Economic Modelling 31 (2013) 70–79

Contents lists available at SciVerse ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Corruption and economic development nexus: Variations across income levels in a non-linear framework☆

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ARTICLE INFO

Article history:
Accepted 3 November 2012

JEL classification:
D72
O1
O5

Keywords:
Corruption
Economic development
Country studies

ABSTRACT

This article investigates the relationship between income and corruption which provides an insight to the changes in the level of perceived corruption and economic development across countries. An existing shortcoming is that previous studies have focused only on detecting the linear effects of income on corruption. We therefore use the hierarchical polynomial regression to evaluate any existence of a non-linear relationship after controlling for socio-economic and institutional factors. Our results challenge some of the findings of a negative income–corruption association in the literature, and provide some new inferences. The findings indicate a quadratic function that best fits the data, and despite an upsurge of corruption among the low-to-medium income countries, the advanced stages of development eventually reduce corruption level substantially. The results persist when per capita income is instrumented for by latitude distance and life expectancy. The policy implications suggest a combination of economic, institutional and social policies that can effectively, in turn, reduce and lower the effects of corruption on the society, economy and development.

1. Introduction

It has been established that the impact of corruption is detrimental to all societies, which also explains poor economic performance especially in the context of developing economies.[1] Lambsdorff (2006) notes that cross-country empirical studies have explored the causes and effects of corruption since last decade, and some consensus has slowly emerged but a number of aspects still remain unresolved. Several studies highlight that prevalent corruption is negatively linked to the level of economic development of a country, hence rich countries (i.e. high per capita income nations) are perceived to be less corrupt than poor nations (i.e. low per capita income countries).[2] However, such a stability or reduction in the perceived level of corruption was accompanied by significant rise in real income per capita. But it remains unclear whether an increase in income consistently reduces corruption across regions and income categorisation of countries.

An important shortcoming has been that researchers' have focused only on detecting the linear effects of income on corruption. While the linear negative relationship between income level and corruption has been noted in the literature, however, the degree of the level of income impact on corruption is not uniform and straight forward. The overall long-term trend of the entire process may resemble the downward slope portrayed by a linear function, but the quadratic function can discriminate the experiences of less developed countries from that of the highly developed countries. Hence, a non-linear framework estimated in this paper explores the degree of responses of corrupt behaviour caused by the change in income level in a more systematic way. This focus provides an insight to the changes in the level of perceived corruption and economic development across countries. We question whether corruption levels increase or decrease in the course of a country's economic development and test the factors that determine the level and trends of perceived corruption.

In addressing the inquiry of what are the causes of corruption, with few exceptions, majority of the empirical studies have examined various country case-studies and/or by regions but cross-sectional comparative analysis has been lacking.[2] Recent studies, notably by Sandholtz and Koetzle (2000), Treisman (2000), Fisman and Gatti (2002), and Pellegrini and Gerlagh (2008), consider several aspects of the causes of corruption. However, with the complexity of corruption issues and use of different empirical methodologies, studies have separately or in combination of factors analysed the economic, political, historical and cultural traditions of the causes of corruption. But their findings show some inconclusive results on the relationship between corruption and political institutions, decentralisation and government policies.

☆ We thank the participants for the valuable comments made at the Association of Allied Science Association, American Economic Association Conference, Chicago, IL, January 6–8, 2012. The usual *caveat* applies.
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[1] These studies include Rose-Ackerman (1978), Klitgaard (1988), Mauro (1995), Knack and Keefer (1995), Bardhan (1997) and Brunetti et al. (1998).
[2] See Lambsdorff (2006) and the literature cited therein.

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http://dx.doi.org/10.1016/j.econmod.2012.11.012

To examine the causes of corruption we test the existence of a non-linearity corruption–income association and identify if an increase in income may increase corruption at the low- to medium level of economic development stage and reduce corruption at the advanced levels of development. If this is indeed the case, then an increase in income level may increase corruption during the early stages of development and once in the advanced development level corruption may decline. We use the hierarchical polynomial regression to evaluate this hypothesis after controlling for socio-economic and institutional factors by regions and income classification for 100 countries over the period 1995–2008. The study provides the first systematic cross-country non-linear analysis of income–corruption nexus, to the best of our knowledge. In addition, the threshold income levels are estimated at which corruption changes its direction, i.e. the turning points at which corruption level starts to decline. By also drawing attention to a non-monotonic relationship between income per capita and the level of corruption, a comparative analysis by income classification, i.e., categorising countries into low-income, middle-income and high-income groups demonstrates that a linear relationship might not reflect the true extent of corruption and economic development nexus.

The paper is structured as follows: the penultimate section reviews a brief theoretical overview of the non-linear income–corruption association. Section 3 presents the empirical models, data and methodologies. The estimated results are discussed in Section 4. We find the evidence of a non-linear relationship between income and corruption levels, which illustrates that an increase in income increases the level of corruption, and once past the threshold income level corruption decreases substantially. These results persist when per capita income is instrumented for by latitude distance and life expectancy. The findings are generally robust when an alternative measure of corruption is employed. Conclusions noted here provide that some policy implications are in the final section.

2. Income–corruption association: a brief theoretical overview

The theoretical models of corruption suggest a principal–agent relationship between public officials and society (see Becker and Stigler, 1974; Klitgaard, 1988, and the literature cited therein). Extending the level of corrupt practices in a country it has been noted that the core argument is linked to the nations' functioning institutions and their level of economic development. Studies by Treisman (2000), Graeff and Mehlkop (2003) note that prevalent corruption is negatively linked to the nations' economic development, thus rich countries (i.e. high per capita income nations) are perceived to be less corrupt than poor nations (i.e. low per capita income countries). However, it is likely that corruption responds differently to similar increases in income at various levels of economic development.

The real world evidence also supports the view that the relationship between levels of income and corruption is not uniform and straight forward. From the microeconomic point of view this may be due to income differences between nations that affect the cost of corruption differently and in turn corruption level, thus illegitimate transactions for private enrichment has been explained by the cost and benefit of a corrupt act. The public official infers to the expected cost of a corrupt act (i.e. moral, social and economic costs) against the expected benefit which may depend on the nations' economic, political and social systems. Also, short of prosecution, miscreants are likely to lose their jobs. The cost of this depends upon the benefit provided by the job, which is essentially the level of salaries in the public office (Becker and Stigler, 1974). As such, higher salaries of officials make corruption more costly.

