**Academia Revista Latinoamericana de Administración**

Heterogeneous research networks in Latin American schools of business management

Luis Antonio Orozco José Luis Villaveces

# Heterogeneous research networks in Latin American schools of business management

Luis Antonio Orozco
*Facultad de Administración de Empresas, Universidad Externado de Colombia, Bogotá, Colombia, and*
José Luis Villaveces
*Universidad de los Andes, Bogotá, Colombia*

Received 20 May 2013
Revised 28 January 2014
14 March 2014
27 June 2014
Accepted 19 November 2014

## Abstract

**Purpose** – The purpose of this paper is to empirically evaluate the effect of heterogeneity in inter-organizational collaboration networks on international high-quality scientific performance of the most reputed business management schools in Latin America according to *AméricaEconomía* ranking.

**Design/methodology/approach** – Starting from the debate between advantages and disadvantages of heterogeneity in scientific performance framed in the debate between organizational population ecology and organizational institutionalism theories, this research explores the relationship between heterogeneity, reputation and the most important features for doing research. Using a binomial negative regression, the paper evaluates the partial effect of those variables in the count of scientific production.

**Findings** – There is an isomorphical tendency from the most reputed schools to establish heterogeneous networks, showing empirical evidence to normative proposals from Latin America, specially formulated in the light of Sabato triangle. Also there are differentiations between schools in aspects like human capital, double-degree agreements, and schools' trajectories.

**Research limitations/implications** – It is necessary to choose a wider sample of schools and to include Latin American journals. The study of diversity (between researchers) and its relationship with heterogeneity (between organizations) is also needed.

**Practical implications** – The research shows that elite business management schools in Latin America that present better performance also present high levels of heterogeneity in their inter-organizational collaboration. Therefore, the promotion of heterogeneity could enhance scientific performance and improve techno-economical networks.

**Social implications** – This research hopes to aim the research policy design to be able to steer and promote heterogeneity that could improve the relationship between producers and users of knowledge.

The authors are grateful for the contributions of Diego Chavarro, DPhil student at SPRU, Sussex University, Ricardo Bonilla, Professor at CESA and Cristhian Ruiz, Researcher and Entrepreneur at RR Conocimiento e Innovación. Also the authors acknowledge the contribution of Faculty of Business Administration at the Universidad Externado de Colombia, especially Cristina Corrigan for her English review, Carolina Saldaña for her econometric review and Henry Noguera, current student of bachelor in Business Administration, for his collaboration in data construction. They also would like to thank Universidad de los Andes, especially the doctoral program in Administration. The author recognizes the funding of Colciencias and Universidad de los Andes for the first author's doctoral study. Finally the authors are grateful to salient editor of *Revista Latinoamericana de Administración*, Elvira Salgado for her theoretical comments, and gives special thanks to the new editor, Carlos Pombo, for his insight, his rigorous standards and his valuable questions in the econometric realm. This work is for Santiago Orozco.

Academia Revista Latinoamericana de Administración
Vol. 28 No. 1, 2015
pp. 115-134

1012-8255
DOI 10.1108/ARLA-05-2013-0052

**Originality/value** – The relationships between reputation, heterogeneity, and scientific performance in administration in Latin America had not been addressed empirically. The worth of this research is the empirical confirmation to the advantages of heterogeneity, rather than intellectual capital features of schools, in research collaboration that contribute to the debate about heterogeneity and performance.
**Keywords** Latin America, Reputation, Heterogeneity, Business management schools, Research collaboration networks, Scientific performance
**Paper type** Research paper

**Propósito** – Evaluar empíricamente el efecto de la heterogeneidad de las redes de colaboración interorganizacionales en el desempeño científico de alta calidad internacional en las escuelas de administración y negocios más reputadas en América Latina de acuerdo con el escalafón de AméricaEconomía.
**Metodología** – Con base en el debate que concierne a las ventajas y desventajas de la heterogeneidad en el desempeño científico enmarcado dentro del debate entre las teorías de la ecología de poblaciones y el institucionalismo organizacional, esta investigación explora la relación entre la heterogeneidad, la reputación y las características más importantes que pertenecen a la investigación. Usando la regresión binomial negativa, el artículo evalúa los efectos parciales de las variables en el conteo de la producción científica.
**Resultados** – Hay una tendencia isomórfica de las escuelas más reputadas por establecer redes heterogéneas, mostrando evidencia empírica para las propuestas normativas de América Latina, especialmente formuladas a la luz del triángulo de Sabato. También hay diferencias entre las escuelas en términos del capital humano, los convenios de doble titulación, y la trayectoria de las escuelas.
**Limitaciones de la investigación** – Es necesario escoger una muestra más amplia de escuela e incluir a las revistas de América Latina. El estudio de la diversidad (entre investigadores) y su relación con la heterogeneidad (entre organizaciones) también es requerida.
**Implicaciones** – La investigación muestra que las escuelas de administración en América Latina que presentan mejor desempeño también presentan altos niveles de heterogeneidad en su colaboración interorganizacional. Por lo tanto, la promoción de la heterogeneidad podría añadir al desempeño científico y mejorar las redes tecno-económicas.
**Implicaciones sociales** – Esta investigación espera impulsar el diseño de políticas de investigación y a su vez promover la heterogeneidad que pueda mejorar la relación entre los productores y usuarios de conocimiento.
**Originalidad/valor** – La relación entre reputación, heterogeneidad y desempeño científico en administración en América Latina no ha sido abordada empíricamente. El valor de esta investigación es la confirmación empírica de las ventajas de la heterogeneidad, en vez de otras características de las escuelas, en la colaboración científica que contribuye al debate sobre heterogeneidad y desempeño.
**Keywords** palabras clave: Heterogeneidad, reputación, desempeño científico,
redes de colaboración científica, América Latina, Escuelas de administración y negocios.

## Introduction

It is a well-established fact that business management schools are pressured to build relationships with other types of organizations such as corporations, not-for-profit, civil, and governmental entities (Whitley, 1984b, 1989, 1995, 2000, 2008). Following Blau (1977), heterogeneity is understood as the degree to which different types of organizations relate to each other (Powell *et al.*, 1996, 2005), and it tends to be considered as a determinant for improving research collaboration and scientific performance. However, recent research suggests that the relationship between heterogeneity and performance is not clear (Gulbrandsen *et al.*, 2011).

Heterogeneity has been found to be an important feature of research performance in nanotechnology (Heinze and Kuhlmann, 2008; Jansen *et al.*, 2010; Pérez and Vinck, 2009), biotechnology, both in developed (Powell *et al.*, 1996, 2005) and developing countries (Orozco *et al.*, 2007, 2011; Schuler and Orozco, 2007), and in the field of management research (Adler *et al.*, 2004; Campbell and Güttel, 2005; Klitkou and Kaloudis, 2007).

However, other empirical evidence does not allow the generalization that heterogeneity always has a positive relationship with performance. There are studies developed in the literature of transaction costs theory that show coordination problems in research between different types of organizations (Arranz and Fdez de Arroyabe, 2007; Belkhodja and Landry, 2007; Landry and Amara, 1998). For instance, university, industry and state relationships can increase communication and coordination problems in research projects (Heimeriks *et al.*, 2003; Langford *et al.*, 2006) even in the field of management studies (Mitev and Venters, 2009). At the same time, it is known that scientific performance decreases when more organizations (Cummings and Kiesler, 2005, 2007) and regions (Tan *et al.*, 2005; Walsh and Maloney, 2007) engage in research collaboration due to the increase of understanding and governance issues.

Additionally, other literature shows that collaboration between different actors does not increase scientometric performance (Lee and Bozeman, 2005; Duque *et al.*, 2005), including co-authorship studies in management and economics (Avkiran, 1997; Krichel and Bakkalbasi, 2006; Ramos *et al.*, 2007; Sutter and Kocher, 2004).

Research on business and management applies knowledge developed in and for organizations (Dávila, 1989; Van de Ven, 2007; Whitley, 1984a, 1995, 2000), and is thought to be the cornerstone of the connection between education and inter-organizational relationships (Whitley, 1984b, 1995, 2000, 2008). However, there is considerably less knowledge regarding the productivity outcomes associated when business and management colleges engage more in heterogeneous research networks.

