



Heterogeneous effects of heterogeneity

Disentangling heterogeneity positive and negative effects on performance

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Abstract

Purpose – The aim of the paper is to test the Heterogeneity Construct as a second-order construct determined by dimensions expressing the resource utilization process carried out by firms, and to test the different impacts of Heterogeneity sub-dimensions on firm's performance.

Design/methodology/approach – After collecting data on the machine tools industry, two models are tested by Lisrel. The first model is a second order confirmatory model. The second one is a structural model testing the causal relations between Heterogeneity components and Performance.

Findings – It is found that Heterogeneity is a second order construct, whose dimensions differently contribute to firm performance: two of them positively and a third dimension negatively.

Research limitations/implications – Limitations of the study refer to single industry used, limited sample size, and single respondents. Even if the sample size is low, it allows to run the model and to estimate results. The single respondent bias is mitigated by interviewing managers involved in the resource utilization process. Future research could improve our comprehension of the heterogeneity construct by testing the model in other industries.

Practical implications – By discovering the different effect of the Heterogeneity dimensions on firm performance, we provide some useful implications for managers involved in the resource utilization process. To reach a competitive advantage, firms should orient their decisions to leverage on "contextuality" and "complexity", while mitigating the effect of "intertwinedness".

Originality/value – Studies in the strategic management field of study measure Heterogeneity by using single variables. This paper fills in this gap by providing a measure of the Heterogeneity construct on a multidimensional basis, showing the different role played by each dimension on firm performance.

Keywords Organizational performance, Business performance, Management strategy

Paper type Research paper

Introduction

How does interfirm heterogeneity affect the performance of firms? This is one of the most crucial questions in the field of business strategy posed by Penrose (1959) nearly half a century ago. Over the last two decades, many attempts have been made to answer this question from the resource-based view (hereafter RBV – Barney, 1991; Wernerfelt, 1995), the competence-based perspective (Henderson and Clark, 1990; Prahalad and Hamel, 1990) and the capabilities approach (Leonard-Barton, 1992; Kogut and Zander, 1992; Teece *et al.*, 1997)[1]. Heterogeneity has been highlighted as a main explanation of how firms succeed in achieving competitive advantage (Sakakibara, 1997; Noda and Collis, 2001; Hoopes *et al.*, 2003; Knott, 2003a). Nevertheless, its definition, the clarification of its construct and whether its effect on performance has to



be assumed as homogeneous or, instead, as heterogeneous (that is, a “sum” of differentiated effects, some positive, while others negative) have been, so far, neglected.

Treating interfirm heterogeneity as a monodimensional positive factor affecting performance hampers the analysis of causality between resources and performance since, before analyzing what kinds of resources have an impact on performance, a more basic question should be addressed: Is heterogeneity really monodimensional? And if not, what are its components and how do they affect performance? Early contributions attributed sources of differences in firms’ performance to unobserved heterogeneity among firms (Mundlak, 1961; Griliches, 1986; Barney, 1991), while more recent studies addressed performance differences as a result of heterogeneity in capabilities and positioning (Henderson and Cockburn, 1994; McGahan and Porter, 1997).

However, if heterogeneity is deemed an important phenomenon in explaining causality between resources and performance, it should be analyzed for its own effect and impact on performance, before addressing how different kinds of resource have a differential role in explaining competitive advantage (i.e. Henderson and Cockburn, 1994). Therefore, the goal of this paper is define with more precision the concept of heterogeneity and identify its underlying constructs, and to explore how heterogeneity affects firms’ performance through its underlying constructs. This is also consistent with recent contributions in the literature of business strategy invoking the use of a more precise approach to construct measurements (Boyd *et al.*, 2005a,b). Also, for the purpose of this article, defining the heterogeneity construct and its dimensions is relevant in order to better understand the link between resource management and competitive advantage.

In fact, RBV theorists emphasized a twofold approach in understanding competitive advantage, creation and sustainability. Regarding the creation approach, it is useful to consider the characteristics of resources firms must possess in order to generate a competitive advantage: valuable, rare, unique and firm-specific (Barney, 1991). According to the sustainability approach the relevance of non-substitutable and non imitable resources should be considered (Peteraf, 1993) without, however, allowing a firm’s top management to lose sight of the actual sources of advantage so to protect them from imitation and consistently invest in the maintenance and innovation of these invaluable resources.

In essence, even though a given firm is able to generate competitive advantage, it may not necessarily gain a persistent advantage over competitors. To do this, firms must first protect their advantage from other actors’ attempts to appropriate such resources and, at the same time, thoroughly understand and value its own source of advantage, so as to implement strategies which sustain competitive advantage (King, 2007; Sirmon *et al.*, 2007).

Therefore, in order to address the sustainability of competitive advantage, the purpose of this paper is to empirically demonstrate that heterogeneity is a multidimensional phenomenon made of several dimensions acting in a differentiated manner on performance, some positively while others negatively. The paper is organized as follows: the next session analyses heterogeneity by defining its concepts and constructs and examines the role of heterogeneity in gaining and sustaining competitive advantage. This is followed by an analysis of the relationship between heterogeneity and firms’ performance. Finally, the discussion highlights implications for research and practice.

Heterogeneity and competitive advantage

The analysis of interfirm differences from the perspective of strategic management can be traced to early contributions in the field of Business Policy. Central to this field are studies highlighting superior managerial capabilities (Barnard, 1938; Selznick, 1957), material and human resources (Penrose, 1959), and distinctive competencies and strengths as sources of heterogeneity (Andrews, 1971). In this paper, the analysis of interfirm differences is carried out from the perspective that:

- Heterogeneity, as an endogenous source of interfirm differences is a multidimensional phenomenon.
- The dimensions of heterogeneity affect performance in a differentiated manner, that is, heterogeneously and not homogeneously.

Heterogeneity as an endogenous multidimensional phenomenon

Although it seems widely accepted in the field of strategic management that firms are unique and socially complex entities and not just, or even not at all, production functions or maximizing actors (Kogut and Zander, 1992), the source of uniqueness –, i.e. heterogeneity – has only recently been carefully scrutinized and studied understand how it contributes to a firm's competitive advantage (Knott, 2003a; Hoopes *et al.*, 2003). Penrose (1959 p. 75) actually first directed our attention to interfirm heterogeneity by observing that “it is the heterogeneity, and not homogeneity, of the productive services available or potentially available from its resources that gives each firm its unique character”.

