The background of the slide features a large, faint watermark of the Rutgers University seal. The seal is circular with a sunburst in the center and the words "RUTGERS UNIVERSITY" around the perimeter.

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Design of Apps for Armchair Auditors to Analyze Government Procurement Contract

Jun Dai

Rutgers University

Qiao Li

Rutgers University

Miklos A. Vasarhelyi

Rutgers University

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?



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Background

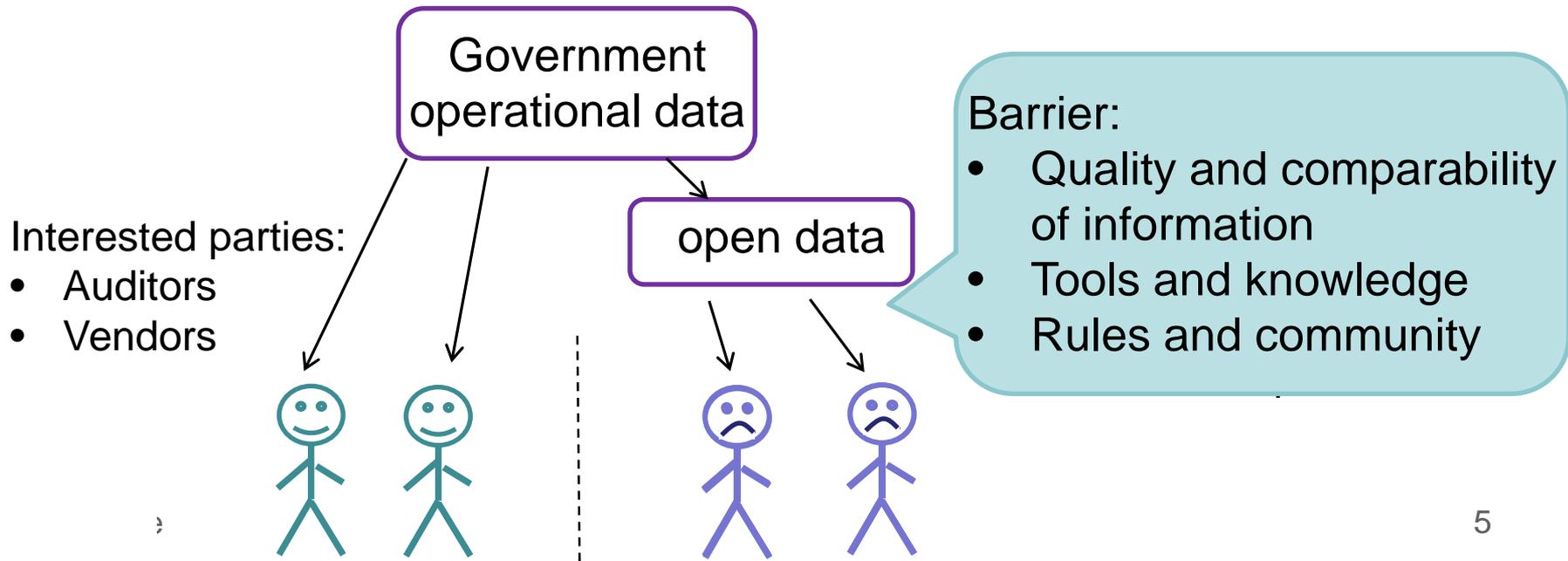
Open Data Initiatives

- 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



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** suspicious 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

No.	Purpose of the app	Data Needed	Anomaly Indicator
1	Check contract values	Initial values of contracts	Unusual number in the values, such as 0, 0.01,0.05
2	Check data completeness and Integrity	Contracts data	Missing suppliers / bidding mode/ dates...

2. Suspicious Suppliers

No.	Purpose of App	Data Needed	Anomaly Indicator	Potential Fraud
1	Check Relationships	Background information of both parties	Contractors or sub-, or their family members work for government	Bribery, Kickback
2	Check contractors in blacklist	Contractor information, "blacklist"	Contractors once occurred in the "blacklist"	Bribery, Kickback
3	Check contracts waived from bidding	Bidding type information	Contractors have very large proportion of "waived bidding" contracts	Bribery, Kickback
4	Identify abnormal bidding winners	Contract data, bidding results	A certain contractor always or never wins, or all contractors win equally	Bid rigging

3. Abnormal Prices

No.	Purpose of App	Data Needed	Anomaly Indicator	Potential Fraud
1	Price comparison	Price data	Contractor sell same product/service to gov. for higher price	Bid rigging
2	Split purchase detection	Contract data	Contracts with same suppliers, same dates and same goods	
3	Winning price prediction	Bidding process	Abnormal winning price found in Regression	Bid rigging

4. Abnormal Bidding Procedure and Mode

No.	Purpose of App	Data Needed	Anomaly Indicator	Potential Fraud
1	Few bidders check	Market data	only very few suppliers	bid rigging, Collusion
2	Bidders withdraw detection	Bidding process information	Qualified bidders inexplicably withdraw valid bids	bid rigging

5. Abnormal Products/Services Implementation

No.	Purpose of app	Data Needed	Anomaly indicator	Potential Fraud
1	Check working hours	invoices	Employees bill for more hours than typically worked in a day	Charging for products not used or services not rendered

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 Licita...

