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How Do Organizational Capabilities Shape Industry Dynamics?

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How Do Organizational Capabilities Shape Industry Dynamics?

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Abstract

This paper aims to reconcile the logic behind stochastic models of firm growth and the notion of organizational capabilities as drivers of economic performance. In the proposed behavioral model of bounded rational firms, two mechanisms drive growth: independent stochastic growth of individual opportunities and the process by which firms capture new opportunities. To extend the stochastic framework, this research incorporates behavioral assumptions about the interactions between the firm and the business environment and the mechanism by which firms sense and seize business opportunities. The model generates statistical regularities in firm size, growth rates, and profit differentials between firms that are consistent with observed patterns in real-world settings. The greater the selective power of organizational capabilities, the more the steady-state distribution of firm size appears to deviate from log normality, which provides a potential explanation of various observed departures from the Law of Proportionate Effect. With regard to firm diversity, the distribution of opportunities per firm is skewed; just a few entities account for most of the business opportunities that arise during the simulation period. Moreover, the interaction between the external environment and the internal structure of firms influences heterogeneity in the value of the opportunities that they capture, as well as the persistence of long-run profits.

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1 Introduction

During the past decade, a significant amount of research has revitalized the debate about well-recognized regularities in the distribution of firm size and the strictly related distribution of growth rates. These research efforts (Stanley et al. 1996; Axtell 2001; Fu et al. 2005; Bottazzi and Secchi 2006; Klepper and Thompson 2006) primarily focus on designing stochastic processes that can better approximate the steady-state distribution of firm size that appears in empirical observations.

Yet despite the growing sophistication of the most recent generation of models, it remains difficult to dismiss the idea that "there is no obvious rationale for positing any general relationship between a firm's size and its expected growth rate, nor is there any reason to expect the size distribution of firms to take any particular form for the general run of industries" (Sutton 1997, p. 42). Some versions of stochastic growth processes reproduce the limit size distribution in some industries better than do others (e.g., pharmaceuticals described by Fu et al. (2005)), but we cannot make predictions about whether and how they apply to other industries. Overall, when the general rule is a skewed size distribution, both the level of approximation and the limit conditions in which deviations can be expected to decrease remain unclear. Moreover, the models generally are compatible with the minimal role of differences among firms. This characteristic stems from the Law of Proportionate Effect (Gibrat 1931) that, since its formulation, has cast doubts on the theory of optimal size.

Even if we dismiss optimal size theory though, we cannot dispose of the differences among the firms in driving the pattern of industry evolution (Nelson 1991). A parallel set of empirical regularities regarding the economic performances of business companies (Geroski and Jacquemin 1988; Mueller 1990; McGahan and Porter 2002; Wiggins and Ruelfi 2002; Hawawini et al. 2003; Misangyi et al. 2006), outlines persistent differences in profitability, even within narrowly defined industrial sectors. Long-lasting profit differentials among firms may indicate that firm-specific organizational capabilities exist, though persistent heterogeneity among firms cannot be reconciled with a law that postulates equal chances of growth according to the observed regularities in firm size distribution (Geroski 2000).

The difficulties of refining a simple generalization (skew distribution of size) and accommodating different sets of regularities demand new theoretical approaches. One such approach proposes models that replace the random growth process with stochastic elements in conventional maximizing models (Sutton 1997). In this paper, we propose an explanatory model that does not require the assumption of maximization. Our starting point is the idea of organizational capabilities as a basic constituent of firms' decision-making processes. That is, we propose a model of organizational behavior in which decisions about growth may be driven or constrained by organizational capabilities. The proposed model therefore focuses on the interplay between the internal structure of the firm (organizational capabilities) and the structure of the environment (Simon 1996; Dosi and Marengo 2007) as the main determinants of emerging patterns of growth and steady state distributions of firm size and profitability.

Two factors underpin our decision to focus on organizational capabilities. First, the peculiar characteristics of observed patterns of firm growth (e.g., the Laplace probability density function that describes growth rates) indicate the existence of self-reinforcing mechanisms, in accordance with the hypothesis that differences among firms play some role in drifting growth (Bottazzi et al. 2007). Second, the evidence of high and persistent interfirm differences in economic performance casts some doubt on the assumption of optimizing behavior by organizations, though it is compatible with varying internal structures of firms acting in imperfect markets.

Our model draws on an agent-based computational approach widely recognized as a flexible and powerful tool to cope with contexts in which microeconomics that are out of equilibrium and imperfectly rational behaviors produce aggregate regularities as an outcome of complex, nonlinear, two way feedback between the two levels (Tesfatsion 2003; Tesfatsion 2006).

We organize the remainder of this paper as follows: In Section 2, we discuss the most widely accepted regularities regarding the size, growth, and profitability of business firms. We also sketch some basic intuitions underpinning the framework that we use to interpret the observed patterns of firm profitability and growth. Section 3 presents a simulation model that we use to address the role of organizational capabilities in shaping the evolution of industrial structure. In Section 4, we provide the results of the simulation model, which generally endorse the viability of our approach as a microfoundation for emergent phenomena. Finally, we conclude and highlight some strategies for further research.

2 Patterns of Firm Performance

2.1 Firm size and growth rates

Antitrust-based concerns about high degrees of market concentration (Hart and Prais 1956) and the observation that firm size distributions are skewed across industries (Schmalensee 1989) have led to a prominent research stream in industrial organization focused on the growth of firms. Within this extensive body of research, stochastic growth models (Ijiri and Simon 1977) and Gibrat's Law[1] (Gibrat 1931) of proportionate growth emerge as viable options for analyzing the observed distribution of firm size. Subsequent empirically oriented studies directly addressed Gibrat's conjecture by exploring the size-growth relationship for samples of large firms observed over successive years (Hymer and Pashigian 1962; Mansfield 1962; Singh and Whittington 1975). This stream of applied research transformed the Law of Proportionate Effect into a benchmark for theoretical and empirical studies dealing with the growth of business companies. More recent econometric studies (Hall 1987; Evans 1987ab; Dunne et al. 1989) and contributions to econo-physics literature (Stanley et al. 1996; Axtell 2001) have revived the interest in the growth of firms concept by drawing attention to certain statistical regularities across industries and over time. Two major patterns emerge from these empirically oriented studies.

> **Stylized Fact 1**. Although there is no single form of size distribution that can be considered typical for the general run of industries, observed distributions of firm size are highly skewed.

Gibrat's Law implies a distribution of firm size that approaches a log normal, with mean and variance that increase indefinitely with time. For the model to achieve a real steady-state distribution, alternative stabilizing mechanisms that restrict the random walk of firm size must be considered.

[1]Gibrat's Law involves three propositions: (1) average growth rates are independent of firm size; (2) there is no heteroskedasticity in the variance of growth rates; and (3) there is no autocorrelation in growth rates (Kumar 1985). The independence of expected rates of growth from the attained size, known as the Law of Proportionate Effect, implies that "the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry - regardless of their size at the beginning of the period" (Mansfield 1962, p. 1030). Furthermore, Gibrat's Law can be formulated in three ways, namely, (1) for all firms in the industry, including those that fail and leave the industry during the period of observation; (2) for all firms in the industry, except for those that exit the industry; or (3) only for firms in the industry that are larger than a minimum efficient size. Geroski (2000) remarks on the economic implications of Gibrat's Law.

Extant research regards the log normal as a first approximation of the observed patterns of firm size (Hall 1987), particularly for companies whose accounting data are publicly available (Cabral and Mata 2003). However, departures from the theoretical benchmark provide indirect evidence that a simple Gibrat model cannot accurately describe the growth of business firms.

