). Moreover, prior research suggests that firm age is also an important determinant of firm growth trajectory (Coad, 2018; Haltiwanger et al., 2013; Lundmark et al., 2020); that firm age is negatively associated with growth (Calvo, 2006; Dunne and Hughes, 1994; Evans, 1987; Yasuda, 2005); and that growth rates tend to decline as firms get older (Delmar et al., 2003; Vining Jr, 1976). In addition, Daunfeldt et al. (2014) found that high-growth firms are younger than other firms on average. To advance our knowledge of firm acceleration, we theorize about the specific effects of firm age on the four firm acceleration types. We also distinguish between four age-groups associated with the transition from startups to mature firms: startups (up to 7 years), established ventures (8–15 years), transitioning firms (16–30 years), and mature firms (30 years plus).

Sales acceleration. Startups tend to devote more time and effort to product innovation and invest more in R&D than established and mature firms (Coad et al., 2016). Moreover, they are often the beneficiaries of successful market strategies from earlier entrepreneurs and their customers (Estrin et al., 2013). The superior ability of startups to fine-tune their business models emerges from their strategic flexibility, which helps to fuel the rapid expansion of their businesses. Conversely, established and mature firms often become preoccupied with strengthening their current customer ties and meeting the demands of their existing customers instead of searching for new business (Siren et al., 2012). Furthermore, their business models are defined, relying on established competencies, products, and markets (Jansen et al., 2006; Jansen et al., 2009). As outcomes of exploitation are proximate and certain (March, 1991), mature firms decrease their explorative efforts over time (He and Wong, 2004). Such excessive focus on exploitation may in turn result

in organizational myopia (Levinthal and March, 1993) and competency traps (Levitt and March, 1988), decreasing a firm's propensity for progressive growth. Analysing the persistence of firm growth, Coad et al. (2018) observed that startups are more likely to have two consecutive periods of positive growth, whereas more mature firms tend towards more erratic growth paths. Taken together, we hypothesize:

Hypothesis 1: Startups are more likely to accelerate in sales than their more mature counterparts.

Market share acceleration. Before the rise of venture capital and internet platforms, firms were rather limited in their ability to reach geographically distant *product*, *labour*, and *capital* markets. Although startups could still sell their ideas to their customers and investors, the number of people they could reach was small, and therefore they often had to produce a product before they could sell it. Various forms of customer prepayment and delayed payments to suppliers provide firms with opportunities to grow startups with limited human and other resources 'out of a garage'. As business models and investor schemas have evolved rapidly, today there are multiple ways for startups to connect to large audiences and accelerate earlier. Bootstrapping and lean startup approaches (Blank, 2013) provide mechanisms for startups to rapidly transition to established firms by building customer-funded businesses based on *mass* product prepayments (e.g., Tesla deposits or crowdfunding via Kickstarter). Other major enablers of pre-production acceleration include professional investors (venture capitalists), business angels, and incubator and accelerator programs that help founders test and build prototypes and consequently scale up faster than was previously possible (Lundmark et al., 2020). With sales and market acceleration tightly linked, we hypothesize:

Hypothesis 2: Startups are more likely to accelerate in market share than their more mature counterparts.

Employment acceleration. The same advances in technology and online markets (platforms) that have enabled many young firms to rapidly increase sales and capture market demand earlier in their life cycle have enabled these organizations to do so without hiring many, or even in some instances *any*, full-time employees. Startups may thus often accelerate in sales and market share before they accelerate in employment. Once a firm has evidence of *sustained* demand for its product or service through consistently growing sales and market share, it may next seek to expand its capacity as a budding established venture by hiring additional fixed-time employees. Employment acceleration is therefore most likely to occur among established ventures that surpass the typical operational and functional challenges associated with the startup phase. This is because these firms tend to have more slack resources than startups to hire new employees, such as the diverse specialists their organization may require to increase the efficiency of its business model (Lundmark et al., 2020). The links between smallness and newness are both empirical (e.g., there is a high correlation between age and size) and theoretical, since being small

and young often means having fewer resources to hire at an accelerating scale. Having lessened some of their liabilities of newness and perhaps smallness (Coad, 2018; Coad et al., 2018; Freeman et al., 1983), more established ventures are in a better position to invest resources in human capital at an accelerating pace. On the other hand, while mature firms possess crucial resources, they may accelerate in employment growth less predictably because their business model will likely have stabilized and perhaps reached the upper bound of its initial growth trajectory.

We expect that established ventures which have achieved the product-market fit will be most likely to accelerate in employment growth, as they transition from exploration to exploitation, with the aim of building on the organization's capabilities and reaping the rewards of their entrepreneurial activities. As ventures grow, they may also experience increasing momentum along their path towards a larger scale (Jansen, 2004). We thus expect the addition of new employees to provide new ideas, insights, and human capital conducive to further fuelling an acceleration in employment (Eisenhardt and Martin, 2000).

Hypothesis 3: Established ventures are more likely to accelerate in employment than startups or their more mature counterparts.

Productivity acceleration (PA). PA refers to an exponential increase in a firm's total output (sales) divided by its total input (employment) (Coad et al., 2016). Thus, only a disproportional boost in sales (as output) or a substantial drop in the resources used (as input) will result in PA. Along these lines, firms have two pathways to PA: optimizing for inputs or optimizing for outputs. A firm may aim to accelerate sales and market cap to enhance its 'output' or instead operate with leaner human resources as its 'input'. Critically, acceleration in productivity and employment act in opposition to each other because an exponential increase in employment without a simultaneous increase in sales and market share will reduce PA. In a firm's growth trajectory, there may be acceleration in employment which may in turn be decoupled from that of productivity. Younger, smaller firms will optimize for output (sales and market share) and more established ventures for a resource-based input (employment), while more mature and larger firms are better positioned for an acceleration in productivity, for example by switching from human labour to mechanical and automated solutions among other increases in efficiency (Brynjolfsson and McAfee, 2013). We therefore hypothesize:

Hypothesis 4: Mature firms are more likely to accelerate in productivity than their younger counterparts.

Outside-In View of Firm Acceleration: The Effects of Competitive Factors

A firm's competitive context influences the 'resource stocks' and 'sources of information' it can use to exploit new opportunities (Aldrich and Mindlin, 1978). In terms of resource stocks, scholars have emphasized a firm's ability to access and protect its resources from competitors and strengthen its bargaining position with suppliers and distributors, whereas with respect to sources of information, scholars have emphasized the availability and reliability of the information accessible to a firm as it seeks to grow (Aldrich and Pfeffer, 1976; Mindlin

and Aldrich, 1975). Firms are challenged by their ability to access and use resources and information when making strategic decisions, and their acceleration in market share, sales, jobs, and productivity may depend on factors related to how much effort they must exert to gain, retain, and use resources and information. One factor related to the presence of market information and resources is the intensity of industry competition between incumbents.

Economists argue that highly competitive industries foster efficiency (e.g., Alchian, 1950; Stigler, 1958) by intensifying information exchange about potential opportunities and providing firms with a better sense of what customers are likely to purchase. Studies have shown that fast-followers often grow faster than market pioneers, building on the lessons learned by the pioneers, and often leapfrogging their market positions (Lieberman and Montgomery, 1998). This is particularly the case when early pioneers must educate customers about the benefits of a new product-market technology (Deng and Wang, 2016).

Moreover, a highly competitive environment may promote collaboration among participants (Chen and Miller, 2015). In other words, firms are likely to engage in both competitive and cooperative actions (Chen, 2008), resulting in resource sharing, new product development, and market opportunities (Eisenhardt, 1989; Hambrick and Finkelstein, 1987) which aid firm acceleration. Such actions create new market opportunities for competitors in an industry (Bradley et al., 2011; Castrogiovanni, 1991), offering niches for growth and hence the potential for rapid advancement in market share, which prompts acceleration in efficiency with potential for employment growth. Certainly, firms will have to work harder to protect their resources when industry competition increases. However, this may also motivate firms to grow faster, particularly when it is perceived that 'winners reap all (or most) of the gains' in the industry (Hoffman and Yeh, 2018), such as when a dominant design is at stake (Suarez et al., 2015). We thus expect that firms will be more likely to experience accelerated growth when an industry ecosystem is more competitive:

Hypothesis 5: Industry competition increases all types of firm acceleration.

Over time, the competitive context may lead a firm to switch industries. Shrinking markets or a desire to locate higher growth opportunities may induce firms to change their industrial setting. Firms may also switch industries seeking to enter new markets and serve new customers (Brush et al., 2009). However, changing their primary industrial setting is a challenging task which often stretches both managerial and financial firm resources (Covin et al., 1994). Novel competitive landscapes are likely to require the adaptation of existing routines and practices to new industry knowledge structures (Walsh, 1995). Likewise, it takes time to form relationships with new suppliers and customers, and to develop different types and combinations of firm capabilities (Nonaka, 1994; Zahra et al., 2006). Firms may therefore find it difficult to access and balance different combinations of capabilities (Tushman and Rosenkopf, 1996), which may slow down or inhibit firm growth. Path-dependence and rigidities in decision-making and capabilities may also explain why many firms fail to experience a smooth transition when switching industries (Plummer et al., 2022). Taken together, we expect that firms switching industries will require time to build industry-specific experience, resources, and capabilities, thus preventing a firm from accelerating within a new industry:

Hypothesis 6: Switching industries diminishes all types of firm acceleration.

Outside-In View of Firm Acceleration: The Effects of Industry and Regional Factors

Industries and regions vary by their level of munificence and resource availability. For instance, a location in a knowledge-intensive geographical or industrial area provides resources and opportunities for firms, allowing them to collaborate within knowledge-based networks and to benefit from knowledge spillovers (Acs et al., 2009; Audretsch and Keilbach, 2007). Considerable strategic interdependencies exist among firms operating in sectors rich in knowledge, with technological and cognitive proximity (industry embeddedness) as well as geographical proximity (regional embeddedness) contributing to resource availability (Balland et al., 2015; Boschma, 2005). Such proximities enable firms to access tacit knowledge, commercialize new knowledge, and appear to offer fertile ground for organizations to achieve higher growth acceleration (Audretsch and Feldman, 2004).

At the industrial level, firms in industries rich in knowledge, such as high-tech manufacturing, education, professional and business services, and knowledge-intensive business sectors (KIBS), are motivated to pursue in-house innovation to achieve competitive differentiation. In these knowledge-intensive industry sectors, open innovation and knowledge spillovers are commonplace (Audretsch and Belitski, 2020). Knowledge-based networks in such industries are mechanisms of knowledge transfer that allow the costs and risks of R&D to be shared among specialist firms and institutions, such as universities and tech companies, and are also likely to contribute to the development of new technologies and products with the potential for a non-linear increase in sales, market share, and productivity (Delmar and Wiklund, 2008). Following prior research on the role of proximities, we argue that firms located in knowledge-intensive industries will have higher knowledge spillovers (Audretsch et al., 2021) and therefore be more likely to experience accelerated growth:

Hypothesis 7a: Knowledge-intensive industries and their associated potential for knowledge spillover increase all types of firm acceleration.

A firm's regional context may also explain its chances of growth in general (Pereira et al., 2020) and an acceleration in its growth trajectory in particular. Specifically, a region's potential for creating knowledge spillovers through, for instance, large multinational enterprises (MNEs) co-located in a region (Driffield et al., 2014) may produce knowledge spillovers. This is because MNEs contribute to the creation of a public good (e.g., it is non-rivalrous and only partially excludable) that may help local firms accelerate their growth by making use of new technologies, techniques, and resources introduced by the MNE. Along these lines, Makino and Delios (1996) identified three potential channels by which local firms can source and use knowledge from their co-located foreign counterparts to create a competitive foundation for rapid growth. First, a local firm may form a joint venture with an MNE, increasing their organizational 'footprint' and developing

new capabilities. Second, an MNE may transfer knowledge from the parent's country of origin, including international market experience and skills, to accelerate firm growth. Third, skills and knowledge may be accumulated by local firms through the poaching of workers, or more sanctioned channels such as joint R&D projects. Taken together, we hypothesize:

Hypothesis 7b: Firms located in regions characterized by a high potential for knowledge spillover are more likely to experience all types of firm acceleration.

Our conceptualization of the four discussed dimensions of accelerated firm growth, along with their driving forces and underlying mechanisms, are summarized in Table III.

METHOD

We test our hypotheses using data from the Business Structure Database (BSD), a registry of all active firms in the UK during the period from 2000 to 2017. This registry contains data on organizations that are registered for value-added tax (VAT) or which pay at least one employee through the pay as you earn (PAYE) tax system. It is therefore one of the most comprehensive sources of data about firm operations within the UK. While the BSD contains limited information, it offers researchers access to the full population of active firms within one specific country. We obtained data on employment, turnover, foreign ownership, and industrial activity for each company based on Standard Industrial Classification (SIC 92, SIC 2003, or SIC 2007). Year of 'birth' (firm start-up date) and 'death' (termination date) are also included, as well as postcodes for both enterprises and their local units. Demographic variables (e.g., start-up and wind-down dates) also provide insights into business cycles. By using industry identifiers (two-digit SIC 2007) and geographic region identifiers by postcode, we were able to create additional industry and industry-region level variables. For example, we used firm-level data to calculate the market size, market concentration, share of employees by industries, and so on.

