

Country Culture and National Innovation

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Abstract

Innovation, the implementation of creative ideas, is not only vital to growth but also to survival as companies and nations must innovate to compete in a rapidly changing global economy. Researchers are just beginning to understand the relationship between country culture and innovation. In a number of studies, cultural dimensions have correlated significantly with measures of innovation and creativity. However, it is difficult to compare findings across studies as multiple frameworks have been used to operationalize culture. Likewise, measures of innovation vary widely across studies. This paper proposes using a new index, the Global Innovation Index (GII), and Hofstede's cultural dimensions to explore the relationships between country culture and innovation. We begin with definitions and a discussion of innovation and national culture. Then, measures of national culture, innovation, and creativity are critically discussed, and followed by a review of existing research on country culture and innovation. Hypotheses are proposed and tested using Hofstede's dimensions and the Global Innovation Index. Our results indicate support for four out of the six hypotheses and suggest that innovative societies are characterized by the following cultural values: individualism, low masculinity, pragmatism, and indulgence.

KeyWords: innovation, country culture, national culture, creativity, Global Innovation Index, Hofstede's cultural framework

INTRODUCTION

Innovation has been defined as the “successful implementation of creative ideas” [1]. Innovation is not only vital to growth but also to survival as companies must innovate to compete in a rapidly changing global economy [2]. Creativity is not only critical for companies but also for the economic development of societies [3]. State Westwood and Low in their discussion of the culture, creativity and innovation connection [2]:

“Given the globalization of business, the increasing interpenetration of businesses across cultures, the international mobility of managers and other forms of labor, and the trend toward the dispersion of innovative activity across national boundaries, it has become increasingly important that there is an informed understanding of the extent to which creativity and innovation processes vary around the world” (p. 236).

Researchers are just beginning to understand the relationship between country culture and innovation. In a number of studies, cultural dimensions have correlated significantly with measures of innovation and creativity. Unfortunately, it is difficult to compare findings across

studies as multiple frameworks have been used to operationalize culture. Likewise, measures of innovation vary widely across studies.

This paper proposes using a new index, the Global Innovation Index (GII), and Hofstede's cultural dimensions to better understand the relationships between country culture and innovation. We begin with definitions and a discussion of the following terms: innovation and national culture. Then, measures of national culture, innovation, and creativity are discussed critically, and followed with a review of existing research on country culture and innovation. Finally, hypotheses are proposed and tested.

LITERATURE REVIEW

Innovation

Innovation has been defined as the "successful implementation of creative ideas" [1] and as a "non-linear, complex, ambidextrous process which includes components of exploration and exploitation" [4]. Creativity is part of the innovation process; for innovation to occur, creative ideas that have economic value need to be recognized, validated, and implemented [5].

Culture

Culture has been defined as a system of shared meanings, beliefs, and values that have resulted from a group's successful response to problems in the environment [6, 7] and a set of basic and shared beliefs and values among individuals within a nation [8, 9]. Shared values distinguish one cultural group from another [10, 11]. "What differentiates one culture from another are its institutions and its ways of dealing with the variety of universal problems (p. 395)" [5] and include unique approaches to work behavior, conceptualization of management and leadership, and openness to changes in the status quo (p. 395) [5].

The Culture, Innovation, and Economic Prosperity

According to Williams and McGuire [5], a country's culture influences the way its citizens think and behave with respect to risk, opportunities, and rewards. The authors propose a process whereby a culture's response to risk, opportunities, and rewards influences entrepreneurial activity and economic creativity (innovation), and national innovation influences national prosperity. State the authors: "We believe a predisposition to support innovation and make capital and resources available is in itself a reflection of shared cultural values" (p. 396).

National prosperity can be viewed as a by-product of innovation [5]. "Countries that improve their standards of living are those in which firms are becoming more productive through the development of more sophisticated sources of competitive advantage based on knowledge investment, insight and innovation (p. 17)" [12]. Innovative solutions have an impact on the revenues of a firm and, in turn, on the prosperity of nations [12, 13].

Measures of Innovation and Creativity

Researchers have used a variety of methods to operationalize a nation's capacity for innovation. These measures include self-employment rates, royalty and license fees, and trademarks [5], patents and per capita income [14], and adoption rates for technological products [15]. Traditional measures of innovation have included number of PhDs, number of research articles, research centers created, patents issued (patent intensity), and R&D expenditures [5]. Two studies have used innovation indices [8, 9, 16]. Sun [16] used the National Innovation Capability Index developed by Porter and Stern [17]. Rossberger and Krause [8, 9] used the Global Innovation Index [18] that utilizes 80 indicators of national innovation.

