A composite indicator of red flags for measuring corruption risk in public procurement: an example based on the Italian National Database of Public Contracts

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Outline

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Public procurement

- Public procurement refers to the purchase of goods, services and works by governments and state-owned enterprises
- OECD countries (2017): 11.8% of GDP and 29.1% of general government expenditures
- Italy (2017): 10.4% of GDP and 21.4% of general government expenditures

Public procurement and corruption

- Public procurement is one of the government activities most vulnerable to **corruption**
- Corruption risks exacerbated by:
  - process complexity
  - close interaction between public officials and businesses
  - multitude of stakeholders
  - volume of transactions and financial interests at stake
  - ...
- 54% of foreign bribery cases occurred to obtain a public procurement contract (OECD, 2014)

Public procurement and corruption

Integrity risks may occur in every stage of the procurement process (OECD, 2016):

- Pre-tendering phase:
  - Needs assessment and market analysis
  - Planning and budgeting
  - Development of specifications/requirements
  - Choice of procurement procedure
- Tendering phase
  - Request for proposal/bid
  - Bid submission
  - Bid evaluation
  - Contract award
- Post-award phase
  - Contract management/performance
  - Order and payment

Outline

Measuring corruption

- Corruption is one of the most challenging threats facing contemporary societies globally
- Latent phenomenon $\leftrightarrow$ latent manifestation
- No overall consensus on how best to measure it
- Three "traditional" approaches:
  1. Perception based (subjective)
  2. Non-perception based (objective)
  3. Judiciary measures of corruption

Perception based measures of corruption

- Based on the subjective perception of corruption provided by experts
- Generally expressed at country-level
- World Bank's Control of Corruption (Kaufmann et al., 2010)
- Transparency International's Corruption Perceptions Index - CPI
- Drawbacks: perceptions not related to actual experiences of corruption, but driven by, for example, the general sentiment reflecting prior economic growth or media coverage of important cases of corruption

Non-perception based measures of corruption

- Surveys including questions assessing the direct involvement of individuals and firms in corrupt practices in well-defined instances
- The World Bank Enterprise Surveys (WBES)
- The Business Enterprise Economic Surveys (BEES)
- Drawbacks: respondents may purposefully misreport corruption events

Judiciary measures of corruption

- Judicial deeds: judgements, sentences and convictions for corrupt crimes
- Drawbacks:
  - limited usability in cross-country studies (different judicial systems)
  - partial utility for preventing corruption (i.e., a conviction for corruption crimes may occur many years after the corrupt event took place)
  - misleading information potential (e.g., an increase in the number of convictions for corruption might depend on an increased level of efficacy of the underlying judicial system, rather than on a real increased level of corruption)

Statistical inference and market measures

- Use of proxies: variables considered expressions of behaviours or situations close to corruption
- Comparison between real data and a theoretical model assuming non-corrupted behaviour $\rightarrow$ estimate of the deviation between (real) observed data deviate and the hypothesis of absence of corruption
- Golden & Picci (2005), Olken (2007): difference between physical quantities of public infrastructure delivered and the price paid by the government
- Drawbacks: indirect measures of corruption; inefficiency, rather than corruption

Red flag indicators

- Prevention rather than repression of corruption
- Purpose of prevention: to detect and remove opportunities for corruption
- Pointing out potential weaknesses in the system $\rightarrow$ raising of red flags capable of uncovering vulnerabilities and opportunities for malpractices
- Advising recommendations for their reduction and minimisation (Carloni, 2017)
- No ex-post quantification of corruption, but ex-ante identification of situations at risk of corruption
- Drawbacks: data availability and quality

Red flag indicators in public procurement

From Fazekas *et al.* 2017

Four blocks:

1. Tendering Risk Indicators
2. Political Connections Indicators
3. Supplier Risk Indicators
4. Contracting Body Risk Indicators

Outline

The Italian National Database of Public Contracts

Banca Data Nazionale dei Contratti Pubblici (BDNCP)