Our data analysis proceeded as follows. First, we collected and matched 18 consecutive waves of BSD data from 2000 to 2017. Second, we created the variables of interest using data for firms, aggregating at the industry level using industry identifiers for 90 industries at a two-digit SIC, creating identifiers for 175 regions, calculating market share by two-digit SIC, scaling-up characteristics, and other variables. There are 18 surveys covering 2000 to 2017; after cleaning for the missing values of the variables of interest, as well as non-active and dormant firms, we were left with a total of 25,699,392 observations (out of 33,807,849). The period from 2000 to 2003 was used to identify the initial year (2004) of firm acceleration. Annually, the original data ranges from 2.59 million independent active firms in 2011 to 4.21 million independent active firms in 2016.

The sample of 25,699,392 observations was used to address the issue of selection bias described later in our analytical approach. When controlling for regional and industry-specific characteristics, our sample drops to 14,628,741 observations. To be included in the sample, all questions related to the variables of interest needed to be completed with no missing values. Table IV includes a description of the variables and their summary statistics, and Table V contains the correlations between examined study variables.

Table III. A conceptualization of four dimensions of firm growth acceleration

Performance dimensions	*Sales*	*Market share*	*Employment*	*Productivity*
Strategic emphasis	WHAT	WHERE	WHO	HOW
Measurement	Quantity of goods sold; breadth and width of product offering	Occupied market space relative to other market participants	Firm size – number of people employed	Total output divided by total input
Key question(s)	How much **value** (in absolute numbers) does the firm **create**?	How much **market control** does the firm have? What is its comparative position relative to other firms?	**Who** (how many people) **creates value** in the firm?	How much of created **value** does a firm **capture**? How efficiently does a firm create value?
Focal processes	Discover, create, and satisfy customer needs	Positioning; gain power via alliances, mergers, contracts, supply chain	Acquire, train, and retain talent	Innovate and rethink ways of producing and delivering value
Meaning	Scope and success of firm's customer serving	Scope of market control / dominance	Labour intensity of the business (non-automatized processes)	Efficiency of operations
Intra- and inter-org. anchoring	Market dynamics (demand)	Market dynamics (supply)	Organizational structure, business model, and technology	Technology, organizational culture, and structure
Acceleration	In sales	In market share	In employment	In productivity
Interpretation	Comparative desirability of firm's products/services	Comparative market power of a firm	Absolute number but constrained by labour market characteristics	Intrafirm output to input comparison
Definition of acceleration / measurement	An exponential increase in the quantity of goods sold	An exponential increase in the occupied market space relative to other market participants	An exponential increase in the number of people employed	An exponential increase in firm's total output (sales) divided by total input relative to industry participants

(Continues)

Table III. (Continued)

Performance dimensions	*Sales*	*Market share*	*Employment*	*Productivity*
Theoretical lens on growth factors	Intersection between Porter and Penrose	Porter's market forces and industry life cycle	Penrose's people and resource bundles with emphasis on human capital (capabilities)	Post-Penrose's people and resource bundles with emphasis on innovation
Dominant drivers	Market and industry (primary); firm (secondary)	Industry (primary); firm and market (secondary)	Firm (primary); industry and labour market (secondary)	Firm, market, and industry (combined)
Rationale for dominant drivers	Quality and pricing of the available alternatives defines the likelihood of a firm to make a sale inasmuch (if not more than) firm's ability to innovate	Firm's ability to exponentially grow its market share depends on other firms (their shares). Competitor's market power shapes the latitude of firm's action	Firm's human resources and means of value creation is a key value creation input. Includes choices of full-time direct employment vs. contractual work	Firm's ability to be exponentially more productive is anchored in its ability to innovate and absorb best practices, technological, HR, and other
Constraints of firm acceleration	*Internal*: Firm's operational ability to produce and sell *External*: Lack of demand – both objective (in the mass market) and comparative (substitutes); industry decline	*Internal*: strategic ability to find, maintain product-market fit and expand the number of markets served *External*: Competitive prowess of other firms; their ability to capture industry growth faster than the focal firm; policies and regulations (antimonopoly laws)	*Internal*: firm's ability to win competition for talent with other firms; relative human productivity; state of technology *External*: Speed of industry growth, speed of increase in sales and market share of other firms	*Internal*: well-being of employees; state of technology; firm's absorptive capacity; balancing exploitation and exploration *External*: ability of other firms to increase their productivity via innovation and employee motivation
Types of rents	Economic rents	Monopoly rents	Capability rents	Innovation and efficiency rents

Table IV. Variable descriptions and summary statistics

Variable	*Description*	*Mean*	*S.D.*	*Mean*	*S.D.*
		Full sample = 14,628,741 obs.		*Reduced sample = 4,234,603 obs.*	
Acceleration type, age, and size (internal factors)					
Sales accelerator	Binary variable = 1 if firm's sales to average market sales (by three-digit SIC) ratio has grown continuously (annually) in absolute terms over the period of 3 consecutive years, 0 otherwise.	0.014	0.121	0.019	0.139
Sales growth	Binary variable = 1 if firm's sales to average market sales (by three-digit SIC) ratio at time t has grown since the last year (t − 1), 0 otherwise.	0.023	0.152	0.031	0.175
Market share accelerator	Binary variable = 1 if firm's market share to average market share (within three-digit SIC) ratio has grown continuously (annually) over the last year in absolute terms over the period of 3 consecutive years, 0 otherwise.	0.018	0.133	0.054	0.225
Market share growth	Binary variable = 1 if firm's market share to average market share (within three-digit SIC) ratio at time t has grown since the last year (t − 1), 0 otherwise.	0.033	0.181	0.102	0.302
Employment accelerator	Binary variable = 1 if firm's employment to average market employment (by three-digit SIC) ratio has grown continuously (annually) in absolute terms over the period of 3 consecutive years, 0 otherwise.	0.003	0.045	0.008	0.087
Employment growth	Binary variable = 1 if firm's employment to average market employment (by three-digit SIC) ratio at time t has grown since the last year (t − 1), 0 otherwise.	0.006	0.072	0.017	0.127
Productivity accelerator	Binary variable = 1 if firm's sales per employee (productivity) to average market productivity ratio (by three-digit SIC) has grown continuously in absolute terms over the period of 3 consecutive years, 0 otherwise.	0.027	0.161	0.031	0.174
Productivity growth	Binary variable = 1 if firm's sales per employee (productivity) to average market productivity ratio (by three-digit SIC) at time t has grown since the last year (t − 1), 0 otherwise.	0.052	0.220	0.059	0.236

(Continues)

Table IV. (Continued)

Variable	*Description*	*Mean*	*S.D.*	*Mean*	*S.D.*
		Full sample = 14,628,741 obs.		*Reduced sample = 4,234,603 obs.*	
Startup (age 4–7 years)	Binary variable = 1 if firm's age is 4–7 years since establishment, 0 otherwise (t − 1).	0.155	0.362	0.086	0.280
Established venture (age 8–15 years)	Binary variable = 1 if firm's age is 8–15 years since establishment, 0 otherwise (t − 1).	0.391	0.488	0.323	0.467
Transitioning firm (age 16–30 years)	Binary variable = 1 if firm's age is 16–30 years since establishment, 0 otherwise (t − 1).	0.331	0.470	0.385	0.486
Industry and regional dynamics (external factors)					
Employment (firm size)	Number of full-time employees, in logs (t − 1).	1.241	1.201	2.756	1.028
Industry: HHI sales	Herfindahl index based on sum of sales shares in a three-digit SIC 2007 (0 – perfect competition, 1 – monopoly) (t − 1).	0.014	0.026	0.014	0.028
Industry: Switch Industry	Binary variable = 1 if a firm changed its industry (two-digit SIC) in year t compared with year t − 1, 0 otherwise. Industry switch is considered if at least one number in the two-digit SIC industry code has changed (t − 1).	0.115	0.320	0.107	0.310
Industry: High-tech manufacturing	Share of employment in high-tech manufacturing sector (SIC 2007 two-digit = 26–30, 32) in total employment by two-letter postcode (borough) (t − 1).	0.027	0.164	0.029	0.168
Industry: ICT	Binary variable = 1 if firm belongs to ICT sector (SIC 2007 two-digit = 58–63) (t − 1).	0.060	0.238	0.063	0.244
Industry: Professional and scientific	Binary variable = 1 if firm belongs to professional and scientific sector (SIC 2007 two-digit = 69–74) (t − 1).	0.150	0.357	0.159	0.366
Industry: Education	Binary variable = 1 if firm belongs to education sector (SIC 2007 two-digit = 85) (t − 1).	0.019	0.134	0.019	0.137
Industry: Knowledge intense business services	Binary variable = 1 if firm belongs to knowledge-intense business services sector (SIC 2007 two-digit = 41, 64–66, 68, 78) (t − 1). This sector excludes education and scientific services.	0.087	0.282	0.090	0.281

(Continues)

Table IV. (Continued)

Variable	*Description*	*Mean*	*S.D.*	*Mean*	*S.D.*
		Full sample = 14,628,741 obs.		*Reduced sample = 4,234,603 obs.*	
Region: Foreign employee share	Share of employment in foreign-owned firms in total employment by two-letter postcode (borough) (t − 1).	0.272	0.186	0.268	0.186
Region: Number of foreign employees	Total employment (full-time employees) in foreign-owned firms (two-letter postcode (borough) in logarithms (t − 1).	10.861	1.271	10.858	1.288
Other firm, industry, and regional variables					
Foreign	Binary variable = 1 if a firm has headquarters abroad, 0 otherwise (t − 1).	0.073	0.260	0.156	0.363
Employment incumbents	Full-time employment in firms within three-digit SIC (excluding firm's own employment), in logarithms (t − 1).	13.295	0.971	13.367	1.054
Merger	Binary variable = 1 if a firm has merged with another firm in (t − 1) and retained its firm status and registration, 0 otherwise.	0.002	0.411	0.002	0.046
Initial employment	Number of full-time employees in the first year of incorporation, in logs.	1.594	1.005	2.839	0.987
Blitzscalers	Binary variable = 1 if an annual sales growth is equal to or greater than 100%, 0 otherwise.	0.021	0.012	0.022	0.009
Industry-region: Pubs and hospitality	Share of employment in pubs and non-licensed restaurants (SIC 2007 = 56,102, 56,302, 56,210) in total employment by two-letter postcode (borough) (t − 1).	0.041	0.032	0.040	0.031
Industry-region: Transport	Share of employment in transportation sector (SIC 2007 = 48, 49, 50, 51, 52, 522) in total employment by two-letter postcode (borough) (t − 1).	0.032	0.033	0.032	0.031
Industry-region: Arts and creative	Share of employment in arts and creativity sector (SIC 2007 = 90, 91, 92, 93) in total employment by two-letter postcode (borough) (t − 1).	0.024	0.016	0.024	0.015

Source: Department for Business, Innovation and Skills, Office for National Statistics, Northern Ireland. Department of Enterprise, Trade and Investment. (2018). *Business Structure Database, 1997–2017: Secure Access*. [Data Collection]. *9th Edition*. UK Data Service. SN: 6697, http://doi.org/10.5255/UKDA-SN-6697-9.

The majority of businesses (82.64%) are micro-firms (1–9 full-time employees [FTEs]), followed by small firms (10–49 FTEs), which constitute 14.0% of the sample, and medium-small firms (50–99 FTEs) with 1.69% of the sample. Medium-large

Table V. Correlation table

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
1. Sales	1																							
2. Market share	0.09*	1																						
3. Employment	0.05*	0.05*	1																					
4. Productivity	0.08*	0.19*	−0.01*	1																				
5. Age 4–7 years	0.01*	−0.02*	0.01*	−0.01*	1																			
6. Age 8–15 years	0.01*	−0.02*	0.01*	−0.01*	−0.60*	1																		
7. Age 16–30 years	−0.01*	0.02*	−0.01*	0.01*	−0.13*	0.07*	1																	
8. Employment	0.04*	0.29*	0.10*	0.02*	−0.01*	−0.01*	0.02*	1																
9. HHI sales	−0.01*	−0.02*	0.01*	0.01*	0.02*	−0.04*	−0.01*	−0.02*	1															
10. Switch industry	0.04*	−0.01*	0.01*	−0.01*	0.04*	0.02*	0.07*	0.02*	0.02*	1														
11. High-tech manuf.	0.01*	0.01*	0.01*	−0.01*	0.06*	−0.03*	0.08*	0.05*	−0.03*	−0.04*	1													
12. ICT	0.01*	−0.01*	−0.01*	−0.01*	0.04*	−0.03*	−0.11*	−0.07*	0.08*	−0.07*	−0.11*	1												
13. Professional & scientific	−0.01*	−0.01*	−0.01*	−0.01*	0.04*	−0.02*	0.09*	−0.04*	0.04*	−0.02*	−0.03*	−0.06*	1											
14. Education	0.01	−0.01*	0.01*	0.01*	0.03*	−0.01*	−0.04*	−0.01*	−0.06*	−0.05*	−0.08*	−0.13*	−0.04*	1										
15. KIBS	−0.01*	−0.01*	−0.01*	0.01*	0.03*	−0.02*	−0.01*	−0.01*	0.17*	−0.01*	0.02*	0.06*	−0.01*	−0.01*	1									
16. Foreign employees share	−0.01*	0.01*	0.01*	0.01*	0.02*	0.03*	−0.01*	0.04*	0.11*	−0.01*	0.03*	0.07*	−0.01*	0.01*	0.70*	1								
17. Number of foreign employees	−0.01*	0.01*	0.01*	0.02*	0.02*	−0.01*	−0.01*	0.05*	0.02*	0.05*	0.01*	−0.02*	0.01*	0.09*	0.04*	0.06*	1							
18. Foreign	0.01*	0.11*	0.02*	0.05*	−0.05*	0.01*	0.29*	−0.13*	0.10*	−0.17*	−0.13*	−0.08*	0.24*	−0.06*	0.01*	−0.01*	−0.06*	1						
19. Employment incumbents	0.01*	0.01*	0.01*	0.01*	−0.01*	0.07*	0.06*	−0.01*	0.01*	0.01*	−0.01*	−0.01*	−0.01*	−0.01*	−0.01*	−0.01*	−0.01*	0.01*	1					
20. Merger	0.01*	−0.01*	0.01*	0.01*	−0.01*	0.01*	0.01*	0.02*	0.01*	0.07*	−0.07*	−0.10*	−0.09*	−0.03*	−0.01*	0.01*	0.30*	0.02*	0.01*	1				
21. Initial employment	0.04*	0.30*	0.10*	0.02*	−0.13*	0.01*	0.59*	0.01	0.02*	−0.01*	0.02*	0.01*	0.01*	0.03*	0.01*	0.01*	0.03*	−0.01*	0.05*	0.01*	1			
22. Blitzscalers	0.06*	0.01*	0.03*	−0.01*	0.01*	−0.01*	0.03*	0.00	0.01	−0.01*	0.02*	0.01*	−0.01*	0.02*	0.02*	0.01*	0.01*	−0.01*	0.02*	0.01	0.04*	1		
23. Pubs and hospitality	−0.01*	0.01*	0.01*	0.01*	0.01*	−0.01*	−0.01*	−0.01*	0.01*	0.00	0.01*	0.01*	−0.01*	−0.02*	0.02*	0.11*	0.00	0.05*	−0.01*	0.01	−0.01*	0.01*	1	