The Global Innovation Index (GII) project [19] was launched to find metrics, measurements and approaches to capture the whole picture of innovation in society. The GII integrates information from the World Bank, UNESCO, and other sources. The GII consists of two sub-indices: innovation-related inputs and innovation-related outputs. Each sub-index has separate components called pillars. Innovation-related inputs (pillars) are as follows:

- Institutions – political, regulatory, business environment
- Human capital and research – education, research and development
- Infrastructure – information and communication technologies, energy supply, and general infrastructure
- Market and business sophistication – credit, investment, trade, competition
- Worker knowledge, innovation linkages, knowledge absorption

Innovation-related outputs (pillars) are as follows:

- Scientific outputs
- Creative outputs

The conceptual and statistical coherence of the GII has been analyzed and validated by the European Commission Joint Research Center [18]. This analysis reports that the GII is statistically coherent, has balanced structure (i.e., is not dominated by any pillar or sub-pillar), and has offered statistical justification for the use of simple averages at the various levels of aggregation from the sub-pillar's onwards. Country rankings are in most cases fairly robust to methodological assumptions. Rossberger and Krause [8, 9] investigated whether the three published editions of the GII are stable and reliable measures of innovation, showing internal consistency and correlations over the years. They also analyzed whether they show consistency with a different and unassociated measure of national innovation. For this purpose, they chose the Porter and Stern Index [17]. The correlation between the indices ranged from $r = 88$ to $r = 95$. These findings indicate that the indices can be considered as reliable and consistent measures of national innovation. Our research uses the GII as the dependent variable because the index includes a variety of measures of innovation (eighty different indicators) rather than a single measure (e.g.—number of patents and trademarks) thus capturing a more complete picture of societal innovation, and because previous research indicates the GII can be considered a reliable and consistent measure of national innovation.

Measures of National Culture

Measures of national culture include Kluckhohn and Strodtbeck [20], Hofstede [6], Trompenaars [21], the GLOBE research consortium model [22], and McGuire et al. [23]. See Williams and McGuire [5] for a complete discussion of these models, and their relative usefulness. They conclude that Hofstede's model has the most replicable, predictive support and includes the most countries. In addition, Hofstede's dimensions have proven to be stable over time.

Hofstede [6] is the widest used model in part due to consistent research support that the proposed dimensions are replicable and predictive of economic outcomes, and because Hofstede offers the most complete country coverage [5]. Two major studies reviewed empirical research carried out with Hofstede's variables: Kirkman et al. [24] reviewed 180 published studies and Sondergaard [25] reviewed 61 empirical studies. Both found overwhelming confirmation of Hofstede's dimensions. While Hofstede's model is perhaps the most influential and widely used, it has been criticized as being outdated despite consistent support that the dimensions are stable over time [5]. The GLOBE project [22, 26] research was intended to correct some of the criticisms of Hofstede. The research identified nine dimensions of national culture, five of which were adapted from Hofstede's original five dimensions. One of the GLOBE

Project's criticisms leveled at Hofstede was that he failed to measure what he thought he was measuring; the GLOBE project was intended to correct that problem [27]. The GLOBE project was presented by its authors as an improvement on Hofstede's five-dimensional model.

Hofstede [28] responded to the GLOBE project's criticisms of his research with a factor-analysis of GLOBE's data that suggests there are five independent dimensions rather than nine. He further outlined the differences between his research and the GLOBE project including the following:

- (1) Hofstede's research was based on the re-analysis of an existing database while the GLOBE project used new data.
- (2) GLOBE's subjects were all managers rather than using a variety of employees (Hofstede used employees in seven occupational categories).
- (3) Hofstede's research was action-driven versus the GLOBE's theory-driven research largely based on Hofstede's 1980 book.
- (4) Hofstede conceptualized national wealth as something separate from national culture while the GLOBE researchers did not control for national wealth
- (5) GLOBE's operationalization of values and practices was not fully divulged and, therefore, impossible to verify.

Smith [29] identified the same differences as House. He also discussed Hofstede's exclusive use of self-reports versus GLOBE's additional use of respondent's characterizations of their own and others' nations. The GLOBE project researchers' use of such characterizations has been criticized as emphasizing stereotyping, and the validity of respondents rating their own nation has also come under criticism [29]. Both Hofstede and Smith question whether nine dimensions is an optimal number for progressing cross-cultural research and contend that that many dimensions may be overly complex. Finally, there are substantial correlations between four of the GLOBE dimensions: Future Orientation, Uncertainty Avoidance, Performance Orientation, and low Power Distance. Smith [29] concludes that both models have inherent errors and that neither can be considered as providing the one best way to measure the dimensions of national culture.

Other research examining the differences between the GLOBE dimensions and Hofstede's dimensions has focused on the similarities and differences among the dimensions. For example, Venaik, Zhu & Brewer [30] focused on the similarities and differences between Hofstede's Long-term Orientation (LTO) dimension and GLOBE's Future Orientation (FO). Their research suggests the two dimensions focus on different aspects of the time orientation of society. The LTO focuses on societal values, capturing the perseverance and thrift aspects of the future whereas GLOBE's FO dimension focuses on planning. The LTO scale items are more multidimensional and focus on multiple aspects of the time dimension; (perseverance and thrift versus tradition and stability); GLOBE's FO is more unidimensional and focuses on planning for the future versus living for the present. Venaik et al. [30] conclude LTO and FO are not interchangeable. Venaik & Brewer [31] also compared the Hofstede and GLOBE Uncertainty Avoidance dimensions and concluded they are measuring different things (p. 1310). The Hofstede Uncertainty Avoidance dimension appears to measure the stress experienced by societies what faced with uncertainty, while the GLOBE Uncertainty Avoidance dimension appears to be related to a societal preference for rule adherence.

