The effect of corruption, seigniorage and borrowing on inflation

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Abstract

Purpose – Governments may finance its expenditures through multiple resources; however, seigniorage and borrowing are commonly used. The authors think that in the presence of corruption, the use of public finance may result in inflationary effect that leads to higher level of inflation, which in turn affects the whole economy.

Design/methodology/approach – This paper investigates if the variation in corruption levels jointly with public finance means, seigniorage and borrowing, accounts for the variation in the level of inflation. This paper uses panel data of 72 countries through the period 1995-2011.

Findings – The author find that corruption jointly with public finance means, seigniorage and borrowing, increase the level of inflation. This finding can address the misuse of these public finance means where corruption is prevalent.

Originality/value – This paper captures the joint effect of corruption with two different means of public finance, seigniorage and borrowing, on the level of inflation within 72 countries through 1995-2011.

Keywords Inflation, Corruption, Borrowing, Seigniorage

Paper type Research paper

1. Introduction

It is well-known that seigniorage (the revenue a government acquires through its ability to issue new currency) causes inflation. Issuing new money is highly profitable source of financing a government may use[1]. The more important thing, however, is that there are determinants that may change the magnitude effect of this relationship. Studying these determinants potentially ensures a full picture to policy-makers. One variable that may affect the relationship between seigniorage and inflation is corruption. The hypothesis of this study is that corrupt officials in different positions waste government's resources through their corrupt practices. The government then has to use its available finance options to make up for this loss; seigniorage as the easiest solution followed by borrowing if the central bank independency is an obstacle. Financing this loss will result in expansionary spending, which in turn leads to higher inflation.

Although the effect of corruption on growth has been an interest of many researchers, the effect of corruption on inflation has not received much attention. Among the fewer studies conducted in this regard is Al-Marhubi (2000). The study directly investigated the effect of

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corruption on inflation using cross-section data averaged through 1980-1995. The author found out that a country with more corruption tends to have more inflation levels. Smith-Himllman (2007) examined whether good governance (represented as an index of corruption) and an effective competition policy are significant indicators for relatively low inflation rate. The author used a sample, which consisted of two groups comprising 23 African economies and 20 industrialized economies. The study found out that lower corruption levels and competition policy in place lead to lower level of inflation. Piplica (2011) examined the role of corruption on inflation in the EU[2] countries through their transition of socialist economies to market economies. The author found out that corruption positively affects the rate of inflation. Blackburn *et al.* (2008) found out that corruption has indirect effect on growth through public finance channels. Corruption drives public finance composition toward more seigniorage and, therefore, lowers growth.

In this study, we investigate the misuse of public finance, namely seigniorage and borrowing, as governments try to exploit funds missing because of corruption practices. Thus, we include seigniorage and debt financing in our model analysis, as seigniorage may not be influenced by corruption level in countries where central bank independence prevails. Moreover, missing from the literature is an empirical study that explicitly account for the joint effect of corruption with public finance means on inflation levels. Previous studies, which examined only seigniorage effect, were built on the assumption that there is a full access to seigniorage, which is far from reality. However, our study accounts for the constraints on using seigniorage by considering the second popular public finance option, namely borrowing. Our model uses a large panel dataset which consists of 72 countries for a long period of time ranging from 1995 to 2011. In addition, our analysis account for endogeneity problems which are typically found in such studies by using Fixed Effects and 2SLS models.

The following section discusses previous studies which are related to our topic. Section 3 identifies data and methodology, whereas Section 4 presents the results of the study. The last section summarizes the conclusion of the study.

2. Corruption and inflation linkage

There are not much empirical studies on the impact of corruption on inflation as we see on the impact of corruption on growth. Al-Marhubi (2000) empirically examined the relationship between corruption and inflation using cross-country data. The author used corruption indicators from Transparency International (TI) for the years 1988-1992 and 1980-1985 and from Business International (BI) for the period 1980-1983. He identified a number of factors crucial to the relationship between corruption and inflation. Corruption can contribute to inflationary finance because of tax evasion and costly tax collections along with capital flight and budget deficits. The author found out that corruption is partly responsible for high inflation, even after controlling for a variety of other determinants of inflation. The author used an OLS estimation for cross-sectional data analysis consisting of 41 countries from 1980 to 1995.

Blackburn *et al.* (2008) examined the impact of corruption on growth through a public finance channel. The hypothesis of their study is that corrupt bureaucrats embezzle tax revenues, which reduces the amount of revenues available to the government, causing it to increase its reliance on seigniorage. This, in turn, affects the decision of financial intermediaries in such a way that non-productive reserves will be favorable. This bias allocation of portfolio limits productivity in terms of investment, which is the driving force of growth. Blackburn *et al.'s* (2008) study builds a bridge between the findings of Al-Marhubi (2000) that corruption positively impacts inflation as well as Adam and Bevan (2005) and Bose *et al.* (2007) that seigniorage negatively impacts growth[3]. Although

Al-Marhubi did not explicitly include seigniorage, Blackburn *et al.* (2008) indicate that inflation is a possible outcome of seigniorage.

