Design of Apps for Armchair Auditors to Analyze Government Procurement Contract

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Introduction

Government procurement:

- 10%-15% of GDP; 7 trillion dollars annually in U.S.
- Not always Open and Transparent
- Fraud schemes: Bid rigging, bribery, kickbacks, cost mischarging, defective pricing, product substitution …
Introduction

Who has interest?

What data to use?

What method to apply?
Background

Open Data Initiatives

- Make info available and transparent
- 45 countries and 163 international regions
- Government procurement data:
  - U.S.: usaspending.gov
  - China: ccgp.gov.cn
  - Australian: tenders.gov.au
  - Canada: buyandsell.gc.ca
  - Brazil: dados.gov.br
  - UK: gov.uk
Background

"Armchair Auditor"

-- Crowdsourcing analysis of government data (O’Leary, 2015)
-- Informal, voluntary and no requirements
-- Pilot projects:
  • Two English councils: Isle of Wight council and Hull City council

Interested parties:
• Auditors
• Vendors

Government operational data

open data

Barrier:
• Quality and comparability of information
• Tools and knowledge
• Rules and community
**Objective**

Although we have open government data, few studies discuss:
- how to use
- what tools

This paper:

Propose a list of audit apps that help armchair auditors to
- **Analyze** procurement data
- **Identify** potential anomalies
- **Find out** suspicions contracts at high fraudulent risk
Why Audit Apps

What is it
- Formalized audit procedures that are performed through computer scripts

Example
- Caseware: test journal entries, accounts payable, fixed assets, etc.

Advantages
- Simplify data analytics procedures
- Require few user interactions
- Easy to create

No apps for open government data analysis or for non-professional auditors such as “armchair auditors”
Proposed Apps for Government Expenditure Audit

Anomaly Type:

1. Data Incompleteness and Unreliability

<table>
<thead>
<tr>
<th>No.</th>
<th>Purpose of the app</th>
<th>Data Needed</th>
<th>Anomaly Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check contract values</td>
<td>Initial values of contracts</td>
<td>Unusual number in the values, such as 0, 0.01, 0.05</td>
</tr>
<tr>
<td>2</td>
<td>Check data completeness and Integrity</td>
<td>Contracts data</td>
<td>Missing suppliers / bidding mode/ dates…</td>
</tr>
</tbody>
</table>
## 2. Suspicious Suppliers

<table>
<thead>
<tr>
<th>No.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check Relationships</td>
<td>Background information of both parties</td>
<td>Contractors or sub-, or their family members work for government</td>
<td>Bribery, Kickback</td>
</tr>
<tr>
<td>2</td>
<td>Check contractors in blacklist</td>
<td>Contractor information, “blacklist”</td>
<td>Contractors once occurred in the “blacklist”</td>
<td>Bribery, Kickback</td>
</tr>
<tr>
<td>3</td>
<td>Check contracts waived from bidding</td>
<td>Bidding type information</td>
<td>Contractors have very large proportion of “waived bidding” contracts</td>
<td>Bribery, Kickback</td>
</tr>
<tr>
<td>4</td>
<td>Identify abnormal bidding winners</td>
<td>Contract data, bidding results</td>
<td>A certain contractor always or never wins, or all contractors win equally</td>
<td>Bid rigging</td>
</tr>
</tbody>
</table>
## 3. Abnormal Prices

<table>
<thead>
<tr>
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<th>Data Needed</th>
<th>Anomaly Indicator</th>
<th>Potential Fraud</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Price comparison</td>
<td>Price data</td>
<td>Contractor sell same product/service to gov. for higher price</td>
<td>Bid rigging</td>
</tr>
<tr>
<td>2</td>
<td>Split purchase detection</td>
<td>Contract data</td>
<td>Contracts with same suppliers, same dates and same goods</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Winning price prediction</td>
<td>Bidding process</td>
<td>Abnormal winning price found in Regression</td>
<td>Bid rigging</td>
</tr>
</tbody>
</table>
4. Abnormal Bidding Procedure and Mode

<table>
<thead>
<tr>
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<th>Anomaly Indicator</th>
<th>Potential Fraud</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Few bidders check</td>
<td>Market data</td>
<td>only very few suppliers</td>
<td>bid rigging, Collusion</td>
</tr>
<tr>
<td>2</td>
<td>Bidders withdraw</td>
<td>Bidding process</td>
<td>Qualified bidders inexplicably withdraw valid bids</td>
<td>bid rigging</td>
</tr>
<tr>
<td></td>
<td>detection</td>
<td>information</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Abnormal Products/Services Implementation