Rossberger & Krause [8, 9] examined the relationship between the GLOBE cultural dimensions and innovation using the GII. They found a significant relationship between three of the GLOBE dimensions (In-group Collectivism, Uncertainty Avoidance, and Human Orientation); and no relationship for the other six dimensions (Institutional Collectivism, Power Distance, Future

Orientation, Gender Egalitarianism, Assertiveness, and Performance Orientation). Our research examines the relationship between Hofstede's dimensions and the GII in order to determine whether there are different results when Hofstede's dimensions are used as the independent variable in place of the GLOBE project's dimensions. Given the criticisms leveled at both Hofstede's and the GLOBE researcher's frameworks, we conclude that there are problems with both. With respect to the GLOBE Future Orientation dimension, it appears to measure a different dimension of time than Hofstede's Long-term Orientation dimension. Therefore, examining the relationship between LTO and innovation seems warranted. The same holds true for Hofstede's Uncertainty Avoidance if it is measuring a different aspect of culture than the GLOBE dimension with the same name [31]. There does not appear to be a direct GLOBE equivalent to Hofstede's Masculinity/Femininity dimension, although Assertiveness does seem to capture one aspect of the dimension. The Hofstede Indulgence/Restraint dimension does not have an equivalent GLOBE dimension and its relationship to innovation using the GII has never been measured. Therefore, we conclude that examining the relationship between Hofstede's cultural dimensions and the GII measures of innovation is warranted and will make a useful contribution to the literature.

An expanded model of Hofstede's cultural dimensions was selected for use in this study as the independent variable [32]. The expanded model includes a fifth dimension (Long-term Orientation/Pragmatic versus Short-term Orientation/Normative) based on research by Hofstede and Bond [33] and Minkov [34], and a sixth dimension (Indulgence versus Restraint) based on Minkov's research [34]. For further details consult Hofstede's website <http://geert-hofstede.com/national-culture.html>.

HYPOTHESES

The following sections review the research that examines the relationship between Hofstede's dimensions and various measures of innovation. Six hypotheses are outlined.

Power Distance and Innovation

Power distance is the degree to which a society adheres to formal power and status differences among group members. Individuals in low Power Distance cultures may be more apt to challenge assumptions, procedures, and authority figures [5]. Hofstede [6] suggested that lower power distance societies exhibit a greater tendency to innovate. Shane [35, 36] found that Power Distance was negatively related to patents and trademarks. In low Power Distance cultures, innovators may be able to more easily manage relations across hierarchical borders, challenge authority, and build independent networks of support [37]. Other studies that found empirical support for a relationship between low Power Distance and innovation using various measures of innovation include Van Everdingen and Waarts [38] and Sun [16]. Rossberger & Krause [8, 9] did not find a relationship between the GLOBE measure of Power Distance and innovation using the GII. That is contradictory to other research and may be due to the use of a more robust measure of innovation.

In low Power Distance cultures, innovators may more easily manage relations across functional and hierarchical boundaries. They may challenge authority, build independent networks of support [37], be more likely to minimize the importance of a superior's acquiescence, and go outside the immediate hierarchy for support [39]. On the other hand, in high Power Distance cultures, creative people may be expected to work through hierarchical organizational channels [14] with only support for the ideas endorsed at the top [5]. Thus, one would expect low Power Distance cultures to be more innovative.

H1: Societies with low power distance will be more innovative than high power distance societies.

Individualism versus Collectivism and Innovation

Individualistic societies place a higher value on personal goals; collective societies place a higher value on group goals. Creativity is essentially the act of an individual, sometimes in opposition to the prevailing norms of a group [1]. In collective societies, individuals tend to subordinate their self-interests to the interests of the group. Individuals in collective societies may choose not to advance new ideas that challenge members of the group or society and jeopardize relationships [5]. Shane [14] found individualistic societies to be more innovative. Lynn and Gelb [15] found individualistic cultures were more apt to adopt technologically innovative products. Other studies that found a relationship between high individualism and innovation measures include Van EverDingen and Waarts [38] and Sun [16]. Rossberger & Krause [8, 9] found a significant negative relationship between In-group Collectivism and innovation (measured by the GII). In-group Collectivism is similar to some aspects of Hofstede's Individualism dimension.

The types of innovation that are acceptable may differ among individualistic and collectivist cultures. Individualism is associated with a predisposition to accept novelty. Individualists are more likely to champion new ideas in the face of resistance [36] while collectivists may foster solutions that are acceptable to all stakeholders [11] even at the expense of innovation.