In essence, it is the *use* of resources, and not resources *per se*, that creates heterogeneity among firms and, thus, the potential for value creation (Sirmon *et al.*, 2007). In fact, extending this observation by Penrose, many have proposed that a firm's heterogeneity rests upon unique, scarce or rare, inimitable and costly-to-build idiosyncratic, firm-specific resources (Teece, 1982; Wernerfelt, 1984; Rumelt, 1984; Dierickx and Cool, 1989; Barney, 1986a; 1991; Castanias and Helfat, 1991; Grant, 1991; Mahoney and Pandian, 1992; Peteraf, 1993; Hoopes *et al.*, 2003). The issue of firm-specific resources represents the cornerstone upon which the focus of business theory has diverted from explanations of performance based on purely industry-based competition towards those approaches in which firms earn above-average returns (Reed and DeFillippi, 1990) and rents (Mahoney, 1991; Amit and Schoemaker, 1993; Peteraf, 1993) through the leverage of assets such as R&D competencies (Helfat, 1997) and marketing capabilities (Srivastava *et al.*, 2001).

Even before the emergence of the RBV, the relevance of heterogeneity has been addressed in the context of mobility barriers (Caves and Porter, 1977), isolating mechanisms (Rumelt, 1984), superior information and/or luck (Barney, 1986 “a”), asset stock accumulation (Dierickx and Cool, 1989), unique factors (Montgomery and Wernerfelt, 1988), causal ambiguity (Reed and De Fillippi, 1990), managerial expertise (Castanias and Helfat, 1991), imperfect mobility (Barney, 1991; Peteraf, 1993), and functional similarity and capability equivalence (Peteraf and Bergen, 2003).

Recent research has addressed the concept of heterogeneity as the source of a firm's sustained competitive advantage at the founding stage (Noda and Collis, 2001), in R&D-intensive industries (Cockburn *et al.*, 2000), in geographical clusters (McEvily and Zaheer, 1999), and in effective network and relationship management (Rodan and Galunic, 2004). Others instead, have identified that it is differences in resource

endowment among firms that determines whether the strategic attainment of goals such as innovation (Knott, 2003a) and interorganizational learning (Sakakibara, 1997) can actually be achieved. Besides these contributions, the concept of heterogeneity has, to date, either not been defined at all[2] or has only received a general and generic definition in the area of strategic management. Given that sources of heterogeneity stem from the utilization process of an embedded bundle of resource within the firm, it may be necessary to consider heterogeneity as a complex endogenous multidimensional phenomenon.

The differentiated effects of heterogeneity dimensions

Interfirm differences are undoubtedly at the core of persistent above-average performances, yet the source of such differences, i.e. the tacit and socially embedded processes (Kogut and Zander, 1992) through which resources are transformed into products, has been treated as either an ambiguous phenomenon which defies definition, or considered only within the context of market failure (Barney, 1986 “a”)[3]. Nelson (1991), in his seminal paper posed the question “Why do firms differ, and how does it matter?” Through this, he debates the validity of neoclassical approaches for understanding innovation and change, pointing out that working with theoretical models which presume that all possible outcomes of economic activities are known to all the competing firms within an industry, is of little help for understanding competitive dynamics in which some firms may not be aware of the opportunities pursued and actions conducted by their competitors. Nelson (1991) stressed the relevance of routines and capabilities, drawing from Schumpeter (1911, 1942) Chandler (1962), Teece (1980, 1982) and his own work with Winter (1982) (why firms do differ), highlighting that it is the differences which exists among firms which accounts for differences in their performances (why it matters).

Besides, it can therefore be argued that without heterogeneity there is little incentive for investing in risky economic activities (Rumelt, 1984 p. 560).

The dynamic approach to RBV, recently addressed by studies which incorporate the dimension of process in resource development (Helfat and Peteraf, 2003), may appear at odds with early RBV formulations. However, it is actually a more integrated approach towards a more complete resource-based theory for strategy (Knudsen, 1995; Foss, 1997). In this paper, the analysis of heterogeneity is thus shifted from a “static-and-exogenous” approach to one in which heterogeneity is considered a “process-generated, endogenous product”, assuming therefore, a central role in how resource utilization establishes competitive advantage (Sirmon *et al.*, 2007). In particular, rejecting the assumption of identical conditions of cost and demand, it is possible to eliminate the neoclassical dogma that firms are basically identical except for size.

This point shifts the central issue regarding heterogeneity/performance from mere resource ownership to the process of resource utilization, thus introducing the additional question of whether resource heterogeneity stemming from this process is a single- or a multiple-dimension phenomenon. We maintain that the resource utilization process which generates heterogeneity calls for a multidimensional analysis of how heterogeneity influences performance since some dimensions may exert a positive impact, while others may have a negative effect on performance. The following

sections provide a detailed discussion of the positive and negative effects of heterogeneity dimensions.

The heterogeneity construct

An extensive number of empirical studies have attempted to operationalize RBV, some using patent data (Henderson and Cockburn, 1994), while others have relied on property rights data (Miller and Shamsie, 1996), surveys (McGrath *et al.*, 1995), simulations (Knott, 2003a) and network analysis (McEvily and Zaheer, 1999; Rodan and Galunic, 2004). However, such studies and their empirical findings are non-convergent (Barney, 2001b; Hoopes *et al.*, 2003). In this paper, we propose that the explanatory power of RBV can be further enhanced once it addresses a major critique which RBV has received: RBV defines, rather than hypothesizes, that the differences in firm performances reflect the heterogeneity in firms' resource utilization process. This hinders future research efforts and, thus, the empirical utility and theoretical robustness of RBV (on this point, see the dialogue between Priem and Butler, 2001, and Barney, 2001a).

If RBV assumes heterogeneity as the source of competitive advantage, it is necessary to define its concept and related constructs. Unfortunately, even the most thorough of many recent contributions on this topic have failed to provide these definitions (see Hoopes *et al.*, 2003; and Knott, 2003 for a review). To define the heterogeneity concept and its construct, this section briefly reviews the theoretical RBV literature. Besides defining the concept, and hence the domain of the heterogeneity phenomenon the purpose is to identify the dimensions of its construct by analyzing what RBV theorists have considered elements contributing to the creation of interfirm differences.

