Does easy availability of cash effect corruption? Evidence from panel of countries

Singh, Sunny and Bhattacharya, Kaushik

Indian Institute of Management, Lucknow (India), Indian Institute of Management, Lucknow (India)

1 June 2016

Does easy availability of cash effect corruption? Evidence from panel of countries

By

Sunny Kumar Singh♣

Doctoral Student, Business Environment Area

Indian Institute of Management, Lucknow (India)

Email: sunnysingh.econ@gmail.com

Kaushik Bhattacharya

Professor, Business Environment Area

Indian Institute of Management, Lucknow (India)

Email: kbhattacharya@iiml.ac.in

♣ Corresponding author. Email: sunnysingh.econ@gmail.com
Contact Number: +91-8009976001

Does easy availability of cash affect corruption?

Evidence from a panel of countries

Abstract

Using annual panel data of 54 countries for the period 2005-14, we examine whether currency in circulation, both in aggregate and in large denominations, affects the level of corruption in a country. Standard panel data models suggest that the ratios of (i) aggregate currency in circulation to M1 and, (ii) large denominated banknotes to M1 are both statistically significant determinants of corruption. Tests for reverse causality within a panel Granger framework reveal uni-directional causality of corruption with the first variable, but a bi-directional one with the second one. These findings suggest that limitations of supply of banknotes of large denomination, inter alia, could be a tool to fight corruption and brings to the fore the important role of payment system, extending an earlier study by Goel & Mehrotra (2012). The results also highlight that along with government, the central bank of an economy can also play an important role in the fight against corruption.

Keywords: Control of corruption Index**;** ICRG Corruption Index; Currency in circulation; Large denominated banknotes; Static panel data model; Dynamic panel data model; Panel. Granger causality

JEL Classification: D73, E51

1. Introduction

There are many studies in the economics literature on corruption and its cross-country determinants (Abramo, 2008; Aidt, 2003; Bardhan, 1997; Elbahnasawy & Revier, 2012; Graf Lambsdorff, 2005; Svensson, 2005; Treisman, 2000, 2007). Based on these studies, cross-country determinants of corruption could be categorized into various economic, socio-cultural and political factors. In most of these studies, economic factors taken into consideration are real GDP per capita, investment, inflation, government size, openness, population growth, educational attainment, etc. Sociocultural and political factors taken are measures of ethnicity, government type, freedom of press, judicial efficiency, religion, etc. Interestingly, most of these determinants, especially socio-cultural and political ones, have limited short-run impact but tend to influence corruption significantly in the long run.

It may be noted that the existing literature on corruption has mostly focused on the role of government but largely ignored the role of the central bank and the payment system in a country. A financial transaction is at the heart of corruption. Examination of this angle is important in a fight against corruption because, in contrast to the role of government ushering institutional changes, a few changes in policies by the central banks may bring quick results. While rigorous academic studies in this area are limited, there are many media reports which argue that transactions by cash are intended to avoid taxes, generate black money and facilitate petty corruption.[1] Some of these reports also recommend that the government should withdraw or avoid printing large denominated

[1] For example, a media report on political corruption in India finds some evidence that political parties do disburse cash to voters prior to elections and for which a huge amount of cash is held and transported from one place to another (http://indiatoday.intoday.in/story/it-is-raining-cash-in-andhra-pradesh-bypolls/1/199369.html). Similarly there are reports on the popularity of Euro 500 banknotes among criminals and how it is facilitating global crime wave around the world (http://www.dailymail.co.uk/home/moslive/article-1246519/How-500-euro-financing-global-crime-wave-cocaine-trafficking-black-market-tax-evasion.html)

banknotes from circulation and simultaneously promote larger transaction via electronic payment system only.[2] In the recent period, there are some instances wherein some economies withdrew large denomination banknotes to deter corruption and black markets.[3]

In a cross-sectional study, Goel & Mehrotra (2012) have attempted to relate corruption to measures relating to the payment system in a country. They find that an increased use of paper-based transactions and cheques adds to corruption while card-based transaction reduces the prevalence of corruption. However, the scope of their study is limited because it covers only 12 advanced economies for the period 2004-08. In another study Goel, Budak, & Rajh (2013), using a sample of bribe payments from Croatia, study the effect of bureaucratic monopoly on the timing and nature of bribe payment. Regarding nature of bribe payment, they try to find the effect of bureaucratic monopoly on cash bribes. Their findings suggest that monopolist bureaucrat is more likely to demand bribes in cash. Adhikari & Bhatia (2010) probe whether the government of India shift from cash payment of wages under the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA) to settlement through bank accounts prevents defrauding of workers thereby reducing leakage of public money. Based on a survey in a limited part of Uttar Pradesh and Jharkhand states in India, they find that the direct transfer of wages into workers' bank accounts is a substantial protection against embezzlement, provided that banking norms are adhered to and that workers are able to manage their own accounts. In a similar study, using micro-level data from the Indian state of Andhra Pradesh, Muralidharan, Niehaus, & Sukhtankar (2014) evaluate the impact

---

[2] http://www.firstpost.com/business/economy/we-should-abolish-rs-500-and-rs-1000-notes-completely-354908.html and http://digitalmoney.shiftthought.co.uk/digital-money-in-india-a-path-to-better-governance/

[3] For instance, the Euro 500 has been withdrawn from circulation in the United Kingdom from May 2010 following concerns that it is the denomination of choice for criminals, tax evaders and terrorists due to its cost effective movement and storage (http://www.telegraph.co.uk/news/uknews/crime/7714809/500-euro-notes-withdrawn-over-organised-crime-fears.html). Similarly, with effect from October 2014, Monetary Authority of Singapore has stopped issuing Sg 10000 notes to help deter money laundering, with critics complaining that the note is the bill of choice for bribe-payers in neighboring Indonesia (http://www.firstpost.com/world/singapore-to-stop-issuing-sg-10000-notes-to-deter-money-laundering-1612645.html).

of biometrically-authenticated payments infrastructure on public employment and pension programs. Their results suggest that the new technology i.e. biometrically-authenticated payments infrastructure delivered a faster, more predictable, and less corrupt payments process without adversely affecting program access.

Regarding theoretical grounding on this issue, researchers attempting to investigate the causes of corruption generally borrow from the broader literature on crime and punishment that considers lawbreakers (bribe payers and bribe payees in our case) as economic agents weighing the relative costs and benefits of their action (Becker, 1968; Goel & Mehrotra, 2012). However, there has been a scarcity of literature investigating direct relation between currency in circulation and the prevalence of corruption. Nevertheless, there are many separate studies related to *"currency demand and the shadow economy"* in which it is found that large shadow economy results into increased cash demand (Drehmann, Goodhart, & Krueger, 2002; Schneider & Enste, 2000) and *"shadow economy and corruption"* in which corruption and the shadow economy is found to be 'complement' in low-income countries (Dreher & Schneider, 2009). Dreher & Siemers (2009), in a related research on corruption and the financial system, try to identify a link between corruption and capital account restrictions. They find that more corrupt countries are more likely to impose capital controls because they are less able to collect tax revenue. This is, because, in the presence of capital controls, individual seeking to make international transactions may offer bribe to avoid restrictions, adding to corruption.