Observed frequencies either exceed (Simon and Bonini 1958; Growiec et al. 2008) or are lower than (Stanley et al. 1995) expected values in the upper tail of the log normal model. The upper tail behavior in total manufacturing distribution thus seems to be an outcome of the aggregation of fairly heterogeneous distributions of firm size at the sectoral level (Bottazzi et al. 2007). Moreover, measures of skewness and kurtosis often deviate from the values of a true log normal distribution (Hart and Oulton 1996; Cabral and Mata 2003; Reichstein and Jensen 2005; Angelini and Generale 2008). The Yule and Pareto distributions are regarded as suitable alternatives to accommodate these deviations and guarantee a better fit than the log normal distribution for the observed frequencies in both tails (Axtell 2001). These advantages notwithstanding, none of the distributions appears typical for all countries and all industries (Schmalensee 1989). Most scholars instead take the view that the firm size distribution will be skewed, but without any expectations about the degree of skewness or the exact form that the distribution might take (Sutton 1997).

> **Stylized Fact 2**. The distribution of (logarithmic) growth rates displays a tent-shaped form.

According to Gibrat's Law, idiosyncratic shocks driving the evolution of firm size generate growth rates, $R_T \equiv S_{t+T}/S_t$, which for sufficiently large time intervals $T \gg \Delta_t$ will be log-normally distributed. However, studies drawing on the early tradition of stochastic growth models portray a different picture, noting that the observed distribution of growth rates departs from the expected Gaussian shape implied by Gibrat's Law and instead displays a "tent-shaped" form. Stanley et al. (1996) pioneered this stream of research by investigating data for all publicly traded U.S. manufacturing companies over the period 1975-1991. They show that a symmetric exponential (Laplace) distribution describes the pattern of annual (logarithmic) growth rates well. Recent contributions corroborate this evidence and reveal that the tent-shaped growth rate distribution offers an invariant property that holds among manufacturing firms in other countries (Reichstein and Jensen 2005; Fagiolo and Luzzi 2006; Coad 2007), as well as in narrowly defined industrial sectors (Fu et al. 2005; Bottazzi et al. 2007).

2.2 Sources and dynamics of profitability

Economists and management scholars show great interest in two intertwined issues regarding the economic performance of business firms: the existence of persistent differences in accounting profitability between firms and the identification of factors that may be responsible for such differences. The first line of inquiry tests the competitive environment hypothesis, which claims that market forces effectively bring profits in line with competitive rates of return. Several studies explore the profit performance of large companies in developed countries during the second half of the 1980s (Mueller 1990) and use the broad evidence they derive to contest the competitive environment hypothesis.

In all countries, permanent differences across firms exist, which implies that firms that enjoy above- (below-) normal profits at any given time should gain above- (below-) normal profits in the future. Short-run deviations from company-specific equilibrium rates of return should erode in the space of approximately three to five years, and dynamic forces produce major impacts on excess profits within a single year. Firm characteristics emerge as key drivers of long-run profitability, whereas industry factors appear more important for explaining the speed of adjustment across firms (Geroski and Jacquemin 1988; Waring 1996; Wiggins and Ruelfi 2002).

The second stream of analysis focuses on sources of observed variations in accounting profitability (McGahan and Porter 2002; Hawawini et al. 2003; Misangyi et al. 2006). Strategy scholars took up this investigation following Schmalensee's (1985) questions about the relevance of corporate factors in explaining persistent heterogeneity in firm performance, a tenet that contrasted with the predictions of the resource-based view of the firm. Disregarding the identification of factors that may drive superior performance and suppressing concerns over causal mechanisms, these studies have focused on "the existence and relative importance of time, corporate, industry, and business-unit effects, *however generated*, on the total dispersion of total rates of returns" (Rumelt 1991, p. 169).

A handful of important upshots emerge from this far-reaching body of investigations: (1) business-specific effects account for a large portion of profit variation; (2) corporate and industry effects are equally important sources of variation; and (3) industry-, corporate-, and business-specific effects relate both cross-sectionally and intertemporally. Overall, the relatively low fraction of profit variation associated with industry effects compared with business-specific effects, as well as the significant fraction attributed to corporate effects, have been interpreted as support for the resource-based view of the firm, as well as the central role of organizational competences that this perspective assumes.

> **Stylized Fact 3**. Heterogeneity in firms' profitability persists in the long run and is significantly influenced by corporate factors.

2.3 Capabilities and firm growth: Bridging the gap

The patterns emerging from firm performance data puzzled scholars for some time. For example, the large random component of empirically observed corporate growth rates undermines the notions of core competences and learning as drivers of corporate growth (Geroski 2000). More recent contributions (Sutton 1998; Fu et al. 2005; Bottazzi and Secchi 2006; Klepper and Thompson 2006) that draw on early stochastic growth models reveal a series of statistical properties in the distributions of firm size and growth rates that may help reconcile evidence about profitability and growth with the notion of organizational capabilities. In particular, the fat tails observed in the growth rate distribution, at different levels of sectoral aggregation, hint at a self-reinforcing mechanism that occurs in the process of corporate growth, which a simple Gibrat-type model would ignore (Bottazzi et al. 2007).

Whereas newer stochastic growth models reprise the notion that the market consists of exogenous investment opportunities, they also provide insights into the sources of correlating mechanisms that might entail a richer structure than commonly assumed in the growth dynamics. Nonetheless, much is left unexplained, and a few compelling questions arise: How can these models of growth be justified? Is there any connection with the firm's decision-making process?

We extend the stochastic framework by proposing a model of bounded rational organizations that incorporates behavioral assumptions about the interactions between the firm and the business environment, as well as the mechanism by which firms may sense and seize business opportunities. The model attempts to show that the self-reinforcing mechanisms alleged to account for observed distributions of firm size and growth can be understood as results of the joint effect of organizational capabilities and the environmental structure.

Our perspective exhibits strong ties to capabilities-based theories of the firm (Dosi and Marengo 2007), as well as the theory of the "artificial" proposed by Simon (1996). Drawing on their terminology, we describe a firm as a system that purposefully maintains goals and functions and then opportunely adapts to fulfill them. The firm therefore is an "interface" between the inner environment, comprised of the organizational capabilities with which it is endowed, and an outer environment, or the surroundings in which it operates. Accordingly, the degree of concurrence between the substance and organization of the firm and the context in which it operates influence its long-run profitability and drive its growth[2]. This perspective is consistent with technology studies that explain the failure of innovating firms on the basis of the mismatch between the firm's system of coordination and control and the nature of the available technological opportunities (Pavitt 1998).

Another feature that distinguishes our contribution from previous work in the Simonian tradition is the way we model how incumbents pursue opportunities. Rather than imposing any specific probability density function that might eventually describe the partition of opportunities across entities, we try to identify and simulate a set of behaviors that might shape the allocation process. To accomplish this task, we borrow from the dynamic capabilities framework, which proposes an analytical separation between the capacity to sense opportunities and the capacity to seize opportunities[3] (Teece 2007). Such a reference scheme entails the identification of those elements, interactions, and stages that an enterprise must manage to address a business opportunity successfully. We incorporate this idea in our simulation model through a two-step procedure: In the first step, firms search the environment and detect opportunities. Their effectiveness in performing these activities depends on their relative size; market share determines the ranking of firms according to their sensing ability. In the second step, the firm that outperforms its rivals in sensing new opportunities has a chance to seize an opportunity and, eventually, earn a profit.

To formalize these ideas we draw on an agent-based computational approach. Our modeling aims to foster the application of the agent-based approach in the field of industrial organization along two general directions (Chang and Harrington 2006). First, it adds "more structure" to organizations in order to map simulated entities into real world regularities. Second, it advances loose assumptions on the amount of information organizations need to implement an effective learning process. In particular, it makes explicit the process of perception and seizing of opportunities in the spirit of Gavetti and Levinthal (2000).

