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)

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

By

Sunny Kumar Singh[*a]

Kaushik Bhattacharya[b]

Using annual panel data of 54 countries for the period 2005-13, we examine whether cash in circulation, both aggregate and large denominated banknotes, affects the level of corruption in a country. Standard panel data models like pooled OLS, random effect and system GMM 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 unidirectional causality of the first variable with corruption, but a bi-directional one with the second variable. These findings suggest that the central banks should try to limit the supply of banknotes of large denomination.

Keywords: Control of corruption Index**,** Cash in circulation, Random effect model, System GMM

JEL Classification: D73, E51

[*] Corresponding author. Email: sunnysingh.econ@gmail.com

[a] Doctoral Student, Indian Institute of Management, IIM Road, Lucknow-226 013, India, Email: sunnysingh.econ@gmail.com

[b] Professor of Economics, Business Environment Area, Indian Institute of Management, IIM Road, Lucknow-226 013, India. kbhattacharya@iiml.ac.in

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1. Introduction

There are many studies in 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 categorised into various economic, socio-cultural and political factors. In most of these studies, economic factors taken 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 central bank and payment system. 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 may bring quick results. While rigorous academic studies on 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

[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

that the government should withdraw or avoid printing large denominated banknotes from circulation and simultaneously promote larger transaction via electronic payment system.[2]

In a recent study, Goel & Mehrotra (2012) have attempted to relate corruption to measures relating to 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 prevalence of corruption. However, the scope of their study is limited because it covers only 12 advanced economies for the period 2004-08.

In this paper, we 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). 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 M1 is a statistically significant explanatory variable of corruption across countries. Second, we test

(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)

[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/

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 empirical results. Section 5 concludes the paper.

2. Data

Our sample consists of 54 countries covering the period 2005-2013. Our choice of countries is 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 (26), upper middle (17) and lower income (11) countries.[3] The list of sample countries along with their income group is provided in Table A.1 in Appendix A.

Corruption is a variable that cannot be measured directly. However there are a number of indices that measure perceived, rather than actual, level of corruption in a country. This paper uses the Control of Corruption Index (*CC*) published by the World Bank's Worldwide Governance Indicators as a measure of corruption. In comparison to the Transparency International's Corruption Perception Index (CPI), it is more suitable when it comes to cross-country and over-time

[3] 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.

comparison (Kaufmann, Kraay, & Mastruzzi, 2011).[4] 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.

We take the ratio of aggregate currency in circulation to narrow money (*CIC*) as well as large denominated banknotes to narrow money (*LCIC*) as a measure of cash in circulation. Here narrow money is taken as M1 which is the sum of total currency and demand deposits. We define large denominated banknotes as the sum of two largest denominated banknotes. The reason for taking sum of two largest denominated banknotes is because some of the largest or second largest denominated banknotes came into existence during 2005-13 while some of them withdrawn from the circulation. The data related to currency in circulation and M1 comes from the International Monetary Fund (IMF). However it is difficult to get denomination wise banknotes data from a single source like IMF. We have compiled the denomination wise banknotes data from the annual reports of the respective country's central bank. Table A.1 reports the value of two largest denominated banknotes in terms of US dollar (USD) for each sample countries. Table A.1 reveal 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

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[4] 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

variables used in this study are income, government size, openness, inflation, democracy and freedom of press.

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 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 consumer price index (CPI) in term of percentage. The data on government size, openness and inflation also comes from the World Bank's WDI database.

Freedom House (FH) publishes data on democracy (*DEMOCRACY*) and press freedom (*PRESS*). Democratic index of (FH) is based on two dimensions namely civil liberties and political rights. The range of each dimension varies between 0-7 where lower value represents better civil liberties and higher political rights. We use the average of civil liberties and political rights as a measures of democracy wherein lower value indicates more democratic country and vice-versa. The freedom of the press index ranks countries on a scale ranging from 0-100 where lower value indicates free press and vice-versa. Table A.2 and A.3 provides summary statistics and correlation matrix for all the variables.