Based on the above discussion, we, in this paper, examine whether increased use of cash and large banknotes affects corruption. It is well known that illegal transactions thrive on anonymity. Common sense suggests that overwhelming majority of such transactions will avoid the banking channel and any payment involved is expected to be carried out through cash only. The role of cash relative to other assets that leave traces in an economic transaction could therefore be one of its important determinants. The role of large denominations in illegal transactions had repeatedly been highlighted in the literature on money laundering (Rogoff, 2002; Rogoff, Giavazzi, & Schneider, 1998; Drehmann et al., 2002). It is well known that availability of large banknotes reduces the transaction cost of corruption. This brings to the fore the important role the central bank in a country could play in the fight against corruption by reducing the availability of banknotes of large denominations.

Empirically, we test two hypotheses. First, we test whether the ratio of currency in circulation to narrow money (M1) is a statistically significant explanatory variable of corruption across countries. Second, we test whether the total value of banknotes of large denominations relative to M1 is another significant cross-country determinant of corruption. We also examine the possibility of reverse causality in both these cases i.e. prevalence of corruption might influence the use of cash.

The plan of the paper is as follows: Section 2 describes the data, section 3 discusses the empirical methodology and section 4 presents the results. Finally, section 5 concludes the paper.

2. The Data

Our sample consists of 54 countries covering the period 2005-2014. We could not take time period prior to 2005 in our study due to unavailability of denomination-wise cash in circulation data for most of the countries, especially for the developing ones. Our choice of countries is also constrained by data availability (e.g., countries from Euro area are excluded due to unavailability of individual country-specific data related to cash in circulation). However, the sample is a fair mixture of high income (26), upper middle income (17) and lower middle income (11) countries.[4] The list of sample countries along with their income groups is provided in Table A.1 in Appendix A.

Corruption is a variable that is not measured directly. However there are a number of indices that measure perceived, rather than actual, level of corruption in a country. This paper uses two alternative measures of corruption; (1) the Control of Corruption Index (*CC*) published by the World Bank's Worldwide Governance Indicators and (2) the International Country Risk Guide's corruption index (*ICRG)*[5]. In comparison to the Transparency International's Corruption Perception Index (CPI), these indices are more suitable when it comes to cross-country and over-time comparison (Kaufmann, Kraay, & Mastruzzi, 2011, Treisman, 2007).[6] According to Kaufmann et al., (2011), the main objective of the *CC* is – *"to capture perceptions of the extent to which public power is exercised for private gain, including both petty and grand form of corruption, as well as "capture" of the state by elites and private interests"*. The *CC* has a range from -2.5 (representing highest corruption) to 2.5 (representing no corruption). On the other hand, the *ICRG* has a range of 0-6, with a higher score means less corruption. The *ICRG* is captured from statements like *'high government officials are likely to demand special payments'* and *'illegal payments are generally expected throughout lower levels of government'* in the form of *'bribes connected with import and export licences, exchange rate controls, tax assessment, police protections, or loans'* (Seldadyo & de Haan, 2006; Tanzi & Davoodi, 1997).

---

[4] The classification is based on the World Bank Income Classification, 2015. The World Bank Income Classification is based on gross national income (GNI) per capita. High income (HI) countries are those with a GNI of more than $12,736 in 2014. Upper middle (UMI) is one with a GNI of between $4,125 to $12,756 while lower middle (LMI) is one with GNI between $1,045 to $4,125 in 2014. Those with a GNI of $1,045 or lower in 2014 are low income (LI) countries.

[5] The number of sample countries reduces to 51 when we use ICRG corruption index as a corruption measure. The ICRG corruption index is not available for Bosnia & Herzegovina, Korea and Kyrgyzstan.

[6]According to Transparency International Corruption Perception Index (2012) report, the CPI score is calculated based on an updated methodology from 2012 onward. Under the previously used methodology, CPI scores are not comparable over time (http://www.transparency.org/files/content/pressrelease/2012_CPIUpdatedMethodology_EMBARGO_EN.pdf).

We take the ratio of aggregate currency in circulation to M1 (*CIC*) as well as large denominated banknotes to M1 (*LCIC*) as a measure of cash. Here M1 is the sum of total currency and demand deposits. We define large denominated banknotes as the ratio of the sum of two largest denominated banknotes to aggregate currency in circulation. The reason for taking two largest denominated banknotes is because some of the largest or second largest denominated banknotes came into existence during 2005-14 while some of them were withdrawn from the circulation. In this study, the data related to currency in circulation and M1 were taken from the International Monetary Fund (IMF). However, it is difficult to get denomination wise banknotes data from a single source like the IMF. We have compiled the denomination wise banknotes data from the annual reports of the respective country's central bank. Table A.2 reports the value of two largest denominated banknotes in terms of US dollar (USD) for each sample countries. It is revealed that almost one-third of the countries in our sample have the value of their largest denominated banknotes more than or equal to USD 100.

Regarding the controls to be included in our model, there is no broadly accepted theory of determinants of corruption that may guide the selection of those variables in the model. The control variables used in this study are income, government size, openness, inflation, internet and freedom of press.[7]

We use GDP per capita (*PCY*) as a measure of income. Data for GDP per capita (in logarithmic form) is adjusted for purchasing power parity and comes from the World Bank's World Development Indicators (WDI) database. Government size (*GOV*) is measured as the ratio of

[7] Initially we also took index for democracy as one of the controls, however, we had to drop it because of high correlation of around 0.93 with the freedom of press. The reason for dropping democracy, vis-à-vis freedom of press, is because of its inconsistent effect on corruption (Graf Lambsdorff, 2005).

general government final expenditure to GDP. The share of trade as a percentage of GDP is used as a measure of openness (*OPENNESS*). Inflation (*INFLATION*) is measured in terms of annual percentage change in consumer price index. Internet *(INTERNET)* is measured as number of internet users per 100 people. The data on government size, openness, inflation and internet also comes from the World Bank's WDI database.

Freedom House publishes data index for the freedom of the press (*PRESS*). The freedom of the press index ranks countries on a scale ranging from 0-100 where a lower value indicates free press and vice-versa. Table A.3 and A.4 provides summary statistics and correlation matrix for all the variables respectively.

3. Empirical Methodology

Static panel data model

Due to the lack of a strong theoretical framework for corruption, there is a lack of consensus on proper regression model for the analysis of corruption (Seldadyo & de Haan, 2006). Apart from pooled ordinary least square model (pooled OLS), the two most widely used techniques for panel data analysis is the fixed effects model and the random effect model. The fixed effect model assumes that the unobservable country-specific effects are fixed parameters to be estimated along with the coefficients of the model while the random effects model assumes the unobservable country-specific effects to be a random disturbance. Despite being used widely, the fixed effect model and the random effect models have their own advantages and limitations (Baltagi, 2008). To select between the fixed effect model and the random effect model, we rely on Hausman (1978) specification test to test the null hypothesis of no correlation between the regressors and the individual country-specific random effects. Hence, to analyze the impact of cash in circulation, both aggregate as well as large denominated banknotes, on the level of corruption, the functional form of the panel data model is as follows:

$$Corruption_{it} = \alpha + u_i + \beta CIC_{it} + \boldsymbol{\gamma X'}_{it} + \varepsilon_{it}; i\text{=number of countries, } t\text{=time period} \quad (1)$$

$$Corruption_{it} = \alpha + u_i + \beta LCIC_{it} + \boldsymbol{\gamma X'}_{it} + \varepsilon_{it}; i\text{=number of countries, } t\text{=time period} \quad (2)$$

Here $Corruption_{it}$ is control of corruption index *(CC)* and ICRG corruption index *(ICRG)*, CIC_{it} is the ratio of aggregate currency in circulation to narrow money, $LCIC_{it}$ is the ratio of large denominated banknotes to narrow money, $\boldsymbol{X'}_{it}$ is a vector of control variables, u_i indicates unobservable time-invariant country-specific effect that is not included in the model and ε_{it} is error term. Further, $u_i \sim IID\ (0, \sigma_u^2)$ and $\varepsilon_i \sim IID(0, \sigma_\varepsilon^2)$.