(Continues)

Table V. (Continued)

Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*	*23*	*24*
24. Transport	−0.01*	−0.01*	−0.01*	−0.01*	0.01*	0.02*	−0.01*	−0.02*	0.29*	−0.01*	−0.01*	0.02*	−0.01*	0.03*	0.16*	0.08*	0.02*	0.05*	0.05*	0.01	0.01*	0.01*	0.05*	1
25. Art and creative	−0.01*	−0.01*	−0.01*	0.01*	0.01*	0.03*	−0.01*	−0.01*	0.34*	−0.02*	0.01*	0.08*	0.02*	0.02*	0.10*	0.05*	0.02*	0.07*	0.07*	0.01*	−0.03*	0.01*	0.20*	0.09*

Note: Number of observations: 14,628,741. Correlation coefficients between industries are suppressed to save space. Further source: Business Structure Database, 1997–2017: Secure Access. UK Data Service.
*Significant at 5% significance level.

(100–249 FTEs) and large (250 FTEs and more) firms constitute less than 2% of the total.

Due to the substantial number of self-employed individuals and micro-firms in the BSD data, we contend that many micro-firms should be excluded from the sample as they may prefer to remain small and not attempt to grow. Firms with fewer than five employees are often headed by lifestyle entrepreneurs, who choose to operate businesses that generate income for themselves and perhaps a few family members (Hurst and Pugsley, 2012). Self-employed people may not be interested in growth (i.e., having low growth aspirations) because they are required to register as employers with His Majesty's Revenue and Customs (HMRC) department in the UK when they start employing staff or using subcontractors for construction work, as well as register for VAT in the UK if, by the end of any month, total VAT taxable turnover for the last 12 months was over £85,000 (Gov.uk, 2021). Third, prior research has demonstrated that for a large share of the population of small business managers (2–20 employees), the 'deterring forces related to growth override the motivating incentives to grow once their firms have reached a size of about 5–9 employees' (Davidsson, 1989, pp. 211–212). Only a minority of firms for whom growth is intrinsically motivating are likely to pursue continuous growth and acceleration.

Additionally, excluding self-employed and micro-firms (<6 employees) allows us to avoid highly skewed distributions in the econometric analysis (Coad and Hoelzl, 2009), which by design focuses on the 'average firm'. We therefore perform a robustness check by excluding micro-firms with fewer than six employees from the sample, which decreases the share of micro-firms from 82.64% to 40.03% and results in a reduced sample of 4,234,603 observations. The distribution of both samples, with 14,628,741 and 4,234,603 observations from 2000 to 2017, is illustrated in Appendix A (Tables AI–AIV).

Measurement

Dependent variables. We build on the growth measures suggested by Shepherd and Wiklund (2009) and focus on firm growth acceleration in sales, market share, employment, and productivity. We apply two conditions when calculating our growth acceleration variables: (i) all indicators of sales, employment, productivity, and market share growth were calculated as ratios to average industry growth rates using a three-digit SIC, thereby demonstrating the relative position of a firm within its industry; and (ii) dynamics and persistence – all indicators were calculated over three consecutive years where ratios could be observed over at least four calendar years. Inclusion of relative acceleration indicators (Coad et al., 2014) was important to capture changes over time and as compared with typical industry dynamics (by three-digit SIC). The correlations between the four dependent variables are low. Each acceleration type requires firms to achieve continuously higher levels of growth over time. Appendix B includes the descriptive statistics for the main variables of interest for firms of different growth acceleration types.

Explanatory and control variables. Prior studies provide strong evidence that firm age and size (Haltiwanger et al., 2013) affect managerial decision-making and the dynamics of

firm growth (Delmar et al., 2003). We use annual BSD data to generate four age-groups: 4–7 years (group one: startups), 8–15 years (group two: established ventures), 16–30 years (group three: transitioning firms), and over 30 years (group four: mature firms). Group four is a reference category in our estimation. We use the number of employees in the logarithm to measure firm size (Coad, 2009; Delmar et al., 2003).

To capture the effects of industry competition on growth acceleration (Coad et al., 2018), we calculated the Herfindahl–Hirschman Index (HHI) by squaring the market share in sales for each firm by three-digit SIC and then summing the squares. The index varies from 0.001 to 0.809, demonstrating the presence of very competitive markets (0.001) and almost monopoly markets (0.89). The use of the HHI is warranted because industry competitors are most likely to face similar conditions and experience common shocks to performance. We measure *switching industry* behaviour using a binary variable that equals one if the firm has changed its industry (three-digit SIC code) in a particular year, and zero otherwise. In order to control for firms' initial conditions, we included the logarithm of employment in the first year of establishment.

Acknowledging that the *rate* of acceleration can vary among firms that accelerate over three years, we additionally control for the effects of blitzscalers – firms that demonstrate three-digit growth (100% and above) (Kuratko et al., 2020).

To measure the effects of industry and region-specific characteristics on firm acceleration (Pereira et al., 2020), we include two groups of variables. First, fixed effect industry controls for firms that belong to a sector with high-level R&D investment, such as high-tech manufacturing, ICT, professional and scientific services, education, and knowledge-intense business services (KIBS) (Boschma, 2005). Second, we use the share of employment in foreign-owned firms in the total employment of a GEO region, as well as the logarithm of the number of people employed by foreign-owned firms in a GEO region. These two measures demonstrate the effects of both knowledge spillover from foreign direct investment and the regional concentration of multinationals.

We also control for the geographical concentration of certain industries (Audretsch et al., 2015; Meyer and Sinani, 2009) by calculating the share of firms in the arts, pubs (restaurants and food industry), and transport sectors, including air, rail, and road transport. The geographical concentrations of industries are limited by the GEO region (e.g., Manchester, Liverpool). Other control variables include 'Foreign', a binary variable equal to one if a firm is foreign-owned or its headquarters are located abroad (Audretsch and Belitski, 2020; Driffield et al., 2014). We also calculated the employment of incumbent firms, taken in logarithm as an additional control for competition and industry size. In addition, we included a set of binary variables to measure firm ownership (legal) status (a company such as an LLC, not-for-profit, sole proprietor, or government, with the listed company as a reference category) (Leiponen and Helfat, 2010; Roper et al., 2008).

Additionally, as firms exit for both good (e.g., mergers and acquisitions) and bad (e.g., bankruptcy) reasons, we included a binary variable 'Merger' which equals one if a firm has merged with another firm in $(t-1)$ and retained its firm status and registration, zero otherwise. It was not possible to include a variable which would tell us whether a firm

survived until the end of the period (2018) due to multicollinearity with another independent variable in the model (1). Finally, we include the rest of 16 aggregated industry sectors following the Office of National Statistics aggregation (Table AII) (mining and quarrying as a reference category), 13-year dummies (2004 as a reference year), and 175 UK GEO-regions (York as a reference category).

We used one-year lagged values of all independent and control variables, which enabled us to differentiate in time the change in the input (t_0) and the likelihood of acceleration in the next period (t_1). We used the first and the second lags of dependent variables (firm acceleration) in each model to capture the persistence (inertia) in firm acceleration.

Analytical Approach

Our firm acceleration function is estimated using a multivariate logit model (Wooldridge, 2009). This model's main covariates are the multi-level factors discussed within our hypothesis development. The model allows us to estimate the probability of firm acceleration for four distinct dependent variables in four separate equations: firm acceleration in sales, in employment, in market share, and in productivity.

The following econometric model is estimated to test our research hypotheses:

$$y_{it} = \beta_0 + \beta_1 y_{it-1} + \beta_2 y_{it-2} + \beta_3 x_{it-1} + \beta_{42} g_{it-1} + \beta_5 m_{rt-1} + \beta_6 z_{jt-2} + a_t + r_s + \psi_j + \lambda_{it} + u_{it} \quad (1)$$

where y_i is a binary variable that equals one if firm i accelerates at time t, and zero otherwise. We are interested in β_i and that the equation to be measured as y_{it-1} and y_{it-2} are the first and second lagged values of firm acceleration and are used to measure the persistence of the acceleration effect and to address the issue of the consequences of acceleration. The term x_{it-1} is a vector of explanatory variables of a firm i in time t, such as firm age and size. All firm-level variables are one year lagged. The term m_{rt-1} is a vector of explanatory variables of industry r where the firm is located, such as binary variable equals 1 if a firm has switched industry (entered a new market), and the Herfindahl index for the level of market competition. All industry variables are lagged one year. The term z_{jt-1} is a vector of industry structure of a region which includes shares of firms across four main industries and employment by foreign firms in 175 geographical regions; λ_{it} is the inverted Mills ratio to correct for the sample selection bias. All regional and industry variables are one-year lagged (Wooldridge, 2009). The terms a_t and r_s are time and industry fixed effects, ψ_j is 175 regions in the UK fixed effects. All coefficients of logit estimations are reported as odds ratios to ease the interpretation of results. Other control variables which represent firm-specific characteristics described in Table I are presented by g_{it-1}; u_{it} is an error term.

Selection Bias

When estimating equation (1), it was necessary to control for a sample selection bias as we moved from a sample of 25,699,392 observations to 14,628,741 observations where some firms that accelerate could have been excluded from the final sample. We relied

on a two-stage Heckman (1979) approach to resolve potential selection bias and endogeneity in a model (see Appendix E). In the first stage of the analysis (selection equation), a probit selection model (equation 2) was estimated for each of the four types of firm acceleration (sales, market share, employment, and productivity).

Selection step:

$$\Pr\left(y = 1 \mid z_{it}\right) = \Phi\left(\alpha' z\right) \tag{2}$$

where $y = 1$ if firm i accelerates at time t, zero otherwise; α is a vector of unknown parameters; and Φ is the cumulative distribution function of the standard normal distribution. Finally, z is a vector containing the explanatory variables that may affect the likelihood of acceleration such as firm age (in logarithms) and the size of the enterprise group, measured by the number of independent firm subsidiaries. We use the continuous variable 'Subsidiaries', which counts the number of units of the alliance, as an additional proxy for a firm's flexibility, size, and technological and organizational diversity (Sampson, 2007) and as an exclusion restriction (Heckman, 1979) to predict the Mills ratio of acceleration. We theorize that firms with a higher number of operating plants within an alliance will take longer to respond to changes in environmental factors and accelerate.

In addition, in model 2 we also control for industry, city-regions, and year fixed effects which may affect the likelihood of firm acceleration. In the second stage (outcome equation), from selection equation (2), we follow the generalized Heckman approach as developed by Green (2002) to compute the inverse Mills ratio (λ_{it}) and to correct the selection bias by including this Mills ratio when equation (2) was estimated for each type of firm acceleration (Appendix E). When calculated, the inverse Mills ratio (λ_{it}) is added in (1) to control for selection bias. The presence and direction of a selection bias can be inferred from the statistical significance and sign of the Mills ratio coefficient in equation (1).

RESULTS

Hypotheses Testing

Firm-level factors. Table VI presents the estimates of the four separate logit models for firm acceleration in sales, market share, employment, and productivity growth.