[2]Barro and Saraceno (2002) adopt a similar approach to study how different degrees of complexity and instability regimes impinge on the evolution of firm structure and learning.

[3]Teece (2007) also mentions the capacity to maintain competitiveness by reconfiguring the firm's tangible and intangible assets, an aspect that we do not explicitly take into account in our proposed model.

3 A Model of Growth Driven by Organizational Capabilities

3.1 Building blocks

We conceive of the *inner system* of the firm as a repertoire of organizational capabilities that may influence its ability to pursue business opportunities in its environment (Nelson and Winter 1982). With this perspective, we can disentangle the relationship between firms and technologies. Were technologies freely available to firms, we could explain all observed heterogeneity with the external environment, that is, by the structure of input markets or the nature of the competition in output markets. However, a long tradition of organizational studies (Woodward 1965; Thompson 1967) demonstrates that access to technologies often necessitates specific organizational assets. In particular, a certain amount of knowledge capital and effective learning processes are required to address novel technical opportunities (Cohen and Levinthal 1990). Therefore, not all technologies are equally available to firms, and complementarities between adopted technologies and organizational characteristics may affect the ability of firms to sense and seize opportunities.

It is also important to recognize that organizational capabilities are embedded in the firm, such that the initial conditions that influence the early development of organizations can become long-term constraints that ultimately cause an organizational structure to become "locked in to a comparatively narrow subset of routines, goals and future work trajectories" (David 1994, p. 214). This notion of embedded capabilities recalls the stickiness of organizational capabilities that (Arrow 1974, p. 56) underlines in arguing that "[s]ince the code is part of the firm's or more generally the organization's capital it will be modified only slowly over time". Assuming the inner system is the repository for organizational capabilities that can mutate only episodically at high costs, firms may not be able to seize, or even sense, all technological opportunities in their environment.

The *outer system*, according to Simon (1996), consists of richness and complexity. Richness relates to the number of opportunities available in the environment, so a rich environment is one in which sustained technological advances nurture a stream of product and process innovations or open new markets for existing products. It offers many opportunities, which firms can exploit with no risk of depletion. Satisfactory solutions are easy to achieve, and "slack", which refers to the various opportunities in the environment that never get exploited (March 1994), is always high.

Complexity represents the difficulty of predicting the outcome of an alternative, given the set of already exploited opportunities: it may reflect the ruggedness of the environment (Kauffman 1993). In a smooth, non complex environment, the outcomes of the nearest opportunities are highly correlated. In a complex environment, the outcome of an exploited opportunity does not carry information about the value of other, nearby opportunities. Complexity therefore translates into difficult environment exploration.

The *exchange between the inner and the outer environment* relies on two fundamental mechanisms: search and feedback of information about performance. Search determines the way firms capture new opportunities. In our proposed two-stage mechanism, incumbents sense opportunities on the basis of their relative sizes and eventually seize those opportunities that appear in the neighborhood of their current position in the landscape. The boundaries of this neighborhood are a function of the endowment of the organizational capabilities of each entity. Therefore, firms can pick up only on opportunities that are close to their organizational capabilities. Furthermore, we assume that newcomers capture a portion of newly available opportunities with a given probability. At the time of entry, their endowment of organizational capabilities perfectly matches the nature of the technological opportunity with which they are associated, so whenever an entry occurs, a new combination of organizational capabilities appears in the market.

Feedback comes through performance, which depends on the value of the opportunities the firm can seize and manage. The value of the opportunities is somewhat predictable, given the structure of the environment. In a correlated environment, the value of a near opportunity should not be dissimilar from that associated with previously captured opportunities. In a rugged landscape, pursuing an opportunity whose structure fits the current set of organizational capabilities does not necessarily lead to similar performance in terms of profitability though. The mechanism of feedback that we implement implies that a firm exits the market when its profitability falls below the level of fixed costs it incurs to establish the business.

3.2 Model

Consider an industry that evolves over a sequence of periods $0, 1, \ldots, t, \ldots, T$, where 0 is the period in which the variables are initialized. In each period, a number of firms F^t is active.[4] Each firm i is endowed with a set of organizational capabilities, OC_i, represented as a vector of 1s and 0s of length L.

[4] In what follows, we use the right superscript to denote the period to which the variable refers; when we include left and right superscript, it indicates "from the period of the left superscript to the period of the right superscript". The subscript $i (i = 1, \ldots, F^t)$ refers to the firm variable.

During its life, the firm can captures one (which is the condition for its existence) or more opportunities. The set of all business opportunities available in the market up to time $t > 0$ is given by ${}^0BO^t = \sum_{\tau=0}^{t} \sum_{i \in F^t} BO_i^\tau$, where BO_i^t refers to the business opportunity captured by firm i at time t. Business opportunities are described as a Boolean vector of the same length as the vector that represents OC_i. Each opportunity has a given value, $v^t(BO)$, that can be thought of as the size of the potential market for that opportunity. The initial value of an opportunity is a random variable whose realization depends on a set of rules defining the environmental setup. In the case of a rugged environment, randomly drawn values are associated with each binary vector that describes a BO. In the case of a smooth environment, the set of values is extracted randomly and ordered from the lowest to the highest score. Such values subsequently are associated with vectors of BOs that previously have been ranked by the number of 1s they contain (vectors with equal numbers of 1s are randomly ranked). In this way, BOs with a nearby structure take nearby values. The value of an opportunity evolves over time, as we describe subsequently.

We define the following measures of firm performance:

- *Firm activities*, or the number of business opportunities a firm pursues up to time t, is ${}^0BO^t = \sum_{\tau=0}^{t} BO_i^\tau$.
- *Firm turnover*, or the total revenue a firm earns in period t from all the activities in which it is involved, $V_i^t = \sum_{\tau=0}^{t} BO\nu\tau(BO_i^\tau)$.
- *Market share*, which is the ratio between firm turnover and the total revenue of the firms existing at time t, V_i^t / V^t, where $V^t = \sum_{i \in F^t} V_i^t$.
- *Firm profits*, or the total turnover net of costs. We consider two categories of costs. The first is the cost of a mismatch between organizational capabilities and business opportunities. The value of each opportunity decreases proportionally with the Hamming distance between the two, that is, with the number of ordered elements in the two vectors that differ. Formally, we can define $m_i^t = |OC_i - BO_i^t|$ as the L length vector of the absolute value of the differences between organizational capabilities and business opportunities, which will contain as many 1s as there are non-equal elements. Let $d_i^t = \mathbf{I}(m_i^t)$ be the scalar product of the unitary vector and the vector of distances, that is, the sum of the 1s of vector m_i^t. The mismatch between organizational capabilities and business opportunities implies a cost of $\frac{d_i^t}{L}\nu^t(BO_i^t)$, such that the net value of the business opportunity is $n\nu^t(BO_i^t) = \left(\frac{L-d_i^t}{L}\right)\nu^t(BO_i^t)$.

The total net value of business opportunities for firm i at time t is then $NV_i^t = \sum_{\tau=0}^{t} n\nu^\tau(BO_i^\tau)$. The second category of costs involves fixed production cost, f_i, for which the height of f_i defines the threshold for survival in the market. Firm profits at time t then are defined as $R_i^t = NV_i^t - f_i$.

