Innovation in Emerging Market Economies: The Importance of National Culture

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Abstract

Innovation development is widely acknowledged to support economic growth. Emerging market economies, dealing with poverty and poor living conditions, increasingly see the benefits of new technologies that could contribute to economic prosperity and well-being. An important barrier to the development of innovation is related to national culture. However, there is a lack of knowledge in this research area that needs to be addressed. This current study contributes to the literature by exploring the influence of national culture on the innovation rate at the national level. This is achieved through implementing Hofstede's (1980, 1991) cultural dimensions as measure of national culture, and using the number of patents granted as an indicator of innovation. The main objective of this study is to answer the research question: to what extent does national culture influence the rates of innovation in emerging economies? Using data for the period 2005-2014 including 15 emerging countries, this study applied the Ordinary Least Squares estimation method to test various hypotheses regarding cross-cultural differences. The results suggest that culture matters for innovation development, with power distance, uncertainty avoidance, and long-term orientation as most influential factors. Therefore, as an incentive for innovation progress, policymakers should implement policies that affect people's beliefs and values, which form their perceptions, dispositions, and behaviours.

Keywords: innovation, national culture, emerging markets, patents

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1. Introduction

Globally, the importance of innovation development is rapidly increasing. The main reason for this increase is that innovation is believed to foster economic growth (Fagerberg & Srholec, 2008; Freeman, 2002; Paunov, 2012; Thoenig & Verdier). Although major technological progress originates from the developed world, innovation is imperative for emerging economies since it may contribute to tackling urgent socio-economic challenges such as poverty and sustainable development (Paunov, 2012). Emerging economies are home to 80 per cent of the world's population, and represent about 20 per cent of the global economy (Haar & Ernst, 2016). It is expected that the emerging markets' share of GDP will grow to 55 per cent by 2018. Besides, about 17 per cent of global innovation is coming from emerging markets, while it is expected that this percentage will rise to 40 per cent within the next decade (Haar & Ernst, 2016). These figures may indicate that emerging markets are where exceptional growth and opportunities exist, both now and in the future.

The rise of emerging economies is, among others, driven by globalisation, which affects people and politics in almost every country (Haar & Ernst, 2016). International trade and foreign direct investment mainly determine the impact of globalisation on economic development and level of innovation. Opening national markets to products from foreign competitors is an effective way of increasing competition and to bring down the market power of domestic manufactures (Paunov, 2012). In addition, the attraction of foreign direct investment facilitates access to expertise and technologies, while trade integration ensures specialisation and economies of scale and scope (Paunov, 2012).

The transfer and adaptation of technologies developed in industrialized countries fundamentally contributed to the establishment of innovation capacities in emerging economies (Paunov, 2012). These countries have realised that innovation not only concerns new technology products, but also depends on the ability to drive innovation at an early stage in the development process to ensure the learning abilities required for catching up (Paunov, 2012). In spite of its benefits, countries should focus not only on technology industries since this might exclude other profitable sectors. Picking sectors that require expertise and skills they lack, or appear highly competitive, could incur high costs without acquiring any benefits. Therefore, the ability of a country to develop, adapt and exploit its innovative potential is crucial for a country's economic performance in today's global economy (Krammer, 2009).

But what enables some countries to innovate more than others? It is believed that research and development (R&D) played a key role in the emergence of China, India, and Korea. Besides, many emerging economies include industries or firms that are close to the technology frontier and need to innovate to be competitive (Paunov, 2012). However, it seems rather unlikely that countries benefit from a higher rate of innovation solely by increasing the investment in R&D, or adjusting the industrial infrastructure (Shane, 1993).

One of the main obstacles to innovation development is related to the concepts of national culture (Wycoff, 2003). National culture could consolidate people's behaviour, but it may also lead to barriers between people. It might affect innovation since it shapes peoples beliefs and values with respect to novelty, individual and collective actions, and with regards to risks and opportunities. Therefore, members of a society may either contribute or impede the process of developing innovation capacities depending on their behaviour (Kaasa & Vadi, 2010). As a consequence, some societies might have a greater tendency to support varied innovation activities when compared to others (Jones & Davis, 2000).

However, there is limited knowledge about how national culture influences innovation development. As yet, not much empirical research has been done into whether culture affects the national rate of innovation (Lee, Lee, & Souder, 2000; Senker, 1996; Shane, 1992, 1993; Suzuki, Kim, & Bae, 2002). This study contributes to the current literature by addressing this gap. Besides, most of the studies that have examined the effects of national culture on innovation included merely one or two countries and only during short time periods. However, comparisons between any two countries are sensitive to selection bias, while research based upon brief time spans could overlook correlations that might only show up in the long run. Taking into account these pitfalls, this study analyses innovation data for multiple countries for the period 2005-2014.

The main objective of this study is to address the research question: to what extent does national culture influence the rates of innovation in emerging economies? Building from previous studies, the aim of this current study is to examine the relationship between national culture and rates of innovation with recent data and contemporary measurements. Besides, this research examines the relevance of R&D and the quality of governance with respect to innovation development and national culture. The main focus, however, will be on a major economic factor of the national rate of innovation – the number of patents granted – to evaluate how national culture affects the development of innovation across time in 15 emerging economies. As a measure of national culture this study employs the cultural dimensions developed by Geert Hofstede (1980, 1991).

This study could help policymakers understand the role of national culture on the rates of innovation across countries, and possibly contains useful insights for multinational corporations involved with locating R&D facilities globally. In addition, if national culture is relevant, allocating more money for research and development or industrial infrastructure may not be sufficient to increase the national innovation rate of a country whose deep-rooted cultural beliefs are contradictory to innovation related activities (Shane, 1993).

The remainder of this paper proceeds as follows. Section 2 provides the theoretical framework. Section 3 describes the data and methodology, while Section 4 presents the empirical results. Finally, section 5 concludes and provides the policy implications.

2. Theoretical framework

This section begins with a description of the concept of national culture and its relation to innovation, followed by a discussion of Hofstede's (1980, 1991) cultural framework. Next, the measures of innovation output will be discussed. Finally, the National Innovation System (NIS) will be explained, followed by a description of the control variables.

2.1 Definition of culture

National culture is a multidimensional concept and a precise definition remains elusive. It could be described as *"an all inclusive system of communications, which incorporates the biological and technical behaviour of human beings with their verbal and nonverbal systems of expressive behaviour"* (Herbig & Dunphy, 1998, pp. 13). In other words, national culture may be defined as a way of life, including matters such as beliefs, values, traits, language, behaviour, and living standards shared by all members of a society (Herbig & Dunphy, 1998).

However, the aim of this current study requires only a practical working definition that serves as a fundamental basis on which to proceed. Therefore, a discussion over competing definitions of culture is beyond the scope of this research. Rather, the objective is to examine whether national culture correlates with national rates of innovation. For this reason, culture is conceptualised as reflecting a country's central tendency in terms of beliefs, preferences, and values (Taylor & Wilson, 2012). In general, this interpretation is consistent with definitions of culture used by other studies related to national culture and innovation. Clearly, individuals and organisations will vary in the extent to which they reflect or deviate from the central cultural tendencies of their nation (Taylor & Wilson, 2012). However, these incidental differences, which can be positive or negative, tend to cancel each other out in the aggregate and in the long term. This allows the systematic central tendencies of national culture to arise and obtain a causal effect on a country's business-related activities, such as the ability to innovate. Although the central tendencies may be subject to change, most culture studies indicate that they do so very slowly over time, if at all, which leaves the impression of their remarkable durability and resilience (Guiso, Sapienza & Zingales, 2006).

Furthermore, Inglehart and Baker (2000) found evidence that cultural beliefs and values can and do change, but also continue to reflect a society's cultural heritage (i.e. Protestant, Orthodox, Communist, or Catholic). In particular, shifts in prevailing values and beliefs are associated with economic development. However, cultural change is path dependent (Inglehart, & Baker, 2000).

2.2 Culture and innovation

A country's level of innovativeness is related to its efforts to discover new products and/or service opportunities, and improvements to existing developments and structures (Hage, 1980). It consists of a willingness to propose new ideas and the ability to pursue solutions through creative problem solving and experimentation (Lumpkin & Dess, 1996).

National culture is found to have a significant influence on the innovative capacity of a society (Barnett, 1953; Hofstede, 1980, 1991; Shane, 1992; Wallace, 1970). Cultural beliefs and values are strong dynamics forming people's perceptions, dispositions, and behaviours (Markus & Kitayama, 1991). Also, it is argued that a society's beliefs and values provide social guidance to the establishment of technological development (Herbig & Dunphy, 1998). Each culture has its own social profile that may either foster or restrict technological growth, since it appears to function as a source of authority, responsibility, ambition, and desire. As a result, social commitment might influence the development of technology and makes culture tangible (Herbig & Dunphy, 1998).

A society's culture may operate as a barrier to technological change through the basic values and beliefs, the ideas of right and wrong, the character of the expression of the aspects of culture, and the underlying fit or incorporation of its factors (Herbig & Dunphy, 1998). Besides, the disposition of the social framework of the group, the individual and society motivations, the relationship between society and its members, the prevailing type of family, the characteristics of the learning process, and the nature of perception, are other barriers that inhibit technological change (Foster, 1962). Cultural profiles that recognise the value of creativity may have an increase in the number and quality of innovations, while those cultures that value higher education and technical ability will succeed in their search for innovation (Herbig & Dunphuy, 1998). Furthermore, the degree of innovation within a society is equivalent to the reward and prominence given to creative and entrepreneurial intentions within the culture. Besides, it tends to indicate the emphasis given relatively to the main goal, the continuation of the culture (Herbig & Dunphy, 1998).

In his book *Culture and Personality,* Wallace (1970) examined the evolution of culture and the psychology of cultural change, and he revealed the relation between culture and personality patterns. Wallace (1970) indicated that culture influences the acceptance rate of new ideas and curiosity. Another study by Shapero and Sokol (1982) found that attitudes towards business formation might vary depending on culture. In addition, Moulin (1961) indicated that the per capita number of Nobel Prize winners in the sciences varied between cultures, while Barnett (1953) observed a positive correlation between the individualism of a nation and its ability to innovate. Barnett (1953) suggests that an increase in the ability of a person to explore and say what he/she thinks, the greater the possibility of new ideas to emerge. Besides, he argued that individualistic nations reward freedom more than collectivist nations, while he implied that freedom is the key for ambition and new development. Societies driven by individualistic beliefs tend to value loyalty to the lesser extent than collectivist societies do, which implies that they are able to gather more information required for new technologies (Barnett, 1953). Finally, it is believed that creators do favour individualistic societies since the reimbursement and admission they desire is more likely available when compared to collectivist societies (Barnett, 1953). Also, the cognitive aspects of nonconformity, achievement, and independence, which all have been indicated as incentive for innovation, tend to be more accepted in societies with an individualistic character (Shane, 1992).

2.3 Hofstede's cultural framework

For many, Hofstede (1980, 1991) developed the most influential national cultural framework, which could be considered as the theoretical foundation of cross-cultural learning (Blodgett, Bakir, & Rose, 2008; Dickson, Den Hartog, & Mitchelson, 2003; Steenkamp, 2001). Hofstede (1980) defined six dimensions of cultural variation, which are unequally represented across countries, including power distance, individualism vs. collectivism, masculinity vs. femininity, long term vs. short-term orientation, uncertainty avoidance, and indulgence vs. restraint. These cultural values indicate meaningful relationships with important demographic, geographic, economic, and political indicators of a society (Kale & Barnes, 1992). Variations in the rates of innovation could be due to differences in these values, if some of the values are more conducive to innovation than others.