To define the concept of heterogeneity and delineate the multidimensional constructs which it represents, it is necessary to identify all the single-dimension constructs which refer to it (Venkatraman and Grant, 1986; Law *et al.*, 1998), and which in turn delineate the elements which contribute to the creation of interfirm differences. This would provide a useful approach to addressing the critiques of RBV (Peteraf, 1993; Priem and Butler, 2001; Barney, 2001). As Law *et al.* (1998: 741) observed:

[...] a necessary condition for a multidimensional construct to be well defined is that the relations between the overall construct and its dimensions must be specified. Without a specification of these relations, one cannot derive the overall construct form its dimension and can only conduct research at the dimensional level, even though these dimensions are claimed theoretically to be under an overall construct.

This point may help address the main flaw attributed to RBV: RBV researchers explore the relationship between firms' heterogeneity and performance differences focusing on differences in a firm's resource endowment (Cockburn *et al.*, 2000) rather than clarifying how to measure heterogeneity as an overall phenomenon (construct) consisting of a number of interrelated dimensions. Here we maintain that the heterogeneity construct exists at a deeper and more embedded level than its dimensions and, hence, is a higher-order abstraction which underlies its dimensions. This has been labelled as a *latent model*.

RBV theoretical studies (see: Foss, 1997; Hoopes *et al.*, 2003; Barney and Arkan, 2001), have shown that elements which contributes to the creation of interfirm differences can be grouped into three main issues:

- (1) the *locus* specificity, the idiosyncraticness and the non-tradability of resource utilization process;
- (2) the complex composition of a given resource bundle; and
- (3) the characteristic of “*interrelation*” of resources during their utilization.

The first point regards *locus*-specificity and idiosyncraticness and thus the non-tradability (Dierickx and Cool, 1989; Barney, 1991) of the outcome of the resource utilization processes. Wernerfelt (1984) dealt with *locus*-specificity under the concept of resource position barrier. Rumelt (1984), instead, addressed non-tradability by introducing the concept of isolating mechanisms (i.e. team-embodied skills, reputation and image, consumer and producer learning), a vehicle for establishing idiosyncraticness and thus a barrier to imitation. Providing a different perspective, Dierickx and Cool (1989), focused on the internal accumulation of asset stock (i.e. resources) in the presence of imperfect strategic factor markets while Barney (1991) more explicitly attributed market imperfections, and hence heterogeneity, to resource immobility among firms. In contrast to this emphasis on extrinsic factors, Kogut and Zander (1992) observed that what constitutes a firm’s source of uniqueness is the bundle of knowledge and capabilities which is embedded within the organization. In fact, Rumelt (1995) emphasized the role of inertia as a result of firm-specific routinized processes and, likewise, Teece *et al.* (1997) maintained that resource endowments are *sticky*. A number of contributions are consistent with these studies (Peteraf, 1993; Amit and Schoemaker, 1993; see, also, special issues edited by: Barney and Zajac, 1994; Helfat, 2000; Hoopes *et al.*, 2003). All these contributions converge to identify that it is *locus*-specificity of the resource utilization process which determines a firm’s uniqueness, and hence its heterogeneity.

The second point concerns the unobservable number of ways resources can interact when being used by a firm. Simon (1947) drew upon the concept of complexity in business administration as a means for criticizing the assumption of perfect rationality of managerial cognition. Nelson and Winter (1982) introduced the concept of routine to delineate socially complex changes within firms. Others pointed out that individuals working across functional barriers within organizations contribute to the creation of a complex network of relations. In this vein, Prahalad and Hamel (1990) highlighted the importance of core competencies which have been developed through collective learning, while Leonard-Barton (1992) on the other hand, maintained that a firm’s core capabilities represents an interrelated and interdependent knowledge system. Likewise, Grant (1991) observed that organizational capabilities differ in their complexity, since they involve the integration of ideas, skills, knowledge and a wide variety of technologies, while Collis (1994) pointed out that organizational capabilities can be conceived as socially complex routines which affect the process of transforming inputs into outputs. Finally, Verona (1999) drew attention to the role that multiple levels of interactions have within the firm, across its functions, and during innovation-related processes. All these scholars share the view that resource utilization is a complex process where individual-, team-, and corporate-based knowledge interact

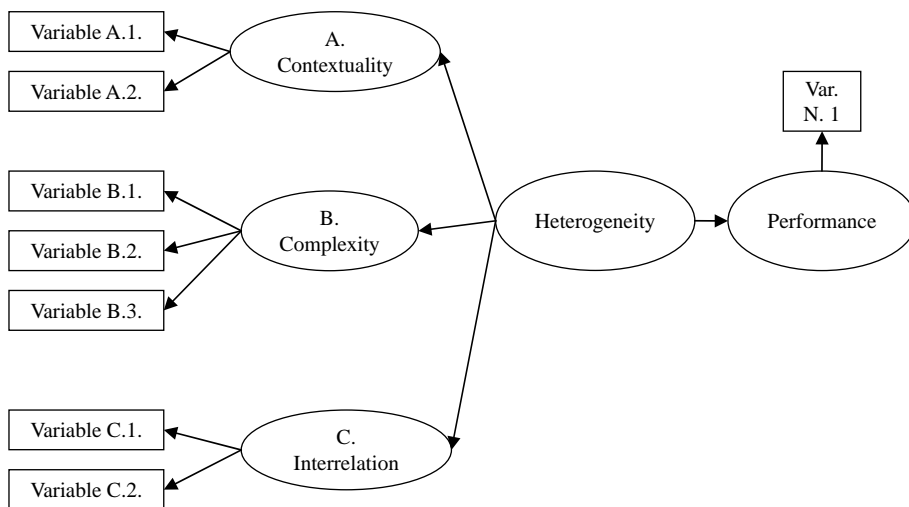
and become integrated to create tacit intra-firm capabilities, which in turn give rise to the underlying interfirm heterogeneity.

