Assessing the development effect of governance

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Abstract: This research attempts to examine the development effect of governance (through exogenous variables) applying instrumental variables estimator and two-stage least squares methods building on cross-sectional regression analysis using data for 64 countries. Governance as measured by governance effectiveness in the model specified in the paper plays important role for economic outcome. The evidence for a positive causal relationship of governance and development has been provided in the paper. The results obtained are consistent with the empirical findings of Kaufmann and Kraay (1999) who found large and highly significant positive effects of governance on per capita incomes on larger sample.
[Dulambaeva R., Orazalin R., Tulembayeva A., Peruashev A. **Assessing the development effect of governance.** *Life Sci J* 2014;11(4s):144-152]. (ISSN:1097-8135). http://www.lifesciencesite.com. 20

Keywords: economic growth; informal economy; instrumental variables estimation; two-stage least squares estimation; governance effectiveness; corruption.

1. Introduction

Early informal economy literature studies have yielded, surprisingly, positive results on the effect of corruption on growth through «speeding money and avoiding delays in bureaucracy» (Leff (1964), Huntington (1968)) [7, 12]. Later, however, in the corruption literature it was argued that corruption lowers economic growth negatively affecting institutions or through reducing investment (Shleifer et al (1993)) [18]. Then a huge number of studies have been followed by the research on the relationship between the institutional quality, governance and economic activity, growth and development.

Generally most authors show positive growth impact of governance, even though some researchers, argues that there is a negative correlation in good quality of the institution and economic growth using the argument that rapid growth brings about political instability (Olson 1963) [16].

In this context, this paper aims to distinguish the positive or negative effect of governance on development outcomes. In particular this research is designed to examine the development effect of governance. Main focus will be on empirical methodology of testing whether governance affects development through exogenous variables.

In order to put the plan into operation, instrumental variables estimator and two-stage least squares methods are going to be used to test the governance and development relationship. Empirical analysis is built on a cross-sectional regression of gross domestic product as an indicator of development on main governance indicator – effectiveness of governing for 64 countries [21, 22].

The paper is structured as follows. Literature review in Section II is followed by the empirical model specification in section III. Then data description is going to be described in Section IV. The next section reports the empirical findings. Section VI concludes the interpretation of the results and suggests further research directions.

2. Material and Methods

Early literature on unofficial economy has very interesting suggestions regarding corruption effect on economic growth. According to Leff (1964) [12] and Huntington (1968) (*i*) [7] corrupt practices prevent bureaucratic delays; (*ii*) bribe encourages government employees to work harder. The former mechanism enhances growth only in countries with burdensome regulations, while the latter operates in any country.

Thus economic growth could be raised if there was corruption. Also Olson (1963) argues that economic growth leads to political instability [16]. In turn political variables affect long run growth rates (Levine and Renelt (1992)) [13]. From this point of view one could summarize that the early literature on unofficial economy yielded controversial results: negative relationship between economic growth and institutions, and positive correlation between economic growth and corruption.

On the other hand more recent studies disagree on the previous results and most authors find evidence suggesting completely opposite results. Starting with Mauro (1995) who first attempted the systematic cross-country empirical analysis relating corruption and efficiency to economic growth, yields a negative correlation between corruption and investment, then between corruption and growth [15]. The result is not at odds with Ades and DiTella (1996) who argue that the lack of competition and weak legal institutions enhance corruption further affecting the foreign investment. It has to be noted that many researchers study the relationship between corruption, investment and growth variables [2].

Building upon on endogenous growth model Loyaza (1996) shows that the growth in the informal sector size leads to lowered economic growth. Positive dependence of the informal sector on tax burden and labor market restrictions which in turn negatively depends on the quality of government institutions has been shown by Loyaza [14]. However Johnson, Kaufmann and Zoido-Lobaton (1998) argue that higher taxes or more regulation does not necessarily define the size of unofficial economy, but rather the state administrative system itself can determine the size of unofficial economy [5].

The reverse causality between institutional quality and economic growth has been shown by Chong and Calderon (1999) building on previous cross-section studies. Indeed there is not only the institutional quality impact on economic growth, but the causal effect growth is also possible [3].

The causal effect between governance and economic development is also in the focus of Kaufmann and Kraay's research (2002) that, surprisingly, shows the negative impact of an income per capita on governance.