Following the view that high incomes of officials increase the opportunity cost of acting corruptly, it is expected that poor countries will be more corrupt than rich countries. In this context, Sandholtz and Koetzle (2000, pp 36–37) point out that because of high marginal value of money in poor countries, any extra income highly affects both the givers and takers of bribes. Paying a bribe can be a beneficial expense if it creates opportunities for higher income gains. Likewise, receiving a bribe generates a direct boost in income for the public officials, such that the risk is judged as being worthwhile. Although it is expected that there is a linear negative relationship between income level and corruption, however, the degree of impact of income level on corruption is not uniform.

On the other hand, the debate in the literature argues whether corruption is detrimental or beneficial to the economic activity based on “grease” vs. the “sand the wheels” hypothesis (Beck and Maher, 1986; Brunetti and Weder, 1998; Huntington, 1968; Leff, 1964; Mauro, 1995; Mo, 2001). Grease the wheel argument suggests that bribe may act as a trouble saving device and that can raise investment and economic growth of a country. Following this argument it can be argued that low income countries produce insufficient level of income to pay for bribes but when income level increases people can afford to pay bribes and which in turn increases the level of corruption. Thus, corruption level may rise with an increase in income at the early stages of growth.

Furthermore, Leys (1965) argued that civil servants in low income countries receive insufficient wages, the existence of bribes may constitute a complement that may attract able civil servants to being corrupt. Sand the wheel argument claims that corruption can be deleterious to growth by making the bureaucratic process slow, costly, inefficient and by transferring the resources to unproductive activities (Mauro, 1998; Myrdal, 1989; Rose-Ackerman, 1997; Shleifer and Vishny, 1993; Tanzi and Davoodi, 1997). Recently Méon and Sekkat (2005) find that corruption slows growth even more in countries suffering from a weak rule of law and inefficient government.

From the above argument it is evident that at the early stages of development countries (low income countries) do not generate sufficient income however, when income level is moderately high (low- to medium-level of income), it can enhance corrupt activities by transferring resources to the non-productive sectors and where there is a high possibility of extracting large bribes. In contrast, at the advanced stages of development, a high level of income increases the cost of corruption to a level sufficiently higher to deter corruption significantly.

In addition, there is a cost involved in reducing corruption. Reducing corruption is mostly dependent on the building of a sound institutional framework of a country that can combat corruption effectively. However, a low level of income does not provide enough support to build the institutional structures in low-income countries and that makes the cost of reducing corruption very high. On the other hand, middle-income countries are more of a transitional stage that provokes a high level of corruption. But at the mature stages of development, a very high level of income makes it possible to build the institutional foundation and thereby increases the efficacy of anti-corruption reform and the cost of getting caught while corrupt and punished. Hence, the non-linearity in income–corruption relation is a valid possibility. The data descriptions below also highlight the theoretical arguments of the variables that enter the models.

3. Models, data and methodology

To explore the non-linear relationship we examine the three models of linear, quadratic and cubic specifications, using recent data covering 100 countries and by regions and income classification for the period 1995 to 2008. The linear model predicts a straight forward negative association between income and corruption. The quadratic equation hypothesizes that as development process progresses corruption level first increases and then decreases. The cubic model anticipates that as development progresses corruption levels first decrease, then increase and then decrease. Hence, if corruption levels increase or decrease at the early- to medium-stages of development at the mature stages of development the consolidation of advanced institutions eventually reduces corruption. Similar to most past empirical corruption literature

the dependent variable corruption used is Transparency International's corruption perceptions index (CPI). The empirical strategy, results and robustness checks for the country-level analysis are undertaken.

3.1. Model specifications and data description

The model specifications are presented for the corruption and economic development nexus and if there exists a non-linear association. Following Treisman (2000) and Saha et al. (2009) we begin the analysis by focusing on the conventional linear nexus by incorporating several right-hand side socio-economic (income per capita, gini coefficient, unemployment rate, and adult literacy rate) and institutional variables (democracy and economic freedom). The linear base model takes the following form:

$$\begin{aligned}\mathrm{CPI}_{i,t} = {} & \beta_0 + \beta_1 \log\mathrm{RGDPPC}_{i,t} + \beta_2 \mathrm{GINI}_{i,t} + \beta_3 \mathrm{UNEM}_{i,t} \\ & + \beta_4 \mathrm{ALR}_{i,t} + \beta_5 \mathrm{DEMO}_{i,t} + \beta_6 \mathrm{EF}_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{1}$$

where CPI is corruption perceptions index, RGDPPC is real per capita income, GINI is gini coefficient, UNEM is unemployment rate, ALR is adult literacy rate, DEMO is democracy index, EF is economic freedom index, ε is error term, i is country and t is time. The sign and significance of β_1 is of interest; RGDPPC coefficient is expected to be negative to reflect that a high level of per capita real GDP reduces corruption. β_2 is expected to be positive as income inequality may lead to an increase in corruption as rich people have a greater ability to pay bribes to buy public services, both legally and illegally (Glaeser et al., 2003).[3] Likewise, the unemployment β_3 coefficient is expected to be positive since in many developing countries unemployment/underemployment rates are usually high.[4] The demand for stable sources of income is high and, therefore, to secure an earning position with stability and reasonable income opportunity, people are willing to make huge investments.

On the other hand, a high literacy rate often also fosters a sense of patriotism and civic duty in the citizenry. It also raises the public's awareness of their rights, responsibilities and duties (Ali and Isse, 2003). Whilst most citizens in developing countries are not fully aware of their public entitlements and as a consequence the general public's ignorance provides opportunities for a large scale corruption, it is expected that corruption levels will fall where the population become more educated and literate, so β_4 is expected to be negative. The β_5 coefficient is expected to be negative as several studies find that democracy tends to reduce corruption where democratic values, freedom of expression, association and press lead to closer monitoring which in turn increase the risk of exposure of unjust activities.[5] In addition to political liberalisation many nations have stimulated economic liberalisation. However, in many nations an environment of regulation provides opportunities and incentives for rent seeking behaviour. In this case more regulation means firms enjoy higher rents and the bureaucrats have higher incentives to engage in corrupt behaviour.[6] It is expected that more competition reduces corruption and so β_6 is expected to be negative.

In the next step the base model is extended to incorporate the effects by region (i.e. model 2) which is further estimated by income classifications of the countries. These hypotheses allow us to ascertain whether the estimated linear relationships are robust across the alternative specifications, and whether the negative linear relationship does not appear across the regions and by income-groupings. Hypothesis expressed in Eq. (2) takes the following form:

$$\begin{aligned}\mathrm{CPI}_{i,t} = {} & \beta_0 + \beta_1 \log\mathrm{RGDPPC}_{i,t} + \beta_2 \mathrm{GINI}_{i,t} + \beta_3 \mathrm{UNEM}_{i,t} \\ & + \beta_4 \mathrm{ALR}_{i,t} + \beta_5 \mathrm{DEMO}_{i,t} + \beta_6 \mathrm{EF}_{i,t} + \beta_7 \mathrm{Asia} \\ & + \beta_8 \mathrm{LatinAmerica} + \beta_9 \mathrm{Africa} \\ & + \beta_{10} \mathrm{MiddleEast} + \beta_{11} \mathrm{EasternEurope} + \mu_{i,t}\end{aligned} \tag{2}$$

where μ is the error term. The regions are Asia, Latin America, Africa, Middle East and Eastern Europe. The countries by income-classification include the Middle-income countries' with the income level range between $976 and $11,905 and the High-income countries that have income greater than $11,906 in 2008 (World Bank, 2010).