H2: Individualistic societies will be more innovative than collectivist societies.

Masculinity/Femininity and Innovation

Masculine cultures are more achievement oriented and exhibit less gender egalitarianism. Feminine cultures are more relationship oriented and exhibit greater gender egalitarianism. Masculinity combines an emphasis on traditional gender roles with a high material achievement orientation [32]. Van Everdingen and Waarts [38] found a negative relationship between higher degrees of masculinity and adoption of innovations. Their innovation measure was the adoption of innovative enterprise resource planning systems. The authors offered the following explanation: enterprise resource planning systems focus on sharing of information and collaboration, values associated with feminine cultures. Steensma et al. [40] found that in countries with high masculinity, small and medium sized firms were less likely to use alliances for technological innovation. Wilhelm & Wilhelm [41] examined the relationship between masculinity, employee empowerment, and innovation. The authors found a significant relationship between low masculinity and the willingness for managers to delegate or empower employees, and a significant positive relationship between employee empowerment and a country's capacity for innovation. Shane [14] demonstrated that masculinity has no effect on the number of trademarks per capita. Williams and McGuire [5] found no significant effect of masculinity on the economic creativity of a country.

Rossberger & Krause's [8, 9] research examining the effect of culture (using GLOBE) and innovation (using the GII) found no significant relationship between Assertiveness and innovation, and no relationship between Gender Egalitarianism and innovation. The GLOBE project splits the Hofstede Masculinity/Femininity dimension into Assertiveness and Gender Egalitarianism [26]. Hofstede [28] found a relationship between the GLOBE Assertiveness dimension and Hofstede's Masculinity/Femininity dimension, but no relationship between Gender Egalitarianism and Masculinity/Femininity. However, Assertiveness is only a part of

the Masculinity/Femininity dimension; Masculinity/Femininity is a much more complex dimension [28].

The results of studies examining the relationship between Masculinity/Femininity and innovation have been mixed with either no relationship found between the two variables or some indication that feminine cultures may be more apt to foster organizational norms that are more favorable to innovation (i.e. – alliance building, employee empowerment, sharing of information). Prior research examining the relationship between Masculinity/Femininity and innovation used output-oriented measures of innovation (patents, adoption of innovations). The GII adds an input-oriented measure of innovation that may be related to some aspects of the Hofstede Masculinity/Femininity dimension. For example, in feminine societies where the focus is on people and cooperation, a more supportive climate for innovators may occur. Feminine cultures may exhibit a preference for cooperative environments that may facilitate innovation. We propose a positive relationship between femininity and innovation, based on evidence that feminine cultures may be more apt to empower employees [41], form the alliances necessary for innovation to occur [40], and the use of a more robust measure of innovation that captures innovation inputs as well as outputs.

H3: Feminine societies (low Masculinity) will be more innovative than masculine societies.

Uncertainty Avoidance and Innovation

Uncertainty Avoidance differentiates societies on willingness to assume risk. Hofstede [6] suggested that societies exhibiting low uncertainty avoidance are more willing to take risks and to accept opinions other than their own, both of which encourage innovation and entrepreneurship. Culture scoring high on Uncertainty Avoidance are more apt to adapt rules to minimize ambiguity. In such cultures, innovators may be less likely to violate societal norms even when doing so would increase the likelihood of innovation implementation [36]. Lynn and Gelb [15] found a relationship between low uncertainty avoidance and higher adoption rates for technological products using Hofstede's dimensions and Readers Digest Euro data (to measure innovation). Other studies that found empirical support for a relationship between low uncertainty avoidance and innovation using various measures of innovation include Van Everdingen and Waarts [38] and Sun [16]. Rossberger and Krause [8, 9] found a significant positive relationship between the GLOBE project Uncertainty Avoidance measure and innovation (using the GII). However, there is some dispute as to whether the GLOBE project Uncertainty Avoidance measure and Hofstede's Uncertainty Avoidance are equivalent dimensions [31].

In high uncertainty avoidance cultures, innovators may be less likely to violate organizational procedures or societal norms, even when doing so would protect or further their project or new venture [5]. Cultures scoring low on uncertainty avoidance are more accepting of risk and ambiguity. Thus, one would expect low uncertainty avoidance cultures to be more innovative.

H4: Societies with low Uncertainty Avoidance will be more innovative than societies with high Uncertainty Avoidance.

Pragmatic (long-term orientation) versus Normative (short-term orientation) and Innovation

A fifth dimension was added to Hofstede's framework in 1991 based on research by Michael Harris Bond [33]. That dimension (based on Confucian thinking) was called Long-term/Short-term orientation. The Long-term/Short-term Orientation dimension represents a range of

Confucian-based principles and basically reflects the difference between a dynamic, future-oriented society (positive Confucian dynamism—longer term perspective) versus a more static, tradition-oriented one (negative Confucian dynamism—shorter term perspective). In societies exhibiting a longer term perspective, values such as perseverance, hard work, shame, and savings may predominate. Shorter-term societies tend to have values indicative of a more present- and past-oriented perspective, including the concepts of “face” and reciprocation, concerns for traditions and fulfilling social obligations [33, 42]. Values associated with the positive (Long-term Orientation) pole of the Confucian dynamism dimension, including the focus on hard work and perseverance, should be associated with higher levels of innovation [43]. Van Everdingen and Waarts [38] investigated the effects of national culture on the adoption of innovations using the Hofstede dimensions. They found that higher degrees of Long-term Orientation were related to increased adoption of innovations.