Although Hofstede's cultural framework is widely acknowledged for analysing cultural differences, there exist some limitations (Steenkamp, 2001). For instance, the conformity between the aspects used to measure the cultural dimensions and the theoretical description of these dimensions is doubtful. Neither is it clear whether the aspects do have the same interpretation in different regions. The cultural dimensions are based on surveys concerning IBM employees, which also form the basis for the country scores. As a consequence, these scores are not necessarily representative for each country. This is especially the case for developing countries (Steenkamp, 2001). Despite this criticism, Hofstede's work can still be seen as the most comprehensive and relevant study of cultural differences (Holden, 2004; Steenkamp, 2001).

Therefore, this current study is using Hofstede's cultural framework (1980,1991) to examine the effect of national culture on innovation at the national level. The remainder of this section will discuss the relationship between Hofstede's (1980,1991) cultural dimensions and innovation-enhancing behaviour. For every dimension, a hypothesis is established based on former studies and previous results. Figures 2 to 7 in the Appendix indicate the country scores for each cultural dimension, with a working scale of 0 to 100.

2.3.1 Power distance

The power distance dimension indicates the acceptance rate of inequality in power and hierarchical relations between members of a society. In addition, it concerns the (uneven) distribution of power in organisations and institutions, and to what degree hierarchy leads to emotional disconnection (Hofstede, 1980, 1991; Shane, 1993).

A high power distance society is characterized by means of a centralized decision structure and formal principles of behaviour. The spreading of information might be constrained due to a strong hierarchy, while the development of innovation is highly dependent on acquiring knowledge. In national cultures that show less power distance it is more common to exchange information across hierarchical barriers (Shane, 1993), which enables the founding of new ideas crucial for innovation activity.

In addition, Herbig and Dunphy (1998) indicated that much bureaucracy decreases innovative behaviour, while Shane (1992) argued that tight control and specific guidance cause employees to be passive and block creative reasoning (Shane, 1992). Besides, Hofstede (1980) indicated that control systems based on trust are more common in low power distant countries when compared with high power distant societies. When it is appropriate for employees to believe to challenge the hierarchical status, the development of innovation will increase. On the other hand, high power distance societies tend to be more discouraged to affect the status quo, resulting in lower innovative activity (Herbig & Dunphy, 1998).

Finally, previous studies that examined the relationship between power distance and innovation development have found comparable results. Shane (1992) indicated a negative correlation between inventiveness, measured through the inventions patented, and power distance societies. In 1993, Shane found evidence that high power distant nations negatively affect the number of trademarks per capita. Additionally, it is argued that societies with an increase in power distance tend to be less involved with innovative activities such as research and development (Williams & McQuire, 2005). Based on these findings, the first set of hypotheses is as follows:

H1a:	Low-power distant countries will invest more in research & development.
H1b:	Low-power distant countries will indicate higher rates of innovation.

2.3.2 Individualism vs. collectivism

The individualism-collectivism dimension indicates the extent to which members of a society are integrated into groups. Hofstede (1998) reported that members of an individualistic society maintain weak relations between other people, while it is assumed that taking care of him/herself and his/her family is everyone’s responsibility. On the opposite, members of a collectivistic society are integrated into strong cohesive groups, which provide protection for a lifetime in exchange for unconditional support and loyalty (Hofstede, 1998). In addition, this cultural dimension includes three particular aspects that have been found to increase the ability to innovate including freedom, outward orientation, and contact with senior managers (Feldman, 1988; Hofstede, 1980, 1991; Katz & Allen, 1982; Mueller, 1962; Pavitt, 1984; Utterback, 1974). Hofstede (1980) indicated that individualistic societies are associated with an outward orientation and are more likely to emphasise the importance of freedom. Besides, Hofstede (1980) found that managers in collectivist societies are less likely to believe in the importance of making contacts with senior managers when compared with individualistic societies. Additionally, it is indicated that societies that score high on individualism, realise an increase in economic growth and a growing propensity to innovate (Hofstede, 1980).

Barnett (1953) and Shane (1992) both found a positive correlation between the individualism of a society and its innovative potential. Taylor and Wilson (2012) indicated that individualism has a strong and positive effect on the level of innovation, while collectivism may be harmful to innovation activity. On the basis of these arguments, the second hypotheses are as follows:

H2a:	Individualistic countries will invest more in research & development.
H2b:	Individualistic countries will indicate higher rates of innovation.

2.3.3 Masculinity vs. femininity

The third dimension masculinity-femininity indicates to what extent a culture is influenced by such masculine values as preference for individual achievement, heroism, assertiveness, and material rewards for victory (Hofstede, 1991). In a masculine society, men are supposed to be tough, and the society at large is more competitive (Hofstede, 2011). By contrast, a preference for modesty, cooperation, quality of life, and taking care of each other indicate feminine behaviour, while the society at large is more conformity aligned. In a feminine society, where men and woman feel more emotionally connected, there is more sympathy for the underdog and less competitive behaviour (Hofstede, 2011). However, this is not concerning the individual members of a society, but concerns the expected emotional characters for men and woman. Masculine societies are indicated as being more openly about gender-specific role patterns than feminine societies. Furthermore, Hofstede (1980) argued that masculine cultures indicate a strong preference for productivity and emphasise performance, while feminine cultures show a preference for processes and principles of art. This implies differences in product innovation proficiency (Haiss, 1990; Schneider, 1989).

Williams and McQuire (2005) suggested that masculinity has no effect on economic development. Additionally, Shane (1993) found no evidence for the masculinity dimension as explanatory variable relating to innovation activity. However, in feminine societies the focus is on people and a more supportive climate (low conflict, trust, social) can be found, which could help employees to cope with the uncertainty related to new ideas, but possibly lacks competition (Nakata & Sivakumar, 1966). These findings lead to the third hypotheses:

H3a:	High-masculine countries will invest more in research & development.
H3b:	High-masculine countries will indicate higher rates of innovation.

2.3.4 Uncertainty avoidance

The uncertainty avoidance dimension indicates to what extent a society is tolerant for uncertainty and ambiguity (Shane, 1993). In societies with low uncertainty avoidance, governmental order may be violated for practical sense, struggles are regarded as an instinctive part of life, and ambiguous situations are considered as essential and appealing. Hofstede (1980) found that societies with low uncertainty avoidance (high-risk tolerance) tend to take risks easier, are relatively easy-going with opinions and behaviours different from their norm, and are committed to technology. Such characteristics tend to encourage entrepreneurship and innovative behaviour (Kaasa & Vadi, 2010). The opposite tends to dominate for societies characterized by high uncertainty avoidance, where strict rules and operating instructions take a key role and are closely followed (Hofstede, 2011). Additionally, Hofstede (1980) indicated that high-uncertainty avoidance cultures tend to pursue more control over their surroundings. Since innovative behaviour is associated with a certain degree of change and uncertainty, national cultures with strong uncertainty avoidance are more resistant to innovation activity (Shane, 1993). One way to avoid uncertainty is to introduce rules and guidelines to decrease ambiguity. The respect of these rules facilitates the limited opportunities with regards to technological development. Also, members of uncertainty avoidance societies are equipped with an attitude that lack to turn ideas into new business opportunities (Hofstede, 2011).

However, it can be argued that in societies with an increase in uncertainty avoidance, there is a growing impulse to secure intellectual property by means of patents or trademarks. Yet, performing innovative activities and subsequently patenting new technologies are intertwined; in the absence of innovations there is no need for protecting them (Kaasa & Vadi, 2010).

Shane (1993) indicated that uncertainty avoidance has a negative effect on innovation development. Besides, it has been argued that uncertainty avoidance negatively affects the level of economic activity, the initial phase of innovation. These findings lead to the following hypotheses:

H4a:	Low-uncertainty avoiding countries will invest more in research & development.
H4b:	Low-uncertainty avoiding countries will indicate higher rates of innovation.

2.3.5 Long-term orientation vs. short-term orientation

The long-term/short-term orientation dimension explains how members of a society deal with change and diversity (Hofstede, 2011). In a long-term-oriented society, the basic notion about the world is that it is in a state of constant change, and requires preparation regarding the future. By contrast, members of a short-term society see the world as basically unchanged, and state that decision-making should be based upon the circumstances of the past to learn and decide in a morally good way (Hofstede, 1998, 2011). Members of a long-term society focus on the future, and are willing to delay short-term material or social success in order to prepare for the future. These societies value persistence, thrift, saving and being able to adapt to changing circumstances (Hofstede, 2011). On the other hand, members of a short-term society are focused on the present or past and consider them more important than the future. Such societies value national pride, the current social hierarchy, respect of tradition, and social obligations. They care more about immediate gratification than long-term fulfilment (Hofstede, 2011).

Long-term oriented societies tend to adjust for changes in circumstances, while short-term oriented nations hold on to social hierarchy. Hence, short-term societies might not value innovation development as long-term societies do. In stead, they are more likely to be reluctant to change and ensure that traditions persist. Based on these findings, the fifth hypotheses are constructed as follows:

H5a:	Long-term oriented countries will invest more in research & development.
H5b:	Long-term oriented countries will indicate higher rates of innovation.

2.3.6 Indulgence vs. restraint

The indulgence-restraint dimension is referring to the good things in life. Members of an indulgence society value freedom and follow their instinct. Social contacts are very important and the feeling that life makes senses dominates (Hofstede, 2011). In an indulgence society members are allowed to freely experience the fulfilment of basic and natural desires with respect to having fun and enjoying life. In a restrained society, however, members experience life as something tough, mandatory, where there is no room for freedom (Hofstede, 2011). A restraint society intends to control for satisfaction of basic needs and desires of individual members through conducting strict regulations, or social norms to prevent undesired behaviour (Hofstede, 2011).

As mentioned before, freedom and communication between members of a society is important for the establishment of new ideas and an innovative spirit. Hence, it is expected that indulgence societies will be more concerned with innovations when compared with restraint countries. These findings lead to the sixth hypotheses:

H6a:	Indulgence countries will invest more in research & development.
H6b:	Indulgence countries will indicate higher rates of innovation.

2.4 R&D and innovation output

It is generally believed that firms with greater research capabilities in fundamental technologies will show an increase in innovation output. Scherer and Ross (1990) indicated that high-tech innovations require the creative mind-set of inventive labour, development opportunities, experimentation and the ability to commercialise. Furthermore, it is argued that a firm's spending in research and development is considered as an investment that contributes to the overall knowledge and expertise of a firm (Hall, Griliches, & Hausman, 1984). The development of skills in a particular research domain contributes to the progress of new innovations in this specific area. The main incentive for firms to initiate R&D activities is to develop innovations that eventually will lead to the establishment of new products and ultimately prove profitable (Scherer & Ross, 1990).

Several researchers have examined the effect of R&D activities through empirical analysis (Mansfield, 1962, 1965; Terleckyj, 1980). Mansfield (1965) indicated that a firm with a high level of R&D activities had a higher rate of productivity when compared to others. Similar results are shown by Griliches (1984), who has found R&D activities to be positively correlated with productivity growth, while primary research activity maintained the key to productivity increase. Additionally, Pakes and Griliches (1980) suggest that patents may be deemed as an output of research and development, instead of an input. Based on these arguments the following hypothesis is as follows:

H7:	Investment in research and development activities will lead to an increase in innovation output.

By examining the direct effects between R&D and innovation (H7), national culture and R&D (H1a-H6a), and national culture and innovation (H1b-H6b), R&D may be considered as a mediator variable to the extent to which it influences the relationship between national culture and innovation.