As we already mentioned about the inclusion of control variables in corruption study, there is no broadly accepted theory that may guide the selection of those variables in the model. However, the variable that has been found to be a robust and a consistent determinant of corruption is GDP per capita (Serra, 2006). It is found that with an increase in per capita GDP, corruption in a country tends to decrease (Bardhan, 1997).

The government size contributes to corruption by increasing bureaucracy and red tape and it can also lower corruption when a larger government is associated with greater check and balances (Elbahnasawy & Revier, 2012; Rose-Ackerman, 1999). Treisman (2001; 2007) argues that openness to trade is also an important determinant of corruption. He finds that greater openness to trade increases market competition, and it discourages rent-seeking behavior of corrupt officials by reducing the monopoly power of domestic producers. Inflation, measures by consumer price index, is also one of the robust predictors of corruption. It is found that countries with higher inflation have greater corruption (Treisman, 2007). Recent studies (Andersen, 2009; Goel, Nelson, & Naretta, 2012; Lio, Liu, & Ou, 2011) have tried to show whether internet uses have any impact on the level of corruption in a country. The findings suggest that increase in the internet uses do have capacity to reduce corruption, however, its full potential is yet to be realized. Furthermore, press freedom is also found to be significant determinants of corruption. It is found that better press freedom enhances transparency and elevates the risk of corrupt acts (Chowdhury, 2004; Freille, Haque, & Kneller, 2007; Serra, 2006; Treisman, 2007).

To select between the fixed effect model and random effect model, the Hausman test suggests using the fixed effect model in the case of *CC* as the dependent variable whereas using the random effect model in case the dependent variable is *ICRG* in the equation (1) and (2).

Dynamic panel data model

We have an additional concern that the corruption in a country may be highly persistent. Most of the studies related to cross-country determinants of corruption have used lagged dependent variable models to address serial correlation in corruption level (Chowdhury, 2004; Dreher & Siemers, 2009; Elbahnasawy, 2014; Lio et. al., 2011). Moreover, one of the limitations of the fixed effect model (the random effect model) is that it assumes exogeneity of all explanatory variables with the fixed (random) country effects. However, the disturbances contain unobservable, time-invariant, country effects that may be correlated with explanatory variables. Dynamic panel data method allows for such endogeneity by employing the instrumental variables technique (Baltagi, 2008). Following this, the functional form of dynamic panel data is written as:

$Corruption_{it} = \alpha + u_i + \beta CIC_{it} + \boldsymbol{\gamma X'}_{it} + \theta\ Corruption_{i(t-1)} + \varepsilon_{it}$; i=number of countries, t=time period (3)

$Corruption_{it} = \alpha + u_i + \beta LCIC_{it} + \boldsymbol{\gamma X'}_{it} + \theta\, Corruption_{i(t-1)} + \varepsilon_{it}$; i=number of countries, t=time period (4)

Where u_i is assumed to be random and independent of ε_{it} and that $u_i \sim IID\,(0, \sigma_u^2)$ and $\varepsilon_i \sim IID(0, \sigma_\varepsilon^2)$.

To estimate equation (3) and (4), Arellano & Bond (1991) have suggested a generalized method of moment (GMM) procedure in which the orthogonality conditions, that exist between the lagged dependent variable and the disturbances ε_{it}, is utilized to obtain additional instruments. The GMM estimator uses the lagged values of the endogenous explanatory variables as instruments to address the endogeneity problem. Using Arellano & Bond (1991) and Blundell & Bond (1998) GMM framework, we have applied a two-step system GMM[8] with robust standard error proposed by Windmeijer (2005) to estimate equation (3) and (4). As compared to one-step system-GMM, two-step system GMM is asymptotically more efficient.

4. Empirical Results

Preliminary results

To get a general idea of the relationship between corruption and cash in circulation, we plot the control of corruption index and measures of cash in circulation, both aggregate as well as large denominated, as shown in Figure 1. It shows the negative relation between control of corruption index and cash in circulation by using their averages over the period 2005-14. Figure 1 also reveals that most of the high and upper middle-income countries fall under upper-left part of the graph

[8] For estimating system GMM, we use the xtabond2 package in STATA developed by (Roodman, 2006).

indicating that these countries are characterized by low level of corruption and cash in circulation simultaneously. In contrast, most of lower middle-income countries fall under lower-right part of the graph, indicating that lower middle-income countries are experiencing a higher level of corruption and cash in circulation simultaneously.

<Figure 1: Scatter plot along with best linear fit of relation between corruption and cash in circulation >

Column (1) to (3) in Table 1 also provides the exact relation between corruption and cash in circulation through pooled OLS in the presence of all the controls. The coefficient of *CIC* and *LCIC* is around 0.61. It means that corruption in a country tends to increase almost in a similar way, in terms of absolute values, with an increase in *CIC* and *LCIC*. Adjusted R-squared also tends to increase from 0.81 to 0.83 as we move from no measure of cash in circulation to *LCIC* as a measure of cash in circulation. In column (4)-(6), we run a similar regression with *ICRG* as a dependent variable for robustness of our results. The coefficient of *CIC* (0.78) and *LCIC* (0.59) is also highly significant, however, the absolute values are different due to different scale range of *ICRG*. Adjusted R-squared also tends to increase from 0.71 to 0.73 as we move from no measure of cash in circulation to *LCIC* as a measure of cash in circulation. Apart from that, most of the controls in both equations are significant with expected sign of coefficients. However, we may not rely on pooled OLS result completely because of the presence of endogeneity between some of the explanatory variables and possible reverse causality between our variables of interest.

<Table 1: Estimation results of pooled OLS model >

Static panel data model

Table 2 presents the results of the static panel data models. Column (1)-(2) and column (3)-(4) present the estimation results with *CC* and *ICRG* as a measure of corruption respectively. Based on the robust Hausman test statistics, column (1)-(2) is estimated using the fixed effect model while column (3)-(4) is estimated using the random effect model. Heteroskedasticity-robust standard error is used to deal with heteroskedasticity. The sign of all the control variables confirm the findings of previous literature and significant at least in one of the specification at least the 10% level.

<Table 2: Estimation results of the static panel data model>

Using *CC* as a dependent variable in Table 2, GDP per capita is significant in each specification. It means that poor countries are more prone to corruption than the rich ones. A one percent increase in GDP per capita tends to increase the control of corruption index by around 0.26-0.36 unit in the presence of all the controls. Similarly, inflation is also coming out to be significant at least at 10% level in one of the specifications. It indicates that countries with high inflation also suffers from higher corruption. One of the controls which are highly significant consistently across all the specification is the internet uses. The result suggests that spread of internet have the potential to decrease the level of corruption in a country. Because spread of internet creates transparency by removing information asymmetry. Similarly, press freedom is also found to be consistently significant at least at 10% level. It means that an increase in press freedom tends to reduce the level of corruption in a country. Government size and trade openness are weakly significant in at least one of the specifications.