<table>
<thead>
<tr>
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<th>Data Needed</th>
<th>Anomaly indicator</th>
<th>Potential Fraud</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check working hours</td>
<td>invoices</td>
<td>Employees bill for more hours than typically worked in a day</td>
<td>Charging for products not used or services not rendered</td>
</tr>
</tbody>
</table>
Illustrations

Data:
Contracts of Brazil federal government from 1989 to 2014 from SIASG (Brazilian public federal procurement information system)

1. Descriptive Dashboard

Software: Qlik Sense Enterprise

-- Dashboard for Visualization
Descriptive Analysis App

- **Modalidade da Licitação**
  - 01: CONVITE
  - 02: TOMADA DE PREÇOS
  - 03: CONCORRÊNCIA
  - 04: CONCORRÊNCIA INTER...
  - 05: PREGÃO
  - 06: DISPENSA DE LICITAÇÃO
  - 07: INEXIGIBILIDADE DE LICITAÇÃO

- **Contract Value by bidding Mode**
  - 01: CONVITE
  - 02: TOMADA DE PREÇOS
  - 03: CONCORRÊNCIA
  - 05: PREGÃO

- **Top contract value**

- **Analysis by UASG**
  - 020001: SENADO FEDERAL
  - 060001: STM SUPERIOR T...
  - 060020: STM-3A.AUDITORI...
  - 05: PREGÃO
  - 06: DISPENSA DE LICITAÇÃO
Data Incompleteness and Unreliability Check

Software: Caseware IDEA
-- Integrity Check for Missing Contractors

**App script**

In 470,683 contracts:

- 35,516 contracts had no contractor info.
  - 90% of these were waived from bidding
- 16,167 contracts had no bidding mode info
- 1,000 contracts had no valid dates

**Sample results**

<table>
<thead>
<tr>
<th>IDENTIFICADOR_DO_CONTRATO</th>
</tr>
</thead>
<tbody>
<tr>
<td>114606500000011984</td>
</tr>
<tr>
<td>154047530000011984</td>
</tr>
<tr>
<td>154047530000011986</td>
</tr>
<tr>
<td>170115600000011988</td>
</tr>
<tr>
<td>170115600000011992</td>
</tr>
<tr>
<td>512084500000011992</td>
</tr>
<tr>
<td>512111500000011992</td>
</tr>
</tbody>
</table>
501 purchases were made with external suppliers at “0” contract value;

527 purchases were made at values less than 1; the values are 0.01, 0.05, 0.1, and 0.53 Brazilian real

Sample results

<table>
<thead>
<tr>
<th>IDENTIFICADOR_DO_CONTRATO</th>
<th>VALOR_INICIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>17007854000011994</td>
<td>0.00</td>
</tr>
<tr>
<td>17005854000011996</td>
<td>0.00</td>
</tr>
<tr>
<td>15326654000011996</td>
<td>0.00</td>
</tr>
<tr>
<td>15325454000011996</td>
<td>0.00</td>
</tr>
<tr>
<td>15326554000011996</td>
<td>0.00</td>
</tr>
<tr>
<td>15325454000011996</td>
<td>0.00</td>
</tr>
<tr>
<td>15301752000011996</td>
<td>0.00</td>
</tr>
<tr>
<td>20104450000012000</td>
<td>0.00</td>
</tr>
<tr>
<td>15303252000011996</td>
<td>0.00</td>
</tr>
<tr>
<td>25502652000012000</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Abnormal prices

Software: Caseware IDEA
-- Benford’s Law Check

Widely used for accounting fraud detection

Values should come from mathematical combination of numbers (quantity × price), they are expected to obey Benford’s Law

First Two Digit: “60”, “79” and “80” do not obey the First Two Digit Law
Suspicious Suppliers

Software: SAS
--“Black list” Contractor Detection

- 25,100 contracts are made with contractors listed in the blacklist
- 1,936 unique suspicious contractors (firms)

Sample results

<table>
<thead>
<tr>
<th>Contractor</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.000.118</td>
<td>1717</td>
</tr>
<tr>
<td>00.212.655</td>
<td>405</td>
</tr>
<tr>
<td>29.739.737</td>
<td>404</td>
</tr>
<tr>
<td>10.788.628</td>
<td>375</td>
</tr>
<tr>
<td>00.329.379</td>
<td>345</td>
</tr>
</tbody>
</table>
Limitations and Future Research

- Design, improve and test the apps
- Develop rule-based algorithm to prioritize suspicious contracts based on the concept of exceptional exception (Issa, 2013)
Thank you!