DECOUPLING MANAGEMENT AND TECHNOLOGICAL INNOVATIONS: RESOLVING THE INDIVIDUALISM–COLLECTIVISM CONTROVERSY

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Abstract

This study aims to resolve the contradictory previous research findings on the relationship between individualism-collectivism and innovation. We draw on innovation theory and relate to the difference between non-technological (management) and technological innovation types as well as to the distinction between exploration and exploitation (invention and commercialization of technological innovations). Using Community Innovation Survey (CIS) 2006 micro data for innovation at the organizational level in 13 countries—along with Hofstede (1980, 2001), GLOBE (2005), and Schwartz (2006) scores for individualism–collectivism—we apply Hierarchical Linear Modeling (HLM). The results indicate that individualism is positively related to the invention phase, whereas collectivism is beneficial for the commercialization of innovative ideas. Furthermore, in collectivistic cultures, management innovation plays a more important stimulating role in enhancing technological innovation than it does in individualistic ones. This provides the managers with an idea of when innovation processes in their companies would be more favorable versus detrimental.

Keywords:

Management innovation; Individualism; Collectivism; Technological innovation

1. Introduction

Firms are nested within nations, and they tend to develop and evolve in ways that are compatible with the surrounding national culture (Sagiv et al., 2010). Firm-level innovations are not developed in a vacuum; rather, the innovation process is not only driven and constrained by the demographics of employees but also it is rooted in its organizational, social, and national contexts (Crossan and Apaydin, 2010; Soriano de Alencar, 2012). Thus, it is imperative to explore how different forms of innovation within firms are executed within specific institutional and cultural settings (Allred and Swan, 2005). Although we are aware that other (institutional) dimensions of the national environment also matter, this paper focuses only on cultural factors. Contextualizing innovation by investigating how specific national cultural characteristics influence innovation processes is relevant for both managers and researchers, specifically from the perspective of the globalization of businesses and the economy.

Such an approach puts research on innovation into a broader context by pointing out the differences in innovation processes at the organizational level within the influence of country-specific national culture characteristics. Because cultural friction is situation-specific, it is important to examine how national culture dimensions influence innovation (Luo and Shenkar, 2011) in order to produce specific suggestions for multinational enterprises to cope with the international business environment (Sethi and Guisinger, 2002). This type of an international management inquiry contributes to verifying innovation-related principles that are at least partly , 2000), and it highlights the patterns of collective characteristics, such as societal values and cultural practices (Soriano de Alencar, 2012), which may influence innovation processes.

National culture is manifested in the shared values of people within a certain national environment (Hofstede, 1980). It is the set of collective beliefs and values that distinguishes

people of one nationality from those of another in a stable, unchanging manner (Hofstede, 2001). Naturally, national culture affects and interplays with corporate culture (Doney et al., 1998; Schneider, 2006), a shared pattern of basic assumptions developed within a company (Schein, 1985). However, as Rosenbusch et al. (2011) point out, national culture has also been directly related to various aspects of innovation, such as national differences in invention and innovation rates (Shane, 1993), cross-national product innovation diffusion (Dwyer et al., 2005), research and development (R&D) activity and productivity (Couto and Vieira, 2004), investments in innovation (Allred and Swan, 2005), and entrepreneurial technology alliance formation (Steensma et al., 2000). Cultural differences at the national level may not only account for cross-national variations in innovation but also influence the relationship among different types of innovations at the organizational level, as cultural differences affect innovation input, process, and output (Rosenbusch et al., 2011).

Three of the most commonly used independent research projects address multiple dimension models for measuring national culture dimensions: Hofstede (1980, 2001), Schwartz (2006), and GLOBE (House et al., 2004). With considerable controversy regarding the rigor and content of the research of the three projects, researchers should be aware of the differences among the scores obtained in them when making comparisons (see Hofstede, 2006, 2010; Javidan et al., 2006; Smith, 2006; Tung and Verbeke, 2010). However, empirical research using any of the aforementioned data and linking them to innovation has produced contradictory results regarding the influence of several dimensions, with the most vivid discrepancy being present in terms of the effect of individualism-collectivism on innovation (e.g., Rosenbusch et al., 2011; Taylor and Wilson, 2012). Therefore, we focus on this dimension of national culture models. In addition to producing the most equivocal results, it is the one dimension that might be most critical in explaining managerial phenomena such as innovation (Shenkar, 2001; Tung and Verbeke, 2010).

Research on individualism-collectivism and innovation has in general produced three types of results: Shane (1993) and Williams and McGuire (2005) propose individualism as a stimulating factor for innovation; Herbig and Miller (1992) pin collectivism as crucial for innovation enhancement; and Taylor and Wilson (2012) indicate that the national culture dimension should be divided into sub-dimensions that play different roles in fostering innovation. Tung and Verbeke (2010) offer an explanation of these contradictory results, stating that the contradictions arise in part because most scholarly pieces take too generic and vague paths rather than examining the studied relationships in sufficient scope and detail.

Previous studies (e.g., Taylor and Wilson, 2012) that dealt with the relationship between individualism-collectivism and innovation have focused on the distinct influences of different types of individualism-collectivism. We aim to contribute to international management and innovation literatures with a closer examination of the role of different types of collectivism on different types of innovation at different stages of the innovation process. We take an output-based approach (cf. Mothe and Thi, 2010) and propose that individualism-collectivism could have different effects on distinct types of innovations (management and technological) as well as play a different role in separate stages of the innovation process. By doing so, we concentrate on the two main stages of technological innovation that reflect the main difference between exploration and exploitation (cf. Tushman and O'Reilly III, 1996): invention (decision to innovate, i.e. innovation initiation) and commercialization (success at innovation commercialization, i.e. innovation performance).

Managing international business represents handling both national and organizational culture differences at the same time (Hofstede, 1994). This is particularly relevant for multinational companies (MNCs), as national cultures massively shape the formulation of business strategies within the multinational group (Matten and Geppert, 2004). The multi-level and multi-cultural natures of these organizations may result in compatibility or clashes

of culture among the various units of the MNC with respect to managerial processes (Brock et al., 2000). To assess the individualism-collectivism dimension in 13 countries, we triangulate Hofstede (1980, 2001), Schwartz (2006), and GLOBE (House et al., 2004) scores. This provides further validation of our research because these national culture data were gathered at different times from different samples using distinct data-gathering approaches.

2. Management innovation and technological innovation

In the past, innovation has inevitably been linked to technological breakthroughs with little attention given to the dynamics of management and other forms of non-technological innovation (Alänge et al., 1998; Birkinshaw et al., 2008; Damanpour and Aravind, 2012). However, such a technological view of innovation that only encompasses product and process innovation has been criticized for ignoring a number of important non-technological elements of innovative organizational activities (Avlonitis et al., 2001). Thus, a broader concept of innovation that includes non-technological innovation is needed. The Organisation for Economic Co-operation and Development (OECD) and Eurostat adopted this view in 2005 by introducing organizational and marketing innovation into the guidelines for collecting and interpreting innovation data (the *Oslo Manual*) and by incorporating respective questions into Community Innovation Surveys (CIS) beginning in 2005 (Schmidt and Rammer, 2007).