Blackburn *et al.* (2008) investigate their hypothesis using panel data for 82 countries between 1980 and 1999. The authors were interested in the revenue side of a government's budget. The main corruption variable is the International Country Risk Guide (ICRG), because of its availability within the period covered. However, the Corruption Perception Index (CPI-TI) and the Kaufmann *et al.* (2007) index (KKM) are included in their analysis but with less confidence. This is because their annual collection began after 1995 and 1996. The results obtained through the use of these alternative corruption indices were found to be consistent with those obtained through the use of the ICRG with regard to the main variable, the interaction term of corruption and seigniorage. However, there are some differences in the coefficients of the other variables in terms of sign and significance. As far as the role of indirect channels is concerned, Mauro (1995) found out that corruption affects growth only indirectly through inefficient investment choices. Li *et al.* (2000) reveal that corruption by itself explains little of the continental growth differences. However, corruption causes a large reduction in growth in countries where the asset distribution is less equal. Fiorino *et al.* (2012) suggest that corruption hinders the positive influence that public expenditure has on economic growth. Mo (2001) indicates that political instability is the most important channel through which corruption reduces growth. Similarly, Blackburn *et al.* (2008) found out that corruption, if taken separately, has no direct implications for growth. However, corruption has an indirect negative effect through its tilting of the composition of public finance toward more seigniorage with a concomitant reduction in growth.

Piplica (2011) investigated the effect of corruption on inflation in the EU through their transition of socialist economies to market economies. In these cases, there have been numerous privatizations that originated in offshore companies, shell companies, countries with tax havens, etc. All of these privatizations have carried a high financial cost. Such costs are often transferred to the final customer in terms of inflated prices. The author used Transparency International index as a measurement of corruption in the underlying countries covered the period of 1995 to 2008. Smith-Himllman (2007) attempted to test whether good governance (measured by level of corruption) and the existence of competition policy significantly explain lower inflation within 23 African countries and 20 industrial countries. The corruption perception index by Transparency International is used as a proxy for good governance. The author used a cross section data for 2003 testing of two groups of countries separately, which resulted in insignificant coefficients. However, the two groups, when tested as one group, reveal statistical significant results that low corruption and effective competition policy jointly account for lower level of inflation.

There are various ways to illustrate how corruption causes losses in public resources. For instance, government revenue collection may suffer from tax evasion and high tax collection costs. While government spending may suffer from the activities of corrupt procurement officials (Olken (2005)), the increased spending and shrinking revenues caused by corruption may possibly lead to budget deficits. This will, in cases of limited borrowing access, result in increased seigniorage and, therefore, adding to inflationary pressures.

The role that corruption plays in inflation is an important area of research. Only a few empirical studies in this area have been conducted, possibly because of the dearth of long-term series data on corruption. Al-Marhubi (2000) examined this issue with data spanning the years 1980-1995. However, data collection and reporting on corruption have improved significantly since then. A number of other data series have also been identified recently which can be used as a proxy for corruption. The renewed expansion of the role played by good governance in economic growth (Acemoglu *et al.*, 2005, 2004, etc.) warrants a

reexamination of the macroeconomic consequences of corruption; specifically the relationship between corruption and inflation.

Although Al-Marhubi (2000) highlighted the usefulness of a number of channels including tax evasion, tax collection costs, capital flight and budget deficits in examining the inflation/corruption relationship. His work was limited to a cross-section analysis that does not explicitly control these channels. Our study explicitly tests for seigniorage and borrowing. On the contrary, Blackburn *et al.* (2008) made use of the way in which seigniorage interacts with corruption, but his interest was in its impact on growth and not on inflation. His work was intended to fill the gap between the findings of Al-Marhubi (2000) on the one hand and those of Adam and Bevan (2005) and Bose *et al.* (2007) on the other. Moreover, as more than a decade has passed by since AL-Marhubi's (2000) findings were revealed, it would be worthwhile to update them, especially with the improvements in calculating corruption variables in terms of time spans and the recently conducted studies. Many studies concerning corruption have addressed the possible endogeneity problem of corruption along with other macroeconomic variables, making use of techniques such as the two- stage least square and the fixed effect all of which are important techniques. Thus, this study applies the fixed effect and the two-stage least squares (2SLS). We also include more variables representing economic, institutional and political aspects, a richer and wider data set in terms of years and countries and a larger variety of alternative model specifications to examine the relationship between corruption and inflation.

