Online Appendix to "Sovereign Default and Tax-smoothing in the Shadow of Corruption and Institutional Weakness"*

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1 Data

The distribution of CC and R&A across all countries in the database (including developing ones) is shown in Figure 1. To construct the distributions we first compute the average value of each institutional variable over time for each country in the sample (there are 166 countries). The definitions of 'Emerging,' 'Developed.' and 'Developing' correspond to the IMF's publication *The Fiscal Monitor*, "Table A Economic Groupings." From Figure 2, we see that CC and R&A are positively related, with most developed economies exhibiting democratic strength and corruption under control. Singapore is an outlier among developed countries: despite low scores on R&A (closer to the average emerging country), its CC value is one of the highest among developed countries. Bhutan, Bahrain, Eswani, the United Arab Emirates, Oman, Rwanda, Qatar, Saudi Arabia, and Cuba also exhibit lower R&A scores relative to their peers with similar CC values. This may be because most of them are monarchies, except Cuba and Eritrea, which are non-representative democracies.

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Figure 1: Distribution of CC (left) and R&A (right) - All countries

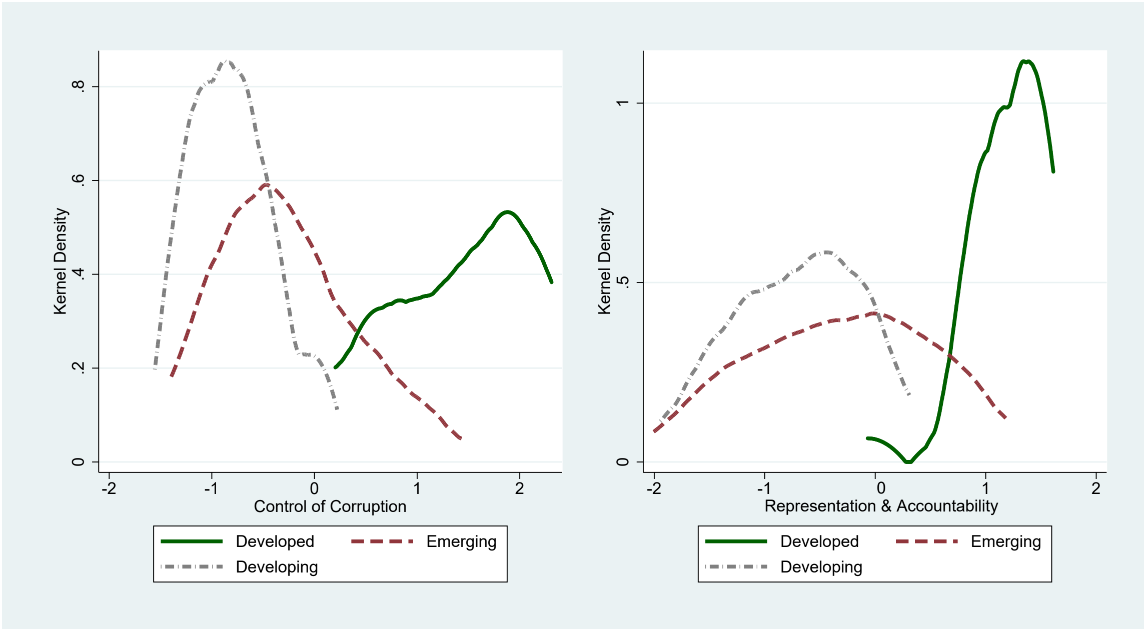
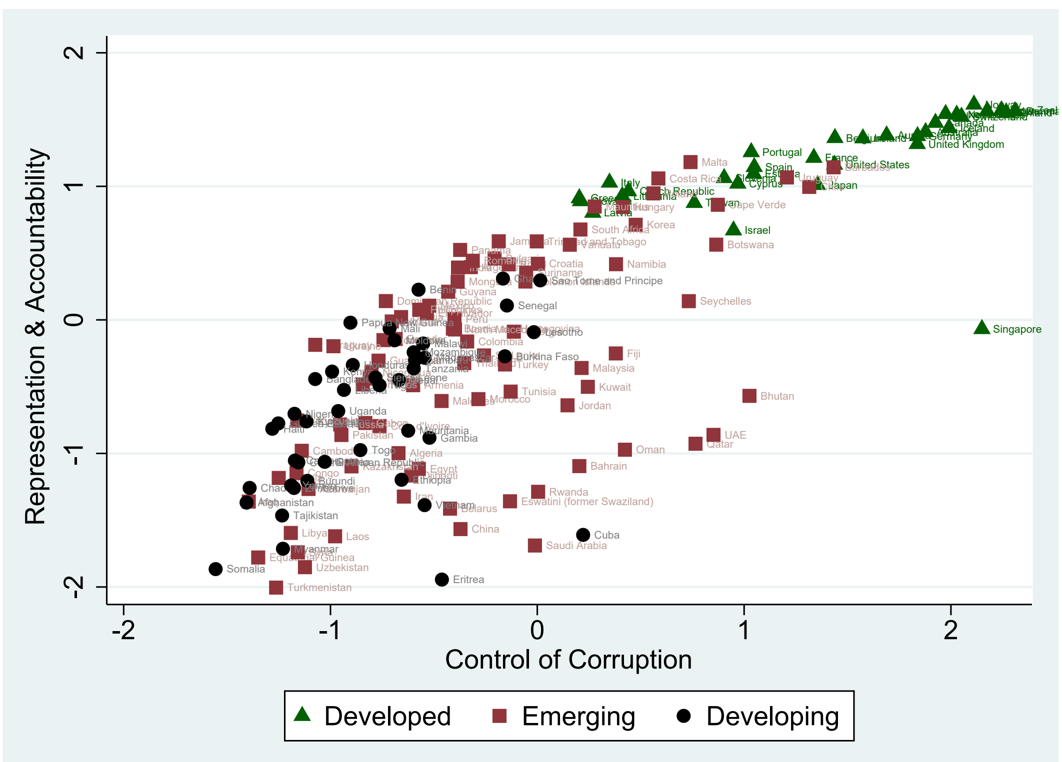


