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Corruption and Growth Under Weak Identification

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Abstract

The goal of this paper is to revisit the influential work of Mauro [1995] focusing on the strength of his results under weak identification. He finds a negative impact of corruption on investment and economic growth that appears to be robust to endogeneity when using two-stage least squares (2SLS). Since the inception of Mauro [1995], much literature has focused on 2SLS methods revealing the dangers of estimation and thus ”traditional” types of inference under weak identification. We reproduce the original results of Mauro [1995] with a high level of confidence and show that the instrument used in the original work is in fact ”weak” as defined by Staiger and Stock [1997]. Thus we update the analysis using a test statistic robust to weak instruments. Our results suggest that under Mauro’s original model there is a high probability that the parameters of interest are locally almost unidentified in multivariate specifications. To address this problem, we also investigate other instruments commonly used in the corruption literature and obtain similar results. After identifying an instrument with sufficient strength we fail to reject a zero effect of corruption on investment and economic growth.

Journal of Economic Literature Classification: C31, D73

Keywords: Corruption, Growth, Weak Identification, LAU

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1 Introduction

The purpose of this paper is to revisit Mauro (1995) and examine the validity of his results as a consequence of recent research that cautions against making "traditional" types of inference in the presence of weak instruments. Early work done by Nelson and Startz (1990a, 1990b) demonstrates that the distribution of the 2SLS estimator and the t-statistic is poorly approximated by the asymptotic representation when instruments are weak. More formally, Staiger and Stock (1997) model the coefficients on the instruments in the first stage equation in the $n^{-1/2}$ neighborhood of zero in which they show that the 2SLS estimator loses consistency resulting in a nonstandard distribution for the t-statistic. In fact, they show that under the local-to-zero framework the distribution of the t-statistic depends on the level of endogeneity, strength and the number of instruments. Thus, the true size of the t-statistic can differ substantially from its perceived size when instruments are weak. Therefore, 95% confidence intervals based on asymptotic approximations, such as $\hat{\beta} \pm 1.96 se(\hat{\beta})$ are no longer reliable. As a rough rule of thumb Staiger and Stock (1997) suggest a first-stage F-stat of 10 on the excluded instruments as an indication of acceptable instruments. In terms of point estimation, Bound, Jaeger, and Baker (1995) show that the 2SLS estimator is biased in the same direction as the OLS when using irrelevant instruments. Hahn and Hausman (2002) illustrate a detailed expression for the 2SLS bias showing that it is monotonically decreasing in the instrument strength while being monotonically increasing in the degree of endogeneity. Cruz and Moreira (2005) verify these results through Monte Carlo simulations also showing that the classic bias corrected 2SLS estimator of Nagar (1959) provides a poor correction when instruments are very weak. We therefore attempt to reproduce Mauro's results and analyze them in light of these recent findings.

From the early work of Leff (1964) and Huntington (1968) corruption in government has been of great interest to economists. These studies argue that corruption could be positively correlated with economic performance in the presence of a thick and cumbersome bureaucracy. Corruption in this view "greases the wheels" of bureaucracy, thus increasing the efficiency in which transactions occur, leading to a positive effect on the economic performance of a country.

On the other hand, Rose-Ackerman (1978), Murphy, Shleifer, and Vishny (1991, 1993), and Shleifer and Vishny (1993) provide theoretical arguments that corruption deteriorates economic growth through the misallocation of talent and other resources.

Mauro (1995) contributes to this debate by examining empirically the relationship between two measures of corruption and investment and economic growth. His results suggest that corruption has a negative impact on investment and economic growth. The significance of his results varies with model specifications but the results appear to be robust when correcting for the endogeneity of corruption. Using the ethnolinguistic fractionalization

(ELF) index as an instrumental variable (IV), he employs 2SLS estimation to correct for endogeneity created by the two measures of corruption.

The impact of Mauro (1995)'s work can be gauged by looking at the numerous citations the paper has received since it was published. According to one ranking, the paper is among the top cited papers in economics.[1] This paper has had a profound influence on the direction of research in corruption as well as policy making. This requires us to examine it closely and ensure the validity of its results using methods unavailable to researchers at the time.

This paper is organized as follows: Section 2 describes our methodology including the test statistic that is robust to weak identification. In section 3 we review the data used in our analysis spending some time on the instrument used by Mauro and another instrument commonly used in the corruption literature. We also introduce an alternative instrument to those listed above. We then review our findings in section 4 and finally conclude.