- Managed by the Italian Anticorruption Authority (ANAC)
- Collection and integration of data concerning all the Italian public procurement procedures (above and below the European threshold)
- "Follow-up" of each procedure throughout its entire life cycle using a "personal" identification code (CIG, *Codice Identificativo Gara*)

The Italian National Database of Public Contracts

- $\sim$ 53 million procedures over 2009-2021
- $\sim$ 2,400 billion €: contract total value
- $\sim$ 38,000 contracting authorities
- $\sim$ 240,000 companies
- Open data: `https://dati.anticorruzione.it`

The Italian National Database of Public Contracts

Content

- Publication of call for tenders (e.g., publication date, procedure type, submission deadline, contract value, identification of the contracting authority)
- Contract award (e.g., winner company, criterion, participants, award value)
- Implementation (e.g., start date, expected completion date, sums paid, possible modifications)
- Completion and final approval (e.g., final value, real completion date, final approval)

Outline

Selected red flag indicators

For each contracting body, the following eight red flags are computed:

1. $I_{nonopen\_proc}$: proportion of non-open procedures (out of all the published procedures)
2. $I_{nonopen\_euro}$: proportion of economic value (€) of non-open procedures (out of the overall value of published contracts)
3. $I_{singlebid\_proc}$: proportion of procedures for which a single bid is received
4. $I_{singlebid\_euro}$: proportion of economic value (€) of procedures for which a single bid is received (out of the total amount of awarded contracts)
5. $I_{nonprice\_proc}$: proportion of procedures awarded through non-price related evaluation criteria (out of all the awarded contracts)
6. $I_{nonprice\_euro}$: proportion of economic value (€) of contracts awarded through non-price related evaluation criteria (out of the overall value of awarded contracts)
7. $I_{days\_pub\_dead}$: average number of days between publication of call for tender and submission deadline
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Composite indicator construction

- y_{ij}: observed value of indicator j for contracting body i ($j = 1, \ldots, J$ and $i = 1, \ldots, n$)
- "Red flag activation" $\rightarrow$ a dichotomous indicator A_{ij} is associated to contracting body i with respect to indicator j, as follows

Indicator j with positive "polarity"

$$A_{ij} = \begin{cases} 1, \text{ if } y_{ij} > q_j(\tau^+), \\ 0, \text{ otherwise,} \end{cases}$$

Indicator j with negative "polarity"

$$A_{ij} = \begin{cases} 1, \text{ if } y_{ij} < q_j(\tau^-), \\ 0, \text{ otherwise,} \end{cases}$$

where $q_j(\alpha)$ is the quantile at level α of indicator j over the sample of n contracting authorities

- Selection of τ^+ and τ^- in order to consider (very) extreme situations $\rightarrow$ tails of the indicator distribution, according to the indicator "polarity"; for example, $(\tau^+ = 0.75, \tau^- = 0.25)$ or $(\tau^+ = 0.90, \tau^- = 0.10)$

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Composite indicator

First approach

Count of activated red flags

$$R_i^{(1)} = \sum_{j=1}^{J} A_{ij}.$$

- For each contracting body, it counts the situations (indicators) at risk
- In case of missing indicators for certain contracting bodies, we can use the mean of A_{ij}, dividing R_i by the number of non-missing indicators (i.e., the proportion of activated red flags)

Composite indicator

Second approach

Quantification of risk

$$R_i^{(2)} = \sum_{j=1}^{J} S_{ij}, \qquad \text{(sum of } S_{ij)}$$

$$R_i^{(3)} = \frac{1}{R_i^{(1)}} \sum_{j=1}^{J} S_{ij}, \qquad \text{(mean of } S_{ij})$$

where S_{ij} corresponds to indicator y_{ij} normalised in [0,1] by considering only the distribution of at-risk contracting bodies for that indicator (i.e., the selected tail)

Indicator j with positive "polarity"

$$S_{ij} = \begin{cases} 0, & \text{if } A_{ij} = 0, \\ \dfrac{y_{ij} - q_j(\tau^+)}{\max(y_{ij}) - q_j(\tau^+)}, & \text{if } A_{ij} = 1 \end{cases}$$

Indicator j with negative "polarity"