Figure 2: CC and R&A - All countries



Note that Figures 2 and 3 in the main text include countries with relatively better institutions. This is the case because they are plotted using our benchmark data, which restricts the sample to countries with economic, policy, and Fitch ratings' availability. Countries with worse institutional quality tend to be excluded from capital markets (and do not receive Fitch ratings), which excludes them from the benchmark case.

There are 30 developed countries in our benchmark data and 28 emerging ones. We do not have data on developing economies. The average values of R&A and CC over the 1996-2022 period for developed and emerging countries in our benchmark sample are reported in the Online Appendix, Tables 1 and 2, respectively. Emerging markets have weaker and more volatile democratic institutions, as well as poorer control of corruption. The correlation between R&A and CC in our sample is 0.81.

Table 1: Developed Countries ($n = 30$) - Benchmark sample

	Representation and Accountability		Control of Corruption		Fitch Ratings
	mean	st.d.	mean	st.d.	mean
Australia	1.41	0.06	1.88	0.10	4.0
Austria	1.38	0.05	1.69	0.20	4.0
Belgium	1.36	0.05	1.44	0.08	4.0
Canada	1.48	0.07	1.93	0.12	4.0
Czech Republic	0.96	0.08	0.44	0.13	3.5
Denmark	1.56	0.08	2.31	0.09	4.0
Finland	1.55	0.07	2.27	0.09	4.0
France	1.21	0.10	1.34	0.09	4.0
Germany	1.38	0.06	1.84	0.07	4.0
Greece	0.89	0.17	0.13	0.24	2.8
Iceland	1.43	0.08	2.01	0.20	3.5
Ireland	1.36	0.08	1.57	0.14	3.7
Israel	0.67	0.06	0.90	0.15	3.5
Italy	1.03	0.07	0.35	0.19	3.6
Japan	1.01	0.05	1.35	0.21	3.8
Latvia	0.80	0.05	0.27	0.23	3.2
Lithuania	0.93	0.05	0.41	0.20	3.3
Luxembourg	1.54	0.06	1.98	0.14	4.0
Netherlands	1.54	0.06	2.03	0.09	4.0
Norway	1.61	0.09	2.11	0.10	4.0
Portugal	1.26	0.14	1.03	0.17	3.6
Singapore	-0.07	0.17	2.15	0.06	4.0
Slovakia	0.90	0.08	0.21	0.12	3.3
Slovenia	1.06	0.09	0.90	0.13	3.6
Spain	1.15	0.12	1.05	0.28	3.7
Sweden	1.56	0.06	2.17	0.05	4.0
Switzerland	1.52	0.08	2.05	0.06	4.0
Taiwan	0.88	0.12	0.76	0.19	3.7
United Kingdom	1.32	0.08	1.84	0.16	4.0
United States	1.16	0.15	1.44	0.21	4.0
Average - Developed	1.19	0.08	1.40	0.14	3.8

