Online Appendix for the paper "Audit Risk and Rent Extraction: Evidence from a Randomized Evaluation in Brazil"

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1 Alternative corruption codings

This section describes alternative corruption codings of CGU auditors' classification of irregularities in procurement. We consider codings by Ferraz and Finan (FF, 2011), ourselves in prior work (Litschig and Zamboni, 2012), and Brollo, Nannicini, Perotti, and Tabellini (BNPT, 2013). Please refer to Table 2 in the paper for the discussion below.

The first procurement-related corruption category in Ferraz and Finan is their "irregular public procurement", which is when "there is an illegal call-for-bids where the contract was awarded to a "friendly firm" and the public good was not provided". This corresponds to a subset of the "simulated tender process" and "evidence of favoritism" categories in the CGU classification, where non-provision of the good or service was somehow confirmed, which we do not distinguish in our data. Another procurement-related type of corruption is what they call "over-invoicing", in which "auditors determined that the goods and services were purchased at a value above market price", or "there is no proof of purchase and community member confirm that goods were not delivered", which corresponds to a subset of the "unjustified or excessive payments for goods and services" type of audit finding in the CGU classification. Another corruption case distinguished in Ferraz and Finan is not related to procurement, namely when resources "disappear" from municipal bank accounts. According to Ferraz and Finan (2011) a mismanagement episode in procurement occurs when "less than three firms bid for a public contract", corresponding approximately to the irregularity "invitation for bids to less than three firms" in the CGU classification.

Brollo et al. (BNPT, 2013) also use the CGU audit reports to construct a narrow and a broad corruption measure. Table 6 in the paper shows that their narrow corruption coding is broader than the corruption measure constructed by Ferraz and Finan. Specifically, Brollo et al.'s narrow corruption measure includes cases of "limited competition", corresponding roughly to the CGU "evidence of favoritism" category, "fraud", corresponding to the "simulated tender process" category, as well as "over-invoicing", which amounts to CGU's "unjustified or excessive payments for goods and services" category. The main difference with Ferraz and Finan's coding is the addition of "manipulation of the bid value", which CGU refers to as "fractionalizing of procurement amounts", that is, deliberate division of a purchase into smaller amounts in order to avoid unrestricted procurement modalities. Another difference with Ferraz and Finan is that corruption episodes are not restricted

to those instances where non-provision of the good or service was somehow confirmed.

Brollo et al.'s broad corruption coding essentially corresponds to the management irregularities in Litschig and Zamboni (2012). Specifically, in their broad measure of corruption Brollo et al. also include "an irregular firm wins the bid process", corresponding roughly to "participating ineligible firm" in CGU terminology, "the minimum number of bids is not attained", which CGU labels "invitation for bids to less than three firms", as well as "the required procurement procedure is not executed", which roughly corresponds to CGU's "procurement modality too restricted".

Table 1: Randomization lottery, May 12 2009

State	N	Draws	P(Treatment) %
Acre (AC)	21		4.0
Amapá (AP)	15	2	4.0
Roraima (RR)	14		4.0
Alagoas (AL)	101	2	2.0
Amazonas (AM)	61	2	3.3
Bahia (BA)	415	10	2.4
Ceará (CE)	183	6	3.3
Espírito Santo (ES)	77	2	2.6
Goiás (GO)	245	6	2.4
Maranhão (MA)	216	6	2.8
Minas Gerais (MG)	849	14	1.6
Mato Grosso do Sul (MS)	77	2	2.6
Mato Grosso (MT)	140	2	1.4
Pará (PA)	142	4	2.8
Paraíba (PB)	222	6	2.7
Pernambuco (PE)	182	4	2.2
Piauí (PI)	223	6	2.7
Paraná (PR)	397	8	2.0
Rio de Janeiro (RJ)	88	2	2.3
Rio Grande do Norte (RN)	166	4	2.4
Rondônia (RO)	51	2	3.9
Rio Grande do Sul (RS)	495	10	2.0
Santa Catarina (SC)	292	6	2.1
Sergipe (SE)	74	2	2.7
São Paulo (SP)	636	10	1.6
Tocantins (TO)	138	2	1.4
Total	5,520	120	

Notes: Source: Portaria Nº 930, May 8 2009. N is the number of municipalities from a given state that are eligible for sampling in the lottery. Draws is the number of municipalities from a given state that are sampled in the lottery. P(Treatment) is the probability of assignment to the high audit risk group, given in percentage points. Municipalities from Acre, Amapá and Roraima states are grouped together for this lottery.

