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The Relationship between Innovation and Hofstede's Culture Dimensions

Econometric Methods and Models
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Abstract:

This paper wants to test the effect of cultural dimension on innovation for European countries by taking the relation between Hofstede's cultural dimension theory and innovation measures. The results from the analysis indicated that only two of the four cultural dimensions have significant influence on innovation. Also previously conducted studies found no clear results. This could be explained by the globalization that countries move always closer together. But also the validity of the dimensions and indexes used must be critically examined.

Key words: Hofstede, culture dimensions, Innovation

Faculty of Economics and Business Administration (FEBA),
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1. Introduction

Why are some societies more innovative than others and do existing cultural conditions determine innovation activities? It is easy to talk about innovation culture, yet hard to truly understand it and even harder to do something about it. No matter what business, innovation is the fuel of growth and a key factor for achieving competitive advantage, increased market share and greater profitability. Lee and Peterson (2000) stressed the fact that innovation fits better with some cultures than with others. Thus, although geographically close to each other, the countries in the European Union (EU) and its neighboring countries differ significantly from each other according to the cultural background. The different rates of national innovativeness leads to the conclusion, that the process of innovation are embedded in socio-cultural processes (Mytelka and Smith 2002, Furman et al. 2002). Culture unifies people's behavior, but it may also create barriers between them, so that innovation faces the consequences of culture for various reasons. In a world that has moved to global trade, innovation rates have become one of the tools by which nations and businesses achieve success in the world. Wind et al. (1990) showed that new products typically derive from innovations and explain one quarter to one third of financial growth in businesses. Thus in creating an innovative environment, countries cultures are supposed to play an important role. Innovation became an issue on the agenda in various disciplines such as economy, sociology, business management, policy and cultural studies. Several studies try to demonstrate the effects of culture on innovation for a better understanding of what fosters innovativeness, but one of the most famous one is the cultural dimension theory from Hofstede (1980).

Thus this paper wants to test the effect of cultural dimension on innovation for European countries by taking the relation between Hofstede's cultural dimension theory and innovation. The analysis covers 27 EU members (Cyprus is excluded due to a lack of culture values) and additionally the five countries Turkey, Norway, Switzerland, Serbia and Iceland. To describe the culture dimensions, Hofstede's (1980) original concept of four cultural dimensions (power distance, uncertainty avoidance, masculinity and individualism) is used. The next section presents the theoretical background followed by introducing the data and measurements. Furthermore, results are given and discussed, and last a conclusion is drawn and limitations are pointed out.

2. Literature Review –Culture and Innovation

There are as many definitions of culture as different cultures exist so that the number of values that could be used to describe cultures is theoretically infinite (Organizational culture and innovation p. 767). Taylor (1871, p. 1) provided one of the first definitions of culture: "Culture […] is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society". Hofstede (1980, 2001) defined culture as the collective mental programming that distinguishes members of a group and compared it to the software of the mind, meaning that culture works as the social basis of human behavior in a way that it can even influence the natural act of thinking (Hall 1976). Considering the extensive use of Hofstede's set of dimensions during the last decades allows it to be viewed as a grounded approach for describing a culture. Although innovations in firms are undoubtedly influenced by organizational factors, it can be assumed (1980) that they are also greatly depend on the surrounding culture as a whole. Hofstede argued that four dimensions, which are explained briefly in the following, could capture the most important differences between cultures:

Power Distance (PDI) shows us on the social and individual level how a culture deals with inequalities of power in organizations. A large power distance is characterized by centralized decision structures and an extensive use of formal rules. Uncertainty Avoidance (UAI) refers to the way, societies deal with uncertainty in the future. A low score shows that organizations regard ambiguous situations as natural and interesting and are better prepared for uncertain situations. Masculinity (MAS) shows to what extent a culture is dominated by masculine values as performance, achievement and materialism. If the score is high, masculine values spread out to the society. The last dimension is Individualism (IDV), which refers to the relation between one individual and other individuals. In individualistic cultures (high score), freedom, autonomy and responsibility are measured.

Innovation can be an informal, ad hoc process or a formal, structured process (Wang et al. 2010, p. 769). Schumpeter defined innovation as "the doing of new things or the doing of things that are already done, in a new way" (Schumpeter 1939), so that it is a complex and ongoing process of discovery, development, learning and application of new ideas.