Indicators of market performance can be defined accordingly as:

- The number of firms operating at time t, F^t.
- The total number of business opportunities available at time t, ${}^0BO^t = \sum_{\tau=0}^{t} \sum_{i \in F^t} BO_i^\tau$.
- The average size of firms in terms of business opportunities, $\overline{BO}^t = \frac{1}{F^t}{}^0BO^t$.
- The average size of firms in terms of turnover, $\overline{V}^t = \frac{1}{F^t}\sum_{i \in F^t} V_i^t$.
- The average size of firms in terms of profits, $\overline{R}^t = \frac{1}{F^t}\sum_{i \in F^t} R_i^t$;

We initialize the market at period 0 as follows: We create the initial number of firms F^0 as strings of OCs. To each firm, we attach a BO_i^0 with the same structure as OC_i (i.e., with the 0s and 1s in the same position) and extract a value for each opportunity according to the procedure devised for the specific environment (smooth versus rugged) that we consider. In each subsequent period the following events occur (Figure 1):

a *Arrival of new opportunities.* A group of business opportunities gets extracted from the population of opportunities and assigned to either an entrant with probability p_E (in which case the number of existing firms increases by 1, $F^t = F^{t-1} + 1$) or to an incumbent firm with probability $1 - p_E$. Among all existing firms, incumbents get selected according to their market share. If an incumbent firm is extracted, it first evaluates the set of newly available opportunities and retains the one whose structure is closer to its set of organizational capabilities (according to the Hamming distance between the two Boolean vectors). The firm also can skip this choice if the mismatch between its organizational capabilities and all the business opportunities extracted is too high, that is, whenever $d_i^t > d^*$, where d^* defines the maximum distance that enables a firm to seize an opportunity (hereafter, seizing distance). In this case, all new opportunities are lost. If the opportunity gets selected, the firm knows its value $\nu^t(BO_i^t)$, and it can calculate the net value $n\nu^t(BO_i^t)$. This procedure acknowledges that a firm does not know the exact market value of the business opportunities it chooses.

b *Updating opportunity values.* In each period, a rate of growth g_t, $(-1 < g_t < 1)$ can be extracted from a normal distribution, $N(0, \sigma_g)$. Thereafter, the value of each business opportunity gets updated according to the rule $\nu^t(BO_i^t) = (1 + g_i^t) \times \nu^{t-1}(BO_i^{t-1})$.

c *Exit of opportunities and firms.* If $n\nu^t(BO_i^t) < f_i$ the opportunity is abandoned. If $R_i^t \leq 0$, firm i exits the market.

We also comment on the way that competitive dynamics enter our framework. The primary channel through which competition occurs is the entry of new firms, a standard mechanism since the earliest generation of stochastic growth models (Simon and Bonini 1958). However, competition may implicitly underpin updated opportunity values. Therefore, the shrinking and

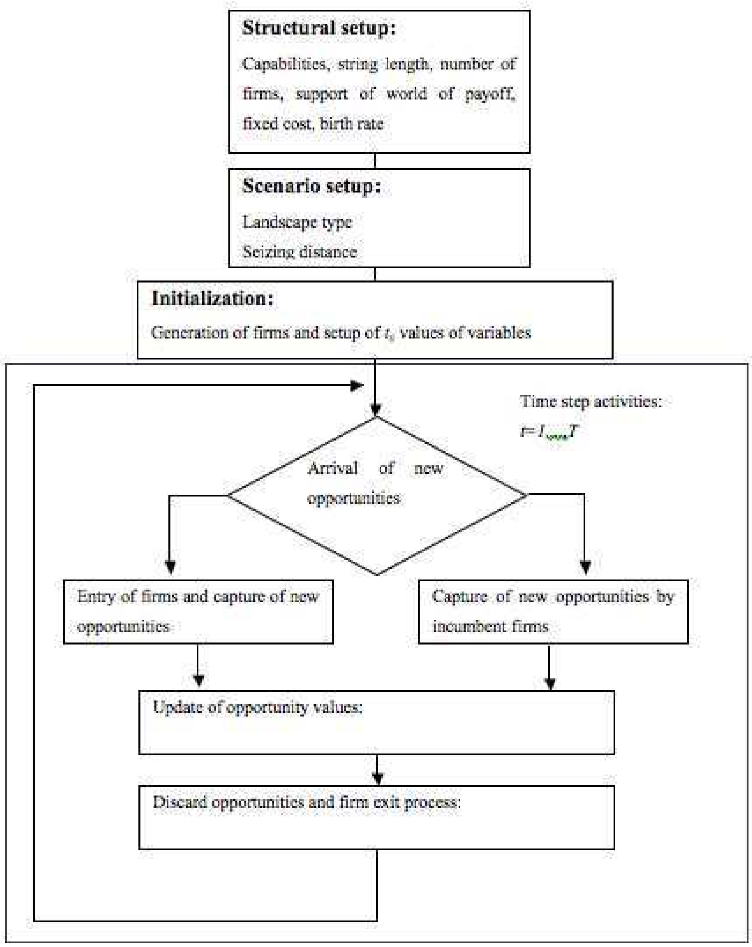


Figure 1: Activity flow of the model

expansion of business opportunities, which we represent as random draws from a $N(0, \sigma_t)$, can be conceived of as the outcomes of underlying processes associated with the pricing behavior and technological advances. The absence of an explicit model of strategic interactions is by no means a limitation in our model: rather, this feature, albeit in an extreme sense, captures the idea "most conventionally defined industries exhibit both some strategic interdependence within submarkets, and some degree of independence among submarkets" (Sutton 1997, p. 49).

3.3 Simulation protocol

The simulation plan involves two sets of parameters that we vary to assess how the interaction between the outer environment and the inner structure of an organization shapes the evolution of firm size and profit. The first set comprises two factors that describe the outer environment: richness and complexity. We determine complexity according to the smoothness or ruggedness of the environment (Kauffman 1993). The environment is smooth when the values of opportunities lying within a given neighborhood are highly correlated; otherwise, it is rugged. Richness reflects the number of new opportunities available at each step. Specifically, the parameter describing the richness of the environment is set to either 1 (poor environment) or 3 (rich environment). In the first case, firms decide whether to take up the emerging opportunity; in the second case, they can choose among all newly available opportunities which one, if any, best matches their organizational capabilities.

The second set consists of a parameter that describes the effect of organizational capabilities on the search process, that is, the seizing distance d^*. With respect to the seizing distance, we alternate a value of 7 (i.e., the length of a string representing OCs), which implies that the organizational capabilities and business opportunities differ in their constituent parts, and a value of 3, which indicates organizational capabilities and business opportunities differ by no more than three bits (approximately 43%).

Combining the parameters that describe the surrounding environment with the two regimes we define for the seizing distance, we generate eight scenarios that provide the background for our simulation exercise. The scenario characterized by a poor and rugged environment, together with a seizing distance of 7, represents our baseline model, because it mimics the structure of prior theoretical contributions (Fu et al. 2005) and provides a benchmark for interpreting the results.

We use a list of structural parameters to define the experimental treatment factors of each scenario. The initial number of firms in the model is set to 400.[5] We also set the length of the vectors representing business opportunities and organizational capabilities to 7. Although the results seem robust to changes in the value of this parameter, in general, the longer the string, the clearer are the differences between the smooth and rugged worlds. The initial number of opportunities that firms capture equals 1, whereas the values of the business opportunities reflect a uniform distribution whose support lies in the interval [25, 100].

We set the birth rate in all scenarios to 0.01, which reflects our need to disentangle the dynamics associated with either the evolution of business opportunities chosen by the incumbents or the ability of entrants to introduce new business opportunities into the market. The fixed cost equals 10, which represents the cost that firms must pay to be able to produce in each time step. This parameter indirectly establishes a minimal size, below which firms must exit the market. The magnitude of adjustment of business opportunity value over time, σ_g, is 0.01 to indicate the pseudo-Gibrat process involving the business opportunities incumbents have already captured and are exploiting to earn their profits.

