

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

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## 1 Details on alternative corruption codings

This section describes alternative corruption codings of CGU auditors' classification of irregularities in procurement in more detail. 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 2 in our 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". The final corruption case "diversion of funds" (e.g. earmarked transfers for supplies are used for salaries instead) distinguished in Brollo et al. is not directly related to procurement.

Table 1: Randomization lottery, May 12 2009

State	G	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 N° 930, May 8 2009. G 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.

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

State	G	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 N° 1581, August 11 2009. G 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, given in percentage points.

Table 3: Corruption in procurement, BNPT (2013) broad measure

Dependent variable	32nd lottery			31st and 32nd lottery			
	Control	Simple	N [G]	Control	Simple	N [G]	Adjusted N [G]
	mean	difference		mean	difference		difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
Panel A: CGU audit reports data, 2009 and 2010 transfers							
Share of audited amount involved in broad corruption in procurement	0.190 (0.041)	-0.107 (0.047)	[60]	0.199 (0.026)	-0.117 (0.034)	[120]	-0.113 (0.052) [111]
Panel B: CGU procurement process-level data, 2009 and 2010 transfers							
Procurement process with evidence of broad corruption	0.407 (0.058)	-0.159 (0.073)	834 [60]	0.419 (0.037)	-0.172 (0.057)	1,304 [117]	-0.119 (0.051) [117]
Restricted procurement process with evidence of broad corruption	0.488 (0.057)	-0.194 (0.076)	539 [60]	0.477 (0.033)	-0.183 (0.070)	880 [113]	-0.113 (0.073) [113]
Unrestricted procurement process with evidence of broad corruption	0.234 (0.113)	-0.056 (0.120)	295 [49]	0.283 (0.068)	-0.105 (0.080)	424 [87]	-0.170 (0.089) [87]

*Notes:* Panel A: Municipality-level OLS estimations with robust standard errors. Panel B: OLS estimations at the procurement-process level with standard errors clustered at the municipality level. Broad corruption corresponds to cases of simulated 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 instances where less than three firms were invited to submit bids or procurement modalities were too restricted or a participating firm was ineligible. The 'Control mean' columns (1) and (4) give the sample average in the low audit risk group. The 'Simple difference' columns (2) and (5) give the difference in means between high and low audit risk groups. In columns (3), (6) and (8) G is the number of municipalities and N is the number of procurement processes used to estimate columns (2), (5) and (7), respectively. The 'Adjusted difference' column (7) reports estimates on the high audit risk group dummy from a regression that also includes state intercepts, mayor's party dummies and mayor characteristics in 2008, and municipality characteristics from 2000 and 2007. In panel A the regression additionally includes the share of audited resources involved in broad corruption in procurement in 2008. Mayor characteristics: first-term mayor indicator, indicator for mayor win margin < 5%, mayor education level indicators, male dummy and age. Municipality characteristics: indicator for CGU audit at least once in lotteries 2 through 27, population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient and indicator for local radio station. 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.

Table 4: Corruption in procurement, FF (2011) measure

Dependent variable	32nd lottery		31st and 32nd lottery			
	Control	Simple N [G]	Control	Simple N [G]	Adjusted N [G]	
	mean difference (1)	(2) (3)	mean difference (4)	mean difference (5) (6)	difference (7) (8)	
Panel A: CGU audit reports data, 2009 and 2010 transfers						
Share of audited amount involved in corruption in procurement	0.155 (0.040)	-0.077 (0.046) [60]	0.154 (0.025)	-0.077 (0.034) [120]	-0.096 (0.055) [111]	
Panel B: CGU procurement process-level data, 2009 and 2010 transfers						
Procurement process with evidence of corruption	0.172 (0.066)	-0.053 (0.073) [60]	0.217 (0.040)	-0.098 (0.050) [117]	-0.102 (0.050) [117]	1,304
Restricted procurement process with evidence of corruption	0.164 (0.064)	-0.051 (0.072) [60]	0.227 (0.043)	-0.113 (0.054) [113]	-0.130 (0.066) [113]	880
Unrestricted procurement process with evidence of corruption	0.188 (0.116)	-0.061 (0.122) [49]	0.194 (0.066)	-0.067 (0.078) [87]	-0.086 (0.070) [87]	424

