Online Annex 2.1. Cross-Country Evidence on Fiscal Institutions, Corruption, and Fiscal Outcomes

This annex provides details on data sources and empirical methodologies used in this chapter. It also includes a summary of the results of the analysis.

Data Sources and Definitions

Measurement of Corruption

This analysis relies primarily on the Control of Corruption Index from the Worldwide Governance Indicators (WGI) produced by Kaufmann, Kraay, and Mastruzzi (2010). The control of corruption indicator incorporates more than 30 sources of data on perceptions of corruption. The estimation uses a version of the WGI Control of Corruption Index that strips out its subcomponents explicitly related to actual or perceived features of fiscal institutions. This step is performed to avoid any mechanical correlation between control of corruption and fiscal institutions.

Robustness of results is tested for by using Transparency International's Corruption Perceptions Index. This indicator assesses the perceived levels of public sector corruption according to experts and businesspeople. The index draws on 13 surveys from independent institutions specializing in governance and business climate analysis. To obtain a score, a country must appear in at least three of the surveys.

Outcomes

Revenue collection is measured by general government revenues, excluding grants, as a percentage of GDP.

Revenue efficiency is an average of personal income tax efficiency and value-added tax (VAT) c-efficiency. Personal income tax efficiency is estimated as the ratio between actual collection and the average statutory rate times GDP. VAT c-efficiency is estimated as the ratio of the actual VAT revenue to the theoretical revenue derived from the product of aggregate final consumption and the VAT standard rate.

Public investment efficiency captures the rate at which public investment spending is transformed into physical and social infrastructure, as measured by an indicator combining data on the volume of economic infrastructure (length of road network, electricity production, and access to water) and social infrastructure (number of secondary teachers and hospital beds). All countries are scored between zero and one. Countries with the highest quantity of physical outcomes for a given amount of input form the investment frontier and are scored as one. Other countries receive a score based on their vertical distance to the frontier relative to peer best performers. The less efficient the country, the greater the distance to the frontier and the lower the efficiency score (IMF 2015).

Test scores are taken from Patrinos and Angrist (2018) and are measured in Trends in International Mathematics and Science Study equivalent units, which constitute a mean of 500 and a standard deviation of 100 across students in member countries of the Organisation for Economic Co-operation and Development. Years of schooling is measured as the number of years of schooling a child can expect to obtain by age 18 given the prevailing pattern of enrollment rates. It is calculated as the sum of age-specific enrollment rates between ages 4 and 17.

Fiscal Institutions

Fiscal transparency. The fiscal transparency indicator incorporates a wide variety of data related to the type, quantity, and quality of central government budgetary audits, the presence of a right-to-information law, and the quality and timeliness of financial statements. Data are aggregated using an unobserved

components model as described and used by Kaufmann, Kraay, and Mastruzzi (2010). The data include specific indicators from the Open Budget Survey (International Budget Partnership), Open Data Barometer (World Wide Web Foundation), Public Expenditure and Financial Accountability Framework (IMF), and World Development Indicators (World Bank).

Revenue institutions. Indicators of institutional characteristics of revenue administration are used, with some coming from the IMF's Revenue Administration Fiscal Information Tool (RA-FIT)[1] and others from the World Bank's Doing Business Indicators.

- Limits on discretionary power (RA-FIT). Includes measures intended to limit tax officials' discretionary power, such as the existence of a formal approach for identifying, assessing, and prioritizing risks and selecting audits.
- Use of third-party information (RA-FIT). Includes measures of the extent to which the revenue institution processes financials from third parties (financial institutions, other government agencies, online trading, value-added tax invoices, and so on) and provides information to third parties (other jurisdictions, other government agencies, and so on).
- Doing Business Indicators. These include the time it takes to pay taxes and to complete audits. The longer it takes to pay taxes reflects the complexity of the tax system.

Public financial management controls. This indicator covers the public financial management system in a country broadly, incorporating information on the handling of payroll and personnel data, the comprehensiveness of internal control rules, the quality of the internal audit function, and the handling of government cash balances.

Central government procurement. The central government procurement indicator covers every stage of the procurement process, from the way a country deals with unsolicited proposals to needs assessments and the payment of suppliers.

Digitalization (e-government). The online services indicator assesses each country's national website in the native language, including the national portal, e-services portal, and e-participation portal, as well as the websites of the related ministries of education, labor, social services, health, finance, and environment.

Public sector wages. This variable is constructed as the ratio between nominal public sector wages (International Labour Organization) and non-oil GDP per worker (World Development Indicators).

Red tape. Two variables are constructed to measure red tape, one related to the number of procedures required for specific public services, and one for the time it takes to comply with those procedures. Procedures relate to starting a business, getting electricity, registering property, obtaining a construction permit, importing, and exporting. Both measures are weighted averages of relevant series from the Doing Business Indicators.

Judiciary. A weighted average is constructed of series related to the ease of enforcing contracts from the Doing Business Indicators. These indicators relate to automation in the judiciary, case management, and time needed to enforce contracts.

Other Variables

The analysis also includes data on freedom of the press, assessments on judiciary variables, size of oil exports as a share of total exports, GDP per capita, ethnolinguistic fractionalization, population, Gini

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[1] The RA-FIT aggregates self-reported data concerning a country's revenue institutions. The survey covers many facets of revenue administration, including institutional arrangements, adoption of online services, rules-based audit procedures, budget formation and dissemination, and the handling of taxpayers.

coefficient, and variables assessing the business environment from the World Bank's *Doing Business Report,* among others.

Methodology and Results

To what extent does corruption affect fiscal outcomes? And to what extent can corruption be kept in check by putting in place and strengthening the institutional framework? Formally, the relationships discussed in this chapter can be described as

$$Fiscal\ outcome_i = g(Corruption_i, Fiscal\ Institutions_i, X_i, \varepsilon_i), \qquad (2.1.1)$$

$$Corruption_i = f(Fiscal\ Institutions_i, X_i, \varepsilon_i), \qquad (2.1.2)$$

where X_i is a vector of observable covariates and ε_i is a vector of unobservables for country *i.* The fiscal outcomes of interest include revenue collection, spending efficiency, and debt distress.

Estimating and interpreting these cross-country regressions is challenging and warrants caution, given (1) the inherent difficulty of measuring corruption, institutional quality, and outcomes; (2) that these variables may be linked in more than one way, potentially raising concerns about the direction of causality (for example, corruption has a negative impact on fiscal activities, but fiscal outcomes may also impact corruption perception indicators); (3) that other factors may affect corruption, fiscal outcomes, and institutions jointly; (4) the persistence of corruption, which leaves little within-country variation over time to exploit for panel studies; and (5) that those countries that have successfully reduced their levels of corruption typically undertook several measures at once.

Corruption is measured by the WGI Control of Corruption Index, which is based on an aggregation of many sources. Since the analysis looks at the relationship between corruption and fiscal institutions, the estimation uses a version of the WGI Control of Corruption Index that strips out its subcomponents explicitly related to actual or perceived features of fiscal institutions.