Non-technological or non-technical innovations are antecedents and facilitators of the efficient use of technical product and process innovations, as their success depends on how organizational structures and processes support the use of new technologies (Armbruster et al., 2008). Management innovation is a term that has recently overtaken other terms for describing non-technological innovations in the scientific literature (e.g., Birkinshaw et al., 2008; Damanpour and Aravind, 2012; Walker et al., 2011). Damanpour and Aravind (2012) define management innovation as "new approaches in knowledge for performing the work of management and new processes that produce changes in the organization's strategy, structure,

administrative processes, and systems" (p. 429). These new approaches play an important role in developing strategies for growth; facilitating employment, social change, and renewal; and enabling continuous performance (Edquist et al., 2001).

The manner in which management innovation stimulates technological breakthroughs is a research area that previous research has cleary neglected (Damanpour and Aravind, 2012), which is particularly true for an international type of scientific inquiry. This is surprising due to the potential importance of this type of research. In line with the resource-based view (Barney, 1991), management innovations can represent an important source of sustainable competitive advantage (Porter, 1985) owing to their intangible nature, which makes them difficult for regional or global competitors to imitate (Alänge et al., 1998). By contrast, technological innovations may be rather easier to imitate due to the simple fact that they usually result in tangible products.

It is important to closely examine the dynamics of different innovation types and to consider them when deciding to innovate in a globalized economy; introducing only technological or only managerial innovations is not optimal. A balanced introduction of both innovation types is necessary (Damanpour and Evan, 1984; Battisti and Stoneman, 2010). Complementary types of innovations would ensure that the organization can use internal and external competencies to cope with environmental change and could thus be effective over time (Van Den Bosch et al., 1999). International management research and practice should thus encompass both non-technological and technological innovation types simultaneously.

Similar logic may be applied to MNCs; in particular, innovation processes in MNCs, which include subsidiaries that are based in different countries, are likely to also reflect a basic management innovation-technological innovation relationship that we conceptualize in the following paragraphs. The literature that examines managerial techniques that are beneficial for fostering various forms of innovations identified—for example, the role of

innovative organizational structures within the MNCs for stimulating innovation (Johnson and Medcof, 2007). Innovative managerial approaches may be particularly important in MNCs in order to overcome the cultural home country-host country clashes (Brock et al., 2000; Dörrenbächer and Geppert, 2006; Sethi and Elango, 2000) and to innovate technologically.

Barañano (2003) claims that innovative management techniques (new approaches to planning, leadership, and expressing support for innovation) are the most crucial drivers of technological innovation. In a similar vein, Read (2000) established that the two most important determinants of technological innovation are management support and an innovative organizational culture. However, despite numerous propositions (e.g. Damanpour, 1991; Ettlie, 1988) that technological innovations alone are not sufficient for firm performance and economic growth, the relationship between management and technological innovation has predominantly not been empirically investigated in the literature (Sanidas, 2004). Very limited existing research on this matter revealed that management innovation often triggers technological innovation, but the process of invention and uptake is typically slower (Battisti and Stoneman, 2010; Damanpour, 1987; Damanpour and Evan, 1984; Kimberly and Evanisko, 1981). This could be related to differences between these types of innovations. Previous research also largely neglected different stages of the technological innovation process as well as failed to acknowledge cultural and societal characteristics that could play a role in innovation processes that take place in international businesses.

Management innovation can play a central role in the process of changing organizations and facilitating organizational adaptation (Walker et al., 2011). Employees should consequently become more adaptive and flexible, thus enhancing their own innovative behavior (Verdu-Jover et al., 2005). Furthermore, managers who are innovative and who serve as role models who implement management innovations have been found to stimulate their employees' innovative performance (de Jong and Den Hartog, 2007). Management

innovation has a crucial role in enhancing flexibility and creativity, which, in turn, facilitate the decision for and the development of technological innovations (Mothe and Thi, 2010).

H1a. Management innovation is positively related to firms' propensity to innovate.

For sustaining a competitive advantage in an international environment, continuous innovation—the introduction of streams of different types of innovations over time—is crucial (Damanpour et al., 2009). Whether or not diverse forms of innovation in an organization are capable of producing positive results in a competitive environment depends largely on the management. New management ideas for modifying and improving the structures and processes that enable strategic renewal and organizational change need to be employed (Damanpour and Aravind, 2012). Firms need to organize their innovation processes diversely by combining technological capabilities with skills in marketing and management as well as with organizational competencies (Mothe and Thi, 2010). Firms that implement a combination of managerial and technological skills tend to introduce and commercialize more innovations (Lokshin et al., 2009). Understanding and implementing both the non-technological and technological aspects of innovation is necessary in order to commercialize technological inventions and to achieve better innovative performance in a globalized economy. We therefore hypothesize:

H1b. Management innovation is positively related to firms' innovative performance.

3. Individualism-collectivism and innovation

As modern-day companies increasingly tend to operate across their national borders, cross-cultural researchers have established different models that attempt to map out differences in national cultures that could influence managerial processes in an international environment. Many of those models turn to dimensions, or specific traits of culture, in order to extract different systems of cultural attitudes and behavior. The three most commonly used models of

national culture dimensions (Hofstede, 1980; House et al., 2004; Schwartz, 2006) have their own views on individualism-collectivism, a national culture dimension that might be the most critical in explaining innovation (Shenkar, 2001; Tung and Verbeke, 2010).

According to Hofstede (1980), an individualistic culture is characterized by loose ties among individual members, by individuals' being the smallest unit of society, and by the superiority of independence and personal achievement to collective interests (Hofstede, 2001). People emphasize task achievement and the realization of personal values, even at the expense of interpersonal relationships (Kim et al., 1994). On the contrary, a collectivist national culture is composed of strong and cohesive groups of people (Hofstede, 1980). In such a cultural context, collective interests are emphasized over individual benefits and values (Hofstede, 2001). A collectivist culture emphasizes interdependence and building friendly relationships, sometimes even at the expense of task achievement (Kim et al., 1994).

Schwartz (2006) created three values at the country level that are parallel to individualism/collectivism. Autonomy, mirroring individualism, denotes an inclination to promote and to protect an individual's pursuit of his or her own ideas and intellectual direction. Schwartz (1994) even denotes this proclivity as curious broadminded creativity. However, autonomy should be understood as a concept that is utterly equivalent to individualism. For example, even though it may be seen as a part of individualism, selfishness is not inherent to autonomy (Schwartz, 1990). Schwartz (2006) actually created two indices of autonomy. Intellectual autonomy measures the degree to which a society encourages individuals to pursue their own ideas and intellectual directions independently, whereas affective autonomy measures the degree to which a society encourages individuals to affectively pursue positive experience for themselves, such as pleasure, excitement, or variation (Schwartz, 2006).

Embeddedness, Schwartz' (2006) value that is most parallel to collectivism, denotes an inclination to identify with a group and its goals and to maintain group traditions and solidarity. The concept has even been dubbed as conservatism because in its essence, it is about restraining potentially disruptive actions. Embeddedness thus represents opposition toward change and preferring to maintain status quo (Schwartz, 2006).

