Government and Corruption: Scylla and Charybdis

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ABSTRACT

Using public sector employment and corruption perception data for 72 countries across the world, this article demonstrates that despite common notion countries with “smaller” governments do not tend to have lower corruption. Under general assumptions, one can demonstrate that there is an optimal size of public sector employment corresponding to the highest capital intensity. The model has several implications: lower optimal sizes of governments for labor intensive countries and higher sizes for capital intensive ones, possibility to reduce corruption paying a cost of suboptimal output, and a higher “price” of an oversized government for labor intensive countries.

Introduction

Corruption is a phenomenon that is constantly attracting the attention of the economists. This is only natural since corruption, in particular, and inefficient government, in general, directly affect the society on various levels. For instance, Gupta, Davoodi, and Alonso-Terme (2002) demonstrated that corruption has a negative impact on income equality and poverty levels, Berger (2014) showed that it can destroy doctor–patient relations and even kill, as it is stated in Ambraseys and Bilham (2011). This article restrains from such dramatic aspects of the phenomenon and is rather focused on the corruption and its influence on the capital formation. There are different approaches to this problem starting from purely ad-hoc ones and finishing with the attempts to build a feasible model of the phenomenon.

Corruption is widely perceived as a factor that has a negative impact on growth. There are a number of empirical studies that aim to find out whether corruption can have a negative influence on growth or of the growth can in return affect the corruption level. For example, Bai, Jayachandran, Malesky, and Olken (2013) claimed that an increase in economic growth can technically reduce the corruption. The ad-hoc articles dealing with the phenomenon of the corruption range from studies of a specific economy, such as Bai et al. (2013), to huge comparative research-projects on a global scale such as Mauro (1995) that remains one of the most cited works in the field or Mo (2001). Naturally, one can expect more empirical results in future, as more and more data-sources are becoming open and available for the research. Despite the fact that these works give insight into the phenomenon of corruption (and in particular its’ interconnection with growth) majority of them does not provide a mathematical model of the phenomenon. Because of that reason these methods could be classified as inductive: such ad-hoc research gives certain insights explaining specific aspects of corruption, but it is hard to generalize these results. Though every empiric result is very important by itself and advances researchers understanding of the certain properties of corruption, this understanding could hardly ever be transferred into a predictive model, moreover, it is a tedious task to incorporate several empirical results that describe different aspects of the phenomenon in one broader model.

The deductive approach to the phenomenon seems to be more promising for policy makers. If it is possible to develop a generalized approach to the modeling of corruption, then this framework could be broadened iteratively with more and more aspects of the phenomenon taken into consideration. Indeed, there are a number of attempts to provide a generalized model of corruption. For instance, Banerjee, Mullainathan, and Hanna (2012) or Bardhan (1997), as well as Mo (2001), proposed certain frameworks that can help to model corruption within the economy yet do not develop them in detail since these frameworks are only justifying the quantitative analysis that is the main focus of
these articles. There are a number of interesting results regarding agency models of corruption. One of the first models of such a type was proposed in Rose-Ackerman (1978), where it was demonstrated that legislative corruption cannot survive under perfect information conditions. This work was followed by other agency models proposed by Barro (1973), Becker (1983), Cadot (1987) and many more. This type of models address various aspects of the decision process of a certain bureaucrat, for example, models a process of bargaining between an official and an investor who wants to carry out a certain project. It might be somehow generalized in future but at the moment these models do not allow spread of the obtained results on a macroeconomic level.

This article proposes an approach to corruption in the framework of an aggregate production function. This promising approach, though hardly ever before applied to the phenomenon, can be a good integration framework for the development of a better and more precise model that could help to understand the impact of this phenomenon on the macroeconomic factors. In this particular work, only two aspects of corruption are taken into consideration: the percentage of labor employed in the public sector and the percentage of capital that is “consumed” by corrupt officials. Analysis shows, that despite a wide spread notion there seems to be no connection between the size of the government sector and the level of corruption in the country. Indeed, using OECD-member data one can even demonstrate an inverse relationship, when countries with “bigger” governments actually enjoy lower levels of corruption. This study proposes an aggregate model that could be used as a baseline to incorporate other aspects of corruption. The model shows that under certain constraints, there is an optimal level of government employment that corresponds to the maximum capital intensity in a steady state.