The sign of our main variables i.e. cash in circulation confirms our hypothesis to be true. *CIC* and *LCIC* are significant at least at 10% level. Interestingly, the impact of *CIC* is similar to that of *LCIC* probably because large banknotes cover a substantial portion of aggregate currency in terms of value. However, there is a difference in the magnitude of the impact. With *CC* as a dependent variable, one unit increase in *CIC* decreases the control of corruption index by 0.20 unit i.e. increases the perception of corruption in a country and vice-versa. In other words, frequent use of cash, rather than the electronic payment system which can be utilized only if one maintains a deposit account in a bank, in day-to-day transaction seems to increase the level of corruption in a country. Similarly, one unit increase in *LCIC* decreases the control of corruption index by 0.30 unit. In comparison to aggregate currency in circulation, the impact of large banknotes on the level of corruption seems to be relatively high. However, with *ICRG* as a dependent variable, *CIC* is significant whereas *LCIC* is insignificant.

Dynamic panel data model

Table 3 and 4 presents the results of dynamic panel data model by utilizing the two-step system GMM procedure with *CC* and *ICRG* as a measure of corruption respectively. In each case, columns (1) to (4) present results with different specifications. Columns (1) and (2) provide the results of simple two-step system GMM, while columns (3) and (4) present the results by collapsed instruments which is used to limit the number of instruments generated in system GMM and avoid bias in the results.[9]

<Table 3: Estimation results of the dynamic panel data model (Dependent variable- CC)>

<Table 4: Estimation results of the dynamic panel data model (Dependent variable- ICRG)>

[9] A large instrument collection, as happens in a system or difference GMM without *collapse*d instruments, overfits endogenous variables even as it weakens the Hansen test of the instruments' joint validity. For more details on the implementation of this technique see (Roodman, 2009).

Based on these alternative estimation options, our estimation results in terms of the direction of the coefficients remain almost same. The effect of the past level of corruption is statistically significant at 1% level with positive sign in all models. Therefore, corruption does seem to have inertia, and that part of present corruption attributes to its initial conditions significantly. The presence of lagged level of corruption in the explanatory variables reduces the magnitude of *CIC* and *LCIC* including controls significantly. Using *CC* as a dependent variable, one unit increase in the *CIC* significantly decreases the control of corruption index by 0.16-0.20 unit while the *LCIC* is insignificant in both cases. Whereas using *ICRG* as a dependent variable, one unit increase in the *CIC* significantly decreases the control of corruption index by 0.31-0.22 unit while one unit increase in *LCIC* significantly decreases the *ICRG* corruption index by 0.22-0.14 unit. Hence, we may conclude that increase in cash in corruption increases the level of corruption in a country even after taking care of endogeneity.

Among the controls, the effect of GDP per capita, government size, inflation, and freedom of press is statistically significant while openness and internet are statistically insignificant. However, the direction of the impact is more or less similar to the previous models.

Reverse causality

In some circumstances, it may happen that the prevalence of corruption in a country may pressurize the central bank to supply the desired amount of cash. To empirically investigate the causal relationship between cash in circulation, *CIC* as well as, *LCIC*, and corruption, we employ panel Granger causality test which utilizes both of the cross-sectional and time series data, and thus is more efficient than solely utilizing the time series data (Dumitrescu & Hurlin, 2012). Following Lio et al. (2011), we apply system GMM estimator (Arellano & Bond, 1991; Arellano & Bover, 1995;

Blundell & Bond, 1998) that employs an instrumental variables technique to estimate the autoregressive equations. The null hypothesis is that cash in circulation does not Granger cause corruption and vice-versa. Using the model and moment selection criteria (MMSC) for GMM estimation (Andrews & Lu, 2001), we calculate the MMSC Akaike information criteria (MMSC-AIC) and MMSC Bayesian information criteria (MMSC-BIC) to choose the optimal number of lags, and taking into consideration the limited number of time period, we use one to two lags for testing panel Granger causality based on measures of corruption and cash in circulation.[10]

<Table 5: Panel Granger causality test >

Table 5 presents the panel Granger causality results. The Wald tests for *CIC* and corruption show that the direction of causality is from *CIC* to corruption with appropriate lag. It means that *CIC* in past period lead to increase in corruption in the present period, not the other way around. Similarly, the Wald tests for *LCIC* and corruption shows the evidence of bi-directional causality. It means increase in *LCIC* in the past increases the current corruption. Also, past corruption increase the *LCIC*. We, therefore, conclude that easy availability of large banknotes facilitates corruption, and a corrupt environment could also sustain its availability, implying that the institutional environment of printing decisions of large banknotes could be an as yet unexamined determinant of corruption.

The presence of reverse causality may bias the estimation results based on pooled OLS and static panel data model, we have tried to solve this issue in the dynamic panel framework by applying

[10] The MMSC-AIC criterian selects the parameters and the instruments that minimizes the following formula: $MMSC - BIC = J_i - \log(N)(l_i - K_i)$; where J_i refers to the Sargan test statistics used to test the validy of over-identifying restrictions evaluated under the model i, K_i is the number of parameters to be estimated, l_i is the number of moment conditions under model i and N is sample size. Replacing $\log(N)$ with 2 in the above formula will give$MMSC - AIC$. The number of instruments is based on the *collapsed* instruments.

system GMM. However, the problem of reverse causality has to be addressed in a separate work that studies the impact of corruption on the cash in circulation.

5. Conclusion

In this paper, we examine whether cash in circulation affects the level of corruption in a country. The results suggest that the ratios of (i) aggregate currency in circulation to M1 and, (ii) large denominated banknotes to M1 are both statistically significant determinants of corruption across countries. Tests for reverse causality within a panel Granger framework reveal uni-directional causality of the corruption with the first variable, but a bi-directional one with the second variable. From policy perspective, we suggest that the government should evolve laws to prohibit cash transactions beyond a threshold level. Lastly, the central banks should also try to reduce the large denominated banknotes significantly, as evidence suggest that these are rarely used in legal transaction.

We stress that reducing the supply of large denominations could be a novel, relatively costless and practically implementable option to limit corruption. In this context, it may be noted that earlier studies almost invariably highlighted the important role of government in curbing corruption. However, implementation of government policies in this area typically involves huge amount of transaction cost. The results of Goel & Mehrotra (2012) extended the scope of relatively costless anti-corruption policies by highlighting the role of payment system. Our results extend the scope of these policies further by bringing to the fore the important role of cash and hence the role of the central bank in an economy in dealing with corruption.

A limitation in our study is that corrupt transactions may not always involve the domestic currency; it may also involve foreign currencies, commodities like gold, or changes in bank deposits maintained in another country. This observation limits the scope of changes in payment practices as a policy tool in fighting corruption unless such changes are carried out on a global scale along with other regulatory measures. Despite these limitations, we believe that unavailability of large banknotes will increase transaction cost of corruption substantially. In this context, an extension of the present study would be to examine the detailed institutional mechanism of printing banknotes of large denominations in a country and to test whether variables like central bank independence are influential in this context and can affect corruption in a country.

References

Abramo, C. W. (2008). How much do perceptions of corruption really tell us? *Economics: The Open-Access, Open-Assessment E-Journal*, *2*, 3.

Adhikari, A., & Bhatia, K. (2010). NREGA wage payments: Can we bank on the banks? *Economic and Political Weekly*, *45*(1), 30–37.