## Business and management research

Literature in America and Europe has shown that business and management schools have steered the development of research among different organizations with achievements in their educational activities, earning themselves a positive reputation (Durand and Dameron, 2008; Lorange, 2002; Porter and McKibbin, 1988; Starkey and Madan, 2001; Van de Ven, 2007; Whitley, 1995, 2000).

However, researchers in US and European schools, guided and pressured by institutional policies and research evaluation systems, are encouraged to produce knowledge that leads to increasing the number of scientific papers, regardless of the priorities of their social surroundings (Wilson and Thomas, 2012). Researchers prefer to establish their reputation in their academic community instead of engaging in concrete and practical applications that managers and organizations seek out (Durand and Dameron, 2008; Knights and Willmott, 1997; Mintzberg, 2004; Thomas and Wilson, 2011; Whitley, 2008).

Despite the recent increase of research collaboration in management and business (Acedo *et al.*, 2006; Cardoza and Fornés, 2011; Larivière *et al.*, 2006; Podsakoff *et al.*, 2008; Ronda-Pupo and Guerras-Martín, 2010), studies in the field show that collaboration between academics and practitioners is problematic (Amabile *et al.*, 2001). This highlights the need for institutional efforts that can govern the differences between objectives and interests (Rynes and Bartunek, 2001). For instance, Montaño (2001, p. 26) presents the difficulties in gaining access to organizational information in Mexico and the problems related to creating heterogeneous networks for research. Meanwhile, Calderón *et al.* (2010, p. 82) found that some schools in Colombia do not focus on their organizational environment, as they would have to sacrifice theoretical reflection in favor of instrumental application. Furthermore, Gantman (2002) describes the disconnection between knowledge production and its use in Argentina, and finally, Gazda and Quandt (2010) found that in Brazil there is no inter-organizational collaboration trend.

In Latin American business and management schools, the administration is concerned with improving education (Varela, 2009), research (Daniels, 2000), and the use of both to enhance local organizational and economic development (Dávila, 1989; Dávila and Gómez, 1994; De la Torre, 1999). Researchers have also proposed to increase the integration of business and management schools with other types of organizations – that are their subject of study – to increase their impact on society (Blanc, 2008; Dávila, 1989; Gómez and Pérez, 1986; Ibarra-Colado, 2006).

In Latin America, the institutional mechanisms to develop techno-economic networks that involve research products with new results in social practices are still emerging (Villaveces, 2005). It is also known that consolidated networks between knowledge producers and users is led by an elite group able to foster cultural patterns that steer the behavior of groups involved in the collective construction of new knowledge. According to Villaveces (2005), the development of systemic techno-economical networks in which the State, society and markets can act collectively, is less hierarchical when institutions allow the creation of scientific products with social relevance. This happens in complex processes of knowledge transfer and linking networks (Orozco and Chavarro, 2006, 2011; Orozco *et al.*, 2011; Pérez and Vinck, 2009).

While Latin American schools tend to imitate the Anglo-Saxon model (Álvarez *et al.*, 1997; Gómez and Pérez, 1986; Gómez, 1999; Rodríguez, 1997; Rivera-Camino and Mejia, 2006), there are reasons to expect them to try to differentiate themselves through the generation of their own functioning according to the cultural dynamics of the region (Dávila, 1991; Dávila and Gómez, 1994; Ibarra-Colado, 2006, 2007), including the type of networks in inter-organizational research collaboration.

## Differentiation or isomorphism

Whitley (2000) proposes that the institutional and organizational dynamics of scientific production in management is different in Anglo-Saxon and other countries. Scientific elites define their own forms and instances of reputation and may rely on imitation or differentiation as mechanisms to improve their research capacity.

The population ecology of organization literature states that organizations tend to differentiate because traditional forms are no longer appropriate to succeed in the changing environment and the increase of competition (Hannan and Freeman, 1977, 1986). Ecologists understand that the environment selects the organizations that are able to survive. Therefore new organizations, including different network arrangements, tend to differentiate from existing ones when it comes to competing in this changing environment (Aldrich, 1999; Hannan and Carroll, 1995; Hannan and Freeman, 1986).

The institutional theory of organizations, however, understands that the institutional environment provides order and stability to social actions, inducing organizations to imitate the characteristics of those who have gained legitimacy (DiMaggio and Powell, 1983, 1991). This theory shows how isomorphic pressures by law, norms and cognitions guided the collective rationality to imitate the structural characteristics of the inter-organizational networks in their organizational field (DiMaggio and Powell, 1983; Phillips *et al.*, 2000; Powell *et al.*, 1996; Scott, 1995).

In Latin America, it is common to find an appropriation of the knowledge produced in the North (Fernández and Gantman, 2011; Ibarra-Colado, 2007; Mayor, 1990). For example, in Colombia the introduction of knowledge can be traced back to the pioneering contributions of Colombian intellectuals such as Florentino González in 1839 (Guerrero, 1997) and Alejandro López in 1928 (Mayor, 2001). This regional trend has been marked by an epistemic colonialism of European and North American

knowledge in management (Dávila, 1997; Ibarra-Colado, 2006) that resides in the organizational isomorphism of Latin American schools (Álvarez *et al.*, 1997), including the tendency to publish in high-quality international journals.

Some of these Latin American schools have advanced in the virtuous cycle that goes from research to teaching, particularly in the framework of MBA programs aimed at scoring high in world rankings (Blanc, 2008) and encouraged by science and technology policies (Malaver, 2006). As a result, we see an increasing network of research collaboration to improve international scientific performance. However, the structural characteristics of inter-organizational networks developed to produce high-quality research and publications have not yet been addressed.

In Latin America, science and technology policy has promoted heterogeneity through the interaction between academy, industry and the State (Albornoz, 2009; Arocena and Sutz, 2001; Dagnino and Velho, 1998; Sutz, 2000; Vessuri, 1994; Villaveces, 2006), based on the idea of the Sabato triangle (Sabato, 1975). Also, some Latin American authors have stressed the importance of heterogeneity in undertaking relevant research in administrative sciences (Dávila, 1980, 1989; Gantman, 2002; Ibarra-Colado, 2006, 2007; Montaño, 2001; Rodríguez-Mena, 1977; Wahrlich, 1978). Accreditations and rankings – an obsession for deans in business management schools (Harmon, 2006; Thomas and Wilson, 2011; Wilson and Thomas, 2012) – promote the establishment of networks with different kinds of stakeholders and the production of high-quality international scientific papers (Durand and Dameron, 2008; Wedlin, 2006).

Latin American business and management schools seek reputation through public funding, rankings and accreditations. Reputation refers to the recognition of a social actor for its past performance, which confers credit and trust in its future performance (Deephouse and Suchman, 2008). One of the most important features of reputation for a business school, as a way to achieve legitimacy, is international scientific production and inter-organizational networking.

The Mertonian sociology of science states that reputation, gained by scientific production, improves the possibility of participating in networks, attract resources, and it increases the capacity to produce more science (Merton, 1968; Orozco and Chavarro, 2010). The Matthew effect in science explains the relationship between reputation and social relations to improve research and results (Katz, 1999; Orozco and Chavarro, 2010; Van Raan, 2006) including management and business (Hunt and Blair, 1987; Podsakoff *et al.*, 2008).

Publications from Latin American countries in journals indexed as management and business[1] in the Social Science Citation Index of Web of Science between 2001 and 2011 showed an exponential increase since 2006. Out of 805 research articles, 660 (78 percent) appeared between 2006 and 2011.

While there are several explanations in the literature to interpret this phenomenon (Podsakoff *et al.*, 2008), including research collaboration with universities located in the North (Guimarães *et al.*, 2009; Koljatic and Silva, 2001), doctoral training (Contreras *et al.*, 2006; Gantman, 2008), and the increase of funding (Contreras *et al.*, 2006; Malaver, 2006), whether heterogeneity in research collaboration networks is related with Latin American schools' capacity to achieve a better international scientific performance has not yet been studied.

It is a well-known fact in inter-organizational network theory that reputation is a symbolic capital that attracts collaborators to develop networks and improve performance (Provan *et al.*, 2007). Also, it is important for business and management schools to rely on human capital, titling conventions, and experience to undertake quality research (Durand and Dameron, 2008; Lorange, 2002; Podsakoff *et al.*, 2008).

This paper empirically explores the relationship between scientometric performance, the reputation and the heterogeneity of inter-organizational research networks in business and management schools in Latin America in the light of Whitley's (2000) proposal of isomorphism in management and business research and the role of elites in the development of techno-economic networks in Latin America (Villaveces, 2005).