The Long-term/Short-term dimension was originally applied to 23 countries. In 2010, Michael Minkov generated two cultural dimensions using the World Values Survey. One of the dimensions is similar to the Long-term/Short-term orientation dimension: Pragmatic versus Normative. The utilization of Minkov’s research allowed Hofstede’s fifth dimension to be extended to 93 countries. Normative societies score low on this dimension and favor time-honored traditions and norms; societal change is viewed with suspicion. Pragmatic societies encourage thrift and efforts in modern education as a way to prepare for the future. People in pragmatic societies believe that truth depends on the situation, context, and time, and tend to have an ability to adapt traditions easily to changing conditions. Pragmatism is related to school math results in international competition. Student achievement in reading, mathematics, and science has been linked to pragmatic societies [44]. Thus, one would expect pragmatic societies to be more innovative than normative societies.

H5: Pragmatic societies will be more innovative than Normative societies.

Indulgence versus Restraint

In 2010, a sixth dimension was added based on Minkov’s analysis of World Values Survey data [34]. This new dimension is called Indulgence versus Restraint and can be defined as the extent to which people try to control their desires and impulses, based on the way they were raised. Indulgent societies are characterized by a desire to gratify basic and natural human drives related to enjoying life and having fun. Restrained societies suppress gratification of needs by means of strict social norms. People in indulgent societies tend to be more optimistic; people in restrained societies tend to be more pessimistic and cynical. A study by Syed & Malik [45] found that cultures with low Uncertainty Avoidance and high Indulgence tend to adopt new technology more readily than cultures with high Uncertainty Avoidance and low Indulgence. Indulgent societies may encourage innovation as a way to continually satisfy drives related to having fun and enjoying life.

H6: Indulgent societies will be more innovative than Normative societies.

METHODOLOGY

Sample

The Global Innovation Index (GII) for 2012 consisted of 176 countries, while Hofstede’s cultural dimensions were available for 101 countries. Merging the two lists along with data from the World Bank reduced the sample to 96 countries. However, missing values for the control variables and the new Hofstede dimensions further reduced the sample and we were left with 77 usable data points for this study. The variables for the study are discussed next.

Dependent Variable

The Global Innovation index (GII) from 2012 [46] was used as the dependent variable for this study. The GII is published by Cornell, INSEAD and the World Intellectual Property Organization (a unit of the United Nations) and ranks countries of the world on their innovation capabilities. The scores for the countries in our sample ranged from 22.2 to 68.2. We used the 2012 index because data from the World Bank was not available for more recent years.

Independent Variables

The independent variables for this are Hofstede's cultural dimensions [47]. We used the scores for each of the six dimensions in the model. Power Distance (PD) measures the inequality in power between the members of society and how the inequality is accepted. High scores for PD signify the acceptance of power differences and inequality. Individualism (IDV) is the next dimension and a high score signifies a society where the focus is only on the individual and their immediate family. Lower scores signify a focus on groups and decision are based on group welfare. High scores on Masculinity (MAS) represent a society that is focused on achievement, competition and assertiveness, while lower scores suggest a cooperative society focused on relationships and quality of life. Uncertainty Avoidance (UA) captures how a society feels about uncertainty and ambiguity. Higher scores represent an aversion to uncertainty. Pragmatic (PRA) societies take a long-term approach and focus on the future. They focus on modern education and less on time honored traditions to prepare for the future. Indulgence (IDG) represents a society that allows free fulfillment of human needs, enjoying life and having fun. Lower scores represent a society governed by strict norms that believes in suppressing gratification.

Hofstede provides scores for each of these dimensions and these scores range from 0 to 100. We used the reported scores for each country in our sample to capture the overall national culture of a country. By including all the cultural variables in a single model, we hope to capture the complete effect of national culture. Using individual dimensions in isolation might make differentiating between countries difficult, since many countries score similarly on one dimension but may differ along other dimensions. Table 1 below provides an example of countries that score very similar on Power Distance, but have varying scores along the rest of the dimensions. By including all the dimensions at once in the model we hope to capture the true effect of national culture.