The GLOBE study (House et al., 2004) produced two cultural measures that center on the opposite of individualism: collectivism. The study's approach splits collectivism into two dimensions. In-group collectivism measures pride in, and loyalty to, a small group such as a family or organization. This can be interpreted as familism or localism (Taylor and Wilson, 2012). Institutional collectivism, on the other hand, measures collectivism across a society as a whole—the degree to which organizational and societal institutional practices encourage and reward the collective distribution of resources and collective action (House et al., 2004). In-group collectivism is most parallel to Schwartz's (2006) and Hofstede's conceptualizations of collectivism or embeddedness, which is why we focus only on this type, not on institutional collectivism.

The contrast between individualism and collectivism has been extensively studied to explain creativity and innovation (Eisenberg, 1999). These cultural conditions can contribute to determining whether, when, how, and in what form a new innovation will be adopted (Herbig and Dunphy, 1998; Herbig and Day, 1993). Cross-country variation in innovation is present due to not only economic conditions but also to the prevailing social conditions that denote the extent to which individuals are inclined to collaborate with one another. This has important implications for understanding international environments that are either beneficial for or detrimental to innovation. It also helps to understand innovation processes in MNCs, which can be influenced by national culture characteristics that provide differential contexts for subsidiaries based in different countries. However, research that examines the relationship

between individualism-collectivism and innovation has produced mixed results (Rosenbusch et al., 2011; Taylor and Wilson, 2012).

Since inventing or adopting something new can be contrary to the prevailing group norm, countries that place strong emphasis on collectivism are normally expected to achieve lower degrees of innovation. On the other hand, individuals in individualistic countries feel free to express their own views, are generally more self-reliant and freethinking, and are therefore more inclined to innovate and adopt new ideas. Such freedom to think and act independently is expected to nurture creativity, thus making firms more innovative (Erumban and de Jong, 2006).

Innovation initiation, or the process of its invention as opposed to its commercialization, is often seen as a one-person act (Williams and McGuire, 2005): Initial ideas emerge in the head of an individual. Other people can subsequently be supportive of him or her or not. Creativity and innovation need to be explicitly valued in order to occur (Hitt, 1975), with individualistic cultures valuing freedom more than collectivistic cultures do (Herbig and Dunphy, 1998; Waarts and Van Everdingen, 2005). Hence, employees have more opportunities to try new things in individualistic societies, which is reflected in firms' innovation initiation.

Individuals in individualistic societies are more likely to be recognized, praised, and rewarded for inventive and useful ideas than they are in collectivistic ones. Furthermore, it has been shown that less loyalty to organizations exists in individualistic societies (Herbig and Dunphy, 1998; Shane, 1993), which promotes external information exchange that is beneficial for innovation. At the invention stage, firms can benefit from highly individualistic managers and employees. Individualism fosters creativity, independence, and autonomy (Jones and Davis, 2000)—characteristics that are beneficial for invention processes (Ramamoorthy et al., 2005; Van de Ven, 1986). Furthermore, individualism can facilitate new product development through product championing (Nakata and Sivakumar, 1996), which involves employees'

persuasive activity in promoting and implementing their novel ideas. Thus, empirical evidence that demonstrates the positive effect of individualism on innovation (Shane, 1993; Williams and McGuire, 2005) does not come as a surprise.

Individualistic societies may be more suitable for innovation because they provide more tolerant environments in which potential innovators can perform. In addition, they offer more social incentives for individuals to do so (Taylor and Wilson, 2012). Societies that rank high on individualism have been shown to be highly inventive (Shane, 1993). Such societies believe in the efficacy of individual effort and therefore are more likely to reward innovators with financial compensation. In addition, the emphasis on personal freedom allows individuals to think and act creatively as well as to discover what works and what does not work for themselves. This has positive implications for stakeholders across all stages of the innovation process, including scientists, entrepreneurs, investors, and customers (Taylor and Wilson, 2012). On the other hand, in predominantly collectivistic societies, individual effort and expression of creativity that is reflected in firms' innovation initiation is not emphasized. Planning in these contexts is likely to be comprehensive, with low levels of variation or innovation (Brock et al., 2000). We therefore hypothesize:

H2. Collectivism is negatively related to firms' propensity to innovate.

On the other hand, several studies propose a positive impact of collectivism on various forms of innovation (Rosenbusch et al., 2011). It appears that individualism can be beneficial but, in some cases, also detrimental to the success of innovation activities at the organizational level. Nakata and Sivakumar (1996) argue that whereas individualism facilitates new product development at the invention stage (Ramamoorthy et al., 2005), it may be detrimental to the implementation of an innovation once the new product or service needs to be brought to market. In the attempt to successfully commercialize their innovations, employees need to interact with one another as well as with outsiders such as customers,

suppliers, and other stakeholders (Van de Ven, 1986). Collectivism fosters social interactions and cooperative team behavior (Eby and Dobbins, 1997), and it should therefore be beneficial during the commercialization stage.

Collectivism can facilitate incremental innovations such as improvements to established products (Herbig and Miller, 1992), as such processes require communication and collaboration within the firm as well as interaction with key suppliers and customers. Individualism might be especially detrimental to companies in this stage because it can weaken the teamwork required to address special challenges, resistances, and extra efforts that innovation projects involve during their finalization (e.g., Edmondson and Nembhard, 2009).

Based on this evidence, a closer examination of the role of collectivism on different forms of innovations and at different stages of the innovation process is necessary. Reward systems that foster innovation in one cultural context may fail to do so in another (Taylor and Wilson, 2012); in the same way, these systems may be successful in one stage of the innovation process but detrimental in the other. The more collectivist a society is, the more organization members engage in cross-functional teamwork to foster innovation effort (Shane et al., 1995). Support and collaboration, the degree to which people in the group actively support and help one another in their work, has been demonstrated to be positively associated with innovativeness (Hurley, 1995). This might be especially true for the commercialization stage of the innovation process, thereby improving firms' innovative performance. Thus:

H3. Collectivism is positively related to firms' innovative performance.

The process of innovation consists of different types of innovations, with non-technological forms such as management innovation facilitating and supporting technological breakthroughs. National culture, particularly the inclination toward collectivism, might play an important role in stimulating knowledge exchange that enables management innovations to serve as a support system for technological innovations.

A significant proportion of the knowledge needed to carry out innovation processes is distributed across multiple individuals in an organization, which is why they must collaborate across functional and hierarchical boundaries (Thomas-Hunt et al., 2003). An exchange of knowledge and information is thus necessary. Firms have opportunities for higher innovation capabilities when they are able to expand, disseminate, and exploit organizational knowledge internally as well as to share, transfer, and receive knowledge from external partners (Mothe & Thi, 2010). Members of an organization need the ability to recognize and incorporate relevant knowledge from other members: This is how non-technological managerial solutions become available to all members, enabling firms to support future technological breakthroughs. Such an occurrence is more likely to foster both firms' inclinations toward innovation and actual innovative performance within cultures that value collectivism.

Michailova and Hutchings (2006) propose that collectivism leads to solidarity and frequent information exchange among organizational members, which, in turn, leads to intensive knowledge sharing (especially within groups). Strong and frequent interpersonal relationships facilitate the transfer of knowledge in organizations (Nonaka and Takeuchi, 1995). However, organizational members in an individualistic culture are less likely to engage in collective information exchange (Škerlavaj et al., 2010), thus diminishing the possibility of the exchange of creative ideas.

