# Combating Political Corruption with Policy Bundles

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Dynamic Structural Models
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# Motivation

- Corruption is a serious concern
  - Considered to be a major obstacle for economic and social development
    - Strong negative relationship between corruption and various measures of economic development such as investment and growth (e.g. Mauro 1995, Bai et al. 2017, Colonnelli and Prem 2022).

# Motivation

- Corruption is a serious concern
  - Considered to be a major obstacle for economic and social development
    - Strong negative relationship between corruption and various measures of economic development such as investment and growth (e.g. Mauro 1995, Bai et al. 2017, Colonnelli and Prem 2022).
- How do we design policies that can be effective at reducing corruption?

# Motivation

- We have several policies to combat corruption
  - e.g. government audits, extending political time horizons, barring corrupt politicians from office, or increasing politicians' wages

- Several studies have found empirical support for such policies in various settings.
  - Audit policy: Olken (2007) for Indonesia, Avis et al (2020) for Brazil, Bobonis et al (2016) for Puerto Rico, Chen and Kung (2018) for China
  - Wage policy: Di Tella and Schargrodsky (2003) for Argentina, Niehaus and Sukhtankar (2013) for India
  - Term-limits: Ferraz and Finan (2011) for Brazil, Lopez-Videla (2020) for Mexico

# Motivation

- But which policies are most effective?
  - It is hard to compare across different policies, implemented in different places and different points in time
- Each policy has its strengths and weaknesses
  - Can we combine policies to minimize each individual policy's limitations?
- Politicians are forward-looking actors. Anti-corruption policies affect futures choices, as well as current ones.
  - It is difficult to capture/isolate these future margins of adjustment in the reduced-form.

# In this paper

- We develop and estimate a dynamic model of a politician's decision to engage in corruption
- The identification and estimation of the model rely on data from:
  - Randomized audits of local governments in Brazil
  - Audit reports provide objective measures of corruption
- Our model allow us to compare different policies, including combined policies, all within the same setting

# In this paper

- We evaluate the effects of 4 policies
  1. Audit policy
  2. Term-limit policy
  3. No-run policy (CRA)
  4. Wage policy
- We also evaluate the effects of policy bundles
- We compare policies based on how much they
  - reduce corruption
  - increase residents' willingness to pay for the policy

# Preview of main findings

- The most effective *individual* policy at reducing corruption is the audit policy:
  - 36% reduction in resources diverted
  - The average willingness to pay is 0.6% of annual income
  - It has the highest cost (average audit direct cost US$50,000)

- The policy with the highest willingess to pay is the no-run policy
  - The average willingness to pay is 1% of annual income
  - 15% reduction in resources diverted

- We can achieve better results with policy bundles
  - Policy bundle term-limit + no-run + audit: Reduces corruption by 56% with a WTP of 1.3% of annual income

# Outline

1. Data and Descriptive Analysis
2. The Model
3. Estimation
4. Policy Results

# Data

- Our model is general and can be applied to various setting
- But we estimate it using data from local governments in Brazil
- Why Brazil?
  - Government implemented an audit program that allows us to measure this corruption
  - Audit program was conducted at random
  - Political corruption at the local level is an important concern
  - Mayors can serve two consecutive terms