Eq. (3) examines if there is an existence of a non-linear nexus between corruption and economic development, the specific form is as follows:

$$\begin{aligned}\mathrm{CPI}_{i,t} = {} & \delta_0 + \delta_1 \log\mathrm{RGDPPC}_{i,t} + \delta_2 \left(\log\mathrm{RGDPPC}_{i,t}\right)^2 + \delta_3 \mathrm{GINI}_{i,t} \\ & + \delta_4 \mathrm{UNEM}_{i,t} + \delta_5 \mathrm{ALR}_{i,t} + \delta_6 \mathrm{DEMO}_{i,t} + \delta_7 \mathrm{EF}_{i,t} + \zeta_{i,t}\end{aligned} \tag{3}$$

where δ_1, and δ_3 to δ_7 are the base model variables' coefficient (Eq. (1)) and ζ is the error term. The non-linear relationship of income per capita is reflected by the coefficients δ_1 and δ_2, where the expected sign for δ_1 is positive and δ_2 as negative.[7] These expected signs of δ_1 and δ_2 represent a parabolic relationship between income per capita and corruption. It reflects that at a certain value of per capita income the effect of income on corruption is 0. Therefore, before this threshold income level the effect on corruption is positive which becomes negative after certain income level. Hence, at the early stages of economic development an increase in per capita income increases corruption and reaches a maximum level, i.e. the threshold point, and thereafter with improved economic performance it has a dampening (decreasing) effect on corruption.

To measure at what level of economic development the level of corruption begins to decline we estimate the threshold (turning) point of this parabolic relationship as follows:

$$\log \mathrm{RGDPPC}^{*} = |\delta_1 / 2\delta_2| \tag{4}$$

where log RGDPPC* is log income per capita at the turning point level.

The major obstacles of comparative studies of corruption have been the lack of a general definition of corruption and the absence of objective cross-national data on corrupt behaviour given its illegal and secret nature.[8] The subjective measure of corruption based on the perceptions of corruption is used as a principal measure, sourced from Transparency International. For simplicity and ease of exposition, the CPI has been converted into a scale from 0 (least corrupt) to 10 (most corrupt).

The level of economic development is measured in terms of natural logarithm of real GDP per capita. For the inter-country comparison the purchasing power parity (PPP) adjusted real GDP per capita is used and the benchmark year is 1990. The logarithmic transformation stabilises the variance of real GDP per capita values and with an expectation of a positive effect of economic development on corruption

[3] You and Khagram (2005) point out that the wealthy have both a greater motivation and more opportunity to engage in corruption, whereas the poor are more vulnerable to extortion and less able to monitor and hold the rich and powerful accountable, thus increasing inequality. Moreover, in the countries where inequality is high, a large number of poor people are more likely to be deprived of basic public services, and hence are more likely to rely on petty corruption to supplement their low incomes. As such, inequality can be expected to foster a more widespread of corruption.

[4] In the case of Indonesia Kristiansen and Ramli (2006) point out that on the process of buying and selling civil service positions prices for obtaining positions have been rising and vary amongst the departments in accordance with available opportunities to boost income. Thus a high level of unemployment may explain the observed variations in corruption, particularly in the case of developing countries.

[5] See Sandholtz and Koetzle, 2000; Montinola and Jackman, 2002; Sung, 2004; Bohara et al., 2004 for details.

[6] Ades and Di Tella (1999) argue that lack of product market competition offers greater potential gain to public officials (e.g. where large endowments of natural resources, i.e. fuels, minerals and metals) and promotes corruption.

[7] See Wooldridge (2009) on the non-linear estimation and the expected signs of parabolic coefficients.

[8] The definition of corruption used is the misuse of public office for private enrichment in this study, see Transparency International http://www.transparency.org/policy_research/surveys_indices/cpi. Also, the TI data set is regarded as a reliable quantitative measure for the cross-national comparisons and it covers a large number of countries.

it assumes a form of marginally declining returns with increasing economic development.

The other socio-economic explanatory variables, viz. GINI, UNEM and ALR reflect the links between reducing and/or increasing corruption. The GINI and UNEM variables account for the level of corrupt actions which attenuates the link between effort and rewards. On the other side ALR emphasises that education is likely to discourage rent seeking activities. Institutional variables, i.e. democracy and economic freedom, indicate law and order and the degree of regulations that encourage political rights, civil liberty and ease of doing business that yield predictions of discouraging corruption.[9] Like CPI, the democracy and economic freedom indices are re-scaled from 0 to 10, and a higher value represents greater freedom.[10] The underlying data sources and list of countries showing the average CPI and RGDPPC values are presented in Appendix Tables A.1 and A.2, respectively.

3.2. Econometric methodology

Following Dawson (2003), and Nelson and Singh (1998) a five-period (four 3-year average for 1995–2006 and a two-year average for 2007–2008) panel is estimated to eliminate potential business cycle effects that are assumed to be present in annual data. The panel least squares (PLS) method employed here measures the variation of corruption for the period 1995–2008. Descriptive statistics and correlation matrix are reported in the Appendix Tables A.3 and A.4, respectively. As panel data for the cross-country analysis can generate clusters or groups where the presence of clustering can lead to error problems in the statistical inference (Moulton, 1986, 1990), we use cross-section standard errors-corrected regressions which allows for general correlation of observations within a cross-section or cross section heteroskedasticity.[11] Wald test is used to determine the significance of independent variables and the instrumental variables explain the mutual causality between corruption and income.[12]

4. Estimation results

The estimated five-period panel results for the relationship between corruption and real GDP per capita are presented. First, we focus on the results of corruption and economic development association for all countries. The penultimate subsection presents the results for nations classified by income groups, followed by the non-linear framework analysis of corruption-economic development nexus. The model diagnostics provide no concerns and all models indicate a good fit to the data.