2 Methodology

Mauro (1995) follows a typical estimation procedure for cross-country analysis, averaging investment share (I_{SHARE}) and per-capita GDP growth over 1960-1985 ($GROWTH$). While averaging across countries may seem inferior to a panel approach, recent work by Hauk and Wacziarg (2004) finds that the

[1] http://ideas.repec.org/top/top.item.nbcites.html

averaging methodology performs best in the presence of endogeneity or measurement error compared to fixed-effects, random-effects, and Arellano-Bond estimators. Mauro (1995) uses the following setup to examine the relationship between corruption and long-run investment and growth of per-capita GDP :

$$y_1 = X\gamma + \beta y_2 + u \quad \text{where} \quad EX'u = 0 \text{ and } \quad Ey_2'u \neq 0 \tag{1}$$

Here X is an $n \times K$ matrix of control variables often used in cross-country growth regressions found in Barro (1991) or Levine and Renelt (1992). y_1 is an $n \times 1$ vector containing data on investment share or per-capita growth, and y_2 is an $n \times 1$ vector containing data on either corruption (COR) or bureaucratic efficiency (BE). The reduced form equation for y_2 is:

$$y_2 = X\pi_0 + \tilde{Z}\pi_1 + v \tag{2}$$

$\tilde{Z}$ is an $n \times k$ matrix of IVs s.t. $E\tilde{Z}'u = 0$ and $cov(\tilde{Z}, y_2) \neq 0$.

The fundamental scaler that arises in the literature regarding a measure of instrument strength is the concentration parameter. Stock, Wright, and Yogo (2002) provide an expression for the concentration parameter: $\lambda = \frac{\pi_1'\tilde{Z}'\tilde{Z}\pi_1}{\sigma_v^2}$. They show, that in large samples, $\lambda/k + 1$ can be thought of as first-stage F-stat on the *IVs only.* So when Staiger and Stock (1997) suggest as a "rule of thumb" a first-stage F-stat of 10 as an indication of "strong" instruments, they refer to a first-stage F-stat on the *IVs* and not the entire set $J = [X \quad \tilde{Z}]$.

As previously mentioned, when the instruments are weakly correlated with the endogenous variable (i.e., a $\lambda/k+1$ smaller than 10) problems arise under 2SLS and limited information maximum likelihood (LIML) estimation. Under the assumption of normal errors, Moreira (2003) describes methods that lead to more reliable test statistics and confidence intervals when confronted with weak identification.

We employ Moreira (2003)'s conditional likelihood ratio (CLR) test statistic:[2]

$$CLR = \frac{1}{2}\left[\bar{S}'\bar{S} - \bar{T}'\bar{T} + \sqrt{[\bar{S}'\bar{S} + \bar{T}'\bar{T}]^2 - 4[\bar{S}'\bar{S} \cdot \bar{T}'\bar{T} - (\bar{S}'\bar{T})^2]}\right] \tag{3}$$

where:

$$\bar{S} = (b'\Omega b \cdot Z'Z)^{-1/2} Z'Yb$$
$$\bar{T} = (a'\Omega^{-1}a \cdot Z'Z)^{-1/2} Z'Y\Omega^{-1}a$$
$$Y = [y_1\, y_2]$$
$$b = [1\ -\beta_{NULL}]'$$
$$a = [\beta_{NULL}\, 1]'$$
$$Z = (I - X(X'X)^{-1}X')\tilde{Z}$$

where Ω is the variance-covariance matrix to be estimated. The conditional nature of the CLR test comes from the fact that in practice the critical

[2]See http://post.economics.harvard.edu/faculty/moreira/softwaresimulations.html for the CLR test code.

value is conditional on the preliminary estimate of the vector π_1.[3] Hence, inference that is based on the CLR test takes into consideration the strength of the instruments, and should therefore always be used when employing 2SLS or LIML estimation. Although there exist other test statistics that are valid under weak identification, Andrews et al. (2006b) demonstrate that the CLR test has the correct null rejection probability when identification is weak and it dominates similar test statistics, such as the Lagrange multiplier (LM) and the Anderson-Rubin (AR) statistics in power comparisons. Even though the assumption of normal errors seems rather restrictive, Andrews et al. (2006b) show that the power of the CLR test can be unaffected even with nonnormal errors. Andrews, Moreira, and Stock (2006a) illustrate that the CLR test outperforms a conditional Wald (CW) test in terms of size and power across many simulation designs. They show that the CW test has a strong asymptotic bias and thus very low power even for large deviations from the null. Because the CLR test is centered around the LIML estimator, we report the LIML estimates in our results.