**Government and corruption: Common sense and data**

There are numerous approaches to estimations and measurements of corruption. A very straightforward one is an approach when one thinks of it as of a “corruption tax” that erodes a certain share of capital on every business cycle. Naturally, not every civil servant is corrupt yet it is possible to assume that some of them are and that their activity reduces the capital available within the economy. Multiple corruption scandals are often connected with off-shores or foreign jurisdictions (see, for example, Christensen, 2012), therefore, it is safe to say that certain level of corruption causes an erosion of the capital when a share of it leaves the economy. Naturally, if is very hard to estimate the size of the “corruption tax” and it is even harder to model it. On a general basis, the “corruption tax” might depend on a range of factors starting from a business culture and climate and finishing with the quality of institutions and salaries of civil servants.

Conventional wisdom tends to connect “bigger” government with higher levels of corruption. In particular, one can hear this line of argument from a number of politicians who, among other ideas, base their campaigns on the general principle that “smaller” government is more effective and less corrupt as a rule. Despite the fact that this assumption seems intuitively correct there are hardly enough comprehensive empirical or theoretical studies that could support this statement. This study tries to test this assumption. In order to do that, it is necessary to obtain data on the sizes of the government sectors in different economies and to compare this size with the levels of corruption attributed to these states. Estimation of the size of the government is a relatively easy task. There are a number of organizations that measure the sizes of public sectors across the world. For this particular research, the data provided by International Labor Organization is used (the dataset is described in detail in the Data Annex of this article). However, direct measurement of a “corruption tax” is far more difficult as any other measurement within “shadow” economy. To estimate the “corruption tax” one has to use an intermediary variable that, on one hand, could be easily found for different countries yet, on the other hand, could give an insight into the size of the “corruption tax” characteristic for these economies.

The measurement of the phenomena attributed to the corruption is a serious and deep topic in itself and a solely ad-hoc research of this topic is not in the scope of this article. For a deep and profound discussion on the measurements of corruption the reader can see Kaufmann (2005) or Lambsdorff (1999). However, there were no articles that authors know of that were directly working with the corruption and a percentage of the work-force employed in the public sector. In this article, to illustrate this connection the Corruption Perception Index (or CPI) is used. This index is measured on a yearly basis by the Transparency International and is one of the most disseminated measure of corruption among policymakers (see Svensson, 2005). This measure is debatable but has a number of advantages important in the scope of this article. CPI is measured for a sufficiently long time (for the purposes of this article the data gathered from 1999 till 2008 is used, on this interval the data on CPI has sufficient consistency). Corruption Perception Index is an aggregate value that is based on a number of surveys that estimate the level of corruption in the country and does not include any macroeconomic data (and therefore the chance of a
false connection attributed to the inner dependency of different macroeconomic factors is reduced). CPI is a measure of corruption widely accepted by policy makers and researchers in the field and has sufficiently large number of data points. In general, CPI is higher if a country is less corrupt. Northern European countries or Singapore are usually associated with CPIs close to 10 whereas more corrupt states have CPIs between 1 and 3. This means that CPI is in some sense inversely proportional to the “corruption tax”. One could think that “corruption tax” for the countries with CPI close to 10 is minimal (if existent) and reaches its peak for the counties with CPI close to 1. The question of establishing a quantitative connection between CPI and the “corruption tax” is challenging itself, however the clear qualitative “inverse” connection should be sufficient to test the common wisdom assumption that smaller governments tend to be less corrupt. To do so one can look at CPI across different counties as a function of the percentage of the population employed in the public sector. This overview of CPI as a function of the government “size” can be seen in Figure 1.