As corruption is mostly hidden, the Control of Corruption Index is based mainly on perceptions. As such, it raises the possibility of measurement errors. Drawing on an analysis of road construction in Indonesia, Olken (2009) argues there are biases in people's perceptions of corruption.[2] He finds that better-educated respondents perceive higher levels of corruption than measured on the basis of missing expenditures. Such risk is less likely for the Control of Corruption Index because the index combines a wide sample of cross-country surveys that include businesses (both small and large, domestic and foreign), households, and experts (including international financial institutions, governments, and nongovernmental organizations). It also includes surveys on experience with corruption, and not just perception (Kaufmann, Kraay, and Mastruzzi 2007). Fisman and Golden (2017) note that for comparing corruption worldwide, the Transparency International or WGI indices are the best available. Even if one could extract road samples in all countries worldwide, one would have huge measurement errors because corruption occurs in different sectors depending on the country.[3]

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[2] Olken (2009) examines the accuracy of corruption perceptions by comparing Indonesian villagers' reported perceptions about corruption in a road-building project in their village with a more objective measure of "missing expenditures," attributing all measurement error to perceptions

[3] The regressions use the WGI Control of Corruption Index, but the results would not change in a significant way if they were replaced with Transparency International's corruption perceptions index (CPI).

Corruption and Fiscal Outcomes

This annex first analyzes the relationship between corruption and measures of revenue and spending outcomes. In particular, it explores equation (2.1.1) through cross-country linear regressions of fiscal outcomes on corruption and some controls (GDP per capita and oil dependence):

$$Fiscal\ outcome_i = a + b \times Control\ of\ corruption_i + c \times Institution_i^k + dX_i + \varepsilon_i,$$

where different sets of explanatory variables are considered: parsimonious regressions with the Control of Corruption Index and a few controls; regressions with fiscal institutions and the same controls; and regressions with control of corruption, fiscal institutions, and the same controls. Additional regressions with a wide set of controls are run with weighted average least squares estimators (WALS).[4] The controls used vary across regressions because specific determinants will matter for specific outcomes. For instance, tax complexity is considered for the revenue regressions only.

Because causality can run both ways and corruption is observed indirectly and hence with errors, the logarithm of settler mortality, a strong determinant of institutions (Acemoglu, Johnson, and Robinson 2001), is also used to instrument corruption in alternative parsimonious regressions.[5]

The analysis first examines the relationship between revenues and control of corruption without controlling for fiscal institutions. Annex Table 2.1.2 reports results for total government revenues minus grants.[6] Parsimonious cross-section regressions and panel regressions shed some light on the association between corruption (which can also reflect a broader effect of good governance) and revenue collection controlling for GDP per capita and other factors. Columns (1) to (3) show the results for a cross-section and column (4) for the panel—the former reflects the total effect (over time), while the latter shows the effect in the short term (one year). The results show a statistically significant correlation. The coefficient reports the effect of a one standard deviation of the Control of Corruption Index on the revenue-to-GDP ratio. This is equivalent to a country that is close to average among advanced economies in terms of control of corruption moving to the top 10 percent. Such a move is associated with an increase of about 4 percentage points in the revenue-to-GDP ratio (Annex Table 2.1.2, column 1).

Columns (7) and (9) show the effect of corruption and fiscal institutions considered together. From theory, corruption is affected by fiscal institutions, and it is possible that past corruption has an impact on fiscal institutions themselves. It is also possible that fiscal institutions have a direct effect on fiscal outcomes and an indirect effect through corruption. The strong association between corruption and fiscal institutions makes it difficult to identify the separate effects on revenues (see the discussion later in this annex). The results suggest that both the level of corruption and fiscal institutions appear to have an impact on revenues. Moreover, fiscal institutions taken together have a significant impact on revenues, and institutions and corruption together also have a significant effect on revenue collection.

Annex Table 2.1.3 reports the relationship between corruption and the share of education and health spending relative to total public spending. Shares are calculated with general government data when

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[4] Magnus, Powell, and Prüfer (2010) have proposed this Bayesian estimator, which is theoretically superior to standard Bayesian model averaging because the prior is neutral and minimizes the risks of rejection.

[5] The identifying assumption is that settler mortality affects fiscal outcomes only through an adverse impact on corruption and, more plausibly, institutional quality more generally. Exercises like this one are intended as due diligence in showing the results using available techniques—not as purported proof of causality.

[6] Regressions using revenue efficiency, instead of total revenues, provide broadly similar results, with a significant effect of control of corruption in parsimonious regressions (ordinary least squares and instrumental variable), but the result is not statistically significant when controlling for fiscal institutions or with alternative additional controls.

available, and with central government data otherwise. Similar to the estimation approach for revenues, the table displays regressions both with and without controlling for fiscal institutions. The instrumental variable regressions do not use the settler mortality variable because it can reflect adverse conditions that also affect today's health spending. Instead, dummies for independence after 1776 and before 1945 and an index of ethnolinguistic fragmentation are used as instruments (Mauro 1995). WALS regressions are not used because of limited degrees of freedom with more limited country coverage for these outcomes.

Parsimonious regressions suggest an association between control of corruption and both education and health spending (columns 1 and 3). Control of corruption has a significant positive effect on the combined share of education and health in total spending that is robust to the inclusion of fiscal institutions (column 6). The coefficient reports the effect of a one standard deviation of the Control of Corruption Index. While the coefficients in the regressions using instrumental variables are of similar magnitude, they are not significant when controlling for GDP per capita (columns 7 and 8).

Annex Tables 2.1.4 and 2.1.5 show a regression of public investment efficiency and education outcomes on corruption. The coefficients of corruption on public investment efficiency and test scores are significant in the parsimonious regressions and in regressions controlling for fiscal institutions. By contrast, corruption is not significant in a specification for years of schooling, suggesting that corruption is more relevant for quality than for quantity of education (additional regressions with fiscal institutions confirm this finding). As before, the results suggest that both corruption and fiscal institutions have an impact on public investment efficiency and test scores. Controlling for adult literacy (test scores and years of schooling) does not change the main results.

In Annex Tables 2.1.2, 2.1.4, and 2.1.5, coefficient magnitudes with instrumental variables are larger than in ordinary least squares regressions. This suggests that the control of corruption is measured with error.

Fiscal Institutions and Corruption

Equation (2.1.2) is explored through a sequence of models ranging from the simple to the complex.

Institution-by-Institution (Univariate Analysis)

The exercise starts from a set of simple univariate regressions with a cross-section of countries:

$$Control\ of\ corruption_i = \alpha + \beta \times Institution_i^k + \varepsilon_i,$$

where k stands for a specific institutional or policy variable (for example, fiscal transparency). All observations are from 2017 or, in some cases, the latest available year. Column (A) in Annex Table 2.1.6 reports the slope coefficients β associated with each institution. Variables are standardized, so that slope's coefficients indicate the impact on corruption of a one standard deviation change in institutional quality.

Column (B) of Annex Table 2.1.6 reports the regression slopes β for an expanded set of linear models

$$Control\ of\ corruption_i = \alpha + \beta \times Institution_i^k + \gamma X_i + \varepsilon_i,$$

where the set of control variables X_i includes GDP per capita (in logs) and oil exports as a share of GDP. Controlling for these factors is important, because a share of the cross-country variation in corruption could be attributed to factors other than fiscal institutions, and these are themselves correlated with fiscal institutions and policies. Column (C) adds an index of press freedom and three variables related to the functioning of the judiciary to the set of controls.[7]

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[7] See Treisman (2007) for a survey of the empirical literature on determinants of corruption.