3 Data Description

The data we use derives from multiple sources including Summers and Heston (1988), Barro (1991) and directly from Mauro (1995).[4] The ethnolinguistic

[3]For a detailed description of this process see Andrews, Moreira, and Stock (2006b).

[4]These data constructed by Barro (1991) and Summers and Heston (1988) can be found at http://www.worldbank.org/research/growth/ddlevren.htm

fractionalization (ELF), corruption and bureaucratic efficiency indices are from the appendix of Mauro (1995). The original source of the ELF index is Taylor and Hudson (1972). The data for legal origins (LO) is from the World Bank[5] and projected trade share (Pr. Trade) comes from Frankel and Romer (1999).

Tables 1 through 4 show that our regressions agree with those of Mauro (1995) very closely in size of the coefficients and significance levels in both bivariate and multivariate OLS. Since our data set seems to match the original data set well, we feel comfortable extending our results to those found in Mauro (1995).

3.1 Instruments

The first instrument we examine, the ethnolinguistic fractionalization (ELF) index, has the following form:

$$ELF = 1 - \sum_{i=1}^{I} \left(\frac{n_i}{N} \right)^2 \tag{4}$$

where I is the number of ethnolinguistic groups in a country, n_i is the number of people in the ith group, and N is the total population of the country. Therefore, the higher the index, the more fragmented the country. Mauro (1995) draws on simple correlations between the ELF index, corruption, and bureaucratic efficiency arguing that greater fragmentation leads to higher

[5] http://econ.worldbank.org/

levels of corruption as a result of bureaucrats favoring their own ethnolinguistic group. The use of the *ELF* index as an instrument for corruption is not limited to Mauro (1995) but has also been used by Neeman, Paserman, and Simhon (2004), Dreher and Schneider (2006), Mocan (2004) and Mauro (1996). The exogeneity of the *ELF* index is an assumption made in Mauro (1995) and will not be addressed in this paper. The main focus of the paper is to address the quality of the instrument in terms of its ability to successfully identify the structural relationship corruption has with growth and investment share.

Legal origins (LO) is another instrument commonly used for corruption as found in Pellegrini and Gerlagh (2004), Fredriksson and Svensson (2003), Dreher and Schneider (2006), and Neeman et al. (2004). These papers argue strongly that 'legal origins' is a sufficient instrument for corruption, offering the empirical results of La Porta, Lopez-de Silanes, Shleifer, and Vishny (1999) as support. The variable is a dummy, indicating whether a country has French, English, Scandinavian, or German legal origin. The justification for using LO as an instrument is its relationship with institutional efficiency as well as with the level of government intervention. La Porta et al. (1999) argue that more interventionist governments and less efficient bureaucracies should have higher levels of corruption. For example, countries founded on English common law focus less on government intervention and place more emphasis on the protection of individual rights and should therefore have lower levels of corruption. La Porta et al. (1999) also argue that LO

are exogenous to economic variables because they are mainly determined by historical factors.

Furthermore, we propose a new instrument for corruption that has been already widely used in the economic growth literature as an instrument for social infrastructure. It is the predicted geographical component of the countries trade share of GDP, or simply the predicted trade share. Frankel and Romer (1999) estimate a version of a gravity model of bilateral trade using only the geographical characteristics of the countries. Estimated parameters are used to obtain the fitted values for the geographical component of countries' overall trade. The estimated trade shares of each country are obtained aggregating over all the countries in the world. A negative correlation between projected trade share and corruption stems from the fact that more corrupt countries are more costly to trade with.

Hall and Jones (1999) use predicted trade shares of Frankel and Romer (1999) as one of the instruments for the social infrastructure.[6] As Kögel (2005) points out, the measure of social infrastructure used by Hall and Jones (1999) (apart of the openness of the economy) is similar to the measure of corruption used in Mauro (1995). Thus the use of predicted trade shares as an instrument for corruption looks natural.

[6]Social infrastructure is measured as a combination of two indexes: (i) index of government antidiversion policies (GADP), and (ii) openness of economy to international trade.

4 Results

Table 6 shows the results for the following specifications:

$$\text{Columns 1-4: } I_{SHARE} = \gamma_0 + X\gamma_1 + \beta BE + u \tag{5}$$

$$\text{Columns 5-8: } I_{SHARE} = \gamma_0 + X\gamma_1 + \beta COR + u \tag{6}$$

Table 5 shows the results for the same specifications listed in equations 5 and 6 excluding X. Table 8 shows the results for the following specifications:

$$\text{Columns 1-4: } GROWTH = \gamma_0 + X\gamma_1 + \beta BE + u \tag{7}$$

$$\text{Columns 5-8: } GROWTH = \gamma_0 + X\gamma_1 + \beta COR + u \tag{8}$$

Table 7 shows the results for the same specifications listed in equations 7 and 8 excluding X.

