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Abstract

By using a sample of 77 countries our analysis applies several nonparametric techniques in order to reveal the link between national culture and corruption. Based on Hofstede's cultural dimensions and the corruption perception index, the results reveal that countries with higher levels of corruption tend to have higher power distance and collectivism values in their society.

Keywords: Nonparametric methods; Corruption perception index; National culture

JEL classification: C14; C19; Z10

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1. Introduction

The aim of this paper is to analyze and reveal the interrelation and the distinct characteristics between culture and corruption. Cultural values guide and shape the way the social institution functions (Licht et al, 2007). Barr and Serra (2010) suggest that social norms cannot be affected only by values and beliefs but by "the proportion of people who adhere to the norm, which in turn affects individuals' beliefs in the values underlying the norm, and, as a consequence, the likelihood that the norm will be internalized by others including future generations". This social mechanism explains the existence of "culture of corruption" indicating that individuals who grow up in societies in which corruption is prevalent will be more likely to accept corruption and act corruptly, in contrast with those who grow up in a more transparent society (Hauk and Saez-Marti, 2002). Our research argues the existence of distinct cultural characteristics which explain countries' corruption levels and can be revealed through nonparametric techniques.

2. Methodology and data

Let the sample realizations (Y_i, X_i) be i.i.d. defined on $\Re$. Then the nonparametric regression model has the form of:

$$Y_i = g(X_i) + u_i, \quad i = 1, ..., n. \tag{1}$$

Following Li and Racine (2007) $g(x) = E(Y|x)$ is a function of x. Then by denoting the joint probability density function (PDF) as $f_{y,x}(x, y)$ the marginal PDF of X as $f(x)$ and the conditional PDF of $Y|X$ as $f_{y,x}(y|x)$ then:

$$f_{y|x}(x, y) = f_{y,x}(x, y) / f(x) \tag{2}$$

Li and Racine (2007, p.59-60) have proved that:

$$E\left(Y\middle|X=x\right)=\int yf_{y|x}(y|x)dy=\frac{\int yf_{y,x}(x,y)dy}{f(x)}\overset{def}{=}g(x) \tag{3},$$

then the $\int yf_{y,x}(x,y)dy$ can be estimated by replacing the unknown PDF $f_{y,x}(x,y)$ with its kernel estimated as $\int y\hat{f}_{y,x}(x,y)dy$ where

$$\int y\hat{f}_{y,x}(x,y)dy=\frac{1}{nh_1\ldots h_q}\sum_{i=1}^{n}K\left(\frac{X_i-x}{h}\right)Y_i \tag{4}.$$

Finally, the $E(Y|x)\equiv g(x)$ can be estimated by:

$$\hat{g}(x)=\frac{\int y\hat{f}_{y,x}(x,y)dy}{\hat{f}(x)}=\frac{\sum_{i=1}^{n}Y_iK\left(\frac{X_i-x}{h}\right)}{\sum_{i=1}^{n}K\left(\frac{X_i-x}{h}\right)} \tag{5}.$$

Equation (5) is the "local constant" kernel estimator or the "Nadaraya-Watson" kernel estimator introduced by Nadaraya (1965) and Watson (1964) and K is a second order Gaussian kernel and h is the appropriate bandwidth which will be analyzed next.

For the calculation of bandwidth a data driven approach introduced by Hurvich et al. (1998) has been applied. The AIC_c criterion can be defined as[1]:

$$AIC_c=\ln(\hat{\sigma}^2)+\frac{1+\mathrm{tr(H)}/n}{1-\{\mathrm{tr}(H)+2\}/n} \tag{6},$$

where

$$\hat{\sigma}^2=\frac{1}{n}\sum_{i=1}^{n}\left\{Y_i-\hat{g}(X_i)\right\}^2=Y'(I-H)'(I-H)Y/n \tag{7}$$

with $\hat{g}(X_i)$ being a nonparametric estimator and H being $n\times n$ weighting function with its (i,j)th element given by