Also, contrary to the often-chosen channel of seigniorage, our study does not constrain public finance channels to seigniorage only but rather adds the possibility of borrowing through the debt- financing channel. There is a number of factors, which draw our attention to this channel. Ghosh and Neanidis (2010) call for new research on a possible extension of their work that:

> One line of enquiry would be to estimate the effects of the different types of corruption in public expenditure on growth and inflation using panel data for a large group of countries.

In addition, Dimakou (2008) indicates that governments can cause inflation despite the stringency of their monetary policies. In other words, a government may strategically increase its debt to induce its central bank to pursue an expansionary monetary policy. In the same context, Miller (1983) found that a higher fiscal deficit leads to inflation through the private sector's response to extra borrowing by the government. Specially, when borrowed money is spent on goods and services used by the private sector, this in turn affects the outcomes of the private sector's efforts. Although no seigniorage is being created in such cases, the result is high inflation as the same amount of money corresponds to fewer goods and services. Moreover, policies and institutions have improved in terms of greater central bank independence, which raises the use and importance of other public finance channels.

3. Data and methodology

3.1 Data description

We collected a country-set panel data sample of 72 countries. Country selection was largely based on data-availability either debt financing or corruption data. The time studied spans 17 years for each country; (1995-2011) for panel analysis. The starting date choice is because the annual data for the Corruption Perception Index (CPI) began in 1995, with data for some countries being reported later on. Beginning the data set in 1995 makes the availability of data concerning corruption variables similar from one country to another. Finally, missing data caused our unbalanced panel to deliver a maximum of 343 observations. Studies on corruption usually face a lack of data availability because of a lack of corruption data. In

addition, obtaining comparable public finance data across countries is a challenge that adds to the problem of missing data. Table AI in the appendix presents summarized statistics of the data and describes their definitions and sources.

Our main variables are corruption, seigniorage, borrowing and inflation. In addition, we include control variables that have been traditionally known to contribute to inflation. We include GDP per capita to control for the level of development across countries. Typically, countries with lower GDP per capita (indicating a lower level of development) tend to have lower prices. Thus, they are expected to experience higher inflation rates as they catch up to other countries. Openness (exports and imports to GDP) is included; no specific sign can be assumed as the magnitude of export and import in forming openness which may affect the sign either way. However, some studies have assumed that countries, which are more open, tend to maintain their comparative advantages in trade by being more competitive, thereby lowering their rates of inflation. Based on the short-run Phillips curve hypothesis, unemployment rate is also included to represent the labor market effect, which is assumed to have a negative effect on inflation. The unemployment rate is associated with more deflation in the economy and less weight on prices. The lending rate represents the rate that is offered by banks in the short and medium terms. We aim to control for the effect of business expansion on inflation when the lending rate is low; thus, we expect it to have a negative effect on inflation. Finally, we control for exchange rate calculated as the value of the dollar per domestic currency, which controls for the differences in prices across countries so that the higher the value, the lower the prices. We use two variables that represent public finance means that influence the effect of corruption indices on the inflation rate; these are seigniorage and debt financing. Seigniorage is defined in two ways[4]: it is the change in reserve money calculated as a fraction of total revenue, grants and budget deficits. It is also defined as the change in reserve money available to the GDP, following Aisen and Veiga (2008); Blackburn *et al.* (2008); Fisher (1982) and Cukierman *et al.* (1992)[5]. The other variable we introduce is debt financing which is constructed in two steps: first, we multiply cash-surplus by minus one to conform to the form of the budget deficit. Second, we subtract seigniorage from the budget deficit to find the volume of other public financing means besides seigniorage, following Adam and Bevan (2005)[6]. We have used two variables in respect to corruption indices, the Transparency International-Corruption Perception Index (TI-CPI) and the International Country Risk Guide (ICRG). We have chosen these two specifically because of their availability and comparability. Both of the variables are constructed by observing the opinions of the general public, business people and experts in corruption matters.

The correlation between these two variables in our sample is 87 per cent, where the TI-CPI ranges from 0 to 10 and the ICRG ranges from 0 to 6. Corruption data are originally reported in such a way those higher values refer to lower levels of corruption and lower values indicate larger amounts of corruption. For convenience, however, we have rescaled these indices so that high values indicate more corruption and low values indicate less corruption[7]. Finally, our dependent variable, inflation, is a GDP deflator. We should mention two things regarding the choice of this particular representation of inflation. First, we use inflation level and not its fluctuation because some studies have found reverse causality when using inflation variability. Second, a weak magnitude of corruption's direct effect on inflation has been claimed to be a result of the fact that some corrupt practices on some goods and services may have been overlooked in the calculation of inflation through the consumer price index.