*Notes* : Panel A: Municipality-level OLS estimations with robust standard errors. Panel B: OLS estimations at the procurement-process level with standard errors clustered at the municipality level. Corruption corresponds to cases of simulated tender processes, cases of favouritism, or when auditors determine that there were unjustified or excessive payments for goods or services. The 'Control mean' columns (1) and (4) give the sample average in the low audit risk group. The 'Simple difference' columns (2) and (5) give the difference in means between high and low audit risk groups. In columns (3) and (7) G is the number of municipalities and N is the number of procurement processes. The 'Adjusted difference' column (6) reports estimates on the high audit risk group dummy from a regression that also includes state intercepts, mayor's party dummies and mayor characteristics in 2008, and municipality characteristics from 2000 and 2007. In panel A the regression additionally includes the share of audited resources involved in corruption in procurement in 2008. Mayor characteristics: first-term mayor indicator, indicator for mayor win margin < 5%, mayor education level indicators, male dummy and age. Municipality characteristics: indicator for CGU audit at least once in lotteries 2 through 27, population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient and indicator for local radio station. 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.

Table 5: Need for medical attention at home or at the health post

Dependent variable	32nd lottery			31st and 32nd lottery		
	Control mean (1)	Simple Difference (2)	N [G] (3)	Control mean (4)	Simple Difference (5)	N [G] (6)
Household should receive visits from community health worker	0.991 (0.009)	-0.025 (0.022)	1,123 [58]	0.994 (0.003)	-0.028 (0.020)	2,403 [113]
Household required a visit from medical staff at home	0.227 (0.063)	-0.011 (0.081)	1,123 [58]	0.217 (0.032)	-0.003 (0.060)	2,403 [113]
Household member required to see a doctor at the health post	0.531 (0.098)	0.019 (0.143)	1,123 [58]	0.578 (0.057)	-0.028 (0.119)	2,403 [113]
Household member required to see a nurse at the health post	0.529 (0.099)	0.008 (0.142)	1,123 [58]	0.575 (0.057)	-0.037 (0.116)	2,403 [113]
Household member required to see a dentist at the health post	0.430 (0.088)	-0.064 (0.119)	1,123 [58]	0.433 (0.050)	-0.067 (0.094)	2,403 [113]
Household usually uses the health post for medical services	0.435 (0.086)	0.068 (0.126)	1,123 [58]	0.468 (0.050)	0.036 (0.105)	2,403 [113]
Household required services from medical staff	0.977 (0.011)	-0.027 (0.024)	1,123 [58]	0.983 (0.005)	-0.033 (0.022)	2,403 [113]
F-statistic		1.170			1.250	
(p-value)		(0.333)			(0.282)	

*Notes:* OLS estimations at the household level. Standard errors are clustered at the municipality level. The 'Control mean' column gives the sample average in the low audit risk group. The 'Difference' column gives the difference in means between high and low audit risk groups. N is the number of respondent households and G is the number of municipalities. F-statistics are for the joint hypotheses that all differences in outcomes are zero.



Table 6: Likelihood that cash transfer recipient household was inspected

Dependent variable	32nd lottery		31st and 32nd lottery			
	Control	Simple N [G]	Control	Simple N [G]	Adjusted N [G]	
	mean difference (1)	(2) (3)	mean difference (4)	(5) (6)	difference (7) (8)	
Household head was interviewed	0.746 (0.023)	-0.012 1,762 (0.041) [60]	0.758 (0.014)	-0.024 3,511 (0.036) [118]	0.007 3,511 (0.041) [118]	
Household composition was assessed	0.751 (0.035)	0.010 1,762 (0.046) [60]	0.780 (0.016)	-0.018 3,511 (0.033) [118]	0.016 3,511 (0.053) [118]	
Household income per capita was assessed	0.770 (0.022)	-0.013 1,762 (0.037) [60]	0.792 (0.013)	-0.035 3,511 (0.032) [118]	0.003 3,511 (0.042) [118]	
Household has children 0 to 6 years old and was interviewed	0.317 (0.031)	0.017 1,762 (0.032) [60]	0.348 (0.013)	-0.014 3,511 (0.028) [118]	-0.024 3,511 (0.036) [118]	
F-statistic		0.270		0.670	0.360	
(p-value)		(0.895)		(0.613)	(0.840)	