The research question for this study is:

*RQ1*. Is the international research production of business and management schools influenced by heterogeneity?

## Methodology

This research uses data from 55 business and management schools ranked by *AméricaEconomía* between 2006 and 2011. The information taken from *AméricaEconomía* was used as a filter to identify the elite business and management schools in the region (Blanc, 2008; Gantman, 2008, 2012). For each school, articles published in journals indexed in the Social Science Citation Index in management and business between 2006 and 2011[2] were obtained, and these data were matched with the Journal Citation Reports – JCR 2006.

Despite the advancement of editorial management in Latin American management journals (Malaver, 2006; Ruiz-Torres *et al.*, 2012), none of the regional journals matched with JCR 2006. Also, citations and journal impact factors are not used here as in other scientometric studies (Orozco *et al.*, 2007) because the values of these indicators for the sample are too low and useless to make comparisons with other scientometric studies in the field of management, like those by Podsakoff *et al.* (2005, 2008).

In order to obtain the organizations that constitute the inter-organizational network of each school, the following procedure was realized: first, for each paper the institutional affiliation of each and every author was recorded. Second, the organizations appearing in the introduction, methodology and acknowledgements were registered. This gave a list of all organizations involved in the research and includes more organizations than traditional scientometric studies that only use the field C1 for authors' addresses, to assure compliance with the notion of organizational field or organizational population used in the theory presented above (DiMaggio and Powell, 1983; Hannan and Carroll, 1995).

### *Variables*

*Dependent*. *Articles (A):* the number of research articles published between 2006 and 2011 by Latin American business and management schools in journals indexed in the fields of management or business in the Journal Citation Reports 2006.

*Independent*. *Reputation (R):* the average school rank in *AméricaEconomía*'s ranking between 2006 and 2011 ordered in inverted form to be congruent with the statistical logics. Because two or more schools present the same average, a factor analysis was performed using accreditations and professors with doctorates.

*Heterogeneity (H):* the result of Blau (1977, p. 9) index given by: $1-\sum p_k^2$, where $p_k$ is the ratio of the number of organizations in the $k$th category of all organizations in the network. This paper uses ten categories: 1 = Latin American business and management schools; 2 = Latin American school or universities; 3 = non-Latin American universities or schools; 4 = Latin American enterprises; 5 = non-Latin American enterprises; 6 = Latin American NPO; 7 = non-Latin American NPO; 8 = Latin American public agencies; 9 = non-Latin American public agencies; 10 = multilateral organizations.

Each school has $n$ articles and each article has a heterogeneity measure given by the Blau index. The heterogeneity measure for each school was obtained using the weighted average with the number of organizations, in the same way that Kao and Pao (2008) did in their work about scientific production in management in Taiwan.

*Control variables*. The intellectual capital management in universities has been increasing in recent years, improving the creation of human, organizational and relational capital (Leitner, 2004; Bucheli *et al.*, 2008; Sánchez and Castrillo, 2009). Business and management schools have features in the frame of intellectual capital that could improve scientific production in the international realm. For human capital full-time professors (FTP) and professors with doctoral degrees (DP) are good indicators. For relational capital, the number of double-degree agreements (DA) is an important resource. For organizational capital, the school age (SA) is a good proxy for the gained capacity. Except for the foundation year that was obtained from the schools' web sites, the information was given by *AméricaEconomía*.

*Method*

The dependent variable is a count variable with 24 of 55 cases at zero and it does not have a normal distribution. The literature recommends the use of regressions for Poisson or binomial negative distributions for this type of variable instead of OLS regressions, even if the variable is log-transformed (Grimm, 1970; Lawless, 1987; Land *et al.*, 1996)[3]. When the variance of the dependent variable is greater than the mean, it is better to use a negative binomial regression model (Cameron and Trivedi, 1998)[4]. In fact, this tool is common in the statistical treatment of scientific publications counts (Grimm, 1970; Manjarrés, 2009) including similar studies developed for Latin American business and management schools publications (Gantman, 2008). The present paper compares two models, the first using control variables and the second including heterogeneity and reputation to evaluate their contribution.

The general regression model is:

$$LogY(A) = \beta_0 + \beta_1 H + \beta_2 R + \beta_3 FTP + \beta_4 DP + \beta_5 DA + \beta_6 SA$$

## Results

The 55 schools studied produced 262 research articles among which only 19 were published in partnership between two or more Latin American schools, showing a high disconnection in research collaboration between the schools in the region.

The descriptive statistics in Table I show that, on average, each school published 4.73 articles between 2006 and 2011. This indicates that a school produces less than one article per year. This is a worrying result considering that a renowned author from the USA produces on average three articles biannually, which are published in the best international management journals (Rynes, 2006, p. 1098).

The schools in the sample have an average degree of heterogeneity and exhibit high dispersion according to the standard deviations. The schools present an average of 32 FTP and 24 PhDs, showing that there is human capital available to do research. Finally, the schools present on average one double DA and most of them were established around 1970, described in other studies as a boom decade (Dávila, 1991; Gómez and Pérez, 1986).

The results of the binomial negative regression for two models are presented in Table II. The first model shows the partial effect of control variables. The only

| | *n* | Min. | Max. | Mean | Variance |
|---|---|---|---|---|---|
| *A* | 55 | 0 | 33 | 4.73 | 7.45 |
| *R* | 55 | 1 | 55 | 28.01 | 16.04 |
| *H* | 55 | 0 | 0.98 | 0.42 | 0.38 |
| *FTP* | 54 | 0 | 95 | 32.20 | 21.01 |
| *DP* | 54 | 0 | 90 | 23.89 | 20.21 |
| *DA* | 54 | 0 | 6 | 1.07 | 1.47 |
| *SA* | 55 | 1,924 | 2,000 | 1,973.73 | 17.17 |

**Notes:** The first column presents the number of valid observations for each variable. The second and third columns show the minimum and maximum value of each variable. The fourth column presents the mean and the fifth column the variance. The sample covers the management and business schools ranked by *AméricaEconomía* between 2006 and 2011. A is the count of research articles published by the schools included in the sample in journals of management and business indexed by SCCI. R (reputation) is the average school rank in *AméricaEconomía*'s ranking between 2006 and 2011 ordered in inverted form. *H* (heterogeneity) is the result of Blau index given by: $1-\sum pk^2$, where *pk* is the ratio of the number of organizations in the *k*th category of all organizations in the network. This paper uses ten categories: 1 = Latin American management and business schools; 2 = Latin American school or universities 3 = non-Latin American universities or schools; 4 = Latin American enterprises; 5 = non-Latin American enterprises; 6 = Latin American NPO; 7 = non-Latin American NPO; 8 = Latin American public agencies; 9 = non-Latin American public agencies; 10 = multilateral organizations. FTP is the number of full time professors. DP is the number of professors with doctoral degree. DA is the count of double-degree agreement, obtained from *AméricaEconomía*, and SA is the school age obtained in school's web sites

**Table I.**
Descriptive statistics

significant variable is the double DA, indicating that this feature represents a chance of improving the scientific production.

Model 2 shows that reputation and heterogeneity variables have a significant effect on the explanation of scientific performance. However, the model shows heteroscedasticity due to the non-constant variance and distribution of residuals. To assess the validity of the results, robust estimation and bootstrapping sample was performed and presented in Table II as a Model 2 validation. The independent variable estimator ($\beta$) should be interpreted in this way. The incidence rate ratio obtained by $e^{\beta}$ gives the value that affects the dependent variable. In Model 2, when all the variables are constant, the incidence rate ratio $= e^{3.5} = 33$ meaning that, maintaining the scale of heterogeneity that varies between 0 and 1, an increase of 0.1 units of heterogeneity, increases the average number of articles per school by a factor of 3.3. Using the elasticity of average marginal effects the results show that a 1 percent increase in *H* is associated with 1.4 percent of the increase in published articles. The normality test for residuals is presented in the Appendix.