3. Empirical Methodology

Random effect 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 using pooled ordinary least square model (pooled OLS), we use the random effect model, rather than fixed effect model, for the analysis of determinants of corruption in panel framework. According to Baltagi (2008), there are too many parameters in the fixed effect model which might exacerbate the multicollinearity problem among explanatory variables that leads to a loss of degree of freedom. Furthermore, the random effect estimator are believed to be more efficient than the fixed effects estimator when N (number of countries) is large and T (number of years) is small. Hence we estimate the following benchmark random effects panel data model to see the impact of cash in circulation, both aggregate as well as large denominated banknotes, on the level of corruption:

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

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

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

As we already mentioned about 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 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, measured as the ratio of trade (sum of export and import) to GDP, is also a determinant of corruption. He finds that greater openness to trade increases market competition and it discourages rent seeking behaviour of corrupt officials by reducing the monopoly power of domestic producers. Inflation, measures by consumer price index (CPI), is also one of the robust predictor of corruption (Treisman, 2007). It is found that countries with higher inflation have greater corruption. Besides these, democracy and press freedom are 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), while the impact of democracy on corruption have been found to be mixed (Graf Lambsdorff, 2005).

To test the suitability of random effect model in our case, we utilize the Breusch-Pagan Lagrange multiplier (LM) test which is significant at 1% level.

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, Liu, & Ou, 2011). Moreover, one of the limitations of the random effect model is that it assumes exogeneity of all explanatory variables with the 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 endogenity by employing the instrumental variables technique (Baltagi, 2008). Following this, the functional form of dynamic panel data is written as:

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

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

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[5] 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.

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

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 2005-13. Figure 1 also reveals that most of the high and upper middle income countries fall under upper-left part of graph indicating that these countries are characterized by low level of corruption and cash in circulation. Whereas most of lower middle income countries fall under lower-right part of the graph. This indicates that lower middle income countries are witnessing higher corruption and cash in circulation simultaneously.

<Figure 1 here>

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 0.72 and 0.81 respectively. It means that corruption in a country tends to increase more with increase in *LCIC* as compared to *CIC*. Adjusted R-squared also tends to increase from 0.80 to 0.84 as we move from no measure of cash in circulation to *LCIC* as measure of cash in circulation. However we may not rely on pooled OLS result completely because of the presence of endogeity between some of the explanatory variables and possible reverse causality between our variables of interest.

<Table 1 here>

Random effect model

Table 2 presents the results of the cross-section random effects panel data models. Column (1) to (3) presents the estimation results with and without measures of cash in circulation. Heteroskedasticity-robust standard error is used to deal with Heteroskedasticity. The sign of all the control variables confirm the findings of previous literature.

<Table 2 here>

GDP per capita comes out as significant at 1% level in all models. It means that rich countries are perceived to have lower corruption than the poor ones. A one percent increase in GDP per capita tends to increase the control of corruption index by around 0.15 unit in the presence of all the controls. Similarly, inflation and democracy index is coming out to be significant at least at 5% level. It indicates that countries with high inflation also suffers from higher corruption whereas a more democratic country experience lower level of corruption. Likewise, openness and freedom of press index is weakly significant at 10% level. It means country with more openness to trade and free press suffers lower level of corruption and vice-versa. However, government size is coming out to be insignificant in our model.

The sign of our main variables i.e. cash in circulation confirm our hypothesis to be true. The ratio of aggregate currency in circulation and large denominated banknotes to narrow money is coming out to be significant at least at 5% level. Interestingly, the impact of aggregate currency in circulation is similar to that of large denominated banknotes probably because large banknotes cover a substantial portion of aggregate currency in terms of value. However, there is difference in the magnitude of the impact. One unit increase in the *CIC* decreases the control of corruption index by 0.187 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 level of corruption in country. Similarly, a unit in the *LCIC* decreases the control of corruption index by 0.475 unit. In comparison to aggregate cash, the impact of large banknotes on the level of corruption seems to be quite high.