The matrix X includes GDP in 1960, secondary education in 1960, population growth rate over the period of 1960-1985. Furthermore, it is assumed that bureaucratic efficiency and corruption are endogenous, therefore in all model specifications β is estimated via 2SLS and LIML.

Table 5 contains the results under 2SLS compared to Mauro (1995)'s using *LO*, *ELF* index, and *Pr. Trade* as IVs. Once again, the results compare well in both the size of the coefficients and significance levels. Table 5 shows that the first-stage F-stats on the *ELF* index are 4.72 and 5.91, and 4.72 and 2.60 for *LO*. These are well below the value of 10 needed for reliable inference based on the t-statistic. Using the methodology of Moreira (2003), we create confidence intervals robust to weak instruments using the CLR test in Equation 3 under $\beta_{NULL} = 0$. The results suggest that the findings in Mauro (1995) are valid under weak instruments in the bivariate 2SLS estimation. The 95% confidence intervals clearly exclude zero, suggesting that both corruption and bureaucratic efficiency have a significant impact on investment share under the model specifications presented in Table 5. This is true using both the *ELF* index and *LO* as instruments.

Table 5 shows that the CLR confidence regions have similar lower bounds but much larger upper bounds than the traditional Wald-type intervals reported. This implies that it is possible for corruption and bureaucratic efficiency to have a much larger impact on investment share than the mean effect reported in Mauro (1995). We report the J-stat for the overidentification restrictions on legal origins which suggests the exogeneity of legal origins at very reasonable significance levels.

A word of caution however. With such small first-stage F-stats, the power of the overidentfication restrictions test is questionable. Furthermore, according to Cruz and Moreira (2005), weak instruments exacerbate the finite sample bias of 2SLS estimators. Thus, there could be substantial bias in the estimates in Table 5, especially if the *ELF* index is endogenous in the structural equation. This point should be kept in mind throughout the analysis as it is relevant in both the bivariate and multivariate specifications.

Our results show that *Pr. Trade* of Frankel and Romer (1999) is a much stronger instrument[7] for corruption or bureaucratic efficiency when compared to legal origins or ethnolinguistic fractionalization. Table 5 shows that first stage F-stats on the *Pr. Trade* are 9.19 and 7.70. More importantly the confidence regions constructed using the CLR test are bounded and similar to those created by inverting the t-statistic.

Frankel and Romer (1999) do not report predicted trade shares for Australia and New Zeland (probably due to distinct remoteness of these countries), thus these countries are excluded from the sample.[8] Note, however, that excluding or including Australia and New Zealand yields very similar results in estimations using *ELF* or *LO* as instruments.

Table 6 shows results from specifications including additional controls. Columns 1 and 5 show our attempt to replicate the results of Mauro (1995) using the *ELF* index as an instrument. The coefficient on bureaucratic efficiency does not match well, however the remaining coefficients are similar in magnitude and significance levels, including the coefficient on corruption. Examining the first-stage F-stat, we see that both instruments are very weak. With a first-stage F-stat of 2.84 and 3 for the *ELF* index, and 0.62 and 0.04 for *LO* in the bureaucratic efficiency and corruption regressions, respectively, we employ the CLR test to construct valid confidence intervals robust to weak instruments.

[7]In terms of first stage regression F-stat

[8]Predicted trade shares for Australia and New Zealand are made available by Hall and Jones (1999). Since estimation results with or without these countries are qualitatively the same, we only report the results based on the original Frankel and Romer (1999) data.

The results are disconcerting as the intervals at the 95% level are unbounded using both IVs. This is consistent with the theoretical results of Dufour (1997), who shows that under local almost unidentification (LAU), [e.g. weak instruments], valid confidence intervals will be unbounded with *at least* probability $(1-\alpha)$, where $(1-\alpha)$ represents the level of the confidence interval constructed. Dufour (1997) also proves that, under LAU, confidence regions which are bounded with probability one, such as the Wald-type, will have zero coverage probability. Moreover, in his later work, Dufour (2003, p.19) concludes that "[u]nbounded sets are highly likely when the model is not identified, so they point to lack of identification." Nelson, Startz, and Zivot (1996) show analytically for various test statistics valid to weak instruments, that unboundedness is a result of near unidentification. They also demonstrate using Monte Carlo simulations that with high levels of endogeneity and weak instruments the structural parameter is in fact excluded from intervals created by inverted t-statistics as we have done in Table 6.