2.5 Measures of innovation output

Previous studies have used different measures to capture the national rate of innovation in a country. For example, Shane (1993) used the per capita numbers of trademarks as a proxy to measure innovation at the national level. Trademarks are described as "words or devices that differentiate one company's goods from those of another" (Shane, 1993, pp. 64). In order to receive a trademark, a firm must prove that the product is something that creates distinctiveness and uniqueness in the eyes of the consumer (Liebesny, 1972). This means that a good must be considered as an innovation in order to acquire a trademark. Shane (1993) mentioned that this measure has some disadvantages. Firstly, companies tend to apply only for trademarks for those innovations that are plan to bring on the market. Hence, they do not register trademarks for process innovations because trademarks will not exclude competitors from imitation of these innovations. Secondly, the relationship between the number of trademarks and innovations is not always linear. Sometimes, several innovations contribute to a particular product that is protected by a single trademark (Shane, 1992).

Other studies have used scientific and technical journal articles as a measure of innovation (Efrat, 2014; Fagerberg, Srholec, & Knell, 2005). This measure refers to the number of scientific and engineering articles published in the following fields: physics, biology, chemistry, mathematics, and biomedical research. Efrat (2014) measured innovation as the ratio of the total number of articles published by a country's researchers to the country's population. Efrat (2014) also includes a country's high-technology exports (as share of its total exports) as measure of innovation. High-technology exports refer to the industry's output aspect of innovation, while scientific articles represents pure products of academia. One of the limitations of such measures is that they are not intended to capture all aspects of innovation, or serve as an alternative to other indicators. Second, these measures do not include interior process innovations. Besides, in the case of scientific and technical journal articles there are issues of judgement involved in the selection of applicable journals and problems in the classification of the innovations (Coombs, Narandren, & Richards, 1996).

Furthermore, the number of patents has become a widely used measure for innovation output and is recognized as an efficient manner to monitor exchanges of knowledge between nations, sectors, and firms (Krammer, 2009). In the 1960s, Scherer (1965) and Schmookler (1966) initiated the use of patents as measure of innovation when they used patent statistics to examine the demand-side determinants of innovative behaviour. Globally, the last decades record an overwhelming increase in the number of patents issued, reflecting the growing importance of intellectual property in today's knowledge based economy (Acs, Anselin, & Varga, 2002; Krammer, 2009). By definition, patents are related to innovation activity (Taylor & Wilson, 2012). Each patent stands for an individual amount of invention that had the approval of skilled technicians and achieved the support of both investors and researchers who devote their time, exertion, and, resources to investigation and to acquiring legal protection (Taylor & Wilson, 2012). Perhaps that is why patents are the most commonly used quantitative measure of national innovation. However, like any other measure, also patents include both advantages and disadvantages (Acs et al., 2002).

Even though patents are good indicators of new technology development, they do not take into account the economic value of these technologies (Hall, Jaffe, & Trajtenberg, 2001). Griliches (1979) and Pakes and Griliches (1980) indicated patents as an inaccurate measure of innovative output, in particular since patents may differ considerably in their economic impact, and because not all innovations are eligible for patent protection.

Similarly, Taylor and Wilson (2012) argue that raw patent counts do not measure the impact or quality of the innovation patented. Besides, most patents are acquired for small innovations, and only a very few could be considered radical innovations (Taylor & Wilson, 2012). Furthermore, it is argued that while raw patents counts have been found empirically to correlate significantly with innovation inputs, such as R&D expenditure, they serve as nothing more than just a very rough measure of innovation output as a result of being too noisy (Griliches, 1984). Nevertheless, patents remain the best available source for determining technological alteration and innovation since no other measure comes close in the number of available data, accessibility and the potential technological design and industrial infrastructure (Griliches, 1990).

Bearing in mind these shortcomings, this study measures the quality of innovation, instead of quantity, by using the number of patents granted retrieved from the World Intellectual Property Organization (WIPO).

2.6 National Innovation System

For inventions and innovations to take place, a supporting infrastructure on the national level is strongly required. This type of infrastructure has been described as the National Innovation System (NIS) (Balzat & Hanusch, 2004; Freeman, 1995). Earlier research defined this system as "*… a network of public and private institutions within an economy that fund and perform R&D, translate the results of R&D into commercial innovations, and effect the diffusion of new technologies*" (Mowery & Oxley, 1995, pp. 80).

Fagerberg and Srholec (2008) found that the appearance of such a system significantly influences the capability to innovate on the national level, and that a country with a solid NIS benefits from an increase in economic prosperity (Efrat, 2014). It is however suggested that other factors besides a supporting infrastructure may affect the incentive to innovate on the firm level and on the national level (Elenkov & Manev, 2005; Lundvall, 2007; Mueller, Rosenbusch, & Bausch, 2013). This is strongly supported by Fagerberg and Srholec (2008), who indicated that several factors such as openness of the economy, ICT infrastructure, the political system, and the quality of governance are related with the ability to innovate. Moreover, they found evidence that specific indicators such as education, civic rights, trust, law and order, corruption, telecommunication, and form of governance influence the national rate of innovation. Besides, these indicators all interact with Hofstede's (1980,1991) cultural dimensions (Fagerberg & Srholec, 2008).

The presence of good governance and institutions is particularly important since it provides firms and nations with the pillars for creation, growth and diffusion of knowledge (Fagerberg and Srholec, 2008). Besides, Fagerberg and Srholec (2008) indicated that good governance is essential for the ability to innovate and to realize the desired economic development. Therefore, this current study further explores the role of the quality of governance as a moderator variable between the cultural dimensions and innovation at the national level. Some may argue that good quality of governance is mainly a question of successfully adapting the political system to the institutional arrangements that have proved to be profitable in Western democracies such as Europe and the United States. Since it is likely that Western democracies score good on quality of governance indicators (e.g. corruption, law and order, political system), a possible interpretation here might be that what is actually measured is the extent to which a country's institutions are "Westernized" (Fagerberg & Srholec, 2008).

However, in line with previous research by Barro (1996) and Glaeser, La Porta, Lopez-de-Silanes, and Shleifer (2004), Fagerberg and Srholec (2008) find the support for such allegations to be quite insufficient. These findings lead to one additional hypothesis:

H8:	The cultural dimensions have less influence on the national rates of innovation for countries with a higher quality of governance.

This final hypothesis will be examined by means of an interaction effect between the cultural dimensions and the quality of governance on the level of innovation. The magnitudes of the coefficients will assist in determining whether this hypothesis is confirmed or rejected.

2.7 Socio-economic control variables

When studying cross-cultural differences, other factors than national culture may cause the observed variance in innovative behaviour (Clark, 1990; Dawar & Parker, 1994; Katona, Strumpel, & Zahn, 1973). Therefore, it is necessary to include control variables to provide an unbiased measure of the effect of Hofstede's (1991) cultural dimensions on national rates of innovation. For instance, it is widely believed that a country's level of social well-being and economic development affect the rates of innovation (Taylor & Wilson, 2012). The reasoning behind this is that innovators with additional economic resources per capita are better able to translate ideas into research and technology activities. Therefore this studies controls for *GDP per capita* obtained from the World Development Indicators, published by the World Bank.

Besides, this study includes four additional control variables that are specifically indicated by scientists as important determinants for innovation. First, it is argued that innovation is more common in some industries when compared with others (Nelson & Winter, 1977). The implementation of new technologies is easier to realise in industries that benefit from strong government support, produce physical products, and where scale economies are important (Shane, 1993). Therefore this study controls for the *total value added in manufacturing* as a share of GDP. Second, natural resources are recognized as a potential barrier to innovation, driving otherwise innovative countries into a vicious circle of dependency on exports of raw materials, agricultural products, energy, and metal (Gelb, 1988; Ross, 1999; Sachs & Warner, 1995). Hence, *fuel exports* (as a share of merchandise exports) is included in the regression models. Third, openness to *trade*, defined as exports/imports as a percentage of GDP, is commonly used by other studies since it is considered as a strong incentive for long-run innovation to enhance the competitiveness (Daniels, 1997; Grossman & Helpman, 1991, 1995). Finally, *military expenditure* (as a share of GDP) is also considered by economists to be a dominant source of technological development (McNeill, 1982; Ruttan, 2006; Smith, 1985). It has been argued that national culture determines levels of violence, and therefore military expenditure. However, other studies report that even societies dominated by rigorous non-violent cultural norms and values, such as some Buddhist religious believes, have practiced military intervention in accordance with societies symbolized by norms and values relatively more accepting of violence (Popovski, Reichberg, Turner, 2009; Tambiah, 1992). Hence, it is interesting to include military expenditure as a control variable.

Figure 1 below shows the conceptual framework to illustrate the relations between the cultural dimensions, patents, moderator, mediator, and control variables.

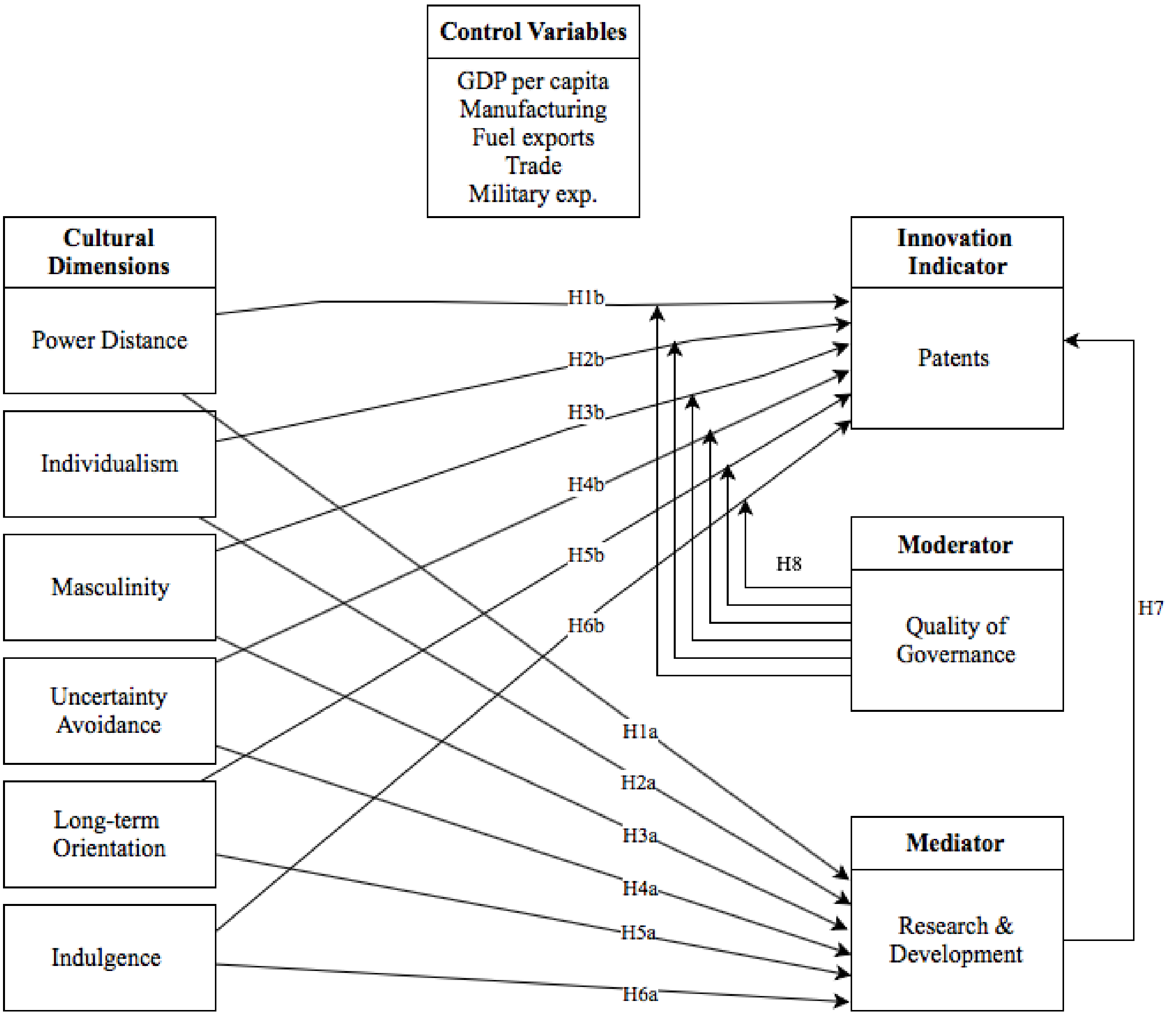

Figure 1. Conceptual Framework

3. Data & methodology

This section starts with an explanation of the applied data to test the hypotheses, followed by a discussion of the methodology. In addition, the dependent and independent variables are described. Finally, the estimation strategy is discussed.