The third point refers to the unobservable network of intertwined interrelations among resources when these are being utilized. Teece (1986) addressed this point maintaining that any innovation, to be a source of profit, must rely on co-specialized resources. Likewise, Dierickx and Cool (1989) also observed that increments in resource stocks depend on complementary resources. Barney (1991), instead, focused on the concept of resource bundle, suggesting that it is necessary to adopt a holistic approach to considering a firm's resource endowment (i.e. physical, human capital and organizational capital resources). Similarly, Amit and Schoemaker (1993), emphasized the entangled nature of strategic assets, such that during their application or deployment, the strategic value of each asset may increase as a function of an increase of the presence other strategic assets. Besides, when resources are being utilized they complement each other systemically, thus creating an underlying bundle not completely observable network of relations which. Drawing from control theory, Winter (1987) maintained that a firm's resources can be compared to state variables and control variables, whereby the former are not subject to change in the short term, but the latter can be; adopting an heuristic frame, which is a systemic, yet non completely coded, network of action, both the variables of state and control (i.e. a firm's resource portfolio) are deployed in order to solve a strategic problem. In a similar vein, Henderson and Clark (1990) dealt with architectural and component competence to emphasize the interconnected nature of a firm's resource endowment. Black and Boal (1994) introduced the concepts of contained and system resources to highlight how these interact during an organization's life, and showed that while contained resources are based on a simple network of resources, system resources emerge from a complex network. Finally, Lippman and Rumelt (1982) used the concept of isolating mechanisms to explain why it is that competitors find it difficult to understand the causal connection between actions and positive results. Likewise, Reed and DeFillippi (1990) emphasized causal ambiguity as a barrier to imitation, since external observers cannot completely comprehend the experience-based interactions which take place among individuals involved in routinized team-based practices. These support the concept that, when resources are being utilized, an unobservable network of relations is created among available resources and the nature of this network determines a firm's heterogeneity. The characteristics and dynamics of these inter-resource networks remain tacit, unobservable and not amenable to definition.

Summarizing, these three issues [locus specificity and idiosyncraticness of resources utilization process; interaction among resources under utilization; and entangled/unobservable network of relationships among resources] may therefore be synthesized into the following dimensions:

- (1) contextuality;
- (2) complexity; and
- (3) interrelation.

As discussed above, with respect to these dimensions, the heterogeneity construct therefore actually exists at a deeper level as an underlying phenomenon, according to a *latent model* of multidimensional construct shown in Figure 1.



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Figure 1.
Heterogeneity as superordinate construct as a cause

The heterogeneity construct can, therefore, be defined as follows: heterogeneity is a multidimensional construct which defines interfirm differences in terms of how resources are utilized. It is comprised of the three overlying dimensions of contextuality, complexity and interrelation, which characterize the process of resources utilization.

Once the heterogeneity construct has been defined, it becomes possible to operationalize it by means of its dimensions (Venkatraman and Grant, 1986; Law *et al.*, 1998; Boyd *et al.*, 2005a,b).

Hypotheses

In this section we hypothesize that heterogeneity is a multidimensional construct which acts through its overlying dimensions, the different effects of which can be seen in the resource utilization process. Many have suggested that the construct of heterogeneity must be measured better given its relevance to the field of strategic management (Boyd *et al.*, 2005a). However, empirical studies reflect the attempt to assess the complex construct of heterogeneity using single-dimension measures. For example, heterogeneity has been defined mono-dimensionally as technological capabilities (Sakakibara, 1997), superior managerial decision making (Cockburn *et al.*, 2000), resource endowment at the founding stages of a firm (Noda and Collis, 2001), and knowledge resources (Knott, 2003a). Indeed, as a complex construct, the impact of heterogeneity on performance requires a two-step approach with the first providing a definition of the heterogeneity construct, including its reliability and validity assessment before undertaking the second step in which the impact of heterogeneity on performance can be assessed.

The first step must therefore confirm the validity of a latent model (Law *et al.*, 1998) as proposed above, and verify whether the heterogeneity construct is indeed an underlying phenomenon defined by the overlying dimensions of contextuality, complexity and interrelation.

The second step of analyzing how heterogeneity influences performance requires a more articulated analysis which examines the relationships between each overlying

dimension of the heterogeneity construct and performance. In fact, here we assume that contextuality, complexity and interrelation affect performance differently. More precisely, while contextuality and complexity supposedly influence performance positively, interrelation, instead, is associated with negative effects upon performance. The positive effect of contextuality reflects how this dimension offers a means for protecting the resources which account for a firm's competitive advantage. Likewise, complexity is also assumed to bring about a positive effect, for it prevents rivals from identifying the sources of competitive advantage, thus impeding imitation. Interrelation, instead, produces a negative effect upon performance since it hampers the capability of a firm's management to understand how resources actually contribute to the development of the competitive advantage.

Thus:

- H1.* Heterogeneity is a multidimensional construct made of three dimensions: contextuality, complexity and interrelation.
- H2.* Heterogeneity does affect a firm's performance as a function of the differentiated impact that its overlying dimensions have on performance and, specifically.
 - H2a.* Contextuality, as an overlying dimension of the heterogeneity construct, affects a firm's performance positively.
 - H2b.* Complexity, as an overlying dimension of the heterogeneity construct, affects a firm's performance positively.
 - H2c.* Interrelation, as an overlying dimension of the heterogeneity construct, affects a firm's performance negatively.

Methodology

The items used to measure the latent variables have been developed for each dimension (Churchill, 1979) following the classical approach in scale development (DeVellis, 1991).

Due to the absence of scales used in literature to measure the constructs of interest, we relied upon theoretical concepts and definitions from the literature on each of the three sub-dimensions. Specifically we have analyzed those contributions within the RBV which have analyzed the main elements in the resource heterogeneity. A detailed analysis of items for each dimension and the respective authors' contributions is shown in Table I.

This study was conducted on a sample randomly drawn from the machine tool (Mazzoleni, 1999) industry, referring to the ATECO 2001 code[4]. The data have been collected by administering a questionnaire to firm executives of 350 firms. After collecting data, some incomplete questionnaires have been deleted, leading to a finale number of 132 complete questionnaires, with a response rate of 35 percent. The questionnaire was built on a typical 7-point Likert scale drawing from the literature on RBV to identify the items for each construct (Appendix).