4.1. Panel estimation results for all countries

The computed regression coefficients of the base model (Eq. (1)) are reported in Table 1. Column (1) result for the linear income-corruption relationship shows that log RGDPPC coefficient has the expected negative sign and is significant at the 1% level, indicating that higher real GDP per capita has a dampening effect on corruption level. It supports the view that as countries become economically advanced corruption level falls, thus enhancing economic development could dampen corruption levels. At the specific country level this means, for example, in the case of India, that a reduction in corruption from its current level (i.e. India's average CPI score for 1995–2008 period is 7.08, see Appendix Table A.2) to a level of, say, Hungary (where the average CPI score for the period 1995–2008 is 5.00) would require an increase in India's growth rate of real GDP per capita by approximately 157% to reduce its corruption level to 5.00.

Table 1
Income per capita and corruption: linear relationship.

	(1) PLS	(2) PLS	(3) PLS
Log RGDPPC	−1.321***	−0.876***	−0.925***
	(16.078)	(9.373)	(9.622)
ALR	0.034***	0.011***	0.025***
	(17.637)	(3.295)	(11.200)
GINI	0.049***	0.054***	0.016***
	(15.307)	(16.932)	(3.134)
UNEM	0.015***	0.017***	0.013***
	(2.825)	(4.428)	(2.529)
DEMO	−0.088***	−0.038	−0.061**
	(2.731)	(1.282)	(2.254)
EF	−0.591***	−0.526***	−0.514***
	(18.334)	(12.074)	(14.838)
MICs			0.608***
			(5.597)
HICs			−1.312***
			(13.455)
Asia		1.373***	
		(15.750)	
Latin America		1.257***	
		(15.139)	
Africa		−0.100	
		(0.425)	
Middle East		0.348***	
		(2.563)	
East Europe		2.238***	
		(22.612)	
Constant	16.140***	14.344***	14.372***
	(51.973)	(36.116)	(34.702)
Adjusted R^2	0.717*	0.802	0.773
Wald test (p-value)	0.000	0.000	0.000
Observations	500	500	500

Absolute t-statistics appear in parentheses with White heteroscedasticity corrected standard.
*** Indicates significance level at the 1%.
** Indicates significance level at the 5%.
* Indicates significance level at the 10%.

The estimated results for other socio-economic effects on corruption indicate positive impacts on corruption. The ALR coefficient is positive and significant which contradicts the (expected) negative sign.[13] It indicates that a one standard-deviation increase in literacy rate increases corruption by 0.543 points, or 21% of a standard deviation in the corruption perception index. This suggests that just an increase in adult literacy rate of the population does not reduce corrupt behaviour, and therefore may lead to a corrupt activity in a more efficient and secret manner. The computed coefficients for income inequality and unemployment are positive and significant, demonstrating that higher income inequality and unemployment levels increase corruption. A one standard-deviation increase in GINI and UNEM increases corruption by 0.438 points and 0.147 points, respectively.

The democracy and economic freedom measures reflect the role of institutions in controlling corruption. The significant negative DEMO coefficient reflects that corruption level decreases with an expansion

[9] The 'freedom from corruption' component is excluded from the original economic freedom index as the CPI value includes the components of corruption. Economic freedom index is an equally weighted index based on eight individual freedom components, viz. business freedom, trade freedom, monetary freedom, freedom from government, fiscal freedom, property right, investment freedom and financial freedom.

[10] Following Nelson and Singh (1998) and Gounder (2002), the democracy variable is constructed by averaging political rights and civil liberties indices.

[11] The use of average actual level of corruption data across countries minimizes the estimation inefficiency due to measurement error. Also, ordinary least square (OLS) with heteroskedasticity consistent standard errors are estimated, these results not reported here are available from the authors on requested.

[12] Period standard errors-corrected and generalized least square estimates are computed for the robustness checks, these results are not reported.

[13] The estimated results for adult literacy rate significantly increase the level of corruption. It is worth noting that countries with very high levels of corruption and adult literacy rates are Albania, Azerbaijan, Belarus and Bosnia. In contrast, Bangladesh represents a high level of corruption and low level of literacy.

of democracy.[14] This is also consistent with low levels of corruption experienced in developed countries.[15] The estimated impact of DEMO is small, i.e. a one standard-deviation increase in democracy level reduces corruption by 0.295 points, or 11% of a standard deviation in the perceived corruption. Thus, an increase in democracy decreases corruption by about 0.87 points on a 10-point scale, i.e. by about the difference between Slovenia and Spain.

The EF coefficient confirms a decline in corruption where a one standard-deviation increase in economic freedom reduces corruption by 0.733 points, or 28% of a standard deviation in the corruption perception index. The magnitude of this coefficient is much larger compared to the estimated DEMO coefficient. The finding is similar to that of Ades and Di Tella (1997, 1999), Sandholtz and Koetzle (2000), Emerson (2006) and Saha et al. (2009) that economic freedom and perceived corruption are negatively correlated. The inclusion of economic, social and institutional variables explains 72% of the variations. The OLS results for robustness check show that log RGDPPC is negative and significant as well as the signs of other coefficients are consistent with the panel computed results (column (1)).[16]

The next step shows the results across regions based on Eq. (2).[17] The estimated coefficients (Column (2)) for Asia, Eastern Europe, Latin America and the Middle East are positive and significant at the 1% level. In comparing the level of corruption by regions it is seen that Asia, Latin America and Eastern Europe have substantially higher corruption levels to that of Middle East and Africa. While the estimated coefficient for Africa is negative it is not significant. The observation of actual CPI scores confirm that African, Asian, Eastern European, Latin American and the Middle Eastern countries are perceived to be more corrupt than the Organisation for Economic Co-operation and Economic Development (OECD) countries (see Appendix Table A2). Estimating the regional effects of corruption by excluding the control variables show that Africa is perceived to be significantly more corrupt than Asia, Latin America, Middle-East and OECD nations. But adding the socio-economic and institutional control variables show Asia, Eastern Europe, Latin America and the Middle East remaining as more corrupt than the OECD.[18]

To test the corruption effect by income classification, column (3) reports the results for middle-income countries (MICs) and high-income countries (HICs) in comparison to that of low income countries (LICs).[19] Interestingly, column (3) depicts some mixed results. The HICs coefficient indicates a strong negative correlation between economic development and perceived corruption, thus HICs are perceived to be less corrupt than LICs. The positive and significant MICs coefficient demonstrates that middle-income countries are perceived to be more corrupt than LICs when we control for socio-economic and institutional factors.[20] This result along with the estimated negative coefficient for Africa raises the question about the validity of a linear relationship, and suggests the possible existence of a non-linear association between corruption and economic development.