Table 2: Sampling probabilities in the 29th lottery, August 17 2009

State	N	Draws	P(Draw) %
Acre (AC)	18		2.3
Amapá (AP)	12	1	2.3
Roraima (RR)	13		2.3
Alagoas (AL)	82	2	2.4
Amazonas (AM)	53	1	1.9
Bahia (BA)	389	5	1.3
Ceará (CE)	166	3	1.8
Espírito Santo (ES)	71	1	1.4
Goiás (GO)	230	2	0.9
Maranhão (MA)	189	3	1.6
Minas Gerais (MG)	812	7	0.9
Mato Grosso do Sul (MS)	71	1	1.4
Mato Grosso (MT)	132	1	0.8
Pará (PA)	127	3	2.4
Paraíba (PB)	207	3	1.4
Pernambuco (PE)	159	3	1.9
Piauí (PI)	205	3	1.5
Paraná (PR)	378	3	0.8
Rio de Janeiro (RJ)	83	1	1.2
Rio Grande do Norte (RN)	153	3	2.0
Rondônia (RO)	46	1	2.2
Rio Grande do Sul (RS)	472	4	0.8
Santa Catarina (SC)	280	2	0.7
Sergipe (SE)	66	1	1.5
São Paulo (SP)	609	5	0.8
Tocantins (TO)	132	1	0.8
Total	5,155	60	

Notes: Source: Portaria Nº 1581, August 11 2009. N is the number of municipalities from a given state that are eligible for sampling in the lottery. Draws is the number of municipalities from a given state that are sampled in the lottery. P(Draw) is the sampling probability. Municipalities from Acre, Amapá and Roraima states are grouped together for this lottery.

Table 3: Distribution of procurement objects by level of audit risk and lottery

| Procurement object | 32nd lottery | | | | 31st lottery | |
| | High audit risk | | Low audit risk | | Low audit risk | |
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Staple foods	85	24.08	117	24.12	184	22.52
Medication	50	14.16	49	10.10	81	9.91
Other non-durable goods	43	12.18	70	14.43	115	14.08
Medical equipment	5	1.42	9	1.86	33	4.04
IT equipment	6	1.70	12	2.47	8	0.98
Agricultural equipment	10	2.83	7	1.44	21	2.57
Other durable goods	11	3.12	11	2.27	26	3.18
Public works	25	7.08	42	8.66	135	16.52
Contracted-out services	48	13.60	46	9.48	92	11.26
Other objects	70	19.83	122	25.15	122	14.93
Total	353	100.00	485	100.00	817	100.00

Notes: The unit of observation is an individual procurement process. The distributions are statistically different from each other according to Pearson's chi-square test.

Table 4: Impacts on the number of restricted and unrestricted procurement processes

Panel A

Dependent variable: number of restricted procurement processes; control group mean 9.6, std. 8.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treatment (0/1)	-3.967*	-3.308*	-7.127**	-4.332*	-5.233*	-3.378***	-3.122**	-2.865**	-3.034*	-3.664*
	(2.224)	(1.816)	(3.129)	(2.305)	(2.772)	(1.268)	(1.272)	(1.424)	(1.655)	(1.973)
R-squared	0.048	0.626	0.277	0.145	0.228	0.018	0.290	0.420	0.491	0.563

Panel B

Dependent variable: number of unrestricted procurement processes; control group mean 4.2, std. 5.1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treatment (0/1)	-0.433	-1.077	0.213	-0.758	-0.246	0.678	0.382	0.678	0.290	0.070
	(1.648)	(1.915)	(2.017)	(1.898)	(1.583)	(0.860)	(0.908)	(1.080)	(1.416)	(1.439)
R-squared	0.001	0.634	0.463	0.073	0.098	0.003	0.596	0.615	0.399	0.680
Municipalities	60	60	60	60	60	120	120	120	120	120
State intercepts	N	Y	N	N	N	N	Y	Y	Y	Y
Mayor's party dummies	N	N	Y	N	N	N	N	Y	Y	Y
Municipality characteristics	N	N	N	Y	N	N	N	N	Y	Y
Mayor's characteristics	N	N	N	N	Y	N	N	N	N	Y

Notes: OLS estimations. Restricted procurement modalities refer to direct purchases by the local administration, bids only by invitation and the modality where only pre-registered bidders can compete for the contract. Unrestricted modalities are the sealed-bid (reverse) auction, on-site (reverse) auction, and electronic (reverse) auction. Sample consists of municipalities from the 32nd and 31st lotteries. Treatment indicates whether the municipality was in the high audit probability group during the year leading up to the 32nd lottery. Municipality characteristics: year 2007 population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient, radio station, all measured in 2000. Mayor's characteristics: first-term mayor indicator, education level indicators, male dummy and age. Robust standard errors are given in parentheses. *, **, and *** indicate significance at 10 percent, 5 percent and 1 percent levels respectively.