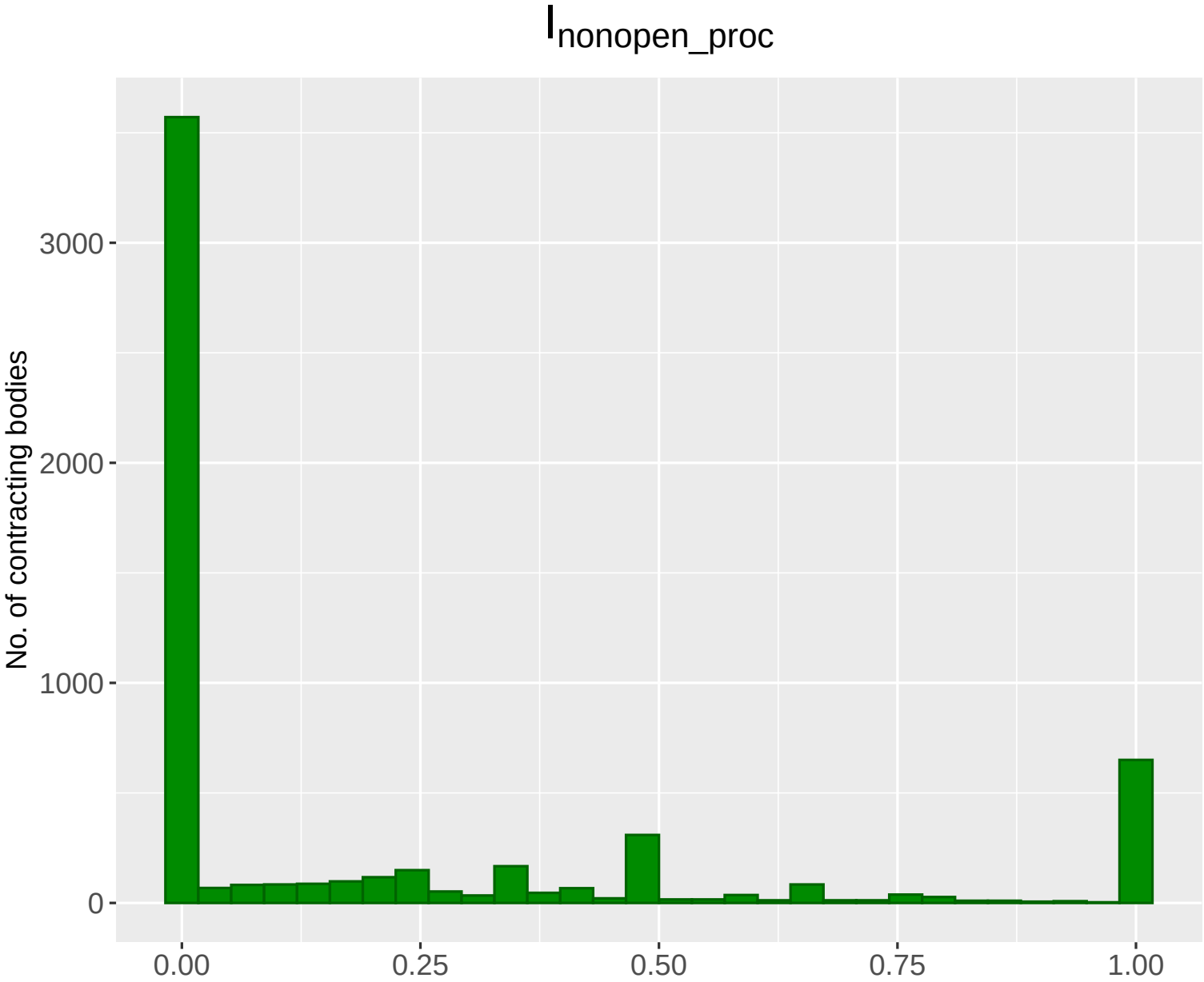
$$S_{ij} = \begin{cases} 0, & \text{if } A_{ij} = 0, \\ \dfrac{y_{ij} - q_j(\tau^-)}{\min(y_{ij}) - q_j(\tau^-)}, & \text{if } A_{ij} = 1 \end{cases}$$