Several studies investigated the relationship between the effects of culture and innovation using Hofstede's (1980) cultural dimension but achieved different results. Shane (1993) found several connections between innovation and Hofstede's model by using trademarks as a proxy for innovations. His research found a positive relationship between national individualism and trademarks and that high uncertainty avoidance and power distance was negatively correlated with the number of trademarks produced (masculinity presented a neutral impact). More recently, Williams and McGuire (2005) divided innovation into two different phases, which they called economic creativity and innovation implementation. The results were slightly different for both phases. For economic creativity, individualism had a positive impact and the other three dimensions presented a neutral impact. Power distance and uncertainty avoidance had a negative impact on innovation implementation and Individualism kept its positive and masculinity a neutral impact. Kaasa and Vadi (2008) developed a different approach. They used patent application indexes and upgraded the data for the cultural dimension by using the European social survey indicators. After a factor analysis, two important factors appeared: Factor one grouped power distance, uncertainty avoidance, masculinity and family related collectivism had a negative impact on innovation. Factor two arose from overall individualism and had no impact.

These exemplary studies show that there is no consensus on the effect of culture on innovation. Different indicators used to measure innovation could explain these different results and thus it should be thoroughly focused on the indicators of innovation.

3. Data and Measurement

Data were taken for the member states of the EU (Cyprus is excluded due to a lack of culture values) and additionally for Turkey, Norway, Switzerland, Serbia and Iceland, so that the sample consists of 32 countries. The data for the four cultural dimensions were taken from Hofstede et al. (2010). A bigger problem was to find the right measurement for innovation, because innovation seems to be a complex phenomenon. Every year many thousands of innovations are added but not every innovation experienced its economic breakthrough and is publicly known, thus there is no database, which can provide all existing innovations available. Patents are more likely to represent the invention activity and are thus seen as an inappropriate measurement because patents

only partially reflect the innovations (Criscuolo and Haskel 2003). Furthermore investments on R&D play an important role in generating new products, so that the expenditures on R&D reflect the effort of innovation and it functions as the indicator of the whole process. Here it must be noted that not all R&D activities generate results, so that this is also no perfect measurement. In addition, more indicators can be identified as trademarks, human capital or the research system, so that a more comprehensive index seems to be a better measurement for innovation. Therefore two possibilities are conceivable: The innovation index from the innovation union scoreboard 2014 and the global innovation index from 2014 (GII). Both models are shown in more detail in the appendix (appendix 1 and 2). Because both indexes seem to reflect innovations as a complex model and especially on a national level, both of them were included in the study. The data, which are represented in appendix 3, were analyzed by using a multiple linear regression, where Hofstede's culture dimensions explain the indexes.

4. Results and Discussion

At first a correlation analysis of the cultural indicators and the two innovation indicators is shown in table one. It can be seen that the correlation of masculinity with the innovation index (innovind) is very weak as well as with GII. Furthermore the correlation of all independent variables seems to be stronger with GII than to the innovation index. Additionally, except individualism, all other culture variables are positively correlated with the dependent variables. In general, it seems that countries with a lower power distance and higher individualism could be more successful innovators. Last, the correlations between the culture dimensions to each other are all under +/- 0.8, so that it can be assumed, that there is no problem with multicollinearity.

	InnovInd	GII	PDI	UAI	IND	MAS
InnovInd	1.000000	0.893892	-0.648278	-0.570062	0.531506	-0.061064
GII	0.893892	1.000000	-0.742849	-0.673791	0.680807	-0.147075
PDI	-0.648278	-0.742849	1.000000	0.638890	-0.622782	0.219206
UAI	-0.570062	-0.673791	0.638890	1.000000	-0.596806	0.200576
IND	0.531506	0.680807	-0.622782	-0.596806	1.000000	0.083092
MAS	-0.061064	-0.147075	0.219206	0.200576	0.083092	1.000000

Table 1: Correlation analysis

Next a regression analysis was conducted to analyze the influence of the four culture indicators on GII. The result is presented in Table figure one.

Dependent Variable: GII
Method: Least Squares
Date: 12/20/14 Time: 20:10
Sample: 1 32
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	56.83664	7.435694	7.643758	0.0000
PDI	-0.157050	0.063671	-2.466595	0.0203
IND	0.134473	0.073725	1.823977	0.0792
MAS	-0.012082	0.040749	-0.296505	0.7691
UAI	-0.090217	0.060495	-1.491295	0.1475

R-squared	0.661908	Mean dependent var	49.69469
Adjusted R-squared	0.611820	S.D. dependent var	8.249711
S.E. of regression	5.139905	Akaike info criterion	6.254547
Sum squared resid	713.3029	Schwarz criterion	6.483569
Log likelihood	-95.07276	Hannan-Quinn criter.	6.330461
F-statistic	13.21498	Durbin-Watson stat	2.012219
Prob(F-statistic)	0.000004		

Figure 1: Regression on GII

The p-value of the F-statistic is highly significant on the 0.01 level and the adjusted R-squared of 0.66 is moderately acceptable. As it was assumed from the correlation output before, it seems again that there is no problem with multicollinearity, not only because of the output, also because of the VIF values, which are ranging from 1.1 to 2.1. A calculation [1] for the durbin-watson test shows, that there is no problem with autocorrelation on the 0.05 level, which was assumed due to the unstructured data set. The White test is conducted to detect heteroscedasticity. Because the probability is 0.87, H_0 (H_0=Homscedasticity) cannot be rejected, which means that it can be assumed that the model is homoscedastic. Furthermore the estimation seems to be normally distributed, so that in sum a reliable estimation might be possible.