Before presenting the simulation results, we consider the possibility that a steady state exists in our model. Prior literature notes that the most important assumptions regarding a steady state pertain to the entry and exit processes, as well as the mechanism governing the growth of firms (de Wit 2005). Therefore, the possibility that our model reaches a steady state relates to the magnitude of the processes governing the demography of the industry. We assume the entry mechanism in our model is exogenous; the birth rate is parametrically given. The exit mechanism instead is endogenous, though strongly influenced by the magnitude of fixed costs. To the extent that these two processes balance out, we should end up with a fixed number of firms in the industry, which represents a necessary condition for a steady state.

4 Results

4.1 Emerging regularities in firm size and growth dynamics

Our analysis[6] begins with a description of the firm size distribution in the baseline scenario, a rugged and poor environment in which organizational

[5] Preliminary simulations show that above a minimal threshold, changes in the number of firms in existence at the initial stage do not generate qualitatively different results.

[6] The model is implemented using C++ programming. The source code is available upon request from the authors.

capabilities do not influence the ability of agents to pursue business opportunities. The first column in Table 1 reports the number of surviving firms and the Monte Carlo means of the first four moments of the distribution. In Figure 2(a), we also depict the Zipf plot (double logarithmic plot of size versus rank) for the pooled data from 10 simulation runs. For small and medium-sized firms, the plotted data are concave in relation to the origin, which suggests a log normal distribution approximates the pattern of firm size well, consistent with empirical evidence from extant literature (Hall 1987; Stanley et al. 1995; Cabral and Mata 2003; Growiec et al. 2008).

A closer look at the plot, however, reveals that for larger firms, the curvature disappears, and a straight line resembling power law behavior might provide a better fit. To investigate this conjecture, we estimate the lower bound to the power law behavior, x_{min} (i.e., the starting value for the apparent linearity in the size distribution), along with the scaling parameter of the power law model, α. We then use these estimates and the approach recommended by Clauset et al. (2009) to test the null hypothesis that a power law distribution offers a plausible fit to the data. The small *p-value* (0.005) reported for the baseline scenario in Table 2 leads us to reject the null hypothesis and dispose of the power law as a reliable model to describe the behavior of the upper tail of the size distribution.

Although the simulation results for the baseline scenario are consistent with most empirical evidence, our primary interest lies in the changes in the limiting distributions of size that arise from the interaction between the outer environment and the internal structure of the firm. Our simulation exercise (Table 1) shows that regardless of the role of organizational capabilities in seizing opportunities, changes in the degrees of richness and complexity in the external environment do not impinge on the number of surviving firms. When we activate the parameter for seizing distance ($d^* = 3$), the selective power of organizational capabilities directly and significantly affects the steady-state distribution of firm size. Irrespective of the external conditions, both the average and median size decrease, because the compelled concurrence between the structures of organizational capabilities and business opportunities prevents firms from capturing opportunities that are highly dissimilar from their internal structure.

In addition, regardless of the external conditions, a binding seizing distance determines a shift in the skewness of the distribution from a negative to a positive value, suggesting the emergence of a fatter upper tail. At the same time, the computed values of the kurtosis shrink[7] as the selective power of organizational capabilities increases, which implies a flatter firm size dis-

[7]The kurtosis increases when the landscape is poor and smooth.

Table 1: Monte Carlo statistics of (log10) firm size

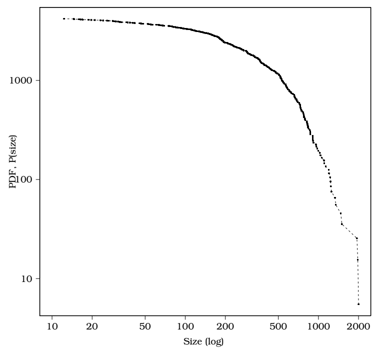
MC meanns	**Scenarios**							
	Poor Environment		Rich Environment		Poor Environment		Rich Environment	
	RU7[a]	RU3	RU7	RU3	SM7	SM3	SM7	SM3
Number of firms	419.385	418.505	418.855	419.260	419.165	419.470	418.675	419.115
	4.283	*4.479*	*4.630*	*4.607*	*4.496*	*4.543*	*4.555*	*4.620*
Mean size	2.353	1.967[b1]	2.354	2.043[d1]	2.351[f1]	1.955[e1]	2.351	2.037[c1,g1]
	0.021	*0.023*	*0.02*	*0.021*	*0.022*	*0.019*	*0.021*	*0.021*
Median size	2.423	1.939[b2]	2.424	2.034[d2]	2.421[f2]	1.942[e2]	2.417	2.022[c2,g2]
	0.025	*0.029*	*0.027*	*0.03*	*0.028*	*0.025*	*0.027*	*0.03*
Standard deviation of size	0.462	0.407	0.463	0.437	0.462	0.364	0.467	0.405
	0.015	*0.013*	*0.014*	*0.013*	*0.015*	*0.012*	*0.016*	*0.012*
Skewness	-0.525	0.241	-0.522	0.101	-0.5	0.173	-0.485	0.125
	0.078	*0.085*	*0.082*	*0.074*	*0.079*	*0.095*	*0.078*	*0.093*
Kurtosis	2.662	2.444	2.644	2.298	2.637	2.671	2.628	2.519
	0.158	*0.137*	*0.152*	*0.114*	*0.157*	*0.16*	*0.144*	*0.132*

Notes: Monte Carlo sample size = 200. Monte Carlo standard errors in italics.[a]Baseline scenario. Mean-comparison tests: [b1]PRU7 vs. PRU3: mean size t-stat. = 176.5; [b2]median size : t-stat. = 181.2 ; [c1]PRU3 vs. RSM3 : mean size: t-stat. = 31.9; [c2]median size : t-stat. = 28.7; [d1]PRU3 vs. RRU3: mean size: t-stat. = 35.1; [d2]median size: t-stat. = 32.5; [e1]PSM3 vs. RSM3: mean size: t-stat. = 40.1; [e2]mean size: t-stat. = 29.2; [f1]PRU3 vs. PSM3: mean size: t-stat. = 5.3; [f2]median size: t-stat. = 1.3; [g1]RRU3 vs. RSM3: mean size: t-stat. = 3.0; [g2]median size: t-stat. = 3.9.

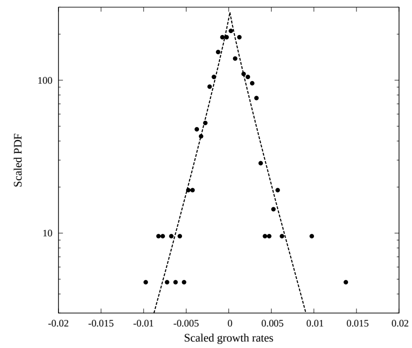
Table 2: Upper tail behavior of firm size distributions

MC means	**Scenarios**							
	Poor Environment		Rich Environment		Poor Environment		Rich Environment	
	RU7[a]	RU3	RU7	RU3	SM7	SM3	SM7	SM3
x_min	723.77	430.81	1327.88	475.37	1105.66	425.43	1318.2	499.51
α	4.29	4.19	6.76	3.97	5.81	4.26	6.35	4.07
p-value	0.005	0.003	**0.684**	**0.143**	**0.956**	**0.442**	**0.539**	**0.295**
% upper tail	12.75	6.14	1.77	8.16	3.97	3.86	1.84	5.78

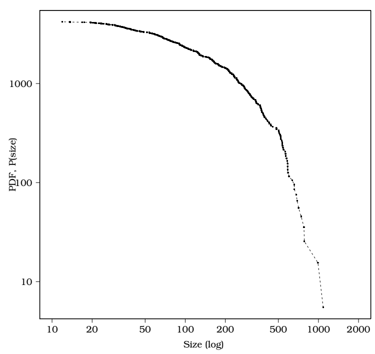
Notes: Monte Carlo sample size = 200. 5% Significant p-values in bold. [a]Baseline scenario.