A collectivistic culture supports and enhances individuals' tendencies to make changes based on their interpretations of the information acquired from the organizational context (Černe et al., 2012). The relationships formed among employees in a more collectivistic organization are more likely to be based on preference and concerns for in-group actions, thereby increasing the likelihood of employees' innovative behaviors. By contrast, organizational members in an individualistic culture tend to pay less attention to the shared

context of information interpretation, and they are less motivated and capable of converting knowledge and non-technological solutions into technological innovations. Thus:

H4. The relationship between management innovation and firms' (a) propensity to innovate and (b) innovative performance is moderated by collectivism. In countries with higher levels of collectivism, the relationship is generally stronger and more positive than it is in countries with low levels of collectivism.

We portray the research model with hypotheses in Figure 1.

Insert Figure 1 about here

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4. Methods

4.1. Measures

We used CIS 2006 micro data (company level) for the innovation and control measures. Anonymized data for the following countries were available and obtained centrally via Eurostat: Bulgaria, Cyprus, Czech Republic, Estonia, Ireland, Lithuania, Norway, Portugal, Romania, Slovakia, Slovenia, and Spain. In an attempt to obtain data from as many countries as possible, we wrote an e-mail to every additional statistical office in the world in countries that carry out company-level innovation research in compliance with *Oslo Manual* guidelines. We obtained one additional dataset from a Chilean innovation survey 2005–2006. Overall, data on 90,646 companies were used. However, this number varies in different models (tables 1 to 4) because data on management innovation were missing or are confidential in some countries and because national culture scores from all projects were not available for all countries.

Out of the 90,646 companies, about 60% had less than 10–49 employees, about 30% had between 50 and 249 employees, and about 10% employed more than 250 people. Only 20.7% of the companies solely operate locally (in their respective regions), while all others are

present at least on a nationwide market. A total of 33.6% of the companies in the CIS dataset (Chilean sample excluded) also operate on a European market, whereas almost 20% of all companies operate internationally or globally. About 22% of all companies are part of a multinational enterprise group.

Management innovation. We used the same approach as Mol and Birkinshaw (2009) did. Management innovation is a composite measure equal to 1 if the firm introduced at least one of the following three management innovations in the 2004–2006 period. (1) The first innovation includes new or significantly improved knowledge management systems, such as innovative workspace architectures to foster informal collaboration and idea exchange among employees (i.e. research-based theatres; Pässilä et al., in press), new company intranets for idea generation and exchange, or an overhaul of the strategic planning system (Birkinshaw et al., 2008; Hamel, 2006). (2) The second innovation includes a major change to the organization of work within the firm, such as a major change in organizational structure, the introduction of self-managing teams, the establishment of free-time initiatives at work to foster autonomy and new idea generation, or an overhaul of reward and promotion systems (Vaccaro, 2010). (3) The final innovation includes new and significant changes in relationships with other firms or public institutions, such as new memberships in national or cross-national innovation partnerships (e.g. centers of excellence), integrated network operations with other companies, value-chain and open innovation initiatives (e.g. crowdsourcing), or collaborative research initiatives.

Organizational size is calculated as the logarithm of the number of employees in 2006 since the distribution of firms tends to be highly skewed. An ***industry*** control variable was a dummy of five NACE sectors that were represented in our data: batch manufacturing (NACE codes 15–27); assembly manufacturing (NACE codes 28–37); construction and utilities (NACE codes 40–45); other services (NACE codes 51–64); and professional and financial

services (NACE codes 65–74). All five were included in our models. ***Geographic scope*** identifies the firm's largest market as local (0), regional (1), national (2), or international (3). ***Innovation inhibitors*** is a count variable that measures the number of factors inhibiting a firm's ability to innovate. Respondents were asked to rate the importance of the listed constraints (e.g., self-reported "lack of quality personnel" or "lack of funds within our enterprise or group") during the 2004–2006 period. They were asked to specify "no effect" or "low," "medium," or "high" for each item. The number of cases in which the respondent gave a positive response is added, resulting in a measure varying from 0 to 33. The introduction of new management practices is one plausible way of overcoming the obstacles that hinder innovation (Mol and Birkinshaw, 2009). ***In-house R&D*** is calculated as a sum of expenditures for in-house R&D in 2006 divided by total turnover in 2006.

Marketing innovation was also used as a control variable. It is a composite variable that consists of two dummy variables. It is equal to 1 if firms introduced at least one of the following two marketing innovations: significant changes to the design or packaging of goods or services, or new or significantly changed sales or distribution methods.

Individualism-collectivism scores were used from three independent research projects measuring national culture dimensions: Hofstede (1980, 2001), Schwartz (2006), and GLOBE (House et al., 2004). First, we used the individualism score from Hofstede (1980, 2001). To triangulate the different data, we used the national culture scores from GLOBE (House et al., 2004) and Schwartz (2006). The in-group collectivism score describing values from the GLOBE study was used. GLOBE also offers scores describing practices. It might be relevant to use practice values for in-group collectivism that were also well correlated with Hofstede's scores (House et al., 2004) because to obtain those scores, respondents were asked to evaluate others in society (referent shift). This usually results in their answering about their own practices, namely taking an actual situation as a personal norm (Hofstede, 2010). This

includes family-related issues (Brewer and Venaik, 2011) that are well-known to respondents. Nevertheless, we decided to go with only one sort of measure if we could claim to study the same type of dimension (Taras et al., 2010).

In terms of Schwartz's (2006) national culture values, affective and intellectual autonomy and embeddedness were used because they are most tightly related to individualism and collectivism, respectively (Schwartz, 2006). Please note that not all data from all countries were available in all research projects.

We controlled for ***uncertainty avoidance*** in all models that examined the influence of the national culture dimensions. Uncertainty avoidance is a national culture dimension that deals with tolerance for uncertainty and ambiguity (House et al., 2004), which are characteristic of innovation processes; it has previously been related to innovation championing (Shane, 1995) and national rates of innovation (Shane, 1993). We used Hofstede's uncertainty avoidance scores in models examining Hofstede's individualism-collectivism, and we used GLOBE's uncertainty avoidance scores in models examining GLOBE's individualism-collectivism as well as Schwartz's autonomy and embeddedness. We also controlled for ***power distance*** (using Hofstede's power distance scores in models examining Hofstede's individualism-collectivism, and using GLOBE's power distance scores in models examining GLOBE's individualism-collectivism along with Schwartz's autonomy and embeddedness), and for GLOBE's institutional collectivism in all models examining GLOBE's in-group collectivism.

Invention (i.e., decision or propensity to innovate) is a composite binary variable made for two other variables: technological product and technological process innovations. It is equal to 1 if the firm introduced new or significantly improved products and/or services new or significantly improved processes for producing or supplying products during 2004–2006; it is 0 otherwise. We follow the approach of previous studies that have conceptualized this variable using CIS data (cf. Mothe and Thi, 2010; Veugelers and Cassiman, 2004) to describe

firms' inclinations to innovate during the initial stage of the innovation process. Since the dependent variable (invention) is a dummy, we used a binary outcome model following a Bernoulli distribution. ***Commercialization*** (i.e., capitalizing on innovation or innovation performance) is expressed as the percentage of total turnover in 2006 from goods and service innovations introduced from 2004 to 2006 new to the firm.