The results in Table 1 provide support to the view that real GDP per capita reduces corruption, the estimated absolute values of log RGDPPC coefficient varies from 0.876 to 1.321, thus income per capita by itself explains more than three-fifths of the variation in corruption between countries. However, the results, after controlling for socio-economic development and political systems, reflect that MICs are more corrupt than LICs. These results provide evidence against an existence of a simple linear relationship between economic development and corruption.[21] It suggests to be cautious of the notion that if a country simply moves up (down) in the income per capita level that it also moves down (up), (i.e. decrease (increase)) in the corruption level. To scrutinise this effect further the next step reports the estimated results for income-classified groups, i.e. LICs, MICs and HICs.

4.2. The per capita income and corruption relationship by income groups

We report the re-estimated results of Eq. (1) by income groupings for the period 1995–2008. The base specification estimates for the LICs (Column (4) Table 2) show log RGDPPC coefficient is positive although not significant indicating that corruption level increases with the level of economic development. In comparing LICs with MICs (column (3) Table 1) the MICs are more corrupt than LICs, but the column (4) result shows that an increase in income increases corruption which contradicts the reservation on the negative linear relationship between economic development and corruption. Interestingly, the results for LICs suggest that higher levels of democracy are vital to reduce corruption than economic freedom while both democracy and economic freedom reduces corruption in the MICs. However, the HICs result reveals that democracy increases corruption and economic freedom reduces corruption (column (6)).

For the MICs and HICs (columns (5) and (6)) real income per capita significantly reduces corruption. The estimated magnitude of income coefficient is far greater for HICs suggesting that significantly higher income levels of developed countries reduce corruption substantially. This means that a 93% increase in per capita real GDP is required in Poland's income level (to that of Estonia) to drop the level of corruption by approximately 2.98 points to bring Poland to somewhere around Chile's level of corruption. The scatter plots (Fig. 1a, b, c) depict the fit of linear relationship between real GDP per capita and corruption levels for the LICs, MICs and HICs, respectively. Negative nexus is evident for the MICs and HICs and the slope of the regression line is relatively steeper for the HICs. But in the case of LICs the finding does not support a negative linear relationship between income and corruption levels.

The range for corruption levels by income groups (Fig. 2) shows that the maximum CPI score for the MICs is greater than the maximum CPI score of the LICs and HICs. Even the minimum CPI score for LICs is far greater than MICs and HICs minimum scores. This suggests that LICs do not generate sufficient income to control corruption level and a small increase in income may not inflate the cost of corruption, but an increase in income increases the opportunity for further corruption. The results illustrate a second degree non-linear relationship between income and corruption levels. In other words, in the early stages of economic development an increase in income encourages corruption whereas in the mature stages of economic development (i.e. high income status) the level of corruption declines. The confirmation of non-linearity between corruption and economic development nexus leads to testing this relationship; the results are reported in the penultimate section.

[14] This result supports the recent empirical findings of Goldsmith (1999), Sandholtz and Koetzle (2000), Treisman (2000), Montinola and Jackman (2002), Ali and Isse (2003), Sung (2004), and Bohara et al. (2004). However, it differs to that of Ades and Di Tella (1999) study who note that political rights had no significant impact on corruption.

[15] It is however noted that in the case of Hong Kong and Singapore the democracy scores are low (indicating low level of democracy) but also have low CPI scores (i.e. low levels of corruption).

[16] The OLS results are not reported here and can be obtained from the authors on request.

[17] Inclusion of regional dummies is to control for the combined impact by various regional specific factors of corruption.

[18] The estimated result not reported here is available from the authors on request.

[19] The LICs, MICs and HICs are based on the World Bank classification of countries by income groups. In 2008, low-income economies are those with a Gross National Income (GNI) per capita of $975 or less. Middle-income economies are those with a GNI per capita of more than $976 but less than $11,905 and high-income economies are those with a GNI per capita of $11,906 or more (World Bank, 2010).

[20] The estimated results for both MICs and HICs (without control variables) show that they are perceived to be less corrupt than LICs.

[21] Inspection of raw data does not provide a simple negative relationship between income per capita and the level of corruption, i.e. there are some countries with high levels of corruption, however, their income levels are quite high compared to the countries with relatively low levels of corruption, for example, South Korea and Qatar. South Korea's both income and corruption level are far greater than Qatar.

Table 2
The RGDP per capita and corruption relationship in LICs, MICs and HICs.

Dependent variable: corruption perception index			
	(4) LICs PLS	(5) MICs PLS	(6) HICs PLS
Log RGDPPC	0.078	−0.758***	−3.206***
	(0.875)	(7.385)	(11.779)
ALR	0.001	0.026***	0.047***
	(0.761)	(6.497)	(4.428)
GINI	0.038**	-0.011**	0.091***
	(2.244)	(2.239)	(8.993)
UNEM	0.024***	0.003	0.015
	(6.809)	(0.469)	(1.128)
DEMO	−0.153***	−0.100***	0.145***
	(6.710)	(4.659)	(2.579)
EF	0.016	−0.461***	−0.440***
	(0.133)	(10.249)	(7.281)
Constant	5.514***	14.668***	28.403***
	(5.520)	(28.132)	(20.035)
Adjusted R^2	0.349	0.484	0.567
Wald test (p-value)	0.000	0.000	0.000
Observations	60	235*	204

LICs — Low-income countries, MICs — Middle-income countries, HICs — High-income countries, and PLS — panel least squares. Absolute t-statistics appear in parentheses with White heteroscedasticity corrected standard.
*** Indicates significance level at the 1%.
** Indicates significance level at the 5%.
* Indicates significance level at the 10%.

4.3. The non-linear real GDP per capita and corruption nexus

The results shown in the scatter plot (Fig. 3), using the fitted Kernel curve illustrate a non-linear nexus between corruption and income for all countries. Identification of this further leads to a systematic evaluation in a quadratic non-linear framework (Eq. (3)) which is represented by a second degree polynomial function. The estimated results are presented in Table 3.

The panel least squares estimates (column (7)) confirm the existence of a non-linear relationship between real GDP per capita and corruption in the form of an inverted-U-shape curve (Fig. 3).[22] The inverted-U hypothesis implies that corruption level increases initially but then reduces in the course of a country's economic development.[23] The significant log RGDPPC coefficient value of 7.98 for the linear income term is positive and the squared income term is negative 0.561 (column (7)). This suggests that corruption increases at the low economic development stage and decreases as the nations' achieve higher levels of economic development.[24] The estimated negative second-degree polynomial of (log RGDPPC)^2 indicates that a concave function fits the data better than the linear function. In addition, the computed linear and quadratic income coefficients are insignificant and the adjusted R^2 value for cubic model (column (8)) of 0.796 (same adjusted R^2 value as the second degree polynomial) do not add to higher explanatory power which suggest that quadratic model is more appropriate than the cubic model.