Column (D) of Annex Table 2.1.6 controls for country circumstances in 1996, the first year for which the WGI measure of corruption is available:

$$Control\ of\ corruption_i = \alpha + \beta \times Institution_i^k + \gamma X_i + \delta Control\ of\ corruption_i^{1996} + \varepsilon_i.$$

Controlling for past corruption allows one form of reverse causality to be ruled out. Governments in countries that had a high degree of corruption in the past may have chosen weaker institutions and a low degree of accountability to facilitate the diverting of funds. Such control also addresses time-invariant geographic or cultural heterogeneity that could influence today's level of corruption. Note, however, that the issue of reverse causality is only partly addressed, since today's institutions could be a reflection of changes since 1996 in the level of corruption rather than the other way around.

Annex Table 2.1.6 indicates that individual institutions are significantly associated with control of corruption. The coefficients show the impact of a one standard deviation change in an individual fiscal institution on control of corruption. Institutions for which the relationship holds, controlling for other factors, include tax complexity as well as other aspects of revenue administration (for example, audits). Fiscal transparency and a lower administrative burden are also correlated with lower corruption. [8]

Multivariate Regressions

While the regressions in Annex Table 2.1.6 treat each institutional variable individually, Annex Table 2.1.7 expands the specifications by jointly examining the importance of several institutions in the same regression:

$$Control\ of\ corruption_i = \alpha + \sum_{k \in K}(\beta_k \times Institution_i^k) + \gamma X_i + \varepsilon_i.$$

This specification helps to disentangle which institutions are responsible for reducing corruption and which ones are correlated with corruption simply because they are correlated with other institutions. The first five columns display results controlling for country characteristics, while the next five add the historical levels of corruption as control. The results mostly confirm the findings of the univariate regressions, but also suggest that fiscal transparency is particularly important when there is more press freedom. In addition, the degree of digitalization of the government also has a positive relationship.[9]

Nonlinearities

The linear specifications studied so far assume that the marginal impact of strengthening one part of the institutional and policy framework is independent from other country-specific circumstances. However, fiscal institutions are likely to have complementarities among each other and with other factors. Indeed, this was evident in the previous section's finding of a significant interaction of fiscal transparency and press freedom (Annex Table 2.1.7). A free press can help spread information to wider groups of the public. In addition, there may be more than one way to establish accountability, since monitoring could be done by a free press, independent judiciary, or through strong internal control mechanisms. It is also likely that these institutions reinforce each other. Similarly, procurement systems and internal controls (public financial management) are also likely to be more effective when supported by the judicial system (to ensure that rules and sanctions are enforced).

Complementarities and substitution effects can help identify priority public institutions to develop based on country-specific circumstances. The ideal framework for institutions that can help fight corruption is

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[8] The results are similar if use the CPI from Transparency International.

[9] The results using the CPI are similar, but wages and digitalization are more significant, while the results for revenue institutions are weaker or not significant.

complex; low-capacity countries can find it challenging to improve along the many different institutional dimensions at once. This analysis could help with prioritization of reforms. Finally, some institutions might only have a noticeable impact on corruption if they are built together with other institutions.

The analysis uses a range of nonlinear techniques to explore nonlinear relationships between institutions and corruption, starting with an examination of simple interaction terms. Annex Table 2.1.8 presents standard ordinary least square (OLS) regressions, with a set of control variables plus two primarily fiscal variables and their respective interaction terms. Past corruption, the judiciary, and press freedom (and other series' that were not found to be significant) were added in the interactions to analyze beyond-fiscally-relevant complementarity. Tax complexity and red tape are inverted for easier interpretation of the interaction terms (that is, in Annex Table 2.1.8, a positive coefficient on tax complexity implies that lower complexity increases the control of corruption). Annex Table 2.1.8 only shows results for equations for which the interaction terms were found to be significant. The series are standardized; therefore, when a variable A is zero (at its mean), the coefficient of the other interaction variable (variable B) is measured by its own coefficient ($Coef_B$). Once A is above or below zero, the impact of variable B becomes ($Coef_B + A \times Coef_{Int}$), where $Coef_{Int}$ is the coefficient of the interaction term. Since both variables are standardized, a one standard deviation increase in A increases or decreases the impact of B by exactly $Coef_{Int}$.

Tax complexity, revenue institutions, public financial management systems, red tape, wages, past control of corruption, and the judiciary interact significantly with other institutions most frequently. Most interaction terms are positive, suggesting complementarities on curbing corruption. However, the wage ratio interacts with several other variables negatively. For example, while the impact of lower tax complexity is positive, the positive impact declines the higher that public sector wages are.

The nonlinear relationships are explored further in a threshold regression. This methodology can identify series' that are systematically more relevant in reducing corruption when other (the threshold) institutions are weaker or stronger. Annex Table 2.1.9 distinguishes between countries where a particular threshold series Z (for example, tax complexity) is above or below the sample median Z^*:

$$Control\ of\ corruption_i = 1_{\{Z_i \geq Z^*\}}\left(\alpha_{high} + \sum_{k \in K}\left[\beta_k^{high} \times Institution_i^k\right] + \gamma_{high}X_i\right) + 1_{\{Z_i < Z^*\}}\left(\alpha_{low} + \sum_{k \in K}\left[\beta_k^{low} \times Institution_i^k\right] + \gamma_{low}X_i\right) + \varepsilon_i.$$

Annex Table 2.1.9 reports the heterogeneity in regression coefficients based on institutions that were found most relevant in the interaction term results (tax complexity, revenue institutions, historical levels of corruption, red tape, and the judiciary; public financial management systems and wages are excluded given the loss of observations). A few results stand out. The impact is found to be dependent on the thresholds for most fiscal series'. The judiciary, red tape, and e-government are significant factors in reducing corruption primarily when the threshold institutions are already stronger and historical corruption is lower. On the other hand, revenue institutions, on average, (see Annex Table 2.1.9), are most relevant when other institutions are weak, and corruption was historically higher. For example, stronger revenue administration is positively correlated with control of corruption when tax complexity is high, when there is a lot of red tape, or when the judiciary is weak. In some cases, it is the only variable that is correlated with corruption under weak institutions, suggesting that revenue institutions could be a crucial element in the fight against corruption, especially in low-capacity countries. In each specification, a statistical F-test confirms that the heterogeneity of slope coefficients is statistically significant.

Regression Trees

An alternative way to identify correlates of corruption is through regression trees (Hastie, Tibshirani, and Friedman 2001). These models attempt to link variations in outcomes, such as corruption, to explanatory

variables by sorting countries into different groups according to variables that are informative about the level of corruption. The sorting is done successively with binary splits, leading to ever-smaller subgroups and hence more granular explanations of corruption. The splitting variables and thresholds are chosen by the algorithm to achieve the maximum reduction in mean-squared error, so that the resulting subgroups explain as much variation in corruption as possible.[10]

To give a stylized illustrative example, countries might first be divided into two groups (branches) by the algorithm: richer and poorer countries (presumably because income is the strongest indicator of corruption). Then, the algorithm may divide countries in the poorer branch into those with a well-functioning judiciary and those without one, whereas the richer countries may be split along the degree of press freedom. In this example, the sample is divided into four groups, each with different average levels of corruption, using three explanatory variables.

Although regression trees are less suitable than linear models for testing hypotheses, they are more flexible in capturing nonlinear relationships and can deal with a larger number of potential explanatory variables. However, regression trees are not able to distinguish between symptoms and causes of corruption.