Our Hypothesis 1 is supported. Startups (up to 7 years) are 7% ($\beta = 1.07$, $p < 0.01$, Table VI) more likely to accelerate in sales than mature firms (30+ years), while established ventures (8–15 years) are 5% ($\beta = 1.05$, $p < 0.01$, Table VI) more likely to accelerate than mature firms (Coad et al., 2016; Wennberg et al., 2016). Large firms are less likely to accelerate in sales than smaller firms, with every percentage point increase in employment decreasing a firm's propensity to accelerate in sales by 41% ($\beta = 0.59$, $p < 0.01$, Table VI). Hypothesis 1 for the reduced sample is also fully supported (see Appendix C). Specifically, we confirm that startups are 47% ($\beta = 1.47$, $p < 0.01$, Appendix C) more likely to accelerate in sales than mature firms, while

Table VI. Logistic panel data estimation across four acceleration types

	DV: Sales		*DV: Market share*		*DV: Employment*		*DV: Productivity*	
Acceleration type	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
DV t − 1	7.28***	0.04	3.15***	0.02	2.63***	0.12	5.50***	0.02
DV t − 2	0.33***	0.01	2.33***	0.01	0.24***	0.03	1.76***	0.01
Age and size (internal factors)								
Age 4–7 years (Hypothesis 1–4)	1.07***	0.02	0.57***	0.01	0.56***	0.02	1.66***	0.02
Employment (Hypothesis 1–4)	0.59***	0.00	1.18***	0.00	0.23***	0.00	2.35***	0.01
Age 4–7 years × Employment	1.01***	0.00	1.53***	0.01	1.56***	0.02	0.82***	0.00
Age 8–15 years (Hypothesis 1–4)	1.05***	0.00	0.67***	0.00	0.68***	0.02	1.53***	0.01
Age 8–15 years × Employment	1.02***	0.00	1.30***	0.00	1.32***	0.01	0.89***	0.00
Age 16–30 years (Hypothesis 1–4)	1.04***	0.01	0.83***	0.01	0.74***	0.02	1.31***	0.01
Age 16–30 years × Employment	0.99	0.01	1.13***	0.00	1.12***	0.00	0.91***	0.00
Industry and regional dynamics (external factors)								
Industry: HHI sales (Hypothesis 5)	0.70***	0.05	0.01***	0.00	0.30***	0.07	0.34***	0.02
Industry: Switch industry (Hypothesis 6)	0.85***	0.00	0.42***	0.00	1.02	0.03	0.54***	0.00
Industry: High-tech manufacturing (Hypothesis 7a)	0.94***	0.01	1.13***	0.01	1.16***	0.04	0.98	0.01
Industry: ICT (Hypothesis 7a)	0.87***	0.01	1.54***	0.02	0.90***	0.03	1.01	0.01
Industry: Professional and scientific (Hypothesis 7a)	0.96***	0.01	1.55***	0.01	0.74***	0.02	0.98*	0.02
Industry: Education (Hypothesis 7a)	0.71***	0.01	0.36***	0.01	1.11***	0.05	1.25***	0.01
Industry: Knowledge-intensive business services (Hypothesis 7a)	0.92***	0.02	1.14***	0.03	1.16**	0.10	1.23***	0.02
Region: Foreign employees share (Hypothesis 7b)	0.79***	0.02	1.02	0.02	1.02***	0.05	1.16***	0.02

(Continues)

Table VI. (Continued)

	DV: Sales		*DV: Market share*		*DV: Employment*		*DV: Productivity*	
Acceleration type	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
Region: Number of foreign employees (Hypothesis 7b)	1.01	0.00	1.04***	0.01	1.03***	0.01	1.03***	0.00
Other firm, industry, and regional controls								
Foreign	0.75***	0.01	1.01	0.02	0.69***	0.01	1.68***	0.00
Employment incumbents	0.96***	0.00	1.01***	0.00	0.90***	0.03	0.94***	0.00
Merger	1.27***	0.04	0.96	0.04	9.04***	0.49	0.43	0.02
Initial employment	2.21***	0.01	1.48***	0.01	8.71***	0.09	0.42***	0.02
Blitzscalers	1.40***	0.00	1.28***	0.00	1.04***	0.00	1.19***	0.00
Industry-region: Pubs and hospitality	0.98	0.06	0.95	0.06	0.78	0.16	1.11**	0.05
Industry-region: Transport	1.12	0.07	0.91	0.06	0.86	0.18	0.91*	0.05
Industry-region: Art and creative	0.64***	0.10	0.61***	0.10	0.85	0.44	0.69**	0.09
Mills ratio	0.47***	0.02	0.56***	0.02	4.91***	0.67	0.25***	0.01
Constant	0.11***	0.01	0.01***	0.00	0.01***	0.00	0.57***	0.06
Other industry, year, and region fixed effects	Yes		Yes		Yes		Yes	
LR(chi^2)	158454.52		464160.72		73528.69		187565.85	
Preudo R^2	0.069		0.180		0.190		0.052	
Log-likelihood	−451582.17		−889761.88		−478895.05		−778511.63	

Note: SE = standard errors robust for heteroskedasticity. Reference groups: mature firms (Age = 30 and more years since establishment); legal ownership (listed company); UK city-region (Newcastle); year (2000); Industry (05–09). Two-digit SIC Industry, year, and city-region fixed effects are suppressed to save space. Significance level: *p < 0.05; **p < 0.01; ***p < 0.001. Number of observations: 14,628,741. Further source: Business Structure Database, 1997–2017: Secure Access. UK Data Service.

established ventures are 53% (β = 1.53, p < 0.01, Appendix C) more likely to accelerate than mature firms.

As Table VI illustrates, our results did not support Hypothesis 2, which states that startups are more likely to accelerate in market share than their more mature counterparts. Startups are 43% (β = 0.57, p < 0.01, Table VI) less likely to accelerate in market share than mature firms. Established (8–15 years) and transitioning firms (16–30 years) are 33% (β = 0.67, p < 0.01) and 17% (β = 0.83, p < 0.01) accordingly less likely to accelerate in market share compared with mature firms (30+ years) (Table VI). Hypothesis 2 is not supported in the reduced sample when we exclude micro-firms (<6 employees), as startups are 5% (β = 1.05, p < 0.01, Appendix C) more likely to accelerate than mature

firms. Established (8–15 years) and transitioning firms (16–30 years) are accordingly 12% ($\beta = 1.12$, $p < 0.01$) and 25% ($\beta = 1.25$, $p < 0.01$) more likely to accelerate in market share compared with mature firms (30+ years) (Appendix C). Our findings point to a non-linear relationship between firm age and market share acceleration, as there exists a point of diminishing returns to firm age.

Our Hypothesis 3, which states that established ventures are more likely to accelerate in employment, is partly supported (Table VI, Appendix C). While there is no difference in employment acceleration between established ventures and startups, we found that established firms (8–15 years) are 32% ($\beta = 0.68$, $p < 0.01$) less likely to accelerate in employment than mature firms. Transitioning firms (16–30 years) are also 26% ($\beta = 0.74$, $p < 0.01$) less likely to accelerate in employment than mature firms (Table VI). We conducted a robustness check with a reduced sample, excluding all firms with fewer than six employees. Appendix C illustrates that established firms are as likely to accelerate in employment as startups compared with mature firms, whereas established firms are 49% ($\beta = 1.49$, $p < 0.01$, Appendix C) more likely to accelerate in employment than mature firms, supporting Hypothesis 3. In this analysis, startups are 57% ($\beta = 1.57$, $p < 0.01$, Appendix C) more likely to accelerate in employment than mature firms. This finding adds to prior research about the effects of small business owners' growth aspirations on firm growth (Autio and Acs, 2010; Delmar and Wiklund, 2008).

Our Hypothesis 4 was not supported, as we found that startups are 66% ($\beta = 1.66$, $p < 0.01$) more likely and established firms are 53% ($\beta = 1.53$, $p < 0.01$) more likely to accelerate in productivity than more mature firms (Table VI). Additionally, we found that larger firms are 2.3 times more likely to accelerate in productivity growth than smaller firms. Our results based on the reduced sample also support these findings (Appendix C).

Interestingly, we found that firms with more employees at incorporation date (initial employment) were less likely to accelerate in productivity, while firm size in the year prior to acceleration is positively associated with productivity. This implies that firms which are larger at incorporation are less likely to accelerate in employment in the future. Given the longitudinal nature of our data, we can confirm that mature firms are less likely to accelerate in productivity than their younger counterparts, with firm size facilitating this relationship. Our findings provide further insight into the 'funnel-shaped' acceleration model, with firm age playing a crucial role in explaining acceleration propensity (see Figures 1 and 2).

Industry Competition Factors. Our Hypothesis 5, which states that market competition increases a firm's propensity to accelerate, is supported for all acceleration types ($\beta = 0.01$–0.70, $p < 0.01$, Table VI). When the self-employed and firms with fewer than six employees are excluded, only the propensity for firm acceleration in sales becomes non-significant with changes in market competition ($\beta = 0.87$, $p > 0.10$, Appendix C), while acceleration propensity in market share, employment, and productivity remains significant. For larger firms, market competition is not associated with sales acceleration; however, smaller firms are more responsive to industry competition, with higher competition increasing

sales acceleration.

Industry switching also changes a firm's propensity to accelerate, yet in comparison with the positive effect of industry competition, switching has a negative effect on acceleration. Our results thus support Hypothesis 6 and demonstrate that switching industry decreases a firm's propensity to accelerate in sales by between 13% ($\beta = 0.87$, $p < 0.01$, Appendix C) and 15% ($\beta = 0.85$, $p < 0.01$, Table VI), and the propensity to accelerate in market share by between 58% ($\beta = 0.42$, $p < 0.01$, Table VI) and 59% ($\beta = 0.41$, $p < 0.01$, Appendix C). Switching industries is unlikely to affect the propensity of acceleration in employment. Switching industry will result in a decrease in a firm's propensity to accelerate in productivity of between 46% ($\beta = 0.54$, $p < 0.01$, Table VI) and 47% ($\beta = 0.53$, $p < 0.01$, Appendix C). Our results are consistent across both samples (Table VI and Appendix C).

Industry and Regional Factors. Our Hypothesis 7a is partly supported. Firms in the high-tech manufacturing sector are 13% more likely to accelerate in market share than firms in mining (reference category) ($\beta = 1.13$, $p < 0.01$) and 16% more likely to accelerate in employment ($\beta = 1.16$, $p < 0.01$) (Table VI). This result is also confirmed in the reduced sample (Appendix C). Acceleration in market share is more likely in ICT ($\beta = 1.54$, $p < 0.01$) and professional services ($\beta = 1.55$, $p < 0.01$) (Table VI), while acceleration in employment ($\beta = 1.11$, $p < 0.01$) as well as acceleration in productivity ($\beta = 1.25$, $p < 0.01$) is more likely in the education sector (Table VI). The professional and scientific sectors are less likely to accelerate in sales ($\beta = 0.96$, $p < 0.01$), employment ($\beta = 0.74$, $p < 0.01$), and productivity ($\beta = 0.98$, $p < 0.10$) (Table VI). These results are confirmed in Appendix C.

Firms located in regions with a higher presence of MNEs and external knowledge are also more likely to accelerate, supporting Hypothesis 7b (Table VI). Regional knowledge stemming from absolute MNE employment increases a firm's acceleration propensity in market share by 4% ($\beta = 1.04$, $p < 0.01$, Table VI) and by at least 5% in the reduced sample ($\beta = 1.05$, $p < 0.01$, Appendix C). It also increases a firm's acceleration propensity in employment and productivity by 3% ($\beta = 1.03$, $p < 0.01$) within both samples (Table VI and Appendix C). Firms that benefit from knowledge spillovers resulting from an increase in share of employees as MNEs are 2% ($\beta = 1.02$, $p < 0.01$) more likely to accelerate in employment and 16% ($\beta = 1.16$, $p < 0.01$) more likely to accelerate in productivity (Table VI). In the reduced sample, the result is 81% for acceleration in employment ($\beta = 1.81$, $p < 0.05$) and 29% for acceleration in productivity ($\beta = 1.29$, $p < 0.01$) (Appendix C). Regional knowledge spillovers from MNEs decrease the likelihood of sales acceleration, with this result consistent between the full ($\beta = 0.79$, $p < 0.01$, Table VI) and reduced ($\beta = 0.81$, $p < 0.05$, Appendix C) samples. The result could be driven by localized competition or co-creation of products together with MNEs.

Other factors. Various firm- and industry-level factors offer further insights into when and how firms accelerate. For instance, we observed that foreign-owned firms are between 52% ($\beta = 0.52$, $p < 0.01$, Appendix C) and 68% ($\beta = 0.68$, $p < 0.01$, Table VI) more likely to accelerate in productivity, while they are less likely to accelerate in employment,

market share, or sales growth. An increase in incumbents' employment reduces firm acceleration in employment by 6% ($\beta = 0.94$, $p < 0.01$, Appendix C) to 10% ($\beta = 0.90$, $p < 0.01$, Table VI), in productivity by 6% ($\beta = 0.94$, $p < 0.01$, Table IV) to 9% ($\beta = 0.91$, $p < 0.01$, Appendix C), and in sales by 2% ($\beta = 0.98$, $p < 0.01$, Appendix C) to 4% ($\beta = 0.96$, $p < 0.01$, Table VI). An increase in employment by incumbents increases a firm's propensity to accelerate in market share by at least 1% ($\beta = 1.01$, $p < 0.01$, Table VI and Appendix C). Additionally, we found that post-merger firms are more likely to accelerate in sales and employment, while there is no effect on productivity or market share growth acceleration. Firms with higher employment in the first year after incorporation are 2.21 times ($\beta = 2.21$, $p < 0.01$) more likely to accelerate in sales, 48% ($\beta = 1.48$, $p < 0.01$) more likely to accelerate in market share, and 8.71 times more likely to accelerate in employment ($\beta = 8.71$, $p < 0.01$, Table VI). Firms with higher initial employment are 58% ($\beta = 0.42$, $p < 0.01$, Table IV) less productive than firms with smaller initial employment. As might be expected, blitzscalers were more likely to accelerate across all four categories of growth, and within sales in particular (by 40%). This means that their acceleration likelihood increases with an increase in firm growth (by 100% and more).