Since the CLR test is "robust" to weak instruments, in the sense that it has correct coverage probability, the role that the F-stat plays in empirical studies can be deemphasized. If the instruments are irrelevant, the CLR test will return unbounded confidence intervals correctly $(1-\alpha)100\%$ of the time. If on the other hand the instruments are strong, then the confidence regions returned by the CLR will be bounded. Thus, one does not need to examine the first-stage F-stat when implementing 2SLS and LIML if the CLR test is used as an alternative to the t-statistic.

With such a low correlation between our measures of corruption and the instruments, it is highly likely that parameters of the equation are unidentified. Since we have reproduced Mauro (1995)'s results with a high level of confidence, one should view the results of Mauro (1995) as uninformative.

Thus, if bureaucratic efficiency and corruption are in fact endogenous in the specifications presented in Table 6, as Mauro (1995) suggests, then the estimation procedure fails to identify the coefficients due to weakness of the *ELF* index. This conclusion is also true when using the *LO* variable as an IV.

Estimating the same specification of the model using *Pr. Trade* as an instrument (column 3 and 7) provides conclusive results. The strength of the instrument is much higher compared to the *ELF* (first stage F-stats of 8.91 and 6.17 as compared to 2.84 and 3.00) and this is reflected by the bounded intervals created by the CLR test. Notice that zero is included in the CLR test intervals, and thus we cannot rule out the possibility that there exists no relationship between corruption (or bureaucratic efficiency) and investment.

Table 7 shows the impact corruption has on long-run growth compared to Mauro (1995). Using the *ELF* index as an instrument suggests that both corruption and bureaucratic efficiency are significant at the 5% level, as found in the original paper. Neither bureaucratic efficiency nor corruption are statistically significant when using *LO* as an instrument. Interestingly, the valid intervals constructed using the CLR test become unbounded for the coefficient on corruption in bivariate growth regressions. Thus using *LO* as an IV only offers uninformative results.

Estimating the impact of corruption on long-run growth using *Pr. Trade* as an instrument, we fail to reject the null of no effect of corruption (or bureaucratic efficiency) on growth.

We present the 2SLS multivariate growth regressions compared to Mauro (1995)'s results in Table 8. The first-stage F-stats on the instruments are identical to those in Table 6, as expected, so we report the confidence regions constructed using the CLR test. We find unbounded confidence intervals for the coefficients on bureaucratic efficiency and corruption when using the *ELF* index or *LO* as IVs. The findings imply that, when using the *ELF* index and *LO* as instruments, the effect of corruption and bureaucratic efficiency on growth cannot be identified under the specifications presented in Table 8.

Again, with such a low correlation between our measures of corruption and the instruments, it is highly likely that parameters of the equation are unidentified. Thus, making conclusions about corruption's impact on per-capita growth based on such results would be deceptive. However, estimation of this specification using predicted trade share as an instrument, yields bounded confidence intervals. Once again, we fail to reject the null of no impact of corruption or bureaucratic efficiency on economic growth.

We have found a new instrument (projected trade share) that bounds the confidence intervals on the CLR test suggesting that the new instrument has identified the effect corruption has on growth and investment. This new instrument thus provides a better point estimate and informative confidence intervals not provided by Mauro (1995). Furthermore, using our instrument, we are capable of estimating reliable upper bounds for the potential effect of corruption (COR) and bureaucratic efficiency (BE) on investment. In Table 6 we report an upper bound of .054 for BE and an upper bound of .071 for COR using projected trade share as an IV. Also notice that our point estimates in Table 6 are much smaller than those presented under Mauro's specification. For example, our point estimate is .018 using *Pr. Trade* as and IV while the point estimate under Mauro's specification is .044 in the bureaucratic efficiency regression. In the regression for corruption we find a point estimate of .0167 using *Pr. Trade* as an IV while it is .034 when using the ELF index as an IV. Since the 95% confidence intervals constructed using the CLR test contain zero in all of our multivariate specifications we cannot rule out a zero effect of corruption and bureaucratic efficiency on investment. The same argument as laid out above holds for the relationship between growth and corruption and growth and bureaucratic efficiency.

