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Effect of corruption on government expenditure

According to the United Nations Office on Drugs and Crime (UNODC) (2019), corruption hinders the achievement of a better quality of life for a larger fraction of society, causes losses, economic inefficiencies, creates poverty and inequality, causes personal losses, intimidation, inconvenience, and dysfunctionality of the private and public sectors.

Measuring corruption is challenging because participants have incentives to hide it. According to the United Nations (2018), citing World Economic Forum data, annual costs from corruption are estimated at 5% of Gross Domestic Product (GDP). The IMF (2016) estimates that the annual cost of bribery is 2% of GDP and according to IMF (2019) corruption reduces tax income in at least 1.25% of GDP. Transparency International estimates that 10% of global net worth has been generated through illicit activities.

To analyze the impact of corruption in the optimization path of government expenditure on goods and services, we present a simplified model where paths for effective expenditure, $g_t \geq 0$, and net worth, $nw_t \gtreqless 0$, are chosen to:

$$\max_{\{g_t, nw_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(g_t)$$

subject to:

$$nw_{t+1} = (1 + (1 - c_t^r)r_t)(1 - c_t^{nw})nw_t + (1 - c_t^y)y_t - (1 + c_t^g)g_t$$

$$nw_0 \ \ given$$

$$\lim_{t\to\infty} \frac{nw_t}{[(1 + (1 - c_t^r)r_t)(1 - c_t^{nw})]^t} \to 0$$

Where $r_t \geq 0$ is the return (or cost) on net worth and $y_t \geq 0$ is the income level. To deliver g_t units of effective consumption, the government, on behalf of the society, pays $(1 + c_t^g)g_t$ units, so $c_t^g \geq 0$ is the corruption associated to overpayment of expenditure, and $(1 + c_t^g)$ is akin to a relative price of expenditure. Income is also subject to corruption, given by $c_t^y \in [0,1]$ and it could be considered as the fraction of income lost due to tax evasion and losses in other sources of income due to corruption. Net worth is also in risk of corruption, given by $c_t^{nw} \in [0,1]$, and it represents when net assets are stolen from the government. Finally, the return on net worth is also subject to corruption, given by $c_t^r \gtreqless 0$, and it represents factors that lower the return on net worth, $c_t^r > 0$, or raises the cost on debt, $c_t^r < 0$. Some technical assumptions include that society's preferences discount the future with the factor β, where $0 < \beta < 1$. In addition, to have an interior solution with positive levels of expenditure in any period, it is assumed that the utility function has the following characteristics: $u'(\cdot) > 0$, $u''(\cdot) < 0$, $\lim_{t\to 0} u'(\cdot) \to \infty$, $\lim_{t\to\infty} u'(\cdot) \to 0$.

The Euler equation for expenditure optimization is given by:

$$\text{(1)} \qquad \frac{u'(g_t)}{(1+c_t^g)} = \beta(1 + (1 - c_{t+1}^r)r_{t+1})(1 - c_{t+1}^{nw})\frac{u\prime(g_{t+1})}{(1+c_{t+1}^g)}$$

This condition implies that it is optimal to postpone expenditure up to the point where the cost of not spending, in terms of the forgone marginal utility, is equal to the discounted marginal benefit of spending in the future. This condition can be expressed as the equalization of the marginal rate of substitution, on the left side, to the marginal rate of transformation, on the right side:

$$(2) \qquad \beta \frac{u\prime(g_{t+1})}{u'(g_t)} \frac{(1+c_t^g)}{(1+c_{t+1}^g)} = \frac{1}{(1+(1-c_{t+1}^r)r_{t+1})(1-c_{t+1}^{nw})}$$

Corruption on expenditure, c_t^g, affects the marginal rate of substitution, increasing the relative cost of spending and therefore reducing the optimal level of spending on high corruption periods. Meanwhile, corruption that affects net worth and its return, c_{t+1}^{nw} and c_{t+1}^r, respectively, lowers the marginal rate of transformation over time, providing incentives to spend earlier and biasing towards a downward trend in the provision of goods and services in the public sector.

To get a solution for the paths of expenditure and net worth, we need to combine the Euler equation with the lifetime resource constraint, given by:

$$(3) \qquad \sum_{t=0}^{\infty} \frac{(1+c_t^g)g_t}{[(1+(1-c_t^r)r_t)(1-c_t^{nw})]^t} \leq nw_0 + \sum_{t=0}^{\infty} \frac{(1-c_t^y)y_t}{[(1+(1-c_t^r)r_t)(1-c_t^{nw})]^t}$$

Here we see that corruption on government expenditure increases the uses of resources, while corruption on income lowers the sources. In general, to get a solution, we would need to specify the utility function and combine elements from both equations. Under some assumptions, there could be simplified solutions to this problem and to gain further intuition, next we review some special cases.

First, let's assume that the elements in the marginal rate of transformation, or discount factor, r_t, c_t^r, c_t^{nw}, are constant over time. Then, the infinite sum of discount factors would have the solution: $\sum_{t=0}^{\infty} \frac{1}{[(1+(1-c^r)r)(1-c^{nw})]^t} = \frac{1}{(1+(1-c^r)r)(1-c^{nw})-1}$.

To further gain intuition, let's consider again the case in which preferences are such that $\beta(1+(1-c_{t+1}^r)r_{t+1})\left(1-c_{t+1}^p\right) = 1$ and corruption on expenditure is constant, such that the optimal level of expenditure is constant over time. Under these three assumptions, the solution to the optimal level of expenditure is to consume a fraction of permanent income:

$$(4) \qquad g = \left[\frac{(1+(1-c^r)r)(1-c^{nw})-1}{1+c^g}\right]\left[nw_0 + \sum_{t=0}^{\infty} \frac{(1-c_t^y)y_t}{[(1+(1-c^r)r)(1-c^{nw})]^t}\right]$$

From this expression we see that corruption on income, c_t^y reduces permanent income, while corruption on net worth and its return, c_t^r, c_t^p, and expenditure, c_t^g, reduce the fraction of permanent income that is consumed.