Dynamic panel data model

Table 3 presents the results of dynamic panel data model by utilizing the two-step system GMM procedure. Column (1) to (4) presents results with different specifications. Columns (1) and (2) reveal the results of simple two-step system GMM, while columns (3) and (4) present results by collapsed instruments which is used to limit the number of instruments generated in system GMM and avoid bias in the results.[6] Implementing the collapsing technique reduces the instrument count from 50 in columns (1) and (2) to 14 in columns (3) and (4).

<Table 3 here>

Based on these alternative estimation options, our estimation results in terms of 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. One unit increase in the *CIC* decreases the control of corruption

[6] 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).

index by 0.07-0.11 unit while a unit increase in the *LCIC* decreases the control of corruption index by 0.08-0.14 unit. It means that increase in cash in corruption increases the level of corruption in a country even if we have taken care the issue of endogeniety.

Among the controls, the effect of GDP per capita, inflation and government size is statistically significant while democracy, freedom of press and openness is statistically insignificant. The direction of the impact is similar to the results from random effect model.

Reverse causality

In some circumstances it may happen that the prevalence of corruption in a country may pressurize the central bank to supply desired amount of cash. Therefore we check the possibility of reverse causality by employing panel Granger causality test which utilizes both of the cross-sectional and time-series data (Dumitrescu & Hurlin, 2012). Results in Table 4 reveal that at 10.0 % level of significance, there is one-way causality from *CIC* to CC. However, in case of *LCIC*, the causality is bi-directional at 1% level of significance. We conclude that easy availability of large banknotes facilitate 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.

<Table 4 here>

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 aggregate currency in circulation and large denominated banknotes to narrow money are both statistically significant determinants of corruption across countries. From the policy perspective, it is suggested 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 which is hardly used by the common people.

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. An extension of 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.