- 01: CONVITE
- 02: TOMADA DE PREÇOS
- 03: CONCORRÊNCIA
- 04: CONCORRÊNCIA INTER...
- 05: PREGÃO
- 06: DISPENSA DE LICITAÇÃO
- 07: INEXIGIBILIDADE DE LI...
- 08: CONCLUIDO

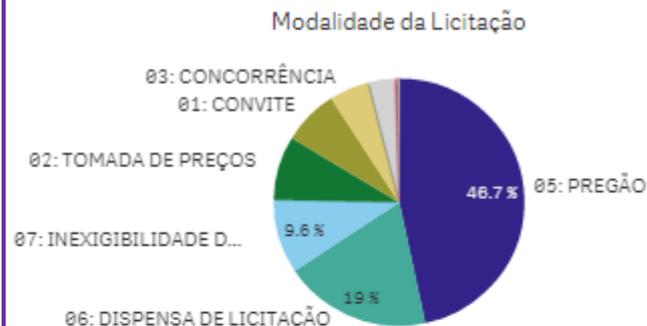
Contratada

- Fornecedor 00.000.000/00...
- Fornecedor 00.000.000/00...
- Fornecedor 00.000.000/00...

UASG

- 020001: SENADO FEDERAL
- 060001: STM_ SUPERIOR T...
- 060020: STM-3A.AUDITORI...

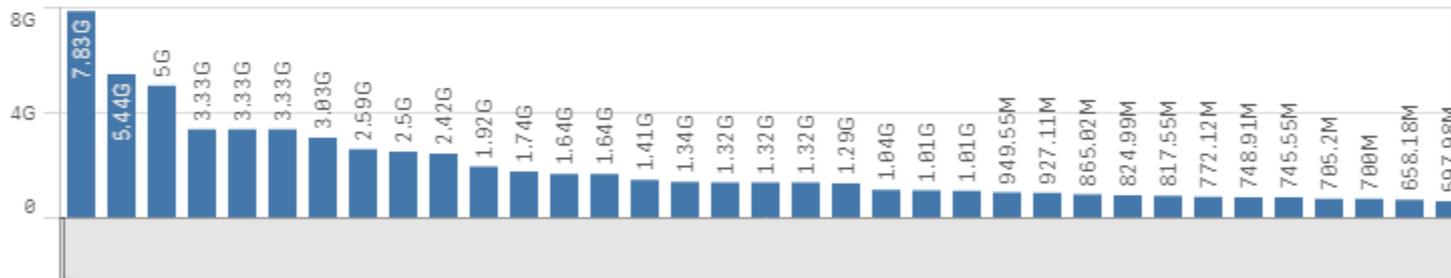
Analyze by Bidding Mode



Contract Value by bidding Mode

Modalidade da Li...	avg((Valor inicial))
-	3496645
99: null	67013472
44: CONCORRÊNCIA INTERNACIONAL POR TÉCNICA E PREÇO	5866328.8
04: CONCORRÊNCIA INTERNACIONAL	5737919.4

Top contract value



Analysis by UASG

153261: HOSPITAL CLINICAS/UF MG	153163: MEC - UNIV. FED DE SANTA CATARINA...	160069: COMAND. LOGISTICO	154421: FUND. UNIVERSIDADE FEDERAL VA...	153010: MEC-CEF ET-CENT. FED.ED.T EC.CELS...	153173: FINE- MEC-FUND ONAC DE DESENVOLVIMENTO EDUCACAO/DF	06: DISPENSA DE LICITAÇÃO
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Data Incompleteness and Unreliability Check