Finally, we included the inverse Mills ratio to correct for the selection bias. All coefficients are statistically significant in both full (Table VI) and reduced samples (Appendix C), with odds ratios less than one. This means that the firms excluded from the sample due to missing data values were less likely to accelerate in sales, market share, and productivity. The odds ratio of employment acceleration is greater than one, signalling that excluded firms were more likely to accelerate in employment.

Post-hoc Analysis

We used the first and the second lags of dependent variables, bearing in mind that firm acceleration is conditional on previous dynamics (Coad et al., 2018; Daunfeldt and Halvarsson, 2015). Given the longitudinal nature of the database, the inclusion of lagged values of firm acceleration enabled us to further analyse the consequences of firm acceleration and to understand whether firm acceleration has short- or long-term implications.

The size of the odds ratio for the first lagged dependent variable is always greater than the one for all types of acceleration, which means that acceleration is a phenomenon that often persists for extended periods of time (Coad et al., 2018; Daunfeldt and Halvarsson, 2015). The size of the odds ratio of the second lag of the dependent variable of market share ($\beta = 2.33$, $p < 0.01$, Table VI) and productivity ($\beta = 1.76$, $p < 0.01$, Table VI) remains greater than one, which means that the effect persists for at least six years. Conversely, for employment and sales, firm acceleration effects fade away after five consecutive years. This finding demonstrates that (a) the consequences of firm acceleration in market share and productivity may last longer than the positive effects of employment and sales acceleration, and that (b) acceleration is a dynamic process with greater persistence than linear growth (Appendix D). Post-hoc estimation of (1) using the

reduced sample confirmed our results for the first and second lagged dependent variables (Appendix C).

As a robustness check, we estimated our equation (1) replacing firm acceleration with relative growth occurrence (binary variable = 1 if a firm demonstrated an increase in sales [employment, market share, productivity] compared with the previous year, 0 otherwise) (Appendix D). Both models demonstrate changes in growth and suggest that firm acceleration patterns are more durable and persistent, particularly when examining market share and productivity growth.

DISCUSSION AND CONCLUSION

Recent studies have suggested that only a small fraction of firms experience remarkable growth (Coad et al., 2016, 2018; Pereira et al., 2020). However, the few firms that manage to achieve remarkable growth have been observed to create most new jobs (Daunfeldt and Halvarsson, 2015), and also diffuse new technological innovations, improve productivity, and generate fruitful knowledge spillovers (Du and Temouri, 2015). As a result, researchers, practitioners, and policymakers have focused on understanding how firms increase their rate of growth (Demir et al., 2017). In this study, we draw attention to the conceptualization and measurement of firm growth *acceleration*, and demonstrate how this phenomenon is related to, yet distinct from, high growth (Demir et al., 2017) and scalability (Piaskowska et al., 2021) (see Table I).

Conceptual Implications and Future Research Directions

Building on the pervasive critique of stable growth rates over time (Baum et al., 2001; Coad et al., 2013; Delmar et al., 2003; Delmar and Wiklund, 2008), our study emphasizes a dynamic perspective on firm growth and specifies that the concept of growth includes both accelerating and non-accelerating growth. In doing so, this study draws attention to growth acceleration as a unique growth phenomenon characteristic of 'flywheel' firms which increase their growth rate over time (Collins, 2001). Unlike prior research focusing on firms that have increased in *total* size or grown larger *compared* with competitors, this study introduces a new dynamic of firm growth which explains how firms grow *faster* each year (e.g., firm acceleration, see Table I). As such, we advance the consideration of firm growth acceleration, a phenomenon emphasized by practitioners (Foley, 2012) and policymakers (Summers, 2013), but which has been all too often absent from the scholarly discourse examining theories of firm growth.

We now outline the conceptual implications of this study related to understanding the phenomenon of firm growth acceleration. First, we demonstrate that absolute and relative firm growth trajectories do not always hold. Expanding on Jansen et al. (2006), Coad et al. (2013, 2016), and others, our study illustrates that firm acceleration occurs at the intersection of firm- and market-level conditions in explaining how firms accelerate. This expands our understanding of why firms grow (Penrose, 1959; Porter, 1980) to when, what, and how firms accelerate their growth. In particular, our research advances the view of Pereira et al. (2020) that no single factor can fully explain growth acceleration by itself, and that compound factors need to be examined.

In this vein, by applying our conceptual lens to growth factors across different performance dimensions (acceleration in sales, market share, employment, and productivity), we discuss theories which facilitate or impede firm acceleration at different stages and combine the views of Penrose (1959) and Porter (1980) on firm growth across the 'inside-out' and 'outside-in' views of growth acceleration (Tables II and III), including the role of managerial capabilities and external endowments. Specifically, to provide a more nuanced conceptualization of accelerated growth in general, we offer a funnel-shaped model of firm growth acceleration (Figures 1 and 2) and offer a conceptual foundation which illustrates how different types of acceleration can be manifested. This boundary-spanning perspective captures both the internal and external architecture of the growth acceleration phenomenon.

Second, in order to better understand the unique nature of firm acceleration and encourage future use of this theoretical lens on the dynamics of high growth in various value-creating outcomes, this study examines potential mechanisms of firm acceleration. We identify specific factors that may facilitate or impede a firm's propensity to accelerate across four types of accelerated growth (in sales, employment, market share growth, and labour productivity) among firms with heterogeneous organizational, industrial, and regional characteristics. Moreover, we investigate the interplay between internal (endogenous) and external (exogenous) factors of firm acceleration across four performance metrics. In doing so, we provide insight into how firm acceleration is manifested as a *multidimensional* phenomenon.

In prior growth literature, these indicators were assumed to be equally valid and, therefore, prone to aggregation or substitution (for an overview, see Baum and Bird, 2010, as well as Wiklund and Shepherd, 2003). Our conceptualization of firm acceleration types and empirical results illustrates the benefits of considering the effects of firm growth drivers on each type of acceleration separately and demonstrates the importance of investigating the relationship between internal and external antecedents and types of acceleration outcomes. Our study clarifies differences in organizational, industry, and regional drivers which shape firm acceleration. In doing so, it enriches our existing knowledge about the heterogeneous nature of factors which drive growth. Moreover, our study helps scholars better understand the processes through which growth occurs (Demir et al., 2017; Pereira et al., 2020; Wiklund et al., 2009) as well as the nuances between different forms of growth (Piaskowska et al., 2021).

Our findings confirm that firm acceleration is often persistent over time, with some types of firm acceleration lasting more than six years. Firm age (and its frequent correlate, firm size) are critical predictors of growth acceleration (Coad et al., 2016; Haltiwanger et al., 2013), along with switching industries and market competition. Given the importance of age and size, we speculate that life cycle effects may be present in which firm acceleration is the result of a firm's transition from market experimentation to exploitation (Lundmark et al., 2020). Moreover, from a periodic perspective, our findings align with and build on Coad et al. (2013, 2018) and Daunfeldt and Halvarsson (2015), as well as earlier studies such as Garnsey et al. (2006) which demonstrate that high growth rates tend to be followed by periods of stagnation which may indicate a potential 'cycling' of acceleration to be considered in future research. Nonetheless, while outsized growth is unstable and often unsustainable (Delmar and

Wiklund, 2008), several conditions were observed that foster growth acceleration. Based on an extended and delineated concept of firm growth, which captures both linear and non-linear growth, past theories of growth may need to be reexamined to understand their implications and predictions for accelerated growth. For instance, along resource-based theory, what valuable, rare, inimitable, and non-substitutable resources, as well as the capacity to exploit these resources, are most predictive of accelerated growth? Moreover, moving beyond singular factors, what specific configurations of industrial dynamics or market competition work together within specific contexts to foster firm growth acceleration?

For a long time, our knowledge about changes in growth patterns has been limited to linear models, with limited consideration of the dynamic nature of this phenomenon. Moreover, the common practice of studying 'already-successful' firms has resulted in the under-representation of young, small firms in many longitudinal data sets (Wiklund et al., 2009). We aimed to overcome these shortcomings by using a robust sample of firms registered and active in the UK to understand whether, when, which, and how firms accelerate their growth.

Policy Implications and Future Research

Our findings offer insights into policy implications that would be difficult to establish without considering the dynamics of acceleration. Scholarly ability to explain firm growth has been limited given that periods of growth acceleration appear difficult to predict, meaning that firms which accelerate in one period generally do not show signs of acceleration in previous or subsequent periods. It is therefore necessary to study firm acceleration using robust longitudinal data, i.e., over 15 years, which can be difficult to locate. However, with such data, relevant organizational, industrial, and regional factors can be readily detected. We can then identify when firms accelerate their growth along relevant avenues, such as in employment (job creation from a policy perspective) or sales (economic growth from a policy perspective).

Our results show that while two of the acceleration types – sales and market share acceleration – are directly and positively intertwined, two other types – productivity and employment acceleration – are negatively interrelated (e.g., increasing productivity in labour and assets often entails generating more value from fewer employees). As such, policies which encourage increased productivity are unlikely to foster a meaningful surge in job creation. While striving to understand the phenomenon, we intentionally abstain from making normative claims indicating what firms should do. Ideally, these choices should be guided with aspects beyond the desire to be *large*, and instead be directed at fulfilling a desire to *create sustainable value* for stakeholders beyond shareholders (Hart and Milstein, 2003). With environmental and social concerns in mind, policymakers may wish to avoid 'blindly' fostering growth acceleration. They may also wish to consider how firms may accelerate along specific avenues as dictated by the needs of society at a given point in time, and in ways which are both sustainable (by producing less waste and causing less damage) and socially responsible (with fair wages and meaningful jobs).

Foremost, policies targeted at young firms are likely to be especially fruitful if they are directed at fostering an acceleration in sales growth. Policies targeted at more mature firms appear better aimed at employment and market share growth acceleration. Policies targeted at productivity acceleration appear to be best suited for firms aged 8 to 15 years old which have survived their early youth. Policymakers may therefore rely on firm age to understand which forms of growth acceleration are most probable, thereby enabling more fruitful programs.

Practical Implications and Future Research

Our findings also have practical implications for top managers and entrepreneurs who manage existing or young ventures and thus need to understand the conditions and consequences of each acceleration type. First, decision makers may benefit from paying attention to the tensions between acceleration types as well as carefully considering (and even strategically choosing) an acceleration sequence. Another implication for managers pertains to encouraging organizations to experiment with new competitive areas or 'blue oceans', as we observe that market concentration is a significant hindrance to firms' growth acceleration.

Additionally, co-location with foreign firms and access to knowledge spillovers within an industry or region appear to generally foster firm growth acceleration and should therefore be taken into consideration. While this study's focus extends beyond firm characteristics to examine organizational, industry, and regional factors as well, there is still the need for additional work exploring how these internal and external forces work in tandem to enable acceleration. In this vein, our study explores multi-level factors which have the potential to jointly enable transitions from startup to scaleup, or to support mature firms in their scaling efforts (Demir et al., 2017). Nonetheless, future research may address this interplay in further detail by predicting how various organizational meso and macro factors combine to affect firm growth acceleration across various market conditions. For example, digitalization and platform creation may be enabling an acceleration in sales and deacceleration in employment for firms in non-tech industries as well, and future studies may wish to explore these effects.

A limitation of our current investigation based on year-over-year data is that the identification of firm acceleration as a phenomenon requires three time periods of continuous growth (e.g., three years of growth). However, some firms may experience exponential growth more rapidly than others. While any firm experiencing a continual increase in growth would fit our definition of growth acceleration, firms that accelerate faster will experience greater forces. We attempted to parse out such substantive differences by including controls for 'blitzscalers', and future studies could further delineate changes in acceleration rates. Change in managerial attention (Joseph and Wilson, 2018) or the growth aspirations of firm founders (Autio and Acs, 2010) at different stages of acceleration also represent prospective research directions.

We conclude our study by calling for further future research into additional drivers of firm acceleration. For example, insights into perceptions of extreme contexts and disruptions by decision makers (e.g., managers, entrepreneurs, business owners) and their normalization of risk (Hällgren et al., 2018) could further inform us about the multi-level nature of this phenomenon and the interdependencies between various drivers of acceleration. Additionally, we encourage studies which examine the stability of our findings

across different countries and socioeconomic contexts. It is our hope that this research will serve as a helpful catalyst for the continued investigation of firm growth acceleration.

NOTES

[1] For convenience we adopted the terminology of a firm, which refers to a for-profit business organization – such as a corporation, a limited liability company (LLC), or a partnership. Most firms have just one location. In this study we use the same employer identification number even if a firm has subsidiaries or multiple locations.

[2] The labels 'inside-out' and 'outside-in' were previously used in studies of corporate entrepreneurship and innovation (Stopford and Baden-Fuller, 1994), strategies in high-velocity environments (Wirtz et al., 2007), and strategic orientations (Saeed et al., 2015), to name a few.