Aidt, T. S. (2003). Economic analysis of corruption: A survey. *The Economic Journal*, *113*(491), F632–F652. http://doi.org/10.1046/j.0013-0133.2003.00171.x

Andersen, T. B. (2009). E-Government as an anti-corruption strategy. *Information Economics and Policy*, *21*(3), 201–210. http://doi.org/10.1016/j.infoecopol.2008.11.003

Andrews, D. W. K., & Lu, B. (2001). Consistent model and moment selection procedures for GMM estimation with application to dynamic panel data models. *Journal of Econometrics*, *101*(1), 123–164. http://doi.org/10.1016/S0304-4076(00)00077-4

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic Studies*, *58*(2), 277–297. http://doi.org/10.2307/2297968

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, *68*(1), 29–51. http://doi.org/10.1016/0304-4076(94)01642-D

Baltagi, B. (2008). *Econometric analysis of panel data* (Vol. 1). John Wiley & Sons.

Bardhan, P. (1997). Corruption and development: A review of issues. *Journal of Economic Literature*, *35*(3), 1320–1346.

Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy*, *76*(2), 169–217.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, *87*(1), 115–143. http://doi.org/10.1016/S0304-4076 (98)00009-8

Chowdhury, S. K. (2004). The effect of democracy and press freedom on corruption: An empirical test. *Economics Letters*, *85*(1), 93–101. http://doi.org/10.1016/j.econlet.2004.03.024

Dreher, A., & Schneider, F. (2009). Corruption and the shadow economy: An empirical analysis. *Public Choice*, *144*(1-2), 215–238. http://doi.org/10.1007/s11127-009-9513-0

Dreher, A., & Siemers, L.-H. R. (2009). The nexus between corruption and capital account restrictions. *Public Choice*, *140*(1-2), 245–265. http://doi.org/10.1007/s11127-009-9423-1

Drehmann, M., Goodhart, C., & Krueger, M. (2002). The challenges facing currency usage: Will the traditional transaction medium be able to resist competition from the new technologies? *Economic Policy*, *17*(34), 193–228.

Dumitrescu, E.-I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, *29*(4), 1450–1460. http://doi.org/10.1016/j.econmod.2012.02.014

Elbahnasawy, N. G. (2014). E-Government, internet adoption, and corruption: An empirical investigation. *World Development*, *57*, 114–126. http://doi.org/10.1016/j.worlddev.2013.12.005

Elbahnasawy, N. G., & Revier, C. F. (2012). The determinants of corruption: Cross-country-panel-data analysis. *The Developing Economies*, *50*(4), 311–333. http://doi.org/10.1111/j.1746-1049.2012.00177.x

Freille, S., Haque, M. E., & Kneller, R. (2007). A contribution to the empirics of press freedom and corruption. *European Journal of Political Economy*, *23*(4), 838–862. http://doi.org/10.1016/j.ejpoleco.2007.03.002

Goel, R. K., & Mehrotra, A. N. (2012). Financial payment instruments and corruption. *Applied Financial Economics*, *22*(11), 877–886. http://doi.org/10.1080/09603107.2011.628295

Goel, R. K., Budak, J., & Rajh, E. (2013). Bureaucratic monopoly and the nature and timing of bribes: evidence from Croatian data. *Comparative Economic Studies*, *55*(1), 43–58. http://doi.org/10.1057/ces.2012.36

Goel, R. K., Nelson, M. A., & Naretta, M. A. (2012). The internet as an indicator of corruption awareness. *European Journal of Political Economy*, *28*(1), 64–75. http://doi.org/10.1016/j.ejpoleco.2011.08.003

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, *46*(6), 1251–1271. http://doi.org/10.2307/1913827

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2011). The worldwide governance indicators: methodology and analytical issues. *Hague Journal on the Rule of Law*, *3*(02), 220–246. http://doi.org/10.1017/S1876404511200046

Lio, M.-C., Liu, M.-C., & Ou, Y.-P. (2011). Can the internet reduce corruption? A cross-country study based on dynamic panel data models. *Government Information Quarterly*, *28*(1), 47–53. http://doi.org/10.1016/j.giq.2010.01.005

Muralidharan, K., Niehaus, P., & Sukhtankar, S. (2014). *Building state capacity: Evidence from biometric smartcards in India* (Working Paper No. 19999). National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w19999

Rogoff, K. (2002). The surprising popularity of paper currency. *Finance and Development*, *39*(1), 56–7.

Rogoff, K., Giavazzi, F., & Schneider, F. (1998). Blessing or curse? Foreign and underground demand for Euro notes. *Economic Policy*, *13*(26), 263–303.

Roodman, D. (2006). How to do xtabond2: An introduction to difference and system GMM in Stata. *Center for Global Development Working Paper*, (103). Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=982943

Roodman, D. (2009). A Note on the theme of too many instruments. *Oxford Bulletin of Economics and Statistics*, *71*(1), 135–158. http://doi.org/10.1111/j.1468-0084.2008.00542.x

Rose-Ackerman, S. (1999). *Corruption and government: Causes, consequences, and reform*. Cambridge University Press.

Schaffer, M. E., & Stillman, S. (2011). XTOVERID: Stata module to calculate tests of overidentifying restrictions after xtreg, xtivreg, xtivreg2, xthtaylor. *Statistical Software Components*. Retrieved from https://ideas.repec.org/c/boc/bocode/s456779.html

Schneider, F., & Enste, D. H. (2000). Shadow economies: Size, causes, and consequences. *Journal of Economic Literature*, *38*(1), 77–114.

Seldadyo, H., & de Haan, J. (2006). The determinants of corruption: A literature survey and new evidence, Working paper. *University of Groningen*.

Serra, D. (2006). Empirical determinants of corruption: A sensitivity analysis. *Public Choice*, *126*(1-2), 225–256.

Svensson, J. (2005). Eight questions about corruption. *The Journal of Economic Perspectives*, *19*(3), 19–42.