It has to be noted that instrumental variables methods is widely used by researchers to investigate the role of various governance measures in development. Instrumenting the institutional quality in East Asian countries Rodrik (1997) shows that good governance is required in terms of development and growth performance [17]. Hall and Jones (1999) using instrumental variables method show that government policies and institutions determine the long run economic performance. They treat historical location and language as the key determinants of an endogenous factor − social infrastructure, which according to the authors' definition is institutions and government policies [6]. Kaufmann, Kraay and Lobaton (1999) following the same methodology find that governance play crucial role for economic outcomes. They used the share of population speaking major European languages as an instrument and regressed GDP per capita (then development indicators) on instrumented six indicators of governance which they aggregated [10, 11]. Acemoglu, Johnson and Robinson (2001) use settler mortality as an instrument assuming that it could be historical determinant of institutions, whereas Easterly and Levine (2001) use geographic endowments as an instrument controlling for institution and regressing economic development on institution measures. They find the evidence for the direct effect of exogenous variables through institutions on development [1, 4].

Given the controversial results of early literature on unofficial economy and more recent studies yielding opposite results, this study reassesses the relationship between governance and development.

In particular, causal effect running from governance to GDP per capita is going to be assessed empirically using conventional instruments but taking several instruments as exogenous variables at the same time. Essentially the purpose of the paper is to assess the application of instrumental variables methods proposed by previous authors in the governance-development context.

The choice of per capita incomes (GDP per capita PPP in current US dollars) as one of the development indicator and the governance effectiveness as one dimension of a governance is argued well enough in Kaufmann and Kraay (2002). Instead of repeating the arguments here, I proceed further assuming the variables are reasonable. Reader is referred to the original papers for further details [8].

In order to empirically specify the model building upon the model presented by Kaufmann (1999), Hall and Jones (1999) let's start with the following simple specification [6, 9]:

$$Y_t = \beta_0 + \beta_1 X_t + e_t \qquad (1)$$

where Y_t is a log of per capita GDP, X_t - government effectiveness, e_t- error term.

Since the determining factors of cross-country differences are excluded from the model the error term reflects the measurement errors. The measurement error in GDP itself is also captured by this error term. It has to be noted that omitted variables bias in OLS can occur depending on how strong the error term is correlated with the governance. Governance has not random distribution across countries.

Governance depends on social and political history of a country. Historically inherited institutions by former colonial countries are likely to result in relatively better governance. Therefore governance can be written as following:

$$X_t = \beta_0 + \beta_1 \gamma_t + u_t \qquad (2)$$

where γ_t is a set of additional unobservable determinants, u_t is a zero-mean error term that reflects unobservable governance determinants. The sign of governance effect on explained variable determines whether the OLS estimates of (1) is biased upward or downwards.

Because governance itself is not exactly measured observed governance indicator provides a noisy signal of "true" governance:

$$X_t^* = X_t + v_t \quad (3)$$

where v_t is a zero-mean disturbance term that captures the measurement error. Assuming v_t is independent of X_t and u_t one could get:

$$Y_t = \beta_0 + \beta_1(X_t^* - v_t) + e_t \quad (4)$$

$$Y_t = \beta_0 + \beta_1 X_t^* + (e_t - \beta_1 v_t) \quad (5)$$

$$Y_t = \beta_0 + \beta_1 X_t^* + u_t^* \quad (6)$$

Observed governance determinants should be uncorrelated with the error term in equation (6), i.e. $E[\gamma_t \cdot e_t] = 0$. Also measurement error in governance effectiveness should be uncorrelated with a zero-mean disturbance term v_t $E[\gamma_t \cdot v_t] = 0$. Only in this case instruments γ_t will be valid. In such a way omitted variables bias can be addressed using twostage least squares (2SLS).

Two groups of instrumental variables have been chosen for the specified model. First, settler mortality presented by Acemoglu et al (2001), secondly, ethnolinguistic fractionalization proposed by Mauro (1995) will be used to instrument the governance efficiency. Settler mortality is a mortality rate faced by European settlers at the time of colonization centuries of XVIII and XIX (Teorell, 2010). This variable shows the historical influence of Western European colonial powers over the past several centuries, which have brought along institutional foundations to the colonial countries. The choice of the second set of instruments which is ethnolinguistic fractionalization measures "the probability of two randomly selected people from a given country will not belong to the same ethnolinguistic group" (Taylor and Hudson (1972)). Higher level of this index means that the country is highly fragmented. Both of the instruments are assumed to be exogenous to economic outcome. They are good proxies that might have effect on economic variables through institutional efficiency [19, 20].