The non-linear estimates for LICs show that this group's quadratic function of log RGDPPC is portraying a weak non-linear relationship. However, the MICs quadratic income coefficient is negative but insignificant while the HICs quadratic income coefficient is negative and significant. These results support the findings in Table 2, i.e., a significant negative linear term of log RGDPPC for MICs and HICs but a positive linear coefficient for LICs. In other words, in low-income countries corruption level rises with income per capita up to a threshold level, whereas the

[22] Except for democracy the signs and significance levels of other control variables remain same after the inclusion of a quadratic term. The OLS estimation results also confirm a non-linear relationship, although not reported here it can be obtained from the authors on request.
[23] Kuznets (1955) seminal work presents the inverted-U hypothesis.
[24] The inclusion of the second-order polynomial term improves the model's goodness of fit by 11% raising the adjusted R^2 value from 0.717 in column (1) to 0.796 in column (7).

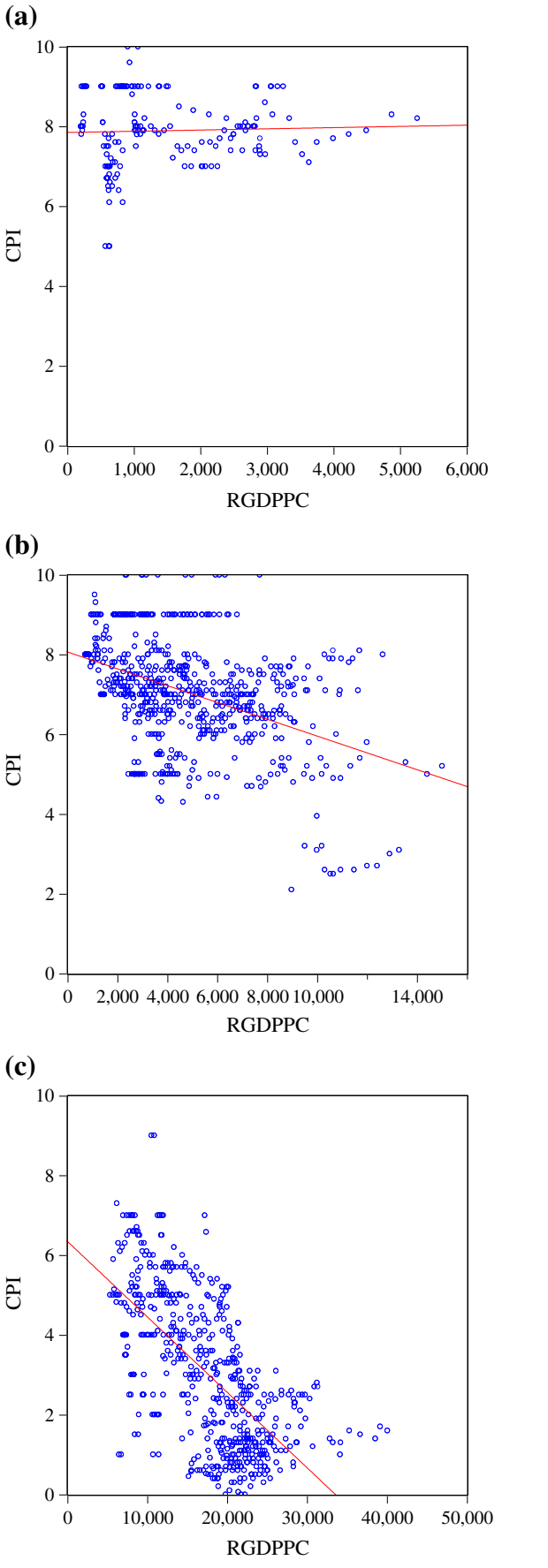

Fig. 1. (a) Income per capita and corruption relationship in LICs. (b) Income per capita and corruption relationship in MICs. (c) Income per capita and corruption relationship in HICs.

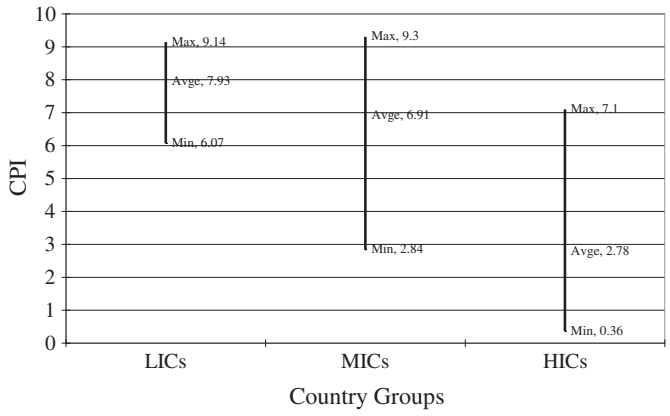

Fig. 2. Range of corruption index by income groups.

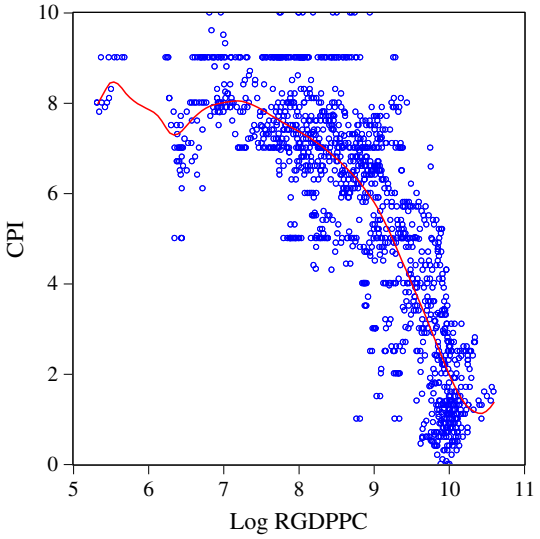

Fig. 3. Kernel Fit plots of log RGDPPC and CPI.

middle-to-high income countries do not experience such a rise in corruption level as income increases.

Based on the findings of a concave relationship between income and corruption we next estimate the threshold level of income at which corruption changes its direction, i.e. the turning point based on Eq. (4). The estimated turning point value at which corruption level starts to decline is approximately at the value of 7 (Table 4). The turning point value of real GDP per capita is US$1339 (1990 PPP), and above this level of income the corruption level starts to decrease for all countries. The result suggests that LICs with extremely low income levels (i.e. GNI<US$975 or less) will exhibit a high level of corruption as they are still in the low economic development stage. For the MICs corruption increases until they reach the turning point (income level of US$1339) at which the average level of corruption is at its maximum, and once past this turning point the corruption levels tend to decline.[25] For the HICs corruption levels become substantially lower at the more mature stages of economic development as their income levels are substantially higher than US$1339, for e.g. Australia, Denmark and New Zealand. Since the income levels of HICs are far beyond the turning point value and have a relatively developed legal system to fight against corruption the steady downward corruption trends are addressed by anticorruption policies.