3.2 Methodology

We will estimate the following equation through different model specifications:

$$Inf_{it} = \propto + \sum_{l=1}^{m} B_l X_{l,it} + \partial C_{it} + \gamma P_{l,it} + \varphi C_{it} * P_{l,it} + \varepsilon_{it} \quad (1)$$

Where Inf_{it} denotes the inflation in i country at time t, X_l indicates the set of controls: Openness, GDP per capita, unemployment, lending and exchange rate. C, Corruption indicators, is represented in the ICRG and the TI-CPI. P reflects the public finance options available to country i, which are seigniorage or borrowing. These two variables also interact with our corruption indices one at a time (the TI-CPI and the ICRG). i: Takes values from 1 to 72, the number of countries. Moreover, not wanting to be limited to the OLS estimate only, we apply different model specifications to solve potential endogeneity problems among the independent variables using the Fixed Effect and the Two-Stage Least Squares (2SLS) models. Our main variable, besides corruption, is an interaction term between corruption and seigniorage and corruption and borrowing. We have chosen to do this because of our expectation that the effect of corruption on inflation is restricted in terms of the elasticity of using seigniorage across countries. Some highly corrupt countries may make lower use of seigniorage because of their central banks' constraints; others may not face such constraints. Thus, seigniorage responses may be considered empirically as a non-additive effect variable, which give us the incentive to use an interaction variable between corruption and seigniorage. Moreover, we will consider alternatives to seigniorage for obtaining funds, namely the interaction effects of corruption with borrowing. This variable is used to examine cases in which a given country's ability to use seigniorage is limited for some reasons and has to meet its needs through borrowing.

4. Results

4.1 Pre-estimation tests and graphs

Figure 1 represents the inflation and corruption rates (ICRG) of 72 countries representing an average of the period 1995 to 2011. From the graph, we can see a considerable degree of coincidence between inflation and corruption; countries with high levels of corruption tend to have a high level of inflation.

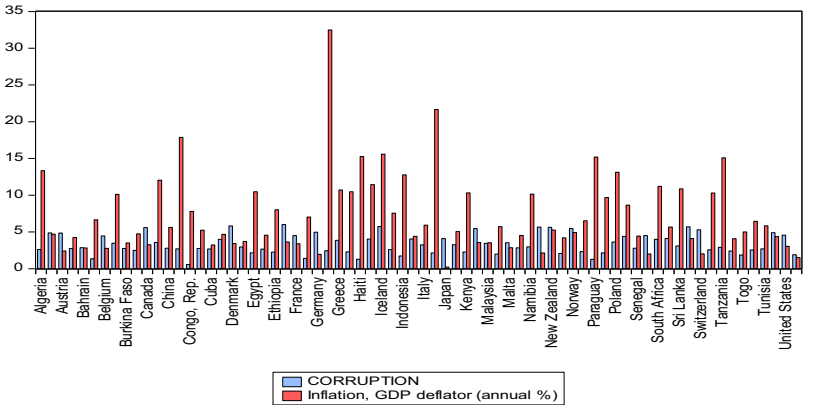

Figure 1.
The cross-country relationship of corruption–inflation (1995-2011)

Figures 2, 3 and 4 illustrate the relationship between our variables of interest: corruption indices, public finance indices and inflation. Figure 2 shows a positive association between the corruption indices (the CPI and the ICRG) and inflation. Figure 3 shows a positive association between the corruption indices and seigniorage. Figure 4 illustrates our initial expectation of a positive relationship between corruption and borrowing.