The cross country analysis is based on the data for 64 countries. Governance indicator is drawn from the World Bank Governance and Anti-corruption group which constructed six aggregated indicators of governance on the basis of quantitative (ratings of commercial risk rating agencies) and descriptive data (cross country surveys of international and nongovernmental organizations). For the purpose of this research only one dimension of governance that is government effectiveness will be used from six clustered indicators. According to World Bank governance defined as "traditions and institutions by which authority in a country is exercised" and government effectiveness as "a measure of the quality of public and civil services, policy formulation and implementation". (Kaufmann and Mastruzzi (2010)).

Data on GDP per capita in US dollars adjusted for purchasing power parity is obtained from World Bank Development Indicators.

Settler mortality is drawn from Acemoglu et al (2001 cited in Teorell, 2010). The index of ethnolinguistic fractionalization is measured as an average value of ethnolinguisic variables taken from Muller (1964), Roberts (1962) and Atlas Narodov Mira (1964) (cited in Teorell, 2010).

3. Results

Hausman endogeneity test conducted in order to define whether it is better to estimate the model using OLS or IV suggests that the consistency of the OLS should be rejected and 2SLS has to be used instead. According to the results of the appropriateness test of OLS or IV/GMM it is observed that chi-square is 7.16 with p-value of 0.0074 which means null hypothesis that the OLS estimator consistent is rejected and provides support for using TSLS (Table 1).

Also the Hausman test for whether a regressor is endogenous can be performed comparing OLS and IV coefficients of endogenous variables. The coefficient of government effectiveness has an OLS estimate of 1.26 differing from the IV estimate of 2.89. We can see the loss in precision in using IV; in particular standard errors are almost doubled which questions the efficiency of IV (Table 2).

However the post estimation Durdin-Wu-Hausman test which uses augmented regressors and produces a robust test statistic provides evidence that the governance efficiency is endogenous. Both robustified chi-squared score and F-statistics' p-value rejects the null that variable is exogenous (robust score chi2(1) = 7.73287, p = 0.0054; robust regression F(1,55) = 14.3797, p = 0.0004) (Table 3).

Testing the relevance of the instruments, performed on the basis of Shea, Anderson, Cragg and Donald's approaches, suggests that instruments are relevant. According to the first stage results, Shea's partial R-squared, which measures the relevance of exogenous variables considering intercorrelations among instruments, is 0.23 and Cragg-Donald's F test of the excluded instruments rejects its null hypothesis of underidentification. The partial R-squared is the same as Shea's partial R-squared because the model has only one endogenous regressor. Anderson's canonical correllation statistic (0.0022) rejects its null hypothesis and suggests that the instruments are adequate to identify the equation (Table 4).

Table 1. Hausman endogeneity test

	Coefficients (b) ivreg	(B) .	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
gov_eff	2.885961	1.260824	1.625138	.6072185
contr_corr	-.4104061	-.1142448	-.2961613	.1106581
pol_stab	-.1453677	-.1482338	.0028661	.0010709
rule_law	-1.063385	-.3945011	-.6688841	.2499227
req_qual	-.2977238	.2567823	-.5545061	.2071863
voice_acco~t	.0480542	.1322416	-.0841874	.0314559
_cons	8.30708	8.287159	.0199209	.0074433

```
                          b = consistent under Ho and Ha; obtained from ivreg
           B = inconsistent under Ha, efficient under Ho; obtained from regress

    Test:  Ho:  difference in coefficients not systematic

                  chi2(1) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        7.16
                Prob>chi2 =      0.0074
                (V_b-V_B is not positive definite)
```