Table 5: Impact on federal transfers per capita in 2009

Dependent variable: per capita federal transfers in 2009; control group mean 884, std. 521

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Treatment (0/1)	-119.8	-177.4	-126.0	-11.98	-190.1	-32.9	-92.2	-123.2	-92.5	-8.8
	(140.2)	(187.8)	(167.5)	(128.6)	(156.8)	(105.7)	(113.8)	(105.2)	(99.0)	(115.4)
R-squared	0.013	0.273	0.406	0.457	0.206	0.001	0.253	0.436	0.401	0.685
Municipalities	57	57	57	57	57	115	115	115	115	115
State intercepts	N	Y	N	N	N	N	Y	Y	Y	Y
Mayor's party affiliation	N	N	Y	N	N	N	N	Y	Y	Y
Municipality characteristics	N	N	N	Y	N	N	N	N	N	Y
Mayor's characteristics	N	N	N	N	Y	N	N	N	N	Y

Notes: OLS estimations. Sample consists of municipalities from the 32nd and 31st lotteries. Treatment indicates whether the municipality was in the high audit probability group during the year leading up to the 32nd lottery. Municipality characteristics: year 2007 population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient, radio station, all measured in 2000. Mayor's characteristics: first-term mayor indicator, education level indicators, male dummy and age. Robust standard errors are given in parentheses. *, **, and *** indicate significance at 10 percent, 5 percent and 1 percent levels respectively.

Table 6: Impact on amount audited per capita

Dependent variable: amount audited per capita; control group mean 733, std. 489

Treatment (0/1)	174.7	212.6	34.91	211.5	130.0	89.85	182.8	122.4	126.3	178.5
	(235.7)	(235.7)	(269.4)	(224.5)	(232.4)	(216.0)	(195.1)	(155.4)	(144.2)	(160.0)
R-squared	0.009	0.564	0.233	0.264	0.108	0.003	0.422	0.543	0.588	0.641
Municipalities	60	60	60	60	60	120	120	120	120	120
State intercepts	N	Y	N	N	N	N	Y	Y	Y	Y
Mayor's party affiliation	N	N	Y	N	N	N	N	Y	Y	Y
Municipality characteristics	N	N	N	Y	N	N	N	N	Y	Y
Mayor's characteristics	N	N	N	N	Y	N	N	N	N	Y

Notes: OLS estimations. Sample consists of municipalities from the 32nd and 31st lotteries. Treatment indicates whether the municipality was in the high audit probability group during the year leading up to the 32nd lottery. Municipality characteristics: year 2007 population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient, radio station, all measured in 2000. Mayor's characteristics: first-term mayor indicator, education level indicators, male dummy and age. Robust standard errors are given in parentheses. *, **, and *** indicate significance at 10 percent, 5 percent and 1 percent levels respectively.

Table 7: Distribution of audit findings by level of audit risk and lottery

| | 32nd lottery | | | | 31st lottery | |
| | High audit risk | | Low audit risk | | Low audit risk | |
Audit result	Freq.	Percent	Freq.	Percent	Freq.	Percent
Procedural irregularity	37	10.48	36	7.42	73	8.94
Management irregularity	38	10.76	60	12.37	119	14.57
Evidence of corruption	58	16.43	153	31.55	283	34.64
Other irregularities	29	8.22	53	10.94	45	5.50
Irregular process	162	45.90	302	62.27	520	63.65
Regular process	124	35.13	112	23.09	222	27.17
Formal error	67	18.98	71	14.64	75	9.18
Total	353	100.00	485	100.00	817	100.00

Notes: The unit of observation is an individual procurement process. The distributions are statistically different from each other according to Pearson's chi-square test.

Table 8: Impact on the likelihood of broad corruption (BNPT 2013) at the procurement process level

Panel A, restricted and unrestricted processes

Dependent variable (0/1): procurement process with evidence of broad corruption (BNPT 2013); control group mean 0.44, std. 0.49

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment (0/1)	-0.157**	-0.104*	-0.206***	-0.130*	-0.190***	-0.159***	-0.167***	-0.117**	-0.134***
	(0.073)	(0.053)	(0.064)	(0.067)	(0.052)	(0.045)	(0.045)	(0.048)	(0.046)
R-squared	0.027	0.458	0.405	0.089	0.025	0.482	0.500	0.192	0.519
Procurement processes	838	838	838	838	1,655	1,655	1,655	1,655	1,655

Panel B, only restricted processes

Dependent variable (0/1): procurement process with evidence of broad corruption (BNPT 2013); control group mean 0.50, std. 0.50