[3] In macroeconomics, these perspectives are aligned with the endogenous and exogenous theories of growth. Exogenous growth theory (Solow, 1956) relies on the premises of the neoclassical growth models rooted in exogenous population expansion and exogenous technological change. Endogenous growth theory (Romer, 1990), on the contrary, draws attention to human capital (including its level – i.e., skilled vs. unskilled labour) and R&D for new goods and products.

REFERENCES

Achtenhagen, L., Brunninge, O. and Melin, L. (2017). 'Patterns of dynamic growth in medium-sized companies: beyond the dichotomy of organic versus acquired growth'. *Long Range Planning*, **50**, 457–71.

Acs, Z., Parsons, W. and Tracy, S. (2008). *High-Impact Firms: Gazelles Revisited*. Washington, DC: U.S. SmallBusiness Administration Office of Advocacy Contract SBAHQ-06-Q-0014.

Acs, Z., Morck, R. and Yeung, B. (1999). 'Productivity growth and firm size distribution'. In Acs Z. J., Carlsson B. and Karlsson C. (Eds), *Entrepreneurship, Small and Medium Enterprises and the Macroeconomy*. Cambridge, United Kingdom: Cambridge University Press, 367–395.

Acs, Z. J., Parsons, W. and Tracy, S. (2008). *High-Impact Firms: Gazelles Revisited*. Washington, DC.

Alchian, A. A. (1950). 'Uncertainty, evolution, and economic theory'. *Journal of Political Economy*, **58**, 211–21.

Aldrich, H. E. and Mindlin, S. (1978). 'Uncertainty and dependence: two perspectives on environment'. In Karpit L. (Ed), *Organization and Environment*. Beverly Hills, CA: Sage, 149–70.

Aldrich, H. E. and Pfeffer, J. (1976). 'Environments of organizations'. *Annual Review of Sociology*, **2**, 79–105.

Almus, M. and Nerlinger, E. A. (1999). 'Growth of new technology-based firms: which factors matter?'. *Small Business Economics*, **13**, 141–54.

Audretsch, D. B. and Belitski, M. (2020). 'The limits to collaboration across four of the most innovative UK industries'. *British Journal of Management*, **31**, 830–55.

Audretsch, D. B., Belitski, M. and Caiazza, R. (2021). 'Start-ups, innovation and knowledge spillovers'. *Journal of Technology Transfer*, **46**, 1–22.

Audretsch, D. B., Belitski, M. and Desai, S. (2015). 'Entrepreneurship and economic development in cities'. *The Annals of Regional Science*, **55**, 33–60.

Audretsch, D. B., Belitski, M. and Desai, S. (2019). 'National business regulations and city entrepreneurship in Europe: a multilevel nested analysis'. *Entrepreneurship Theory and Practice*, **43**, 1148–65.

Audretsch, D. B. and Feldman, M. P. (2004). 'Knowledge and the geography of innovation'. In *Handbook of Regional and Urban Economics*. Amsterdam, North-Holland: Elsevier, **4**, 2713–39.

Audretsch, D. B. and Keilbach, M. (2007). 'The theory of knowledge spillover entrepreneurship'. *Journal of Management Studies*, **44**, 1242–54.

Autio, E. and Acs, Z. (2010). 'Intellectual property protection and the formation of entrepreneurial growth aspirations'. *Strategic Entrepreneurship Journal*, **4**, 234–51.

Balland, P. A., Boschma, R. and Frenken, K. (2015). 'Proximity and innovation: from statics to dynamics'. *Regional Studies*, **49**, 907–20.

Baum, J. R. and Bird, B. J. (2010). 'The successful intelligence of high-growth entrepreneurs: links to new venture growth'. *Organization Science*, **21**, 397–412.

Baum, J. R., Locke, E. A. and Smith, K. G. (2001). 'A multidimensional model of venture growth'. *Academy of Management Journal*, **44**, 292–303.

Baysinger, B. D., Meiners, R. E. and Zeithaml, C. P. (1982). *Barriers to Corporate Growth*. Lexington, MA: Lexington Books.
Bennett, V. M. and Levinthal, D. A. (2017). 'Firm lifecycles: linking employee incentives and firm growth dynamics'. *Strategic Management Journal*, **38**, 2005–18.
Blank, S. (2013). 'Why the lean start-up changes everything'. *Harvard Business Review*, **91**, 63–72.
Boschma, R. (2005). 'Proximity and innovation: a critical assessment'. *Regional Studies*, **39**, 61–74.
Bradley, S. W., Wiklund, J. and Shepherd, D. A. (2011). 'Swinging a double-edged sword: the effect of slack on entrepreneurial management and growth'. *Journal of Business Venturing*, **26**, 537–54.
Bruch, H. and Menges, J. I. (2010). 'The acceleration trap'. *Harvard Business Review*, **88**(4), 80–86.
Brush, C. G., Ceru, D. J. and Blackburn, R. (2009). 'Pathways to entrepreneurial growth: the influence of management, marketing, and money'. *Business Horizons*, **52**, 481–91.
Brynjolfsson, E. and McAfee, A. (2013). 'The great decoupling'. *New Perspectives Quarterly*, **30**, 61–63.
Calvo, J. L. (2006). 'Testing Gibrat's law for small, young and innovating firms'. *Small Business Economics*, **26**, 117–23.
Castrogiovanni, G. J. (1991). 'Environmental munihcence; a theoretical assessment'. *Academy of Management Review*, **16**, 542–65.
Chan, L. K., Karceski, J. and Lakonishok, J. (2003). 'The level and persistence of growth rates'. *The Journal of Finance*, **58**, 643–84.
Chen, M. J. (2008). 'Reconceptualizing the competition – cooperation relationship: a transparadox perspective'. *Journal of Management Inquiry*, **17**, 288–304.
Chen, M. J. and Hambrick, D. C. (1995). 'Speed, stealth, and selective attack: how small firms differ from large firms in competitive behavior'. *Academy of Management Journal*, **38**, 453–82.
Chen, M. J. and Miller, D. (2015). 'Reconceptualizing competitive dynamics: a multidimensional framework'. *Strategic Management Journal*, **36**, 758–75.
Chrisman, J. J., Bauerschmidt, A. and Hofer, C. W. (1998). 'The determinants of new venture performance: an extended model'. *Entrepreneurship theory and practice*, **23**, 5–29.
Coad, A. (2007). 'Testing the principle of "growth of the fitter": the relationship between profits and firm growth'. *Structural Change and Economic Dynamics*, **18**, 370–86.
Coad, A. (2009). *The Growth of Firms: A Survey of Theories and Empirical Evidence*. Cheltenham: Edward Elgar Publishing.
Coad, A. (2018). 'Firm age: a survey'. *Journal of Evolutionary Economics*, **28**, 13–43.
Coad, A., Daunfeldt, S. O. and Halvarsson, D. (2018). 'Bursting into life: firm growth and growth persistence by age'. *Small Business Economics*, **50**, 55–75.
Coad, A., Daunfeldt, S. O., Hölzl, W., Johansson, D. and Nightingale, P. (2014). 'High-growth firms: introduction to the special section'. *Industrial and Corporate Change*, **23**, 91–112.
Coad, A., Frankish, J., Roberts, R. G. and Storey, D. J. (2013). 'Growth paths and survival chances: an application of Gambler's Ruin theory'. *Journal of Business Venturing*, **28**, 615–32.
Coad, A. and Hoelzl, W. (2009). 'On the autocorrelation of growth rates: evidence for micro, small and large firms from the Austrian service industries, 1975–2004'. *Journal of Industry Competition and Trade*, **9**, 139–66.
Coad, A., Segarra, A. and Teruel, M. (2016). 'Innovation and firm growth: does firm age play a role?'. *Research Policy*, **45**, 387–400.
Coad, A. and Teruel, M. (2013). 'Inter-firm rivalry and firm growth: is there any evidence of direct competition between firms?' *Industrial and Corporate Change*, **22**, 397–425.
Cohen, W. M. and Levinthal, D. A. (1990). 'Absorptive capacity: a new perspective on learning and innovation'. *Administrative Science Quarterly*, **35**, 128–52.
Collins, J. (2001). *Good to Great*. London: Random House Business Books.
Cooper, A. C., Woo, C. Y. and Dunkelberg, W. C. (1989). 'Entrepreneurship and the initial size of firms'. *Journal of Business Venturing*, **4**, 317–32.
Covin, J. G., Slevin, D. P. and Schultz, R. L. (1994). 'Implementing strategic missions: effective strategic, structural and tactical choices'. *Journal of Management Studies*, **31**, 481–506.
Daunfeldt, S. O., Elert, N. and Johansson, D. (2014). 'The economic contribution of high-growth firms: do policy implications depend on the choice of growth indicator?' *Journal of Industry, Competition and Trade*, **14**, 337–65.
Daunfeldt, S. O. and Halvarsson, D. (2015). 'Are high-growth firms one-hit wonders? Evidence from Sweden'. *Small Business Economics*, **44**, 361–83.
Davidsson, P. (1989). 'Entrepreneurship – and after? A study of growth willingness in small firms'. *Journal of business venturing*, **4**, 211–26.
Delmar, F., Davidsson, P. and Gartner, W. B. (2003). 'Arriving at the high-growth firm'. *Journal of Business Venturing*, **18**, 189–216.

Delmar, F., McKelvie, A. and Wennberg, K. (2013). 'Untangling the relationships among growth, profitability and survival in new firms'. *Technovation*, **33**, 276–91.
Delmar, F. and Wiklund, J. (2008). 'The effect of small business managers' growth motivation on firm growth: a longitudinal study'. *Entrepreneurship Theory and Practice*, **32**, 437–57.
Demir, R., Wennberg, K. and McKelvie, A. (2017). 'The strategic management of high-growth firms: a review and theoretical conceptualization'. *Long Range Planning*, **50**, 431–56.
Deng, Z. and Wang, Z. (2016). 'Early-mover advantages at cross-border business-to-business e-commerce portals'. *Journal of Business Research*, **69**, 6002–11.
Driffield, N., Love, J. H. and Yang, Y. (2014). 'Technology sourcing and reverse productivity spillovers in the multinational enterprise: global or regional phenomenon?' *British Journal of Management*, **25**, S24–41.
Du, J. and Temouri, Y. (2015). 'High-growth firms and productivity: evidence from the United Kingdom'. *Small Business Economics*, **44**, 123–43.
Dunne, P. and Hughes, A. (1994). 'Age, size, growth and survival: UK companies in the 1980s'. *The Journal of Industrial Economics*, **42**, 115–40.
Eisenhardt, K. M. (1989). 'Making fast strategic decisions in high-velocity environments'. *Academy of Management Journal*, **32**, 543–76.
Eisenhardt, K. M. and Martin, J. A. (2000). 'Dynamic capabilities: what are they?' *Strategic Management Journal*, **21**, 1105–21.
Estrin, S., Korosteleva, J. and Mickiewicz, T. (2013). 'Which institutions encourage entrepreneurial growth aspirations?' *Journal of Business Venturing*, **28**, 564–80.
Eurostat-OECD (2007). *Eurostat-OECD Manual on Business Demography Statistics*. Luxembourg: Office for Official Publications of the European Communities.
Evans, D. S. (1987). 'The relationship between firm growth, size, and age: estimates for 100 manufacturing industries'. *The Journal of Industrial Economics*, **35**, 567–81.
Foley, S. (2012). *Acceleration: Changing the Speed of Growth*. US: CreateSpace.
Freeman, J., Carroll, G. R. and Hannan, M. T. (1983). 'The liability of newness: age dependence in organizational death rates'. *American Sociological Review*, **48**, 692–710.
Garnsey, E., Stam, E. and Heffernan, P. (2006). 'New firm growth: exploring processes and paths'. *Industry and Innovation*, **13**, 1–20.
Gilbert, B. A., McDougall, P. P. and Audretsch, D. B. (2006). 'New venture growth: a review and extension'. *Journal of Management*, **32**, 926–50.
Gov.uk (2021). *Business Tax*. London: His Majesty Revenue & Customs. Available at https://www.gov.uk/topic/business-tax/vat (Accessed 20 December 2021).
Greve, H. R. (2008). 'A behavioral theory of firm growth: sequential attention to size and performance goals'. *Academy of Management Journal*, **51**, 476–94.
Hällgren, M., Rouleau, L. and De Rond, M. (2018). 'A matter of life or death: how extreme context research matters for management and organization studies'. *Academy of Management Annals*, **12**, 111–53.
Haltiwanger, J., Jarmin, R. S. and Miranda, J. (2013). 'Who creates jobs? Small versus large versus young'. *Review of Economics and Statistics*, **95**, 347–61.
Hambrick, D. C. and Finkelstein, S. (1987). 'Managerial discretion: a bridge between polar views of organizational outcomes'. *Research in Organizational Behavior*, **9**, 369–406.
Hamilton, R. T. and Satterthwaite, S. (2019). 'Regional spread of high-growth enterprises in New Zealand'. *Australasian Journal of Regional Studies*, **25**, 26–53.
Hart, S. L. and Milstein, M. B. (2003). 'Creating sustainable value'. *Academy of Management Perspectives*, **17**(2), 56–67.
He, Z. L. and Wong, P. K. (2004). 'Exploration vs. exploitation: an empirical test of the ambidexterity hypothesis'. *Organization Science*, **15**, 481–94.
Heckman, J. J. (1979). 'Sample selection bias as a specification error'. *Econometrica: Journal of the Econometric Society*, **47**, 153–61.
Helfat, C. E. and Martin, J. A. (2015). 'Dynamic managerial capabilities: review and assessment of managerial impact on strategic change'. *Journal of Management*, **41**, 1281–312.
Hoffman, R. and Yeh, C. (2018). *Blitzscaling: The Lightning Fast Path to Building Massively Valuable Companies*. New York: Currency Books.
Hurst, E. and Pugsley, B. (2012). 'What do small businesses do?' *Brookings Papers on Economic Activity*, **43**, 73–142.
Jansen, K. J. (2004). 'From persistence to pursuit: a longitudinal examination of momentum during the early stages of strategic change'. *Organization Science*, **15**, 276–94.