# Defining corruption

**Definition:**

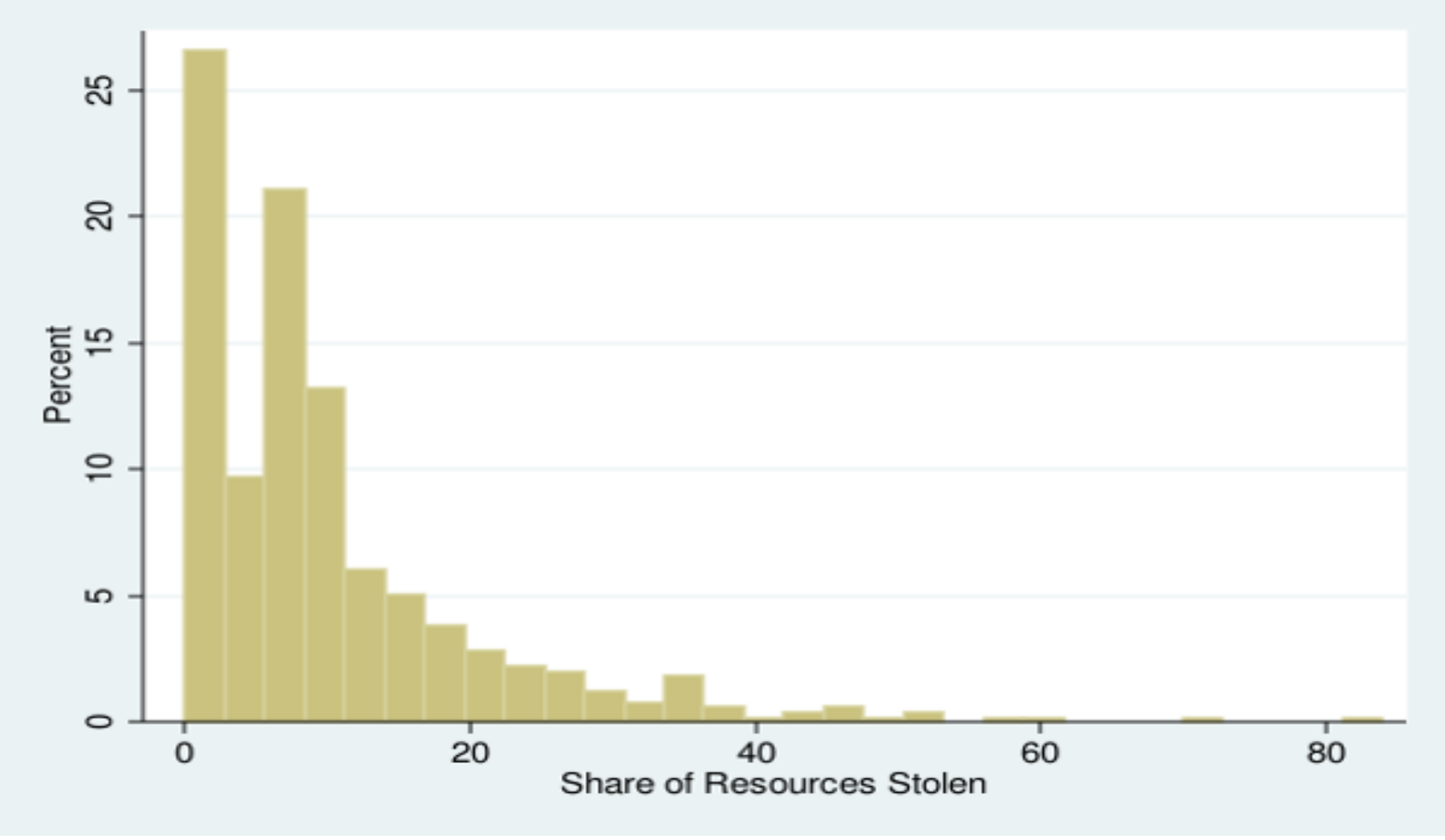
1. Fraud in procurement
2. Diversion of public resources
3. Over-invoicing

**Measure:**

- Total amount of resources associated with corruption

▸ Pictures

# Descriptive Evidence: Corruption




$\Rightarrow$ **Our model should account for this skewness in corruption**

# Descriptive Evidence: Corruption

- Corruption varies by term (mayors can serve at most 2 terms)
  - Average stealing is 5.6% in the first terms vs 7.3% in the second term
  - 71% of mayors steal in the first term against 76% in the second term

  - Literature shows that politicians with shorter time horizons are often associated with worse outcomes.
    - Coviello and Gagliarducci (2017) - costs of public work in Italy were significantly higher in municipalities with a term-limited mayor relative to municipalities with a first-term mayor.
    - Lopez-Videla (2020) - Mexican mayors with longer time horizons steal less and provide more public goods.

$\Rightarrow$ **Our model of political corruption needs dynamics**

# Descriptive Evidence: Public consumption

- Mayors provide public goods and set policies that affect the local economy
- We use per-capita GDP of a municipality as our measure of public consumption
  - Many different types of public goods
  - Proxies for the dollar value for the bundle of public goods that are being provided
  - Is strongly correlated with other proxies of public goods (e.g. access to electricity, number of schools, etc.)