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment (0/1)	-0.194**	-0.130**	-0.232***	-0.170**	-0.203***	-0.171***	-0.184***	-0.119**	-0.109**
	(0.076)	(0.065)	(0.075)	(0.074)	(0.068)	(0.055)	(0.056)	(0.056)	(0.054)
R-squared	0.037	0.519	0.470	0.088	0.025	0.536	0.550	0.193	0.573
Procurement processes	541	541	541	541	1,148	1,148	1,148	1,148	1,148

Panel C, only unrestricted processes

Dependent variable (0/1): procurement process with evidence of broad corruption (BNPT 2013); control group mean 0.29, std. 0.45

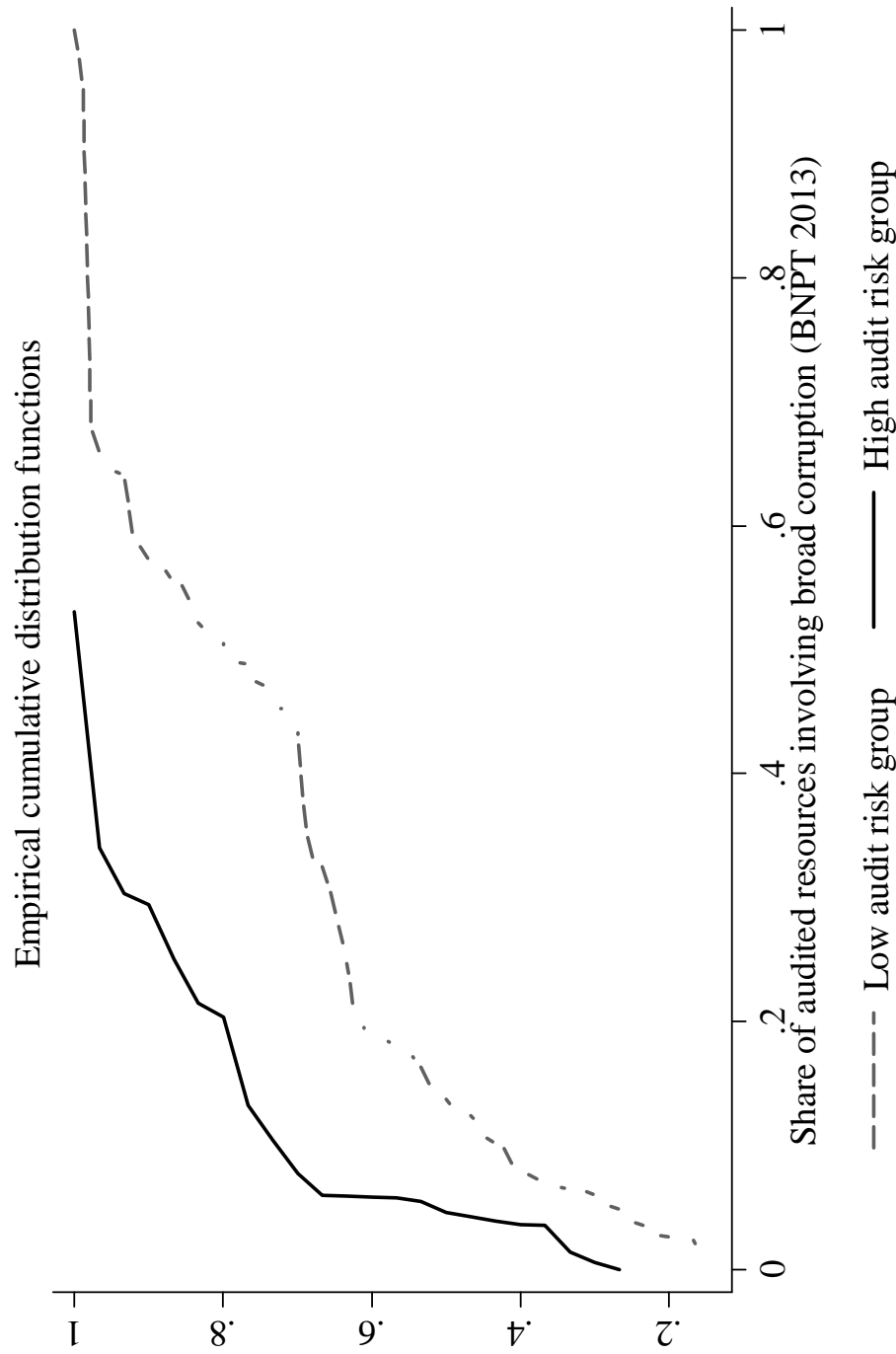|	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment (0/1)	-0.049	0.015	-0.066	0.018	0.092	-0.083	-0.106*	-0.044	-0.090
	(0.120)	(0.057)	(0.122)	(0.081)	(0.083)	(0.060)	(0.063)	(0.065)	(0.065)
R-squared	0.004	0.418	0.274	0.115	0.141	0.384	0.422	0.269	0.487
Procurement processes	297	297	297	297	507	507	507	507	507
Municipalities	60	60	60	60	120	120	120	120	120
State intercepts	N	Y	N	N	N	Y	N	N	Y
Mayor's party dummies	N	N	Y	N	N	N	Y	N	Y
Municipality characteristics	N	N	N	Y	N	N	N	Y	Y
Mayor's characteristics	N	N	N	N	N	N	N	N	Y