5 Conclusion

Our paper reexamines a key study in the corruption literature under weak identification. We find that the instrument used by Mauro (1995), the ethnolinguistic fractionalization (*ELF*) index, is not useful in identifying the parameters of interest in all multivariate 2SLS specifications. Using legal origins, an instrument commonly used in empirical work on corruption, we show that our main results do not change. Therefore, if corruption is endogenous in the multivariate regressions presented in Mauro (1995), as the literature suggests, neither the *ELF* index nor legal origins serve as relevant instruments. Due to the widespread use of both instruments in applied studies on corruption, caution should be exercised when interpreting their results, unless proper techniques, as laid out in this paper, have been used.

We propose a new instrument, predicted trade share of Frankel and Romer (1999), that is shown to perform much better in terms of it ability to return bounded and therefore informative results. Estimation using this instrument can not rule out the possibility of no effect of corruption on economic growth or investment, a result opposite to the wide spread belief in the literature.

This paper serves as an example of the problematic nature of weak instruments as first noted by Nelson and Startz (1990b, 1990a). Broadly speaking, empirical researchers should always utilize Moreira (2003)'s CLR test to avoid making erroneous inference.

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Table 1: Investment on Corruption, Bureaucratic Efficiency
Dependent Variable: Investment/GDP (1960-1985 Average)

Independent Variables	[1] SKJ (2007)	[2] Mauro (1995)	[3] SKJ (2007)	[4] Mauro (1995)
Constant	0.059	0.059	0.087	0.086
	[2.69]	[2.74]	[4.07]	[4.14]
Bureaucratic	0.022	0.022		
efficiency	[7.34]	[7.47]		
Corruption			0.018	0.018
			[6.32]	[6.43]
Estimation method	OLS	OLS	OLS	OLS
R^2	0.46	0.46	0.40	0.40
	N=58	N=58	N=58	N=58

Robust t-stats in brackets

Table 2: Investment on Corruption, Bureaucratic Efficiency
Dependent Variable: Investment/GDP (1960-1985 Average)

Independent Variables	[1] SKJ (2007)	[2] Mauro (1995)	[3] SKJ (2007)	[4] Mauro (1995)
Constant	0.104	0.104	0.114	0.114
	[2.89]	[3.03]	[3.04]	[3.18]
GDP in 1960	-0.008	-0.008	-0.006	-0.006
	[-1.25]	[-1.31]	[-0.77]	[-0.81]
Secondary	0.06	0.06	0.111	0.111
education in 1960	[0.93]	[0.97]	[1.61]	[1.68]
Population	-1.373	-1.373	-0.621	-0.62
growth	[-1.32]	[-1.38]	[-0.58]	[-0.61]
Bureaucratic	0.019	0.019		
efficiency	[3.86]	[4.04]		
Corruption			0.013	0.013
			[2.81]	[2.94]
Estimation method	OLS	OLS	OLS	OLS
R^2	0.51	0.51	0.47	0.47
	N=58	N=58	N=58	N=58

Robust t-stats in brackets

Table 3: Growth on Corruption, Bureaucratic Efficiency
Dependent Variable: Per Capita GDP growth (1960-1985 Average)

Independent Variables	[1] SKJ (2007)	[2] Mauro (1995)	[3] SKJ (2007)	[4] Mauro (1995)
Constant	0.005	0.05	0.012	0.012
	[0.62]	[0.63]	[1.61]	[1.63]
Bureaucratic	0.003	0.003		
efficiency	[2.53]	[2.58]		
Corruption			0.002	0.002
			[1.93]	[1.97]
Estimation method	OLS	OLS	OLS	OLS
R^2	0.13	0.13	0.07	0.07
	N=58	N=58	N=58	N=58

Robust t-stats in brackets

Table 4: Growth on Corruption, Bureaucratic Efficiency
Dependent Variable: Per Capita GDP growth (1960-1985 Average)

Independent Variables	[1] SKJ (2007)	[2] Mauro (1995)	[3] SKJ (2007)	[4] Mauro (1995)
Constant	0.012	0.012	0.019	0.019
	[1.21]	[1.26]	[1.78]	[1.86]
GDP in 1960	-0.009	-0.008	-0.007	-0.007
	[-4.66]	[-4.87]	[-3.71]	[-3.88]
Secondary	0.011	0.011	0.031	0.031
education in 1960	[0.78]	[0.81]	[2.29]	[2.40]
Population	-0.654	-0.654	-0.395	-0.395
growth	[-2.72]	[-2.85]	[-1.80]	[-1.88]
Bureaucratic	0.006	0.006		
efficiency	[2.94]	[3.09]		
Corruption			0.003	0.003
			[1.83]	[1.91]
Estimation method	OLS	OLS	OLS	OLS
R^2	0.38	0.38	0.27	0.27
	N=58	N=58	N=58	N=58