The higher stages of economic development also make it possible for the HICs to pay higher compensation (wage levels) to the officials, which in turn deter corruption.[26] It is also observed that countries with relatively well-developed and highly integrated structures are amongst the least corrupt nations, some of these are Denmark, Finland, Iceland, Canada, New Zealand and Sweden. On the other hand, the most corrupt countries are traditionally viewed as having less developed and integrated structures, where an increase in income level increases the opportunities for more corruption, for e.g. Bangladesh, Indonesia, Kenya, and Nigeria.

4.4. Robustness checks: two-stage estimation and alternative corruption measure

The problem of endogeneity noted in the literature that points to using appropriate methodology to address this bias.[27] The potential issue of simultaneous causation is addressed here using the two-stage least square (TSLS) procedure and employing instrumental variables that may affect economic development but not be affected by corruption. Distance from the equator (absolute value) is used as an instrument for per capita income variable.[28] We also use life expectancy as another instrument for economic development.[29] The latitude distance and life expectancy variables perform remarkably well from a statistical standpoint. The TSLS estimates show that latitude distance and life expectancy variables are good predictors of per capita income and also confirm the PLS estimates (column 1), that a higher level of income per capita is significantly associated with lower perception of corruption. Also, the non-linear TSLS result for RGDPPC is consistent with the PLS results (column 7).[30] This finding is robust and provides strong evidence that higher economic development does itself reduce corruption only after a threshold level of development.

The results in Tables 2 and 3 utilise CPI that raises the question whether these results are the characteristics of specific data since CPI is a subjective measure. We extend the analysis by estimating the equations by using control of corruption index (CCI) constructed by Kaufmann et al. (2005). The results for CCI measure in both cases show that the estimated log RGDPPC coefficients are consistent with that of CPI measure. Furthermore, the second degree polynomial results decisively justify the existence of a non-linear relationship. The evidence strongly supports the hypothesis that an increase in income controls the level of corruption only after a certain level of economic development.[31]

5. Conclusion

This study provides strong evidence that corruption can be explained by various socio-economic, political and institutional factors

[25] It is noted that those countries in the lower-middle income group of MICs (i.e. US$976 to $3745) will exhibit higher corruption level until they reach the income level greater than US$1339.

[26] The result confirms the businessman's approach to control corruption by paying higher wages to bureaucrats, see Ades and Di Tella (1997, p. 497).

[27] Since corruption is likely to reduce economic growth the OLS estimation may overestimate the income impact on corruption. Mauro (1995) finds that perceived corruption reduces economic growth.

[28] Latitude is known to be associated with the level of economic development probably due to the tropical climate and diseases (Gallup et al., 1999), but there is no reason that the distance from the equator is directly correlated with corruption. See Treisman (2000). Latitude distance is obtained from La Porta et al. (1999).

[29] Sachs and Warner (1997) note that higher life expectancy raises growth. The mortality rate, for example, represents a community health indicator which may have an impact on per capita income via productivity and they are highly correlated with economic development. Correlation between life expectancy and log RGDPPC is 0.89. As life expectancy cannot directly affect corruption but may affect corruption via economic development.

[30] The TSLS results are not reported here and can be obtained from the authors on request.

[31] The alternative corruption index results are not reported here and can be obtained from the authors on request.

Table 3
Non-linear relationship between per capita income and corruption.

	(7) All country PLS	(8) All country PLS	(9) LICs PLS	(10) MICs PLS	(11) HICs PLS
Log RGDPPC	7.984***	−0.356	3.554*	1.662	1.142
	(13.938)	(0.141)	(1.949)	(1.129)	(0.549)
(Log RGDPPC)^2	−0.561***	0.478	−0.249*	−0.145	−0.226**
	(15.719)	(1.608)	(1.898)	(1.574)	(1.985)
(Log RGDPPC)^3		−0.043***			
		(3.712)			
ALR	0.025***	0.024***	0.002	0.025***	0.05***
	(15.968)	(12.845)	(0.914)	(6.228)	(5.207)
GINI	0.034***	0.032***	0.035*	−0.009**	0.09***
	(5.818)	(5.619)	(1.925)	(2.283)	(9.304)
UNEM	0.017***	0.017***	0.026***	0.004	0.015
	(3.735)	(3.660)	(6.047)	(0.561)	(1.091)
DEMO	−0.019	−0.019	−0.0156***	−0.102***	0.136***
	(0.526)	(0.521)	(6.154)	(4.911)	(2.553)
EF	−0.513***	−0.501***	−0.085	−0.466***	−0.441***
	(10.778)	(12.351)	(0.772)	(10.572)	(7.551)
Constant	−21.188***	0.814	−0.859	4.729	7.446
	(10.120)	(0.116)	(0.965)	(0.805)	(0.765)
Adjusted R^2	0.796	0.796	0.366	0.484	0.565
Wald test (p-value)	0.000	0.000	0.000	0.000	0.000
Observations	500	500	60	235	205

LICs — Low-income countries, MICs — Middle-income countries, HICs — High-income countries, and PLS — panel least squares. Absolute t-statistics appear in parentheses with White heteroscedasticity corrected standard.
*** Indicates significance level at the 1%.
** Indicates significance level at the 5%.
* Indicates significance level at the 10%.

and that there also exists a non-linear relationship between corruption and the level of economic development of the nations. The linear results show a strong negative nexus between income and corruption across countries. In addressing the level of how much improvement in corruption can countries expect from a higher income level, the estimated coefficients range from 0.876 to 1.321 indicating that an improvement of one standard deviation in real GDP per capita reduces corruption between 0.925 and 1.39 points. This association is robust after controlling for endogeneity bias. In spite of its role in controlling corruption, however the classification by regions shows that higher income does not appear to reduce corruption.

The estimated regional results indicate that higher levels of corruption are in Asia, Eastern Europe, Latin America and the Middle East. The results by income classification of the nations' manifest that high-income countries are less corrupt compared to low-income countries but the middle-income countries are perceived to be more corrupt than the low-income countries. The interesting finding is that an increase in income increases corruption in low-income countries. The non-linear results show that corruption increases at low economic development stage and decreases as nations' achieve higher levels of economic development. Also, a small increase in income at a low economic development stage is not sufficient to reduce corruption; instead it increases opportunities for more corruption. Consequently, as nations' achieve a higher economic development status (i.e. higher income level) corruption declines, whereby this concave relationship between income and corruption requires an income level of over US$1339 to start reducing corruption level.