Notes: OLS estimations at the level of the procurement process. See Table 2 for details on corruption codings. Restricted procurement modalities refer to direct purchases by the local administration, bids only by invitation and the modality where only pre-registered bidders can compete for the contract. Unrestricted modalities are the sealed-bid (reverse) auction, on-site (reverse) auction, and electronic (reverse) auction. Sample consists of municipalities from the 32nd and 31st lotteries. Treatment indicates whether the municipality was in the high audit probability group during the year leading up to the 32nd lottery. Municipality characteristics: year 2007 population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient, radio station, all measured in 2000. Mayor's characteristics: first-term mayor indicator, education level indicators, male dummy and age. Clustered standard errors are in parentheses. *, **, and *** indicate significance at 10 percent, 5 percent and 1 percent levels respectively.

Table 9: Impact on the likelihood of corruption (FF 2011) at the procurement process level

Panel A, restricted and unrestricted processes

Dependent variable (0/1): procurement process with evidence of corruption (FF 2011); control group mean 0.23, std. 0.42

Treatment (0/1)	-0.052	-0.062	-0.048	-0.037	-0.053	-0.113**	-0.116***	-0.125**	-0.117**	-0.128***
	(0.072)	(0.054)	(0.069)	(0.055)	(0.070)	(0.045)	(0.041)	(0.050)	(0.049)	(0.044)
R-squared	0.005	0.329	0.199	0.143	0.105	0.013	0.338	0.351	0.194	0.375
Procurement processes	838	838	838	838	838	1,655	1,655	1,655	1,655	1,655

Panel B, only restricted processes

Dependent variable (0/1): procurement process with evidence of corruption (FF 2011); control group mean 0.25, std. 0.43

Treatment (0/1)	-0.050	-0.058	-0.051	-0.031	-0.061	-0.136***	-0.158***	-0.177***	-0.164***	-0.150***
	(0.071)	(0.053)	(0.065)	(0.053)	(0.077)	(0.049)	(0.046)	(0.055)	(0.058)	(0.055)
R-squared	0.005	0.347	0.207	0.138	0.072	0.016	0.371	0.387	0.227	0.406
Procurement processes	541	541	541	541	541	1,148	1,148	1,148	1,148	1,148

Panel C, only unrestricted processes

Dependent variable (0/1): procurement process with evidence of narrow corruption (FF 2011); control group mean 0.18, std. 0.39