Table 2. Comparison of OLS and IV coefficients of endogenous variables

First-stage regressions

```
                                     Number of obs   =        63
                                     F(   8,     54) =    129.42
                                     Prob > F        =    0.0000
                                     R-squared       =    0.9274
                                     Adj R-squared   =    0.9167
                                     Root MSE        =    0.2106
```

gov_eff	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
contr_corr	.1861667	.1050135	1.77	0.082	-.0243728	.3967062
pol_stab	.065505	.0512308	1.28	0.206	-.0372066	.1682167
rule_law	.2980488	.1244032	2.40	0.020	.0486355	.5474621
req_qual	.3255121	.0839374	3.88	0.000	.1572277	.4937965
voice_acco~t	.0411232	.0824336	0.50	0.620	-.1241461	.2063926
sett_mort	-10.65737	3.295326	-3.23	0.002	-17.2641	-4.050641
avef	-.227235	.2657289	-0.86	0.396	-.7599894	.3055194
ef_anm	.3574426	.2532851	1.41	0.164	-.1503635	.8652487
_cons	.4122534	.1716779	2.40	0.020	.0680599	.7564469

```
Instrumental variables (2SLS) regression          Number of obs =       63
                                                  Wald chi2(6)  =   117.86
                                                  Prob > chi2   =   0.0000
                                                  R-squared     =   0.4867
                                                  Root MSE      =   .66181
```

log_gdp	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
gov_eff	2.885961	.731653	3.94	0.000	1.451948	4.319975
contr_corr	-.4104061	.3761824	-1.09	0.275	-1.14771	.3268979
pol_stab	-.1453677	.1507101	-0.96	0.335	-.4407541	.1500188
rule_law	-1.063385	.4819552	-2.21	0.027	-2.008	-.1187704
req_qual	-.2977238	.3044945	-0.98	0.328	-.894522	.2990745
voice_acco~t	.0480542	.2071066	0.23	0.817	-.3578673	.4539757
_cons	8.30708	.1156636	71.82	0.000	8.080383	8.533777

```
Instrumented:  gov_eff
Instruments:   contr_corr pol_stab rule_law req_qual voice_account sett_mort
               avef ef_anm
```

Table 3. Durdin-Wu-Hausman test

```
Instrumental variables (2SLS) regression               Number of obs =       63
                                                       Wald chi2(6)  =   117.86
                                                       Prob > chi2   =   0.0000
                                                       R-squared     =   0.4867
                                                       Root MSE      =   .66181
```

log_gdp	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
gov_eff	2.885961	.731653	3.94	0.000	1.451948	4.319975
contr_corr	-.4104061	.3761824	-1.09	0.275	-1.14771	.3268979
pol_stab	-.1453677	.1507101	-0.96	0.335	-.4407541	.1500188
rule_law	-1.063385	.4819552	-2.21	0.027	-2.008	-.1187704
req_qual	-.2977238	.3044945	-0.98	0.328	-.894522	.2990745
voice_acco~t	.0480542	.2071066	0.23	0.817	-.3578673	.4539757
_cons	8.30708	.1156636	71.82	0.000	8.080383	8.533777

```
Instrumented:  gov_eff
Instruments:   contr_corr pol_stab rule_law req_qual voice_account sett_mort
               avef ef_anm

Tests of endogeneity
Ho: variables are exogenous

Robust score chi2(1)           =  7.73287  (p = 0.0054)
Robust regression F(1,55)      =  14.3797  (p = 0.0004)
```

Evaluating the correlation degree between the instruments and endogenous regressor it appears that the ethnolinguistic fractionalization is not correlated with the government effectiveness and only settler mortality passes the test of instrument correlation with regressor. Nevertheless the next stage - instrumental variables (2SLS) regression shows that endogenous regressor government efficiency has an IV coefficient which is well distinguished from zero and conditioning on other factors government effectiveness appears to play an important role in determining the gross domestic product (Table 5).

Test of over identifying restrictions which helps to test the validity of the instruments suggests that the null hypothesis that the instruments are uncorrelated cannot be rejected at 1% level which means that the over identifying restriction is valid. However at 5% critical value level the null could be rejected signaling that the specification could be improved and better instrument should be identified. Alternatively two of the instruments which are less or not related to the endogenous variable could be dropped, although it cannot ensure that the problem will be resolved since we will not be able to test the validity of the instrument because model will be just-identified (Table 6).

If the errors are not independently and identically distributed IV and TSLS are result in consistent but inefficient estimates in which case better to use GMM. Also GMM generates heteroscedasticity-robust standard errors which are helpful in the context of heteroscedasticity problems. For the efficient GMM estimator, the test statistic is Hansen's J statistic which is the minimized value of the GMM criterion function. Comparing GMM with 2SLS of our reestimated model ensures that the government effectiveness still plays significant role in the equation and Hansen's J statistic confirms the independence of the instruments and the disturbance process (p-val =0.0135) (Table 7).