[1] Li and Racine (2004) have proved that AIC_c tends to perform better than the least square cross-validation method for small samples (as in this case).

$$H_{ij} = K_{h,ij} / \sum_{l=1}^{n} K_{h,il}, K_{h,ij} = \prod_{s=1}^{q} h_s^{-1} k\left(\left(X_{is} - X_{js}\right) / h_s\right) \quad (8).$$

According to Li and Racine (2007) there is a within sample measure goodness of fit analogue to the one of R^2 parametric regression models. Let Y_i denote the outcome and $\hat{Y}_i$ the fitted values for observation i, then the R^2 for the nonparametric regression can be defined as:

$$R^2 = \frac{\left[\sum_{i=1}^{n}\left(Y_i - \bar{y}\right)\left(\hat{Y}_i - \bar{y}\right)\right]^2}{\sum_{i=1}^{n}\left(Y_i - \bar{y}\right)^2 \sum_{i=1}^{n}\left(\hat{Y}_i - \bar{y}\right)^2} \quad (9).$$

Then a consistent significance test for continuous regressors defined by Racine (1997) is applied in order to verify the significance of the explanatory variables on the depended. Let z denote the explanatory variable(s) that might be redundant, let X denote the remaining explanatory variable(s) in the regression model, and let Y denote the dependent variable. Then the null hypothesis can be written as (Racine 2008, p. 67):

$H_0 : E\left(y|x,z\right) = E\left(Y|z\right)$ almost everywhere, which is equivalent to

$H_0 : \dfrac{\partial E\left(y|x,z\right)}{\partial x} = \beta(x) = 0$ almost everywhere. In this way the test statistic is an estimator of $I = E\left\{\beta(x)^2\right\}$.

Our paper uses a sample of 77 countries[2] with the variable of interest being the average value (of 1996-2006) of corruption perception index (CPI)[3] provided by the

[2] Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Czech Rep, Denmark, Ecuador, Egypt, El Salvador, Estonia, Ethiopia, Finland, France, Germany, Ghana, Greece, Guatemala, Hong Kong SAR, Hungary, India, Indonesia, Iran, Islamic Rep, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Kenya, Kuwait, Lebanon, Libyan Arab Jamahiriya, Luxembourg, Malaysia, Malta, Mexico, Morocco, Netherlands, New Zealand, Niger, Norway, Pakistan, Panama, Peru, Philippines, Poland, Portugal, Romania, Russian, Saudi Arabia, Sierra Leone, Singapore, Slovakia, South Africa, Spain, Suriname, Sweden, Switzerland, Taiwan,

Transparency International. The explanatory variables used in order to measure countries' national culture are derived from the four cultural dimensions as introduced by Hofstede (1980)[4]: power distance (PDI); individualism versus collectivism (IDV,); masculinity versus femininity (MAS); and uncertainty avoidance (UAI)[5].

3. Empirical analysis

Table 1 presents the results from the local constant no-parametric regression with average CPI value as dependent variable and the four cultural values as independent (the full model). The results indicate a goodness of fit of 80.6% (R^2=0.8059) and the nonparametric significant test (Racine, 1997) reveals that the four explanatory variables are statistically significant at 10% level (p-value= 0.097744). However, the individual influence of every explanatory variable needs to be assed; therefore four additional nonparametric regressions have been applied.

Table 1: *The results of the nonparametric regressions*

Variable Name	Selected Bandiwth	R-squared	Significant test
PDI	8.0323	0.6013	0.0751***
IDV	9.7042	0.5555	0.0150**
MAS	9.5203	0.2356	0.0350**
UAI	21.1777	0.0683	0.0726***
Full model		0.8059	0.0977***

**Significant at 1% level.*
***Significant at 5% level.*
****Significant at 10% level.*

Tanzania, Thailand, Turkey, United Arab Emirates, United Kingdom, United States of America, Uruguay, Venezuela, Viet Nam and Zimbabwe.