From the estimation output it can be seen that not all cultural dimensions have significant influence on the GII. Masculinity and Uncertainty Avoidance have no impact, Individualism is only on the 0.1 level positively related to GII and Power Distance appeared to be the dimension that is most strongly related to innovations with a

[1] value of durbin-watson (2.012219) lies between 2 and 4-du (1.732) = 2.268

negatively impact on the 0.05 level. The redundant variable test shows that the masculinity is redundant as well as uncertainty avoidance (appendix 4 and 5). Additionally all culture dimensions are plotted against GII in appendix 6, so that the relationship can be seen, which confirms the estimation output as well as the correlation table. In the plot between GII and pdi, a clear positive correlation can be detected, so that a highly significant coefficient for pdi is expected. Whereas the relationship between GII and ind becomes weaker compared to the first one, even it is still obvious, the plot against uai is more dispersed, so that the insignificant coefficient for uai is not surprising. In the last plot against mas, a negative relationship can only be guessed, which is why the coefficient is highly insignificant.

Next it should be tested, if the estimation is similar by using the innovation index from the scoreboard instead of GII, the results are presented in figure two.

Dependent Variable: INNOVINDEX
Method: Least Squares
Date: 12/20/14 Time: 20:10
Sample: 1 32
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.723612	0.199822	3.621280	0.0012
PDI	-0.003782	0.001711	-2.210570	0.0357
IND	0.001038	0.001981	0.523914	0.6046
MAS	0.000548	0.001095	0.500037	0.6211
UAI	-0.001962	0.001626	-1.206909	0.2379

R-squared	0.476590	Mean dependent var	0.476844
Adjusted R-squared	0.399048	S.D. dependent var	0.178179
S.E. of regression	0.138127	Akaike info criterion	-0.978691
Sum squared resid	0.515132	Schwarz criterion	-0.749670
Log likelihood	20.65905	Hannan-Quinn criter.	-0.902777
F-statistic	6.146195	Durbin-Watson stat	1.909114
Prob(F-statistic)	0.001190		

Figure 2: Regression on innovindex

The estimation outputs differ from each other. Not only the adjusted R-squared is lower (0.47), also the p-values varied widely. Now, the only significant innovation indicator seems to be power distance and all others are even on the 0.1 level not significant. By looking deeper at the estimation, it can be identified, that the tests for heteroscedasticity and others are similar to the conducted estimation with GII, but the coefficients are

worse. If we have a closer look at the plot between the InnovIndex and GII in appendix 7, an almost linear relationship can be identified. Also the graphs of the two indexes as shown in appendix 8, seems to be very similar, so that we can assume, that indeed the two indexes for innovation are very similar but that the index of the European union scoreboard is not as suitable as GII to Hofstede's culture values, as it was supposed from the correlation analysis before, so that in the following only the relationship between GII and the culture dimensions is focused.

Next, the only two significant dimensions, Power Distance and Individualism (also individualism is only significant on the 0.1 level), are plotted against each other, to have a closer look on the relationship to innovativeness as shown in figure three.