Software : Caseware IDEA

-- Integrity Check for Missing Contractors

App script

```

Sub Main
  Call ExcellImport() 'C:\Users\Administrator\Downloads\integrity check.xlsx
  Call DirectExtraction() 'integrity check3-Sheet2.IMD
End Sub

File - Import Assistant: Excel
Function ExcellImport
  Set task = Client.GetImportTask("ImportExcel")
  dbName = "C:\Users\Administrator\Downloads\integrity check.xlsx"
  task.FileToImport = dbName
  task.SheetToImport = "Sheet2"
  task.OutputFilePrefix = "integrity check3"
  task.FirstRowIsFieldName = "TRUE"
  task.EmptyNumericFieldsAsZero = "FALSE"
  task.PerformTask
  dbName = task.OutputFilePath("Sheet2")
  Set task = Nothing
  Client.OpenDatabase(dbName)
End Function

Data: Direct Extraction
Function DirectExtraction
  Set db = Client.OpenDatabase("integrity check3-Sheet2.IMD")
  Set task = db.Extraction
  task.IncludeAllFields
  dbName = "Integrity check - Contractors.IMD"
  task.AddExtraction dbName, "", "@IsBlank(CONTRATADA)"
  task.CreateVirtualDatabase = False
  task.PerformTask 1, db.Count
  Set task = Nothing
  Set db = Nothing
  Client.OpenDatabase(dbName)
End Function
  
```

Sample results

	IDENTIFICADOR_DO_CONTRATO
1	11460650000011984
2	15404753000011984
3	15404753000011986
4	17011650000011988
5	51208450000011992
6	51211150000011992
7	17011950000011990

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

Data Incompleteness and Unreliability Check

Software: Caseware IDEA

-- Unusual Initial Values

App script

```

Sub Main
  Call ExcellImport()
  Call DirectExtraction()
End Sub

'File - Import Assistant: Excel
Function ExcellImport
  Set task = Client.GetImportTask("ImportExcel")
  dbName = "C:\Users\Administrator\Downloads\initial value.xlsx"
  task.FileToImport = dbName
  task.SheetToImport = "Sheet1"
  task.OutputFilePrefix = "initial value2"
  task.FirstRowsFieldName = "TRUE"
  task.EmptyNumericFieldsAsZero = "FALSE"
  task.PerformTask
  dbName = task.OutputFilePath("Sheet1")
  Set task = Nothing
  Client.OpenDatabase(dbName)
End Function

'Data: Direct Extraction
Function DirectExtraction
  Set db = Client.OpenDatabase("initial value2-Sheet1.IMD")
  Set task = db.Extraction
  task.IncludeAllFields
  dbName = "small value.IMD"
  task.AddExtraction dbName, "", "VALOR_INICIAL < 0.1"
  task.CreateVirtualDatabase = False
  task.PerformTask 1, db.Count
  Set task = Nothing
  Set db = Nothing
  Client.OpenDatabase(dbName)
End Function
  
```

Sample results

IDENTIFICADOR_DO_CONTRATO	VALOR_INICIAL
17007854000011994	0.00
17005854000011996	0.00
15326654000011996	0.00
15325454000011996	0.00
15326654000011996	0.00
15325454000011996	0.00
15301752000011996	0.00
20100454000012000	0.00
15303252000011996	0.00
25502652000012000	0.00