4.2. Multilevel analysis results

The dataset consisted of two hierarchically nested levels: 90,646 firms (level 1) nested within 13 countries (level 2). To test our hypotheses, we used Hierarchical Linear Modeling (with HLM 7.0) to develop a set of multilevel models based on theoretical predictions using the incremental improvement procedure that Hox (2010) demonstrated. In the construction of these models, all variables were grand mean-centered. The fixed effects with robust standard errors for all models are presented in Table 1 and Table 3. We began with the intercept-only model, with invention as the dependent variable (Model 1).

First, we added management innovation as a level-1 predictor of invention. To try to address the issue of endogeneity in addition to other control variables that were tested in each model (see Table 1), we added marketing and process innovation as controls. The results show that management innovation positively and significantly predicted invention (Model 2: $\gamma = .14$, $SE = .04$, $p < .01$), even when controlling for marketing innovation, which was also positively related to invention. Thus, our findings support Hypothesis 1a. Of other control variables, in-house R&D, professional and financial services industry control, geographic scope, and innovation inhibitors were significantly positively related to invention. Because invention is a binomial variable and, hence, Bernoulli distribution was used, in terms of assessing overall model fit, we report Laplace deviance estimations for all models.

To test the cross-level effects of individualism/collectivism on invention, we added the scores regarding this dimension obtained from the three research projects to Model 2 (Models

3a to 3c). Individualism (Hofstede) was positively related to invention (Model 3a: γ = .01, *SE* = .00, *p* < .01). In-group collectivisms (GLOBE) was found to be negatively related to invention (Model 3b: γ = -.08, *SE* = .04, *p* < .05). Both Schwartz's intellectual and affective autonomy dimensions were positively related to invention (Model 3c: γ = .03, *SE* = .01, *p* < .05 and γ = .10, *SE* = .05, *p* < .05, respectively). Embeddedness, on the other hand, was negatively related to invention (Model 3c: γ = -.08, *SE* = .04, *p* < .05). Thus, we found support for Hypothesis 2.

Insert Table 1 about here

Models 4a to 4c (Table 1 and Table 2) deal with the cross-level interaction effects of individualism-collectivism scores and management innovation on firms' invention. The results indicate that the interaction effect of individualism (Hofstede) and management innovation was significant (Model 4a: γ = -.01, *SE* = .00, *p* < .01), as was the interaction effect of in-group collectivism (GLOBE) and management innovation (Model 4b: γ = .03, *SE* = .01, *p* < .01). The interaction effect of affective autonomy (Schwartz) and management innovation was negative and significant (Model 4c: γ = -.05, *SE* = .02, *p* < .01), as was the interaction effect of intellectual autonomy (Schwartz) and management innovation (Model 4c: γ = -.02, *SE* = .01, *p* < .05). The cross-level interaction effect of embeddedness (Schwartz) and management innovation was positive and significant (Model 4c: γ = .04, *SE* = .02, *p* < .05).

Insert Table 2 about here

The following set of models investigated commercialization as the dependent variable (Table 3). For multilevel model estimation, we report Snijders and Bosker's (1999) overall pseudo R^2 for each model. We also report deviance estimations for all models indicating overall model fit. As in previous models, we first added management innovation as a level-1

predictor of commercialization. The results indicate that management innovation is positively and significantly related to commercialization (Model 2: $\gamma = .04$, $SE = .00$, $p < .01$). Thus, our findings support Hypothesis 1b.

Of other control variables, in-house R&D, professional and financial services industry control, geographic scope, and innovation inhibitors were significantly positively related to commercialization. A positive relationship between innovation inhibitors and both stages of the technological innovation process may be viewed as surprising, even if it is in line with findings of previous studies using similar data (e.g. Mol and Birkinshaw, 2009). Apparently, firms that recognize innovation inhibitors and their impact also manage to overcome these obstacles and report more innovation. However, a positive relationship may also be due to the analytical approach of operationalizing this variable as a sum of different inhibitors, which may carry unique effects on innovation.[1] We thus conducted a supplementary analysis with each innovation inhibitor in the model separately. Prior innovations and lack of funds were not significantly related to invention. High innovation costs, lack of information on technology, and no demands of innovation from the market (with a strong correlation) were negatively related to invention. Other inhibitor types exhibited a positive relationship with invention (uncertain demand for innovative goods or services, in particular, exhibited a strong relationship with invention). Lack of finance from sources outside of the enterprise, lack of qualified personnel, difficulty in finding cooperation partners, a market dominated by established enterprises, and uncertain demand exhibited positive relations with commercialization, whereas lack of information on technology, prior innovations, and lack of demand for innovations exhibited negative relations with commercialization.

To test the cross-level effects of individualism/collectivism on commercialization, we added the scores regarding this dimension obtained from the three research projects to Model

[1] We would like to thank anonymous reviewer #3 for pointing this issue out.

2 (Models 3a to 3c). Individualism (Hofstede) was not significantly related to commercialization (Model 3a: γ = -.00, *SE* = .00, *ns*). In-group collectivism (GLOBE) was found to be positively related to commercialization (Model 3b: γ = .01, *SE* = .00, $p < .05$). Both Schwartz's intellectual and affective autonomy were negatively related to commercialization (Model 3c: γ = -.01, *SE* = .00, $p < .05$ and γ = -.02, *SE* = .00, $p < .01$, respectively) in contrast with embeddedness dimension, which was positively related to commercialization (Model 3c: γ = .03, *SE* = .01, $p < .01$). Thus, we also found support for Hypothesis 3.

Insert Table 3 about here

Models 4a to 4c (Table 3 and Table 4) deal with the interaction effects of individualism-collectivism scores and management innovation on firms' commercialization. The results indicate that the interaction effect of individualism (Hofstede) and management innovation was significant (Model 4a: γ = -.01, *SE* = .00, $p < .01$). The interaction effect in-group collectivism (GLOBE) and management innovation was positive and significant (Model 4b: γ = .03, *SE* = .01, $p < .01$). The interaction effect of both intellectual and affective autonomy (Schwartz) and management innovation was negative and significant (Model 4c: γ = -.01, *SE* = .00, $p < .05$ and γ = -.03, *SE* = .01, $p < .01$). The interaction effect of embeddedness (Schwartz) and management innovation, on the other hand, was positive and significant (Model 4c: γ = .02, *SE* = .01, $p < .05$), thus supporting Hypothesis 4.

Insert Table 4 about here

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5. Discussion

Innovation in organizations occurs within specific institutional and cultural settings, sharing the values and suffering the influences of political, historical, and cultural conditions

(Soriano de Alencar, 2012). Individualism-collectivism is a national culture dimension that was proposed to be most critical for explaining and understanding managerial phenomena such as innovation (Shenkar, 2001; Tung and Verbeke, 2010). This is why clarifying previously contrasting results (e.g., Shane et al., 1995; Taylor and Wilson, 2012) is important to facilitate a better understanding of the conditions that influence the link between individualism and collectivism at the country level and innovation at the organizational level.