Controlling for corruption implies that enhancing nations' economic development and the choice of policies are crucial dynamics for all nations. The high-income, middle-income and low-income countries can control corruption significantly through changing economic and education prospective of children and parents. This suggests policy requirements aimed at achieving a high level of educational attainment, employment opportunities and equal income distribution that are necessary to intensively discourage corrupt activities. Also, the suppressing of corrupt behaviour in the democratic nations requires monitoring and controlling predetermined factors that influence the policies for reducing corruption. A combination of economic, institutional and social policies can effectively, in turn, reduce and lower the effects of corruption on the society, economy and development. This analysis is consistent with the view that, while several anti-corruption policy measures may appear to be ineffective for many developing countries, however with continued economic development the level of corruption could eventually be reduced.

Table 4
Turning point of the real GDP per capita.

	All country	LICs
Turning point	7.2	7.1
RGDPPC at the turning point	1339.439	1211.967

Appendix A

Appendix Table A1
Data Source.

Variables	Data source
Corruption perceptions index (CPI)	Transparency International http://www.transparency.org/policy_research/surveys_indices/cpi
Real GDP per capita (1990 US dollars) (RGDPPC)	Groningen Growth and Development Centre http://www.ggdc.net/index-dseries.html
Gini coefficient (GINI)	WIDER World Income Inequality Database http://www.wider.unu.edu/wiid/wiid.htm
Unemployment rate (UNEM)	Political Risk Year Book, Political Risk Services, The PRS Group, Inc., 2009. http://www.prsgroup.com/
Adult literacy rate (ALR)	World Bank (2010) World Development Indicators
Democracy index (DEMO)	Freedom House http://www.freedomhouse.org/uploads/fiw/FIWAllScores.xls
Economic freedom (EF)	The Heritage Foundation http://www.heritage.org/index/, 2009
Low-income countries (LICs)	World Bank (2010) World Development Indicators
Middle-income countries (MICs)	World Bank (2010) World Development Indicators
High-income countries (HICs)	World Bank (2010) World Development Indicators

Appendix Table A.2
List of countries, average CPI, and average RGDPPC.

Countries	Average CPI	Average RGDPPC	Countries	Average CPI	Average RGDPPC	Countries	Average CPI	Average RGDPPC
Albania	8.51	2973	Hong Kong	2.17	23,578	Poland	5.69	7668
Algeria	5.9	3049	Hungary	5.00	7658	Portugal	3.58	13,533
Argentina	6.88	8741	Iceland	0.67	21,831	Qatar	2.54	10,250
Armenia	6.84	6394	India	7.08	2113	Romania	7.05	3586
Australia	1.32	22,341	Indonesia	7.87	3797	Russia	7.60	6147
Austria	2.1	20,873	Iran	8.34	5079	Saudi Arabia	4.39	8342
Azerbaijan	8.06	4660	Iraq	8.63	1249	Serbia	8.17	2669
Bangladesh	8.83	915	Ireland	2.30	22,606	Singapore	0.82	22,719
Belarus	8.24	7691	Israel	3.16	16,132	Slovakia	6.35	9276
Belgium	3.31	20,896	Italy	5.31	18,801	Slovenia	4.34	14,171
Bosnia	8.62	5569	Japan	3.12	21,196	South Africa	5.06	4176
Brazil	6.36	5619	Jordon	6.01	4287	South Korea	5.44	15,468
Bulgaria	6.43	6215	Kazakhstan	8.32	7225	Spain	3.61	15,500
Canada	1.15	22,620	Kenya	7.91	1051	Sri Lanka	6.48	3805
Chile	2.85	10,940	Kuwait	4.61	10,590	Sudan	8	900
China	6.79	3512	Kyrgyzstan	7.41	2269	Sweden	0.76	21,194
Colombia	6.64	5667	Latvia	5.99	9534	Switzerland	1.17	22,518
Congo Democratic Republic	8.44	239	Lithuania	6.26	7853	Syria	7.03	7300
Cote d' Ivore	7.41	1320	Luxemburg	1.55	33,087	Taiwan	4.46	17,397
Croatia	5.96	6973	Macedonia	8.26	3347	Tajikistan	8.62	1105
Cyprus	4.25	14,239	Malaysia	4.91	8855	Tanzania	7.75	613
Czech Republic	5.41	10,017	Malta	6.17	11,871	Thailand	6.71	7154
Denmark	0.42	22,913	Mexico	6.60	7120	Turkey	6.37	7021
Ecuador	7.69	4295	Moldova	7.37	2626	Turkmenistan	8.8	2453
Egypt	6.18	3180	Morocco	6.01	2934	Ukraine	7.45	3458
Estonia	4.12	14,424	Myanmar	8.67	1793	UAE	2.46	11,739
Ethiopia	7.24	655	Netherland	1.15	21,948	United Kingdom	1.51	20,918
Finland	0.45	20,285	New Zealand	0.55	17,252	United States	2.46	11,739
France	3.09	20,957	Nigeria	8.41	1425	Uzbekistan	8.12	3789
Georgia	8.3	3891	Norway	1.25	25,597	Venezuela	7.57	8781
Germany	2.1	18,922	Oman	4.04	7416	Vietnam	7.67	2065
Ghana	6.17	655	Pakistan	7.78	2042	Yemen	7.99	2779
Greece	5.42	13,058	Peru	5.99	4018			
Guatemala	6.2	4463	Philippines	7.24	2517			

Appendix Table A3
Descriptive statistics.

	ALR	CPI	DEMO	EF	GINI	Log RGDPPC	UNEM
Mean	88.180	5.498	6.187	6.117	38.458	8.733	12.157
Median	95.950	6.300	6.667	6.240	37.550	8.856	9.000
Maximum	100.000	10.000	10.000	9.150	63.700	10.598	42.200
Minimum	33.590	0.000	0.000	1.000	20.000	5.323	0.800
Std. dev.	15.964	2.595	3.352	1.241	8.9484	1.056	9.770
Observations	1400	1400	1400	1400	1400	1400	1400

Appendix Table A4
Correlation matrix.

	ALR	CPI	DEMO	EF	GINI	Log RGDPPC	UNEM
ALR	1.000						
CPI	−0.363	1.000					
DEMO	0.512	−0.588	1.000				
EF	0.350	−0.683	0.581	1.000			
GINI	−0.301	0.469	−0.391	−0.189	1.000		
Log RGDPPC	0.627	−0.776	0.626	0.660	−0.463	1.000000	
UNEM	−0.431	0.466	−0.356	−0.446	0.216	−0.543	1.000000

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