Regression trees are built using a list of 57 institutional, economic, demographic, and political variables. Annex Table 2.1.10 reports the 10 most important variables chosen by the algorithm from this list of candidates and documents their relative importance in explaining cross-country variation in corruption. Even though the level of development, both current and past, is the most important factor in distinguishing levels of corruption, it is noteworthy that institutional variables, including fiscal institutions, are chosen over alternatives to predict cross-country variation in corruption. And when restricting the sample to countries with below-median governance in 1996, fiscal institutions become even more important than the level of development.

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[10] While, in principle, the splitting could continue until each observation has its own separate group, we split only if the resulting improvement in R^2 is least 1 percentage point.

Annex Table 2.1.1. Variables and Sources

Variable	Source
Corruption Indicators	
Control of Corruption Index	Worldwide Governance Indicators
Corruption Perceptions Index	Transparency International
Fiscal Outcomes	
Public Investment Efficiency	IMF, Investment and Capital Stock Dataset
Education Efficiency	IMF, Investment and Capital Stock Dataset
Harmonized Test Scores	World Bank, Human Capital Index
Years of Schooling	World Bank, Human Capital Index
Defense Spending	Global Financial Statistics
Social Protection	Global Financial Statistics
Social Spending	Global Financial Statistics
Health Spending	World Bank, World Development Indicators
Education Spending	World Bank, World Development Indicators
General Government Services	Global Financial Statistics
General Government Expenditure	World Bank, World Development Indicators
General Government Investment	IMF, Investment and Capital Stock Dataset
Personal Income Tax Efficiency	IMF, World Economic Outlook Tax Rate Database
Value-added Tax (VAT) c-efficiency	IMF, Revenue Analysis Tool
Fiscal Institutions	
Public Sector Wages	International Labor Organization; World Bank, World Development Indicators
Fiscal Transparency	International Budget Partnership; Open Data Barometer; IMF, Public Expenditure and Financial Accountability Framework; World Bank, World Development Indicators
Limitations on Tax Official Discretionary Power	IMF, Revenue Administration Fiscal Information Tool
Use of Third-Party Information	IMF, Revenue Administration Fiscal Information Tool
Time to Pay Taxes	
Time to Complete Audits	
Time to Comply with VAT Refund Procedures	
Time to Obtain VAT Refund	
Time to Comply with Tax Audit	
Time to Register Property	
Red Tape (Procedures)	World Bank, Doing Business Survey
Red Tape (Audits)	
Number of Tax Payments	
Tax Rates for Businesses:	
Profit Tax Rate	
Labor Tax Rate	
Other Tax Rates	
Average Import Tariff Rate	World Bank, World Development Indicators
Public Financial Management Controls	IMF, Public Expenditure and Financial Accountability Framework
Procurement	World Bank, Benchmarking Public Procurement, Benchmarking Public-Private Partnerships
Central Government Procurement	
Payment of Suppliers	World Bank, Benchmarking Public Procurement
Needs Assessment, Call for Tender	

Bid Opening, Evaluation, and Award	
Public-Private Partnership Procurement Public-Private Partnership Preparation Public-Private Partnership Contract Management Handling of Unsolicited Public-Private Partnership Proposals	World Bank, Benchmarking Public-Private Partnerships
Anti-corruption Agency (dummy) E-Government Default History	Baum and others (2017) United Nations E-Government Survey Bank of Canada and IMF Staff
Other Variables	
GDP Per Capita Population Growth Rate Population, Total Fertility Rate Life Expectancy at Birth Population Density Age Dependency Ratio, Percent of Working-Age Population Gini Index Urban Population (Percent of total)	World Bank, World Development Indicators
Ethnolinguistic Fractionalization Trade Openness Capitalism Dummy Socialism Dummy Fraction of GDP in Mining Oil-Producing Country Dummy Absolute Latitude Landlocked Country Dummy Land Area Small States Dummy Colony Dummy British Colony Dummy Spanish Colony European Dummy East Asian Dummy African Dummy Latin American Dummy	Sala-i-Martin, Doppelhofer, and Miller (2004)
Oil Exporter Dummy Oil Exports as a Percent of GDP Doing Business Distance to Frontier Indicator Press Freedom	IMF, October *Fiscal Monitor* (2015) IMF, World Economic Outlook Database World Bank, Doing Business Survey Reporters Without Borders
Ease of Enforcing Contracts (Judiciary) Indicator Automation in Judiciary Indicator Case Management in Judiciary Indicator	World Bank, Doing Business Survey
Public Debt Primary Spending	IMF, World Economic Outlook Database

Annex Table 2.1.2. Control of Corruption and Government Revenues

Variables	(1) General Government Revenues Minus Grants	(2) General Government Revenues Minus Grants	(3) General Government Revenues Minus Grants	(4) General Government Revenues Minus Grants	(5) General Government Revenues Minus Grants	(6) General Government Revenues Minus Grants	(7) General Government Revenues Minus Grants	(8) General Government Revenues Minus Grants	(9) General Governmen Revenues Minus Grant
	OLS	IV	IV	Panel FE	OLS	OLS	OLS	WALS	WALS
Log of GDP Per Capita (lagged)	2.98***		-2.99	-1.18	5.01***	4.15***	3.44***	2.88**	1.81
	(0.00)		(0.41)	(0.29)	(0.00)	(0.00)	(0.00)	(0.05)	(0.29)
Control of Corruption	3.77***	9.98***	14.46**		3.05***		2.86	1.37	1.45
	(0.00)	(0.00)	(0.04)		(0.01)		(0.13)	(0.29)	(0.43)
Control of Corruption (time varying)				1.73**					
				(0.02)					
Log of Population	-0.65	0.36	0.75		-0.47	-0.73*	-0.77*	-0.61	-0.55
	(0.32)	(0.44)	(0.31)		(0.27)	(0.10)	(0.08)	(0.39)	(0.49)
Oil Exports Share (5-year average)	14.54*	28.01*	41.14	12.99*	3.56	8.07	11.15	26.25***	24.29**
	(0.06)	(0.08)	(0.14)	(0.07)	(0.63)	(0.35)	(0.20)	(0.00)	(0.02)
Red Tape (procedures)						-1.22	-0.61		-1.18
						(0.37)	(0.67)		(0.44)
Time to Enforce Contracts (Doing Business)						0.88	1.77		-0.50
						(0.67)	(0.38)		(0.78)
Revenue Institutions (mean)						0.17**	0.16*		0.05
						(0.05)	(0.07)		(0.62)
Online Service Index (e-government)						10.32**	7.73		1.62
						(0.03)	(0.13)		(0.78)
Fiscal Transparency						3.38	1.99		-4.47
						(0.27)	(0.55)		(0.26)
Press Freedom						0.13*	0.07		-0.00
						(0.07)	(0.35)		(0.96)
Press FreedomXFiscal Transparency						0.06	0.01		-0.12
						(0.42)	(0.91)		(0.34)
Tax Complexity (time)						3.07**	4.05***		4.29**
						(0.03)	(0.01)		(0.01)
Inflation				-2.68**					
				(0.01)					
Trade Openness				-0.01					
				(0.29)					
Constant	21.20***	22.67***	28.27***	15.60***	17.09***	16.06***	18.64***	15.03**	26.71***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)
Fiscal Institutions F-test (p-value)						0.007	0.098		0.678
Fiscal Institutions and WGI CC F-test(p-value)							0.004		0.747
Additional Controls	NO	NO	NO	NO		NO	NO	YES	YES
Observations	185	75	75	810	114	114	114	111	87
Fiscal Institution Sample	NO	NO	NO	NO	NO	YES	YES	NO	YES
R-squared	0.37			0.19	0.56	0.60	0.61		
First-Stage R-squared		0.44	0.56						
Number of Countries	185	75	75	181	114	114	114	111	87

Source: IMF staff estimates.