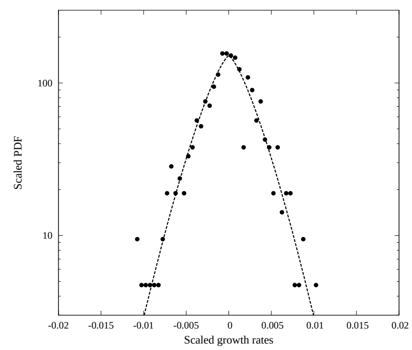
(a) PoorRU7



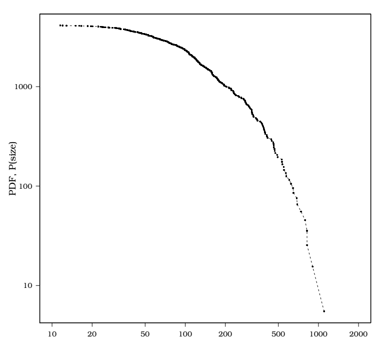
(b) PoorRU7



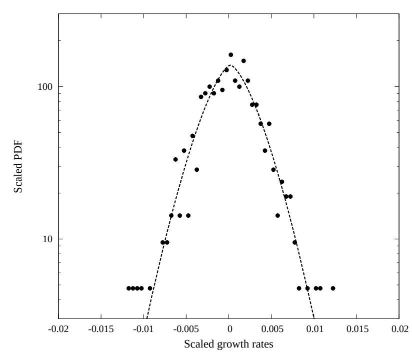
(c) RichRU3



(d) RichRU3



(e) RichSM3



(f) RichSM3

Figure 2: Simulation results of a typical run: Size and growth.
Notes. Log rank-log size plot of logarithmic sizes: (a) poor, rugged, $d^* = 7$, PoorRU7, (b) rich, rugged, $d^* = 3$, RichRU3; (c) rich, smooth, $d^* = 3$, RichSM3. Distributions of growth rates (log on y-axis) with fitted densities: (e) poor, rugged, $d^* = 7$, PoorRU7); (f) rich, rugged, $d^* = 3$, RichRU3; (g) rich, smooth, $d^* = 3$, RichSM3. These results derive from a setting with fixed costs = 10, birth rate = 0.01, initial number of firms = 400, and time step $T = 2000$.

tribution. Notwithstanding these variations, the small *p-value* (0.003) in the second column of Table 2 indicates that a departure from the baseline scenario that involves only a change in the seizing distance is not sufficient to generate an upper tail in the firm size distribution, consistent with a power law model.

We next extend our analysis by considering how moving toward a rich and smooth landscape influences the evolution of firm size when organizational capabilities are binding. Comparing the two extreme scenarios (i.e., a poor and rugged landscape versus a rich and smooth one), we realize that as the environment gets richer and more correlated, the average and median size significantly increase (see second and last columns in Table 1). Moreover, the distribution fitting procedure we implement returns a *p-value* of 0.295 (Table 2), which implies that we can no longer reject the null hypothesis according to which observations for large firms can be drawn from a power law distribution (Figure 2(e)).

However, a deeper inspection of our results also reveals that when we consider shifts toward a smooth or rich environment independently, they induce opposite consequences on the average and median size of the firm. On the one hand, the average and median size significantly increase as the environment gets rich, regardless of the degree of complexity in the surrounding landscape. On the other hand, the average and median size significantly decrease as the level of correlation in the value of opportunities rises,[8] in both poor and rich environments. The expansion associated with a movement toward a rich environment, which allows firms to order new business opportunities and choose the one that best fits their structure, dominates the decline spurred by a smooth landscape. Hence, the joint effect of the two forces engender the positive outcome discussed previously. Finally, we note that despite the opposite influences that a shift toward a smooth or a rich environment produces on the average and median size, they are autonomously sufficient to transform the upper tail of the size distribution (Figure 2(c)) and make it consistent with a power law model (Table 2).

Figures 2(b), 2(d) and 2(f) show the distributions of growth rates that underpin the limiting distribution of firm size in three diverse scenarios. Each plot reveals the binned empirical densities of logarithmic growth rates versus the fitted probability density function of a generalized error distribution (Bottazzi 2004). The latter provides a useful benchmark to quantify our model's ability to generate growth rate distributions that are consistent with empirical findings (Stanley et al. 1996; Amaral et al. 2001; Fu et al. 2005;

[8]The median size does not significantly change in a poor environment when the landscape becomes smooth.

Bottazzi and Secchi 2006). In particular, the probability density of the generalized error distribution can be characterized by two parameters: a scale parameter a and a shape parameter b. Its functional form is:

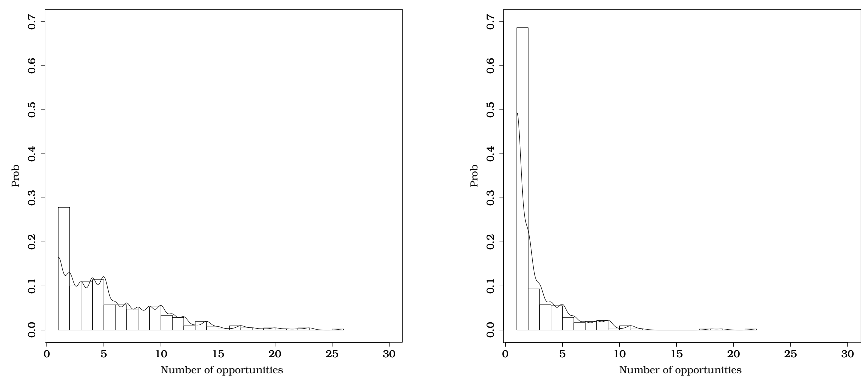
$$p(x)dx = \frac{1}{2a\Gamma(1 + 1/b)} e^{(-|x/a|^b)dx}$$

where $\Gamma(x)$ is the Gamma function. The density function above reduces to a Gaussian form for $b = 2$, but it converges to a Laplace form when $b = 1$. By considering the graphic representations and the estimated values of the shape parameter b, we can assess whether the simulated distributions of growth rates display a tent-shaped form rather than the expected Gaussian shape implied by Gibrat's Law.

In Figure 2(b), we reveal that the simulated distribution of one-period growth rates, in the baseline scenario, closely mirrors the tent-shaped form commonly observed in real-world data. The median value of the shape parameter, computed over 200 Monte Carlo simulations, equals 0.93, which suggests that a Laplace model describes the firms' dynamics well. When we consider the estimated shape parameter together with the graphical representation, we find that the probability density function that best approaches growth rates in Figure 2(b) is more leptokurtic than Laplace-like, and it displays tails that resemble a power law (Fu et al. 2005).

The distributions of growth rates in Figures 2(d) and 2(f) also exhibit noticeable departures from a Gaussian form, in support of the idea that the tent shape is fairly stable throughout the scenarios, an invariant property that also emerges when we compare narrowly defined sectors (Bottazzi et al. 2007). However, a deeper exploration of the two plots hints at the existence of nonnegligible differences in the shape of these distributions with respect to the one observed in the baseline scenario. The fitting exercise thus returns a median shape parameter of approximately 1.36 in those scenarios in which organizational capabilities are effective for seizing opportunities and the outer environment becomes rich and smooth.