# Descriptive Evidence: Public consumption

- Public consumption is negatively associated with corruption
- Public consumption is larger in a second term, but the effect is imprecisely measured

$\Rightarrow$ **Our model must include the production of public goods**

# Descriptive Evidence: Decisions to Run

- Elections take place every 4 years
- 72% of mayors choose to run for reelection
- The decision to run is correlated with outcomes in the first term:
  - Having been caught stealing reduces the probability of running by 12.3 p.p.
  - A 10% increase in public consumption is associated with a 13.5 p.p. increase in the probability of running

$\Rightarrow$ **The model should include the decision to run**

# Descriptive Evidence: Electoral Outcomes

- Conditional on running, 57% of mayors were reelected
- Reelection is correlated with outcomes in the first term:
  - Having been caught diverting funds reduces the reelection probability by 15 p.p.
  - A 10% increase in public consumption is associated with a 2 p.p. increase in the reelection probability
- Literature documents voters punish corrupt politicians and reward high public consumption
  - Ferraz and Finan (2008) - Brazil
  - Bobonis, Camara Fuertes, and Schwabe (2016) - Puerto Rico
  - Costas-Perez, Sole-Olle, and Sorribas-Navarro (2012) for Spain
  - Chong et al. (2015) for Mexico.
  - Brender and Drazen (2005)

$\Rightarrow$ **In the model, voter's decisions should depend on stealing and the amount of public consumption provided**

# Descriptive Evidence: Wages of Ex-Politicians

- We find no relationship between wages of ex-mayors in the formal sector and
  - Having been audited
  - And caught stealing

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# The goal of the model

- To capture the main incentives and constraints politicians face to engage in corruption
- To account for the variation we see in the distribution of corruption $\rightarrow$ heterogeneity across politicians
- To capture the possibility that politicians may refrain from stealing in the current period to steal more in a future period $\rightarrow$ dynamic model
- To capture other key decisions: to run and to save
- Sufficiently rich to simulate different anti-corruption policies

# Preferences

Individuals $i$ in period $t$ have the following utility function:

$$u^i\left(c_t^i, \bar{Q}_t\right) = \frac{\left(c_t^i\right)^{1-\delta}}{1-\delta} + \theta \ln \bar{Q}_t + \rho - \kappa,$$

- $c_t^i =$ private consumption
- $\bar{Q} = \frac{Q}{d^\eta}$ is per-capita public consumption
- $d$ is population size and $\eta \in [0, 1]$ is the degree of rivalry
- $\rho$ is the utility from being in power
- $\kappa$ is the utility cost of running for election

# Production Function

Production function for public goods:

$$\frac{Q_t}{d_t} = \left(\frac{z_t^{pu}}{d_t}\right)^{\alpha_1} \left(z_t^{pr}\right)^{\alpha_2} \; a_i.$$

- $z_t^{pu} = f_t^{pu} - s_t^i$ amount of public funds invested in public consumption
- $f_t^{pu}$ funds transfer from the central government
- $s_t^i =$ stealing
- $z_t^{pr} =$ inputs from the private sector
- $\log a_i \sim N(\mu_a, \sigma_a)$ mayor's ability (unobservable)

$\Rightarrow$ We allow for heterogeneity in mayor and municipal characteristics

# The Mayor

- Mayors make three decisions:
  - They decide how much of the funds $f^{pu}$ to steal $s$ and, hence, how much to invest in $Q$
  - Given $s$, they decide how much to consume $c$ versus save $b$
  - They choose whether to run for reelection, if not in their last term

# The Mayor - Wages

- All individuals supply inelastically $\bar{h}$ units of labor in return for a wage $w$
- Current mayors receive a deterministic wage $\bar{w}^m$ based on population size
- Ex-mayors receive wages based on the wage process:

$$\ln w_t^{pm} = \gamma_0 + \gamma_1 e_t + \gamma_2 age_t + \gamma_3 age_t^2 + \gamma_4 \delta_{mm} + \gamma_5 \delta_{lm} + \epsilon_t,$$

  - $e_t =$ education
  - $\delta_{mm} = 1$ if population is between 10,000 and 50,000
  - $\delta_{lm} = 1$ if the municipality's population is above 50,000
  - $\epsilon_t \sim N(0, \sigma_w)$