Robust t-stats in brackets

Table 5: Investment on Corruption, Bureaucratic Efficiency

Dependent Variable: Investment/GDP (1960-1985 Average)

Independent variables	[1] SKJ (2007) BE	[2] SKJ (2007) BE	[3] SKJ (2007) BE	[4] Mauro (1995) BE	[5] SKJ (2007) COR	[6] SKJ (2007) COR	[7] SKJ (2007) COR	[8] Mauro (1995) COR
Constant	-0.08	-0.003	0.054	-0.082	-0.021	-0.037	0.064	-0.021
	[-0.77]	[-0.05]	[0.91]	[-0.78]	[-0.25]	[-0.51]	[1.08]	[-0.27]
β_{2SLS}	0.042	0.031	0.023	0.043	0.033	0.035	0.021	0.033
	[2.80]	[4.17]	[2.62]	[2.84]	[2.86]	[3.43]	[2.45]	[3.04]
β_{LIML}	0.042	0.033	0.023		0.033	0.038	0.021	
Wald (95%)	[0.012, 0.073]	[0.016, 0.045]	[0.005, 0.040]		[0.01, 0.06]	[0.015, 0.056]	[0.004, 0.038]	
CLR (95%)	[0.021, 0.288]	[0.016, 0.066]	[0.001, 0.046]		[0.016, 0.121]	[0.019, 0.171]	[0.000, 0.049]	
Instrument (s)	ELF	Legal Origins	Pr. Trade	ELF	ELF	Legal Origins	Pr. Trade	ELF
J-stat		3.581				1.90		
P-value		0.167				0.386		
F-stat (first stage)	4.72	4.72	9.19		5.91	2.60	7.70	
	N=57	N=57	N=56	N=57	N=57	N=57	N=56	N=57

Table 6: Investment on Corruption, Bureaucratic Efficiency

Dependent Variable: Investment/GDP (1960-1985 Average)

Independent Variables	[1] SKJ (2007) BE	[2] SKJ (2007) BE	[3] SKJ (2007) BE	[4] Mauro (1995) BE	[5] SKJ (2007) COR	[6] SKJ (2007) COR	[7] SKJ (2007) COR	[8] Mauro (1995) COR
Constant	0.036	0.017	0.106	0.036	0.039	-0.19	0.098	0.039
	[0.40]	[0.16]	[2.01]	[0.42]	[0.42]	[0.20]	[1.60]	[0.40]
GDP in 1960	-0.023	-0.024	-0.008	-0.026	-0.021	-0.06	-0.01	-0.021
	[-1.34]	[-1.16]	[-0.82]	[-1.57]	[-1.23]	[-0.35]	[-0.83]	[-1.41]
Secondary	-0.078	-0.082	0.078	-0.078	0.017	-0.21	0.10	0.017
education in 1960	[-0.48]	[-0.43]	[0.82]	[-0.56]	[0.15]	[-0.20]	[1.25]	[0.16]
Population	-2.75	-2.964	-1.274	-2.574	-1.144	-2.60	-0.69	-1.144
growth	[-1.43]	[-1.31]	-0.95	[-1.84]	[-0.81]	[-0.39]	[-0.58]	[-1.12]
β_{2SLS}	0.044	0.048	0.018	0.004	0.034	0.094	0.0167	0.034
	[1.59]	[1.38]	[1.29]	[1.76]	[1.50]	[0.36]	[1.22]	[1.56]
β_{LIML}	0.044	0.069	0.018		0.034	0.441	0.0167	
Wald (95%)	[-0.011, 0.1]	[-0.022, 0.117]	[-0.01, 0.046]		[-0.012, 0.08]	[-0.43, 0.62]	[-0.011, 0.044]	
CLR (95%)	$(-\infty, -0.090] \cup [-0.015, \infty)$	$(-\infty, \infty)$	[-0.020, 0.054]		$(-\infty, -0.126] \cup [-0.008, \infty)$	$(-\infty, \infty)$	[-0.02, 0.071]	
Instrument (s)	ELF	Legal Origins	Pr. Trade	ELF	ELF	Legal Origins	Pr. Trade	ELF
J-stat		1.037				1.666		
P-value		0.596				0.435		
F-stat (first stage)	2.84	0.62	8.91		3.00	0.04	6.17	
	N=57	N=57	N=56	N=57	N=57	N=57	N=56	N=57