These results corroborate our conjecture that the degree of concurrence between the substance of the firm and the context in which it operates has important bearings on growth patterns. In particular, the interaction of these forces causes the growth process to deviate from the outcome implied by Gibrat's Law, though not as strongly as in the baseline scenario. We propose a possible rationale for this piece of evidence: When organizational capabilities are effective, an increasing number of firms tend to seize fewer opportunities. The tighter the role of organizational capabilities, the larger is the portion of entities that can pursue one opportunity at most. As the distribution of opportunities increasingly becomes dominated by single-business firms (Figure 3(b)), the unconditional distribution of growth rates tends to coincide with the distribution that describes changes in the size of opportunities pursued - that is, the Gibrat process. Eventually, the self-reinforcing mechanisms that can spur growth chances fade away, and the fat tails in the growth distributions disappear (Fu et al. 2005).



(a) PoorRU7

(b) RichSM3

Figure 3: Simulation results of a typical run: Number of opportunities.
Notes. Distributions of number of opportunities per firm and Kernel density estimation with bandwidth equal to 0.5 are shown. (a) poor, rugged, $d^* = 7$, PoorRU7; (b) rich, rugged, $d^* = 3$, RichRU3; (c) rich, smooth, $d^* = 3$, RichSM3. The results derive from a setting with fixed costs = 10, birth rate = 0.01, initial number of firms = 400, and time step $T = 2000$.

4.2 Profit differentials between firms

The simulation model replicates a skewed distribution of the number of opportunities per firm, consistent with the patterns observed in empirical investigations. This shape implies that most firms seize few opportunities, and very few entities account for a large fraction of the business opportunities that arise during the simulation period. Figures 3(a) and 3(b) clarify the rationale that underlies decreasing average firm size as we move away from the baseline scenarios. In this scenario (Figure 3(a)), the average number of opportunities per firm is 5.7, the median is 4.3, and approximately 30% of firms capture at most one opportunity. When organizational capabilities are effective (Figure 3(b)), the portion of companies that seize at most one opportunity increases dramatically, to 60%, which causes the average number of opportunities per firm to shrink to 2.9. When organizational capabilities get activated, mutations in the surrounding environment do not significantly affect the shape of the distribution: many firms tend to cluster around the minimum, and a small bunch of entities grab more than 10 opportunities.

The selective power of organizational capabilities and the interaction between the internal structure of the firm and the external environment also influence the configuration of the portfolio of opportunities. To assess the importance of this phenomenon, we categorize the total variation in the value of seized opportunities into between and within variation. The former reflects between-firm differences in the portfolios of opportunities; the latter reflects the degree of variability in the portfolio of a typical firm.

Our analysis (Table 3) reveals that the higher the selective power of organizational capabilities, the wider are the interfirm differences in terms of seized opportunities. Shifting to a regime in which we set the seizing distance at a higher level ($d^* = 3$) causes the share of between-firm deviance in the value of opportunities to increase from 13.3% in the baseline scenario to 44.6%. Moreover, when the selective power of organizational capabilities interacts with a correlated structure of the outer environment, the differences in the portfolios of business opportunities that firms address increase; the between-firm deviance then reaches a maximum value of 61.2%. This result primarily reveals that each entity tends to capture similar opportunities, and this process is self-reinforcing. Nevertheless, dissimilarities among firms get partially mitigated by the richness of the environment. With a binding seizing distance and some degree of complexity in the landscape (see columns two and six in Table 3), the percentage of within-firm deviance increases as the environment gets richer (columns four and eight in Table 3). Therefore, the abundance of new opportunities in the surrounding environment engenders greater heterogeneity in the portfolio of activities of each firm.

To explicate the joint effect of binding organizational capabilities and a higher level of correlation in the value of opportunities, we explore the average unitary profits by quartiles across the eight scenarios (Table 4). Our results clearly show that when organizational capabilities play a selective role, the mean value of profits per opportunity increases, independent of the surrounding conditions. Such an upsurge involves only firms in the second or higher quartiles of the distribution. In contrast, firms that perform poorly when their organizational capabilities cannot grab opportunities do not enhance their score in these new scenarios. Other differences in the average profitability of firms appear when we assess the additional effect of moving toward a smooth landscape, after setting the seizing distance at its binding level. In this case, the number of entities that experience a boost in their average performance shrinks and, ultimately, includes only firms in the fourth quartile.

Table 3: Decomposition of the total variability in the value of opportunities

	Scenarios							
	Poor Environment		Rich Environment		Poor Environment		Rich Environment	
	RU7[a]	RU3	RU7	RU3	SM7	SM3	SM7	SM3
	Total deviance							
MC Mean	1745100	952842	1762700	1100550	1815390	908187	1828790	1051030
	Within deviance							
Contribution to total deviance	86.71%	55.43%	86.48%	64.05%	86.59%	38.80%	85.98%	50.15%
MC Mean	*1513180*	*528124*	*1524390*	*704956*	*1571880*	*352363*	*1572330*	*527116*
	Between deviance							
Contribution to total deviance	13.29%	44.57%	13.52%	35.95%	13.41%	61.20%	14.02%	49.85%
MC Mean	*231919*	*424717*	*238311*	*395599*	*243512*	*555824*	*256460*	*523918*

Notes: Monte Carlo sample size = 200. [a]Baseline scenario.

Table 4: Monte Carlo statistics of the distribution of profits by quartiles.

		Scenarios							
Quartiles	**MC means**	Poor Environment		Rich Environment		Poor Environment		Rich Environment	
		RU7[a]	RU3	RU7	RU3	SM7	SM3	SM7	SM3
Q4	Mean	54.375	79.064	54.040	77.353	55.234	88.552	54.597	85.489
	Standard deviation	*15.943*	*21.489*	*14.675*	*23.131*	*16.606*	*26.073*	*12.778*	*27.444*
Q2-Q3	Mean	36.500	49.114	37.386	48.811	37.888	50.825	38.459	49.820
	Standard deviation	*2.219*	*4.474*	*2.330*	*3.954*	*2.299*	*5.239*	*2.556*	*4.856*
Q1	Mean	19.226	19.279	19.228	19.206	20.182	20.197	19.715	20.267
	Standard deviation	*5.634*	*7.051*	*5.875*	*7.243*	*5.168*	*6.836*	*5.925*	*6.977*
Whole distribution	Mean	34.955	45.772	35.233	45.378	35.892	48.805	35.858	47.772
	Standard deviation	*0.511*	*1.263*	*1.255*	*1.269*	*0.815*	*18.168*	*1.283*	*1.127*

Notes: Monte Carlo sample size = 200. [a]Baseline scenario.

Table 5: Monte Carlo statistics for the persistence of profits

Parameters (MC Means)	**Scenarios** Poor Environment RU7[a]	RU3	Rich Environment RU7	RU3
β_0	0.444	0.601	0.466	0.592
	0.009	*0.042*	*0.03*	*0.023*
Percentage of series with a significant β_0 coefficient	27.083	28.145	32.028	30.057
β_1	0.987	0.987	0.986	0.987
	0.000	*0.001*	*0.001*	*0.000*
Percentage of series with significant β_1 coefficient	100	100	100	100
R^2	0.974	0.973	0.973	0.974
	0.001	*0.001*	*0.001*	*0.001*
	Poor Environment SM7	SM3	Rich Environment SM7	SM3
β_0	0.482	0.682	0.481	0.613
	0.019	*0.049*	*0.026*	*0.031*
Percentage of series with a significant β_0 coefficient	31.611	31.639	29.959	29.759
β_1	0.986	0.986	0.986	0.987
	0.001	*0.001*	*0.000*	*0.000*
Percentage of series with a significant β_1 coefficient	100	100	100	100
R^2	0.973	0.973	0.973	0.974
	0.001	*0.001*	*0.001*	*0.001*

Notes: Monte Carlo sample size = 200. Monte Carlo standard errors in italics. Coefficients β_0 and β_1 refer to the estimation for each firm i of the linear equation: $\pi_{i,t} = \beta_0 + \beta_1 \pi_{i,t-1} + \epsilon_{i,t}$, where π represents the unitary profit of firm i at time t, and $t = 1900, .., 2000$.
[a]Baseline scenario.