Table 1. Comparing Dimensions Across a Sample Group of Countries

Country	Power Distance (PD)	Individualism (IDV)	Masculinity (MAS)	Uncertainty Avoidance (UA)	Pragmatism (PR)	Indulgence (IDG)
Bhutan	94	52	32	28		
Iraq	95	30	70	85	25	17
Panama	95	11	44	86		
Philippines	94	32	64	44	27	42
Russia	93	39	36	95	81	20
Saudi Arabia	95	25	60	80	36	52

Control variables

Research has shown that foreign direct investment (FDI) leads to spillover learning and innovation. Therefore, we use FDI as a control variable. The FDI variable was taken from the World Bank database [48]. We calculated the average FDI from year 2004 to 2011 and then took the log of the variable (FDI_{Log}) to scale it. The second control variable was the average R & D Expenditure (RDE) as a percentage of GDP for the period 2004 to 2011 also based on the World Bank database. As countries spend more on R&D innovation should increase.

ANALYSIS AND RESULTS

The descriptive statistics and correlations for the sample variables are given in Table 2 and Table 3 respectively. We analyzed the data using a stepwise regression analysis. Since innovations take time after investments have been made, we used lagged values for the control variables in the model. We also used average values for the control variables to capture the long-term trends rather than just a one-time short-term effect. Since the value for the cultural dimensions is unchanged over extended period of time, and Hofstede has only provided singular values we used these values for the cultural dimensions.

The correlation table shows that both the control variables are significantly correlated with the dependent variable. The regression analysis was carried out in two steps. In both steps we utilized stepwise regression with backward elimination. In the first step only the control variables were included. The regression model was significant and both control variables were significant and in the expected direction, FDI and R&D Expenditure both increase innovation, however, R & D expenditure variable is more influential. The control variable model had an Adjusted Rsq of 69.9%.

Table 2. Descriptive Statistics

Variable	N	Mean	StDev
GII2012	96	40.29	12.52
FDI_Log	95	9.62	0.7808
RD_Expenditure (RDE)	83	1.04	1.009
Power Distance (PD)	96	61.98	21.16
Individualism (IDV)	96	39.08	22.463
Masculinity (MAS)	96	47.7	18.78
Uncertainty Avoidance (UA)	96	63.86	21.21
Pragmatism (PR)	83	43.53	23.54
Indulgence (IDG)	78	48.31	23.11

Table 3. Correlations

	GII2012	FDIlog	RDE	PD	IDV	MAS	UA	PR
FDIlog	.639**							
RDE	.803**	.468**						
PD	-.540**	-0.196	-.567**					
IDV	.697**	.495**	.570**	-.595**				
MAS	-0.091	0.161	-0.08	0.138	0.062			
UA	-0.107	0.017	-0.159	0.074	-0.121	0.026		
PR	.401**	.263*	.385**	-0.1	.225*	0.084	0.084	
IDG	0.146	0.148	0.186	-0.221	0.111	-0.049	-0.124	-.453**

† P < 0.10, *P < 0.05, **p < 0.01, ***p < 0.001

The independent variables were added to the regression model in the second step. The model was again significant but Power Distance and Uncertainty Avoidance were not significant and were dropped from the final model. The coefficients for variables that remained in the model were in the expected direction and provided support for the hypotheses. The adjusted RSq for the complete model was 75%. The regression results are presented in Table 4. Since some of the independent variables were correlated we checked the Variance Inflation Factors (VIF) and all the VIF values were well below 10, with the maximum being under 3; thus, there is no multi-collinearity problem and we can assume that the coefficients in the regression are showing the correct relationship.

Table 4. Regression Results

Predictor	Controls Standardized Beta	Stepwise All Variables Standardized Beta
Constant	-10.752	-1.881
FDIlog	0.281***	0.153*
RDE	0.672***	0.451***
PD		
IDV		0.255**
MAS		-0.149*
UA		
PR		0.244**
IDG		0.168*
RSq	0.706	0.771
RSq(adj.)	0.699	0.75

† P < 0.10, *P < 0.05, **p < 0.01, ***p < 0.001

The results for the hypotheses are summarized in Table 5. All the hypotheses were supported except for Hypothesis 1 and 4. Power Distance was negatively correlated and significant (Table 3) as was predicted (Hypothesis 1) but did not come out significant when it was included with all the other variables in the regression model and was dropped from the model

along with Uncertainty Avoidance (Hypothesis 4) which was also expected to have a negative relationship with innovation.

Table 5 - Summary of Results

Hypothesis	Result
H1: Societies with low power distance will be more innovative than high power distance societies.	Not Significant
H2: Individualistic societies will be more innovative than collectivist societies.	Supported
H3: Feminine societies (low masculinity) will be more innovative than masculine societies.	Supported
H4: Societies with low uncertainty avoidance will be more innovative than societies with high uncertainty avoidance.	Not Significant
H5: Pragmatic societies will be more innovative than normative societies.	Supported
H6: Indulgent societies will be more innovative than normative societies.	Supported

According to the standardized coefficients reported in Table 4, Individualism (0.255) had the strongest effect in the model among the Hofstede variables followed by Pragmatism (0.244), Indulgence (0.168) and Masculinity (-0.149). These coefficients are all in the expected direction. These results support our hypotheses that Individualistic, Pragmatic/Long-term Oriented, Indulgent, and Feminine societies are more innovative, while countries focused on values tied to Collectivism, Normative/Short-term Orientation, Restraint, and Masculinity are lower in innovation.