3.1 Data description

The regression analysis in this study includes 15 emerging market economies over two periods of five years. The first period ranges from 2005-2009, and the second period ranges from 2010-2014. Since the country scores on the cultural dimensions do not change over time, the average values are taken for both the dependent and the explanatory variables to capture the effect of national culture on innovation over time. The descriptive statistics for both periods are showed in Table 4 and Table 5, respectively. Several sources have been used in order to obtain the most adequate data. The countries included are selected based on data availability.

The dependent variable consists of the number of patents granted per capita, retrieved from the World Intellectual Property Organisation (WIPO). The WIPO is an international organisation that is responsible for the promotion of innovation and creativity for the economic, social and cultural development of every country, by means of a balanced and adequate worldwide intellectual property structure. This specialised agency of the United Nations is taking care of the administration of the Patent Cooperation Treaty (PCT), which is an international agreement with more than 150 contracting states (Watal, 2001).

Data with regards to Hofstede's (1980, 1991) cultural dimensions are available for researchers through his own website. Hofstede's comprehensive database includes information from 117,000 surveys and interviews from more than 88,000 managers spread across 72 countries at IBM, in the period 1967-1969 and 1971-1973. Later on, Hofstede added 10 countries from three other regions such as Arabia and East and West Africa, and the values have been updated regularly. Hofstede identified patterns of similarities as well as differences among the respondents. From his data analysis, he aggregated national means of different sets of individual questions to develop six dimensions of culture for each country. These cultural dimensions explain the interaction between a society's culture and the values and beliefs of its members, and to what extent these values relate to behaviour, using a structure derived from factor analysis (Yaveroglu & Donthu, 2002).

For the moderator variable, represented by the quality of governance, data is obtained from the International Country Risk Guide (ICRG), published by the Political Risk Services Group (PRS Group). The ICRG provides political, economic, and financial risk indexes for 140 nations, evaluated every month, and are used by banks, shipping concerns, foreign exchange traders, investors, and multinational enterprises. The ICRG model allows users to make their own risk assessments to meet their specific requirements (Howell, 2011).

The mediator variable, represented by investment in R&D, and the socio-economic control variables are all obtained from the World Development Indicators (WDI) database, published by the World Bank. This database provides the fundamental data collection of development indicators in multiple areas, gathered from official recognised sources, worldwide. The data is adequate and updated on a regularly basis and contains estimates on global, national, and regional scale. Besides, the WDI database includes more than 800 indicators, covering more than 150 economies (World Bank, 2018).

Considering the descriptive statistics, the average number of patents granted is very similar for both time periods (as showed in Table 4 and Table 5). In the first period, the top 5 countries that applied for patents consist of South-Korea, Russian Federation, Malaysia, Czech Republic, and Poland, respectively. In the second period, the top 5 countries include South-Korea, Russian Federation, China, Mexico, and Malaysia, respectively. The statistics for the cultural dimensions are identical for both periods since these values do not change over time.

The correlation matrices for both periods are showed in Table 6 and Table 7, respectively. In both periods, the number of patents is strongly correlated with GDP per capita, R&D, and long-term orientation. Besides, R&D has a strong relationship with both manufacturing and long-term orientation. Concerning the cultural dimensions, there is a strong negative correlation between long-term orientation and indulgence, while individualism and masculinity are positively correlated. Regarding the control variables, the strongest correlation can be found between fuel exports and military expenditures, while trade and manufacturing are moderately correlated.

Table 4. Descriptive Statistics 2005 – 2009

Variables	*Mean*	*Std. Dev.*	*Min.*	*Max.*	*Source*
Dependent variable					
Patents per capita (ln)	3.91	1.51	1.99	7.54	WIPO
Control variables					
GDP per capita (ln)	8.85	0.82	7.01	9.90	World Bank
Manufacturing (% of GDP)	21.37	5.77	13.39	32.11	World Bank
Fuel exports (% of merchandise exports)	13.20	17.45	1.94	63.69	World Bank
Trade (% of GDP)	82.48	45.61	25.56	187.63	World Bank
Military expenditure (% of GDP)	1.95	0.87	0.46	3.60	World Bank
Mediator variable					
R&D (% of GDP)	0.83	0.73	0.08	2.98	World Bank
Moderator variable					
Quality of governance	61.18	11.65	44.11	80	PRS Group
Cultural dimensions					
PDI	72.2	15.08	46	100	Hofstede
IDV	34.73	19.30	13	80	Hofstede
MAS	53.73	16.14	28	88	Hofstede
UAI	70.27	21.93	30	95	Hofstede
LTO	48.13	25.90	13	100	Hofstede
IVR	45.67	23.00	20	97	Hofstede
Number of countries	15				

Table 5. Descriptive Statistics 2010 – 2014

Variables	*Mean*	*Std. Dev.*	*Min.*	*Max.*	*Source*
Dependent variable					
Patents per capita (ln)	3.93	1.49	1.42	7.66	WIPO
Control variables					
GDP per capita (ln)	9.01	0.76	7.30	10.05	WorldBank
Manufacturing (% of GDP)	20.18	6.48	11.97	31.17	WorldBank
Fuel exports (% of merchandise exports)	16.19	21.88	0.92	68.93	WorldBank
Trade (% of GDP)	82.80	45.23	24.25	165.03	WorldBank
Military expenditure (% of GDP)	1.83	0.89	0.60	3.78	WorldBank
Mediator variable					
R&D (% of GDP)	1.03	0.97	0.082	3.93	WorldBank
Moderator variable					
Quality of governance	60.02	12.38	39.67	77.89	PRS Group
Cultural dimensions					
PDI	72.2	15.08	46	100	Hofstede
IDV	34.73	19.30	13	80	Hofstede
MAS	53.73	16.14	28	88	Hofstede
UAI	70.27	21.93	30	95	Hofstede
LTO	48.13	25.90	13	100	Hofstede
IVR	45.67	23.00	20	97	Hofstede
Number of countries	15				

Table 6. Correlation Matrix 2005 – 2009

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(1) Patents per capita (ln)	1.00													
(2) GDP per capita (ln)	0.69**	1.00												
(3) Manufacturing (% of GDP)	0.34	-0.04	1.00											
(4) R&D (% of GDP)	0.76**	0.42	0.56*	1.00										
(5) Fuel exports (% of total exports)	-0.00	0.01	-0.38	-0.08	1.00									
(6) Trade (% of GDP)	0.35	0.27	0.52**	0.04	-0.32	1.00								
(7) Military expenditure (% of GDP)	0.09	-0.03	-0.21	0.21	0.69**	-0.28	1.00							
(8) Quality of governance	0.44	0.44	-0.21	0.28	-0.39	0.25	-0.05	1.00						
(9) PDI	-0.01	-0.42	0.04	-0.16	0.38	-0.02	0.17	-0.47*	1.00					
(10) IDV	0.11	0.22	-0.12	0.08	-0.17	0.28	-0.21	0.43	-0.31	1.00				
(11) MAS	-0.11	-0.10	0.04	-0.06	-0.18	0.10	-0.34	-0.03	-0.11	0.55*	1.00			
(12) UAI	0.23	0.65**	-0.54*	0.02	0.29	-0.26	0.09	0.33	-0.50*	0.16	-0.19	1.00		
(13) LTO	0.70**	0.31	0.52*	0.90**	0.03	0.08	0.27	0.15	-0.07	0.18	-0.07	-0.06	1.00	
(14) IVR	-0.28	0.08	-0.45	-0.48**	0.09	-0.17	-0.21	-0.11	0.07	-0.42	0.02	0.15	-0.71**	1.00

Note: * $p < 0.05$, ** $p < 0.01$

Table 7. Correlation Matrix 2010 – 2014

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
(1) Patents per capita (ln)	1.00													
(2) GDP per capita (ln)	0.71**	1.00												
(3) Manufacturing (% of GDP)	0.42	0.08	1.00											
(4) R&D (% of GDP)	0.78**	0.52*	0.62**	1.00										
(5) Fuel exports (% of total exports)	0.06	-0.04	-0.46	-0.17	1.00									
(6) Trade (% of GDP)	0.23	0.37	0.55**	0.27	-0.37	1.00								
(7) Military expenditure (% of GDP)	0.24	-0.03	-0.26	0.16	0.76**	-0.41	1.00							
(8) Quality of governance	0.12	0.37	-0.02	0.26	-0.45*	0.42	-0.18	1.00						
(9) PDI	-0.02	-0.42	-0.11	-0.21	0.31	-0.30	0.18	-0.54**	1.00					
(10) IDV	-0.09	0.18	-0.06	0.05	-0.22	0.43	-0.26	0.40	-0.31	1.00				
(11) MAS	-0.10	-0.12	0.11	-0.05	-0.12	0.17	-0.38	-0.01	-0.11	0.55*	1.00			
(12) UAI	0.28	0.63**	-0.43	0.01	0.25	-0.06	0.17	0.29	-0.50*	0.16	-0.19	1.00		
(13) LTO	0.67**	0.35	0.55*	0.87**	-0.06	0.18	0.29	0.03	-0.07	0.18	-0.07	-0.06	1.00	
(14) IVR	-0.17	0.04	-0.44	-0.44**	0.15	-0.24	-0.22	-0.07	0.07	-0.42	0.02	0.15	-0.71**	1.00

Note: * $p < 0.05$, ** $p < 0.01$

3.2 Methodology

This study uses secondary data to apply Ordinary Least Squares (OLS) regression analysis to test the hypotheses regarding cross-cultural differences. The use of secondary data could save time that would otherwise be spent on conducting interviews and surveys, two main sources of primary data. Besides, secondary data potentially provide databases of a larger extent and a higher quality, particularly in the case of quantitative data, that would be unfeasible for any individual analyst to collect independently (Schutt, 2006). In addition, secondary data is considered essential by researchers of social and economic change, since it is practically impossible to conduct a new survey that can sufficiently capture developments and alterations seen in the past. However, secondary data analysis might be less effective in this current research, as data relating to the cultural dimensions may be inaccurate or out-dated (Schutt, 2006).

The database used in this research includes variables that are measured as total sums or annual averages for each country for the period 2005-2014. Therefore, a panel data regression analysis is not appropriate in this study due to the lack of yearly observations. Besides, the presence of rarely changing values of the cultural dimensions over time may lead to multicollinearity, in particularly when applied with country fixed effects. As a result this study sticks with OLS, with robust standard errors. The OLS regressions are based on log-log specification, except for the cultural dimensions and variables that are measured as percentages. By doing so, the estimates could be interpreted in terms of elasticities and are less sensitive for outliers and avoid biased results. In addition, logarithm analysis is in line with much of the previous studies in this field of investigation (Furman, Porter, & Stern, 2002; Jones, 1998). In order to capture the effect of national culture on the rates of innovation along time, the years 2005-2014 have been split into five-year sub-periods and are examined separately.