The data collection stage was followed by a purification process carried out to identify the items to be used for each construct measurement. A factor analysis was run to identify the number of factors to retain. The scree-plot and the parallel

Authors	Main contribution	Dimensions	Heterogeneous effects of heterogeneity
Wernerfelt (1984); Hoffman <i>et al.</i> (2005); Doh (2005)	Resource position barrier	Contextuality	
Rumelt, 1984; Rugman and Verbeke (2002)	Isolating mechanism		
Dierickx and Cool (1989); Thomke and Kuemmerle (2002)	Asset stock accumulation		
Barney (1991); Tripsas and Gavetti (2000)	Immobility		
Rumelt (1995); Das and Teng (2000)	Inertia		
Peteraf (1993), Amit and Schoemaker (1993); Barney and Zajac (1994)	Imperfect mobility		
Teece, Pisano and Shuen (1997)	Resource stickiness		
Nelson and Winter (1982)	Routine	Complexity	
Kogut and Zander (1992)	Social embeddedness		
Grant (1991)	Variety		
Prahalad and Hamel (1990); Leonard-Barton (1992); Collis, 1994	Collective Learning		
Barney (1985)	Socially complex routines		
Lippman and Rumelt (1982); Reed and DeFillippi (1990)	Causal ambiguity	Interrelation	
Teece (1986); Chan <i>et al.</i> (2004)	Co-specialization and complementarity		
Winter (1987); Joia (2000)	Heuristic frame		
Dierickx and Cool (1989); Helfat (1997)	Interconnectedness and complementarity		
Henderson and Clark (1990)	Architectural and component competence		
Barney (1991)	Resource bundle		
Amit and Schoemaker (1993); Black and Boal (1994)	Strategic asset complementarity System resources		

Table I.
Heterogeneity dimensions, main authors and their contribution

(Keeling, 2000) analysis suggested us to retain three factors, thus confirming our assumption about the three sub-dimensions of the heterogeneity construct. With the factor analysis we deleted items poorly loading (< 0.40) on the expected construct and items with cross-loadings. The final structure was composed of seven items, each loading on the expected construct. All the scales have high cronbach's alpha and inter-item-correlation, thus showing good reliability and internal consistency, as can be seen from Table II.

As regards the performance measurement, it has to be observed that studies in the management field recognize the existence of several performance measures, such as ROI, ROE, Market Share, Growth, Profitability and Customer Satisfaction, just to mention a few (Keats and Hitt, 1988; Lumpkin and Dess, 1996). The financial literature highlights that the maximization of shareholder value is the most appropriate criterion of firm effectiveness (Bettis, 1983), while several scholars have also put forth that other indicators, such as stakeholder satisfaction, reputation and image, have to be taken into account (Cameron, 1978). Other researchers have posed that both financial and non-financial performance measures have different meanings at different moments during the life of an organization (Zahra, 1993; Dess and Lumpkin, 1996), and in different environmental conditions (Keats and Hitt, 1988). For the purpose of this

Table II.
Scales Reliability

	Cronbach α	Item-to-total correlations
<i>Contextuality</i>	0.87	
Resource position		0.77
Non-replicability		0.77
<i>Complexity</i>	0.62	
Routine		0.40
Collective learning		0.50
Variety		0.43
<i>Interrelation</i>	0.86	
Complementarity		0.75
Interconnectdness		0.76

paper, it is assumed that heterogeneity has a positive effect on financial performances, namely on the Return on Investment (ROI).

The factor structure emerging from the purification process constitutes the basis for the analysis, elaborated by the Lisrel software 8.5 (Jöreskog and Sörbom, 1998). The test of the first hypothesis is conducted by running a second-order confirmatory model where the Heterogeneity construct is a superordinate one, measured by the three reflective measures previously identified, and a cause of firm performance (Edwards, 2001).

In order to test the second set of hypothesis stated in the previous session we need to take the three sub-dimensions of the heterogeneity construct as a set of independent, even if related, factors (Edwards, 2001). This structure enables to assess the different impacts exercised by the three sub-dimensions of the Heterogeneity construct on Firm Performance. For this reason we run a second model on Lisrel, taking the three dimensions as distinct constructs and linking them to performance.

The covariance matrix used as input in the structural equation model is reported in Table III.

Model results

The first model we run on Lisrel was the Second-order confirmatory one, where we tested the existence of the Heterogeneity construct as a superordinate construct acting as a cause on firm performance (Edwards, 2001), as stated in *H1*. The goodness of fit indexes show a very good fit of the model to the data, not rejecting the *H1* of

Table III.
Covariance matrix

	Mean	STD	1	2	3	4	5	6	7	8
ROI	7.97	7.72	59.69							
Resource position	4.14	1.83	3.06	3.34						
Non-replicability	3.83	1.80	3.69	2.81	3.22					
Routine	4.83	1.34	1.84	0.83	0.65	1.82				
Collective learning	4.91	1.39	2.28	0.60	0.55	0.70	1.75			
Variety	4.83	1.41	-0.21	0.73	0.63	0.46	0.76	2.00		
Complementarity	4.76	1.41	-0.38	1.10	1.02	0.43	0.61	0.72	1.99	
Interconnectdness	4.82	1.29	-0.16	0.83	0.84	0.60	0.48	0.67	1.38	1.68

Heterogeneity as a second-order construct whose reflective measures are three latent constructs: Contextuality, Complexity and Interrelation.

The χ^2 was equal to 33.97(11), with a p-value equal to 0.00847. Even if this result is not satisfying, we need to consider the sample sensitivity of the chi-square statistics (Bagozzi and Baumgartner, 1994). The other fit indexes show a very good fit. Indeed, GFI was equal to 0.94, AGFI was equal to 0.87, and CFI was equal to 0.95. The other results, RMR = 0.65, RMSEA = 0.089, show a good fit, taking into account that they indicate perfect fit when they are equal to 0. Besides taking into account the goodness of fit model results, we have also to look at the measurement and structural model results. The measurement model refers to the relations between each of the observed variables and the latent constructs. In this case all the factor loadings linking the items to the latent constructs are high and significant, indicating reliability and convergent validity of the scales used to measure the three constructs (Anderson and Gerbing, 1988). The measurement results are reported in Table IV.