DISCUSSION

The results provide support for four out of the six hypotheses. The results suggest that cultural dimensions do influence the decisions that affect the innovation capabilities of a country. It is clear that all dimensions are not equally important with respect to innovation. Power Distance which deals with inequality between members of society was not significant in the model. How countries deal with uncertainty does not seem to influence innovation either. While the analysis of the Variance Inflation factors does not show a multicollinearity problem, it is possible that negative correlation between Power Distance and Individualism may be negating the link between Power Distance and the dependent variable. Our results suggest that innovative societies are characterized by the following cultural values: Individualism, low Masculinity, Pragmatism/Long-term Orientation, and Indulgence. Societies with these four cultural characteristics may be more apt to have environments where creativity and innovation can flourish.

Contributions to Research

This study examines the relationship between Hofstede's cultural dimensions and the Global Innovation Index (GII). Previous studies of Hofstede's cultural dimensions and innovation used more simplistic measures of innovation (self-employment rates, royalty and license fees, trademarks, technology adoption rates, patents, R&D expenditures, number of research centers, etc.). The GII utilizes 80 different indicators of innovation and includes both innovation-related inputs and innovation-related outputs. Therefore, we believe it is a more robust measure of innovation. Rossberger & Krause [8, 9] also used the GII, but measured culture using the GLOBE project.

With regard to the Hofstede Power Distance variable, our results differ from previous research in that we found no significant relationship between Power Distance and Innovation.

Rossberger & Krause [8,9] found no significant relationship between the GLOBE power distance variable and the GII. The use of the GII (a more complex measure of innovation) by our study and by Rossberger & Krause may be the reason for the results differing from previous research.

Our results for the Individualism/Collectivism dimension support prior research examining the relationship of the dimension with various measures of innovation. Rossberger & Krause [8, 9] found a negative relationship between the GLOBE project In-Group Collectivism dimension and innovation but no relationship between Institutional Collectivism and innovation. In-Group Collectivism and Institutional Collectivism are proposed by House et al. [26] to represent two different aspects of Hofstede's Individualism/Collectivism variable. In-Group Collectivism is the degree to which individuals express pride, loyalty, and cohesiveness in their organizations or families. Institutional Collectivism is the degree to which organizational and societal institutional practices encourage and reward collective distributions of resources and collective action. Hofstede's Collectivism represents a preference for a tightly-knit society in which individuals can expect their relatives or members of their in-group to look after them in exchange for unquestioning loyalty. There is a great deal of debate in the literature as to whether the two GLOBE dimensions are the equivalent of the Hofstede dimension [28, 29]. Nonetheless, our findings for the Hofstede Individualism/Collectivism dimension and innovation are supportive of the In-Group Collectivism and innovation finding by Rossberger & Krause [8, 9]. Societies that are more individualistic are more apt to be innovative than societies that favor cohesive family-oriented collectivism.

Our results for the Hofstede Uncertainty dimension and innovation are not supportive of Rossberger & Krause's [8, 9] finding that the GLOBE Uncertainty dimension is related to innovation as measured by the GII. There is debate as to whether the two variables are equivalent [31]. The results of this study provide support for the contention that the Uncertainty variables from the two frameworks (GLOBE and Hofstede) are, in fact, measuring something different. Our findings do not link Uncertainty Avoidance to innovation and are contradictory to previous research examining the Hofstede Uncertainty Avoidance dimension and innovation. However, previous research used a less sophisticated and robust measure of innovation. Venaik & Brewer's research [31] suggests that Hofstede's Uncertainty Avoidance index represents the "stress" dimension of uncertainty avoidance, while the GLOBE Uncertainty Avoidance index represents the "rule orientation practices" dimension of uncertainty avoidance. It may be that rule orientation inhibits innovation, but the stress created by uncertainty does not.

While Rossberger & Krause [8, 9] examined the relationship between the GLOBE project Future Orientation variable and innovation and found no relationship, our results showed a positive relationship for the Pragmatic/Long-Term Orientation dimension. Future Orientation has been proposed as the equivalent to Hofstede's Pragmatic/Long-Term Orientation dimension. One would predict that if the two dimensions are equivalent, our results would be the same as the Rossberger and Krause study. Our research suggests that the two dimensions are not equivalent, supporting the Venaik et al. [30] conclusion that the two dimensions are not interchangeable. Their research suggests the two dimensions focus on different aspects of the time orientation of society. The Hofstede Pragmatic/Long-term Orientation dimension focuses on societal values, capturing the perseverance and thrift aspects of the future whereas GLOBE's Future Orientation dimension focuses on planning. Our findings suggest that perseverance is related to innovation but planning for the future is not.