These are data-points on 9 years 1999–2008 across 72 countries. The method according to which CPI is calculated was changed several times, so it is obligatory to restrict the research to this maximal timespan, where the methodology could be regarded as a consistent one. Some of the labor data were missing for certain years (see Data Annex for a detailed description of the dataset). Indeed, this is important to think of a method to fill the non-defined values and come up with a method, that could adjust CPI in some way so that the same dependence could be demonstrated on a longer time span, but for illustrative purposes of this particular research this number of data-points should be sufficient. Two linear regression lines are added: one for the participants of the OECD (with $R^2 = 0.38$) and one for the non-OECD countries ($R^2$ is negligibly small). As it has been mentioned before, the CPI is an index that might depend on a number of factors, so it would be naive to expect higher values of $R^2$ in such a simplistic one-parameter approach. Yet the data seems to be illustrative enough to state that despite the conventional wisdom countries with smaller governments do not enjoy lower levels of corruption (i.e. higher CPI), and the connection between the corruption and the size of the government, if existent, is the opposite. Indeed, OECD countries, that proclaim the reduction of corruption as their strategic initiative, tend to have lower levels of corruption associated with bigger governments and not vise versa, whereas non-OECD members do not demonstrate any significant connection between the size of the government and the levels of corruption. This is an interesting and, somewhat, counterintuitive fact that, one should believe, deserves a separate attention. Further on a mathematical model that could be based on this interesting notion is developed and discussed.
At this moment, it is crucial to make several remarks on this particular empiric result.

First of all, one should discuss the difference between OECD and non-OECD countries. Both groups of countries demonstrate that the smaller government does not imply lower levels of corruption, yet OECD-members even tend to demonstrate an opposite tendency. What possible explanation could there be? It is possible to suggest several. On a general basis one can assume that as a size of government grows it tends to create control-mechanisms and parallel structures that may be inefficient yet stimulate inner competition within the government sector. This inside pressure could explain lower levels of corruption taxes within the countries that have bigger government sectors. Since the lower corruption is one of the proclaimed strategic aims for OECD members it is only to be expected that this inside-government competition grows even higher in OECD-countries. Another possible explanation might be that there are structural differences between OECD and non-OECD countries. Due to these structural differences the size of the government does not affect the levels of corruption in non-OECD countries, where inefficiency of the government leads to the situation when increased regulation and broader control does not lead to the desired reduction of corruption. In the meantime, OECD-governments are structured differently and can “clean” themselves through new regulations and control mechanisms.

Second series of questions that are to be discussed in light of this empiric notion is how this interesting and counterintuitive connection between the size of the government and the level of corruption can affect growth on a macroeconomic level. Yet again, one can often hear that smaller government is a panacea for higher growth but since this study has just seen that common knowledge can sometimes contradict with empiric facts it would be good to give this hypothesis a test as well. In the next sections of this article a simple macroeconomic model is proposed. It incorporates this inverse connection between the size of the government and the level of corruption and helps to draw several interesting conclusion concerning growth in this framework.

**General framework**

The model proposed by Cobb and Douglas (1928) was profoundly discussed and criticized (see, for example, Kadiyala, 1972). This study has no intention to discuss its advantages and disadvantages, but has to mention that despite known mishaps it was and is revisited up to the moment, for example, this approach was used in Bloom, Canning, and Sevilla (2004) to obtain interesting insights on the connection between health and economic growth. Since Solow (1957) proposed an approach that can separate the variations of output per capita depending on different aspects of the model, taken into consideration, the aggregate production function is used as the most simple and illustrative mathematical approach to different macroeconomic problems. For example, Mo (2001) applied it to the problems of corruption and considered corruption as a “hidden” variable, that affects the growth rate. This study will approach that problem differently.

The simplest Cobb–Douglas aggregate production function has a form

\[ Y = AL^{1-a}K^a, \]

where \( Y \) is a final real output, \( A \) is a total factor productivity, that captures technological progress, \( L \) is a labor input, \( K \) is an input of capital and \( 0 < a < 1 \) is a constant parameter that influences the shape of the production function, it could be as well regarded as a partial elasticity of the output with respect to the capital. It is important to note here, that the structure of capital is not in the focus of this article, so out of three macroeconomic frameworks described by Garrison (2002) neither the labor nor capital framework are used but rather a neutral money-framework. For the sake of simplicity, it is also assumed from now on that \( A \) is constant. Since in article’s future reasoning this study deals with a capital intensity in a steady state one can apply the same reasoning to the model with dynamic \( A \) and obtain corresponding results. In future it is possible to research the influence of corruption on technologic advancements in this framework, but it is not in the focus of interest of this article at the moment.