Finally, to derive a simplified solution to the expenditure level, in addition to the previous assumptions of $\beta(1+(1-c_{t+1}^r)r_{t+1})\left(1-c_{t+1}^p\right) = 1$ and r_t, c_t^r, c_t^p, c_t^g constant, we also assume that income and its corruption are constant over time, to get:

$$(5) \qquad g = \frac{(1+(1-c^r)r)(1-c^{nw})-1}{1+c^g} nw_0 + \frac{1-c^y}{1+c^g} y$$

Here we can see that all corruption margins negatively affect optimal expenditure. Corruption on net worth and its return through the marginal rate of transformation, affect the fraction of initial net worth that is consumed, corruption on government expenditure affects the marginal rate of substitution, increasing the relative price of spending, while corruption on income limits the available resources hindering permanent income.

Expression (5) could be used to see how expenditure would change if any of its determinant changes. When income changes, expenditure change is given by $\frac{\partial g}{\partial y} = \frac{1-c^y}{1+c^g} \leq 1$. When initial net worth changes, expenditure change is given by $\frac{\partial g}{\partial nw_0} = \frac{(1+(1-c^r)r)(1-c^{nw})-1}{1+c^g} > 0$. When interest rate changes, expenditure change is given by $\frac{\partial g}{\partial r} = \frac{(1-c^r)(1-c^{nw})}{1+c^g} > 0$. Therefore, an increase in income, net worth and its return contribute to increase government expenditure.

What are the effects of corruption on effective government expenditure? When corruption in income changes, expenditure change is given by $\frac{\partial g}{\partial c^y} = \frac{-1}{1+c^g} y < 0$. When corruption in net worth changes, expenditure change is given by $\frac{\partial g}{\partial c^{nw}} = \frac{-(1+(1-c^r)r)}{1+c^g} nw_0 < 0$. When corruption in net worth return changes, expenditure change is given by $\frac{\partial g}{\partial c^r} = \frac{-r(1-c^{nw})}{1+c^g} nw_0 < 0$. When corruption in government expenditure changes, expenditure change is given by $\frac{\partial g}{\partial c^g} = -\left[\frac{(1+(1-c^r)r)(1-c^{nw})-1}{(1+c^g)^2} nw_0 + \frac{1-c^y}{(1+c^g)^2} y\right] < 0$. Therefore, any increase in corruption reduces effective government expenditure.

The previous optimization model of government expenditure can serve as a basis to empirically analyze the effect of corruption. To do so, we use information from the IMF's Government Finance Statistics (GFS), Main Aggregates and Balances (MAB) to get information on the General Government flows and stocks of 113 countries, with General Government's statistics as a share of GDP, covered in the database between 1972 and 2021. It is important to note that the observed variables already contain corruption such that the relationship between the observed variables and those described in the model are: $expenditure_t = (1 + c_t^g)g_t$, $revenue_t = (1 - c_t^y)y_t$, and $interest\ expense_t = (1 - c_t^r)r_t(1 - c_t^{nw})nw_t$.

In addition, we use information of the 181 countries covered in the Transparency International's Corruption Perception Index from 2012 to 2021. The Panel Data estimation is performed with data of 91 countries between 2012 and 2021. The estimated equation, on countries indexed by i at time t, is given by:

$$expenditure_{it} = \alpha_0 + \alpha_1 corruption_{it} + \alpha_2 revenue_{it} + \alpha_3 interest\ expense_{it} + \eta_i + u_{it}$$

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. xtreg Expenditure corruption Revenue Interest_expense, re

Random-effects GLS regression                   Number of obs     =        710
Group variable: c_id                            Number of groups  =         91

R-squared:                                      Obs per group:
     Within  = 0.1534                                         min =          1
     Between = 0.7361                                         avg =        7.8
     Overall = 0.6225                                         max =         10

                                                Wald chi2(3)      =     363.07
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =     0.0000

------------------------------------------------------------------------------
     Expenditure | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
-----------------+------------------------------------------------------------
      corruption |  -.1385203   .0227342    -6.09   0.000    -.1830786   -.0939621
         Revenue |   .2187172   .0131895    16.58   0.000     .1928663    .2445682
Interest_expense |   1.300958   .2362367     5.51   0.000     .8379428    1.763974
           _cons |   32.91532   1.411553    23.32   0.000     30.14872    35.68191
-----------------+------------------------------------------------------------
         sigma_u |  3.3575245
         sigma_e |  3.2759804
             rho |  .51229091   (fraction of variance due to u_i)
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Therefore, we see that corruption negatively affects observed government's expense. To get a sense of the effect of corruption we can take the average corruption index of the 5 most corrupt countries in the sample (Somalia, Yemen, Afghanistan, Democratic Republic of Congo, and Cambodia, which are not necessarily the most corrupt in the Transparency International database as other 18 highly corrupt countries does not report Government Finance Statistics), which is 83.74, while the one of the 5 least corrupt countries (Denmark, New Zealand, Finland, Singapore, and Sweden) is 12.84. Therefore, on average, corruption reduces expenditure by 9.9% of GDP, which is half of the expenditure difference which averaged 21.3% of GDP for the high corruption countries and 41% of GDP for the low corruption ones.