The three sub-dimensions of Heterogeneity are all highly and significantly correlated to the Heterogeneity construct, thus confirming its existence as a second-order multidimensional constructs with three reflective constructs as indicators. Results are shown in Table V.

Finally, we focus on the relation between the Heterogeneity construct and Firm Performance. The coefficient obtained was equal to 0.19 and the t-value was equal to 1.67, indicating the non significance of the parameter estimated. These results further support the need to look at the different contribution provided by the three Heterogeneity sub-dimensions to firm performance. The conceptual model is depicted in Figure 2.

Construct	Observed variable	Unstandardized values	Completely standardized values	R2	Standard errors	t-values
Contextuality	Resource position	1.00	0.95	0.91	0.09	— ^a
	Not-replicability	0.92*	0.90	0.80	0.20	9.77
Complexity	Routine	1.00	0.55	0.30	0.70	— ^a
	Collective learning	1.17*	0.66	0.43	0.57	4.32
Interrelation	Variety	1.10*	0.58	0.33	0.67	4.13
	Complementarity	1.00	0.90	0.80	0.20	— ^a
	Interconnectdness	0.87*	0.85	0.71	0.29	7.60

Notes: * p-value < 0.001; ^a t-values are not computed since the first parameter for each constructs has been fixed to 1 for parameterization

Table IV. Measurement results from the superordinate model

First-order construct	Unstandardized coefficient	Standardized coefficient	t-values
Contextuality	1.93*	0.66	3.61
Complexity	1.00	0.80	
Interrelation	1.52*	0.71	3.56

Note: * p-value < 0.001

Table V. Relations between the first-order constructs and the second-order heterogeneity construct

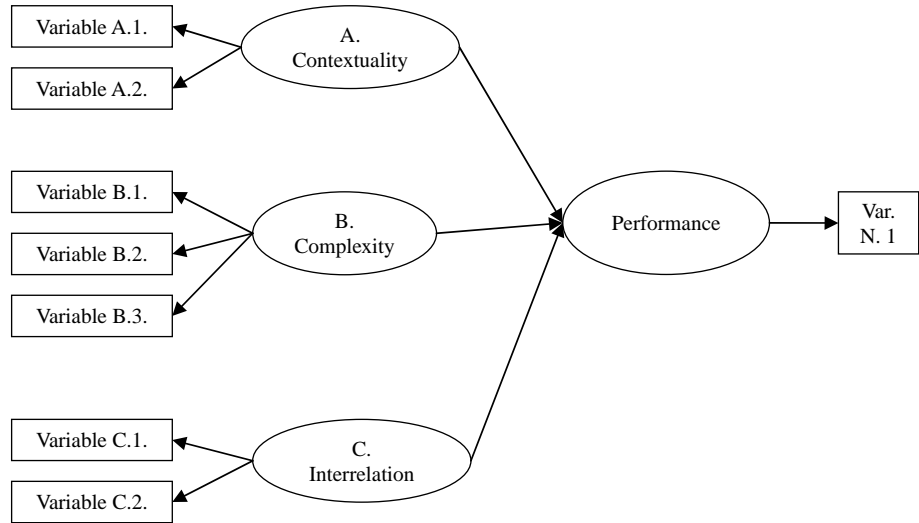


Figure 2.
Conceptual Model for the differentiated impact of the three constructs on performance

The goodness of fit model results obtained from the second structural equation model show a good fit. The chi-square was equal to 25.82 (df = 15), with a p-value equal to 0.087. GFI was equal to 0.96, AGFI was equal to 0.90, and CFI was equal to 0.97. The RMR value was equal to 0.048, and the RMSEA was equal to 0.064.

Results referring to the measurement model are reported in Table VI. All the loadings are high and significant, showing internal consistency and convergent validity of the scales used to measure the three latent constructs.

A final set of results refers to the structural model, carried out to assess the strength and the sign of the relations among the hypothesized latent variables. The results from the structural model are reported in Table VII.

From Table VII we can infer the relations between the three latent dimensions of the heterogeneity constructs and firm performance. All the coefficients are high and significant. This result shows that the three dimensions do exert an impact on

Costrutto	Variabili osservate	Unstandardized values	Completely standardized values	R2	Standard errors	t-values
Contextuality	Resource position	1.69*	0.93	0.86	0.14	12.02
	Not-replicability	1.66*	0.92	0.85	0.15	11.98
Complexity	Routine	0.73*	0.54	0.30	0.70	5.43
	Collective learning	0.91*	0.59	0.47	0.53	6.83
	Variety	0.79*	0.66	0.31	0.69	5.59
Interrelation	Complementarity	1.27*	0.90	0.81	0.19	10.95
	Interconnectdness	1.09*	0.84	0.70	0.30	10.08

Table VI.
Measurement results from the second model

Note: * p -value < 0.001

competitive advantage, even if with different strength and sign, as proposed above. Specifically we found that “Contextuality” and “Complexity” positively affect performance (standardized coefficient, respectively, are 0.29 and 0.30), while “Interconnectedness” has a negative effect on performance (standardized coefficient is equal to -0.34). As we can see from the Table V, the parameters linking “Contextuality” and “Interconnectedness” to Performance are significant (>1.96), while the parameter for “Complexity” to Performance is slightly lower than the threshold value (1.92).

The results referring to both the measurement and the structural model are reported in Figure 3.