3.2.1 Dependent variable

The dependent variable in this analysis is the average number of patents per capita. By using the number of patents granted, rather than total patent applications, this study measures the quality of innovation activity instead of the quantity. Although this measure has its limitations, it still remains one of the best available indicators of technological change and innovation output. The obtained data is averaged over two periods of five years in order to capture changes in the number of patents over time for each country, in relation to changes in values or other aspects.

3.2.2 Independent variables

In this analysis there are several independent variables of interest. The most relevant for this study are the cultural dimensions by Hofstede (1980, 1991) followed by the moderator variable (quality of governance) and mediator variable (investment in R&D). Besides, there are some additional control variables included in the analysis that are specified by researchers as possibly masking the effects of culture on innovation.

3.2.2.1 Cultural dimensions

In contrast to previous research, this current study examines all six cultural dimensions in relation with innovation, including power distance, individualism, masculinity, uncertainty avoidance, long-term orientation, and indulgence. These cultural dimensions can only be used meaningfully by comparison between countries, nations or regions (Hofstede, 2011). Conform the formulated hypotheses a positive and significant coefficient is expected for individualism, masculinity, long-term orientation, and indulgence, while a negative significant coefficient is expected for power distance and uncertainty avoidance, with regards to the number of patents.

3.2.2.2 Mediator variable

Investment in research and development (R&D) is closely related to the ability to innovate and is possibly influenced by cultural values. This study examines the potential mediating impact of R&D through determining if the cultural dimensions significantly affect investment in R&D, the national rates of innovation, and if R&D has a significant effect on innovation. In addition, a Sobel-Goodman mediation test will be performed in cases where there are reasons to believe that investment in R&D mediates the relationship between national culture and innovation. R&D expenditure is defined as the total spending on R&D performed by domestic firms, research organisations, and university institutions, in a country. This indicator is measured in million dollars and as a share of GDP.

3.2.2.3 Moderator variable

This study also examines the role of the quality of governance as a moderator in the relationship between innovation and the cultural dimensions. Fagerberg and Srholec (2008) measured the quality of governance based on corruption, law and order, independence of courts, property rights, and business friendly regulation. Due to data availability, this study uses three component variables that are part from the Political Risk Index, constructed by the Political Risk Services Group (PRS Group). This Political Risk Index includes 12 weighted components covering both political and social attributes. The components corruption, law and order, and democratic accountability, together, form the pillars to measure the quality of governance. The maximum score for each component is six, which means a maximum total score of 18 points. Hence, the total country scores are divided by 18 and multiplied by 100 per cent in order to calculate the relative number of points obtained. A low-risk point total indicates higher risk, while a high-risk point total indicates a lower risk. Thus, a positive and significant coefficient is expected for this variable.

3.2.3 Socio-economic control variables

This study also includes additional control variables in order to examine the effect of specific variables which may counter or mask the effects of culture on innovation, including GDP per capita, manufacturing, fuel exports, trade, and military expenditure.

3.2.3.1 GDP per capita

The majority of researchers assume that the level of a country's economic development has an impact on the national rates of innovation. Innovators with an increase in economic resources per capita are better able to develop concepts into new technologies. In order to capture economic development, GDP per capita is included as a control variable and is expected to positively impact the number of patents.

3.2.3.2 Manufacturing industry

It is argued that innovation activity is more prevalent in some industries than in others (Nelson & Winter, 1977). Hence, this study controls for the total value added in the manufacturing industry. Manufacturing refers to industries with respect to the production of rubber, plastics, chemical, non-metallic minerals, machinery, and electrical equipment. These physical products are often produced in large amounts, resulting in economies of scale. This variable is measured as a share of GDP and is expected to positively affect the number of patents.

3.2.3.3 Fuel exports

The presence of natural resources is usually seen as something positive. However, it is argued that the dependence on exports of energy, metals, raw materials, and agricultural products, is considered as an obstacle to innovation (Gelb, 1988; Ross, 1999; Sachs & Warner, 1995). In order to capture a country's natural resource base, this study uses fuel exports as indicator. This variable is measured as a share of merchandise exports and is expected to negatively affect the number of patents.

3.2.3.4 Trade

The extent to which a country participates in world trade is often used as an indicator of the degree of openness of the economy (Rodrik, 1999). Open countries benefit from knowledge and technology spill overs, which are considered to provide incentives for innovation development (Daniels, 1997). Therefore this study controls for the volume of trade, which is measured as the ratio of exports and imports as a share of GDP. It is expected that for countries with a significant trade volume will acquire a higher number of patents.

3.2.3.5 Military expenditure

Expenditure on military defence is considered by innovation scientists to be a major source of technological development (McNeil, 1982). Military expenditure is measured as a share of GDP and is considered as a rough indicator of the allocation of national resources used for military activities and of the burden on the economy (World Bank, 2018). It is expected that investment in military defence positively affect the number of patents.

3.3 Estimation strategy

In order to examine the relationship between national culture and the rates of innovation, the regression analysis starts with the estimation of a baseline model consisting of the dependent variable and the control variables. Thereafter, the cultural dimensions are added separately to the regression model to capture the effect of each dimension individually. However, in a society, the norms and values together embody national culture. Therefore, a full model including all cultural dimensions together with the explanatory variables is estimated in an attempt to adopt a coherent approach. Subsequently, the mediator and moderator effects will be examined. Finally, as a robustness check, other indicators of innovation are implemented in order to check whether the results found hold.

4. Empirical results

This section presents the empirical results of the regression estimates and provides a discussion of the empirical findings, and how they are related to the hypotheses formulated earlier in this study.

4.1 Main results

This analysis starts with examining the effect between the cultural dimensions and the national rates of innovation (H1b-H6b). The results of the regressions are showed in Table 8 and Table 9 below. The baseline model includes the dependent variable and the control variables, where GDP per capita and total value added in manufacturing are significant for both periods. Subsequently, the cultural dimensions are added separately in the model. Power distance shows a significant coefficient for both periods, while long-term orientation is significant only during the first period. The main results of this study are based on the full regression models, which consist of the dependent variable, the cultural dimensions, and the socio-economic control variables, all together. The primary reason to base the results on this comprehensive model is because in a society, all these factors are interactive and interdependent.

Looking at the results in the first period, the full regression model explained 91% of the variance in the number of patents granted, with power distance, uncertainty avoidance, and long-term orientation significantly impacting the level of innovation. From the socio-economic control variables, only fuel exports and trade are significant at a 10% level. The other control variables indicate no significant effect on innovation. The results for the second period are rather different. This time, the full regression model explained 99% of the variance in the number of patents granted, while this model has strong significant coefficients for all cultural dimensions. Besides, GDP per capita, fuel exports, trade, and military expenditure, indicate strong significant impact on the number of patents granted.

Based on these findings, power distance appears to be the most important cultural variable as it is significant for both periods and in all regression models in which it is included. Besides, uncertainty avoidance and long-term orientation appear to be important cultural determinants as they each are significant in the full equation model, but not in the individual regression models. In addition, individualism, masculinity, and indulgence appear to have some explanatory power, as they are significant in the full regression model for the second period, but not in the first period, suggesting, perhaps, that the importance of these variables is increasing. As regards the hypotheses, the results are as follows. H1b is not supported, as high power distant societies tend to have an increase in the number of patents granted, where a negative effect was expected. H2b is also not supported, as individualistic societies are found to have a negative impact on innovation, where a positive effect was expected. In addition, H4b is not substantiated, as uncertainty avoidance societies are found to have a positive impact on innovation. As for H3b, the impact of masculinity on innovation is as expected in the second period, thereby confirming H3b. Finally, H5b and H6b are confirmed, since both long-term societies and indulgence societies are found to positively impact the number of patents granted, at least in the second period.

Regarding the signs of the control variables, the findings are as follows. As expected, GDP per capita and total value added in manufacturing are positively correlated with the number of patents, while fuel exports is found to have a negative effect in both periods. Moreover, trade intensity and military expenditure are both positively related to the number of patents. In terms of the importance of these variables, per capita income turns out to have the most explanatory power in comparison with the others. All these findings are in line with the results from previous studies.

Table 8. OLS Estimation Results 2005 – 2009

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	1.306***	1.643**	1.295**	1.310**	1.430*	0.854**	1.317**	-0.610
	(0.394)	(0.512)	(0.420)	(0.423)	(0.734)	(0.322)	(0.409)	(0.594)
Manufacturing (%)	0.111*	0.099	0.117*	0.111*	0.103	-0.001	0.092	0.009
	(0.055)	(0.054)	(0.054)	(0.056)	(0.089)	(0.066)	(0.068)	(0.059)
Fuel exports (%)	0.002	-0.019	0.003	0.002	0.004	0.005	0.005	-0.066**
	(0.022)	(0.022)	(0.023)	(0.024)	(0.024)	(0.018)	(0.021)	(0.017)
Trade (%)	-0.000	-0.003	-0.001	-0.000	-0.001	0.006	-0.000	0.021*
	(0.007)	(0.008)	(0.008)	(0.007)	(0.009)	(0.008)	(0.008)	(0.007)
Military (%)	0.317	0.456	0.326	0.327	0.293	-0.049	0.187	0.709
	(0.550)	(0.467)	(0.596)	(0.651)	(0.601)	(0.541)	(0.622)	(0.312)
PDI		0.039*						0.073**
		(0.021)						(0.017)
IDV			0.005					-0.010
			(0.014)					(0.017)
MAS				0.001				0.024
				(0.022)				(0.014)
UAI					-0.007			0.085**
					(0.029)			(0.022)
LTO						0.032**		0.072**
						(0.012)		(0.014)
IVR							-0.011	0.039
							(0.017)	(0.017)
Constant	-10.665**	-15.966**	-10.818**	-10.787**	-11.010**	-5.644	-9.654*	-10.565**
	(3.904)	(5.446)	(4.086)	(4.375)	(4.250)	(3.370)	(4.314)	(3.298)
Observations	15	15	15	15	15	15	15	15
Adjusted R2	0.455	0.543	0.391	0.387	0.391	0.588	0.417	0.908

Notes: t statistics are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9. OLS Estimation Results 2010 – 2014

Variables	Baseline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	1.497***	1.712***	1.497***	1.527***	1.567**	1.385***	1.474***	0.502**
	(0.322)	(0.292)	(0.346)	(0.339)	(0.536)	(0.306)	(0.356)	(0.109)
Manufacturing (%)	0.136***	0.122***	0.136***	0.133***	0.131**	0.113*	0.140***	0.003
	(0.028)	(0.030)	(0.027)	(0.032)	(0.049)	(0.052)	(0.035)	(0.015)
Fuel exports (%)	0.006	-0.005	0.005	0.002	0.006	0.008	0.003	-0.044***
	(0.016)	(0.011)	(0.016)	(0.018)	(0.016)	(0.016)	(0.014)	(0.005)
Trade (%)	-0.008	-0.006	-0.008	-0.008	-0.008	-0.007	-0.007	0.015***
	(0.007)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)	(0.007)	(0.002)
Military (%)	0.416	0.541	0.417	0.533	0.419	0.262	0.517	1.036***
	(0.487)	(0.433)	(0.518)	(0.527)	(0.526)	(0.605)	(0.458)	(0.108)
PDI		0.031**						0.057***
		(0.013)						(0.004)
IDV			-0.000					-0.045***
			(0.012)					(0.006)
MAS				0.009				0.053***
				(0.014)				(0.006)
UAI					-0.004			0.048***
					(0.016)			(0.004)
LTO						0.009		0.040***
						(0.013)		(0.002)
IVR							0.005	0.016***
							(0.014)	(0.002)
Constant	-12.487***	-16.574***	-12.473***	-13.341***	-12.766***	-11.273***	-12.764***	-14.403***
	(2.620)	(2.586)	(3.025)	(3.085)	(3.277)	(2.793)	(2.734)	(0.429)
Observations	15	15	15	15	15	15	15	15
Adjusted R2	0.680	0.759	0.640	0.653	0.641	0.654	0.644	0.993

Notes: t statistics are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2 Mediator effect

In order to examine the potential mediator effect of investment in R&D, the first step involves examining the direct effect between the national culture and R&D. It is necessary for the cultural dimensions to be correlated with the mediator. Based on the correlation matrices (see Table 6 and Table 7) there is no evidence to assume that there is a direct effect between power distance and R&D for both periods, therefore rejecting H1a. This is also not the case for cultural dimensions uncertainty avoidance, masculinity, and individualism. Hence, H2a, H3a, and H4a are not supported either. However, long-term orientation is found to have a positive direct effect on the investment in R&D, thereby confirming H5a. Indulgence is found to have a negative impact on the investment in R&D, while a positive correlation was expected. Therefore, H6a is rejected. The second step involves the establishment of the direct effect between the innovation indicator and investment in R&D. As indicated in the correlation matrices, this study founds a strong positive correlation between investment in R&D and the number of patents for both periods, thereby confirming H7.