*Notes:* WLS estimations at the municipality level with weights corresponding to the number of households investigated in each municipality. Robust standard errors in parentheses. The 'Control mean' columns (1) and (4) give the sample average in the low audit risk group. The 'Simple difference' columns (2) and (5) give the difference in means between high and low audit risk groups. In columns (3), (6) and (8) G is the number of municipalities and N is the number of respondent households or students to whom a given inspection applies that are used to estimate columns (2), (5) and (7), respectively. The 'Adjusted difference' column (7) reports estimates on the high audit risk group dummy from a regression that also includes state intercepts, mayor's party dummies and mayor characteristics in 2008, and municipality characteristics from 2000 and 2007. Mayor characteristics: first-term mayor indicator, indicator for mayor win margin < 5%, mayor education level indicators, male dummy and age. Municipality characteristics: indicator for CGU audit at least once in lotteries 2 through 27, population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient and indicator for local radio station. F-statistics are for the joint hypotheses that all coefficients in a given column are zero.

Table 7: Unduly discretionary modality

Dependent variable	32nd lottery			31st and 32nd lottery			
	Control mean	Simple difference	N [G]	Control mean	Simple difference	N [G]	Adjusted N [G] difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
<u>Panel A: CGU audit reports data, 2009 and 2010 transfers</u>							
Share of audited amount involved in unduly discretionary modalities	0.063 (0.028)	-0.035 (0.031)	[60]	0.053 (0.014)	-0.025 (0.020)	[120]	0.004 (0.037) [120]
<u>Panel B: CGU procurement process-level data, 2009 and 2010 transfers</u>							
Procurement process with unduly discretionary modality	0.224 (0.057)	-0.110 (0.066)	834 [60]	0.186 (0.035)	-0.070 (0.049)	1,304 [117]	-0.006 (0.045) [117]
Restricted procurement process with unduly discretionary modality	0.308 (0.063)	-0.147 (0.080)	539 [60]	0.227 (0.042)	-0.066 (0.063)	880 [113]	0.035 (0.063) [113]
Unrestricted procurement process with unduly discretionary modality	0.045 (0.027)	0.004 (0.037)	295 [49]	0.088 (0.036)	-0.039 (0.044)	424 [87]	-0.084 (0.076) [87]

*Notes :* Panel A: Municipality-level OLS estimations with robust standard errors. Panel B: OLS estimations at the procurement-process level with standard errors clustered at the municipality level. Unduly discretionary modalities are determined by auditors and include (without being limited to) cases of deliberate reductions of contract size by procurement officers (fractionalization). The 'Control mean' columns (1) and (4) give the sample average in the low audit risk group. The 'Simple difference' columns (2) and (5) give the difference in means between high and low audit risk groups. In columns (3) and (7) G is the number of municipalities and N is the number of procurement processes. The 'Adjusted difference' column (6) reports estimates on the high audit risk group dummy from a regression that also includes state intercepts, mayor's party dummies and mayor characteristics in 2008, and municipality characteristics from 2000 and 2007. Mayor characteristics: first-term mayor indicator, indicator for mayor win margin < 5%, mayor education level indicators, male dummy and age. Municipality characteristics: indicator for CGU audit at least once in lotteries 2 through 27, population, income per capita, average years of schooling, urbanization, poverty headcount ratio, poverty gap, gini coefficient and indicator for local radio station. 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.

Table 8: Federal transfers per capita before, during, and after increased audit risk, audited municipalities

Dependent variable	2008		2009		2010		2011	
	Control	Simple difference	Control	Simple difference	Control	Simple difference	Control	Simple difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Federal education transfers per capita	245.1 (11.0)	6.9 (23.3)	278.7 (11.7)	12.9 (24.3)	327.5 (14.7)	-1.7 (28.1)	396.1 (17.5)	-3.6 (30.7)
Federal health transfers per capita	82.3 (4.0)	-5.8 (11.7)	94.1 (4.5)	0.0 (12.5)	109.3 (5.9)	-3.0 (16.5)	121.6 (6.3)	5.6 (19.7)
Federal welfare transfers per capita	10.7 (1.4)	0.8 (2.6)	13.1 (1.3)	-1.5 (2.6)	17.3 (1.9)	-3.4 (3.2)	19.1 (1.4)	1.8 (3.5)
Other federal transfers per capita	25.9 (3.7)	-7.8 (6.7)	42.0 (4.1)	-7.5 (6.6)	43.8 (10.0)	-8.6 (15.3)	34.7 (11.9)	-8.0 (13.8)
Federal capital transfers per capita	49.2 (8.0)	-3.5 (16.3)	37.0 (6.4)	-1.3 (12.4)	91.1 (1.1)	-32.4 (31.3)	88.0 (20.7)	-4.8 (28.7)
Number of municipalities	87	117	89	119	88	118	85	114
F-statistic		0.410		0.360		0.580		0.180
(p-value)		(0.838)		(0.874)		(0.717)		(0.971)