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Appendix 1

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

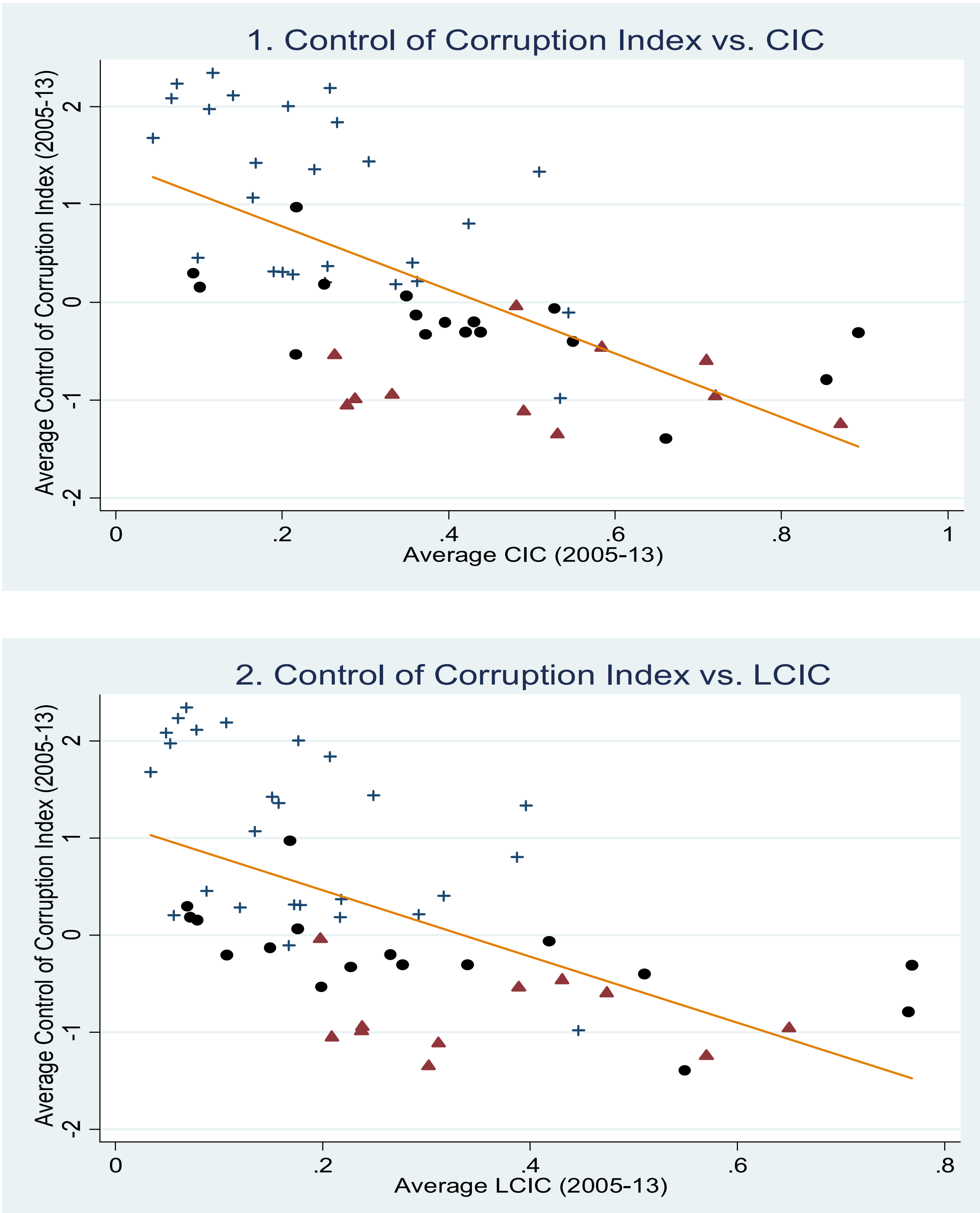
Variable	*No. of Observations*	*Mean*	*Standard Deviation*	*Minimum*	*Maximum*
Control of Corruption Index	486	0.277	1.057	-1.576	2.462
Currency in Circulation to M1 (Share)	486	0.354	0.218	0.044	1.017
Large banknotes to M1 (Share)	472	0.252	0.180	0.033	0.812
Log of GDP per Capita	485	8.840	1.367	6.167	11.143
Government Size	471	15.910	4.689	2.8	27.08
Openness	479	96.373	70.798	22.14	455.28
Inflation	477	5.700	5.520	-10.07	53.23
Democracy	486	3.091	1.915	1	7
Freedom of Press	486	44.549	22.887	10	87

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

	CC	*CIC*	*LCIC*	*PCY*	*GOV*	*OPENNESS*	*INF*	*DEMOCRACY*	*PRESS*
CC	1								
CIC	-0.622	1							
LCIC	-0.571	0.870	1						
PCY	0.841	-0.555	-0.507	1					
GOV	0.192	-0.178	-0.119	0.263	1				
OPENNESS	0.266	-0.050	-0.096	0.227	-0.243	1			
INF	-0.512	0.369	0.355	-0.564	-0.204	-0.161	1		
DEMOCRACY	-0.611	0.453	0.399	-0.455	-0.367	0.114	0.296	1	
PRESS	-0.632	0.455	0.405	-0.486	-0.365	0.073	0.289	0.932	1

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

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 model (Dependent variable- CC)