Outline

Data

- Year 2016
- 68,166 tenders above €40,000 (ordinary tenders)
- 6,496 contracting authorities
- Selected eight red flags not available for the entire dataset due to:
  - missing data
  - unavailable data
  - uncleaned data

Indicator distributions



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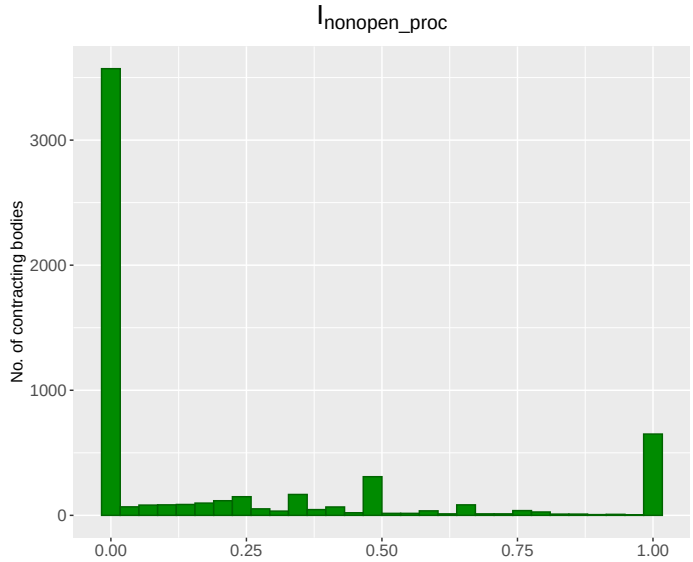
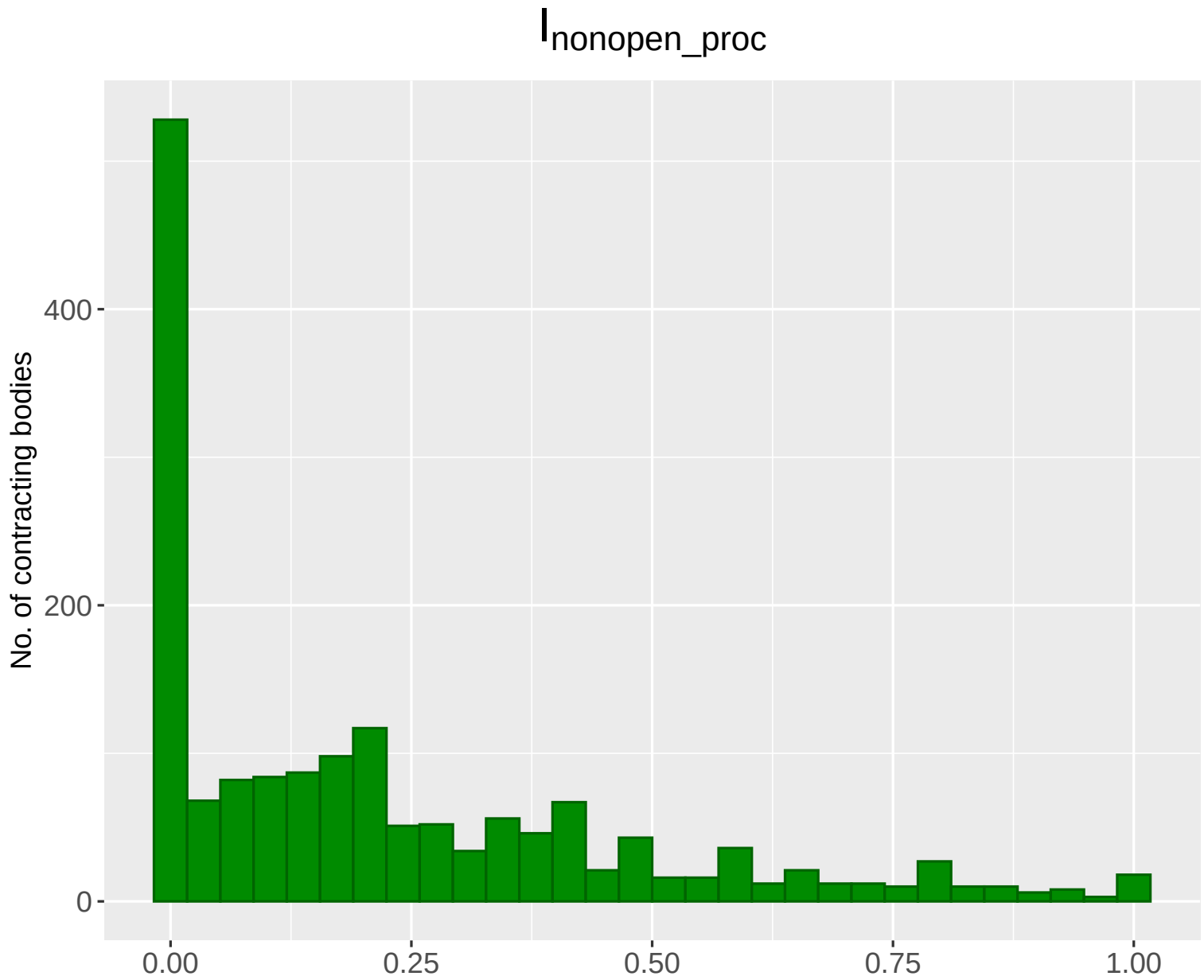