Our results for the Hofstede Masculinity/Femininity dimension and innovation is supportive of prior research that found a relationship [38, 40, 41] and differs from prior research that found no relationship [5, 35]. Prior research examining the relationship between Masculinity/Femininity and innovation used output-oriented measures of innovation (patents, adoption of innovations, etc.). The GII adds an input-oriented measure of innovation that may be related to some aspects of the Hofstede Masculinity/Femininity dimension. For example, in feminine societies where the focus is on people and cooperation, a more supportive climate for innovators may occur. Feminine cultures may exhibit a preference for cooperative environments that may facilitate innovation.

Rossberger & Krause [8, 9] found no relationship for Gender-Egalitarianism and Assertiveness and innovation using the GII as the innovation measure. Gender Egalitarianism and Assertiveness have been proposed as equivalent to the Hofstede Masculinity/Femininity dimension. Our findings suggest that the two GLOBE dimensions are not interchangeable with Hofstede's Masculinity/Femininity dimension. Hofstede [28] found a relationship between the GLOBE Assertiveness dimension and Hofstede's Masculinity/Femininity dimension, but no relationship between Gender Egalitarianism and Masculinity/Femininity. Assertiveness is only a part of the Masculinity/Femininity dimension; Masculinity/Femininity is a much more complex dimension [28]. Hofstede's Masculinity is defined as a preference in society for achievement, assertiveness, and material rewards for success. Masculine societies tend to be more competitive than feminine societies. Hofstede's Femininity dimension applies to societies that emphasize cooperation, modesty, caring for the weak, and quality of work. While assertiveness may not be related to innovation, the cooperative aspects of femininity appear to be related. Societies that emphasize quality of work and cooperation may be more predisposed to innovation than masculine societies that emphasize competition and material rewards.

Finally, we found support for a relationship between Indulgence and GII. Prior research [45] found a relationship between adoption of new technology and indulgence but did not use the GII as an innovation measure. The GLOBE project has no dimension that is similar or the equivalent of the Hofstede Indulgence dimension. Indulgent societies may encourage innovation as a way to continually satisfy drives related to having fun and enjoying life.

We add to the literature by comparing Hofstede's dimensions to innovation using the Global Innovation Index. Our research expands the research of Rossberger & Krause [8, 9] by suggesting that in addition to Globe's Uncertainty Avoidance, In-group Collectivism (similar to Hofstede's Collectivism), and Human Orientation dimensions, the following Hofstede dimensions are related to innovation as measured by the Global Innovation Index: Pragmatism/Long-term Orientation, Masculinity/Femininity, and Indulgence/Restraint. Societies characterized by individualism, a human orientation, feminine values like cooperation, a pragmatic/long-term orientation, low uncertainty avoidance (as measured by the GLOBE index and related to rule-orientation), and indulgence may be more predisposed to innovation.

Limitations and Future Research

This research is limited by a small sample size due to missing values for some countries on some of the new Hofstede dimensions. Future research is needed to further explore whether some dimensions work against each other (for example, the strong correlation between Power Distance and Individualism). In addition, there may be clusters of countries with similar cultural tendencies—further research is needed to address this question. Rossberger & Krause [8, 9] conducted a cluster analysis but did not use Hofstede's dimensions. Our research may bring some light to the continuing debate of whether or not the Hofstede and GLOBE

dimensions are interchangeable. With respect to innovation as measured by the GII, the Power distance, and Individualism/In-group Collectivism dimensions yielded similar results. With respect to Hofstede's Masculinity/Femininity dimension and GLOBE's suggested equivalents (Gender Egalitarianism and Assertiveness) the results were different, suggesting that at least with respect to innovation, the dimensions are not equivalent. The GLOBE Uncertainty Avoidance dimension was related to innovation; the Hofstede Uncertainty Avoidance dimension was not—suggesting the two dimensions are not interchangeable. While Hofstede's Pragmatism/Long-term Orientation (LTO) dimension was found to be related to the GII measure, GLOBE's Future Orientation (FO) measure was not related. LTO and FO may be measuring different aspects of the cultural time dimension. Further research is needed to further clarify the differences between the GLOBE and Hofstede dimensions.

CONCLUSION

This research extends prior research by examining the relationship between Hofstede's framework and the Global Innovation Index. Our results indicate support for four out of the six hypotheses and suggest that innovative societies are characterized by the following cultural values: individualism, low masculinity, pragmatism/long-term orientation, and indulgence. This research has implications for government policy; governments may want to develop policies that overcome cultural tendencies that inhibit innovation. Without a change in government policy, countries with cultures negatively predisposed to innovation may not be able to grow economically and compete effectively with more innovative societies. Our results may also have implications for foreign direct investment; companies may wish to consider country culture when considering where to invest. Additionally, the relationship between culture and innovation may have implications for organizational culture. An organizational environment where innovation can flourish may be characterized by the following:

- Challenging the status quo (high Individualism)
- Sharing of information and the promotion of collaboration (low Masculinity)
- Encouragement of achievement and long-term thinking (Pragmatism)
- Creating new technology as a way to improve life (Indulgence)

Companies with goals of becoming more innovative may want to develop policies that encourage the above cultural values.

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