Now assume that a certain percentage of labor \( g \) is employed within the public sector (corresponds to the size of the government) and does not directly contribute to the total production. On one hand, this is a wild assumption since there are countries, where certain industries are governmentally owned and still contribute to the total real output. On the other hand it is possible to resolve this problem in the following way. One can regard \( g \) as the percentage of publicly employed labor that does not directly contribute to the total production, the labor resources that are “taken” from the market by the government and do not create any additional real output. Naturally, it can be lower than the official percentage of governmentally employed workers, but since it could be regarded as a function of the employment in the public sector (say, official values of the employment discounted on a constant that differs from country to country) \( g \) can be perceived as the employment within the government sector without any loss of generality. This means that
the total labor input is \((1 - g)\) times lower and equals to \((1 - g)L\), where \(1 - g\) is, naturally a share of workers, not employed by the government.

One may further assume that corruption “absorbs” certain share of capital that is denoted as \(c\). This coefficient cannot be measured directly, but it is a very typical situation for any quantitative value used to describe a shadow economy. One can understand this factor in a straightforward manner as the level of “greed” of the corrupt officials or the level of “corruption tax” on the capital. Though this variable lacks direct measurability it is standard for corruption models. Corruption lowers the total capital input \((1 - c)\) times and makes it equal to \((1 - c)K\), where \(1 - c\) is a share of capital available for the economy after the “corruption tax”. Under a more precise consideration one would claim that certain share of the corrupt money still stays in the economy and works in the production cycle, but there are two following arguments. First of all, there is a considerable number of articles that show the outflow of the corrupt capitals offshore and even claim that the very existence of certain tax-heavens stimulates the corruption inshore, see, for instance Hampton (1996). The second argument is similar to the one that was already given in a previous paragraph. Since this analysis is talking about an implicit variable that cannot be measured directly, one can say that actual share of capital that does not contribute to the production is a discounted share of corrupt capital and work with parameter \(c\) without any loss of generality.

Now, in the presence of these two factors the Equation (1) looks as follows

\[
Y = A(1 - g)^{1 - \alpha}(1 - c)^\alpha L^{1 - \alpha}K^\alpha,
\]

where \(g\) is a share of governmentally employed that do not contribute to the production directly and \(c\) is a level of corruption “tax”, that does not contribute to the production directly. Out of (2) one can immediately obtain a connection between a capital intensity \(k_{\text{solow}}\) from the Solow model, i.e. the capital stock per unit of effective labor, and a capital intensity for model, adjusted to the effect of corruption that will be denoted as \(k_{\text{corrupt}}\). The adjustment looks as follows

\[
k_{\text{corrupt}} = (1 - g)^{\frac{1 - \alpha}{\alpha}}(1 - c)k_{\text{solow}}.
\]

Since it is assumed that \(g\) and \(c\) are time-independent the same adjustment would hold for a steady state in Solow model, which means that

\[
k'_{\text{corrupt}} = (1 - g)^{\frac{1 - \alpha}{\alpha}}(1 - c)\left(\frac{s}{n + \delta}\right)^{\frac{1 - \alpha}{\alpha}},
\]

where \(s\) is a saved share of final output that is left for investments, \(\delta\) is a rate of capital depreciation, and \(n\) is the rate of population growth (assuming that it is growing exponentially over time). In fact, all the values in the last multiplier are not that important for us, using the same reasoning another aggregate production function can actually be substituted instead of the current one. The Solow model is used only for the sake of simplicity and clearness. Further reasoning will be focused on Equation (3) rather than on Equation (4), but the results that are obtained are relevant for a steady state of several other models (or could be correspondingly obtained for them).

**Corruption and government employment**

A closer look on the coefficients of (3) that depend on \(g\) and \(c\) is particularly interesting. Assuming that \(c = c(g)\), means that the level of “greed” of corrupt officials can depend on the size of the government. This assumption can have various economic explanations. One of the arguments could be that when a lot of people work in a public sector, they take more capital out of the economy. Other, more controversial, yet possible reasoning could be that as the number of employees in public sector grows, they start to “compete” between one another for the corruption “tax” and that reduces the outflow of the capital from the economy. No matter what reasoning one has in mind assuming that \(c\) can be regarded as a function of \(g\) it is interesting to see what consequences this assumption would have in a proposed framework.