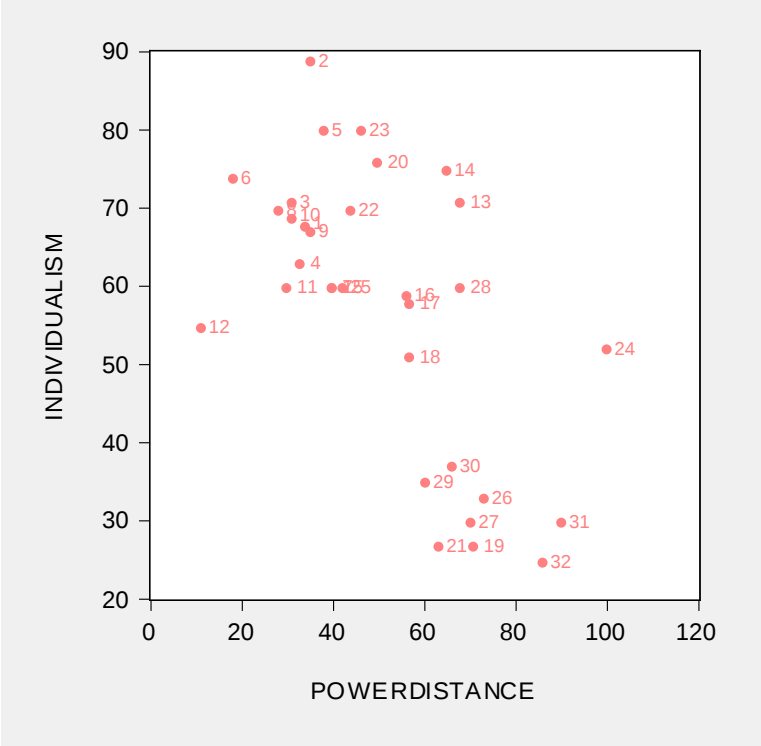

Figure 3: Plot between power distance and individualism

The numbers represent the ranks in the GII. Noticeable is, that for the most part, the countries which have a better innovation performance are located in the upper left quadrant and the countries which have a worse innovation performance can be seen in the lower right quadrant. This confirms the assumptions from the beginning of this chapter, that countries with a lower power distance and a higher individualism value are more successful innovators.

5. Conclusion

This paper explored the relationship between cultural values and national innovation ratings by using Hofstede's original cultural dimensions and GII as well as the innovation index from the European Union scoreboard as a comprehensive measure of national innovation. A multiple regression analysis was conducted, in which the innovation index from the scoreboard was found to be unsuitable.

The results from the analysis indicated that only two cultural dimensions (Power Distance and Individualism) have significant influence on innovation on the 0.1 level and only Power Distance is significant on the 0.05 level. Uncertainty avoidance and especially masculinity had no impact on the GII. Additionally these two insignificant coefficients were identified as redundant. Furthermore plotting individualism and power distance against each other showed that the probability of a high level of innovation activity is greater if the value of individualism is high and the value of power distance is low. In high power distance nations employees expect to be told what to do, so that opportunities to think for oneself and to use imagination is limited (Hofstede 2010). This means that cultures, which reduce the barriers between status levels, so that a person is able to decide about his own approach and beliefs that everybody has the same rights and opportunities to succeed, have higher innovation scores. The strong positive connection between individualism and innovation is in support with the findings of Shane (1993), so that autonomy, independence and freedom are needed for a nation to be innovative. It can be concluded that power distance and individualism are in a way the opposite of each other. The unrelated value for uncertainty avoidance is also in accordance to Shane (1993) who found also no clear relationship between this culture dimension and innovation. Previous research found similar results for the masculinity indicator, so that there is no strong argument for a connection between a masculine culture and a higher innovation score. But other researches, which have used Hofstede's culture dimension as an indicator for innovation, differ from the findings in this paper. As an example can be mentioned the research from Vecchi and Brennan (2006) who found a positive impact of power distance and a negative impact of individualism on innovation. And depending on the chosen innovation variable, uncertainty avoidance and masculinity had a negative or a neutral impact. So reasons has to be mentioned for the results:

Although Hofstede provides a comprehensive model for national culture, it was criticized by many researchers e.g. McSweeney (2002), who criticized the entire model from the notion of culture to the methodology approach. So in the end, the culture dimensions do not represent national culture with all the aspects of such a complex concept, but such a concept do not exist till now. The wide applicability and the fact that every theoretic model is subject to criticism is a reason that so many researchers work with this model as long as no better model for culture is found.

Furthermore businesses have globalized and many companies have corporations in multiple countries. This and the general globalization movement contributes that the countries becomes closer to each other and leads to mixed cultures. National culture differences become weaker in the last decades, especially countries in Europe or generally within a continent are not as strong as between continents. Very probably, the free movement of persons in the member states of the EU contributes to more similar cultures. Hofstede (2010) argued that also if cultures are changing, they do this together, so that the relative positions remained intact. But due to the globalization trend, this argument is doubtful, especially for Europe but also for the world where the cultures become always closer to each other.

It should be also considered, that the culture dimensions has changed. Hofstede's original culture dimensions date back to 1980, so that the actuality should be reviewed. In recent years, other factors have already been developed, for example pragmatism or indulgence, but these factors are not yet matured and do not provide significant results.

Despite all conclusions, the small sample size of 32 has to be mentioned, so that the possibility of micronumerosity is present. Furthermore, a big problem is also to find the right measure for innovations. Previous researches have used for example patents, trademarks, R&D data or comprehensive indexes, which leads, as mentioned before, to different results. Innovation cannot be measured directly, due to the complex phenomenon. Because of the globalization, future research should focus not only on national culture but also on organizational culture and other factors that foster together innovation, so that this, in combination with a larger sample, could lead to a greater explanatory power for innovation.