Since long-term orientation is both positively correlated with innovation and R&D, a Sobel-Goodman mediation test is performed to examine whether R&D carries influence with respect to long-term orientation and innovation. The results of this test (see Figure 8 in the Appendix) indicate that the mediation effect of R&D is statistically significant with approximately 1 per cent of the total effect between long-term orientation and innovation being mediated. Based on these findings, there is no reason to believe that investment in R&D effectively mediates the relationship between the cultural dimensions and innovation in this study.

4.3 Moderator effect

The results of the moderator analysis are indicated in Table 10 and Table 11 below. In this case, the baseline model is expanded with the quality of governance as an additional variable to capture its effect on the number of patents. In the first period, the quality of governance is highly significant and has a positive effect. This means that countries with a higher quality of governance will have an increase in the number of patents. However, in the second period it has no statistically significant effect on the number of patents. The other regressions include the interaction effects between the cultural dimensions and quality of governance, separately. First, the effect between power distance and the quality of governance is tested, which has a negative and significant effect for both periods. Second, the interaction between individualism and quality of governance is examined and also reports a significant and negative effect for both periods. Regarding the first period, uncertainty avoidance and indulgence both show a positive and significant interaction effect with the quality of governance, while in the second period all other interactions between the dimensions and quality of governance are statistically insignificant at a 10 per cent level. Looking at the magnitudes of the (significant) interaction coefficients, it is remarkable that they contain minimal values when compared with the magnitudes of the cultural dimensions, individually. This suggests that the effect of the cultural dimensions is decreasing as for the interactions.

As a result, it is plausible that the influence of national culture on the number of patents is less for countries with a higher quality of governance, thereby confirming H8.

Table 10. Moderation Effect 2005-2009

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR
GDP per capita (log)	0.828**	1.102***	0.786**	0.771**	0.927*	0.807*	0.791**
	(0.278)	(0.140)	(0.284)	(0.249)	(0.432)	(0.406)	(0.270)
Manufacturing (%)	0.229***	0.213***	0.223***	0.237***	0.188**	0.218*	0.248***
	(0.049)	(0.029)	(0.044)	(0.048)	(0.059)	(0.109)	(0.055)
Fuel exports (%)	0.060**	0.038***	0.053**	0.081***	0.108***	0.061**	0.067***
	(0.019)	(0.009)	(0.021)	(0.021)	(0.021)	(0.022)	(0.013)
Trade (%)	-0.009	-0.012***	-0.006	-0.006	-0.010	-0.008	-0.010
	(0.007)	(0.003)	(0.006)	(0.006)	(0.006)	(0.010)	(0.007)
Military expenditure (%)	-0.396	-0.299*	-0.333	-0.710	-0.860**	-0.449	-0.441
	(0.349)	(0.135)	(0.321)	(0.377)	(0.289)	(0.310)	(0.236)
Quality of governance	0.098***	0.227***	0.169***	0.211**	-0.047	0.131*	0.046
	(0.029)	(0.044)	(0.033)	(0.063)	(0.083)	(0.057)	(0.037)
PDI		0.153***					
		(0.034)					
PDI*QoG		-0.002**					
		(0.001)					
IDV			0.184**				
			(0.074)				
IDV*QoG			-0.003**				
			(0.001)				
MAS				0.130			
				(0.083)			
MAS*QoG				-0.002			
				(0.001)			
UAI					-0.174**		
					(0.067)		
UAI*QoG					0.003*		
					(0.001)		
LTO						0.044	
						(0.035)	
LTO*QoG						-0.001	
						(0.001)	
IVR							-0.083**
							(0.032)
IVR*QoG							0.001**
							(0.001)
Constant	-13.595***	-26.531***	-17.966***	-20.392***	-3.099	-15.399*	-10.611**
	(2.994)	(2.517)	(1.993)	(4.843)	(7.821)	(7.050)	(4.061)
Number of observations	15	15	15	15	15	15	15
Adjusted R-squared	0.705	0.929	0.756	0.710	0.792	0.668	0.718

Notes: t statistics are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11. Moderation effect 2010 - 2014

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR
GDP per capita (log)	1.452***	1.363***	1.316**	1.469***	1.505*	1.317**	1.208***
	(0.317)	(0.198)	(0.356)	(0.336)	(0.695)	(0.402)	(0.290)
Manufacturing (%)	0.157**	0.186***	0.190**	0.128*	0.148*	0.189	0.259**
	(0.059)	(0.045)	(0.060)	(0.062)	(0.068)	(0.113)	(0.088)
Fuel exports (%)	0.015	0.028	0.025	0.010	0.020	0.039	0.071
	(0.031)	(0.022)	(0.030)	(0.036)	(0.049)	(0.051)	(0.054)
Trade (%)	-0.011	-0.016**	-0.012	-0.005	-0.011	-0.014	-0.020
	(0.010)	(0.005)	(0.011)	(0.010)	(0.012)	(0.011)	(0.013)
Military expenditure (%)	0.252	-0.161	0.017	0.455	0.205	-0.227	-0.797
	(0.693)	(0.533)	(0.649)	(0.738)	(0.873)	(1.011)	(1.230)
Quality of governance	0.016	0.273**	0.103	0.062	-0.002	0.084	-0.027
	(0.036)	(0.097)	(0.056)	(0.096)	(0.100)	(0.117)	(0.033)
PDI		0.217**					
		(0.062)					
PDI*QoG		-0.003**					
		(0.001)					
IDV			0.178				
			(0.091)				
IDV*QoG			-0.003*				
			(0.001)				
MAS				0.080			
				(0.101)			
MAS*QoG				-0.001			
				(0.001)			
UAI					-0.023		
					(0.097)		
UAI*QoG					0.000		
					(0.002)		
LTO						0.051	
						(0.068)	
LTO*QoG						-0.001	
						(0.001)	
IVR							-0.155
							(0.093)
IVR*QoG							0.003
							(0.001)
Constant	-13.090***	-29.920***	-17.816***	-16.800**	-12.037	-16.097	-8.640*
	(3.234)	(5.187)	(3.597)	(5.966)	(10.063)	(8.500)	(4.112)
Number of observations	15	15	15	15	15	15	15
Adjusted R-squared	0.649	0.858	0.658	0.575	0.540	0.584	0.672

Notes: t statistics are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3 Robustness checks

In order to test the validity of the results found this study checks the robustness of the estimated coefficients through changing or omitting variables to the existing regressions. As a first robustness check, the dependent variable is changed to another indicator of innovation: scientific and technical journals. A higher value (more publications) of this variable indicates an increase in innovative activity. The estimation results are showed in Table 12 and Table 13 in the Appendix. Considering the cultural dimensions, individualism and long-term orientation indicate a significant coefficient in the first period, while individualism, masculinity, and uncertainty avoidance are statistically significant in the second period. However, the full model regressions indicate no significant impact on the number of scientific and technical journals at all. Hence, the relationship between national culture and this measure of innovation is rather weak.

As a second robustness check, the dependent variable is changed to high-technology exports, where a higher value (more exports) of this variable indicates a modern, highly complex production structure that offers better opportunities for technological innovation. Looking at the coefficients (see Table 14 and Table 15 in the Appendix) of the cultural dimensions, only power distance and uncertainty avoidance show a significant effect on the volume of high-technology exports in both periods. Again, the variables in the full model regressions show no significant impact on this measure of innovation output.

Finally, the regression model is simplified by leaving out some additional control variables including trade, fuel exports, and military expenditure, since the correlations between these variables may be problematic. The results are shown in Table 16 and Table 17 in the Appendix. For both periods GDP per capita is strongly significant and has a positive impact on the number of patents granted, while only power distance and long-term orientation are significant in the individual regression models. Besides, these cultural dimensions are significant solely in the full regression model of the second period, indicating some explanatory power.

5. Conclusion

This section provides the answer to the research question through a discussion of the main findings. Next, the policy implications arising from these findings are discussed. Finally, the limitations and suggestions for future research will be explained.

5.1 Main findings

The primary objective of this present study is to answer the question to what extent national culture influences the national rates of innovation in emerging market economies. Building from previous studies and by using recent data and contemporary measurements this study has led to some interesting findings. Although investment in research and development is found to be a strong facilitator of innovation, it is important to emphasise that cultural factors are substantial incentives for innovation development in emerging economies.

However, not all findings are as expected. In particular, cultural dimensions power distance, uncertainty avoidance, and individualism are found to have a significant impact, but its influence on innovation is different when compared to western countries. In high power distant nations, where authority is distributed unequally amongst members of a society, the national rates of innovation tend to be higher. High uncertainty avoidance societies, where members feel uncomfortable with uncertainty and ambiguity, are also found to have higher rates of innovation. Regarding individualism nations, where members of a society are expected to take care of only themselves, tend to have lower national rates of innovation. These findings are in contrast to developed countries. This implies that the influence of these cultural values differs depending on economic conditions.

Additionally, the impact of the cultural dimensions appears to fluctuate across two periods of time. Individualism, masculinity, and indulgence increased in its influence on the national rates of innovation, while power distant, uncertainty avoidance, and long-term orientation diminished in its importance. In sum, these findings indicate that the role of national culture is substantial and maintains a significance influence on the ability of emerging economies to create and continue innovation development. The adjustment of the dependent variable through alternative measures of innovation (i.e. scientific and technical journals and high-tech exports), each referring to a different aspect of innovation, does not invalidate this conclusion.

In addition, this study considers investment in research and development as a potential mediator variable to the extent to which it influences the relationship between national culture and innovation. However, this study found no evidence to believe that investment in R&D adequately mediates the effect between national culture and innovation.

Furthermore, this study has established an interaction effect between the cultural dimensions and the quality of governance. Although an increase in the quality of governance is found to positively affect the number of patents granted, in combination with the cultural dimensions this effect turns out to be negative for power distant and individualism societies. However, the interaction effects between the quality of governance and uncertainty avoidance and indulgence have a positive impact on innovation activity. Nevertheless, looking at the magnitudes of all interaction effects, the quality of governance mitigates the effect of national culture on the number of patents. This implies that the role of national culture is less important for countries with a higher standard of quality of governance.