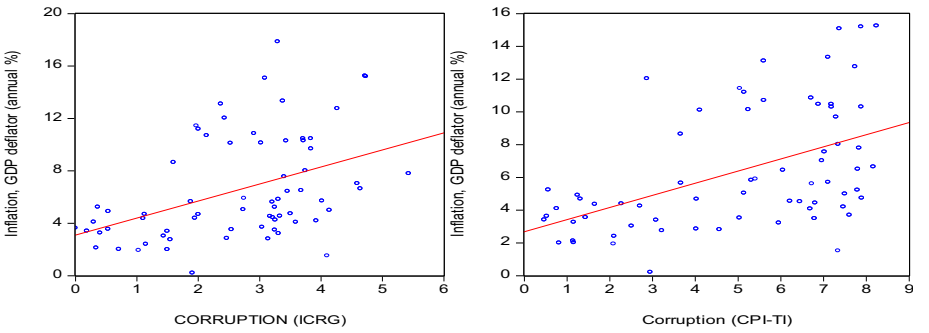

Figure 2.
Corruption and inflation

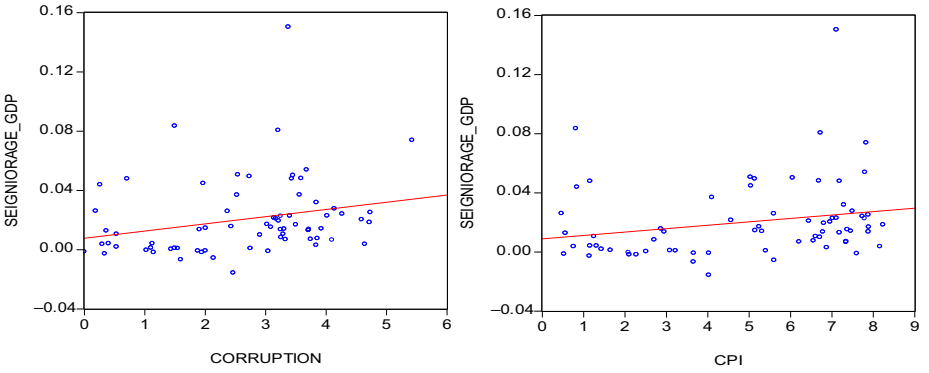

Figure 3.
Corruption and seigniorage

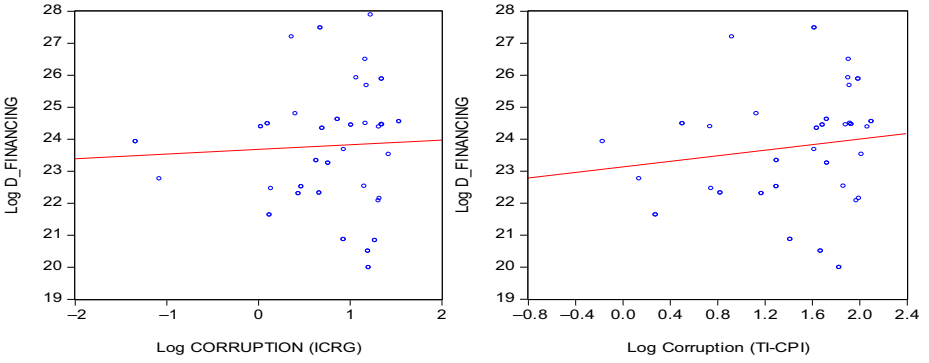

Figure 4.
Corruption and debt-financing

Table AI, in the Appendix, reports the summary statistics of the variables. Inflation rises to a maximum of 80.7, but this number represents only a few observations of a few countries' high inflation levels. As the standard deviation shows the dispersion of the observations, it can be seen that inflation is the noisiest of the variables relative to the other variables, which have standard deviations that show less dispersion from the mean but still exhibit some significant variations. Table AII, in the Appendix, shows the correlation and corresponding t statistic for our variables. There is a positive correlation between the corruption indices and inflation, with high t statistics. There is also a positive correlation between the corruption indices and the public finance means of seigniorage and debt financing. Interestingly, the magnitudes of the correlation and the t statistic are very similar. In regard to the other variables, we observe a high correlation between the corruption indices and some of the other variables such as GDP per capita. This may refer to a sign of possible multicollinearity among the independent variables mentioned in some corruption studies (Blackburn *et al.* (2008).

4.2 Panel analysis estimates

We use three model specifications to test our hypothesis: the baseline panel model, the fixed effect model and the 2SLS model. The estimates in Table I contain two model specifications, the base panel model and the fixed effect model, while Table II contains the 2SLS model[8]. Table I has 8 columns showing the estimates for each corruption index representing its interactions with public finance indices. A look at the panel estimations in Table I reveals a great coincidence in terms of the signs and significance of the variable coefficients throughout the different specifications. We can also observe from the table that GDP per capita has the expected sign, minus, and it is significant with one exception. In addition, the coefficient for openness has a positive sign and is significant throughout all the models. The coefficient for unemployment has a negative sign, implying that unemployment causes a higher level of operating, thereby reducing inflation, but is insignificant. The regression models include lending, which represents the interest rate; it has a negative correlation with inflation because a higher lending rate hampers investment.

The lending coefficient has negative coefficients throughout all the models and is mostly significant. The exchange rate is very significant and has a negative sign in all eight models with one exception. Seigniorage is insignificant and has a sign that is mostly positive; however, as we use interaction terms in each model, the significance of individual variables may be affected. The same scenario is revealed in the other public finance variable, debt financing, where it is insignificant. However, as we have used an interaction model that in some models contains debt financing, it is individual significance might have been affected. As we have indicated, our interest lies in the corruption indices and their interactions with the public finance indices of seigniorage and borrowing. In the pool model, the corruption indices, the ICRG and the CPI, have the right sign with a very significant level of 1 per cent. In addition, their interaction terms have the right sign with a level of significance ranging from 1 to 5 per cent with one exception, the interaction term of the CPI with seigniorage. The R squared value for the base estimation model ranges from 24 to 27 per cent.