Taking a partial derivative of \(k_{\text{corrupt}}\) with respect to \(g\) and keeping in mind that \(c = c(g)\) one obtains

\[
\frac{\partial k_{\text{corrupt}}}{\partial g} = \left(- (1 - g)^{\frac{1 - \alpha}{\alpha}} \frac{\partial c}{\partial g} - \frac{1 - \alpha}{\alpha} (1 - g)^{\frac{1 - \alpha}{\alpha} - 1} (1 - c)\right)k_{\text{solow}}.
\]

(5)

If there is an optimal value of \(g\) such that \(k_{\text{corrupt}}\) (i.e. capital intensity in the presence of corruption) is maximal that naturally means that in this point \(g_{\text{optimal}} = g_0\) the first derivative of capital intensity with respect to \(g\) is equal to zero and the second derivative with respect to \(g\) is negative. The condition \(\frac{\partial k_{\text{corrupt}}(g_0)}{\partial g} = 0\) essentially means that

\[
-(1 - g)^{\frac{1 - \alpha}{\alpha}} \frac{\partial c}{\partial g} - \frac{1 - \alpha}{\alpha} (1 - g)^{\frac{1 - \alpha}{\alpha} - 1} (1 - c) = 0,
\]

(6)

or writing it in another way

\[
\frac{\partial c}{\partial g} = \frac{1 - \alpha}{\alpha} \frac{1 - c}{1 - g}.
\]

(7)
Since $\alpha$, $c$, and $g$ are less then one by definition it directly follows from (7) that the first derivative of $c$ with respect to $g$ is always not positive. This is an interesting implication that is worth noting here and coming back to it later. In our framework $c = c(g)$, so Equation (6) is actually an ordinary differential equation and can be solved keeping in mind that $\frac{\partial c}{\partial g} < 0$, the solution looks as follows

$$c = 1 - \sqrt{c_1 - \frac{1 - \alpha}{\alpha} g^2 + 2 \frac{1 - \alpha}{\alpha} g}, \quad (8)$$

where $c_1$ is an arbitrary constant. Due to the chosen framework $c_1$ needs to be adjusted in such a way that $0 < c < 1$. Since $c_1$ is an arbitrary constant it can be shifted, so that Equation (9) can be rewritten in a more convenient form

$$c = 1 - \sqrt{\xi(\beta - \Theta^2)}, \quad (9)$$

where $\xi = \frac{1 - \alpha}{\alpha}$, $\xi > 0$ since $0 < \alpha < 1$, $\Theta = 1 - g$ and $\beta$ is a new arbitrary constant such that $0 < \beta < 1$. It is useful to rewrite Equation (6) in terms of $\Theta$ and obtain

$$\frac{\xi \Theta}{\sqrt{\xi(\beta - \Theta^2)}} - \xi \Theta^{-1} \sqrt{\xi(\beta - \Theta^2)} = 0. \quad (10)$$

The solution of this equation can be easily found

$$\Theta = \sqrt{\beta(1 - \alpha)}$$

or in terms of $g$

$$g_0 = 1 - \sqrt{\beta(1 - \alpha)}. \quad (11)$$

The found $g_0$ is an extremum of $k_{corrupt}$. The last question that is to be answered is whether it is a maximum or a minimum. First of all, it is necessary to note that in order to find if $g_0$ in a point, where $k_{corrupt}$ reaches a maximum or a minimum it is needed to figure out if $\frac{\partial^2 k_{corrupt}}{\partial g^2} \bigg|_{g=g_0}$ is smaller or bigger than zero. This can be done in a straightforward manner. Indeed, if

$$\frac{\partial^2 k_{corrupt}}{\partial g^2} = \frac{\partial^2 k_{corrupt}}{\partial \Theta^2},$$

then differentiating Equation (10) with respect to $\Theta$ one obtains

$$\frac{\partial^2 k_{corrupt}}{\partial \Theta^2} = \frac{\xi}{\sqrt{\xi(\beta - \Theta^2)}} + \frac{\xi^2 \Theta^2}{\sqrt{\xi^3(\beta - \Theta^2)^3}}$$

$$+ \xi \Theta^{-2} \sqrt{\xi(\beta - \Theta^2)} + \frac{\xi^2}{\sqrt{\xi(\beta - \Theta^2)}}.$$ 

Since all four elements of the sum above are positive it is easy to conclude that $\frac{\partial^2 k_{corrupt}}{\partial g^2} \bigg|_{g=g_0} > 0$, which means that $k_{corrupt}(g_0)$ is, indeed, a maximum.