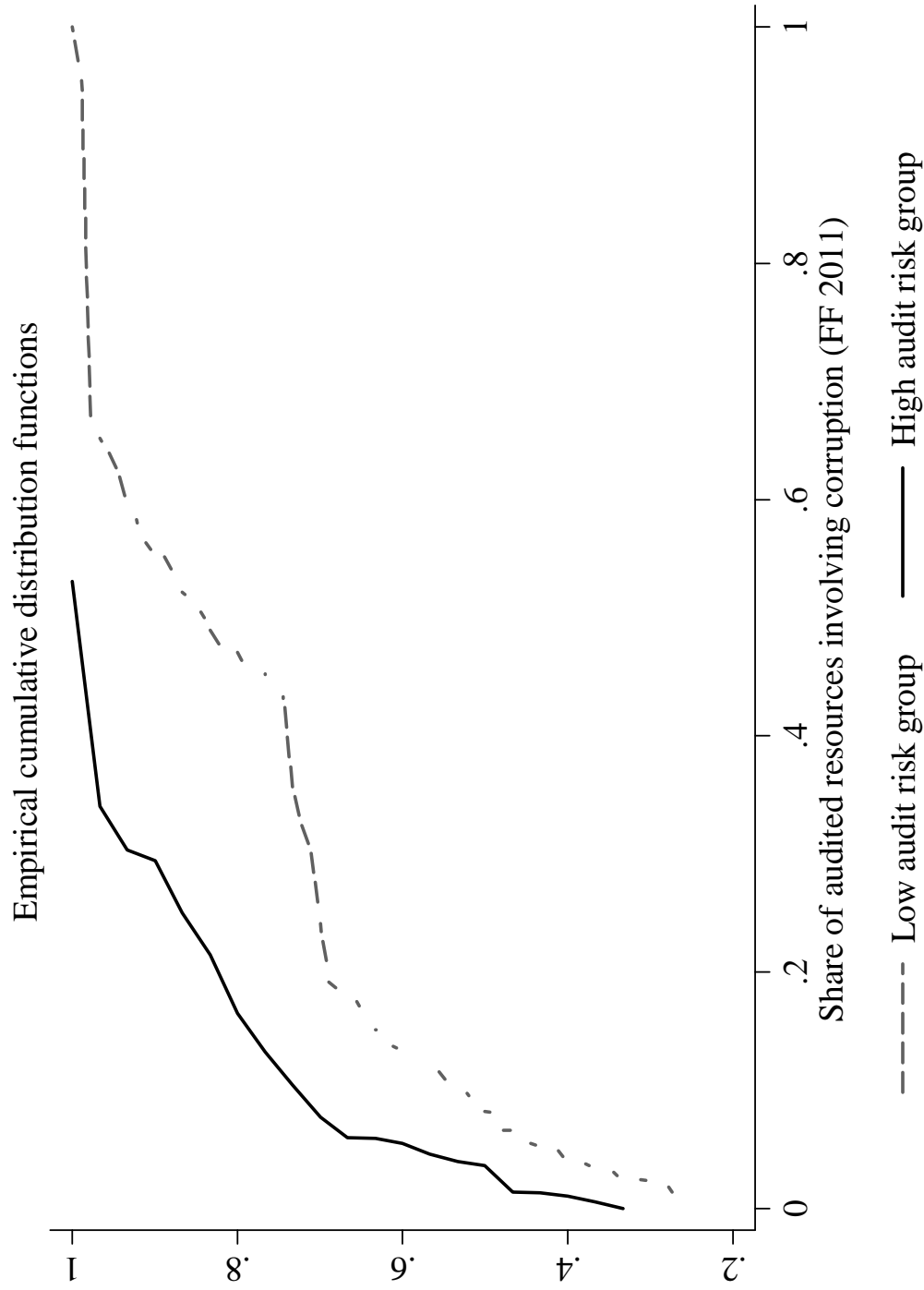|										
Treatment (0/1)	-0.060	-0.005	-0.056	0.002	0.003	-0.060	-0.048	-0.042	-0.063	-0.080
	(0.122)	(0.068)	(0.121)	(0.074)	(0.063)	(0.068)	(0.056)	(0.069)	(0.064)	(0.051)
R-squared	0.007	0.369	0.223	0.176	0.213	0.005	0.306	0.340	0.246	0.430
Procurement processes	297	297	297	297	297	507	507	507	507	507
Municipalities	60	60	60	60	60	120	120	120	120	120
State intercepts	N	Y	N	N	N	N	Y	Y	Y	Y
Mayor's party dummies	N	N	Y	N	N	N	N	Y	Y	Y
Municipality characteristics	N	N	N	Y	N	N	N	N	Y	Y
Mayor's characteristics	N	N	N	N	Y	N	N	N	N	Y

Notes: OLS estimations at the level of the procurement process. See Table 2 for details on corruption codings. Restricted procurement modalities refer to direct purchases by the local administration, bids only by invitation and the modality where only pre-registered bidders can compete for the contract. Unrestricted modalities are the sealed-bid (reverse) auction, on-site (reverse) auction, and electronic (reverse) auction. Sample consists of municipalities from the 32nd and 31st lotteries. Treatment indicates whether the municipality was in the high audit probability group during the year leading up to the 32nd lottery. Municipality characteristics: year 2007 population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient, radio station, all measured in 2000. Mayor's characteristics: first-term mayor indicator, education level indicators, male dummy and age. Clustered standard errors are in parentheses. *, **, and *** indicate significance at 10 percent, 5 percent and 1 percent levels respectively.