Having tested the entire set of overidentifying restrictions with Hansen-Sargan tests we could proceed further in detail evaluating particular subsets of excluded instruments using difference-in-Sargan test (C test). However this test is for models with very large sets of instruments and our model does not contain large number of instruments. Therefore we can carry on with the heteroscedasticity test.

In the context of IV testing for heteroscedasticity is important to check whether the errors are not conditionally heteroscedastic. Stata uses Pagan and Hall test which is similar to the Breusch-Pagan and White tests. The idea behind the test is checking whether the errors are conditionally heteroscedastic depending on the possibility of exogenous variables to predict the squared residuals. The test using the levels of the instruments as associated variables and using fitted value and its square shows that there is no problem with heteroscedasticity in the disturbance term of the model (Table 8).

Table 4. Testing the relevance of the instruments

```
Summary results for first-stage regressions
-------------------------------------------

Variable     | Shea Partial R2 |   Partial R2    |  F(  3,    54)    P-value
gov_eff      |     0.2313      |    0.2313       |        5.42       0.0025

Underidentification tests
Ho: matrix of reduced form coefficients has rank=K1-1 (underidentified)
Ha: matrix has rank=K1 (identified)
Anderson canon. corr. N*CCEV LM statistic   Chi-sq(3)=14.57    P-val=0.0022
Cragg-Donald N*CDEV Wald statistic          Chi-sq(3)=18.96    P-val=0.0003

Weak identification test
Ho: equation is weakly identified
Cragg-Donald Wald F-statistic                       5.42
See main output for Cragg-Donald weak id test critical values

Weak-instrument-robust inference
Tests of joint significance of endogenous regressors B1 in main equation
Ho: B1=0 and overidentifying restrictions are valid
Anderson-Rubin Wald test     F(3,54)=  12.37     P-val=0.0000
Anderson-Rubin Wald test     Chi-sq(3)=43.29     P-val=0.0000
Stock-Wright LM S statistic  Chi-sq(3)=25.66     P-val=0.0000

Number of observations               N  =          63
Number of regressors                 K  =           7
Number of instruments                L  =           9
Number of excluded instruments       L1 =           3

IV (2SLS) estimation
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Estimates efficient for homoskedasticity only
Statistics consistent for homoskedasticity only

                                                      Number of obs =       63
                                                      F(  6,     56) =    11.99
                                                      Prob > F      =   0.0000
Total (centered) SS     =  53.75979371                Centered R2   =   0.4867
Total (uncentered) SS   =  4028.047787                Uncentered R2 =   0.9931
Residual SS             =  27.59316507                Root MSE      =    .6618

------------------------------------------------------------------------------
     log_gdp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     gov_eff |   2.885961   .7794868     3.70   0.000     1.358195    4.413728
  contr_corr |  -.4104061   .3438282    -1.19   0.233    -1.084297    .2634847
    pol_stab |  -.1453677   .1555483    -0.93   0.350    -.4502367    .1595014
    rule_law |  -1.063385   .4931857    -2.16   0.031    -2.030011   -.0967591
    req_qual |  -.2977238    .388419    -0.77   0.443    -1.059011    .4635636
voice_acco~t |   .0480542   .1941899     0.25   0.805     -.332551    .4286593
       _cons |    8.30708   .1076274    77.18   0.000     8.096134    8.518026
------------------------------------------------------------------------------
Underidentification test (Anderson canon. corr. LM statistic):          14.574
                                                   Chi-sq(3) P-val =    0.0022
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):                5.417
Stock-Yogo weak ID test critical values:  5% maximal IV relative bias    13.91
                                         10% maximal IV relative bias     9.08
                                         20% maximal IV relative bias     6.46
                                         30% maximal IV relative bias     5.39
                                         10% maximal IV size             22.30
                                         15% maximal IV size             12.83
                                         20% maximal IV size              9.54
                                         25% maximal IV size              7.80
Source: Stock-Yogo (2005).  Reproduced by permission.
------------------------------------------------------------------------------
Sargan statistic (overidentification test of all instruments):           8.903
                                                   Chi-sq(2) P-val =    0.0117
------------------------------------------------------------------------------
Instrumented:         gov_eff
Included instruments: contr_corr pol_stab rule_law req_qual voice_account
Excluded instruments: sett_mort avef ef_anm
------------------------------------------------------------------------------
```