Our study was based on firm-level innovation data from 13 countries and national culture data from three independent projects that aimed to measure individualism-collectivism (GLOBE, Hofstede, and Schwartz). Taking an output-based approach (cf., Mothe and Thi, 2010), we found support for the positive role of individualism during the initial stage of innovation (invention; decision to innovate in the form of introducing new technological products and processes). The positive association between Hofstede's individualism or Schwartz's autonomy and firms' invention of technological innovations demonstrates this. Individualistic cultures value freedom more than collectivistic cultures do (Herbig and Dunphy, 1998; Waarts and Van Everdingen, 2005). Hence, in individualistic societies, employees have more opportunities to try new things. This finding is coherent with the pro-individualism view (e.g., Shane, 1993; Williams & McGuire, 2005) in terms of stimulating innovation.

By contrast, several studies have proposed a positive impact of collectivism on various forms or stages of innovation (Rosenbusch et al., 2011). Our findings support and provide further explanation to such claims in terms of a positive role of collectivism in the final commercialization stage of innovation. We revealed a positive association between GLOBE's collectivism dimension or Schwartz' embeddedness and firms' commercialization of technological innovations (innovative performance). Collectivism fosters social interactions

and cooperative team behavior (Eby and Dobbins, 1997), and it is therefore beneficial for innovation during the commercialization stage.

We also explored the interaction effects of individualism-collectivism and management innovation in stimulating firms' technological invention and commercialization. First, the results support a positive role of management innovation in fostering technological innovation and in commercially benefiting from it. This finding can be, to some extent, attributed to the intangible nature of management innovations (Teece, 1980), thus making them a more valuable source of sustainable competitive advantage (Porter, 1985). Our findings further reveal that collectivism strengthens the relationship between management innovation and technological innovation. An environment that emphasizes collaboration and information exchange is therefore beneficial for management innovation in order to result in technological breakthroughs.

Even though our approach inevitably resulted in sacrificing the within-country heterogeneity with respect to innovation, this study provides important contextual evidence for national culture significance. We used broad cross-cultural data from countries that can be placed into six GLOBE country clusters (House et al., 2004): Latin American (Chile), Nordic (Norway), Anglo (Ireland), Latin European (Spain, Portugal), Eastern European (Slovenia, Czech Republic, Estonia, Lithuania, Bulgaria, Slovakia), and Middle Eastern (Cyprus). A broad scope of countries and the three datasets upon which we have drawn provide means for the generalization of findings that first indicate that management innovation is a key concept for stimulating technological innovation. Furthermore, we emphasize and validate the culture-bound dimension of innovation; our findings thereby suggest that collectivism (not individualism) provides a more suitable context for management innovations to support technological ones. These findings add to the case made by Taylor and Wilson (2012) that

international management and innovation scholars should avoid stereotyping all collectivist cultures as anti-innovation.

6. Conclusion

Due to some indications that individualism-collectivism might play a different role in different stages of the innovation process (e.g., Rosenbusch et al., 2011), we examined these relationships, accounting for the two stages of the technological innovation process (invention and commercialization) as well as simultaneously accounting for different types of innovations: management and technological. Using secondary CIS data and national culture data gathered in three independent research projects, we found support for a positive relationship between management innovation and technological innovation. Individualism was revealed as playing a positive role in enhancing a firm's invention phase. By contrast, collectivism was more desirable in achieving technological advances when receiving support from management innovations as well as in the final commercialization stage of the innovation process, when collaboration within the firm and with other stakeholders is more important.

6.1. Contributions

Several dimensions of national culture have previously been found to be characteristics of a national culture that is suitable for enhancing innovation (Scott and Bruce, 1994). Yet, regarding the influence of individualism-collectivism, previous research has produced contradictory results. Some of this can be explained via different types of individualism-collectivism (Taylor and Wilson, 2012); however, such an approach cannot explain the different results obtained using a uniform score for individualism and linking it to innovation. First, in line with the evidence for strong correlations among various national culture measures (House et al., 2004) and for their equivalence (Drogendijk and Slangen, 2006), we contribute to understanding the relationship between individualism-collectivism and

innovation by switching the main focus from national culture characteristics to innovation theory. Thus, the main value-added of our research is in examining two distinct innovation types (management and technological) along with two different stages of the innovation process (invention and commercialization). The core finding is that individualism-collectivism affects innovation differently depending on the form of innovation and the innovation stage.

To achieve this contribution, our approach is deeply rooted in innovation theory. In an attempt to resolve the "individualism-collectivism controversy" in terms of its relationship with innovation, we relate to the distinction between exploration and exploitation (cf. Tushman and O'Reilly III, 1996) as well as the distinction between non-technological (management) and technological innovation that is present in the innovation literature, at least since Daft (1978). Regardless of the impact that these two perspectives had on innovation literature, international management research that has examined the link between individualism-collectivism and innovation has unfortunately thus far neglected them in attempts to obtain an accurate understanding of the examined relationship.

Second, by contributing to explaining the innovation processes in cross- or multi-national firms, we make a contribution to the international management literature. As the large portion of our sample consists of international or multinational firms, we contribute to understanding the innovation processes in such firms by specifying the environment that is favorable for or detrimental to fostering innovation types in international subsidiaries. We extend the innovation research , 2000) and add unique knowledge to this field with a culture-bound assessment of the examined relationships. Our study supports that MNCs hold an important place in the generation and diffusion of management innovations to other countries (Mol and Birkinshaw, 2010). As previous research indicated that country characteristics were "by far the most important determinant of

subsidiary performance" (Christmann et al., 2000, p. 241), we estimated the influence of a national culture dimension, individualism-collectivism. Our study is also useful for evaluating cultural matches or mismatches between MNCs' subsidiaries in different cultural environments, which shape their ability to successfully integrate and share resources (Brock, 2005), thereby affecting innovation processes. We use a broad dataset, namely CIS 2006 micro data for firm-level innovation obtained from 13 countries. We thereby address the call made by Franke and Richey (2010) that in order to draw credible generalizations from cross-cultural studies, a minimum of seven countries must be used. We also triangulate three datasets from independent projects in order to measure individualism-collectivism, providing more objective and less biased results. This is the first time, to our knowledge, that the combination of these datasets (multiple country CIS micro data and three national culture measures) has been used together in a quantitative study.

Third, our study provides support for the positive relationship between management innovation and technological innovation, contributing to the management innovation literature by empirically associating this form of non-technological innovation with a beneficial outcome in terms of technological innovation. This answers calls for an empirical examination of the outcomes of management innovation that are lacking (Damanpour and Aravind, 2012). We apply a similar approach that Mol and Birkinshaw (2009) used to investigate its antecedents by using CIS data. However, by focusing on companies from 13 countries, our study moves such research of the antecedents or outcomes of management innovation using CIS data beyond single-country investigations. Furthermore, we contribute to the management innovation literature by providing a more in-depth treatment of the outcomes of management innovation, extending its nomological network and indicating that it leads to better results in terms of technological innovation more intensively in cultures that score high in the collectivism dimension.

6.2. Practical implications

Innovative activities of an enterprise do not depend solely on intra-firm organizational capacities; they are also fundamentally shaped by the organization's environment, which influences specific patterns in which innovation processes are embedded (Kaiser and Prange, 2004). Hence, national differences in innovation processes and performance can be attributed, at least to an extent, to variations in the cultural environment. Our study contributes to a better understanding of what national culture implies for managerial practice as well as for policymakers in terms of designing appropriate strategies that would allow the firms to fully capitalize on innovation.