In addition, this study examines the effect of different socio-economic variables on the national rates of innovation. The level of economic development is found as a strong determinant of innovation progress. Also, the total value added in manufacturing, an industry known for it’s innovative opportunities, is indicated as a key determinant of innovation activity. Besides, a country’s degree of trade openness and its military expenditure both have a positive impact on the national rates of innovation, while the dependency on raw materials is counter-productive. These findings largely support the results of previous studies.

5.2 Policy implications

In the light of these conclusions a careful policy recommendation is required since the used measure of national rate of innovation is not without limitations, and the results concerning the cultural dimensions are not fully robust. However, it is clear that national culture matters for innovation development, with power distant as the strongest cultural variable. Hence, for countries that are keen to increase their rates of innovation, public policies that encourage the investment in research and development or industrial infrastructure may not be sufficient. It is conceivable that countries also need to revise the attitudes of their members of society. Highly innovative nations include people who are high in power distance, avoid uncertainty, prefer collectivism to individualism, and take a long-term vision. Societies that have people that lack these values and beliefs may invest in research and development and industrial infrastructure, but still fall short with respect to their desired rates of innovation due to their people’s attitudes. Therefore, policymakers in emerging countries must have a strong focus on policies that affect the beliefs and values underpinning people’s behaviour.

Furthermore, the evidence that national culture affects innovation development could be of great importance for business managers involved with locating research and development facilities on a global scale. More specifically, firms should take national culture in consideration when establishing their expectations with respect to the quantity of outputs and profits.

Finally, the relevance of national culture with respect to innovation is found to be less for countries with a higher standard of quality of governance. As a consequence, emerging countries could use their quality of governance as a measure of the extent to which they should value the importance of national cultural on their rates of innovation.

5.3 Limitations & future research

In spite of these findings, this study has some limitations. The first limitation is caused by the fact that changes in the cultural values could not be scrutinized. The data of the cultural dimensions provided by Hofstede (1980,1991) includes values measured at one point in time, while his study shows a constant ranking of cultures over a longer term. It could be that the fluctuations in national rates of innovation between the first and the second period appeared as a reaction to changes in cultural values. Unfortunately, one can only speculate, unless the survey of Hofstede is replicated. Future studies should investigate the relation between national culture and innovation in a dynamic way through aiming at the correlation between changes in cultural values and shifts in rates of innovation. This may indicate if countries could increase their rates of innovation through a change in their values. Using primary data sources rather than secondary data might offer a practical solution to achieve this goal.

A second limitation arises from the imperfections of the measurements of rates of innovation and cultural values applied in this study. The number of patents granted is indicated as a very rough measure of innovation output, while the cultural dimensions by Hofstede (1980,1991) only concern one company. Future research could examine other measures of innovation output together with alternative measures of culture. Until then, the number of patents granted remains one of the best available benchmarks for determining technological development and innovation at the national level.

A third limitation concerns the measurement of the dependent variable, the number of patents. It is calculated as the average number of patents granted for 10 years, divided over two periods of five years. The lack of yearly observations of the cultural values has restrained this study from using a panel data regression.

Finally, this current research has examined the interaction effect between the quality of governance and the cultural values on innovation. However, additional research is needed to further examine this specific interaction.

In short, this study suggests that researchers involved with innovation across countries should include national culture in their investigation. Although this research has some limitations, it indicates that culture matters for the development of innovation.

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7. Appendices

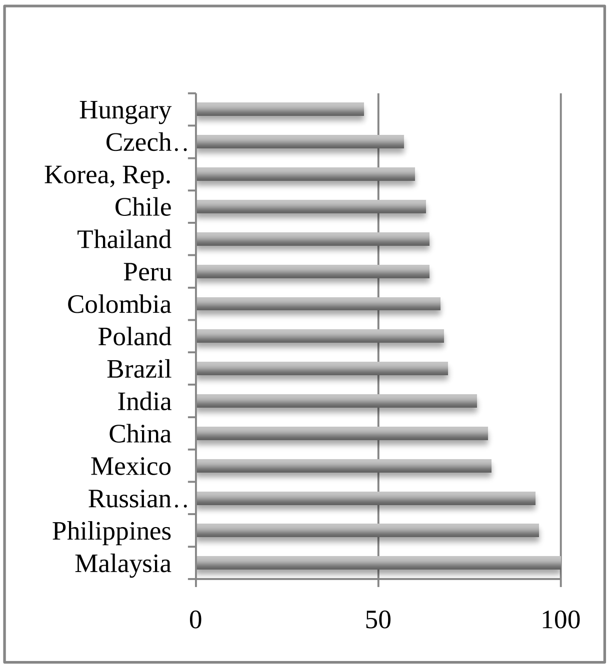

Figure 2. Power Distance

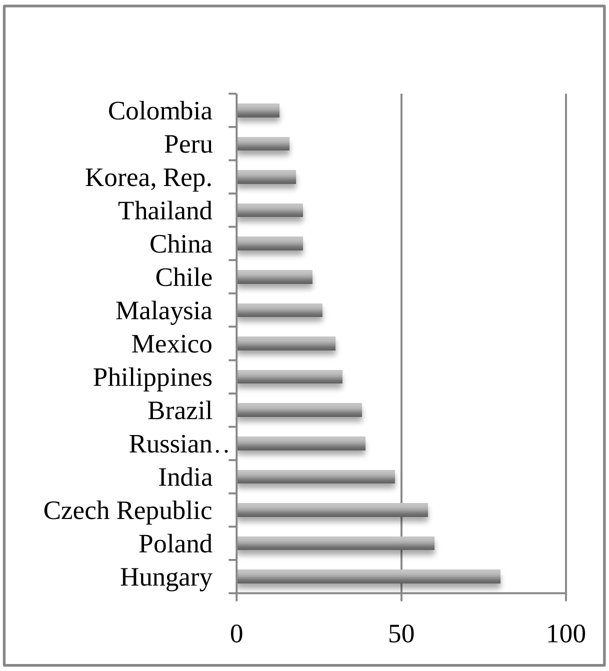

Figure 3. Individualism

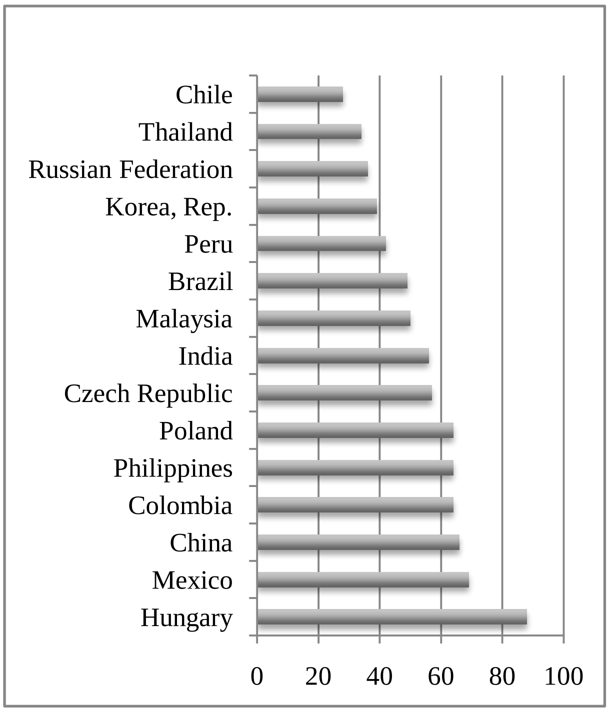

Figure 4. Masculinity

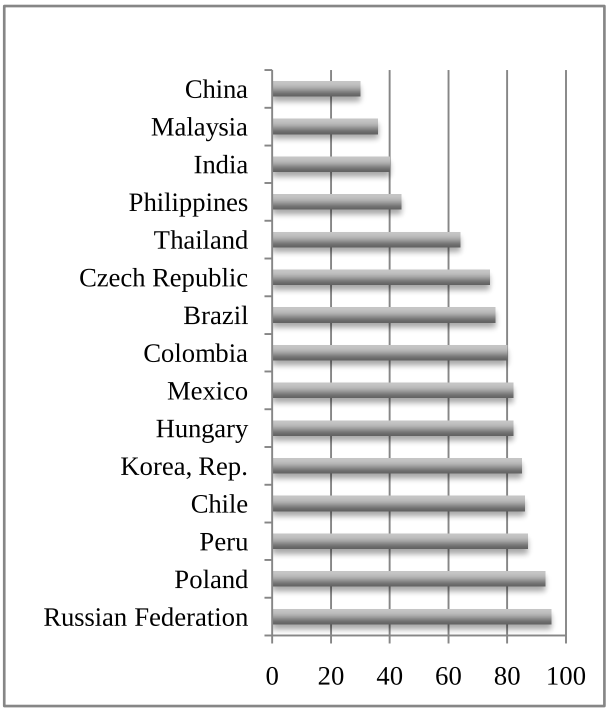

Figure 5. Uncertainty Avoidance

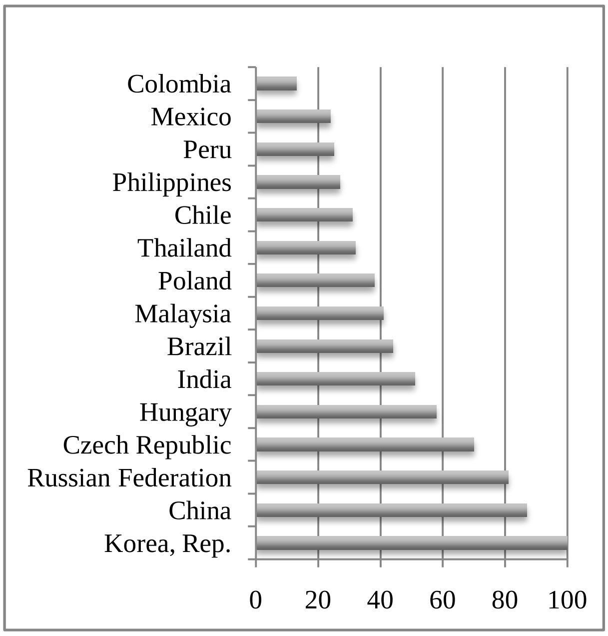

Figure 6. Long-term Orientation

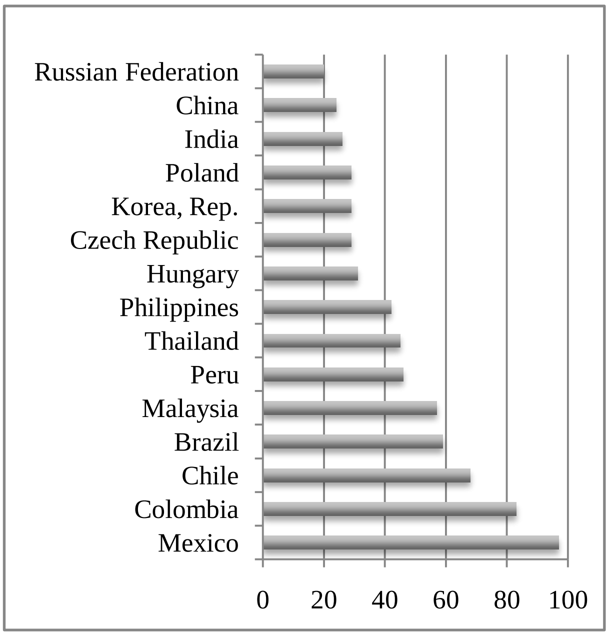

Figure 7. Indulgence

Figure 8. Sobel-Goodman Test

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Sobel-Goodman Mediation Tests