In regards to the fixed effect, the results improved in comparison with the pool estimates in terms of goodness of fit. The R squared value improved along with the fixed effect models to explain 40 per cent of the inflation rate variations. The corruption indices in the fixed effect models are individually insignificant, which a result literature has indicated that using interaction terms may absorb the effects of individual indices. The interaction terms of the CPI were insignificant but have the right sign, while the interaction term of the ICRG was

Table I. Panel estimation: Dependent variable: Inflation, the of percentage change in GDP deflator

	POOL	POOL	FE	FE	POOL	POOL	FE	FE
C	1.44 [0.01]	1.50 [0.00]	1.01 [0.80]	2.15 [0.60]	2.30 [0.00]	1.92 [0.00]	5.46 [0.00]	5.47 [0.00]
GDP per capita	−19.59 [0.04]	−22.96 [0.02]	−27.48 [0.01]	−29.79 [0.00]	−17.42 [0.08]	−13.87 [0.17]	−30.91 [0.00]	−26.24 [0.01]
Openness	10.14 [0.00]	10.47 [0.00]	9.83 [0.01]	10.04 [0.01]	12.59 [0.00]	12.14 [0.00]	12.68 [0.00]	13.24 [0.00]
Unemployment	−0.12 [0.55]	−0.12 [0.53]	−0.08 [0.67]	−0.10 [0.62]	−0.27 [0.19]	−0.28 [0.17]	−0.21 [0.29]	−0.19 [0.35]
Lending	−0.01 [0.11]	−0.01 [0.08]	−0.02 [0.00]	−0.02 [0.00]	−0.01 [0.17]	−0.01 [0.13]	−0.02 [0.01]	−0.02 [0.00]
Exchange	0.0008 [0.00]	−0.0007 [0.00]	0.001 [0.05]	0.001 [0.05]	0.001 [0.00]	0.0009 [0.00]	0.001 [0.13]	0.001 [0.08]
Seigniorage	4.43 [0.68]	5.52 [0.27]	0.24 [0.98]	7.12 [0.26]	−19.18 [0.15]	4.16 [0.45]	−21.42 [0.15]	8.81 [0.19]
Debt-Financing	4.06E-14 [0.34]	−4.15E-13 [0.08]	3.04E-14 [0.46]	−2.93E-13 [0.23]	7.21E-14 [0.12]	−2.12E-13 [0.07]	6.17E-14 [0.17]	−2.03-13 [0.07]
CPI	0.78 [0.00]	0.81 [0.00]	0.86 [0.40]	0.60 [0.56]				
ICRG					0.91 [0.00]	1.06 [0.00]	−0.30 [0.62]	−0.37 [0.54]
Seigniorage*CPI	0.31 [0.87]		1.60 [0.52]					
Debt-financing*CPI		6.56E-14 [0.05]		4.65E-14 [0.18]				
Seigniorage*ICRG					7.32 [0.05]		10.22 [0.02]	
Debt-financing*ICRG						1.09E-13 [0.00]		1.02E-13 [0.01]
R-squared (%)	27	27	40	40	24	25	40	40
DW	1.72	1.78	2.05	2.09	1.64	1.72	2.07	2.16
Observations	333	327	333	327	343	343	343	343

Note: *p*-values in brackets

	2SLS	2SLS	2SLS	2SLS
C	1.43 [0.06]	1.07 [0.28]	2.12 [0.03]	1.38 [0.15]
GDP per capita	22.89 [0.37]	−13.45 [0.76]	−50.34 [0.31]	9.11 [0.85]
Openness	*−1.03 [0.78]*	*6.19 [0.26]*	*10.75 [0.07]*	*6.08 [0.26]*
Unemployment	*−0.05 [0.81]*	*−0.04 [0.89]*	*−0.20 [0.54]*	*−0.06 [0.86]*
Lending	*−0.01 [0.18]*	*−0.03 [0.14]*	*−0.04 [0.05]*	*−0.02 [0.37]*
Exchange	*0.0004 [0.00]*	*0.0002 [0.24]*	*0.0002 [0.21]*	*0.0004 [0.01]*
Seigniorage	*−10.98 [0.54]*	*10.00 [0.62]*	*−7.33 [0.44]*	*−7.03 [0.47]*
Debt-Financing	*−2.13E-14 [0.57]*	*6.85E-14 [0.16]*	*−5.18E-13 [0.06]*	*−2.60E-13 [0.04]*
ICRG	*1.17 [0.00]*			*1.38 [0.00]*
CPI		*1.17 [0.00]*	*1.14 [0.00]*	
Seigniorage*ICRG	*1.81 [0.70]*			
Debt-financing*ICRG				*1.35E-13 [0.00]*
Seigniorage*CPI		*−3.62 [0.31]*		
Debt-financing*CPI			*8.27E-14 [0.03]*	
R-squared (%)	22	18	16	22
DW	1.60	1.59	1.78	1.59
Endogenous variables used as instruments	Twice lagged values to four time lags	Twice lagged values to four time lags	Twice lagged values to four time lags	Twice lagged values to four time lags
Observations	273	276	276	297