Note: Robust p-values in parentheses. In panel regressions, residuals are clustered by country. The five-year average of revenues minus grants. Revenue Institutions is the average of use of third-party information, limits on discretionary power, and time for audit completion (inverted). Control of Corruption is instrumented by log of settler mortality in IV regressions. Additional controls are log of population density, log of population growth, capitalism and socialism dummies, latitude, air distance to big cities, landlocked country dummy, cultural and colonial history dummies, and regional dummies. In column (4), explanatory variables are lagged by one year. FE: fixed effects; IV: instrumental variables; OLS: ordinary least squares; WALS: weighted average least squares; WDI CC: Worldwide Governance Indicators Control of Corruption. *** p< 0.01, **p<0.05, *p<0.1.

Annex Table 2.1.3. Control of Corruption and Government Expenditure

(Percent of total expenditure)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Education Expenditure	Education Expenditure	Health Expenditure	Health Expenditure	Education and Health Expenditure	Education and Health Expenditure	Education and Health Expenditure	Education and Health Expenditure
	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV
Log of GDP per capita (Lagged, 10-year average)	-1.96***	-2.04**	0.46	0.24	-1.50	-1.80*		-0.83
	(0.01)	(0.02)	(0.35)	(0.72)	(0.12)	(0.09)		(0.80)
Control of Corruption	1.54**	2.07*	2.37***	0.74	3.91***	2.81**	2.83**	3.68
	(0.03)	(0.06)	(0.00)	(0.29)	(0.00)	(0.05)	(0.01)	(0.41)
Online Service Index (e-government)		1.88		4.90		6.78		
		(0.65)		(0.18)		(0.11)		
Fiscal Transparency		-5.13**		1.02		-4.11		
		(0.03)		(0.51)		(0.16)		
Central Government Procurement		-0.34		6.31*		5.97		
		(0.95)		(0.07)		(0.36)		
Press Freedom		0.05		0.05		0.10		
		(0.42)		(0.12)		(0.14)		
Press Freedom X Fiscal Transparency		-0.14**		0.02		-0.12*		
		(0.02)		(0.65)		(0.09)		
Log Population Total (WDI)	-0.54**	-0.46	-0.16	-0.36	-0.71*	-0.82		
	(0.04)	(0.23)	(0.49)	(0.20)	(0.08)	(0.13)		
Oil Exports (as percent of GDP)	-0.00	0.01	-0.04*	-0.01	-0.04	-0.01		
	(0.81)	(0.84)	(0.09)	(0.23)	(0.16)	(0.77)		
Constant	40.65***	41.64***	7.81	8.63	48.46***	50.28***	22.72***	30.29
	(0.00)	(0.00)	(0.16)	(0.27)	(0.00)	(0.00)	(0.00)	(0.31)
Observations	103	90	103	90	103	90	65	65
R-squared	0.13	0.16	0.41	0.54	0.26	0.32		
First-Stage R-squared							0.35	0.68

Source: Sala-i-Martin, Doppelhofer, and Miller (2004) and IMF staff estimates.

Note: Robust p-values in parentheses. Control of Corruption is instrumented by log of ethnolinguistic fractionalization and log of date of independece in IV regressions. Additional controls are log of population density, log of population growth, capitalism and socialism dummies, latitude, air distance to big cities, landlocked country dummy, cultural and colonial history dummies, and regional dummies. IV: instrumental variables; OLS=:ordinary least squares; WDI: World Development Indicators. *** p< 0.01, **p<0.05, *p<0.1.

Annex Table 2.1.4. Control of Corruption and Public Investment Efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Public Investment Efficiency	**Public Investment Efficiency**	**Public Investment Efficiency**	**Public Investment Efficiency**	**Public Investment Efficiency**	**Public Investment Efficiency**	**Public Investment Efficiency**	**Public Investment Efficiency**
Variables	OLS	IV	IV	OLS	OLS	OLS	WALS	WALS
Log of GDP per capita (lagged, 10-year average)	-0.08***		-0.10	-0.10***	-0.10***	-0.12***	-0.03	-0.04
	(0.01)		(0.22)	(0.00)	(0.00)	(0.00)	(0.54)	(0.44)
Control of Corruption	0.15***	0.15***	0.23**	0.16***		0.10**	0.06*	0.03
	(0.00)	(0.00)	(0.02)	(0.00)		(0.03)	(0.07)	(0.49)
Online Service Index (e-government)					0.24**	0.13		0.17
					(0.03)	(0.29)		(0.18)
Fiscal Transparency					0.05	-0.02		0.05
					(0.60)	(0.83)		(0.62)
Central Government Procurement					-0.00	-0.01		0.03
					(0.99)	(0.96)		(0.87)
Press Freedom					0.00	-0.00		0.00
					(0.44)	(0.72)		(0.53)
Press Freedom X Fiscal Transparency					-0.00	-0.00		0.00
					(0.94)	(0.35)		(0.74)
Tax complexity (time)					-0.08**	-0.06		-0.04
					(0.03)	(0.10)		(0.43)
Time for Tax Audit					0.00	0.00		0.00
					(0.65)	(0.57)		(0.29)
Red Tape (procedures)					-0.06	-0.05		-0.00
					(0.14)	(0.28)		(0.97)
Time to Enforce Contracts (Doing Business)					-0.15**	-0.13**		-0.02
					(0.02)	(0.03)		(0.78)
Constant	0.05	-0.04	0.01	0.06**	0.01	0.06	-0.10	0.03
	(0.13)	(0.20)	(0.92)	(0.04)	(0.95)	(0.61)	(0.80)	(0.96)
Fiscal Institutions F-test (p-value)					0.000	0.011		0.000
Fiscal Institutions and WGI CC F-test(p-value)							0.000	
Additional Controls	NO	NO	NO	NO		NO	YES	YES
Observations	118	54	54	107	107	107	85	81
Fiscal institution sample	NO	NO	NO	YES	YES	YES	NO	YES
R-squared	0.21			0.23	0.35	0.39		
First-Stage R-squared		0.22	0.45					

Source: IMF Staff estimates.

Note: Robust p-values in parentheses. Control of corruption is instrumented by log of settler mortality in IV regressions. Additional controls are oil exports, fertility rate, life expectancy, log of population density, log of population growth, log of population, the Gini coefficient, the share of urban population, the Doing Business distance to frontier score, capitalism and socialism dummies, latitude, landlocked country dummy, colonial history dummies, and regional dummies. IV: instrumental variable; OLS: ordinary least squares; WALS: weighted average least squares; WGI CC: Worldwide Governance Indicators Control of Corruption. ***p<0.01,**p<0.05,*<0.1.