Table 5. Evaluating the Correlation Degree Between the Instruments and Endogenous Regressor

First-stage regressions

Source	SS	df	MS
Model	30.6180134	8	3.82725168
Residual	2.39515175	54	.044354662
Total	33.0131652	62	.532470406

Number of obs =	63
F(8, 54) =	86.29
Prob > F =	0.0000
R-squared =	0.9274
Adj R-squared =	0.9167
Root MSE =	.21061

gov_eff	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
contr_corr	.1861667	.103732	1.79	0.078	-.0218035	.3941369
pol_stab	.065505	.0523124	1.25	0.216	-.039375	.170385
rule_law	.2980488	.1271933	2.34	0.023	.0430416	.5530561
req_qual	.3255121	.0910705	3.57	0.001	.1429269	.5080974
voice_acco~t	.0411232	.061046	0.67	0.503	-.0812666	.1635131
sett_mort	-10.65737	3.106394	-3.43	0.001	-16.88532	-4.429427
avef	-.227235	.244502	-0.93	0.357	-.7174321	.2629621
ef_anm	.3574426	.2517847	1.42	0.161	-.1473554	.8622406
_cons	.4122534	.150212	2.74	0.008	.1110964	.7134104

Instrumental variables (2SLS) regression

Source	SS	df	MS
Model	26.1666286	6	4.36110477
Residual	27.5931651	56	.492735091
Total	53.7597937	62	.867093447

Number of obs =	63
F(6, 56) =	11.99
Prob > F =	0.0000
R-squared =	0.4867
Adj R-squared =	0.4317
Root MSE =	.70195

log_gdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
gov_eff	2.885961	.8267706	3.49	0.001	1.229741	4.542182
contr_corr	-.4104061	.3646848	-1.13	0.265	-1.140958	.3201454
pol_stab	-.1453677	.1649839	-0.88	0.382	-.4758701	.1851347
rule_law	-1.063385	.5231024	-2.03	0.047	-2.111285	-.0154852
req_qual	-.2977238	.4119806	-0.72	0.473	-1.12302	.5275726
voice_acco~t	.0480542	.2059694	0.23	0.816	-.3645522	.4606605
_cons	8.30708	.1141561	72.77	0.000	8.078398	8.535762

Instrumented: gov_eff
Instruments: contr_corr pol_stab rule_law req_qual voice_account sett_mort avef ef_anm

Table 6. Tests of Overidentifying Restrictions

Tests of endogeneity
Ho: variables are exogenous

Durbin (score) chi2(1)	=	8.05829	(p = 0.0045)
Wu-Hausman F(1,55)	=	8.06684	(p = 0.0063)

Summing up, IV is more appropriate in comparison with OLS according to Hausman endogeneity test due to the endogeneity problem, however there is a possibility of loss in precision. Postestimation DWH test suggests that the governance efficiency should be treated as endogenous variable. Testing the relevance of instruments suggests that the instruments are adequate to identify the equation. Although evaluating the correlation degree between the instruments and endogenous regressor shows that the ethnolinguistic fractionalization is not correlated with the government effectiveness and only settler mortality passes the test of instrument correlation with regressor. Nevertheless the next stage - instrumental variables (2SLS) regression shows that endogenous regressor government efficiency has an IV coefficient which is well distinguished from zero and conditioning on other factors government effectiveness appears to play an important role in determining the gross domestic product. Test of overidentifying restrictions suggests that the instruments are valid at 1% level, but at 5% critical value level the null could be rejected signaling that the specification could be improved and better instrument should be identified. There is no problem with heteroscedasticity in the disturbance term of the model according to Pagan and Hall test.