[3] Many studies (Gokcekus and Knörich, 2006; Gokcekus, 2008; Gundlach and Paldam, 2009) have used CPI as a proxy of corruption with a scale from 0 (perceived to be highly corrupt) to 10 (perceived to have low levels of corruption). For details see: http://www.transparency.org/policy_research/surveys_indices/gcb

[4] For an extensive analysis of Hofstede's cultural indexes see Halkos and Tzeremes (2010). For details see: http://www.geert-hofstede.com/.

[5] Power distance: ''the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally'' (p. 28). Individualism versus collectivism: ranges from ''societies in which the ties between individuals are loose'' to ''societies in which people from birth onwards are integrated into strong, cohesive in-groups'' (p. 51). Masculinity versus femininity: ranges from ''societies in which social gender roles are clearly distinct'' to ''societies in which social gender roles overlap'' (p. 82). Uncertainty avoidance: ''the extent to which the members of a culture feel threatened by uncertain or unknown situations'' (p. 113).

Sub-figures 1a, 1c, 1e and 1g illustrate graphically the conditional densities (stochastic kernels) for the four cultural values. In addition the sub-figures 1b, 1d, 1f and 1h represent the local linear nonparametric regression plots with their bootstrapped point wise error bounds. For the case of PDI (sub figures 1a and 1b) the stochastic kernel reveals that the probability mass lies on high PDI values and lower CPI values. In addition we observe that the probability mass lies also at lower PDI and higher CPI values. Moreover the nonparametric regression line indicates a negative relation between the PDI and CPI with a goodness of fit of 60% with the PDI being statistically significant at 10% level (Table 1).

According to Getz and Volkema (2001) in higher power distance cultures the acceptance of separations between socioeconomic classes leads to the likelihood that officials demand or accept bribes and leads to the phenomenon where businesses will offer or pay bribes. For the case of IDV (1c and 1d) the nonparametric regression reveals a positive relationship with a goodness of fit of 55% and the IDV variable being statistically significant at 5% level. The stochastic kernel reveals that probability mass lies at higher IDV and CPI values, but also at lower IDV and CPI values.

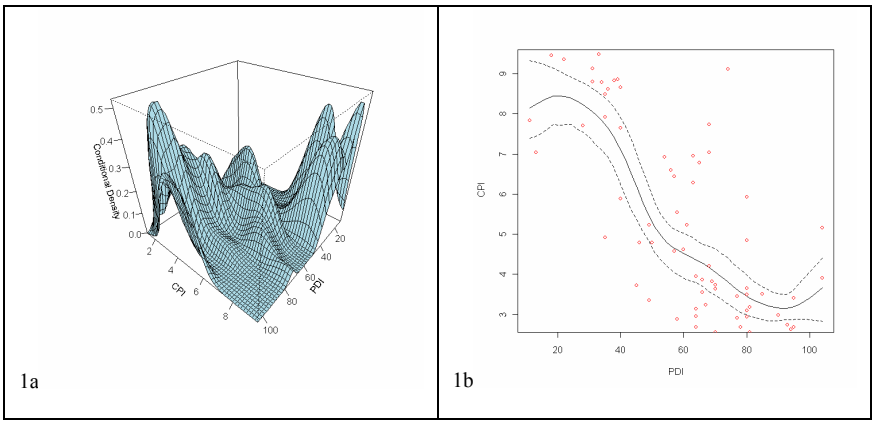
Collectivism in a society is associated with lower standards (in contrast with the individualistic cultures) which in turn affect whether a public official would demand or accept bribe Getz and Volkema (2001). Collectivism cultures may contain networks of friends and family creating relationships which can facilitate abnormal or illegal transactions. Furthermore, in the case of MAS (1e and 1f) the results indicate a "U" shape relationship with a goodness of fit of 23% and the MAS variable being statistically significant at 10% level. The stochastic kernel reveals that probability

mass lies in two distinct points; first at higher MAS and lower CPI values and secondly at lower MAS and high CPI values.