                      Coef          Std Err      Z            P>|Z|
Sobel                .03877793     .01899524    2.041       .04120565
Goodman-1 (Aroian)   .03877793     .01921287    2.018       .04355687
Goodman-2            .03877793     .01877509    2.065       .03888587

                     Coef       Std Err     Z           P>|Z|
a coefficient   =  .032512    .005225    6.22271     4.9e-10
b coefficient   =  1.19271    .551912    2.16106     .030691
Indirect effect =  .038778    .018995    2.04145     .041206
  Direct effect = -7.2e-06    .020738   -.000347     .999723
   Total effect =  .038771    .011774    3.29303     .000991

Proportion of total effect that is mediated:  1.0001855
Ratio of indirect to direct effect:           -5390.9973
Ratio of total to direct effect:              -5389.9973
```

Table 18. Country list

Brazil	Malaysia
Chile	Mexico
China	Peru
Colombia	Philippines
Czech Republic	Poland
Hungary	Russian Federation
India	Thailand
Korea, Rep.	

Table 12. Scientific and technical journals (2005-2009)

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	1.517***	1.472**	1.439***	1.570***	1.738**	1.158**	1.533***	1.097
	(0.439)	(0.498)	(0.303)	(0.440)	(0.523)	(0.409)	(0.411)	(0.677)
Manufacturing	0.054	0.056	0.095**	0.057	0.038	-0.035	0.024	0.154
	(0.044)	(0.045)	(0.030)	(0.032)	(0.043)	(0.050)	(0.050)	(0.086)
Fuel exports	-0.023	-0.020	-0.018	-0.025	-0.020	-0.021	-0.018	-0.023
	(0.016)	(0.020)	(0.011)	(0.016)	(0.018)	(0.013)	(0.013)	(0.033)
Trade	0.000	0.001	-0.005	-0.000	-0.001	0.005	0.000	-0.007
	(0.004)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)	(0.004)	(0.008)
Military	0.612	0.593	0.679*	0.764*	0.568	0.321	0.415	0.878
	(0.364)	(0.388)	(0.347)	(0.401)	(0.351)	(0.304)	(0.414)	(0.514)
PDI		-0.005						0.005
		(0.020)						(0.037)
IDV			0.032***					0.066
			(0.008)					(0.025)
MAS				0.020				-0.022
				(0.013)				(0.018)
UAI					-0.012			0.001
					(0.018)			(0.035)
LTO						0.025**		0.013
						(0.009)		(0.021)
IVR							-0.016	0.035
							(0.010)	(0.023)
Constant	-10.660**	-9.949	-11.738***	-12.468**	-11.278**	-6.681	-9.128*	-12.727
	(4.356)	(5.558)	(2.939)	(4.358)	(4.540)	(4.182)	(4.812)	(5.824)
Number of observations	15	15	15	15	15	15	15	15
Adjusted R-squared	0.637	0.594	0.824	0.658	0.605	0.717	0.661	0.735

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13. Scientific and technical journal articles (2010-2014)

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	1.318**	1.352**	1.334***	1.385***	1.799***	1.114**	1.345**	1.903**
	(0.413)	(0.449)	(0.336)	(0.393)	(0.438)	(0.408)	(0.421)	(0.543)
Manufacturing	0.015	0.012	0.050	0.008	-0.022	-0.026	0.010	0.114
	(0.045)	(0.047)	(0.034)	(0.033)	(0.044)	(0.044)	(0.044)	(0.077)
Fuel exports	-0.019	-0.021	-0.013	-0.026*	-0.018	-0.014	-0.015	-0.004
	(0.013)	(0.015)	(0.008)	(0.012)	(0.016)	(0.013)	(0.014)	(0.016)
Trade	0.009	0.010	0.003	0.009	0.009*	0.011*	0.008	-0.007
	(0.006)	(0.006)	(0.007)	(0.006)	(0.005)	(0.005)	(0.007)	(0.008)
Military	0.721*	0.741	0.668**	0.981**	0.740	0.442	0.601	0.846
	(0.387)	(0.410)	(0.277)	(0.395)	(0.410)	(0.344)	(0.502)	(0.437)
PDI		0.005						-0.009
		(0.014)						(0.022)
IDV			0.022*					0.063
			(0.011)					(0.031)
MAS				0.021*				-0.026
				(0.011)				(0.020)
UAI					-0.024*			-0.035
					(0.012)			(0.016)
LTO						0.016		-0.008
						(0.010)		(0.018)
IVR							-0.005	0.022
							(0.009)	(0.020)
Constant	-8.681*	-9.327*	-9.792**	-10.581**	-10.589**	-6.482	-8.351*	-13.335*
	(3.884)	(4.426)	(3.241)	(3.713)	(3.732)	(3.985)	(4.287)	(5.163)
Number of observations	15	15	15	15	15	15	15	15
Adjusted R-squared	0.697	0.662	0.764	0.730	0.748	0.712	0.666	0.814

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14. High-tech exports (2005-2009)

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	-6.836	-0.757	-6.433	-6.672	1.042	-6.753	-6.991	-7.724
	(8.434)	(5.731)	(8.369)	(8.916)	(9.517)	(9.486)	(8.651)	(19.947)
Manufacturing	1.078	0.851	0.863	1.086	0.518	1.098	1.357	0.512
	(0.633)	(0.641)	(0.593)	(0.674)	(0.857)	(1.225)	(0.800)	(2.371)
Fuel exports	0.081	-0.302	0.057	0.074	0.171	0.081	0.035	-0.586
	(0.168)	(0.268)	(0.151)	(0.198)	(0.180)	(0.168)	(0.183)	(0.832)
Trade	0.160*	0.117	0.187**	0.158	0.108	0.159	0.159*	0.225
	(0.083)	(0.081)	(0.078)	(0.091)	(0.074)	(0.090)	(0.075)	(0.263)
Military	-3.935	-1.426	-4.283	-3.469	-5.482	-3.868	-2.090	2.340
	(4.793)	(3.937)	(5.019)	(5.692)	(4.980)	(4.136)	(5.196)	(14.059)
PDI		0.699*						0.873
		(0.350)						(0.956)
IDV			-0.167					-0.272
			(0.177)					(0.720)
MAS				0.060				0.412
				(0.224)				(0.511)
UAI					-0.423*			0.389
					(0.220)			(0.955)
LTO						-0.006		0.204
						(0.214)		(0.578)
IVR							0.150	0.116
							(0.132)	(0.663)
Constant	51.130	-44.570	56.729	45.608	29.121	50.207	36.740	-56.029
	(84.329)	(60.588)	(85.199)	(89.037)	(91.871)	(97.125)	(92.715)	(160.745)
Number of observations	15	15	15	15	15	15	15	15
Adjusted R-squared	0.203	0.441	0.145	0.108	0.217	0.104	0.144	-0.207

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15. High-tech exports (2010-2014)

VARIABLES	Basline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	-4.900	-0.629	-5.004	-5.019	2.919	-5.061	-5.309	-0.623
	(6.413)	(4.338)	(6.503)	(6.872)	(7.386)	(7.133)	(6.794)	(11.819)
Manufacturing	1.151**	0.877*	0.919**	1.163**	0.563	1.118	1.219**	-0.304
	(0.367)	(0.384)	(0.355)	(0.408)	(0.572)	(0.687)	(0.403)	(1.431)
Fuel exports	0.149	-0.062	0.110	0.161	0.164	0.153	0.099	-0.262
	(0.166)	(0.181)	(0.123)	(0.219)	(0.142)	(0.167)	(0.162)	(0.353)
Trade	0.042	0.080	0.084	0.043	0.034	0.043	0.054	0.205
	(0.090)	(0.054)	(0.123)	(0.095)	(0.069)	(0.096)	(0.106)	(0.213)
Military	-4.901	-2.419	-4.554	-5.359	-4.589	-5.121	-3.122	0.489
	(4.409)	(4.056)	(3.997)	(6.140)	(4.484)	(4.703)	(5.689)	(9.006)
PDI		0.611**						0.630
		(0.184)						(0.448)
IDV			-0.146					-0.482
			(0.202)					(0.630)
MAS				-0.036				0.429
				(0.229)				(0.458)
UAI					-0.395**			0.031
					(0.157)			(0.412)
LTO						0.013		0.086
						(0.163)		(0.362)
IVR							0.081	-0.102
							(0.156)	(0.410)
Constant	42.012	-39.306	49.239	45.359	11.001	43.744	37.123	-37.355
	(61.760)	(41.033)	(64.650)	(68.883)	(69.274)	(70.017)	(67.703)	(93.622)
Number of observations	15	15	15	15	15	15	15	15
Adjusted R-squared	0.120	0.558	0.0571	0.0128	0.260	0.0108	0.0278	0.0994

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16. Simplified regression model (2005-2009)

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	1.288***	1.536***	1.289***	1.278***	1.364**	1.008***	1.310***	0.976
	(0.325)	(0.405)	(0.369)	(0.330)	(0.475)	(0.210)	(0.304)	(0.583)
Manufacturing (%)	0.097*	0.095*	0.097*	0.098	0.089	0.033	0.073	0.066
	(0.053)	(0.050)	(0.054)	(0.057)	(0.091)	(0.044)	(0.056)	(0.087)
PDI		0.033**						0.035
		(0.012)						(0.020)
IDV			-0.000					0.002
			(0.013)					(0.024)
MAS				-0.005				0.003
				(0.017)				(0.023)
UAI					-0.005			0.015
					(0.023)			(0.025)
LTO						0.027**		0.030
						(0.010)		(0.018)
IVR							-0.014	0.007
							(0.014)	(0.022)
Constant	-9.576**	-14.077***	-9.577**	-9.225**	-9.743**	-7.021***	-8.617**	-11.729**
	(3.289)	(4.391)	(3.455)	(3.199)	(3.285)	(1.981)	(3.079)	(3.737)
Number of observations	15	15	15	15	15	15	15	15
Adjusted R-squared	0.546	0.616	0.505	0.508	0.506	0.675	0.549	0.604

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 17. Simplified regression model (2010-2014)

VARIABLES	Baseline	PDI	IDV	MAS	UAI	LTO	IVR	Full
GDP per capita (ln)	1.333***	1.631***	1.407***	1.318***	1.293**	1.094***	1.341***	0.901**
	(0.309)	(0.331)	(0.297)	(0.319)	(0.464)	(0.308)	(0.336)	(0.347)
Manufacturing (%)	0.084	0.090*	0.080	0.085	0.087	0.037	0.078	0.073
	(0.048)	(0.043)	(0.047)	(0.052)	(0.067)	(0.042)	(0.059)	(0.054)
PDI		0.036*						0.038**
		(0.017)						(0.014)
IDV			-0.015					-0.023
			(0.009)					(0.012)
MAS				-0.005				0.022
				(0.018)				(0.016)
UAI					0.002			0.029
					(0.018)			(0.016)
LTO						0.022*		0.031**
						(0.010)		(0.011)
IVR							-0.003	0.007
							(0.014)	(0.012)
Constant	-9.769***	-15.211***	-9.835***	-9.370**	-9.623**	-7.749**	-9.573***	-12.722***
	(2.893)	(3.896)	(2.673)	(3.086)	(3.101)	(2.948)	(2.929)	(2.425)
Number of observations	15	15	15	15	15	15	15	15
Adjusted R-squared	0.570	0.674	0.579	0.535	0.532	0.647	0.534	0.808

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1