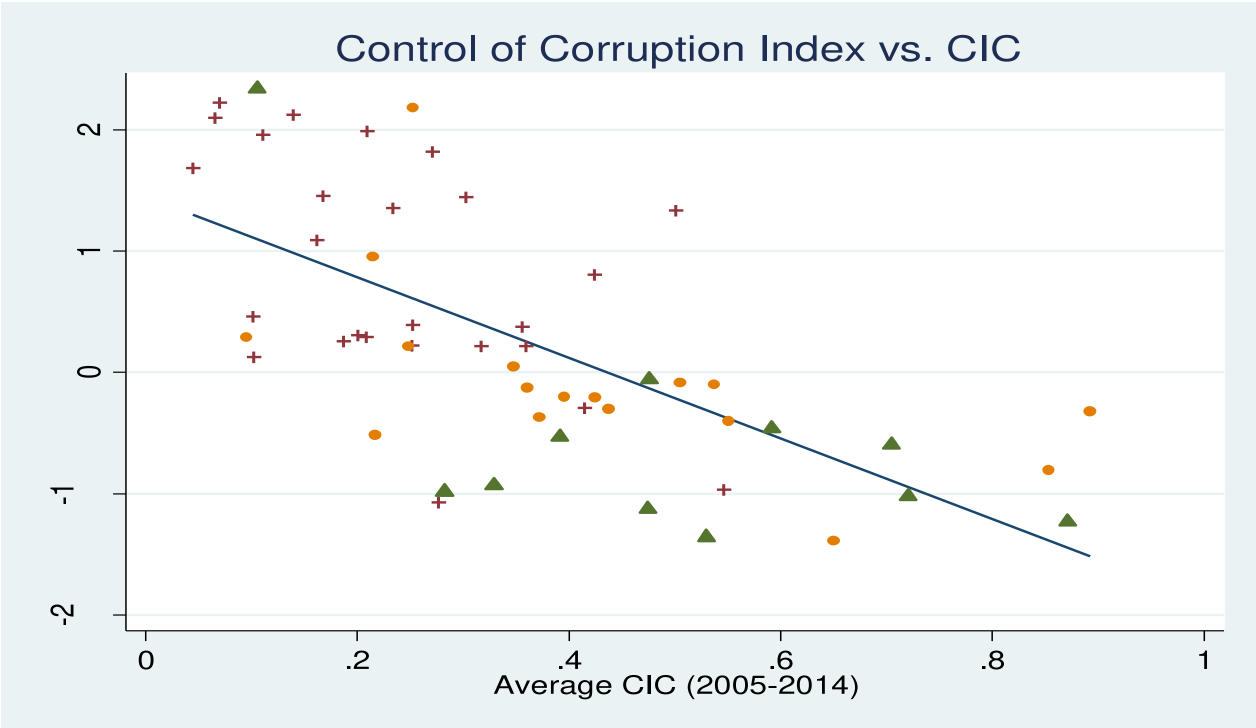
Tanzi, M. V., & Davoodi, M. H. R. (1997). *Corruption, public Investment, and growth*. International Monetary Fund.

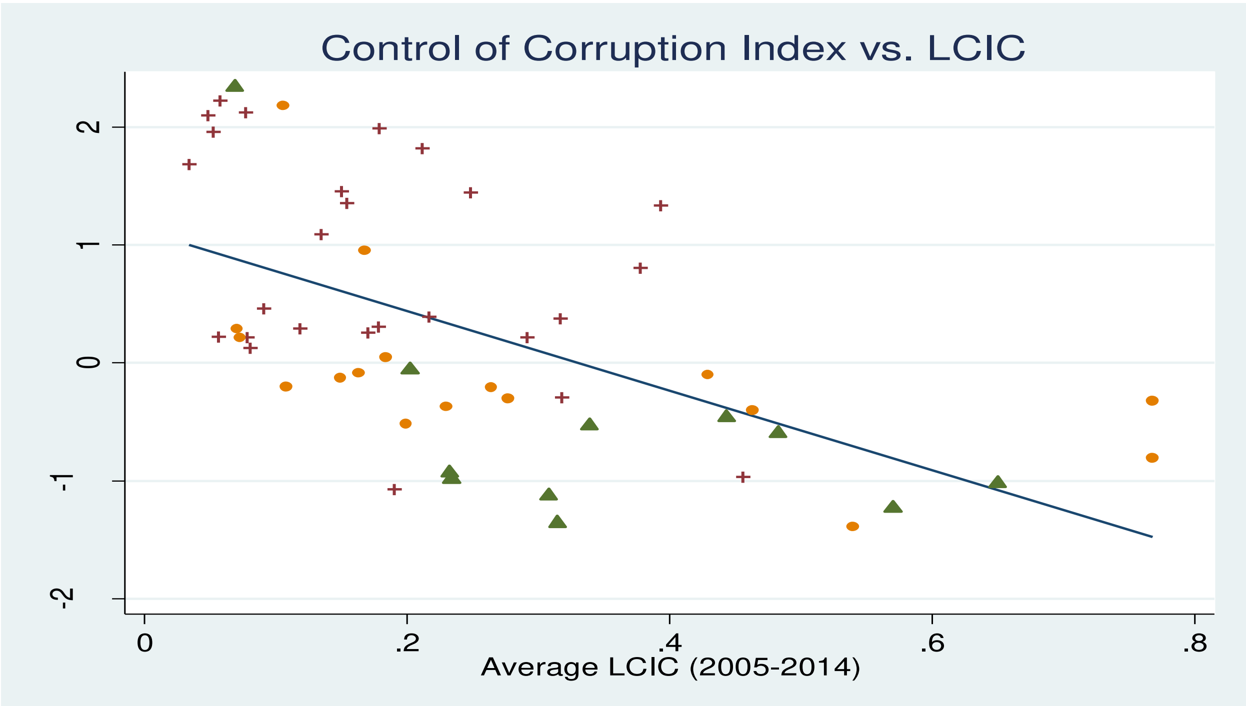
Treisman, D. (2000). The causes of corruption: A cross-national study. *Journal of Public Economics*, *76*(3), 399–457. http://doi.org/10.1016/S0047-2727 (99)00092-4

Treisman, D. (2007). What have we learned about the causes of corruption from ten years of cross-national empirical research? *Annual Review of Political Science*, *10*(1), 211–244. http://doi.org/10.1146/annurev.polisci.10.081205.095418

Windmeijer, F. (2005). A finite sample correction for the variance of linear efficient two-step GMM estimators. *Journal of Econometrics*, *126*(1), 25–51. http://doi.org/10.1016/j.jeconom.2004.02.005

Figure 1. Scatter plot along with best linear fit of relation between corruption and cash in circulation





Notes: Here +=high income, ●=upper middle income, ▲=lower middle income.

Table 1. Estimation results of pooled OLS

	Dependent Variable - CC			Dependent Variable - ICRG		
	(1)	(2)	(3)	(4)	(5)	(6)
CIC		-0.614***			-0.775***	
		(-7.34)			(-6.11)	
LCIC			-0.609***			-0.584***
			(-5.70)			(-3.88)
PCY	0.508***	0.476***	0.498***	0.489***	0.464***	0.481***
	(20.38)	(18.97)	(19.42)	(12.33)	(11.65)	(11.58)
GOV	-0.019***	-0.018***	-0.017***	-0.027***	-0.028***	-0.028***
	(-4.41)	(-4.17)	(-3.97)	(-3.80)	(-4.01)	(-3.80)
INFLATION	-0.006	-0.005	-0.004	-0.013***	-0.011**	-0.011**
	(-1.56)	(-1.30)	(-1.12)	(-2.65)	(-2.20)	(-2.14)
OPENNESS	0.002***	0.002***	0.002***	0.000	0.000	0.000
	(5.19)	(5.60)	(5.31)	(0.74)	(0.75)	(0.50)
INTERNET	0.001	0.001	0.001	0.005***	0.004**	0.005***
	(1.04)	(0.42)	(0.89)	(2.93)	(2.22)	(2.71)
PRESS	-0.015***	-0.014***	-0.014***	-0.015***	-0.014***	-0.015***
	(-13.85)	(-13.15)	(-13.75)	(-11.51)	(-10.33)	(-10.32)
CONSTANT	-3.454***	-3.012***	-3.307***	-0.651**	-0.173	-0.461
	(-14.48)	(-12.66)	(-13.70)	(-2.01)	(-0.54)	(-1.32)
R-Squared	0.81	0.83	0.83	0.72	0.73	0.73
F Statistics	466.59	417.47	414.28	248.30	221.01	204.68
No. of Observations	508.00	504.00	488.00	478.00	476.00	460.00

Notes: *, ** and *** indicates statistically significant at 10%, 5% and 1% respectively. Figures in parenthesis are their respective t-statistics with robust standard error.