- Peaks at the extreme points of the distribution
- Indicators computed with too few observations for each contracting body
- Indicator $I_{nonopen\_proc}$ was initially computed for 5,892 contracting bodies (involved in 51,860 contracts)
- But 1,861 contracting bodies out of 3,536 (with $I_{nonopen\_proc} = 0$) have only one tender (52.2%) ...
- and 474 contracting bodies out of 648 (with $I_{nonopen\_proc} = 1$) have only one tender (73.1%)

Indicator distributions

- Robust results $\rightarrow$ data subset in order to analyse only contracting authorities with a consistent public procurement activity $\rightarrow$ **at least five contracts**
- Example: 1,871 contracting authorities are retained as regards indicator $I_{nonopen\_proc}$ $\rightarrow$ 30% of initial contracting bodies, but 85% of total tenders
- Final dataset $\rightarrow$ complete cases (non missing indicators) with 1,346 contracting authorities

Indicator distributions in the final dataset



First or second approach?

Example with thresholds ($\tau^+ = 0.75$, $\tau^- = 0.25$)

- Indicators $R_i^{(1)}$ (sum of activated red flags), $R_i^{(2)}$ and $R_i^{(3)}$ (sum and mean of "normalised" indicators) are then computed for each contracting authority

Contr. body	$R_i^{(1)}$	$R_i^{(2)}$	$R_i^{(3)}$
A	8	3.62	0.45
C	7	4.48	0.64
F	6	5.63	0.94
⋮	⋮	⋮	⋮
H	5	0.88	0.18
⋮	⋮	⋮	⋮
N	4	4.00	1.00
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T	4	3.66	0.91
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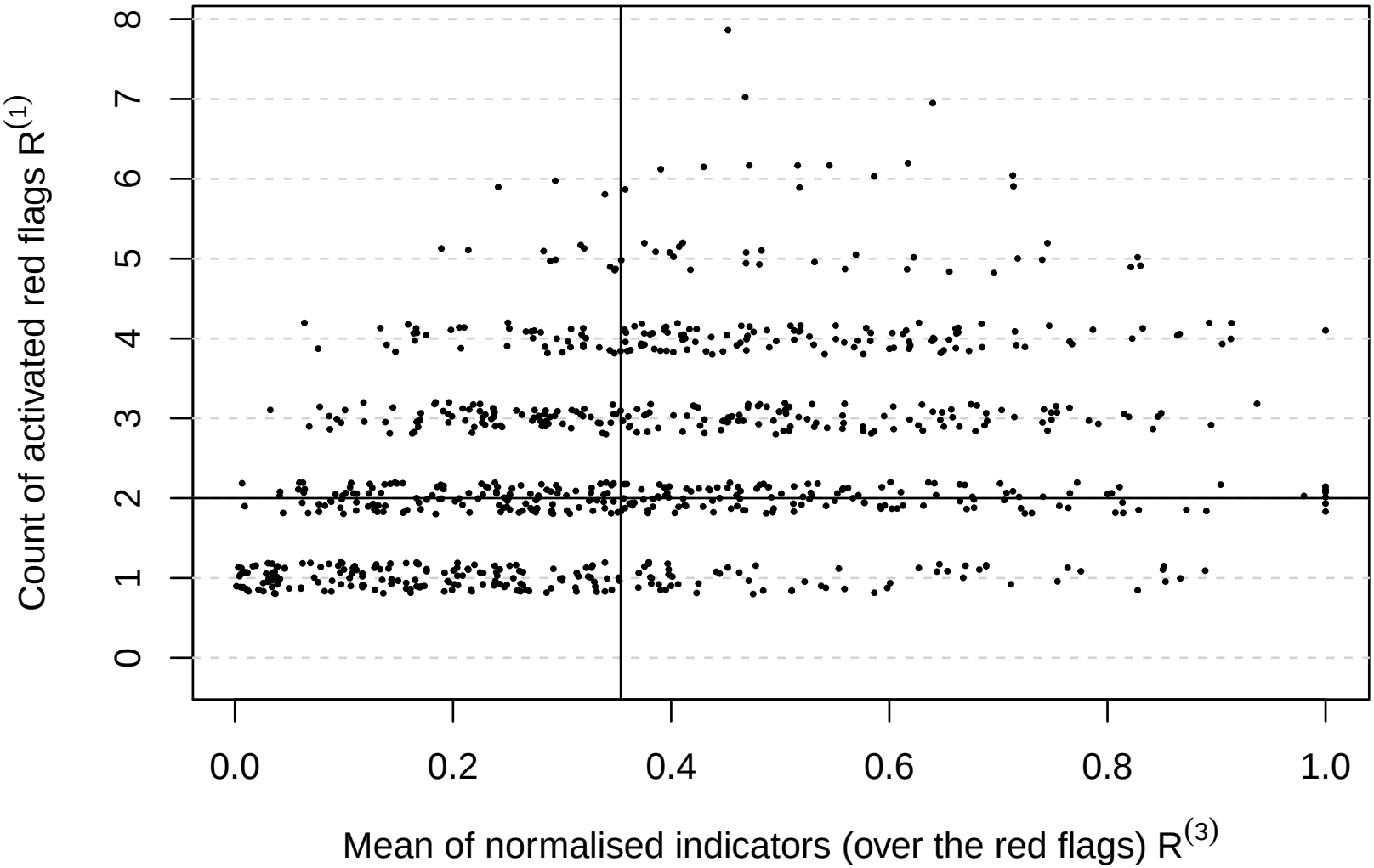