Contrasting the impacts of individualism-collectivism on innovation in different stages might leave managers wondering what they can do about it, as each of these poles is bound to influence firms' innovations negatively in one of the stages. However, our findings provide the managers across countries with an idea of when innovation processes in their companies would be more favorable and when they would be more detrimental to innovative performance. Our study suggests that managers in more collectivistic societies need to be more careful and aware of their firms' innate shortcomings during the initial innovation stage, when they need to put extra effort on emphasizing freedom and independent thinking. On the other hand, managers in more individualistic cultures need to put more energy into stimulating cooperation and collaboration during the final commercialization stage of the innovation process.

Our study also provides managers with an idea of the particular stage of the innovation process during which their employees' national cultural characteristics represent a potential competitive advantage against their competitors from other countries. This is perhaps even more relevant for the policy makers; they are in a position to design national strategies and guidelines in a way that they can either fully benefit from their countries' characteristics or

overcome potential shortcomings. For example, in highly collectivistic cultures, innovation policies should be designed in a way that they offer incentives for innovative ideas in the first stage of the innovation process—something that is not crucial in individualistic cultures, where creative inventiveness is more present by default. In addition, as firms in collectivistic countries seem to be more effective during the commercialization stage, innovation policies should be designed in a way that they would provide support for the inter-organizational collaboration that takes place during this final stage of the innovation process.

6.3. Limitations and future research suggestions

Despite the aforementioned contributions and implications, our research is not without limitations. First, national culture dimensions are robust assessments that attempt to describe in an imperfect fashion what really goes on in terms of the values and practices of people across countries and cultures. They do not exist in a tangible sense; rather, they are constructs that are not directly accessible to observation (Hofstede, 2010). This is a generic limitation to any applied cross-cultural research that assumes cultural homogeneity within a single nation and puts intra-national diversity in second place. Cultural values, however, may also be determined via the micro characteristics of age, gender, education, and socio-economic status as well as the macro characteristics of wealth and freedom (Steel and Taras, 2010). Whether bundling individual measures into aggregate indices is completely accurate thus is debatable (Tung and Verbeke, 2010). If we do in fact choose to take the country as the level-2 subject, it is arguable whether companies are neatly nested within countries. Many firms operate internationally and employ people from a wide variety of nationalities. It is thus uncertain how much of a meaningful connection to a company that is registered in a country a national average individualism-collectivism score has. Nonetheless, evidence suggests that national cultural differences can be appropriate and useful for analysis (Smith and Bond, 1999); these scores may be the best we have when attempting to understand the differences that drive

people's behavior across the globe in a broad scope. We tried to diminish the influence of this robustness by investigating the national culture scores obtained in three different independent research projects. Even if they have differences and should thus be compared with caution (Smith, 2006), such an approach is more objective compared with using only one dataset, as our research questions call for contextualization, generalization, and objectivity.

Second, we have only focused on national culture as a contextual factor in shaping innovation within firms in particular countries. The results reveal very small cross-level effect sizes and thus should be interpreted in proportion to their impact. Therefore, national culture dimensions just shape a context with a limited amount of impact (that is, nevertheless, significant) on innovation processes within firms. Other country-level factors such as institutional support and other socio-economic conditions are, however, equally or more important in influencing innovation activities. The national innovation systems literature (Freeman, 1992; Lundvall, 1992) has revealed many factors that are responsible for differences in national innovation performance. Nevertheless, national innovation systems themselves may be under the influence and shaped by national culture conditions. This is why future research should be devoted to connecting these two research streams, which are at times (too) separated.

Third, another limitation of our study is linked to the measurements we have used for innovation. Even if the *Oslo Manual* (OECD, 2005) did a lot in terms of standardizing innovation survey procedures across the world, secondary CIS data may have their shortcomings. These surveys are translated into different languages and distributed by national institutes, and rules regarding whether firms have to reply and how important such replies are may vary across countries. CIS data thus might be of doubtful quality in terms of the accuracy of such assessments as well as in terms of the content validity of the sometimes too-broad and too-generic items used. For assessing management innovation, for example, we

were left with no choice but to apply a rather liberal view with the three items used in CIS (although this has also been done in previous studies, e.g., Mol & Birkinshaw, 2009). More accurate measures have been developed (e.g., Vaccaro et al., 2012), even if it would be difficult to conduct a study of such a broad scope by collecting primary data.

Fourth, when conceptualizing the hypotheses, our arguments and mechanisms regarding how individualism-collectivism affects innovation at the organizational level also relate to lower levels within the organizations. Employees within the firms carry out innovations, even at the organizational level. Thus, the rationale with which any of the national culture dimensions might affect firm-level innovation naturally flows through lower levels of research. However, individual- and group-level occurrences do not necessarily translate automatically to the firm level. Many factors within the firms, such as selection mechanisms or budget limitations, etc., could affect whether or not individual-level initiatives are consequently adopted. Future research should examine these within-firm processes in more detail. In addition, the nature of our cross-sectional data prevents us from drawing any final causal conclusions. Even though we base our conceptualizations on theoretical grounds, findings may stem from reverse causality. For example, technological product or process innovation may force firms to create new management practices and not vice versa. Nonetheless, we were able to allude to the importance of management innovation for enhancing technological innovation in both stages (invention and commercialization). We also highlighted the need to account for the cultural context of individualism-collectivism for the innovation processes in international firms. Future research should apply longitudinal designs to strengthen causal claims proposed in our research.

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Table 1: Multilevel analysis results for invention as the dependent variable