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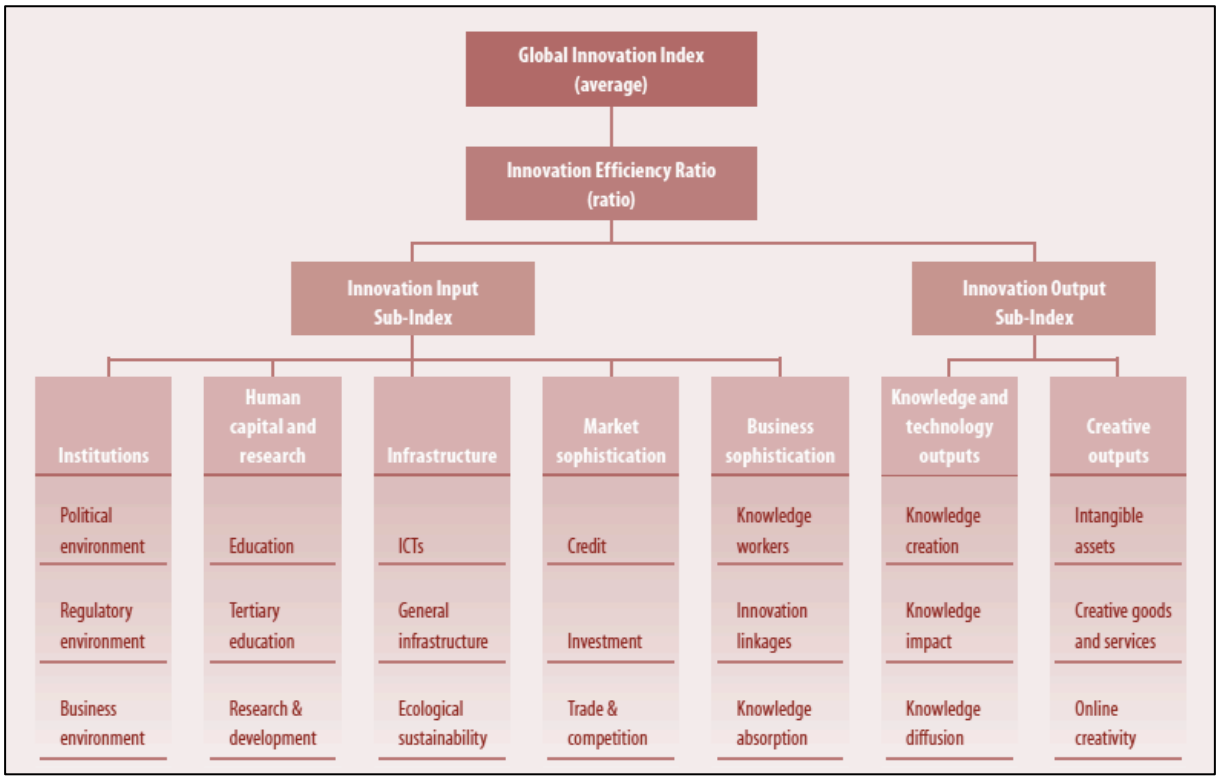
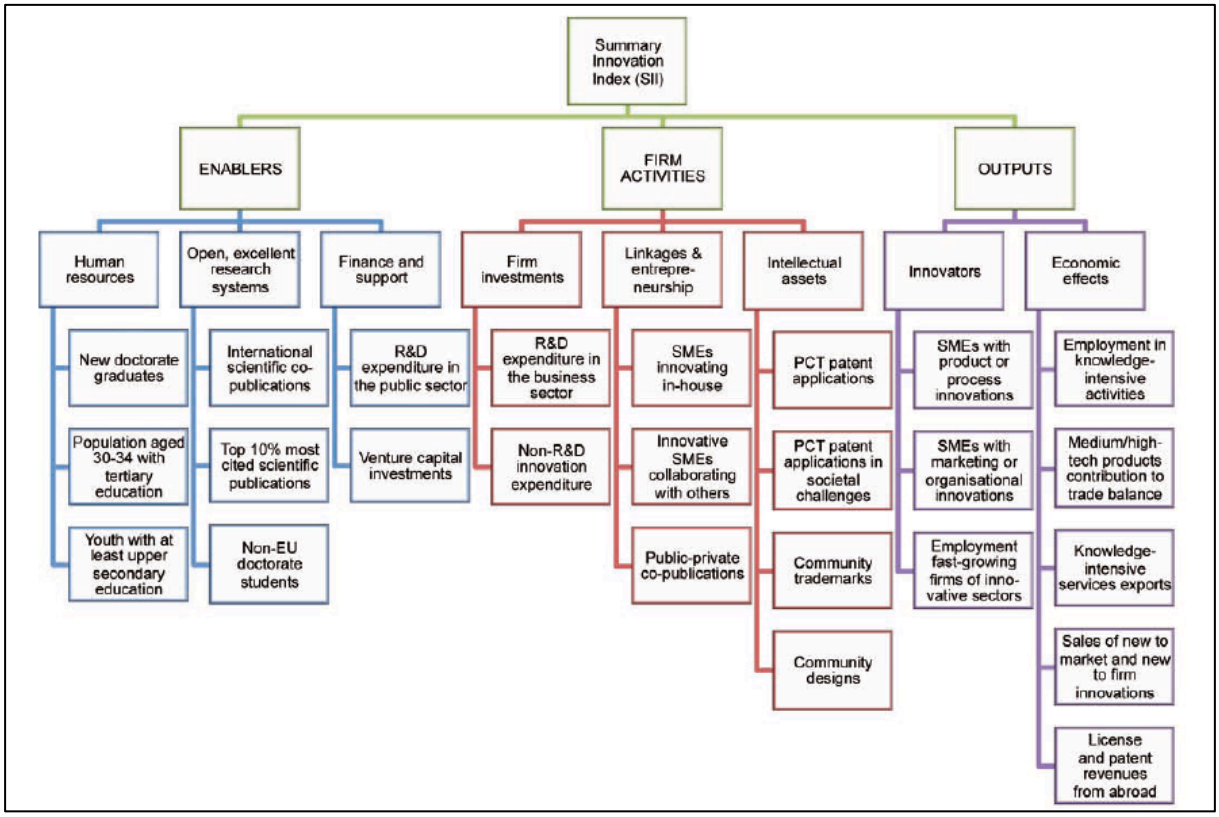
Appendix