The first issue is the discussion of results in Model 1 that presents the control variables. If legitimacy is due to the intellectual capital, the results should show that those characteristics are pursued isomorphically by schools to achieve better scientific performance. For instance, Lorange (2002) and Durand and Dameron (2008) consider that business and management schools in Europe, regardless of their trajectory, their double DA, and human capital, develop different strategies to achieve reputation, scientific production and relations with their stakeholders, as proposed by Whitley (2000)[5]. These descriptions are congruent with the population ecology of organizational theory that proposes that organizations tend to achieve different features to survive in a selective environment.

| | Model 1 | | | Model 2 | | | Model 2 validation | | |
|---|---|---|---|---|---|---|---|---|---|
| A (dependent variable) | Coef. | Robust SE | $p>\|z\|$ | Coef. | Robust Std. Err. | $p>\|z\|$ | Coef. | Robust SE | $p>\|z\|$ |
| *R* | | | | 0.3050 | 0.0933 | 0.001 | 0.5759 | 0.2392 | 0.020 |
| *H* | | | | 3.5083 | 0.4359 | 0.000 | 3.3185 | 1.0157 | 0.002 |
| *FTP* | 0.0212 | 0.0245 | 0.386 | 0.0081 | 0.0094 | 0.388 | −0.0507 | 0.0553 | 0.072 |
| *DP* | 0.0201 | 0.0227 | 0.376 | 0.0022 | 0.0075 | 0.764 | 0.09567 | 0.3146 | 0.004 |
| *DA* | 0.4297 | 0.0913 | 0.000 | −0.1226 | 0.0946 | 0.195 | 0.9309 | 0.3296 | 0.007 |
| *SA* | −0.0124 | 0.0087 | 0.156 | 0.01044 | 0.0065 | 0.108 | 0.02394 | 0.3296 | 0.159 |
| α | 0.8076 | 0.2592 | | 0.1137 | 0.476 | | 0.0986 | 2.464 | |
| Likelihood-ratio test of α | 87.47 | 0.000 | | 11.62 | 0.000 | | 13.34 | 0.000 | |
| Log likelihood at zero | −124.834 | | | −121.252 | | | −148.807 | | |
| Log likelihood | −111.510 | | | −81.851 | | | −133.802 | | |
| McFadden $R^2$ | 0.165 | | | 0.387 | | | 0.462 | | |
| *n* | 55 | | | 55 | | | 55 | | |
| | Test | *p*-value | | Test | *p*-value | | Test | *p*-value | |
| Omnibus test | 62.814 | 0.000 | | 95.882 | 0.000 | | 95.997 | 0.000 | |
| Goodness of fit Pearson $\chi^2$ | 46.333 | 0.094 | | 15.022 | 0.032 | | 4.345 | 0.018 | |
| Likelihood-ratio test of α | 87.47 | 0.000 | | 11.62 | 0.000 | | | | |

**Notes:** The negative binomial regression finds the maximum likelihood estimate for the mean and dispersion parameter of the dependent variable: *A* is the count of research articles published by Latin American management and business schools, ranked by *AméricaEconomía*, in journals of management and business indexed by SCCI. The period of time is five years (from 2006 to 2011). The first column shows the $\beta$ estimator and the second column shows the robust standard errors. Column 3 presents the significance (using Wald $\chi^2$ test) for Model 1 developed for control variables: *FTP* is the number of full time professors, *DP* is the number of professors with doctoral degree, *DA* is the count of double-degree agreement and *SA* is the school age. The third and fourth columns present the estimators and significance respectively for Model 2 which includes: *R* (reputation) that is the average school rank in *AméricaEconomía*'s ranking between 2006 and 2011 ordered in inverted form. *H* (heterogeneity) is the result of Blau index given by: $1-\sum pk^2$, where *pk* is the ratio of the number of organizations in the *k*th category of all organizations in the network. This paper uses ten categories: 1 = Latin American management and business schools; 2 = Latin American school or universities; 3 = non-Latin American universities or schools; 4 = Latin American enterprises; 5 = non-Latin American enterprises; 6 = Latin American NPO; 7 = non-Latin American NPO; 8 = Latin American public agencies; 9 = non-Latin American public agencies; 10 = multilateral organizations. Finally, columns 5 and 6 present the estimators and significance respectively from Model 2 validation treated by a bootstrapping technique. ***,**,*Statistical significance at 1, 5 and 10 percent, respectively, with the Wald $\chi^2$ statistic. The log likelihood finds the maximum of a function and serves to compare models. The higher log likelihood value means a better model. McFadden $R^2$ or likelihood ratio index are presented. High value means it is a better model. Omnibus test shows the overall significance of the model when explained variance is greater than the unexplained variance. Goodness of fit Pearson $\chi^2$ evaluates observed and expected values fit in the model

**Table II.**
Scientific performance determinants with negative binomial regression

According to Table II, older schools present less scientific production. As population ecology states, it is possible that organizational inertia explains why some schools created to teach remain static in their mission despite institutional pressures.

Moreover, double DA seem to be important. However, they do not guarantee scientific productivity, as Durand and Dameron (2008) describe. Although these agreements have influenced the scientific production and the creation of reputation in the context of Latin American MBAs (Blanc, 2008), their effect, as shown by the results, open an interesting debate. Model 1 shows the importance of this variable and in Model 2 validation this variable performed better than reputation. However, Model 2 replaces their explanatory power in the covariation of reputation and heterogeneity. It is necessary to do more research on the relationship between double DA and scientific performance, and the meaning of these relationships for Latin American schools.

Gantman (2008) evaluates the scientific production of Latin American schools using *AméricaEconomía* 2004. His results, obtained by negative binomial regression, showed that FTP and professors with DP do not have a significant influence on the number of ISI papers. The results shown in Table II are congruent with this finding and they suggest that employing more PhDs in business management schools does not mean more international scientific production. Therefore, business and management schools may be developing different strategies in terms of human capital, as predicted by population ecology and Whitley (2000) when analyzing isomorphism in non-Anglo-Saxon countries.

Furthermore, the results indicate that Latin American business and management schools with better reputations and a higher level of heterogeneity exhibit better scientific performance. In these variables, the schools show isomorphism, as organizational institutionalism theory states. Schools could be pressured by rankings, accreditations and public policy to pursue heterogeneity to increase scientific productivity.

The relationship between reputation and scientific production is cyclical (Bourdieu, 2003; Merton, 1968). Schools that produce high-quality science generate reputation, which is used to produce more and better results in terms of productivity and networking. Calderón *et al.* (2010) found that in the Colombian case, inter-organizational interactions for research in management and business are difficult. Similar conclusions could be inferred in Montaño (2001) in the Mexican case, Gantman (2002) in Argentina, Gazda and Quandt (2010) in Brazil, and Contreras *et al.* (2006) in Chile. The results shown in Table II give empirical support to the importance of heterogeneity for élite schools in the production of international high-quality research and shed light on the importance of managing heterogeneous research networks and creating a culture of inter-organizational relationships.

## Conclusions

This paper reviews the field of research in management and business and discuses it in the light of research collaboration literature and two main theoretical approaches in organizational theory the heterogeneous networks. The results show that Latin American élite schools tend to mobilize techno-economical networks in which heterogeneity is the principal engine to achieve scientific high-quality production in the international management and business field.

The relevant contribution of this research is that heterogeneity is presented as a determinant to achieve better scientific production in Latin American business and management schools, and constitutes a feature pursued by most schools in the region to gain legitimacy in reputation and scientific performance.

This research constitutes an empirical evidence for assertions that policy for science and technology in Latin America, based on the Sabato triangle (Villaveces, 2005), promotes heterogeneity in management and business research to enhance scientific production (Calderón *et al.*, 2010; Dávila, 1989; Dávila and Malaver, 2004; Guarido, 2008; Guarido *et al.*, 2009; Malaver, 2006).

This paper opens the debate to discuss Whitley's assertion that: "Distinct national and international English language intellectual communities exist and compete with each other as a separate collective phenomena, rather than being isomorphic" (Whitley, 2000, p. xxxvii). The sample does not include regional journals; however, it represents an important advancement for the Latin American scientific community (Ruiz-Torres *et al.*, 2012; Chavarro, 2013). Thus, more research on the production in journals indexed by Scielo and Latindex is needed (Chavarro, 2013) to further evaluate Whitley's statement.

One of the major challenges for research management is to take advantage of institutional mechanisms to strengthen the diversity of their networks, particularly between researchers and practitioners. Also is important the development of interdisciplinary research, as Chavarro *et al.* (2014) found. This is a research topic that this paper hopes to encourage. It could be expected that diversity among people affects the creation of heterogeneous networks, but it is necessary to evaluate this hypothesis empirically.