	Pooled OLS		
	(1)	*(2)*	*(3)*
CIC		-0.720***	
		(-7.40)	
LCIC			-0.809***
			(-6.66)
PCY	0.503***	0.455***	0.482***
	(20.41)	(18.08)	(19.11)
GOV	-0.017***	-0.015***	-0.014***
	(-3.48)	(-3.31)	(-2.99)
OPENNESS	-0.009**	-0.007*	-0.006
	(-1.99)	(-1.74)	(-1.63)
INFLATION	0.002***	0.002***	0.002***
	(5.55)	(5.93)	(5.74)
DEMOCRACY	-0.085**	-0.073**	-0.068*
	(-2.33)	(-2.09)	(-1.94)
PRESS	-0.009***	-0.009***	-0.009***
	(-2.88)	(-2.86)	(-3.05)
Constant	-3.370***	-2.807***	-3.101***
	(-12.41)	(-10.03)	(-11.01)
Adj. R-squared	0.800	0.823	0.84
F Statistics	385.3	360.31	365.46
N	462	462	448

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 the random effects panel data model (Dependent variable- CC)

	Random Effect Model		
	(1)	*(2)*	*(3)*
CIC		-0.187**	
		(-1.99)	
LCIC			-0.475***
			(-3.17)
PCY	0.145***	0.140***	0.149***
	(5.65)	(5.37)	(5.78)
GOV	0.003	0.003	0.005
	(0.64)	(0.71)	(1.11)
OPENNESS	0.001*	0.001*	0.001*
	(1.68)	(1.81)	(1.82)
INFLATION	-0.004**	-0.004**	-0.003*
	(-2.57)	(-2.29)	(-1.72)
DEMOCRACY	-0.080***	-0.085***	-0.099***
	(-2.93)	(-3.09)	(-3.49)
PRESS	-0.004*	-0.004*	-0.004
	(-1.85)	(-1.80)	(-1.53)
Constant	-0.669**	-0.562**	-0.605**
	(-2.56)	(-2.08)	(-2.29)
R-squared (Overall)	0.74	0.765	0.76
LM Test	1391.63	1353.92	1296.77
Wald Chi2	90.83	100.09	117.03
N	462	462	448

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

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

	Two-step System GMM		*Two-step System GMM (CL)*	
	(1)	*(2)*	*(3)*	*(4)*
CC(-1)	0.9040***	0.8890***	0.8430***	0.8041***
	(28.14)	(25.40)	(14.57)	(10.99)
CIC	-0.0696**		-0.1082**	
	(-2.22)		(-2.34)	
LCIC		-0.0774**		-0.1372**
		(-1.99)		(-2.06)
PCY	0.0431**	0.0568**	0.0693**	0.1009**
	(2.20)	(2.44)	(2.26)	(2.49)
GOV	-0.0025	-0.0034*	-0.0041**	-0.0036*
	(-1.08)	(-1.71)	(-1.99)	(-1.69)
OPENNESS	0.0001	0.0000	0.0002	0.0003
	(0.46)	(0.26)	(1.18)	(1.32)
INFLATION	-0.0033***	-0.0035***	-0.0029***	-0.0022**
	(-3.01)	(-3.15)	(-3.04)	(-2.13)
DEMOCRACY	-0.0061	-0.0150	-0.0127	-0.0142
	(-0.41)	(-0.88)	(-0.82)	(-0.88)
PRESS	-0.0008	-0.0003	-0.0012	-0.0014
	(-0.66)	(-0.22)	(-0.91)	(-1.04)
Constant	-0.2338	-0.3329*	-0.3900*	-0.6639**
	(-1.49)	(-1.80)	(-1.73)	(-2.23)
F Statistics	2518.06	2361.37	2287.11	1698.60
Hansen Test (p-value)	0.49	0.35	0.9	0.21
AR(2) (p-value)	0.2	0.37	0.20	0.37
No. of Instruments	50	50	14	14
N	412	402	412	402

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: Panel Granger causality test

Direction of causality	*Lags*	*Wald Statistics*	*No. of Observations*	*No. of Countries*
CC →CIC	[1/1]	2.51	450	50
CIC→CC	[1/1]	2.81*	450	50
CC→LCIC	[1/1]	3.42***	450	50
LCIC→CC	[1/1]	3.35***	450	50

Notes: ***, **& * denote significant at 1%, 5% & 10% level respectively.