Table 7: Growth on Corruption, Bureaucratic Efficiency

Dependent Variable: Per Capita GDP growth (1960-1985 Average)

Independent Variables	[1] SKJ (2007) BE	[2] SKJ (2007) BE	[3] SKJ (2007) BE	[4] Mauro (1995) BE	[5] SKJ (2007) COR	[6] SKJ (2007) COR	[7] SKJ (2007) COR	[8] Mauro (1995) COR
Constant	-0.049	-0.005	-0.007	-0.049	-0.034	-0.009	-0.005	-0.034
	[-1.34]	[-0.30]	[-0.38]	[-1.53]	[-1.16]	[-0.43]	[-0.26]	[-1.33]
β_{2SLS}	0.011	0.004	0.005	0.011	0.008	0.005	0.004	0.008
	[2.05]	[1.92]	[1.74]	[2.33]	[2.06]	[1.72]	[1.61]	[2.34]
β_{LIML}	0.011	0.005	0.005		0.008	0.007	0.004	
Wald (95%)	[0.0002, 0.021]	[-0.0002, 0.0091]	[-0.001, 0.010]		[0.0002, 0.017]	[-0.0008, 0.011]	[-0.001, 0.010]	
CLR (95%)	[0.004, 0.101]	[-0.001, 0.015]	[-0.001, 0.014]		[0.003, 0.043]	$(-\infty, -0.18] \cup [-0.001, \infty)$	[-0.001, 0.016]	
Instrument (s)	ELF	Legal Origins	Pr. Trade	ELF	ELF	Legal Origins	Pr. Trade	ELF
J-stat		2.235				2.053		
P-value		0.327				0.358		
F-stat (first stage)	4.72	4.72	9.19		5.91	2.60	7.70	
	N=57	N=57	N=56	N=57	N=57	N=57	N=56	N=57

Table 8: Growth on Corruption, Bureaucratic Efficiency

Dependent Variable: Per Capita GDP growth (1960-1985 Average)

Independent Variables	[1] SKJ (2007) BE	[2] SKJ (2007) BE	[3] SKJ (2007) BE	[4] Mauro (1995) BE	[5] SKJ (2007) COR	[6] SKJ (2007) COR	[7] SKJ (2007) COR	[8] Mauro (1995) COR
Constant	-0.011	-0.022	0.013	-0.011	-0.010	-0.166	0.010	-0.010
	[-0.40]	[-0.59]	[0.84]	[-0.45]	[-0.33]	[-0.29]	[0.56]	[-0.32]
GDP in 1960	-0.013	-0.015	-0.008	-0.013	-0.012	-0.040	-0.008	-0.012
	[-2.58]	[-2.13]	[-2.75]	[-2.91]	[-2.30]	[-0.39]	[-2.42]	[-2.53]
Secondary	-0.031	-0.051	0.02	-0.031	-0.001	-0.168	0.028	-0.001
education in 1960	[-0.65]	[0.76]	[0.74]	[-0.71]	[-0.03]	[-0.27]	[1.11]	[-0.03]
Population	-1.080	-1.278	-0.531	-1.077	-0.564	-1.547	-0.363	-0.564
growth	[-1.88]	[-1.65]	[-1.39]	[-2.04]	[-1.26]	[-0.39]	[-1.01]	[-1.66]
β_{2SLS}	0.014	0.018	0.005	0.014	0.011	0.053	0.005	0.011
	[1.71]	[1.50]	[1.29]	[1.88]	[1.50]	[0.35]	[1.18]	[1.49]
β_{LIML}	0.014	0.022	0.005		0.011	0.084	0.005	
Wald (95%)	[-0.002, 0.031]	[-0.004, 0.04]	[-0.003, 0.013]		[-0.004, 0.026]	[-0.25, 0.36]	[-0.003, 0.013]	
CLR (95%)	$(-\infty$, -0.033]$\cup$	$(-\infty, \infty)$	[-0.006, 0.015]		$(-\infty$, -0.05]$\cup$	$(-\infty, \infty)$	[-0.006, 0.022]	
	[-0.001, ∞)				[-0.001, ∞)			
Instrument (s)	ELF	Legal Origins	Pr. Trade	ELF	ELF	Legal Origins	Pr. Trade	ELF
J-stat		2.165				0.266		
P-value		0.339				0.875		
F-stat (first stage)	2.84	0.62	8.91		3.00	0.04	6.17	
	N=57	N=57	N=56	N=57	N=57	N=57	N=56	N=57