Annex Table 2.1.5. Control of Corruption and Education Outcomes

Variables	(1) Log of Test Scores OLS	(2) Log of Years of Schooling IV	(3) Log of Test Scores IV	(4) Log of Test Scores IV	(5) Log of Test Scores OLS	(6) Log of Test Scores OLS	(7) Log of Test Scores OLS	(8) Log of Test Scores WALS	(9) Log of Test Scores WALS
Log of GDP per capita (Lagged, 10-year average)	0.07***	0.15***		0.03	0.07***	0.07***	0.06***	0.06***	0.06**
	(0.00)	(0.00)		(0.39)	(0.00)	(0.00)	(0.00)	(0.01)	(0.03)
General Government Expenditure on Education, % of GDP, natural log	0.00	0.02***	-0.06	-0.05	0.02	0.03	0.02	0.01	0.00
	(0.97)	(0.00)	(0.16)	(0.34)	(0.35)	(0.22)	(0.42)	(0.79)	(0.95)
Control of Corruption	0.05***	0.01	0.19***	0.15**	0.05***		0.04**	0.02	0.03
	(0.00)	(0.68)	(0.00)	(0.03)	(0.00)		(0.01)	(0.25)	(0.21)
Online Service Index (e-government)						0.04	0.00		-0.03
						(0.48)	(0.95)		(0.66)
Fiscal Transparency						0.05	0.02		0.01
						(0.12)	(0.51)		(0.83)
Central Government Procurement						0.22***	0.21***		-0.01
						(0.00)	(0.01)		(0.91)
Press Freedom						-0.00	-0.00*		-0.00
						(0.58)	(0.10)		(0.43)
Press Freedom X Fiscal Transparency						0.00	-0.00		-0.00
						(0.61)	(0.63)		(0.69)
Constant	-0.03***	-0.07***	-0.02	-0.03	-0.03***	-0.16***	-0.13***	-0.52**	-0.49
	(0.00)	(0.00)	(0.30)	(0.19)	(0.00)	(0.00)	(0.00)	(0.04)	(0.10)
Fiscal Institutions F-test (p-value)						0.000	0.001		0.869
Fiscal Institutions and WGI CC F-test(p-value)							0.000		0.785
Additional Controls	NO	NO	NO	NO		NO	NO	YES	YES
Observations	153	153	71	71	137	137	137	98	93
Fiscal Institution Sample	NO	NO	NO	NO	YES	YES	YES	NO	YES
R-squared	0.62			0.55	0.61	0.65	0.67		
First-Stage Least Squared Sample		0.44	0.56						

Source: IMF Staff estimates.

Note: Robust p-values in parentheses. Control of Corruption is instrumented by log of settler mortality in IV regressions. Additional controls are oil exports, fertility rate, life expectancy, log of population density, log of population growth, log of population, the Gini coefficient, the share of urban population, the Doing Business distance to frontier score, capitalism and socialism dummies, latitude, landlocked country dummy, colonial history dummies, and regional dummies. ***p<0.01, **p<0.05, *<0.1. IV: instrumental variable; OLS: ordinary least square; WALS: weighted average least squares; WGI CC: Worldwide Governance Indicator Control of Corruption.

Annex Table 2.1.6. Fiscal Institutions and Corruption: Correlations without and with Controls

	Dependent Variable: 2017 Worldwide Governance Indicators, Control of Corruption Index															
	Univariate Regressions				Controlling for GDP Per Capita and Oil				Controlling for GDP Per Capita, Oil, Press Freedom, and Judiciary				Controlling for GDP Per Capita, Oil, Judiciary, Press Freedom, and Corruption in 1996			
	A				B				C				D			
	Beta	SE	R-squared	N	Beta	SE	R-squared	N	Beta	SE	R-squared	N	Beta	SE	R-squared	N
Fiscal Institutions:																
Public Sector Wages	-0.24***	0.09	0.06	90	0.15	0.09	0.63	90	0.12*	0.07	0.72	90	0.12*	0.06	0.88	88
PFM Controls	0.25***	0.06	0.14	100	0.11*	0.06	0.31	99	0.04	0.06	0.49	91	0	0.05	0.65	87
Revenue Institutions (Mean)	0.85***	0.11	0.31	129	0.31***	0.10	0.61	129	0.25***	0.08	0.73	121	0.16***	0.05	0.88	119
Use of Third-Party Information (Revenue Administration)	0.38***	0.08	0.15	131	0.04	0.06	0.57	131	0.03	0.05	0.72	121	0.02	0.04	0.87	119
Limits to Discretionary Power (Revenue Administration)	0.48***	0.07	0.24	131	0.11	0.07	0.58	131	0.09	0.07	0.72	121	0.01	0.05	0.87	119
Time for Tax Audit	-0.14***	0.05	0.02	178	-0.13***	0.05	0.54	176	-0.07*	0.04	0.70	165	-0.05	0.03	0.87	161
E-government	0.57***	0.06	0.33	184	0.11	0.08	0.50	182	0.11*	0.07	0.69	167	0.07	0.04	0.85	163
Fiscal Transparency	0.52***	0.07	0.29	178	0.2***	0.07	0.50	175	0.03	0.07	0.68	160	-0.03	0.05	0.85	156
Overall Procurement	0.34***	0.07	0.12	181	0.05	0.07	0.51	179	0.02	0.06	0.69	165	0.02	0.05	0.86	161
CG Procurement	0.34***	0.07	0.12	178	0.09	0.06	0.51	177	0.01	0.06	0.69	163	0.05	0.05	0.86	159
Paying Suppliers	0.47***	0.07	0.23	170	0.21***	0.06	0.57	169	0.15***	0.05	0.71	160	0.08*	0.05	0.86	156
Needs Assessment, Call for Tender, and Bid Preparation	0.28***	0.07	0.08	176	0.01	0.06	0.51	175	-0.09	0.06	0.70	161	-0.02	0.04	0.86	157
Bid Opening, Evaluation and Award	0.08	0.07	0.01	175	0.06	0.06	0.52	174	-0	0.05	0.69	161	0.02	0.03	0.86	157
PPP Procurement	0.44***	0.06	0.21	135	0.09	0.06	0.57	134	0.02	0.06	0.68	132	0.01	0.04	0.85	129
PPP Preparation	0.41***	0.07	0.18	135	0.12*	0.07	0.58	134	0.08	0.06	0.68	132	0.03	0.04	0.85	129
PPP Contract Management	0.14	0.09	0.02	135	-0.07	0.06	0.57	134	-0.04	0.05	0.68	132	-0.04	0.05	0.85	129
Handling of Unsolicited PPP Proposals	0.23***	0.07	0.09	91	0.03	0.05	0.47	90	0.02	0.05	0.57	90	-0.01	0.05	0.79	88
Anticorruption Unit (Dummy)	0.27	0.23	0.02	77	0.26	0.19	0.51	76	0.32**	0.14	0.66	74	0.24**	0.10	0.82	74
Average Import Tariff Rate	-0.09***	0.02	0.16	180	-0.01	0.01	0.53	179	-0.01	0.01	0.69	165	-0	0.01	0.85	162
Number of Tax Payments	-0.46***	0.06	0.22	185	-0.1	0.06	0.51	183	-0.04	0.06	0.69	169	-0.03	0.04	0.86	165
Tax Complexity (Time)	-0.55***	0.07	0.31	185	-0.34***	0.05	0.61	183	-0.29***	0.04	0.76	169	-0.18***	0.03	0.88	165
Tax Rate for Businesses	-0.18**	0.08	0.03	185	-0.07	0.08	0.51	183	-0.05	0.06	0.69	169	-0.03	0.06	0.86	165
Profit Tax Rate	-0.07	0.08	0.00	185	0	0.07	0.51	183	0.03	0.06	0.69	169	0.01	0.04	0.86	165
Labor Tax Rate	-0	0.07	0.00	185	-0.14***	0.05	0.53	183	-0.14***	0.05	0.71	169	-0.08**	0.04	0.86	165
Other Tax Rates	-0.16*	0.08	0.03	185	0.01	0.06	0.51	183	0.01	0.04	0.69	169	0.01	0.04	0.86	165
Time for Compliance with VAT Refund Procedure	-0.39***	0.10	0.16	106	-0.09	0.08	0.53	105	-0.1	0.07	0.67	96	-0.06	0.06	0.85	94
Time for VAT Refund	-0.45***	0.08	0.22	106	-0.19***	0.07	0.55	105	-0.09	0.06	0.67	96	-0.04	0.05	0.85	94
Time for Tax Audit Compliance	-0.21***	0.07	0.05	178	-0.07	0.05	0.53	176	-0.02	0.04	0.69	165	0	0.03	0.86	161
Red Tape (Procedures)	-0.48***	0.06	0.25	181	-0.3***	0.04	0.61	180	-0.22***	0.04	0.74	167	-0.14***	0.03	0.87	164
Red Tape (Time)	-0.63***	0.08	0.42	179	-0.33***	0.06	0.59	178	-0.22***	0.06	0.72	165	-0.16***	0.04	0.87	162

Soure: IMF staff estimates.