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

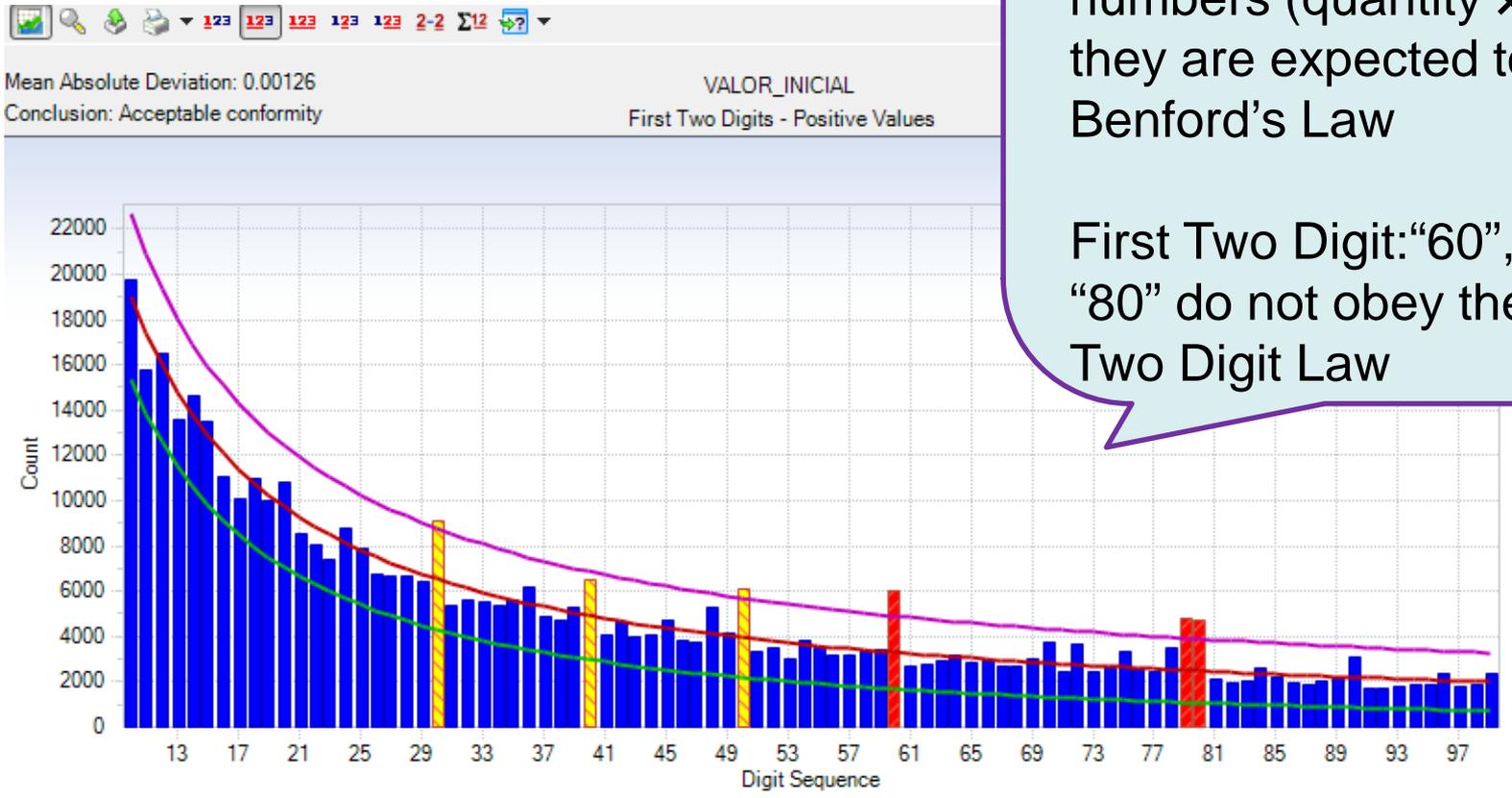
Abnormal prices

Software: Caseware IDEA
 -- Benford's Law Check

Widely used for accounting fraud detection

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

First Two Digit: "60", "79" and "80" do not obey the First Two Digit Law

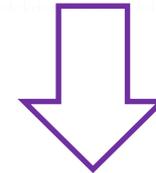
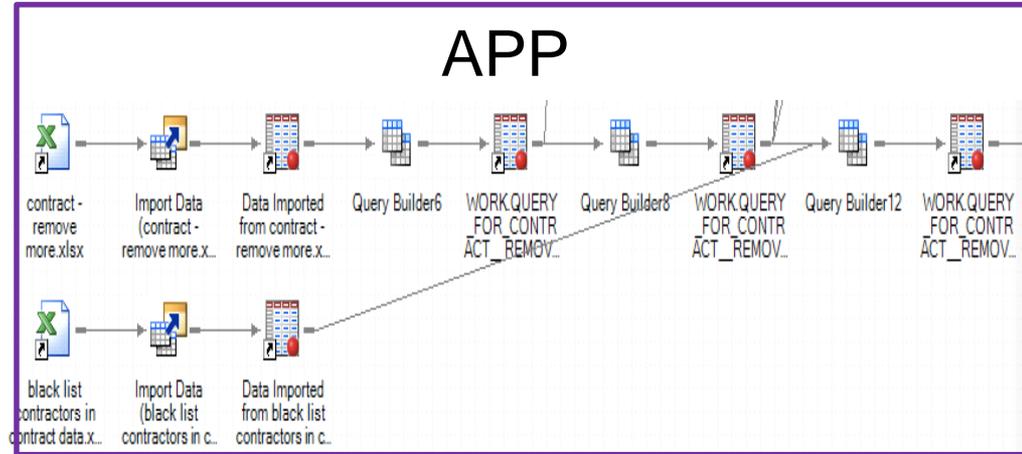


— Upper Bound — Lower Bound — Expected Count
■ Actual Count ■ Highly Suspicious ■ Suspicious

Suspicious Suppliers

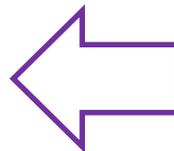
Software: SAS

--“Black list” Contractor Detection



Sample results

Contractor	Frequency
33.000.118	1717
00.212.655	405
29.739.737	404
10.788.628	375
00.329.379	345



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

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!