Jansen, J. J., Van Den Bosch, F. A. and Volberda, H. W. (2006). 'Exploratory innovation, exploitative innovation, and performance: effects of organizational antecedents and environmental moderators'. *Management Science*, **52**, 1661–74.
Jansen, J. J. P., Vera, D. and Crossan, M. (2009). 'Strategic leadership for exploration and exploitation: the moderating role of environmental dynamism'. *Leadership Quarterly*, **20**, 5–18.
Joseph, J. and Wilson, A. J. (2018). 'The growth of the firm: an attention-based view'. *Strategic Management Journal*, **39**, 1779–800.
Kancs, A. and Siliverstovs, B. (2016). 'R&D and non-linear productivity growth'. *Research Policy*, **45**, 634–46.
Kuratko, D. F., Holt, H. L. and Neubert, E. (2020). 'Blitzscaling: the good, the bad, and the ugly'. *Business Horizons*, **63**(11), 109–19.
Leiponen, A. and Helfat, C. E. (2010). 'Innovation objectives, knowledge sources, and the benefits of breadth'. *Strategic Management Journal*, **31**, 224–36.
Lepak, D. P. and Snell, S. A. (2002). 'Examining the human resource architecture: the relationships among human capital, employment, and human resource configurations'. *Journal of Management*, **28**, 517–43.
Levinthal, D. A. and March, J. G. (1993). 'The myopia of learning'. *Strategic Management Journal*, **14**, 95–112.
Levitt, B. and March, J. G. (1988). 'Organizational learning'. *Annual Review of Sociology*, **14**, 319–38.
Lieberman, M. B. and Montgomery, D. B. (1998). 'First-mover (dis) advantages: retrospective and link with the resource-based view'. *Strategic Management Journal*, **19**, 1111–25.
Litan, R. E. (2016). 'Entrepreneurship, innovation, and antitrust'. *The Antitrust Bulletin*, **61**, 580–94.
Lockett, A., Wiklund, J., Davidsson, P. and Girma, S. (2011). 'Organic and acquisitive growth: re-examining, testing and extending Penrose's growth theory'. *Journal of Management Studies*, **48**, 48–74.
Lundmark, E., Coad, A., Frankish, J. S. and Storey, D. J. (2020). 'The liability of volatility and how it changes over time among new ventures'. *Entrepreneurship Theory and Practice*, **44**, 933–63.
Makino, S. and Delios, A. (1996). 'Local knowledge transfer and performance: implications for alliance formation in Asia'. *Journal of International Business Studies*, **27**, 905–27.
March, J. G. (1991). 'Exploration and exploitation in organizational learning'. *Organization Science*, **2**, 71–87.
McGahan, A. M. and Porter, M. E. (1997). 'How much does industry matter, really?' *Strategic Management Journal*, **18**, 15–30.
Meyer, K. E. and Sinani, E. (2009). 'When and where does foreign direct investment generate positive spillovers? A meta-analysis'. *Journal of International Business Studies*, **40**, 1075–94.
Mindlin, S. E. and Aldrich, H. (1975). 'Interorganizational dependence: a review of the concept and a reexamination of the findings of the aston group'. *Administrative Science Quarterly*, **20**, 382–92.
Nason, R. S., McKelvie, A. and Lumpkin, G. T. (2015). 'The role of organizational size in the heterogeneous nature of corporate entrepreneurship'. *Small Business Economics*, **45**, 279–304.
Nason, R. S. and Wiklund, J. (2018). 'An assessment of resource-based theorizing on firm growth and suggestions for the future'. *Journal of Management*, **44**, 32–60.
Nonaka, I. (1994). 'A dynamic theory of organizational knowledge creation'. *Organization Science*, **5**, 14–37.
Penrose, E. T. (1959). *The Theory of the Growth of the Firm*. Oxford: Basil Blackford.
Pereira, V., Corradini, C., Temouri, Y. and Mellahi, K. (2020). 'Investigating institutional, economic and social determinants of European regions for firm growth through employment generation'. *British Journal of Management*, **31**, 162–83.
Piaskowska, D., Tippmann, E. and Monaghan, S. (2021). 'Scale-up modes: profiling activity configurations in scaling strategies'. *Long Range Planning*, **54**, 102101.
Plummer, L. A., Parker, S. C. and Reyes, S. C. (2022). 'Regional path breaking: the role of industry switching, industry diversity, and new knowledge in new venture exit'. *Entrepreneurship Theory and Practice*, **46**, 1231–55.
Porter, M. E. (1980). 'Industry structure and competitive strategy: keys to profitability'. *Financial Analysts Journal*, **36**(4), 30–41.
Romer, P. M. (1990). 'Endogenous technological change'. *Journal of Political Economy*, **98**, S71–S102.
Roper, S., Du, J. and Love, J. H. (2008). 'Modelling the innovation value chain'. *Research Policy*, **37**, 961–77.
Saeed, S., Yousafzai, S., Paladino, A. and De Luca, L. M. (2015). 'Inside-out and outside-in orientations: a meta-analysis of orientation's effects on innovation and firm performance'. *Industrial Marketing Management*, **47**, 121–33.

Sampson, R. C. (2007). 'R&D alliances and firm performance: the impact of technological diversity and alliance organization on innovation'. *Academy of Management Journal*, **50**, 364–86.
Sandberg, W. R. and Hofer, C. W. (1987). 'Improving new venture performance: the role of strategy, industry structure, and the entrepreneur'. *Journal of Business Venturing*, **2**, 5–28.
Shepherd, D. and Wiklund, J. (2009). 'Are we comparing apples with apples or apples with oranges? Appropriateness of knowledge accumulation across growth studies'. *Entrepreneurship Theory and Practice*, **33**, 105–23.
Singh, K. and Mitchell, W. (2005). 'Growth dynamics: the bidirectional relationship between interfirm collaboration and business sales in entrant and incumbent alliances'. *Strategic Management Journal*, **26**, 497–521.
Siren, C. A., Kohtamäki, M. and Kuckertz, A. (2012). 'Exploration and exploitation strategies, profit performance, and the mediating role of strategic learning: escaping the exploitation trap'. *Strategic Entrepreneurship Journal*, **6**, 18–41.
Solow, R. M. (1956). 'A contribution to the theory of economic growth'. *Quarterly Journal of Economics*, **70**, 65–94.
Spanos, Y. E. and Lioukas, S. (2001). 'An examination into the causal logic of rent generation: contrasting Porter's competitive strategy framework and the resource-based perspective'. *Strategic Management Journal*, **22**, 907–34.
Stigler, G. J. (1958). 'The economies of scale'. *The Journal of Law and Economics*, **1**, 54–71.
Stopford, J. M. and Baden-Fuller, C. W. (1994). 'Creating corporate entrepreneurship'. *Strategic Management Journal*, **15**, 521–36.
Suarez, F. F., Grodal, S. and Gotsopoulos, A. (2015). 'Perfect timing? Dominant category, dominant design, and the window of opportunity for firm entry'. *Strategic Management Journal*, **36**, 437–48.
Summers, L. (2013). 'Why stagnation might prove to be the new normal'. *Financial Times*, **15**, 12.
Tanriverdi, H. and Lee, C. H. (2008). 'Within-industry diversification and firm performance in the presence of network externalities: evidence from the software industry'. *Academy of Management journal*, **51**, 381–97.
Tushman, M. L. and Rosenkopf, L. (1996). 'Executive succession, strategic reorientation and performance growth: a longitudinal study in the US cement industry'. *Management Science*, **42**, 939–53.
Vining, D. R., Jr. (1976). 'Autocorrelated growth rates and the Pareto law: a further analysis'. *Journal of Political Economy*, **84**, 369–80.
Walsh, J. P. (1995). 'Managerial and organizational cognition: notes from a trip down memory lane'. *Organization Science*, **6**, 280–321.
Wennberg, K., Delmar, F. and McKelvie, A. (2016). 'Variable risk preferences in new firm growth and survival'. *Journal of Business Venturing*, **31**, 408–27.
Wiklund, J., Patzelt, H. and Shepherd, D. A. (2009). 'Building an integrative model of small business growth'. *Small Business Economics*, **32**, 351–74.
Wiklund, J. and Shepherd, D. (2003). 'Aspiring for, and achieving growth: the moderating role of resources and opportunities'. *Journal of Management Studies*, **40**, 1919–41.
Wirtz, B. W., Mathieu, A. and Schilke, O. (2007). 'Strategy in high-velocity environments'. *Long Range Planning*, **40**, 295–313.
Wooldridge, J. M. (2009). *Introductory Econometrics: A Modern Approach*, 4th edition Mason, OH: South-Western.
Yasuda, T. (2005). 'Firm growth, size, age and behavior in Japanese manufacturing'. *Small Business Economics*, **24**, 1–15.
Zahra, S. A., Sapienza, H. J. and Davidsson, P. (2006). 'Entrepreneurship and dynamic capabilities: a review, model and research agenda'. *Journal of Management Studies*, **43**, 917–55.

APPENDIX A
Data description

Table AI. Sample distribution by survey year

Sample	*Full sample*		*Reduced sample (6+ employees)*	
Sector	*# obs.*	*Share*	*# obs.*	*Share*
2004	1,145,912	7.83	323,512	7.64
2005	1,153,162	7.88	324,722	7.67
2007	1,156,100	7.90	326,350	7.71
2008	1,238,762	8.47	338,483	7.99
2009	1,265,652	8.65	347,350	8.20
2010	1,275,799	8.72	348,246	8.22
2011	1,295,810	8.86	344,268	8.13
2012	1,198,091	8.19	339,175	8.01
2013	1,103,880	7.55	329,009	7.77
2014	1,033,380	7.06	318,728	7.53
2015	972,952	6.65	310,633	7.34
2016	919,975	6.29	296,803	7.01
2017	869,266	5.94	287,327	6.79
Total	14,628,741	100	4,234,603	100

Table AII. Sample distribution by industry (SIC 2007)

Sample	*Full sample*		*Reduced sample (6+ employees)*	
Sector	*# obs.*	*Share*	*# obs.*	*Share*
Manufacturing	1,056,196	7.22	329,463	7.78
Utilities	54,126	0.37	185,929	4.39
Construction	1,851,999	12.66	345,338	8.16
Wholesale and retail	2,662,431	18.20	837,961	19.79
Transportation and storage	743,140	5.08	222,118	5.25
Accommodation	890,890	6.09	380,795	8.99
Information and communication	993,292	6.79	183,646	4.34
Financial and real estate	754,843	5.16	185,928	4.39
Professional and scientific services	2,419,594	16.54	429,585	10.14
Public administration and education	1,338,529	9.15	295,392	6.98
Health and social activities	629,036	4.30	436,659	10.31
Arts and entertainment	520,783	3.56	219,530	5.18
Other consumer services	713,882	4.88	219,861	5.19
Total	14,628,741	100	4,234,603	100.00

Table AIII. Sample distribution by UK region (states)

Sample	*Full sample*		*Reduced sample (6+ employees)*	
Region	*# obs.*	*Share*	*# obs.*	*Share*
North East	382,069	2.61	132,912	3.14
North West	1,418,846	9.70	437,537	10.33
Yorkshire and the Humber	1,051,317	7.19	333,011	7.86
East Midlands	1,011,934	6.92	300,467	7.10
West Midlands	1,211,713	8.28	359,116	8.48
East England	1,518,335	10.38	409,759	9.68
London	2,231,230	15.25	594,926	14.05
South East	2,405,144	16.44	628,307	14.84
South West	1,377,359	9.42	392,826	9.28
Wales	605,231	4.14	179,537	4.24
Scotland	983,026	6.72	322,257	7.61
Northern Ireland	432,537	2.96	143,948	3.40
Total	**14,628,741**	**100**	**4,234,603**	**100**

Table AIV. Sample distribution by firm size

Sample	*Full sample*		*Reduced sample (6+ employees)*	
Firm size in FTEs	*# obs.*	*Share*	*# obs.*	*Share*
Micro 1–9	12,089,416	82.64	1,695,278	40.03
Small 10–49	2,048,034	14.00	2,048,034	48.36
Medium small 50–99	247,054	1.69	247,054	5.83
Medium large 100–249	139,908	0.96	139,908	3.30
Large >249	104,329	0.71	104,329	2.46
Total	**14,628,741**	**100**	**4,234,603**	100.00

Source: Business Structure Database, 1997–2017: Secure Access. UK Data Service.