Table 2. Estimation results of static panel data model

	Dependent Variable- CC		Dependent Variable- ICRG	
	Fixed effect	Fixed effect	Random effect	Random effect
	(1)	(2)	(3)	(4)
CIC	-0.198***		-0.365**	
	(-2.64)		(-2.01)	
LCIC		-0.299**		-0.305
		(-1.99)		(-0.79)
PCY	0.266*	0.362**	0.392***	0.413***
	(1.75)	(2.20)	(6.20)	(6.15)
GOV	0.007	0.009*	0.026	0.023
	(1.50)	(1.91)	(1.59)	(1.39)
INFLATION	-0.003**	-0.002*	-0.005	-0.005
	(-2.39)	(-1.75)	(-1.12)	(-1.12)
OPENNESS	-0.000	-0.000	0.002*	0.001
	(-0.08)	(-0.16)	(1.86)	(1.34)
INTERNET	0.003**	0.003**	0.004*	0.005*
	(2.45)	(2.33)	(1.67)	(1.90)
PRESS	-0.002	-0.002	-0.008**	-0.007*
	(-1.14)	(-1.15)	(-2.28)	(-1.67)
CONSTANT	-1.853	-2.735*	-1.199	-1.515
	(-1.42)	(-1.91)	(-1.36)	(-1.61)
R-Squared (Within)	0.11	0.11	0.12	0.1
R-Squared (Overall)	0.75	0.75	0.69	0.68
F Statistics (p-value)	4.82	5.83	17.14	13.47
Robust Hausman Test (p-value)	0	0	0.07	0.10
No. of Countries	54	54	51	51
No. of Observations	504.00	488.00	476.00	460.00

Notes: *, ** and *** indicates statistically significant at 10%, 5% and 1% respectively. Figures in parenthesis are their respective t-statistics with robust standard error clustered by country. Robust Hausman test is based on Schaffer & Stillman (2011) user written command in **xtoverid** which is recommended when robust standard error is used in panel data.

Table 3. Estimation results of the dynamic panel data model

	Dependent Variable- CC			
	Two-step Sys-GMM		Two-step Sys-GMM (CL)	
	(1)	(2)	(3)	(4)
CC(-1)	0.743***	0.792***	0.667***	0.728***
	(6.13)	(7.41)	(4.54)	(5.08)
CIC	-0.157*		-0.198*	
	(-1.71)		(-2.03)	
LCIC		-0.077		-0.116
		(-0.86)		(-1.03)
PCY	0.117*	0.095*	0.166*	0.143
	(1.84)	(1.69)	(1.96)	(1.66)
GOV	-0.006*	-0.006*	-0.008**	-0.008*
	(-1.94)	(-1.71)	(-2.31)	(-1.89)
INFLATION	-0.003**	-0.003**	-0.003***	-0.003**
	(-2.44)	(-2.57)	(-2.70)	(-2.25)
OPENNESS	0.000	0.000	0.000	0.000
	(1.01)	(0.52)	(1.43)	(0.99)
INTERNET	0.000	0.001	0.000	0.001
	(0.36)	(0.99)	(0.07)	(0.75)
PRESS	-0.003*	-0.003	-0.004**	-0.003*
	(-1.91)	(-1.66)	(-2.34)	(-1.90)
CONSTANT	-0.709*	-0.604	-1.030*	-0.959
	(-1.69)	(-1.54)	(-1.79)	(-1.52)
F Statistics	1054.23	890.87	1156.70	841.49
Hansen Test (p-value)	0.34	0.29	0.54	0.38
AR(2) (p-value)	0.15	0.14	0.18	0.15
No. of Instruments	28	28	18	18
No. of Countries	54	54	54	54
No. of Observations	454.00	442.00	454.00	442.00

Notes: *, ** and *** indicates statistically significant at 10%, 5% and 1% respectively. Figures in parenthesis are their respective t-statistics with Windmeijer-corrected cluster-robust standard error. CL denotes two-step system GMM estimation with collapse instruments. The row for the Hansen test reports the *p*-values for the null hypothesis of instrument validity. The values reported for AR(2) are the *p*-values for second order autocorrelated disturbances in the first differences equations.

Table 4. Estimation results of the dynamic panel data model

	Dependent Variable- ICRG			
	(1)	(2)	(3)	(4)
ICRG(-1)	0.796***	0.822***	0.822***	0.862***
	(11.01)	(12.41)	(8.40)	(10.78)
CIC	-0.307***		-0.224**	
	(-3.40)		(-2.10)	
LCIC		-0.218**		-0.142*
		(-2.07)		(-1.78)
PCY	0.101**	0.093**	0.091*	0.070
	(2.59)	(2.39)	(1.79)	(1.63)
GOV	-0.006	-0.004	-0.006	-0.004
	(-1.38)	(-1.14)	(-1.34)	(-1.10)
INFLATION	-0.005**	-0.005*	-0.005*	-0.005*
	(-1.99)	(-1.71)	(-1.93)	(-1.84)
OPENNESS	0.000	0.000	0.000	0.000
	(0.21)	(0.38)	(0.68)	(0.76)
INTERNET	-0.000	-0.000	-0.001	-0.001
	(-0.33)	(-0.15)	(-0.96)	(-1.02)
PRESS	-0.003*	-0.003	-0.003*	-0.003*
	(-1.91)	(-1.66)	(-1.86)	(-1.88)
CONSTANT	0.048	-0.042	0.041	0.040
	(0.24)	(-0.17)	(0.28)	(0.25)
F Statistics	385.10	428.41	846.48	1013.35
Hansen Test (p-value)	0.29	0.24	0.33	0.29
AR(2) (p-value)	0.54	0.58	0.52	0.56
No. of Instruments	43	43	16	16
No. of Countries	51	51	51	51
No. of Observations	427.00	415.00	427.00	415.00

Notes: *, ** and *** indicates statistically significant at 10%, 5% and 1% respectively. Figures in parenthesis are their respective t-statistics with Windmeijer-corrected cluster-robust standard error. CL denotes two-step system GMM estimation with collapse instruments. The row for the Hansen test reports the *p*-values for the null hypothesis of instrument validity. The values reported for AR(2) are the *p*-values for second order autocorrelated disturbances in the first differences equations.

Table 5: Panel Granger causality test

Direction of Causality	Lags	Joint Significance	Sum of Coefficients	MMSC-AIC	MMSC-BIC	No. of Observations	No. of Countries
CIC→CC	[1/2]	4.54*	-2.13*	-4.36	-16.56	432	54
CC →CIC	[2/2]	1.39	-1.09	-3.98	-20.20	427	54
LCIC→CC	[1/1]	6.16**	-2.48**	-3.14	-11.45	472	54
CC→LCIC	[2/2]	8.12**	-1.47	-7.55	-39.65	409	54
CIC→ICRG	[1/1]	6.09**	-2.47**	-3.00	-11.25	458	51
ICRG →CIC	[1/1]	1.61	-1.27	-3.89	-12.13	455	51
LCIC→ICRG	[1/2]	3.78*	-1.94*	-2.79	-14.70	392	51
ICRG→LCIC	[2/1]	3.98**	-1.98**	-0.81	-12.67	386	51

Notes: ***, **&* denote significant at 1%, 5% & 10% level respectively. We have tested lags [1/1], [1/2], [2/1] and [2/2] and presented the best model based on the minimum value of MMSC-AIC and MMSC-BIC. The test statistics for joint significance follow the Chi-square distribution. The test statistics for the test of sum of coefficients follow the z distribution if the lag length is one, and in other cases it follow the Chi-square distribution.