Table 2: Emerging Countries ($n = 28$) - Benchmark sample

	Representation and Accountability		Control of Corruption		Fitch Ratings
	mean	st.d.	mean	st.d.	mean
Argentina	0.40	0.10	-0.32	0.14	1.1
Brazil	0.42	0.10	-0.14	0.22	2.8
Bulgaria	0.46	0.10	-0.20	0.10	2.8
Chile	1.00	0.16	1.31	0.18	3.5
China	-1.57	0.12	-0.37	0.17	3.5
Colombia	-0.16	0.22	-0.34	0.11	3.0
Costa Rica	1.06	0.08	0.59	0.13	2.8
Ecuador	-0.14	0.14	-0.68	0.11	1.8
Egypt	-1.14	0.19	-0.58	0.10	2.5
El Salvador	0.05	0.08	-0.53	0.20	2.7
Hungary	0.85	0.29	0.41	0.25	3.1
India	0.39	0.09	-0.38	0.10	3.0
Indonesia	-0.15	0.36	-0.74	0.26	2.7
Kazakhstan	-1.10	0.13	-0.90	0.27	3.0
Korea	0.71	0.07	0.48	0.14	3.6
Malta	1.19	0.07	0.77	0.22	3.5
Mexico	0.11	0.14	-0.52	0.28	3.0
Panama	0.52	0.11	-0.37	0.14	3.0
Peru	0.01	0.29	-0.40	0.13	3.0
Philippines	0.08	0.16	-0.57	0.15	3.0
Poland	0.95	0.16	0.56	0.19	3.3
Romania	0.46	0.09	-0.28	0.14	2.9
Russia	-0.78	0.31	-0.95	0.10	2.8
South Africa	0.68	0.09	0.21	0.29	3.0
Thailand	-0.32	0.54	-0.35	0.10	3.0
Tunisia	-0.54	0.61	-0.13	0.19	2.8
Uruguay	1.08	0.12	1.21	0.18	2.8
Venezuela	-0.75	0.50	-1.16	0.25	2.1
Average - emerging	0.13	0.19	-0.16	0.17	2.9

2 Numerical Algorithm

The numerical algorithm for this model uses taste shocks in both the choice of borrowing b' and the default decision as in Mihalache (2020). Similar discrete choice methods are also used in Chatterjee and Eyigungor (2012). The idea is to perturb the borrowing choice[1], and the default decision to make the value function $J(\Pi')$ smoother, which in turn aids numerical convergence.

1. We start with discrete, equally spaced grids for labor income taxes, debt, TFP shock, and the degree of political constraints. The τ grid is of size 100 in the range $[0.0, 0.75]$. The b grid is of size 150 ranging between 0 and 150 percent of average GDP in the benchmark simulation. The m grid has 20 points starting from 1 to 20. The z grid has 201 points, discretized using the Tauchen and Hussey (1991) method.

2. Starting with a guess for continuation values both in repayment and default: $J(\Pi')$ and $J^d(\mathbf{s}') \equiv J(z', \Omega' = 0, m', b' = 0)$ and the price function $q(z, m, b')$, we calculate the optimal taxes (τ) and pure public goods expenditure, g, given state Π and borrowing b'[2]. First, we compute the optimal taxes assuming that the constraint $B(\Pi, \Phi)$ does not bind. If it is negative, we impose $B(\Pi, \Phi) = 0$, and compute the optimal policies. We compute these optimal static policies for both repayment and default in all states Π.