Appendix 1: Global Innovation Index (GII)



Appendix 2: Innovation Index from the European Union Scoreboard

Country	InnovInd	GII	PDI	IND	MAS	UAI
Belgium	0.627	51.69	65	75	54	94
Bulgaria	0.188	40.74	70	30	40	85
Czech Republic	0.422	50.22	57	58	57	74
Denmark	0.728	57.52	18	74	16	23
Germany	0.710	56.02	35	67	66	65
Estonia	0.502	51.54	40	60	30	60
Ireland	0.606	56.67	28	70	68	35
Greece	0.384	38.95	60	35	57	100
Spain	0.414	49.27	57	51	42	86
France	0.571	52.18	68	71	43	86
Italy	0.443	45.65	50	76	70	75
Latvia	0.221	44.81	44	70	9	63
Lithuania	0.289	41.00	42	60	19	65
Luxembourg	0.646	56.86	40	60	50	70
Hungary	0.351	44.61	46	80	88	82
Malta	0.319	50.44	56	59	47	96
Netherlands	0.629	60.59	38	80	14	53
Austria	0.599	53.41	11	55	79	70
Poland	0.279	40.64	68	60	64	93
Portugal	0.410	45.63	63	27	31	99
Romania	0.237	38.08	90	30	42	90
Slovenia	0.513	47.23	71	27	19	88
Slovakia	0.328	41.89	100	52	100	51
Finland	0.684	60.67	33	63	26	59
Sweden	0.750	62.29	31	71	5	29
United Kingdom	0.613	62.37	35	89	66	35
Croatia	0.306	40.75	73	33	40	80
Turkey	0.224	38.20	66	37	45	85
Iceland	0.593	54.05	30	60	10	50
Norway	0.480	55.59	31	69	8	50
Switzerland	0.835	64.78	34	68	70	58
Serbia	0.358	35.89	86	25	43	92

Appendix 3: Dataset

Redundant Variables Test
Equation: EQ01GII
Specification: GII C PDI IND MAS UAI
Redundant Variables: MAS