Note: Each row summarizes four separate regressions. Starting with a univariate regression of control of corruption on the independent variable in question, each set of columns adds additional controls. Standard errors are adjusted for heteroscedasticity. Public sector wages refers to the ratio of public sector wages to non-oil GDP per worker. See text for other data definitions and sources. All variables are rescaled by their respective standard deviation. PFM: public financial management; PPP: public-private partnership; VAT: value-added tax; SE: standard deviation.

Annex Table 2.1.7. Fiscal Institutions and Corruption: Multivariate Regressions

Dependent Variable: 2017 Worldwide Governance Indicators Control of Corruption

Variables	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)
Tax Complexity (Time)	-0.245***	-0.287***	-0.220***	-0.104**	-0.156	-0.134***	-0.141***	-0.125***	-0.052	-0.054
	(0)	(0)	(0)	(0.04)	(0.12)	(0)	(0)	(0)	(0.21)	(0.42)
E-government	0.116	0.112	0.194***	0.171*	0.148	0.047	0.04	0.076	0.058	0.05
	(0.1)	(0.11)	(0.01)	(0.06)	(0.19)	(0.29)	(0.34)	(0.16)	(0.32)	(0.61)
Red Tape (Time)	-0.148***	-0.113**	-0.194***	-0.182*	-0.180*	-0.115***	-0.098**	-0.143**	-0.157	-0.145
	(0)	(0.04)	(0)	(0.06)	(0.08)	(0.01)	(0.02)	(0.02)	(0.11)	(0.15)
Fiscal Transparency	0.423***	-0.022	0.468***	0.471***	0.449**	0.180**	-0.016	0.272**	0.351***	0.260*
	(0)	(0.77)	(0)	(0)	(0.04)	(0.04)	(0.73)	(0.02)	(0)	(0.07)
Press Freedom X Transparency	0.536***		0.683***	0.735***	0.558***	0.237**		0.361**	0.488***	0.273*
	(0)		(0)	(0)	(0.01)	(0.01)		(0.01)	(0)	(0.09)
Time for Tax Audit	-0.018	-0.051		-0.057	0.033	-0.033	-0.047*		-0.064**	-0.029
	(0.6)	(0.19)		(0.14)	(0.55)	(0.18)	(0.09)		(0.01)	(0.44)
CG Procurement	0.018	0.012	-0.018	-0.107*	-0.008	0.06	0.06	0.026	-0.038	0.027
	(0.74)	(0.84)	(0.77)	(0.1)	(0.93)	(0.23)	(0.25)	(0.69)	(0.49)	(0.75)
Revenue Institutions (Mean)			0.181**					0.142**		
			(0.02)					(0.02)		
Public Sector Wages				0.138					0.082	
				(0.12)					(0.29)	
Anti-Corruption Unit (Dummy)					0.225*					0.222**
					(0.08)					(0.02)
Constant	-1.869***	-2.632***	-1.293*	-3.969***	-1.317	-0.22	-0.381	0.123	-1.191	-0.543
	(0)	(0)	(0.06)	(0.01)	(0.15)	(0.66)	(0.44)	(0.84)	(0.3)	(0.49)
Controls:	log(GDP per capita), oil exports/GDP, judiciary, press freedom.					log(GDP per capita), oil exports/GDP, judiciary, press freedom, and control of corrruption in 1996.				
N	148	148	112	79	69	145	145	110	78	69
Adj. R-squared	0.78	0.75	0.81	0.82	0.68	0.88	0.88	0.89	0.90	0.81

Source: IMF staff estimates.

Note: Robust p-values in parentheses. Public Sector Wages refers to the ratio of public sector wages to non-oil GDP per worker. See text for other data definitions and sources. All variables are rescaled by their respective standard deviation. CG= central government.

***p<0.01,**p<0.05,*p<0.01.

Annex Table 2.1.8. Interaction Term Results

		Dependent Variable for All Columns: 2017 Control of Corruption												
Control Variables	GDP Per Capita	0.13**	0.12**	0.06	0.11*	0.08	0.21**	0.11***	0.12***	0.09	0.10**	0.11**	0.23***	0.19**
	Oil Exports	-0.58	-0.58	-0.80**	-0.98*	-0.84**	-0.04	-0.77**	-0.65**	-0.54	-0.82***	-0.52	0.44	0.45
	Control of Corruption in 1996		0.60***	0.57***	0.43***	0.60***	0.55***		0.57***	0.54***	0.55***	0.66***		0.60***
	Judiciary	0.22***	0.22***	0.13*	0.24*	0.08	0.1	0.19***		0.19*			0.12	0.12
	Press Freedom	0.13***		0.11*	0.09	0.07	0.14***	0.14***	0.14***	0.09	0.11*	0.05	0.14***	
Variables in Interaction	Online Services													
	Fiscal Transparency	-0.03	-0.04											
	CG Procurement													
	Revenue Institutions			0.18***	0.25***	0.17***								
	Tax Complexity (Time)			0.17***			0.15***	0.19***	0.17***					
	PFM Systems				-0.02					0.05	0.07			
	Red Tape (Procedures)					0.19***				0.13**		0.20***		
	Wages						0.11						0.10*	0.12*
	Control of Corruption in 1996	0.61***						0.54***					0.60***	
	Judiciary								0.16**		0.17*	0.08		
	Press Freedom		0.17***											0.16***
	Interaction Term	**0.06****	**0.08***	**0.15****	**0.20***	**0.19****	**-0.05****	**0.10****	**0.06***	**0.17****	**0.20***	**0.21****	**-0.07***	**-0.11****
	Constant	-1.31***	-1.22**	-0.56	-1.11**	-0.78*	-2.05**	-1.09***	-1.17***	-0.90*	-1.10**	-1.14***	-2.24***	-1.90***
	Observations	155	155	119	61	119	88	164	164	86	87	162	88	88
	Adjusted R-Squared	0.84	0.84	0.89	0.6	0.89	0.88	0.88	0.88	0.67	0.65	0.88	0.87	0.87

Note: Ordinary least squares regressions. Standard errors adjusted for heteroscedasticity. GDP per capita is used in logarithm. All fiscal institutions, press freedom, and the judiciary variables are standardized. Tax complexity and red tape are inverted (an increase in the variable means a reduction in time or procedures). Revenue Institutions is an average of limits to discretionary power (RA-FIT), use of third-party information (RA-FIT), and the inverted time for tax audit completion (World Bank, Doing Business Indicators). CG: central government; PFM: public financial management; RA-FIT: Revenue Administration Fiscal Information Tool. ***$p<0.0.1$,**$p<0.05$,*$p<0.1$.