APPENDIX B
Descriptive statistics for firms that experienced different types of acceleration

Accelerator type	*Sales*		*Market share*		*Employment*		*Productivity*		*Acceleration all four criteria*	
Variables	*Mean*	*SE*	*Mean*	*SE*	*Mean*	*SE*	*Mean*	*SE*	*Mean*	*SE*
Age and size (internal factors)										
Age 4–7 years	0.375	0.484	0.155	0.361	0.283	0.450	0.256	0.436	0.256	0.439
Age 8–15 years	0.298	0.457	0.297	0.457	0.339	0.473	0.320	0.466	0.333	0.474
Age 16–30 years	0.213	0.410	0.344	0.475	0.249	0.433	0.243	0.429	0.244	0.432
Employment	1.359	1.233	2.833	1.419	3.289	1.242	1.147	1.233	3.870	1.417
Industry and regional dynamics (external factors)										
Industry: HHI sales	0.015	0.029	0.013	0.024	0.016	0.030	0.014	0.027	0.009	0.015
Industry: Switch industry	0.181	0.385	0.183	0.387	0.197	0.398	0.151	0.358	0.103	0.305
Industry: High-tech manufacturing	0.021	0.146	0.027	0.164	0.033	0.178	0.018	0.133	0	0
Industry: ICT	0.058	0.234	0.055	0.228	0.054	0.226	0.066	0.248	0.065	0.249
Industry: Professional and scientific	0.159	0.366	0.148	0.355	0.119	0.324	0.157	0.364	0.184	0.390
Industry: Education	0.017	0.131	0.022	0.147	0.048	0.212	0.024	0.153	0	0

Accelerator type	Sales		Market share		Employment		Productivity		Acceleration all four criteria	
Variables	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Industry: Knowledge-intensive business services	0.074	0.263	0.075	0.262	0.077	0.266	0.091	0.287	0.065	0.249
Region: Foreign employees share	0.280	0.185	0.301	0.203	0.297	0.191	0.318	0.204	0.287	0.186
Region: Number of foreign employees	10.87	1.26	11.01	1.28	11.00	1.26	11.06	1.24	11.13	1.25
Other firm, industry, and regional controls										
Foreign	0.065	0.247	0.202	0.401	0.179	0.384	0.110	0.313	0.225	0.421
Employment incumbents	13.261	0.968	13.268	0.960	13.339	1.039	13.208	0.939	13.020	1.013
Merger	0.004	0.065	0.002	0.047	0.006	0.078	0.001	0.036	0.013	0.113
Initial employment	1.684	1.038	2.943	1.320	3.345	1.210	1.530	1.019	3.909	1.389
Blitzscalers	0.495	1.099	0.370	1.199	0.679	1.545	0.169	0.662	2.321	2.393
Industry-region: Pubs and hospitality	0.040	0.031	0.041	0.031	0.041	0.032	0.040	0.033	0.050	0.043
Industry-region: Transport	0.033	0.033	0.033	0.033	0.032	0.034	0.033	0.031	0.028	0.025
Industry-region: Art and creative	0.023	0.015	0.024	0.015	0.023	0.016	0.024	0.016	0.025	0.017
Number of observations	394.142		404.000		36.913		558.614		78	

Source: Business Structure Database, 1997–2017: Secure Access. UK Data Service.

APPENDIX C
Logistic panel data estimation across firms with six or more employees across four acceleration types

Accelerator type	*DV: Sales*		*DV: Market share*		*DV: Employment*		*DV: Productivity*	
Variables	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
DV t − 1	3.57***	0.05	2.40***	0.01	2.31***	0.10	4.84***	0.04
DV t − 2	0.42***	0.01	1.93***	0.01	0.27***	0.03	1.51***	0.01
Age and size (internal factors)								
Age 4–7 years (Hypothesis 1–4)	1.47***	0.07	1.05***	0.03	1.57***	0.08	1.42***	0.05
Employment (Hypothesis 1–4)	0.66***	0.00	0.84***	0.00	0.27***	0.00	3.55***	0.02
Age 4–7 years × Employment	0.91***	0.00	1.18***	0.01	1.08***	0.02	0.94***	0.00
Age 8–15 years (Hypothesis 1–4)	1.53***	0.05	1.12***	0.02	1.49***	0.05	1.52***	0.03
Age 8–15 years × Employment	0.91***	0.00	1.08***	0.00	1.03***	0.01	0.93***	0.00
Age 16–30 years (Hypothesis 1–4)	1.26***	0.03	1.25***	0.02	1.14***	0.04	1.42***	0.03
Age 16–30 years × Employment	0.94***	0.01	1.01**	0.00	1.02***	0.00	0.91***	0.00
Industry and regional dynamics (external factors)								
Industry: HHI sales (Hypothesis 5)	0.87	0.13	0.01***	0.00	0.45***	0.10	0.36***	0.04
Industry: Switch industry (Hypothesis 6)	0.87***	0.00	0.41***	0.00	1.04	0.02	0.53***	0.00
Industry: High-tech manufacturing (Hypothesis 7a)	0.89***	0.02	1.11***	0.01	1.09**	0.04	1.02***	0.01
Industry: ICT (Hypothesis 7a)	0.96	0.01	1.89***	0.02	1.32***	0.05	1.09***	0.01
Industry: Professional and scientific (Hypothesis 7a)	0.93***	0.01	1.71***	0.01	1.09***	0.02	0.99***	0.02
Industry: Education (Hypothesis 7a)	0.84***	0.02	0.45***	0.01	1.21***	0.05	1.12***	0.02

Accelerator type	*DV: Sales*		*DV: Market share*		*DV: Employment*		*DV: Productivity*	
Variables	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
Industry: Knowledge-intensive business services (Hypothesis 7a)	0.88	0.14	1.09***	0.03	1.04*	0.08	1.16***	0.04
Region: Foreign employees share (Hypothesis 7b)	0.81**	0.04	1.05***	0.02	1.81**	0.06	1.29***	0.04
Region: Number of foreign employees (Hypothesis 7b)	0.99	0.00	1.05***	0.00	1.03***	0.01	1.03***	0.00
Other firm, industry, and regional controls								
Foreign	0.77***	0.01	1.02**	0.00	0.75***	0.01	1.52***	0.01
Employment incumbents	0.98***	0.00	1.01***	0.00	0.94***	0.00	0.91***	0.00
Merger	1.05	0.07	0.88**	0.04	7.18***	0.39	0.53***	0.04
Initial employment	1.78***	0.01	1.76***	0.01	5.87***	0.06	0.29***	0.00
Blitzscalers	1.38***	0.00	1.20***	0.00	0.99	0.00	1.18***	0.00
Industry-region: Pubs and hospitality	0.85	0.11	0.94	0.07	0.82	0.17	1.08	0.10
Industry-region: Transport	0.96	0.12	0.98	0.07	0.89	0.19	0.92	0.09
Industry-region: Art and creative	1.02	0.34	1.03	0.19	1.73	0.91	0.59**	0.14
Mills ratio	0.91***	0.02	1.68***	0.02	1.70***	0.20	0.34***	0.02
Constant	0.02***	0.01	0.57***	0.02	0.01***	0.00	0.53***	0.09
Other industry, year, and region fixed effects	Yes		Yes		Yes		Yes	
LR(chi^2)	28705.17		140223.70		36611.88		74475.25	
Preudo R^2	0.040		0.101		0.114		0.063	
Log-likelihood	−341762.27		−793661.78		−142235.96		−554671.36	

Note: SE = standard errors robust for heteroskedasticity. Reference groups: mature firms (Age = 30 and more years since establishment); UK region (Northern Ireland); year (2000); Industry (Mining).
Industry, year, and region fixed effects are suppressed to save space. Significance level: *p < 0.05; **p < 0.01; ***p < 0.001.
Number of observations: **4,234,603**.
Source: Business Structure Database, 1997–2017: Secure Access. UK Data Service.

APPENDIX D
Logistic panel data estimation for firm growth

Growth type	*DV: Sales growth*		*DV: Market share growth*		*DV: Employment growth*		*DV: Productivity growth*	
Variables	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
DV t − 1	7.28***	0.04	20.81***	0.08	6.19***	0.11	19.01***	0.06
DV t − 2	0.33***	0.00	0.76***	0.00	0.18***	0.01	0.76***	0.00
Age and size (internal factors)								
Age 4–7 years (Hypothesis 1–4)	1.07***	0.02	0.52***	0.01	0.74***	0.01	1.67***	0.01
Employment (Hypothesis 1–4)	0.59***	0.00	1.04***	0.00	0.19***	0.00	2.21***	0.01
Age 4–7 years × Employment	1.01*	0.00	1.58***	0.01	1.53***	0.01	0.80***	0.00
Age 8–15 years (Hypothesis 1–4)	1.05***	0.05	0.63***	0.02	0.82***	0.01	1.44***	0.01
Age 8–15 years × Employment	1.02***	0.00	1.31***	0.00	1.32***	0.00	0.89***	0.00
Age 16–30 years (Hypothesis 1–4)	1.04***	0.02	0.78***	0.00	0.82***	0.01	1.27***	0.00
Age 16–30 years × Employment	0.99	0.05	1.15***	0.00	1.12***	0.00	0.93***	0.00
Industry and regional dynamics (external factors)								
Industry: HHI sales (Hypothesis 5)	0.85***	0.00	0.72***	0.00	1.01	0.01	0.82***	0.00
Industry: Switch industry (Hypothesis 6)	0.93***	0.00	1.07***	0.00	1.08***	0.02	0.94***	0.01
Industry: High-tech manufacturing (Hypothesis 7a)	0.87***	0.01	1.57***	0.01	0.83***	0.04	1.01***	0.01
Industry: ICT (Hypothesis 7a)	0.96***	0.01	1.67***	0.01	0.74***	0.01	0.95***	0.00
Industry: Professional and scientific (Hypothesis 7a)	0.71***	0.01	0.48***	0.01	0.99	0.03	1.11***	0.01
Industry: Education (Hypothesis 7a)	0.75***	0.00	1.03***	0.00	0.62***	0.00	1.62***	0.00
Industry: Knowledge-intensive business services (Hypothesis 7a)	0.92***	0.02	1.15***	0.02	1.10*	0.06	1.21***	0.02

Growth type	*DV: Sales growth*		*DV: Market share growth*		*DV: Employment growth*		*DV: Productivity growth*	
Variables	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
Region: Foreign employees share (Hypothesis 7b)	0.79	0.01	1.01	0.02	0.79	0.03	1.12***	0.02
Region: Number of foreign employees (Hypothesis 7b)	1.01	0.00	1.04***	0.00	1.04***	0.00	1.03***	0.00
Other firm, industry, and regional controls								
Foreign	0.96***	0.01	1.02***	0.00	0.94***	0.01	0.95***	0.01
Employment incumbents	0.75***	0.05	1.02***	0.00	0.45***	0.07	0.99	0.05
Merger	1.27***	0.04	1.17***	0.04	6.75***	0.26	0.45***	0.02
Initial employment	2.21***	0.01	1.73***	0.01	9.74***	0.08	0.46***	0.00
Blitzscalers	1.40***	0.00	1.08***	0.00	1.01***	0.00	1.08***	0.00
Industry-region: Pubs and hospitality	0.98	0.06	0.92	0.05	0.85	0.11	1.08	0.04
Industry-region: Transport	1.10	0.07	0.89*	0.05	0.88	0.12	0.95	0.04
Industry-region: Art and creative	0.64**	0.10	0.75	0.11	0.54	0.18	0.88	0.09
Mills ratio	0.47***	0.02	0.72***	0.02	3.64***	0.31	0.36***	0.01
Constant	0.10***	0.01	0. 04***	0.00	0.01***	0.00	0.30***	0.03
Other industry, year, and region fixed effects	Yes		Yes		Yes		Yes	
LR(chi^2)	158454.50		142448.85		145115.50		933203.10	
Preudo R^2	0.060		0.341		0.170		0.150	
Log-likelihood	−351418.87		−137855.05		−346889.48		−2493250.20	

Note: SE = standard errors robust for heteroskedasticity. Reference groups: mature firms (Age = 30 and more years since establishment); UK region (Northern Ireland); year (2000); Industry (Mining).
Industry, year, and region fixed effects are suppressed to save space. Significance level: *p < 0.05; **p < 0.01; ***p < 0.001.
Number of observations: **14,628,741**.
Source: Business Structure Database, 1997–2017: Secure Access. UK Data Service.

APPENDIX E
Random-effects probit estimates to predict firm acceleration across four existing types

	DV: Sales		*DV: Market share*		*DV: Employment*		*DV: Productivity*	
Acceleration type	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
Age in logs	−0.167***	0.001	0.262***	0.001	0.009***	0.002	0.019***	0.001

	DV: Sales		*DV: Market share*		*DV: Employment*		*DV: Productivity*	
Acceleration type	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*	*Beta*	*SE*
Number of subsidiaries	0.026***	0.002	0.057***	0.002	0.047***	0.002	0.057***	0.001
Constant	−1.698***	0.006	−2.865***	0.006	−2.848***	0.013	−2.028***	0.005
Industry fixed effects	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Geo region fixed effects	Yes		Yes		Yes		Yes	
Number of obs.	25,699,392		25,699,392		25,699,392		25,699,392	
LR chi^2	48600.32		103829.80		8763.46		73355.63	
Pseudo R^2	0.023		0.027		0.013		0.012	
Log-likelihood	−1814168.1		−1833906.84		−310077.90		−3000658.39	

Note: SE = standard errors robust for heteroskedasticity. Reference groups: UK region (Northern Ireland); year (2000); Industry (Mining). Significance level: *p < 0.05; **p < 0.01; ***p < 0.001.
Source: Business Structure Database, 1997–2017: Secure Access. UK Data Service.