**Discussion of the model**

A simple model, proposed above has a number of interesting implications.

The first one is the existence of an optimal "size" of the government that provides the biggest capital intensity given in Equation (11). It directly follows from the formula, that this optimal size of the government sector is bigger for capital intensive countries and smaller for labor intensive ones.

The second interesting implication is following from the formula (6). At least in the neighborhood of the optimum point $g_0$ (obviously, the model cannot handle extreme cases, when $g$ is too close to 1 or to 0) the first derivative of corruption with respect to the size of the government is negative. This is very interesting. This means, as some might claim counterintuitively, that when the country is near the optimal point a bigger government leads to a smaller corruption "tax" (the other direction of casualty, i.e. lower corruption "tax" leads to the bigger government seems too improbable). There are at least two possible reasons behind it. If one attributes corruption not to the quality of the government institutions directly, but rather to the moral standards of the society, that could be considered as an averaged universal quality, one can say, that when a "healthy" society increases the government sector this does not lead to the growth of the corruption "tax", since new employees will rather fight corruption, than become corrupt themselves. Another reasoning can be developed if one thinks in the framework of institutions rather than of individuals. The growth of the government can inevitably increase the competition within government structures, this competition might lead to the reduction of the total level of corruption. Indeed, the world knows situations, when huge corruption scandals were actually caused by a competition within government structures rather than due to the activity of a civil society.

The third implication directly follows from the second one. Since $\alpha$ cannot be measured directly and around the optimal state $\frac{\partial c}{\partial g} < 0$ there is always a temptation to increase the size of the government, that in return can actually reduce corruption but will be suboptimal for the output of the economy and a personal capital intensity.

The last implication directly follows from the Equation (4). The negative effect of the government that differs from an optimal one ($g \neq g_0$) tends to be stronger for a labor-intensive country, than for a capital-intensive one (see Figure 2). This is due to the fact that the level of corruption "tax" has a linear influence on the capital intensity, while the level of government employment influences it non-linearly and the influence of $g$ grows drastically as $\alpha$ gets smaller. This also means that capital-intensive economies might fight
corruption at the expense of the growth whereas labor-intensive ones cannot afford this luxury.

**Conclusion**

This study has empirically demonstrated that a widely popular notion that countries with smaller governments tend to have smaller levels of corruption does not have a solid empirical background. In fact, according to the provided data for 72 countries the connection, if existent, is the opposite.

As far as the authors know this research is the first to broaden a framework of an aggregate production function and to use it in order to describe a relation between the employment in the government sector and the level of corruption. Assuming that there is a connection between the corruption-tax and the size of the government sector this work provides a very basic model that demonstrate an existence of optimal size of the government that corresponds to the highest capital-intensity of the economy under very general assumptions.

The model combines mathematical and economic simplicity with a possibility to describe certain phenomena associated with corruption. In particular it shows that labor-intensive countries should have lower percentage of labor employed in the public sector in comparison with capital intensive countries, since the optimal size of the government depends on the parameter $\alpha$ that characterizes the type of the economy in a standard aggregate production framework. The model also shows that it is crucial for a labor-intensive country to have a size of the government that would be close to the optimal size, since the capital intensity decreases steeply if the government size differs from the optimal one. For the capital-intensive countries this aspect is, however, far less important and suboptimal size of the government that can be too big or too small would still correspond to a comparable capital intensity. The model also shows that the level of corruption could be reduced with higher sizes of the government (say, stronger governmental control) but this reduction does not have to lead to a higher capital intensity, especially for a labor intensive country. Finally, due to the simplicity and generality of the model it can be used as and integrating framework, that can help to take a phenomena associated with corruption and the size of the government into consideration within more complicated multi-factor models.

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