It is surprising that after a huge effort made by Latin American countries to train researchers, PhDs do not have a strong relationship with scientific performance, as evidence on the global analysis of the field of management shows (Podsakoff *et al.*, 2008). Research systems are organized in terms of research groups integrated by teachers, doctoral, and post-doc students (Orozco *et al.*, 2013; Ruiz *et al.*, 2010; Villaveces, 2005; Whitley, 2000). It is necessary to continue research about the role of professors with PhD degrees and also the value of double DA for research.

The institutional environment that promotes heterogeneity in the development of science (Villaveces, 2005) seems to influence the strategies of Latin American business management schools as a key to improve the advancement of administration (Dávila, 1989). Heterogeneity is a feature of Latin American management and business élite schools that could become an isomorphic trend, appealing to other schools searching for legitimacy in the production and use of scientific knowledge in heterogeneous networks. As Gantman states, "if research in administration is important, then it has to be of value for someone" (Gantman, 2002, p. 5).

## Notes

1. Only the management and/or business publications in international journals are used, as suggested by Whitley (2008) and in concordance with *AméricaEconomía*'s ranking of Latin American business and management schools (cf. Colodro, 2006).
2. The query to Web of Science was: CU = (Argentina) OR CU = (Bolivia) OR CU = (Brazil) OR CU = (Colombia) OR CU = (Costa Rica) OR CU = (Chile) OR CU = (Cuba) OR CU = (Ecuador) OR CU = (El Salvador) OR CU = (Guatemala) OR CU = (Honduras) OR CU = (Mexico) OR CU = (Nicaragua) OR CU = (Panama) OR CU = (Paraguay) OR CU = (Peru) OR CU = (Puerto Rico) OR CU = (Dominican Republic) OR CU = (Uruguay) OR CU = (Venezuela). Refined by: Subject Areas = (MANAGEMENT OR BUSINESS). Timespan = 2006-2011. Databases = SCCI. Document Types = (Article).
3. OLS regression assumes a linear relationship. However, in this case the appreciation of counts between 0 and 1 distinct from counts between 10 and 11 events is required.

4. In Model 1, Table II the likelihood-ratio test of $\alpha = 0$ is 87.47 Prob > $= \chi^2 = 0.000$. In Model 2, Table II the likelihood-ratio test of $\alpha = 0$ is 11.62 Prob > $= \chi^2 = 0.000$. This suggests that $\alpha$ is non-zero and the negative binomial model is more appropriate to treat the data.
5. "Rather than simply offering research results upon some neutral and impervious market for reputations, scientists engage in various strategies, with varying amount of resources, to manipulate actively others options and evaluations" (Whitley, 2000, p. 26). See also Thomas and Wilson (2011) and Wilson and Thomas (2012).

## References

Acedo, F.J., Barroso, C., Casanueva, C. and Galán, J.L. (2006), "Co-authorship in management and organizational studies, an empirical and network analysis", *Journal of Management Studies*, Vol. 43 No. 5, pp. 957-983.

Adler, N., Shani, A. and Styhre, A. (2004), *Collaborative Research in Organizations: Foundations For Learning, Change and Theoretical Development*, Sage, Thousand Oaks, CA.

Albornoz, M. (2009), "Desarrollo y políticas públicas en ciencia y tecnología en América Latina", *Revista de investigaciones políticas y sociológicas*, Vol. 8 No. 1, pp. 65-75.

Aldrich, H. (1999), *Organizations Evolving*, Sage, Thousand Oaks, CA.

Álvarez, J., Enrione, A. and Mazza, C. (1997), "Legitimation and integration through dependency: graduate business education in Latin America", *Organization*, Vol. 4 No. 4, pp. 564-581.

Amabile, T.M., Patterson, C., Mueller, J., Wojcik, T., Odomirok, P.W., Marsh, M. and Kramer, S.J. (2001), "Academic-practitioner collaboration in management research: a case of cross-profession collaboration", *Academy of Management Journal*, Vol. 44 No. 2, pp. 418-431.

Arocena, R. and Sutz, J. (2001), "Changing knowledge production and Latin American universities", *Research Policy*, Vol. 30 No. 8, pp. 1221-1234.

Arranz, N. and Fdez de Arroyabe, J. (2007), "Governance structures in R&D networks: an analysis in the European context", *Technological Forecasting and Social Change*, Vol. 74 No. 5, pp. 645-662.

Avkiran, N.K. (1997), "Scientific collaboration in finance does not lead to better quality research", *Scientometrics*, Vol. 39 No. 2, pp. 173-184.

Belkhodja, O. and Landry, R. (2007), "The Triple-Helix collaboration: why do researchers collaborate with industry and the government? What are the factors that influence the perceived barriers?", *Scientometrics*, Vol. 70 No. 2, pp. 301-332.

Blanc, G. (2008), "Business education in Latin America", in Durand, T. and Dameron, S. (Eds), *The Future of Business Schools. Scenarios and Strategies for 2020*, Palgrave Macmillan, New York, NY, pp. 316-326.

Blau, P. (1977), *Inequality and Heterogeneity: A Primitive Theory of Social Structure*, Free Press, New York, NY.

Bourdieu, P. (2003), *El oficio de científico. Ciencia de la ciencia y reflexividad*, Anagrama, Barcelona.

Bucheli, V., Villaveces, J.L. and Daza, S. (2008), "Recursos destinados a los procesos de investigación en la Universidad de los Andes. Una aproximación desde el capital intelectual", in Orozco, L.A. (Ed.), *La investigación en Uniandes 2007: elementos para una política*, Ediciones Uniandes, Bogotá, pp. 63-101.

Calderón, G., Arrubla, J., Gutiérrez, L., Castaño, G., Posada, R., Ruiz, A., Serna, H. and Vivares, J. (2010), *La investigación en administración en Colombia. Condiciones para la generación de conocimiento, investigadores, institucionalización y producción científica*, 1st ed., Ascolfa, Bogotá, p. 250.

Cameron, A. and Trivedi, P. (1998), *Regression Analysis of Count Data*, Cambridge University Press, Cambridge.

Campbell, D.F.J. and Güttel, W.H. (2005), "Knowledge production of firms: research networks and the scientification of business R&D", *Technology Management*, Vol. 31 Nos 1-2, pp. 152-175.

Cardoza, G. and Fornés, G. (2011), "International co-operation of Ibero-American countries in business administration and economics research. Presence in high-impact journals", *European Business Review*, Vol. 23 No. 1, pp. 7-22.

Chavarro, D. (2013), "¿Son los sistemas de indexación y resumen un indicador de la buena calidad editorial de las revistas académicas?", *Research Proceedings Presented in RICyT – Red Iberoamericana de indicadores de Ciencia y Tecnología, Bogotá, 9-11 October 2003*.

Chavarro, D., Tang, P. and Rafols, I. (2014), "Interdisciplinarity and research on local issues: evidence from a developing country", *Research Evaluation*, Vol. 23 No. 2, pp. 195-209.

Colodro, I. (2006), "Escuelas en movimiento", *AméricaEconomía*, 18 al 31 de agosto de, pp. 30-43.

Contreras, C., Edwards, G. and Mizala, A. (2006), "La productividad científica de economía y administración en Chile. Un análisis comparativo", *Cuadernos de Economía*, Vol. 43, pp. 331-354.

Cummings, J.N. and Kiesler, S. (2005), "Collaborative research across disciplinary and organizational boundaries", *Social Studies of Science*, Vol. 35 No. 5, pp. 703-722.

Cummings, J.N. and Kiesler, S. (2007), "Coordination costs and project outcomes in multi-university collaborations", *Research Policy*, Vol. 36 No. 10, pp. 1620-1634.

Dagnino, R. and Velho, L. (1998), "University-industry-government relations on the periphery: the University of Campinas, Brazil", *Minerva*, Vol. 36 No. 3, pp. 229-251.

Daniels, J.D. (2000), "La Enseñanza, la Investigación y el Servicio a la Comunidad", *Academia Revista Latinoamericana de Administración*, Vol. 23, pp. 28-34.

Dávila, C. (1980), "La Crisis de la Educación en Administración en Colombia", *Revista Eafit Temas Administrativos*, Vol. 39, pp. 20-35.

Dávila, C. (1989), "Grounding management education in local research: a Latin American experience", in Davies, J., Easterby-Smith, M., Mann, S. and Tanton, M. (Eds), *The Challenge to Western Management Development*, Routledge, London, pp. 40-56.