Annex Table 2.1.9. Fiscal Institutions and Corruption: Threshold Regressions

Dependent Variable for All Columns: 2017 Control of Corruption	Linear Model	Threshold Models (Splitting Sample at the Median of the Threshold Variable)									
		Tax Complexity (Time)		Revenue Institutions		1996 Control of Corruption		Red Tape (Procedures)		Judiciary	
		Upper Regime	Lower Regime	Upper Regime	Lower Regime	Upper Regime	Lower Regime	Upper Regime	Lower Regime	Upper Regime	Lower Regime
GDP Per Capita	0.02	0.07	0.02	-0.08	0.15*	-0.07	0.01	0.17**	-0.03	0.03	0.12
	(0.74)	(0.42)	(0.87)	(0.43)	(0.1)	(0.39)	(0.92)	(0.04)	(0.77)	(0.76)	(0.19)
Oil Exports / GDP	-0.47	-1.86	-0.21	-0.37	-1.9	-0.57	-1.39	-1.63*	-0.79	-0.28	-1.82
	(0.5)	(0.13)	(0.8)	(0.57)	(0.19)	(0.66)	(0.11)	(0.08)	(0.6)	(0.67)	(0.13)
Control of Corruption in 1996	0.53***	0.41***	0.60***	0.52***	0.59***	0.78***	0.02	0.40***	0.58***	0.52***	0.51***
	(0)	(0)	(0)	(0)	(0)	(0)	(0.91)	(0)	(0)	(0)	(0)
Judiciary	0.06	0.08	0.03	0.20**	-0.16	0.03	0.21	-0.08	0.13	0.16	-0.01
	(0.37)	(0.57)	(0.68)	(0.02)	(0.1)	(0.66)	(0.11)	(0.39)	(0.12)	(0.2)	(0.94)
Red Tape (Procedures)	-0.20***	-0.12	-0.16	-0.19*	-0.05	-0.15*	-0.11	-0.07	-0.35	-0.30**	0.02
	(0.01)	(0.26)	(0.11)	(0.07)	(0.5)	(0.08)	(0.15)	(0.46)	(0.16)	(0.01)	(0.79)
CG Procurement	0.02	0.04	0.01	-0.03	0.14	0.06	-0.11	0.05	-0.02	-0.03	0.09
	(0.79)	(0.64)	(0.9)	(0.66)	(0.2)	(0.42)	(0.32)	(0.56)	(0.79)	(0.68)	(0.43)
E-government	0.08	0.06	0.04	0.11*	0	0.02	0.01	-0.05	0.13**	0.05	-0.03
	(0.18)	(0.48)	(0.53)	(0.08)	(1)	(0.66)	(0.93)	(0.65)	(0.04)	(0.48)	(0.81)
Press Freedom	0.13*	0.21***	-0.11	0.11	0.08	0	0.16	0.04	0.1	0.03	0.16**
	(0.06)	(0.01)	(0.27)	(0.16)	(0.38)	(0.95)	(0.17)	(0.49)	(0.37)	(0.76)	(0.05)
Fiscal Transparency	-0.04	-0.06	0.05	-0.01	-0.09	-0.04	0.15*	0.03	-0.04	-0.06	-0.02
	(0.49)	(0.41)	(0.63)	(0.93)	(0.43)	(0.66)	(0.09)	(0.71)	(0.6)	(0.39)	(0.87)
Transparency X Press Freedom	0.10**	0.1	0.18	0.15**	0.07	0.11	0.08	0.01	0.1	0.21***	0.09
	(0.03)	(0.21)	(0.11)	(0.02)	(0.39)	(0.22)	(0.39)	(0.9)	(0.2)	(0.01)	(0.32)
Revenue Institutions	0.13**	0.15**	0.05	0.19	0.20*	0.02	0.22**	0.15*	0.1	0.11	0.20***
	(0.03)	(0.02)	(0.73)	(0.32)	(0.09)	(0.81)	(0.01)	(0.07)	(0.34)	(0.38)	(0.01)
Tax Complexity (Time)	-0.12***	-0.07	-0.32**	-0.07	-0.06	-0.14**	-0.01	-0.09*	-0.11	-0.04	-0.06
	(0.01)	(0.2)	(0.01)	(0.42)	(0.23)	(0.02)	(0.9)	(0.09)	(0.25)	(0.57)	(0.41)
Constant	-0.27	-0.73	-0.36	0.59	-1.44*	0.55	-0.6	-1.71**	0.08	-0.45	-1.13
	(0.61)	(0.34)	(0.75)	(0.54)	(0.09)	(0.47)	(0.5)	(0.03)	(0.93)	(0.66)	(0.15)
F-Test for Regime Difference (13 DoF, Prob > F)		<0.01		<0.01		<0.01		<0.01		0.01	
Observations	110	110		110		110		110		110	
Adjusted R-Squared	0.89	0.9		0.89		0.91		0.89		0.89	

Source: IMF staff estimates.
Note: Standard errors adjusted for heteroscedasticity. P-values in parentheses. GDP per capita is used in logarithm. All fiscal institutions, press freedom, and the judiciary variables are standardized. Revenue institutions is an average of risk based auditing (RA-FIT), use of third party information (RA-FIT), and the inverted time for tax audit completion (World Bank, Doing Business Indicators). CG: central government. PFM: public financial management, RA-FIT: Revenue Administration Fiscal Information Tool. ***p<0.01,**p<0.05,*p<0.1.

Annex Table 2.1.10. Regression Trees: Relative Importance of Top 10 Variables

	1. Pooled: All Countries			2. Split Sample:					
				Countries with High 1996 Control of Corruption Index Levels			Countries with Low 1996 Control of Corruption Index Levels		
Rank	Variable	Relative Importance		Rank	Variable	Relative Importance	Rank	Variable	Relative Importance
1	GDP per capita	18.2		1	GDP per capita	13.3	1	Fiscal transparency	9.8
2	GDP per capita in 1996	10.4		2	GDP per capita in 1996	11.1	2	Red tape (time)	8.3
3	e-government	9.1		3	Red tape (procedures)	6.8	3	Judiciary	7.9
4	Press freedom	8.0		4	Red tape (time)	6.7	4	e-government	7.0
5	Tax complexity (time)	6.9		5	e-government	6.7	5	Case management in judiciary	6.3
6	Fiscal transparency	6.3		6	Tax complexity (time)	4.9	6	Press freedom	4.5
7	Urban population share	6.0		7	Press freedom	4.6	7	Automation in judiciary	4.4
8	Population	4.8		8	Urban population share	4.1	8	GDP per capita	3.6
9	Red tape (time)	4.4		9	Fiscal transparency	3.1	9	Time to register property	3.0
10	Judiciary	2.7		10	CG procurement	3.0	10	Number of tax payments	3.0

Source: IMF staff estimates.
Note: Table reports top 10 variables (out of 57) in regression trees to explain the 2017 modified control of corruption scores for 196 countries. High and low 1996 control of corruption samples are split at the median of 1996 control of corruption. Relative importance capture the reduction in mean squared error attributed to each variable and is normalized to sum to 100 in each tree. Importance measures are averages over 5,000 bootstrapped samples. CG: central government.