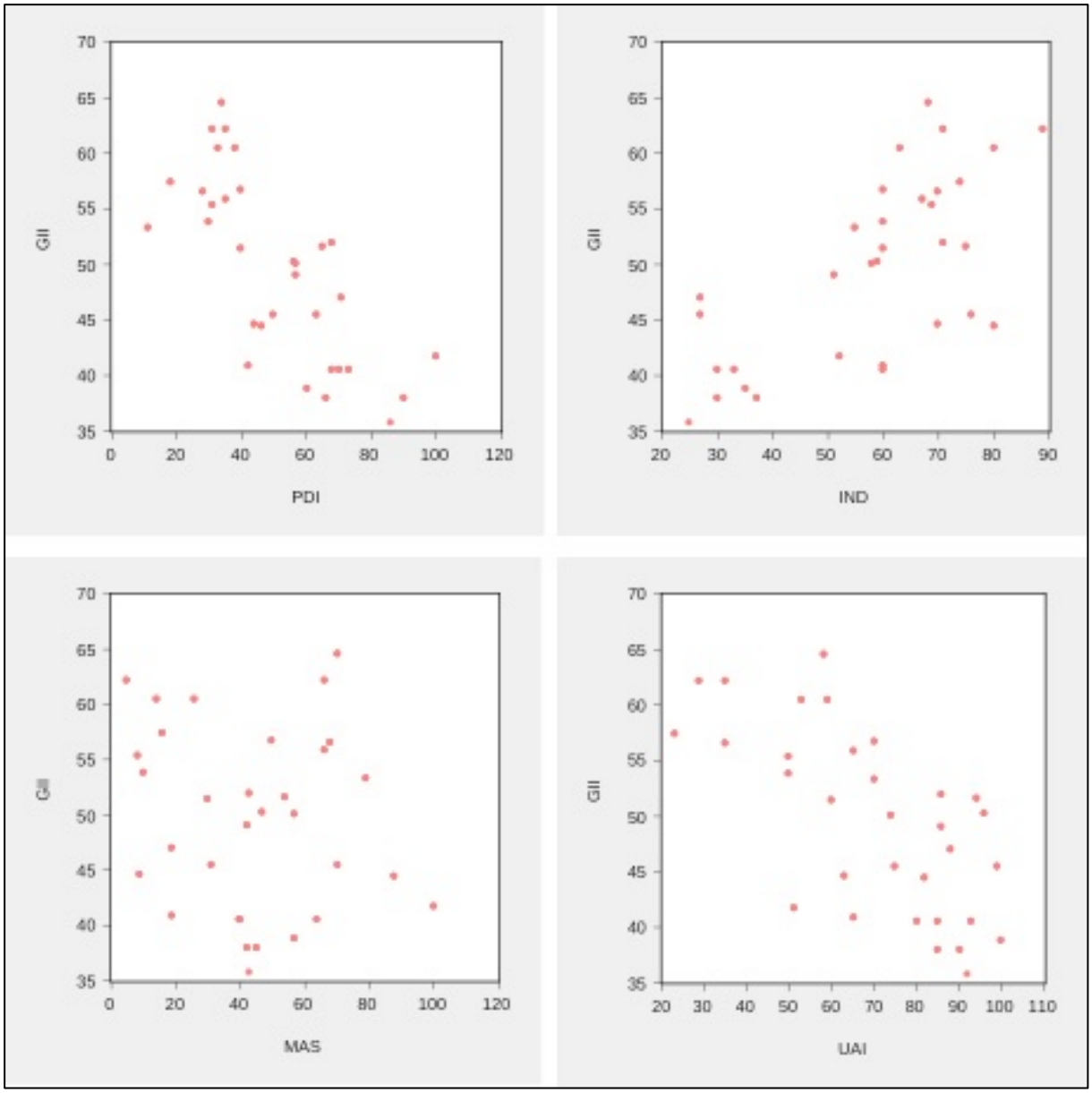
	Value	df	Probability
t-statistic	0.296505	27	0.7691
F-statistic	0.087915	(1, 27)	0.7691
Likelihood ratio	0.104027	1	0.7471

Appendix 4: redundant variable test for masculinity (mas)

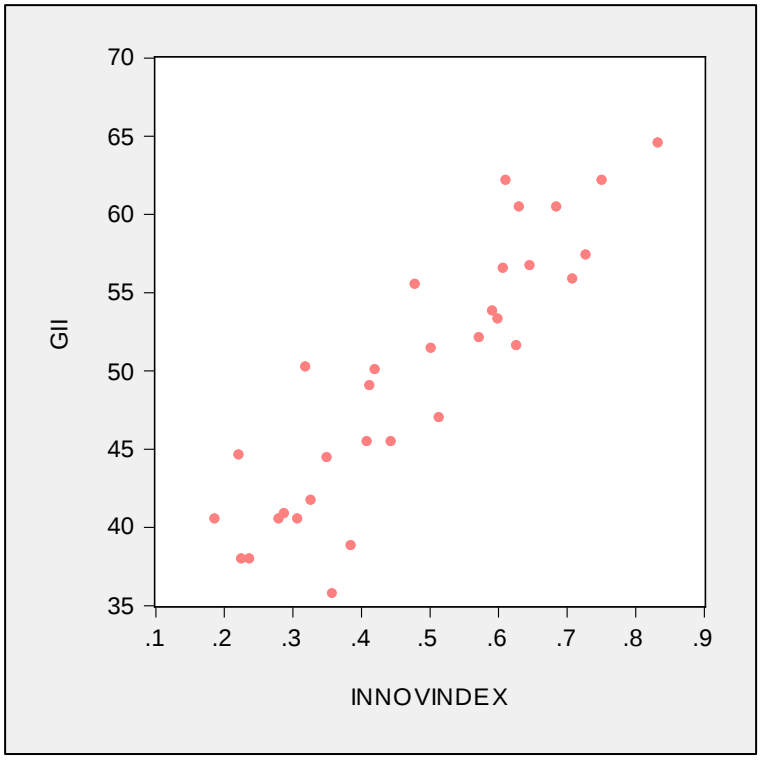
Redundant Variables Test
Equation: EQ01GII
Specification: GII C PDI IND MAS UAI
Redundant Variables: UAI