Dávila, C. (1991), "The evolution of management education and development in Latin America", *Journal of Management Development*, Vol. 10 No. 6, pp. 22-31.

Dávila, C. (1997), "Best practices in Latin American organizations: a challenge for organization theory", *Organization*, Vol. 4 No. 4, pp. 582-589.

Dávila, C. and Gómez, H. (1994), "Innovative management and organizational development in Latin America", *The International Executive*, Vol. 36 No. 6, pp. 671-688.

Dávila, C. and Malaver, F. (2004), "A propósito del reconocimiento de Colciencias a grupos de investigación en administración", *Cuadernos de Administración*, Vol. 17 No. 27, pp. 5-9.

Deephouse, D.L. and Suchman, M. (2008), "Legitimacy in organizational institutionalism", in Greenwood, R., Oliver, C., Suddaby, R. and Sahlin, K. (Eds), *The Sage Handbook of Organizational Institutionalism*, Sage Publications, Los Angeles, CA, pp. 49-77.

De la Torre, J. (1999), "Carrera académica en escuelas latinoamericanas de gerencia: Retos y opciones", *Academia Revista Latinoamericana de Administración*, Vol. 23, pp. 15-27.

DiMaggio, P. and Powell, W. (1991), *The New Institutionalism in Organizational Analysis*, University of Chicago Press, Chicago, IL.

DiMaggio, P. and Powell, W.W. (1983), "The iron cage revisited: institutional isomorphism and collective rationality in organizational fields", *American Sociological Review*, Vol. 48 No. 2, pp. 147-160.

Duque, R.B., Ynalvez, M., Sooryammorthy, P., Dan-Bright, D. and Shrum, W. (2005), "Collaboration paradox: scientific productivity, the internet, and problems of research in developing areas", *Social Studies of Science*, Vol. 35 No. 5, pp. 755-785.

Durand, T. and Dameron, S. (Eds) (2008), *The Future of Business Schools: Scenarios and Strategies for 2020*, Palgrave Macmillan, New York, NY.

Fernández, C. and Gantman, E. (2011), "Spain and Argentina as importers of management knowledge (1955-2008): a comparative analysis", *Canadian Journal of Administrative Sciences Revue Canadienne Des Sciences De L'Administration*, Vol. 28 No. 2, pp. 160-173.

Gantman, E.R. (2002), "La creación de conocimiento administrativo en la República Argentina. Reflexiones sobre el desarrollo de la investigación en management en universidades argentinas (1995-2000)", Documento de Trabajo 81, Universidad de Belgrano, Buenos Aires.

Gantman, E.R. (2008), "Determinantes de la produccion de conocimiento administrativo en escuelas de negocios de America Latina", *Vision de Futuro*, Vol. 9 No. 1, available at: http://revistacientifica.fce.unam.edu.ar/index.php?option=com_content&view=article&id=138:determinantes-de-la-produccie-conocimiento-administrativo-en-escuelas-de-negocios&catid=55:artlos (accessed June 15, 2011).

Gantman, E.R. (2012), "Escuelas de negocios latinoamericanas y graduados exitosos: un análisis empírico", *Revista Contaduría y Administración*, pp. 1-17, available at: www.contaduriay administracionunam.com.mx/userFiles/app/pp_17012012.pdf (accessed June 15, 2011).

Gazda, E. and Quandt, C. (2010), "Inter-institutional collaboration in research in Brazil: trends in articles in the innovation management area", *RAE eletrônica*, Vol. 55, No. 11, pp. 1-27.

Gómez, H. (1999), "Gestión social: nuevo reto para las escuelas de gerencia", *Academia Revista Latinoamericana de Administración*, Vol. 23, pp. 6-14.

Gómez, H. and Pérez, C. (1986), *Estudios de administración en América Latina*, IESA, Ediciones, Caracas.

Grimm, H. (1970), "Random counts in scientific work", in Patil, G. (Ed.), Vol. 1, Pennsylvania State University Press, Pennsylvania, PA, pp. 193-206.

Guarido, E.R. (2008), "A construção da teoria institucional nos estudos organizacionais no Brasil: o período 1993-2007", Tesis de doctorado, Doutorado em administração, Universidade Federal do Paraná, available at: www.academia.edu/1301824/A_construcao_da_teoria_institucional_nos_estudos_organizacionais_no_Brasil_o_periodo_1993-2007 (accessed August 18, 2009).

Guarido, E.R., Machado-da-Silva, C.L. and Gonçalves, S.A. (2009), "Organizational institutionalism in the academic field in Brazil: social dynamics and networks", *Brazilian Administration Review*, Vol. 6 No. 4, pp. 299-315.

Guerrero, O. (1997), "La trascendencia de los Elementos de la ciencia administrativa: estudio introductorio", *Tecnología administrativa*, Vol. 11 No. 24, pp. 33-70.

Guimarães, T.D.A., Gomes, A.D.O., Odelius, C.C., Zancan, C. and Corradi, A.A. (2009), "A rede de programas de pós-graduação em administração no Brasil: Análise de relações acadêmicas e atributos de programas", *Revista de Administração Contemporânea*, Vol. 13 No. 4, pp. 564-582.

Gulbrandsen, M., Mowery, D. and Feldman, M. (2011), "Introduction to the special section: heterogeneity and university – industry relations", *Research Policy*, Vol. 40 No. 1, pp. 1-5.

Hannan, M. and Carroll, G. (1995), *Organizations in Industry: Strategy, Structure and Selection*, Oxford University Press, New York, NY.

Hannan, M. and Freeman, J. (1977), "The population ecology of organizations", *American Journal of Sociology*, Vol. 82 No. 5, pp. 929-964.

Hannan, M. and Freeman, J. (1986), "Where do organizational forms come from?", *Sociological Forum*, Vol. 1 No. 1, pp. 50-72.

Harmon, M.M. (2006), "Business research and Chinese patriotic poetry: how competition for Status distorts the priority between research and teaching in US business schools", *Academy of Management Learning & Education*, Vol. 5 No. 2, pp. 234-243.

Heimeriks, G., Hoerlesberger, M. and Van den Besselaar, P. (2003), "Mapping communication and collaboration in heterogeneous research networks", *Scientometrics*, Vol. 58 No. 2, pp. 391-413.

Heinze, T. and Kuhlmann, S. (2008), "Across institutional boundaries? Research collaboration in German Public Sector Nanoscience", *Research Policy*, Vol. 37 No. 5, pp. 888-899.

Hunt, J.G. and Blair, J.D. (1987), "Content, process, and the Matthew effect among management academics", *Journal of Management*, Vol. 13 No. 2, pp. 191-210.

Ibarra-Colado, E. (2006), "Mexico's management and organization studies challenges in the twenty-first century: practices, knowledge, and reencounters", *Management Research*, Vol. 4 No. 3, pp. 181-192.

Ibarra-Colado, E. (2007), "Organization studies and epistemic coloniality in Latin America: thinking otherness from the margins", *Organization*, Vol. 13 No. 4, pp. 463-488.

Jansen, D., Görtz, R. and Heidler, R. (2010), "Knowledge production and the structure of collaboration networks in two scientific fields", *Scientometrics*, Vol. 83 No. 1, pp. 219-241.

Kao, C. and Pao, H.-L. (2008), "An evaluation of research performance in management of 168 Taiwan universities", *Scientometrics*, Vol. 78 No. 2, pp. 261-277.

Katz, J. (1999), "The self-similar science system", *Research Policy*, Vol. 28 No. 5, pp. 501-517.

Klitkou, A. and Kaloudis, A. (2007), "Scientific versus economic specialisation of business R&D – the case of Norway", *Research Evaluation*, Vol. 16 No. 4, pp. 283-298.

Knights, D. and Willmott, H. (1997), "The hype and hope of interdisciplinary management studies", *British Journal of Management*, Vol. 8 No. 1, pp. 9-22.

Koljatic, M.M. and Silva, M.R. (2001), "The international publication productivity of Latin American countries in the economics and business administration fields", *Scientometrics*, Vol. 51 No. 2, pp. 381-394.

Krichel, T. and Bakkalbasi, N. (2006), "A social network analysis of research collaboration in the economics community", *Journal of Information Management and Scientometrics*, Vol. 3, pp. 1-12.