*Notes:* OLS estimations at the municipality level. Robust standard errors in parentheses. The sample consists of municipalities that were audited in the 31st or 32nd lottery with available data on federal transfers. The dependent variable is the per capita transfer of a given type and in a given year. Transfers are in current Reals. The 'Control mean' columns (1), (3), (5) and (7) give the sample average for a given type of revenue in a given year in the low audit risk group. The 'Simple difference' columns (2), (4), (6) and (8) give the difference in means between high and low audit risk groups for a given type of transfer in a given year. F-statistics are for the joint hypotheses that all differences in outcomes in a given year are zero.

Table 9: Municipal expenditure per capita before, during, and after increased audit risk, audited municipalities

Dependent variable	2008		2009		2010		2011	
	Control	Simple difference	Control	Simple difference	Control	Simple difference	Control	Simple difference
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Education expenditure per capita	446.8 (20.7)	-37.1 (36.5)	468.3 (18.1)	-26.6 (29.9)	555.4 (24.6)	-17.5 (51.8)	678.9 (33.1)	-41.6 (51.2)
Health expenditure per capita	345.6 (19.3)	-26.5 (34.2)	359.2 (18.4)	-25.0 (35.5)	415.4 (22.1)	-19.4 (38.8)	517.8 (28.2)	-84.2 (48.9)
Welfare expenditure per capita	85.7 (9.5)	-1.6 (14.8)	90.9 (8.4)	-11.3 (12.8)	110.5 (10.4)	-20.5 (15.6)	125.8 (10.6)	-10.5 (18.1)
Transportation expenditure per capita	87.8 (14.3)	17.4 (28.6)	91.6 (18.7)	-8.2 (26.6)	130.3 (26.5)	-54.6 (34.8)	125.1 (24.0)	-19.3 (40.7)
Housing expenditure per capita	180.9 (16.5)	-16.7 (31.9)	128.9 (11.1)	9.5 (22.0)	175.6 (22.1)	12.2 (41.3)	204.2 (19.8)	-27.1 (35.8)
Number of municipalities	79	105	87	115	78	105	72	99
F-statistic		0.500		0.430		0.780		0.640
(p-value)		(0.774)		(0.828)		(0.568)		(0.668)

*Notes:* OLS estimations at the municipality level. Robust standard errors in parentheses. The sample consists of municipalities that were audited in the 31st or 32nd lotteries with available budget data. The dependent variable is the per capita municipal expenditure in a given budget category and year. The 'Control mean' columns (1), (3), (5) and (7) give the sample average for a given budget category in a given year in the low audit risk group. The 'Simple difference' columns (2), (4), (6) and (8) give the difference in means between high and low audit risk groups for a given budget category in a given year. F-statistics are for the joint hypotheses that all differences in outcomes in a given year are zero.

Table 10: Distribution of procurement modalities by level of audit risk and lottery

<u>Procurement modality</u>	32 <sup>nd</sup> lottery				31 <sup>st</sup> lottery			
	High audit risk		Low audit risk		High audit risk		Low audit risk	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Direct purchase	69	19.60	74	15.35	57	12.13	57	12.13
Bids only by invitation	98	27.85	188	39.00	198	42.13	198	42.13
Only pre-registered bidders	44	12.50	66	13.69	86	18.30	86	18.30
Restricted modalities	211	59.95	330	68.04	341	72.56	341	72.56
Sealed-bid auction	6	1.70	10	2.07	5	1.06	5	1.06
On-site auction	105	29.83	108	22.41	114	24.26	114	24.26
Electronic auction	30	8.52	36	7.48	10	2.12	10	2.12
Unrestricted modalities	142	40.05	155	31.96	210	27.44	210	27.44
Total	352	100.00	482	100.00	470	100.00	470	100.00

*Notes:* The unit of observation is an individual procurement process. For the 32<sup>nd</sup> lottery the data are from 2009 or 2010, while for the 31<sup>st</sup> lottery the procurement processes are almost entirely from 2009. The high vs low audit risk distributions from the 32<sup>nd</sup> lottery are statistically different from each other according to Pearson's chi-square test (p-value 0.012).