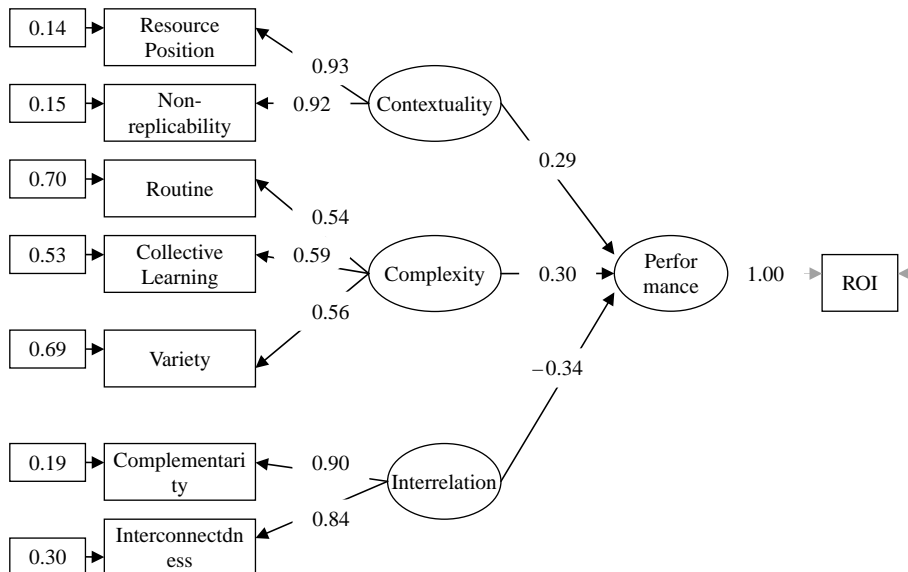
Discussion

Within the strategic management literature, RBV has focused on the firm’s internal side in order to find the sources of competitive advantage. One of its main assumptions is the existence of heterogeneity among firms in a same industry, leading to firm performance and sustainable competitive advantage. Though its relevance for the field

Path	Unstandardized coefficient	Standardized coefficient	t-values
Contextuality → Performance	2.22*	0.29	2.56
Complexity → Performance	2.31†	0.30	1.92
Interrelation → Performance	-2.66*	-0.34	2.52

Notes: † p -value < 0.10 ; * p -value < 0.05

Table VII. Structural results from the second model



Chi-square = 22.83, df = 15, P-value = 0.08779, RMSEA = 0.064

Figure 3. Differentiated impact of the three heterogeneity dimensions on performance

of study, the heterogeneity construct to date has not been fully explored or defined. The purpose of our study was to investigate the Heterogeneity construct in order to identify its main dimensions, and the role played by each of them on firm performance. The study shows how each of the three dimensions identified differently affect firm performance, thus providing interesting results for both practice and theory.

Implications for practice

Managers involved in the resource utilization process could find useful directions from the comprehension of the link between firm specific dimensions and performance. The positive effect of contextuality on performance empirically demonstrates that it is the resource utilization process and not only resource ownership, that plays an important role in explaining differences in interfirm performance and highlights the importance of managerial choices such as those concerning differentiation strategies, human resource management (Wright *et al.*, 2001) and new market entry (Alvarez and Busenitz, 2001). In terms of managerial implications, assuming the case of a firm opting for a new market entry (Alvarez and Busenitz, 2001), differentiation and segmentation choices (Wright *et al.*, 2001) should eventually lead this company to challenge incumbent leading firms, and, mainly in hostile environments, this may prompt managers to opt for an imitative conduct (Lanza, 2005). Yet, this imitation strategy may be unsuccessful if it overlooks an incumbent's "non-replicability" and "resource position barriers". The Italian "Parmalat vs Barilla" challenge[5] in the bakery industry provides a concrete example for understanding how the related-diversification strategy performed by Barilla (through the Mulino Bianco bakery product subsidiary) could not be imitated by Parmalat (through the Mister Day bakery product subsidiary) since successful "Barilla-Mulino Bianco" strategies were due to the excellent management of distribution channels, superior managerial culture and innovation competences.

We found that the dimension of complexity highlight the collective nature of the resource utilization process as a means for acquiring a sustainable capability-based competitive advantage (Makadok, 2001). As to implications for management, there are some controversial points. For instance, a firm coping with a new positioning strategy due to a successful newcomer in its market will try to understand the reasons behind the competitor's success and, then, strategically counter-manoeuve. Yet, observing a rival's strategies will probably not allow an incumbent to fully comprehend the origins of a newcomer's competitive advantage. The empirical evidence regarding complexity and its variables is also consistent with studies implicating human resource management (Wright *et al.*, 2001) and marketing (Srivastava *et al.*, 2001) as sources of successful performance. An example is the case of Levi's, the US denim and apparel producer. By the early 1990s, Levi's began facing tough competition from makers such as Fiorucci, Benetton, Gap, Replay, Guess and Diesel, all of whom gained relevant shares in the apparel and denim market (Cillo and Lanza, 2003). When, Levi's attempted to remediate in the mid 1990s, it discovered that the most impressive competitor was actually a then small Italian company, Diesel, which was actually not a mainstream Italian apparel and fashion business[6]. Understanding the origins of Diesel's competitive advantage was a critical issue, due to a complex set of items: Italian top management, international chief-stylist, continuous experimentation and orientation towards innovation, hi-tech design and textile processing and non-orthodox

media strategy (Cillo and Lanza, 2003). As a result, Levi's changed its positioning strategy, also opting for a brand-extension strategy in the apparel business, but the attempt was not successful. In effect, Diesel's success was hardly understandable via simple observation.

The third and most controversial finding of this research is that concerning the component the dimension of interrelation which affected performance negatively through the variables of "interconnection" and "complementarity". In fact, studies have already pointed out that resources may indeed have a *dark side* (Rumelt, 1995). Our findings may provide decision makers with stimulating and unorthodox insights. As discussed above, interrelation hinders managers who are operating inside the processes of a given firm from understanding what are the sources of competitive advantage. In fact, when resources are highly interrelated, it is hard to understand how each single resource has contributed to the outcome generated by the managerial decision making. The not easy comprehension of the relation between resources and performance has been highlighted by causal ambiguity literature (King, 2007). Another explanation for the negative effect of interrelation on firm performance is attributed to the difficulty in transferring resources among different units where they can provide greater value if integrated and combined with other complementary asset (Teece, 1987). Moreover, without knowing the relations among resources, the risk is to replicate over time the same actions without the possibility to modify potentially negative decisions.

An example of this is when BMW[7], the German carmaker, purchased Rover, the English carmaker, at the end of 1990s with the rationale of rapidly expanding BMW into the medium and city-car segments, where Rover had operated quite unsuccessfully for more than twenty years. Although the whole operation seemed rather complex and difficult, BMW's top management was confident that Rover's earlier experience with joint ventures and interfirm cooperation, such as those carried out with Honda, the Japanese motorcycle and carmaker, would facilitate the process. Unfortunately for BMW, there were enormous differences between sharing knowledge when performing a joint venture and absorbing best practice after having been acquired by another firm. After five painful years, BMW decided to sell the so-called *English Patient* to a private equity fund and decided to pursue an internal growth strategy by launching the new Series 1 models. Such examples suggests that firms would do well to identify how much of what they do successfully, they actually understand (Brusoni *et al.*, 2001).