	Model 1	Model 2	Model 3a	Model 3b	Model 3c	Model 4a	Model 4b	Model 4c
Level 1								
Intercept	-1.08** (.14)	-1.57** (.13)	-1.67** (.14)	-1.66** (.14)	-1.68** (.14)	-1.99** (.12)	-1.97** (.12)	-1.91** (.12)
Organizational size		.01 .(00)	.01 (.02)	.01 (.02)	.01 (.02)	.02 (.03)	.02 (.03)	.02 (.03)
In-house R&D		.04** (.01)	02** (.01)	02** (.01)	02** (.01)	02** (.01)	02** (.01)	02** (.01)
Batch manufacturing		.04 (.03)	.03 (.03)	.03 (.03)	.03 (.03)	.02 (.02)	.02 (.03)	.02 (.03)
Assembly manufacturing		.01 (.01)	.01 (.02)	.01 (.02)	.01 (.02)	.01 (.03)	.01 (.03)	.01 (.03)
Construction and utilities		.01 (.01)	.01 (.02)	.00 (.01)	.00 (.01)	.00 (.01)	.00 (.01)	.00 (.01)
Other services		.03 (.02)	.03 (.02)	.03 (.03)	.03 (.02)	.03 (.03)	.03 (.03)	.02 (.03)
Professional and financial services		.03** (.01)	.03** (.01)	.03** (.01)	.03** (.01)	.02* (.01)	.02* (.01)	.02* (.01)
Geographic scope		.28** (.03)	.23** (.07)	.28** (.08)	.22** (.07)	.16** (.07)	.16** (.07)	.17** (.06)
Innovation inhibitors		.12** (.00)	.05** (.02)	.04** (.02)	.06** (.02)	.08** (.03)	.08** (.03)	.07** (.03)
Management innovation		**.14** (.04)**				.14** (.06)	.14** (.06)	.12** (.05)
Marketing innovation		.13** (.04)				.17** (.07)	.16** (.05)	.15** (.05)
Level 2								
Uncertainty avoidance			.04* (.02)	.06* (.03)	.07* (.03)	.05* (.02)	.04* (.02)	.05* (.02)
Power distance			-.03 (.03)	-.04 (.03)	-.03 (.03)	-.02 (.03)	-.02 (.03)	-.02 (.03)
GDP/capita			.08** (.03)	.07** (.02)	.08** (.03)	.07** (.03)	.08** (.03)	.07** (.03)
Economic freedom index			.04** (.01)	.05** (.01)	.04** (.01)	.04* (.02)	.04* (.02)	.04* (.02)
Institutional collectivism (GLOBE)				-.02* (.01)			-.02** (.01)	
Individualism (Hofstede)			**.01** (.00)**			-.02** (.00)		
In-group collectivism (GLOBE)				**-.08* (.04)**			-.08* (.04)	
Intellectual autonomy (Schwartz)					**.03* (.01)**			.02* (.01)
Affective autonomy (Schwartz)					**.10* (.05)**			.06** (.03)
Embeddedness (Schwartz)					**-.08* (.04)**			-.06* (.03)
Laplace deviance estimation		231228.41	85321.14	97764.76	90123.43	1874512.87	197633.90	190764.55
Observations	90646	19660	63553	53300	66439	19660	16306	20119

Notes. Entries are the estimations of fixed effects with robust standard errors. **p<.01, *p<.05, †p<.1. Number of observations differs by model. Data on management and marketing innovation were missing or confidential in some countries. The national culture scores for all countries included in the research are not available in all three research projects. Values in bold are relevant for tests of hypotheses.

Table 2: Interaction effects between management innovation and national culture scores on invention

Interaction effects	Model 4a	Model 4b	Model 4c
Management innovation x Individualism (Hofstede)	**-.01** (00)**		
Management innovation x In-group collectivism (GLOBE)		**.03** (.01)**	
Management innovation x Intellectual autonomy (Schwartz)			**-.02* (.01)**
Management innovation x Affective autonomy (Schwartz)			**-.05** (.02)**
Management innovation x Embeddedness (Schwartz)			**.04* (.02)**
Laplace deviance estimation	1874512.87	197633.90	190764.55
Observations	19660	16306	20119

Notes. Entries are estimations of the interaction effects with robust standard errors. **p<.01, *p<.05, †p<.1. Values in bold are relevant for tests of hypotheses.

Table 3: Multilevel analysis results for commercialization as the dependent variable

	Model 1	Model 2	Model 3a	Model 3b	Model 3c	Model 4a	Model 4b	Model 4c
Level 1								
	.096**	.078**	0.163**	.103**	.128**	0.160**	.081**	.125**
Intercept	(.00)	(.02)	(.05)	(.04)	(.04)	(.03)	(.03)	(.04)
Organizational size		.01 (.00)	.01 (.00)	.01 (.00)	.01 (.00)	.00 (.00)	.00 (.00)	.00 (.00)
In-house R&D		.02** (.00)	.02** (.00)	.02** (.00)	.02** (.00)	.02** (.00)	.02** (.00)	.02** (.00)
Batch manufacturing		-.04 (.03)	-.03 (.03)	-.04 (.03)	-.06 (.05)	-.05 (.06)	-.04 (.04)	-.05 (.04)
Assembly manufacturing		.02 (.02)	.01 (.01)	.01 (.01)	.02 (.02)	.02 (.02)	.02 (.02)	.02 (.02)
Construction and utilities		.00 (.00)	.00 (.00)	.00 (.00)	.00 (.00)	.00 (.01)	.00 (.01)	.00 (.01)
Other services		.01 (.01)	.01 (.02)	.01 (.02)	.01 (.02)	.01 (.02)	.01 (.02)	.01 (.02)
Professional and financial services		.03* (.01)	.02* (.01)	.02* (.01)	.02* (.01)	.02* (.01)	.02* (.01)	.02* (.01)
Geographic scope		.01** (.00)	01** (.00)	02** (.01)	02** (.01)	01** (.00)	.01** (.00)	.01** (.00)
Innovation inhibitors		.02** (.00)	.01** (.00)	.01** (.00)	.01** (.00)	.01** (.00)	.01** (.00)	.01** (.00)
Management innovation		**.04** (.00)**				.03** (.00)	.03** (.00)	.03** (.00)
Marketing innovation		.03** (.00)				.02** (.00)	.02** (.01)	.02** (.01)
Level 2								
Uncertainty avoidance			.02* (.01)	.02* (.01)	.02* (.01)	.02* (.01)	.02* (.01)	.02* (.01)
Power distance			.05** (.02)	.03** (.01)	.03** (.01)	.03** (.01)	.03** (.01)	.03** (.01)
GDP/capita			.02** (.00)	.02** (.00)	.02** (.00)	.02** (.01)	.02** (.01)	.02** (.01)
Economic freedom index			.02 (.02)	.02 (.02)	.01 (.01)	.02 (.02)	.02 (.03)	.02 (.03)
Institutional collectivism (GLOBE)				.02** (.00)			.02** (.00)	
Individualism (Hofstede)			-.00 (.00)			.00 (.00)		
In-group collectivism (GLOBE)				**.01* (.00)**			.01* (.00)	
Intellectual autonomy (Schwartz)					**-.01* (.00)**			-.01* (.00)
Affective autonomy (Schwartz)					**-.02**(.00)**			-.01*(.00)
Embededness (Schwartz)					**.03** (.01)**			.03** (.00)
Pseudo R^2		.28	.48	.52	.53	.39	.42	.42
Deviance		-9254.23	2345.32	2100.98	2345.23	2525.66	2002.85	2099.67
Observations	90646	19660	63553	53300	66439	16306	20119	19660

Notes. Entries are the estimations of fixed effects with robust standard errors. **p<.01, *p<.05, †p<.1. Number of observations differs by model. Data on management and marketing innovation were missing or confidential in some countries. The national culture scores for all countries included in the research are not available in all three research projects. Values in bold are relevant for tests of hypotheses.

Table 4: Interaction effects between management innovation and national culture scores on commercialization

Interaction effects	Model 4a	Model 4b	Model 4c
Management innovation x Individualism (Hofstede)	**-.01** (.00)**		
Management innovation x In-group collectivism (GLOBE)		**.03** (.01)**	
Management innovation x Intellectual autonomy (Schwartz)			**-.01* (.00)**
Management innovation x Affective autonomy (Schwartz)			**-.03** (.01)**
Management innovation x Embeddedness (Schwartz)			**.02* (.01)**
Pseudo R^2	.39	.42	.42
Deviance	2345.23	2525.66	2002.85
Observations	16306	20119	19660

Notes. Entries are estimations of the interaction effects with robust standard errors. **p<.01, *p<.05, †p<.1. Values in bold are relevant for tests of hypotheses.

Figure 1: Research model with hypotheses