Figure 1: Impact on the distribution of broad corruption (BNPT 2013), share of audited amount
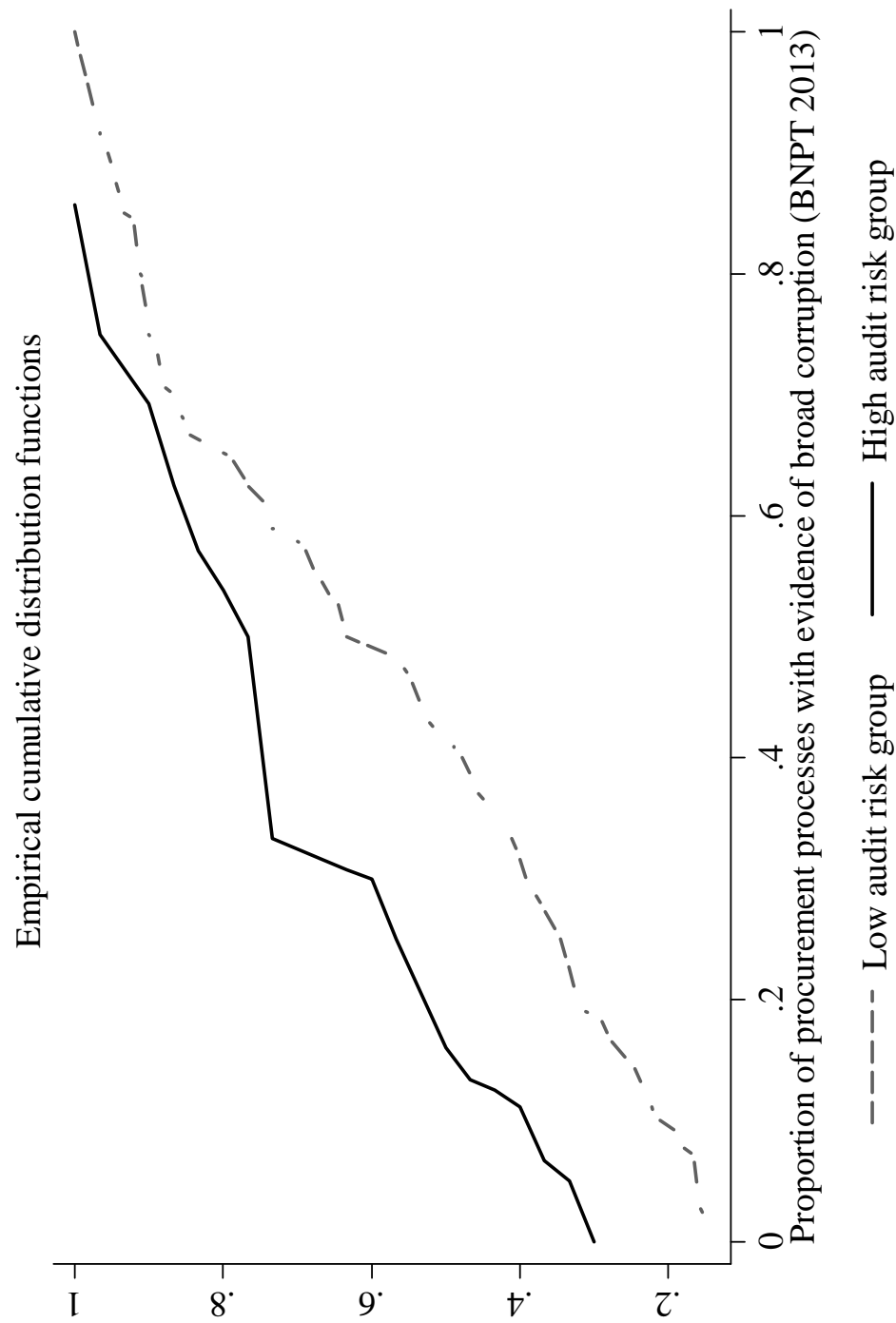
Empirical cumulative distribution functions

Share of audited resources involving broad corruption (BNPT 2013)

- - - Low audit risk group   ——— High audit risk group

Notes: Broad corruption corresponds to cases of simulated (fake) tender processes, cases of favouritism, or when auditors determine that there were unjustified or excessive payments for goods or services, as well as cases of fractionalized procurement amounts. Broad corruption also includes what could be considered management irregularities, including instances where less than three firms were invited to submit bids or procurement modalities were too restricted or a participating firm was ineligible. See Table 2 for details.