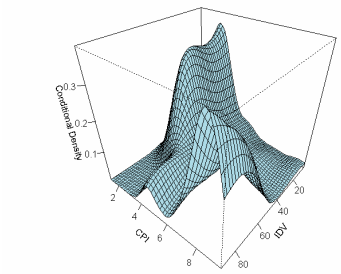
According to Getz and Volkema (2001) in masculine cultures people may be comfortable pursuing their goals through bribes provided they view the probability of success to be high. Furthermore, the nonparametric analysis between UAI and CPI (1g and 1h) reveals a negative relationship with a goodness of fit of only 7% and the UAI variable being statistically significant at 10% level. The stochastic kernel reveals that the probability mass lies again in two distinct points; first at lower UAI and higher CPI values and then at higher UAI and lower CPI values. In societies with high uncertainty avoidance individuals perceive that is necessary to work through informal channels in order to achieve their personal objectives and thus to minimize uncertainty. Similarly the officials accept and demand those bribes and illegal channels. Since the corruption patterns are established breaking out of them would create further uncertainty (Getz and Volkema 2001).

Finally, looking at the R^2 values of the four variables (Table 1) it appears that only PDI and IDV values in a society have a dominant role determining countries' corruption levels.

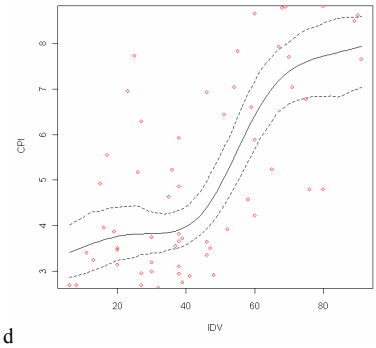
Figure 1: *Nonparametric conditional PDF figures and local constant estimators using the AIC_c bandwidth selection and a second order Gaussian kernel throughout.*



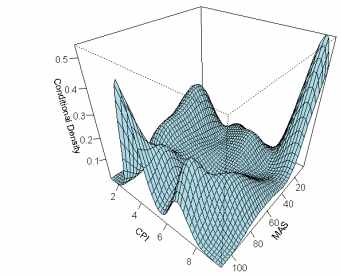
1a 1b



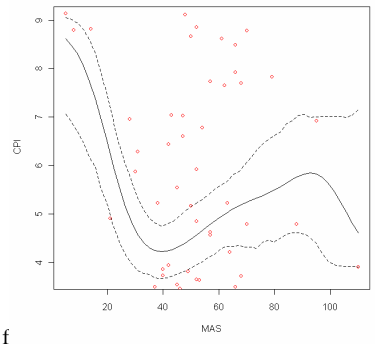
1c



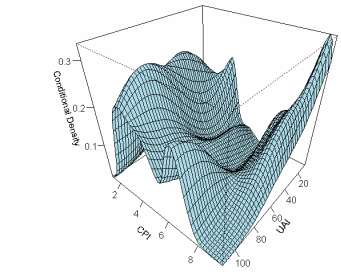
1d



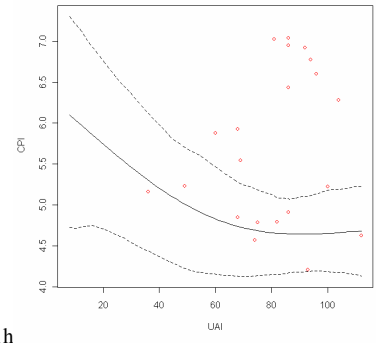
1e



1f



1g



1h

4. Conclusions

The nonparametric analysis reveals the fact that culture and corruption are interrelated. The highly corrupted countries have strong and distinct cultural characteristics. These are high power distance and lower individualistic values. Since cultural values are not inborn and can be taught (Hofstede 1980), the biggest task of governments and policy makers lies ahead and that is to shape countries' national cultural values towards an ethos of transparency through social institutions changes.

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