3. Assuming repayment in all states, given the optimal choices for $\tau(\Pi, b')$ and $g(\Pi, b')$ we associate the choice of each b' with an IID taste shock that follows a Type 1 Extreme Value distribution.

$$W(\Pi, < \epsilon_{b'} >) = \max_{b'} \left\{ V(\Pi, b') + \rho_b \epsilon_{b'} \right\} \tag{1}$$

with

$$V(\Pi, b') \equiv (1-\beta) u\bigg(c(\Pi, b'), l(\Pi, b'), g(\Pi, b') \bigg) + \frac{B(\Pi, b')}{\phi m} + \beta \mathbb{E}_{\mathbf{s}'} J(\mathbf{s}', b') \tag{2}$$

where $c(\Pi, b')$ incorporates the optimal taxes from step (2). $\rho_{b'}$ signifies the importance of taste-shocks in the bond choice. If $\rho_{b'} \longrightarrow \infty$, choice of b' becomes an uniform distribution. At the other extreme, if $\rho_{b'} \longrightarrow 0$, we recover the singleton choice for b'. We set the value of $\rho_{b'}$ to $1e^{-4}$. Before the shocks are realized, the choice probabilities are given by

$$Pr(b' = x | \Pi) = \frac{\exp\left((V(\Pi, x) - \overline{V(\Pi)}) / \rho_{b'} \right)}{\sum_{\tilde{x}} \exp\left((V(\Pi, \tilde{x}) - \overline{V(\Pi)}) / \rho_{b'} \right)} \tag{3}$$

where $\overline{V(\Pi)} = \max_{b'} V(\Pi, b')$. This is the maximum that the government can achieve if there are no taste shocks. The government's value after taking expectations over the taste

[1]This is more useful in a model with long-term debt as the bond prices in the current period are a function of the prices in the future periods. This feature of such models disrupts convergence.

[2]In our computations, we multiply the period utility by $(1 - \beta)$ for ease of convergence.

shocks is as follows.

$$\mathbb{W}(\Pi) = \mathbb{E}_{<\epsilon_{b'}>}\{W(\Pi, <\epsilon_{b'}>)\} = \overline{V(\Pi)} + \rho_{b'} \log \sum_{b'} \left\{ \frac{V(\Pi, b') - \overline{V(\Pi)}}{\rho_{b'}} \right\} \tag{4}$$

From this step, we obtain the bond choice probabilities in the state of repayment. The value in default is then computed using the optimal τ and g in default.

4. We apply similar taste shocks in the default decision. The government at the beginning of each period observes the default decision shocks and decides accordingly. The optimal value of the government when default is a possibility is given as follows.

$$\mathbb{E}_{\{\epsilon_r, \epsilon_d\}} \max \left\{ \mathbb{W}(\mathbf{s}, b) + \rho_d \epsilon_r, \mathbb{W}^d(\mathbf{s}) + \rho_d \epsilon_d \right\} \tag{5}$$

where $\mathbb{W}^d$ is the default value function of the government. ρ_d is also assumed to be $1e^{-4}$, similar to the borrowing taste shock. The probability of default is then computed using the following equation.

$$Pr(d = 1|\mathbf{s}, b) = \frac{\exp(\mathbb{W}^d(\mathbf{s})/\rho_d)}{\exp(\mathbb{W}^d(\mathbf{s})/\rho_d) + \exp(\mathbb{W}(\mathbf{s}, b)/\rho_r)} \tag{6}$$

5. Compute $J^r(\Pi'|\Omega' = 1)$ (defined as continuation value if the debt is repaid in every state in the following period) using **??** and the equilibrium policies, including the optimal distribution for b' obtained in step 3. Similarly, compute $J^d(\mathbf{s}|\Omega' = 0)$ using default policy choices. Then we compute $J(\Pi')$ as the expectation of J^r and J^d over the probability of default given in 6.

6. Compute the bond price schedule using the following equation.

$$q(z, m, b') = \frac{1}{1+r} \mathbb{E}_{\mathbf{s}'} Pr(d = 0|\mathbf{s}', b') \tag{7}$$

7. Check if J, J^d and q functions are close enough to the guess. We use a tolerance value of $1e^{-5}$ for the value functions. If not, move back to step 2. Repeat until both the value functions and the bond price schedule converge.

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