	Value	df	Probability
t-statistic	1.491295	27	0.1475
F-statistic	2.223961	(1, 27)	0.1475
Likelihood ratio	2.532867	1	0.1115

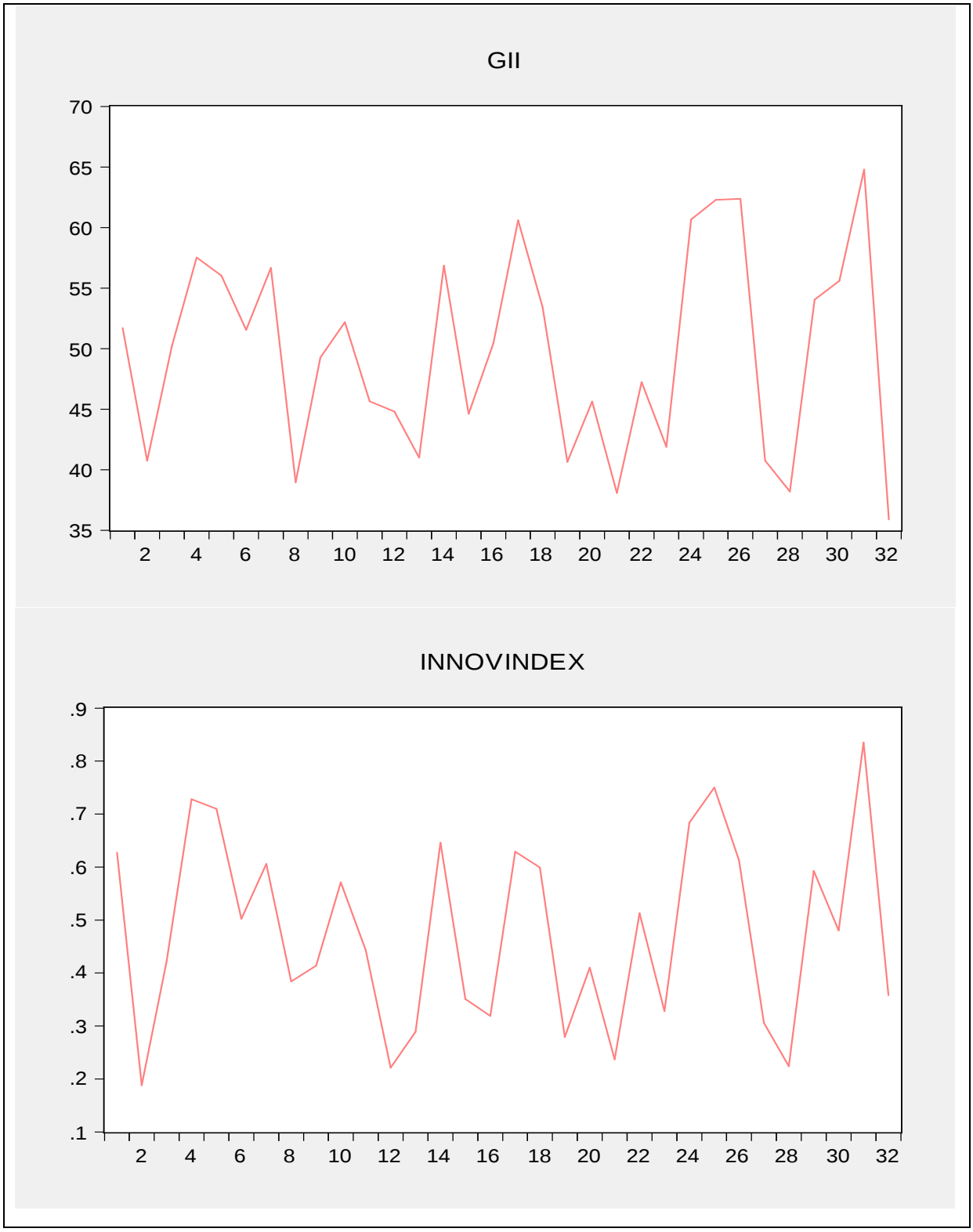
Appendix 5: redundant variable test for uncertainty avoidance (uai)



Appendix 6: Plot of each coefficient against GII



Appendix 7: GII and INNOVINDEX plotted against each other



Appendix 8: Graph between GII and INNOVINDEX