Implications for research

Our study makes a number of contributions to the resource-based theory and to the practice of resource management. First, we have developed the heterogeneity construct as a multidimensional phenomenon. To our knowledge, this is the first study which addresses the impact of heterogeneity upon performance through a multidimensional approach. So far, studies on RBV have used single variables to measure differences among firms, such as R&D, innovation, and organizational capabilities (Knott, 2003; Sakakibara, 1997; Cockburn *et al.*, 2000). We suggest that monodimensional measurements of heterogeneity may oversimplify the complex relation between heterogeneity and performance. Thus, our measurement of the heterogeneity is based on a global analysis of the dimensions involved in the

resource utilization process. Specifically, we have identified contextuality to take into account the firm specificity, complexity to analyze the complex mechanisms linking resources, and interrelation to address the interconnections among resources when they are used.

After defining the heterogeneity construct, we have tested the role played by each dimension in explaining variance performance. This is an important contribution since prior research has assumed the positive effect of heterogeneity on performance. In more detail, we have found that contextuality and complexity affect positively firm performance, while interrelation impacts negatively on firm profitability, thus demonstrating that heterogeneity dimensions affect performance heterogeneously. Therefore, it is interesting to analyze the causes of these results. With respect to the relation between contextuality and performance, the reasons of the positive effect can be traced by referring to the measures of contextuality, which are “resource position” and “non replicability”. These variables highlight the cognitive and collective components of the resource utilization process and identify these as relevant for the protection of competitive advantage, making difficult the imitation process by competitors.

Referring to complexity, the variables used to measure it are: “routine”, “collective learning” and “variety”. Analyzing these items we highlight the complexity of the mechanisms leading to generate resources. In fact, firms rely on their tacit and routine knowledge and skills to take decisions on resource allocation. These mechanisms lead to better performance by improving the efficiency with which the internal activity is carried out.

The interrelation construct is measured by “interconnectedness” and “complementarity”. They highlight how the resource utilization process leads to complex relations among resources. This aspect has a negative impact on performance since it creates difficulty in comprehending the relation between action and results, thus limiting the firm ability to operate.

Future research may adopt this construct for further investigation on the role of heterogeneity in different contexts. In fact, the resource utilization process leading to Heterogeneity, might change depending on the features of the setting, such as the level of hostility or the rate of technological innovation.

Limitations to the study have to also be taken into account in order to improve future research. For example, although sample size was sufficient to guarantee that best fit was achieved between theory and data, involving a larger multi-industry sample may provide better understanding of how heterogeneity affects performance. Subjective survey may incur biases and distortion, mainly related to the “single-respondent” effect. Involving multiple respondents for each firm would avoid, or reduce, biases. Finally, as regards performance indicators, although extant research confirms the relevance of the variable we adopted (return on investment, ROI) using different performance indicators, both financial and non financial, may provide meaningful insights about the kind of effects which heterogeneity may engender.

Notes

1. In this paper, following Barney (1991) and Peteraf (1993), the terms resources, competences and capabilities are assumed interchangeably. Further, amongst the streams of research

- assumed under the label RBV are also comprehended evolutionary (Nelson and Winter, 1982), dynamic capabilities (Teece *et al.*, 1997), and knowledge-based (Kogut and Zander, 1992) approaches.
2. This may be the heritage, in a sense, of the neoclassical approaches to the analysis of differences among firms' performances. Yet, it should be noted that a concept of such relevance in whatever scholarly field deserves robust theoretical definition (Dubin, 1978; Whetten, 1989), as stated by recent contributions in the field of strategic management (Foss, 1997; Hoopes *et al.*, 2003).
 3. According to Foss (1997), the reason of such ambiguity can probably be attributed to the neoclassical roots of many strategy-focused articles.
 4. The Ateco code is a multi-digit code for the identification of Italian industries, likewise the SIC code for USA
 5. Delsoldato L, Pini P. 2005. Innovation and participation. The Barilla and Parmalat cases. Ediesse (in Italian).
 6. Apparel and fashion firms are jointly interested in the denim business, given that many fashion *maisons* such as Calvin Klein and Armani are successfully operating in this market; a different case, instead is, that represented by Versace and Dolce&Gabbana, whose design, positioning and pricing are consistent with their fashion business strategies.
 7. Tierney C. 2000. BMW: Unloading Rover May Not Win the Race, *Business Week*, April, issue 3.

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Further reading

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Appendix. Heterogeneity construct definition

Managers have been asked to give their agreement to the following statements (1 = totally disagree; 7 = totally agree). The term "resource bundle" is used to refer to all the resources used by firm, either internal or accessed through social relations (Table A1).

Items from the questionnaire	Labels
Contextuality Scale	
We have a specific position in the market due to our physical and intangible resources	Resource Position
Our resource bundle cannot be replicated by competitors	Non-replicability
Our resource bundle has been accumulated over time with continuous investments	Accumulation
Our resource bundle is not transferable	Immobility
We can't modify our resource bundle in the short term	Inertia
Our resource bundle is not tradable on a marketplace	Not tradability
Our resource bundle is related to the context of creation	Stickiness
Complexity Scale	
We use informal mechanisms for our managerial and operation practices	Routine
We rely on strong social relations in our daily practices	Social Embeddedness
We draw on different skills and competences when carrying out our activities	Variety
All people tacitly share coordination mechanisms	Socially complex routine
We all learn about how to solve problems by sharing problems and solutions	Collective Learning
Interrelation Scale	
The resources making up our resource bundle depend on each other to properly behave	Complementarity
Each resource making up the resource bundle is built to meet other resources characteristics	Cospecialization
We rely on shared understanding and vision to carry out our activities	Heuristic Frame
The resources making up the resource bundle are used in conjunction to carry out a specific task	Interconnectdness
Our competencies at different levels, from the lower one (single operations) to the higher one (decisions), are interrelated	Architectural
Our resource bundle is more than the sum of the single components	Resource Bundle
The deployment of the resource bundle in each activity implies a coordination of the single components	System
We are not able to discern the contribution of each single resource to the resource bundle creation	Causal Ambiguity

Table AI.

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