Appendix A

Table A.1. List of sample countries

Australia (HI)	Ghana (LMI)	Malaysia (UMI)	South Africa (UMI)
Azerbaijan, Republic of (UMI)	Hong Kong SAR (HI)	Mexico (UMI)	Sudan (LMI)
Bahamas (HI)	Hungary (HI)	Namibia (UMI)	Sweden (HI)
Bahrain (HI)	India (LMI)	New Zealand (HI)	Switzerland (HI)
Bosnia and Herzegovina (UMI)	Iraq (UMI)	Nigeria (LMI)	Thailand (UMI)
Botswana (UMI)	Israel (HI)	Norway (HI)	Tunisia (UMI)
Brazil (UMI)	Jamaica (UMI)	Oman (HI)	Turkey (UMI)
Bulgaria (UMI)	Japan (HI)	Pakistan (LMI)	UAE (HI)
Canada (HI)	Kenya (LMI)	Poland (HI)	UK (HI)
Chile (HI)	Korea (HI)	Romania (UMI)	USA (HI)
China (UMI)	Kuwait (HI)	Russia (HI)	Yemen ((LMI)
Congo Republic (LMI)	Kyrgyzstan (LMI)	Saudi Arabia (HI)	Zambia (LMI)
Czech Republic (HI)	Latvia (HI)	Serbia (UMI)	
Egypt (LMI)	Lithuania (HI)	Singapore (HI)	

Notes: Here HI=High Income, UMI=Upper Middle Income, LMI=Lower Middle Income.

Table A.2. Values of large banknotes (in local currency and US dollar)

Country	D1	D2	D1*	D2*	Country	D1	D2	D1*	D2*
Australia	AUD 100	AUD 50	74.63	37.31	Lithuania	LTL 500	LTL 200	160.77	64.31
Azerbaijan, Republic of	AZN 100	AZN 50	95.24	47.62	Malaysia	MYR 500	MYR 100	131.58	26.32
Bahamas	BSD 100	BSD 50	100.00	50.00	Mexico	MXN 1000	MXN 500	63.53	31.77
Bahrain	BHD 20	BHD 10	52.63	26.32	Namibia	NAD 200	NAD 100	16.10	8.05
Bosnia and Herzegovina	KM 200	KM 100	113.64	56.82	New Zealand	NZD 100	NZD 50	67.11	33.56
Botswana	BWP 200	BWP 100	19.92	9.96	Nigeria	NGN 1000	NGN 500	5.04	2.52
Brazil	BRL 100	BRL 50	31.35	15.67	Norway	NOK 1000	NOK 500	122.55	61.27
Bulgaria	BGN 100	BGN 50	56.82	28.41	Oman	OMR 200	OMR 100	526.32	263.16
Canada	CAD 1000	CAD 100	781.25	78.13	Pakistan	PKR 5000	PKR 1000	49.14	9.83
Chile	CLP 20000	CLP 10000	30.95	15.48	Poland	PLN 200	PLN 100	53.33	26.67
China	RMB 100	RMB 50	16.37	8.18	Romania	RON 500	RON 200	124.07	49.63
Congo Republic	FC 500, 2000 & 5000	FC 200	0.54	0.22	Russia	RUB 5000	RUB 1000	88.32	17.66
Czech Republic	CZK 5000	CZK 2000	203.92	81.57	Saudi Arabia	SAR 500	SAR 200	133.33	53.33
Egypt	EGP 200	EGP 100	25.54	12.77	Serbia	RSD 5000	RSD 1000	46.16	9.23
Ghana	GH 50	GH 20	14.49	5.80	Singapore	SGD 10000	SGD 1000	7407.41	740.74
Hong Kong SAR	HKD 1000	HKD 500	128.53	64.27	South Africa	ZAR 200	ZAR 100	16.01	8.01
Hungary	HUF 20000	HUF 10000	71.32	35.66	Sudan	SDG 50	SDG 20	8.71	3.48
India	INR 1000	INR 500	15.76	7.88	Sweden	SEK 1000	SEK 500	118.91	59.45
Iraq	IQD 25000	IQD 10000	20.72	8.29	Switzerland	CHF 1000	CHF 500	1052.63	526.32
Israel	ILS 200	ILS 100	52.91	26.46	Thailand	B 1000	B 500	29.43	14.71
Jamaica	JMD 5000	JMD 1000	42.85	8.57	Tunisia	D 50	D 20	25.38	10.15
Japan	JPY 10000	JPY 5000	81.63	40.82	Turkey	TRY 200	TRY 100	74.91	37.45
Kenya	KES 1000	KES 500	9.93	4.97	UAE	AED 1000	AED 500	272.48	136.24
Korea	KRW 50000	KRW 10000	44.25	8.85	UK	GBP 50	GBP 20	78.13	31.25
Kuwait	KWD 100	KWD 50	333.33	166.67	USA	USD 100	USD 50	100.00	50.00
Kyrgyzstan	KGS 5000	KGS 1000	79.66	15.93	Yemen	YR 1000	YR 500	4.66	2.33
Latvia	LVL 500	LVL 100	781.25	156.25	Zambia	K 50000	K 20000	9.62	3.85

Source: http://www.xe.com/currencyconverter/ and each country's central bank website. Exchange rate per USD is taken as average of 2014.
Notes: Here D1= Largest denomination currency in local currency unit, D2= Second largest denomination currency in local currency unit. D1*= Largest denomination currency in USD, D2*= Second largest denomination currency in USD.

Table A.3. Summary statistics of the variables included in the study

Variable	No. of Observations	Mean	Standard Deviation	Minimum	Maximum
Control of Corruption Index	540	0.27	1.06	-1.58	2.46
ICRG Corruption Index	509	2.80	1.17	0.50	5.50
Currency in Circulation to M1 (Share)	535	0.35	0.22	0.01	1.02
Large banknotes to M1 (Share)	519	0.25	0.18	0.02	0.81
Log of GDP per Capita	538	8.84	1.37	6.17	11.14
Government Size	521	16.06	4.48	2.80	27.51
Inflation	529	5.54	5.56	-10.07	53.23
Openness	529	96.48	70.76	19.12	455.28
Internet	537	43.87	27.85	0.90	96.30
Freedom of Press	540	44.92	22.97	10.00	87.00

Table A.4. The correlation matrix for the variables under study

	CC	*ICRG*	*CIC*	*LCIC*	*GDP*	*GOV*	*OPENNESS*	*INFLATION*	*INTERNET*	*PRESS*
CC	1									
ICRG	0.931	1								
CIC	-0.630	-0.571	1							
LCIC	-0.559	-0.470	0.884	1						
PCY	0.854	0.765	-0.584	-0.511	1					
GOV	0.183	0.238	-0.171	-0.137	0.262	1				
OPENNESS	0.278	0.200	-0.071	-0.112	0.240	-0.235	1			
INFLATION	-0.504	-0.486	0.378	0.347	-0.561	-0.236	-0.175	1		
INTERNET	0.731	0.696	-0.539	-0.452	0.822	0.214	0.202	-0.523	1	
PRESS	-0.632	-0.592	0.459	0.425	-0.489	-0.361	0.064	0.285	-0.448	1

Note: All the correlation coefficients are significant at 1% level.