Note: *p*-values in brackets

Table II.
Panel estimation: Dependent variable: Inflation, the of percentage change in GDP deflator

significant and has the right sign, draining the individual effects of the corruption indices so that these indices turn out to be insignificant in the fixed effect models. Regarding the magnitude effects of our interaction terms, 1 standard deviation change in the interaction terms of ICRG with seigniorage results in 0.43 and standard deviation increase in inflation, while 1 standard deviation of the interaction terms of ICRG with debt financing results in 0.39 standard deviation increase in inflation. As a multicollinearity problem is to be expected when dealing with a corruption investigation, we have checked for a status of error term estimated to assess for the presence of misspecifications and autocorrelation. Thus, we checked the estimated error term autocorrelation problem and also regressed it for our independent variables. We found it stationary and insignificant with all our independent variables in all of the models. We now turn to the use of 2SLS model techniques to address the possible endogeneity problem between the independent variables. This possibility can also be seen in the table of correlation where we can see a significant correlation among the independent variables. The instruments we used are the twice-lagged value to four lags of the endogenous variables.

Table II in the IV model follows the same specifications as those given in Table I. A look at Table II shows that, though fewer controls are significant, our interaction terms are significant and have the right sign through all specifications except for the seigniorage interacted with CPI and ICRG. However, the latter variables turn to be significant when their individual corruption indices dropped. In terms of the magnitude effects of our interaction terms, 1 standard deviation change in the interaction terms of ICRG with seigniorage results in 2.64 standard deviation increase in inflation, while 1 standard deviation of the interaction terms of ICRG with debt financing results in 0.35 standard deviation increase in inflation. The R squared value ranges from 16 to 22 per cent in all of the models. Thus, there is a potential supplement to this study that one may consider measuring the elasticity of government using different public finance

means upon the level of its central bank independency through panel data of a set of countries.

5. Conclusion

We aimed in this article to contribute to the existing literature concerned with the effects of corruption on inflation jointly with public finance indices. Our contributions are as follows: the use of an updated data set, the application of appropriate techniques and the introduction of a new public finance variable in empirical analysis in this context. We have updated the investigation on the effects of corruption on inflation using data gathered since 2011 across 72 countries. We have also applied techniques that control for the possible endogeneity, autocorrelation and serial correlation problems that have been observed in the literature on corruption studies. We have also added the new public finance variable of borrowing as we assumed the existence of some level of constraints on the use of seigniorage across countries. In all of our various models, the estimated specifications show that corruption contributes to inflation both on its own and jointly with public finance indices. The results are significant and have the right signs, which give evidence of the contribution made by corrupt officials to increasing inflation, thus eventually hurting growth. The positive and significant results linking debt financing with corruption indicate that corrupt officials have alternative sources of funds by which they contribute to high inflation. Thus, the independence of a central bank may not guarantee the elimination of the effects of corruption on inflation. For policy-makers, bringing about a reduction in the effects of corruption on inflation requires a dual strategy involving both central bank independence and government borrowing.

6. List of countries

Algeria, Australia, Austria, Bahamas, Bahrain, Bangladesh, Belgium, Botswana, Burkina Faso, Cameroon, Canada, Chile, China, Colombia, Congo, Rep., Cote d'Ivoire, Cuba, Cyprus, Denmark, Ecuador, Egypt, El Salvador, Ethiopia, Finland, France, Gabon, Germany, Greece, Haiti, Hungary, Iceland, India, Indonesia, Ireland, Italy, Jamaica, Japan, Jordan, Kenya, Luxembourg, Malaysia, Mali, Malta, Morocco, Namibia, Netherlands, New Zealand, Niger, Norway, Papua New Guinea, Paraguay, Philippines, Poland, Portugal, Senegal, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Syrian Arab Republic, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, the UK, the USA and Zimbabwe.

Notes

1. There are sufficient literature advocate this relationship include Al-Marhubi (2000); Piplica (2011); A. Vindelyn (2007) and Blackburn *et al.* (2008).
2. The EU countries are Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Romania, Slovakia and Slovenia, including Croatia as a future member of the EU based as of the year 2008.
3. I thank Dr. AKM Morshed for first mentioning the connection between the two studies; Blackburn *et al.* (2008) and Adam and Bevan (2005).
4. Although each seigniorage variables delivers similar results, results in panel estimation are based on seigniorage as the change in money reserve to GDP it contains higher number of observations than the other seigniorage variable.