Land, K.C., McCall, P.L. and Nagin, D.S. (1996), "A comparison of Poisson, negative binomial, and semiparametric mixed Poisson regression models: with empirical applications to criminal careers data", *Sociological Methods & Research*, Vol. 24 No. 4, pp. 387-442.

Landry, R. and Amara, N. (1998), "The impact of transaction costs on the institutional structuration of collaborative academic research", *Research Policy*, Vol. 27 No. 9, pp. 901-913.

Langford, C.H., Hall, J., Josty, P., Matos, S. and Jacobson, A. (2006), "Indicators and outcomes of Canadian university research: proxies becoming goals?", *Research Policy*, Vol. 35 No. 10, pp. 1586-1598.

Larivière, V., Gingras, Y. and Archambault, É. (2006), "Canadian collaboration networks: a comparative analysis of the natural sciences, social sciences and the humanities", *Scientometrics*, Vol. 68 No. 3, pp. 519-533.

Lawless, J. (1987), "Negative binomial and mixed Poisson regression", *Canadian Journal of Statistics*, Vol. 15 No. 3, pp. 209-225.

Lee, S. and Bozeman, B. (2005), "The impact of research collaboration on scientific productivity", *Social Studies of Science*, Vol. 35 No. 5, pp. 673-702.

Leitner, K.H. (2004), "Intellectual capital reporting for universities: conceptual background and application for Austrian universities", *Research Evaluation*, Vol. 13 No. 2, pp. 129-140.

Lorange, P. (2002), *New Vision for Management Education. Leadership Challenges*, Elsevier-Pergamon, Oxford.

Malaver, F. (2006), "El despegue de la investigación colombiana en administración: análisis de sus avances en el periodo 2000 2006", *Cuadernos de Administración*, Vol. 19 No. 32, pp. 71-109.

Manjarrés, L. (2009), "Las relaciones Universidad-empresa y su efecto sobre la segunda misión universitaria", Tesis de doctorado, Universidad Politécnica de Valencia. available at: www.ingenio.upv.es/es/node/3178 (accessed enero 10, 2010).

Mayor, A. (1990), *Institucionalizado!! y perspectivas del taylorismo en Colombia: conflictos y subculturas de trabajo entre ingenieros, supervisores y obreros en torno a la productividad, 1959-1990. IV coloquio colombiano de sociología*, Universidad del Valle, Cali.

Mayor, A. (2001), *Técnica y utopía. Biografía intelectual y política de Alejandro López, 1876-1940*, Fondo editorial Universidad Eafit, Medellín.

Merton, R. (1968), "The Matthew effect in science", *Science*, Vol. 159 No. 3810, pp. 56-63.

Mintzberg, H. (2004), *Managers Not MBAs: A Hard Look at the Soft Practice of Managing and Management Development, Development*, Berrett-Koehler Publishers, San Francisco, CA, p. 464.

Mitev, N. and Venters, W. (2009), "Reflexive evaluation of an academic – industry research collaboration: can mode 2 management research be achieved?", *Journal of Management Studies*, Vol. 46 No. 5, pp. 733-754.

Montaño, L. (2001), "Dilemas y desafíos de la investigación en administración en México", *Revista contaduría y administración*, Vol. 202, pp. 21-28.

Orozco, L.A. and Chavarro, D.A. (2006), "De historia y sociología de la ciencia a indicadores y redes sociales", in Charum, J. and Villaveces, J.L. (Eds), *Observatorio Colombiano de Ciencia y Tecnología*, Javegraf, Bogotá.

Orozco, L.A. and Chavarro, D.A. (2010), "Science as institution", *RES, Revista de Estudios Sociales*, Vol. 37, pp. 143-162.

Orozco, L.A. and Chavarro, D.A. (2011), *El Programa del Centro de Investigaciones en Microbiología y Parasitología Tropical – CIMPAT*, Ediciones Uniandes, Bogotá.

Orozco, L.A., Chavarro, D.A. and Ruiz, C.F. (2011), "Redes e híbridos como formas organizacionales de gobernanza en la biotecnología en Colombia", in Beltrán, A., Rodríguez, A. and Restrepo, C. (Eds), *Memorias Encuentro Internacional de Investigadores en Administración 2011*, Universidad Externado de Colombia, Universidad del Valle, Bogotá, pp. 2433-2460.

Orozco, L.A, Chavarro, D.A, Olaya, D. and Villaveces, J.L. (2007), "Methodology for measuring the socio-economic impacts of biotechnology: a case study of potatoes in Colombia", *Research Evaluation*, Vol. 16 No. 2, pp. 107-122.

Orozco, L.A., Ruiz, C.F., Bonilla, R. and Chavarro, D.A. (2013), "Los grupos de investigación en Colombia. Sus prácticas, su reconocimiento y su legitimidad", in Salazar, M., Lozano-Borda, M., Fog, L. and Sagasti, F. (Eds), *Colciencias cuarenta años. Entre la legitimidad, la normatividad y la práctica*, Observatorio Colombiano de Ciencia y Tecnología, Bogotá, pp. 634-687.

Pérez, C and Vinck, D. (2009), "Redes sociotécnicas de cogestión de conocimiento en nanotecnología en Colombia: Entre la visibilidad internacional y la apropiación local?", *REDES Revista de estudios sociales de la ciencia*, Vol. 15 No. 29, pp. 113-137.

Phillips, N., Lawrence, T.B. and Hardy, C. (2000), "Inter-organizational collaboration and the dynamics of institutional fields", *Journal of Management Studies*, Vol. 37 No. 1, pp. 23-43.

Podsakoff, P.M., MacKenzie, S.B., Bachrach, D.G. and Podsakoff, N.P. (2005), "The influence of management journals in the 1980s and 1990s", *Strategic Management Journal*, Vol. 26 No. 5, pp. 473-488.

Podsakoff, P.M., MacKenzie, S.B., Podsakoff, N.P. and Bachrach, D.G. (2008), "Scholarly influence in the field of management: a bibliometric analysis of the determinants of university and author impact in the management literature in the past quarter century", *Journal of Management*, Vol. 34 No. 4, pp. 641-720.

Porter, L.W. and McKibbin, L.E. (1988), *Management Education and Development – Drift or Thrust into the 21st Century?*, McGraw-Hill, New York, NY.

Powell, W.W., Koput, K.W. and Smith-Doerr, L. (1996), "Interorganizational collaboration and the locus of innovation: networks of learning in biotechnology", *Administrative Science Quarterly*, Vol. 41 No. 1, pp. 116-145.

Powell, W.W., White, D.R., Koput, K.W. and Owen-Smith, J. (2005), "Network dynamics and field evolution: the growth of interorganizational collaboration in the life sciences", *American Journal of Sociology*, Vol. 110 No. 4, pp. 1132-1205.

Provan, K.G., Fish, A. and Sydow, J. (2007), "Interorganizational networks at the network level: a review of the empirical literature on whole networks", *Journal of Management*, Vol. 33 No. 3, pp. 479-516.

Ramos, R., Royuela, V. and Suriñach, J. (2007), "An analysis of the determinants in economics and business publications by Spanish universities between 1994 and 2004", *Scientometrics*, Vol. 71 No. 1, pp. 117-144.

Rivera-Camino, J. and Mejia, L.G. (2006), "Management education in Ibero-America: an exploratory analysis and perspective", *Journal of World Business*, Vol. 41 No. 3, pp. 205-220.

Rodríguez, F. (1997), "Las maestrías en administración en Europa, las Américas y Colombia", *Innovar Journal*, Vol. 9, pp. 7-20.

Rodríguez-Mena, L. (1977), "La transferencia de ciencia y tecnología: Con referencia al caso de la ciencia administrativa", *International Review of Administrative Sciences*, Vol. 43 No. 1, pp. 31-38.

Ronda-Pupo, G.A. and Guerras-Martín, L.Á. (2010), "Dynamics of the scientific community network within the strategic management field through the *Strategic Management Journal* 1980-2009: the role of cooperation", *Scientometrics*, Vol. 85 No. 3, pp. 821-848.

Ruiz, C.F., Bonilla, R., Chavarro, D.A., Orozco, L.A., Zarama, R. and Polanco, X. (2010), "Efficiency measurement of research groups using Data Envelopment Analysis and Bayesian networks", *Scientometrics*, Vol. 20 No. 37, pp. 101-116.

Ruiz-Torres, A., Penkova, S. and Villafañe-Rodríguez, C. (2012), "Evaluación y clasificación de revistas arbitradas en el área de administración de empresas publicadas en español", *Academia Revista Latinoamericana de Administración*, Vol. 51, pp. 48-64.