Figure 2: Impact on the distribution of corruption (FF 2011), share of audited amount
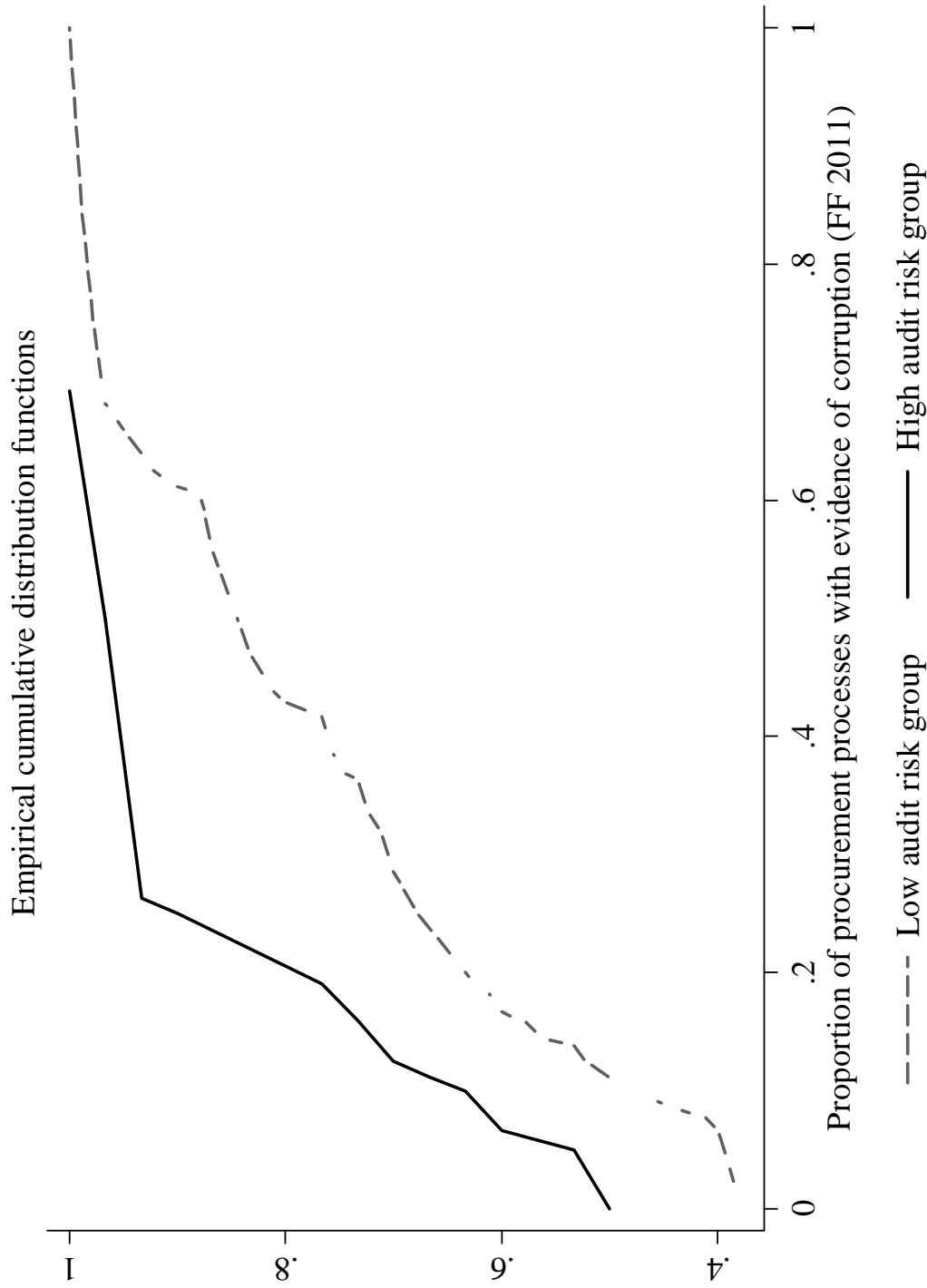
Empirical cumulative distribution functions

Share of audited resources involving corruption (FF 2011)

- - - Low audit risk group ——— High audit risk group

Notes: Corruption corresponds to cases of simulated (fake) tender processes, cases of favouritism, or when auditors determine that there were unjustified or excessive payments for goods or services. See Table 2 for details.

Figure 3: Impact on the distribution of broad corruption (BNPT 2013), proportion of processes

Empirical cumulative distribution functions

Proportion of procurement processes with evidence of broad corruption (BNPT 2013)

– – – Low audit risk group   ——— High audit risk group

Notes: Broad corruption corresponds to cases of simulated (fake) tender processes, cases of favouritism, or when auditors determine that there were unjustified or excessive payments for goods or services, as well as cases of fractionalized procurement amounts. Broad corruption also includes what could be considered management irregularities, including instances where less than three firms were invited to submit bids or procurement modalities were too restricted or a participating firm was ineligible. See Table 2 for details.

Figure 4: Impact on the distribution of corruption (FF 2011), proportion of processes

Empirical cumulative distribution functions

Proportion of procurement processes with evidence of corruption (FF 2011)

- - - Low audit risk group   —— High audit risk group

Notes: Corruption corresponds to cases of simulated (fake) tender processes, cases of favouritism, or when auditors determine that there were unjustified or excessive payments for goods or services. See Table 2 for details.