5. The two common measures of seigniorage are the change in monetary base either to GDP or government total revenues; see Buiter (2007); Aisen and Veiga (2008); Blackburn *et al.* (2008) and Cardoso and Fishlow (1990). However, there are some exceptions, for instance, Click (2000) uses the change in M1 to GDP as a seigniorage measure to Argentina due to data limitation. Others point out some inappropriate measure of seigniorage; for instance, Bose et al. (2007) have not considered the measure of seigniorage that is given by the ratio product of inflation and money reserve to GDP due to difficulty in comparability across developing countries. He also abstained from using the concept of opportunity cost of seigniorage due to difficulty in choosing the correct interest rate across countries and time.
6. Those authors indicate that poor and incomplete borrowing data makes such a construction reasonable.
7. Corruption is scaled by the outcome of "maximum score minus the country score".
8. Due to size constraints we separate our estimates into two tables, Table III and Table IV (Click, 2000) (Buiter, 2007).

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Further reading

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Appendix

	Mean	Median	Maximum	Minimum	SD	Observations
GDP per capita	10708.71	3403.651	56285.28	113.871	12597.69	1212
Openness	0.872	0.742	4.858	0	0.624	1196
Unemployment	8.003	7.2	37.6	0	5.048	878
Inflation	5.206	3.466	80.75	−27.048	7.201	1212
Seigniorage	1689936	5142.933	1.31E + 08	−14818679	11330911	961
Debt financing	9.13E + 11	3.97E + 09	9.37E + 13	−1.06E + 13	6.16E + 12	835
ICRG	2.836	3	6	0	1.423	1155
TI-CPI	4.669	5.1	10	0	2.571	982
Exchange	561.23	8.91	25000	0	2397.48	1040

Sources: Data inflation, on per capita growth, GDP, exchange rate, total reserve of money minus gold, cash surplus/deficit and openness are from the World Development Indicators (World Bank, online); data on total revenue (Tax revenue + Non-tax revenue + grants) are from the Government Finance Statistics (CD-2013); these data are used to compute the seigniorage; GDP per capita: Gross domestic product constant (2000); Unemployment: percentage rate of total labor force; Exchange rate: official exchange rate of domestic currency per US dollar; Seigniorage = change in money reserve as fraction of total revenue; Cash surplus/deficit: Cash surplus or deficit is revenue (including grants) minus expense, minus net acquisition of non-financial assets. For convenience, we multiply this variable by (−1) so positive figures will reflect deficit and negative one will reflect surplus; debt financing is calculated by taking the residuals between budget deficit and seigniorage; TI-CPI: Corruption index, Transparency International Index; ICRG: corruption and other country's risk indicator, International Country Risk Guide Index

Table AI.
Summary statistics

Table AII. The correlation and corresponding *t*-statistics

Correlation/ *t*-statistic	INFLATION	GDP_PER	OPENNESS	UNEMP	LENDING	EXCHANGE	SEIGNIORAGE	D_FINANCING	CPI	ICRG
INFLATION	1									
GDP_PER	−0.36 [−7.54]	1 [–]								
OPENNESS	−0.08 [−1.66]	0.03 [0.70]	1 [–]							
UNEMP	0.09 [1.77]	−0.31 [−6.32]	−0.24 [−4.82]	1 [–]						
LENDING	0.021 [0.41]	−0.16 [−3.30]	−0.05 [−1.14]	−0.1 [−2.08]	1 [–]					
EXCHANGE	0.37 [7.94]	−0.27 [−5.55]	−0.06 [−1.28]	0.05 [1.05]	0.04 [0.84]	1 [–]				
SEIGNIORAGE	0.15 [2.95]	−0.17 [−3.51]	0.29 [6.07]	−0.009 [−0.18]	−0.03 [−0.76]	−0.005 [−0.10]	1 [–]			
D_FINANCING	0.11 [2.22]	−0.08 [−1.66]	−0.1 [−2.08]	0.04 [0.94]	−0.003 [−0.06]	0.59 [14.28]	−0.003 [-0.06]	1 [–]		
CPI	0.39 [8.25]	−0.85 [−32.14]	−0.16 [−3.29]	0.21 [4.32]	0.2 [4.06]	0.37 [7.88]	0.17 [3.53]	0.18 [3.66]	1 [–]	
ICRG	0.31 [6.36]	−0.72 [−20.13]	−0.01 [−0.23]	0.11 [2.27]	0.26 [5.37]	0.3 [6.18]	0.24 [4.96]	0.12 [2.37]	0.86 [33.94]	1 [–]