Table 7. GMM and heteroscedasticity-consistent standard errors

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2-Step GMM estimation

Estimates efficient for arbitrary heteroskedasticity
Statistics robust to heteroskedasticity

                                                   Number of obs =        63
                                                   F(  6,     56) =     19.22
                                                   Prob > F      =    0.0000
Total (centered) SS     =  53.75979371             Centered R2   =    0.5288
Total (uncentered) SS   =  4028.047787             Uncentered R2 =    0.9937
Residual SS             =  25.33074603             Root MSE      =     .6341
```

log_gdp	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
gov_eff	2.60906	.721267	3.62	0.000	1.195403	4.022717
contr_corr	-.5629419	.362928	-1.55	0.121	-1.274268	.1483838
pol_stab	-.1182672	.1500971	-0.79	0.431	-.4124521	.1759177
rule_law	-.8140628	.468295	-1.74	0.082	-1.731904	.1037784
req_qual	-.1982798	.3017153	-0.66	0.511	-.7896308	.3930713
voice_acco~t	.0551289	.2069697	0.27	0.790	-.3505242	.460782
_cons	8.329996	.1038438	80.22	0.000	8.126466	8.533526

```
Underidentification test (Kleibergen-Paap rk LM statistic):          9.786
                                                 Chi-sq(3) P-val =    0.0205

Weak identification test (Kleibergen-Paap rk Wald F statistic):      6.111
Stock-Yogo weak ID test critical values:  5% maximal IV relative bias    13.91
                                         10% maximal IV relative bias     9.08
                                         20% maximal IV relative bias     6.46
                                         30% maximal IV relative bias     5.39
                                         10% maximal IV size             22.30
                                         15% maximal IV size             12.83
                                         20% maximal IV size              9.54
                                         25% maximal IV size              7.80
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.

Hansen J statistic (overidentification test of all instruments):     8.614
                                                 Chi-sq(2) P-val =    0.0135

Instrumented:          gov_eff
Included instruments: contr_corr pol_stab rule_law req_qual voice_account
Excluded instruments: sett_mort avef ef_anm
```

Table 8. Testing for Heteroscedasticity in the IV context

```
IV heteroskedasticity test(s) using levels of IVs only
Ho: Disturbance is homoskedastic
    Pagan-Hall general test statistic    :   5.904  Chi-sq(6) P-value = 0.4341
    Pagan-Hall test w/assumed normality  :   5.719  Chi-sq(6) P-value = 0.4554
    White/Koenker nR2 test statistic     :  10.322  Chi-sq(6) P-value = 0.1117
    Breusch-Pagan/Godfrey/Cook-Weisberg  :   9.888  Chi-sq(6) P-value = 0.1295

IV heteroskedasticity test(s) using fitted value (X-hat*beta-hat) & its square
Ho: Disturbance is homoskedastic
    Pagan-Hall general test statistic    :   0.484  Chi-sq(2) P-value = 0.7850
    Pagan-Hall test w/assumed normality  :   0.495  Chi-sq(2) P-value = 0.7808
    White/Koenker nR2 test statistic     :   0.843  Chi-sq(2) P-value = 0.6562
    Breusch-Pagan/Godfrey/Cook-Weisberg  :   0.807  Chi-sq(2) P-value = 0.6680
```

4. Discussions

The results of key specification tests show that the p-value associated with the null hypothesis that the instruments affect income through their effects on governance is equal to p = 0.0117 (Sargan (score) chi2(2) = 8.90). The test barely passes the test at 1% critical value level which indicates one should not be satisfied with the instruments identified. Although still the null is not rejected and gives support for identifying assumptions $E[x_j \cdot e_j] = 0$ and $E[x_j \cdot u_j] = 0$. Thus the tests of overidentifying restrictions do pass and government efficiency is important for economic outcome which is in our case GDP per capita.

Summarizing the strength of the instruments it was observed that the F-statistic from the first-stage regressions of governance indicator on the instruments is highly significant (F(8, 54) = 129.42) which means that the instruments have explanatory power for governance. In summary, the specification tests suggest that the IV estimator is producing consistent estimates of β and captures the causal effect from governance to gross domestic product (per capita income).

The results obtained are consistent with the empirical findings of Kaufmann and Kraay (1999) who found large and highly significant positive effects of governance on per capita incomes on larger sample.

The research could be further developed by assessing the effect of governance looking at other or all dimensions (possibly all together) on social development indicators as adult literacy or infant mortality. Alternatively causal effect running in the opposite direction from per capita incomes to governance would be interesting to investigate which surprisingly has negative correlation according to Kaufmann (2002).

Governance as measured by governance effectiveness in the specified model plays important role for economic outcome. The evidence for a positive causal relationship of governance and development has been provided in the paper.

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3/1/2014