To examine whether the degree of concurrence between the substance of the firm and the context in which it operates gives rise to long-lasting differences across firms, we estimate an autoregressive model over the simulated data of the surviving firms:

$$\pi_{i,t} = \beta_{0,i} + \beta_{1,i}\pi_{i,t-1} + \epsilon_{i,t}, \qquad t = 1900, \ldots, 2000$$

In this regression, $\pi_{i,t}$ represents the unitary profit accruing to the firm i at time t, β_0 captures idiosyncratic differences that may cause the long-run profits, $\pi_{ip} = \frac{\beta_{0,i}}{1-\beta_{1,i}}$, which firms earn to diverge from the zero excess profits conjectured in neoclassical economic theory, β_1 reflects the persistence with which profits differ period by period from their long-run level, and $\epsilon_{i,t}$ is an error component that summarizes the influence of unsystematic shocks on profitability.

Previous research (Mueller 1990) indicates that firm characteristics are more important than industry factors for explaining the long-run equilibrium value of company profits. Accordingly, we expect our capabilities-based simulation model to predict a nonnegligible fraction of β_0 coefficients different from 0. The data in Table 5 show that the average estimated β_0 in the baseline model is equal to 0.4, which is significantly different from the null profit level for 27.1% of the series. A change in the baseline scenario that enables organizational capabilities to play a selective role has a positive bearing on the persistence of long-run profit rates. The average value of the parameter β_0 increases to 0.6, and the portion of series in which this coefficient is statistically different from 0 increases more than one percentage point. If we activate the selective power of organizational capabilities and hold the richness of the outer environment constant, the decline in the complexity of the landscape significantly affects the estimates of β_0. In a poor environment, for example, moving toward a smooth landscape raises the estimated β_0 to 0.68, leading to an upsurge of approximately 3.5 percentage points in the number of series for which this parameter is statistically significant.

5 Conclusions

We develop an agent-based model to investigate the role of organizational capabilities in shaping growth and profit differentials across firms. Although most empirical evidence supports the idea that organizational competences offer important sources of variation in long-run profitability, the large random component of empirically observed corporate growth rates undermines the notions of core competences as drivers of corporate growth (Geroski 2000).

To reconcile these apparently contrasting regularities, we draw on the deep-rooted tradition of stochastic models of growth (Ijiri and Simon 1977) and propose a model of bounded rational organizations to show how the interplay between organizational capabilities and the structure of the environment bear on the observed patterns of size, growth, and rate of profits. Our contribution extends standard stochastic growth models by incorporating behavioral assumptions about the interactions between the firm and the business environment; as well as the mechanism by which firms sense and seize business opportunities. The resulting framework provides a viable platform that combines the analytical robustness of stochastic modeling with widely accepted insights from capabilities-based theories of the firm (Dosi and Marengo 2007) and technology studies (Pavitt 1998).

The simulation model we implement also generates firm size distributions that are right-skewed and heterogeneous across sectors, which is consistent with empirical evidence from extant literature (Hall 1987; Stanley et al. 1995; Cabral and Mata 2003; Growiec et al. 2008). The selective power of organizational capabilities significantly affects the steady-state distribution of firm size. As the required concurrence between the internal structure of the firm and the nature of business opportunities increases, firms become unable to capture opportunities that are highly dissimilar from their internal structure; irrespective of the external conditions, a decline in their average and median size occurs. A binding seizing distance also changes the peak and skewness of the size distribution, which becomes flatter with a fatter upper tail. Nonetheless, a departure from the baseline scenario that involves only a change in the seizing distance is not sufficient to generate an upper tail in the firm size distribution that is consistent with a power law model. Rather, the interaction between the selective power of a firm's organizational capabilities and variations in the surrounding landscape provokes significant departures from the log normal in the upper tail of the size distribution. Furthermore, when organizational capabilities are effective, a movement toward a rich environment emerges as the primary force that underlies the observed upsurge in the average and median size.

In the baseline scenario, the distribution of growth rates computed on a one-period interval displays a tent-shaped form that closely mirrors the one typically found for real-world data (Stanley et al. 1996; Fu et al. 2005; Bottazzi et al. 2007), which can be well approximated by a Laplace model. Moreover, our simulation model points out that more effective organizational capabilities lead to increases in the portion of entities that pursue one opportunity at most. This shift in the distribution of business opportunities has a direct bearing on the shape of the growth rate distribution, which still deviates from the bell-shaped form implied by a simple Gibrat's process but not as strongly as in the baseline scenario. Therefore, the interaction between binding organizational capabilities and the outer environment causes the tails of the growth rate distribution to grow smaller.

This finding has an important implication for the alleged relationship between organizational capabilities and firm growth. Our results suggest that the lack of significance of lagged dependent variables in a typical autoregressive model of growth (Geroski 2000), or the mild association that lasts for no more than one period (Coad 2007), do not necessarily undermine the notions of core competence and learning as drivers of corporate growth. Rather than the average effects that standard econometric techniques detect, we identify major changes triggered by organizational capabilities in firms' dynamics, in both tails of the growth rate distribution.

A skewed distribution of the number of opportunities per firm also emerges from our simulation exercise, such that a handful of entities appear to account for much of the business opportunity that arises throughout the simulation period. When organizational capabilities are effective, a sharp increase in the portion of companies that seize at most one opportunity occurs, which in turn causes many surviving firms to polarize around the minimum threshold that allows them to run their business.

The interplay between the internal firm structure and the external environment also influences the configuration of the portfolio of opportunities pursued. Our analysis reveals that the higher the selective power of organizational capabilities, the wider are the interfirm differences in terms of the value of seized opportunities. When the selective power of organizational capabilities interacts with a smooth landscape, the differences in the portfolios of the business opportunities that firms address get even larger. This result primarily indicates that each entity tends to capture similar opportunities, and this process is self-reinforcing.

In addition, our statistical exercise reveals that the mean value of unitary profits in the second and higher quartiles of the distribution increases when organizational capabilities play a selective role, independent of the surrounding conditions. A correlated landscape magnifies such an upsurge in the average profitability of firms. Nonetheless, the set of entities that undergo a boost in their average performance shrinks and, ultimately, comprises only firms in the fourth quartile.

A complementary analysis of the autoregressive process governing the dynamics of unitary profits shows that the degree of concurrence between the substance of the firm and the context in which it operates gives rise to long-lasting differences between firms. According to our exploration, moving away from the baseline scenario by allowing organizational capabilities to play a selective role has a positive effect on the persistence of long-run profit rates.

If this change occurs together with declining complexity in the surrounding landscape, the parameter that captures idiosyncratic differences in the autoregressive model grows even larger. Overall, when the landscape is correlated, firms that are better positioned at the beginning of the process tend to reinforce their position as time goes by; in such a context, organizational capabilities drive the capture of new, highly valued opportunities.

The agent-based approach proposed herein may enrich the debate on growth and performance by suggesting explanatory models that bring together insights from various strands of economic literature that so far have developed independently. We also believe that a few extensions could make the model more generalizable. First, competition could be modeled explicitly, such that the value of investment opportunities is sensitive to the number of firms that choose them. Second, it may be desirable to include an evolutionary component in our model, for example, a process of organizational change that may lead firms to modify their positions in the landscape. Further work also is required to define an empirical counterpart for the "artificial worlds" we built, a necessary step to test the predictive power of this model. This extension could help classify the environmental conditions in which firms operate, as well as capture the role of organizational capabilities in seizing business opportunities. Historical data about patents, new products, and the volatility of sales and market shares might provide a good empirical content for concepts such as environmental richness and complexity.

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