Rynes, S. (2006), "Getting on board with *AMJ*: balancing quality and innovation in the review process", *Academy of Management Journal*, Vol. 49 No. 6, pp. 1097-1102.

Rynes, S. and Bartunek, J. (2001), "Across the great divide: knowledge creation and transfer between practitioners and academics", *Academy of Management Journal*, Vol. 44 No. 2, pp. 340-355.

Sabato, J. (1975), *El Pensamiento Latinoamericano en la Problemática Ciencia – Tecnología – Desarrollo-Dependencia*, Paidós, Buenos Aires.

Sánchez, M.P. and Castrillo, R. (2009), "Intellectual capital dynamics in universities: a reporting model", *Journal of Intellectual Capital*, Vol. 10 No. 2, pp. 307-324.

Schuler, I. and Orozco, L.A. (2007), "Managing agricultural biotechnology in Colombia", *Electronic Journal of Biotechnology*, Vol. 3 No. 10, pp. 1-20.

Scott, R.W. (1995), *Institutions and Organizations*, Sage, London and Thousand Oaks, CA.

Starkey, K. and Madan, P. (2001), "Bridging the relevance gap: aligning stakeholders in the future of management research", *British Journal of Management*, Vol. 12 No. S1, pp. S3-S26.

Sutter, M. and Kocher, M. (2004), "Patterns of co-authorship among economics departments in the USA", *Applied Economics*, Vol. 36 No. 4, pp. 327-333.

Sutz, J. (2000), "The university-industry-government relations in Latin America", *Research Policy*, Vol. 29 No. 2, pp. 279-290.

Tan, C.W., Pan, S.L., Lim, E.T.K. and Chan, C.M.L. (2005), "Managing knowledge conflicts in an interorganizational project: a case study of the Infocomm Development Authority of Singapore", *Journal of the American Society for Information Science and Technology*, Vol. 56 No. 11, pp. 1187-1199.

Thomas, H. and Wilson, A. (2011), "'Physics Envy', cognitive legitimacy or practical relevance: dilemmas in the evolution of management research in the UK", *British Journal of Management*, Vol. 22 No. 3, pp. 443-456.

Van de Ven, A. (2007), *Engaged Scholarship: A Guide for Organizational and Social Research*, Oxford University Press, Oxford.

Van Raan, A.F.J. (2006), "Statistical properties of bibliometric indicators: research group indicator distributions and correlations", *Journal of the American Society for Information Science*, Vol. 57 No. 3, pp. 408-430.

Varela, O. (2009), "El rol de las escuelas de negocios en el desarrollo de destrezas gerenciales: análisis conceptual", *Academia Revista Latinoamericana de Administración*, Vol. 42, pp. 73-89.

Vessuri, H. (1994), "La ciencia académica en América Latina en el siglo XX", *REDES, Revista de estudios sociales de la ciencia*, Vol. 2, pp. 41-76.

Villaveces, J.L. (2005), "Redes tecnoeconómicas entre productores y usuarios de conocimiento", in Albornoz, M. and Rato, D. (Eds), *Indicadores de Ciencia y Tecnología en Iberoamérica, Agenda 2005*, Red Iberoamericana de Indicadores de Ciencia y Tecnología – RICYT, Buenos Aires.

Villaveces, J.L. (2006), "Nuevas políticas de ciencia y tecnología", in Vessuri, H. (Ed.), *Universidad e investigación científica*, CLACSO, Consejo Latinoamericano de Ciencias Sociales, Buenos Aires, pp. 193-205.

Wahrlich, B. (1978), "Evolucion de las ciencias administrativas en America Latina", *International Review of Administrative Sciences*, Vol. 44 No. 1, pp. 70-92.

Walsh, J. and Maloney, N. (2007), "Collaboration structure, communication media, and problems in scientific work teams", *Journal of Computer Mediated Communication*, Vol. 12 No. 2, pp. 712-732.

Wedlin, L. (2006), *Ranking Business Schools: Forming Fields, Identities, and Boundaries in International Management Education, International Management*, Edward Elgar Publishing Limited, Northampton.

Whitley, R. (1984a), "The scientific status of management research as a practically-oriented social science", *Journal of Management Studies*, Vol. 21 No. 4, pp. 369-390.

Whitley, R. (1984b), "The fragmented state of management studies: reasons and consequences", *Journal of Management Studies*, Vol. 21 No. 3, pp. 331-348.

Whitley, R. (1989), "On the nature of managerial tasks and skills: their distinguishing characteristics and organization", *Journal of Management Studies*, Vol. 26 No. 3, pp. 209-224.

Whitley, R. (1995), "Academic knowledge and work jurisdiction in management", *Organization Studies*, Vol. 16 No. 1, pp. 81-105.

Whitley, R. (2000), *The Intellectual and Social Organisation of the Sciences*, 2nd ed., Oxford University Press, Oxford.

Whitley, R. (2008), "Varieties of knowledge and their use in business and management studies: conditions and institutions", *Organization Studies*, Vol. 29 No. 4, pp. 581-609.

Wilson, D. and Thomas, H. (2012), "The legitimacy of the business of business schools: what's the future?", *Journal of Management Development*, Vol. 31 No. 4, pp. 368-376.

## Appendix. Average marginal effects in Delta-method

The variables are defined in Table I. The first column shows the elasticity of average marginal effect results. The second column shows the standard errors. The third column presents the significance and the last column the interval of confidence.

| | ey/ex | SE | $p > \|z\|$ | 95% CI | |
|---|---|---|---|---|---|
| *H* \| | 1.411859 | 0.2228763 | 0.000 | 0.9750295 | 1.848689 |
| *R* \| | 1.103813 | 0.3579807 | 0.002 | 0.4021837 | 1.805442 |
| *PFT* \| | 0.2587601 | 0.4063415 | 0.524 | −0.5376547 | 1.055175 |
| *DP* \| | 0.0533612 | 0.2701513 | 0.843 | −0.4761257 | 0.582848 |
| *DA* \| | −0.1315968 | 0.106249 | 0.216 | −0.3398412 | 0.0766475 |
| *SA* \| | 20.62338 | 12.30337 | 0.094 | −3.490787 | 44.73755 |

**Table AI.**

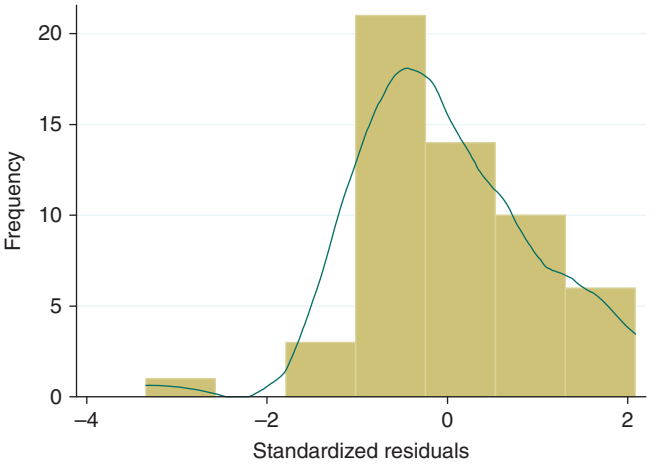


**Figure A1.**
Normality test for residuals

## About the authors

Dr Luis Antonio Orozco is a Doctor in Administration at the Universidad de los Andes – Colombia and a Professor at Faculty of Business Administration at the Universidad Externado de Colombia. His research is focussed on the management of research focussed in networks, institutions, entrepreneurship, innovation and socio-economic value of science and technology. He was a Researcher at Vice-rectory of Research at the Universidad de los Andes and at the

Colombian Observatory of Science and Technology – OCyT. Dr Luis Antonio Orozco is the corresponding author and can be contacted at: luis.orozco@uexternado.edu.co

Dr José Luis Villaveces is a Doctor in Sciences at the Universite Catholique De Louvain – Belgium and a Research Advisor at the Universidad de los Andes – Colombia. His research is focussed on the theoretical chemistry and the studies of science, technology and society. He was a Provost of Research at the Universidad de los Andes, the Director of Colombian Observatory of Science and Technology – OCyT, Secretary of Education of Bogotá, a Subdirector of Colciencias, and a Research Director at the Universidad Nacional de Colombia.