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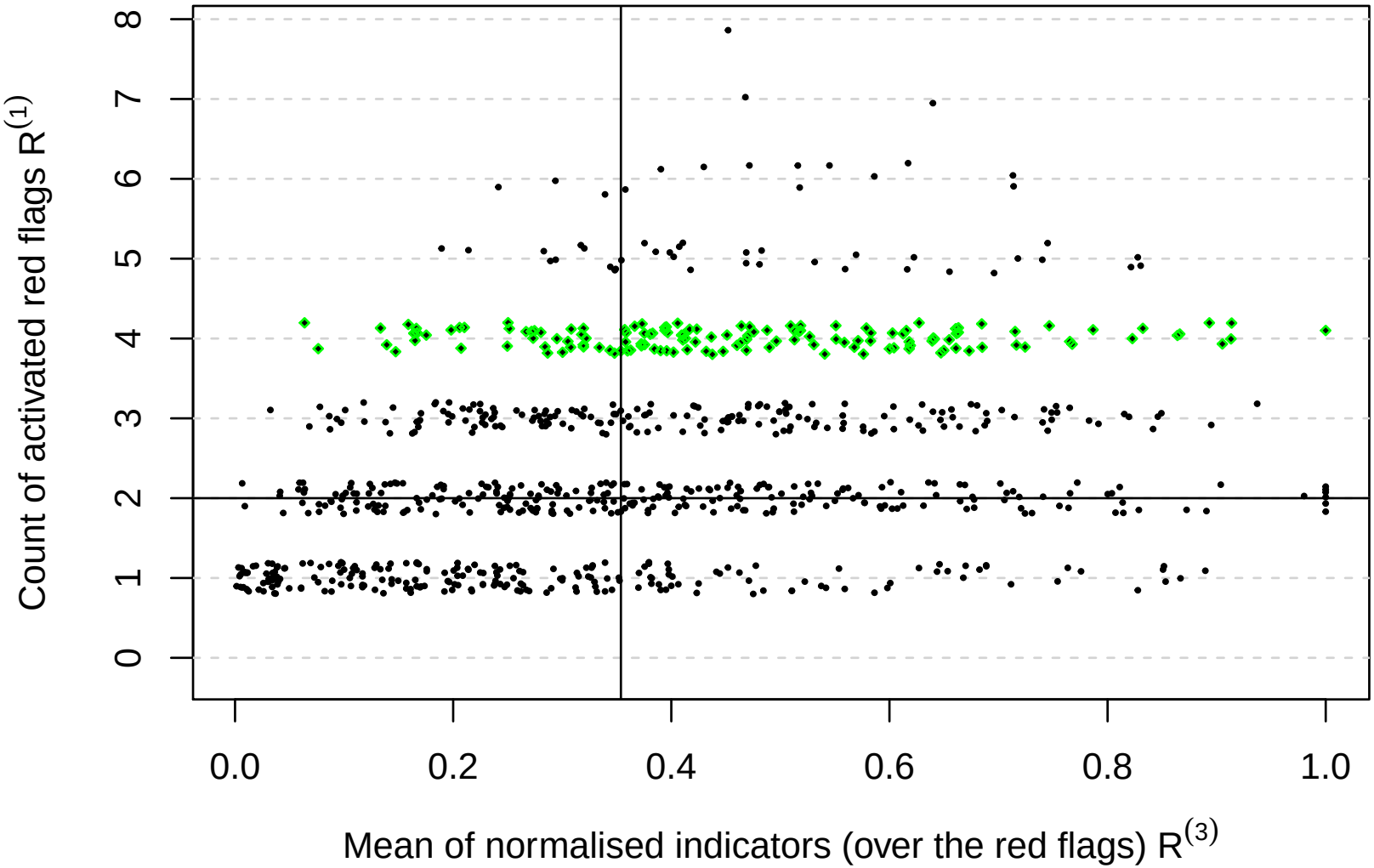

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Summary

- Red flag indicators developed with the aim of alerting the system to the possible risk of corruption in the public procurement field
- Italian National Database of Public Contracts: very rich data, about every phase of a tender
- Exercise: selection of some relevant red flag indicators already suggested in literature and proposal of composite indicators for corruption risk in public procurement

Open issues (1)

- Is a composite indicator suitable in this context?

→ Ranking of contracting bodies according to their risk → comparisons among them

- Corruption risk: is it measured by the number activated red flags? Or, rather, by a composite measure of the "distance" between the alert thresholds?

Open issues (2)

- Each red flag indeed might signal about a different aspect of corruption risk in public procurement:
  - type of procedure
  - amount of bids
  - type of award criterion
  - time distance between procurement main phases
  - etc.

$\rightarrow$ Uncorrelated red flag indicators

Open issues (3)

- Essential to consider corruption risk (in public procurement) as a multidimensional phenomenon → each indicator might be a different dimension
- As a consequence, a "clear-cut" composite indicator for each contracting authority could be misleading
- Milder version of a composite indicator → use of several single indicators for classifying contracting authorities in terms of corruption risk in public procurement

- Validation of red flags → need of real evidences for connecting a risk with an actual corrupt behaviour

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