# Government Audits

- The central government audits municipalities at random with probability $p$
- Audited mayors that were stealing:
  - Are caught with probability 1 and the amount stolen becomes public knowledge
  - They are convicted with probability $p_t^c$
  - And incur a fine that is increasing in the amount stolen $g(s) = s + \tau s$, where $\log \tau \sim N(\mu_\tau, \sigma_\tau)$

# The Mayor - Savings

- Individuals can save or borrow $b$ at an interest rate $R$
- We observe heterogeneity in wealth in the data
- This heterogeneity can generates variation in corruption across mayors for two reasons
    1. Wealthier mayors derive less utility from diverting resources
    2. The deterrent effect of financial penalties declines

# Voters

Residents vote for the incumbent or challenger by comparing

- Their own expected lifetime utility conditional on the incumbent being elected
- With the corresponding expected lifetime utility if the challenger wins the election
- After an electoral shock, $\varepsilon_{i,t} \sim N(0,1)$, is taken into account

# Voters

To account for learning about the incumbent's ability, the voter's expected lifetime utility conditional on the incumbent being elected depends also on

- The amount of public consumption provided by the incumbent in the current term
- Whether the municipality was audited
- If audited, the amount stolen

# Measurement Errors in Stealing

- Our corruption data contain measurement errors
- We add a measurement error $\nu_t^i$ such that

$$s_t^{i,o} = s_t^i \nu_t^i$$

- Where $\log \nu_t^i \sim N(0, \sigma_\nu)$
- This implies that voters cannot infer the exact mayor's ability even in case of an audit

# Recursive Formulation

- For Mayors, we have to consider two problems:
  - The problem of a current mayor ($V_M^i$)
  - The problem of a past mayor ($V_{PM}^i$)

▸ Recursive Formulation

# Voters' Value Functions

To determine the probabiliy of reelection, we need the voters' expected value functions:

- Conditional on the incumbent being reelected:

$$V_{vot}^{i}\left(Inc\right)=E_{t-1}^{Inc}\left[V_{V}^{i}\left(S_{t}^{V},t\right)\middle|\ Q_{t-1},1_{\{au,t-1\}},s_{t-1}^{i}1_{\{au,t-1\}}\right]$$

- Conditional on one of the challengers being elected:

$$V_{vot}^{i}\left(Ch\right)=E_{t-1}^{Ch}\left[V_{V}^{i}\left(S_{t}^{V},t\right)\right].$$

# Voters' Value Functions

The voters' expected value functions conditional on the incumbent being reelected is approximated by

$$E_{t-1}^{Inc}\left[V_V^i\left(S_t^V,t\right)\middle|\ Q_{t-1},1_{\{au,t-1\}},s_{t-1}^i 1_{\{au,t-1\}}\right]\approx$$

$$E_{t-1}^{Inc}\left[V_V^i\left(S_t^V,t\right)\right]+\delta_1+\delta_2 f\left(Q_{t-1}\right)+\delta_3 1_{\{au,t-1\}}1_{\{s_{t-1}^i=0\}}+\delta_4 s_{t-1}^i 1_{\{au,t-1\}}$$

# Probability of Reelection

A citizen votes for the incumbent if

$$V_{vot}^{i}(Inc) + \varepsilon_{i,t} > V_{vot}^{i}(Ch).$$

where $\varepsilon_{i,t} \sim N(0,1)$ is the electoral shock

With one representative voter, the probability of reelection is

$$\Phi\left(V_{vot}^{i}(Inc) - V_{vot}^{i}(Ch)\right)$$

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# Estimation

- There are eight sets of parameters in the model:
  1. The curvature and discount factor parameters
  2. The production function and ability parameters
  3. Wages of past mayors parameters
  4. Fine parameters
  5. Distribution of mayor's characteristics
  6. The electoral decision parameters
  7. The relative taste for public consumption parameter
  8. The utility cost of running and from being in power parameters

- We can estimate all parameters except
  - Utility curvature parameter $\delta = 2$ (Attanasio and Weber (1995))
  - Discount factor $\beta = 0.98$ (Attanasio, Low, and Sanchez-Marcos (2008))

# Estimation

- The production function and ability parameters can be estimated independently of the other parameters
- Their identification requires knowledge of the amount stolen
- And the randomization of the audits
- The wage process, fine, and distribution of mayor's characteristics can also by estimated independently
- The remaining parameters are estimated jointly using the Simulated Method of Moments

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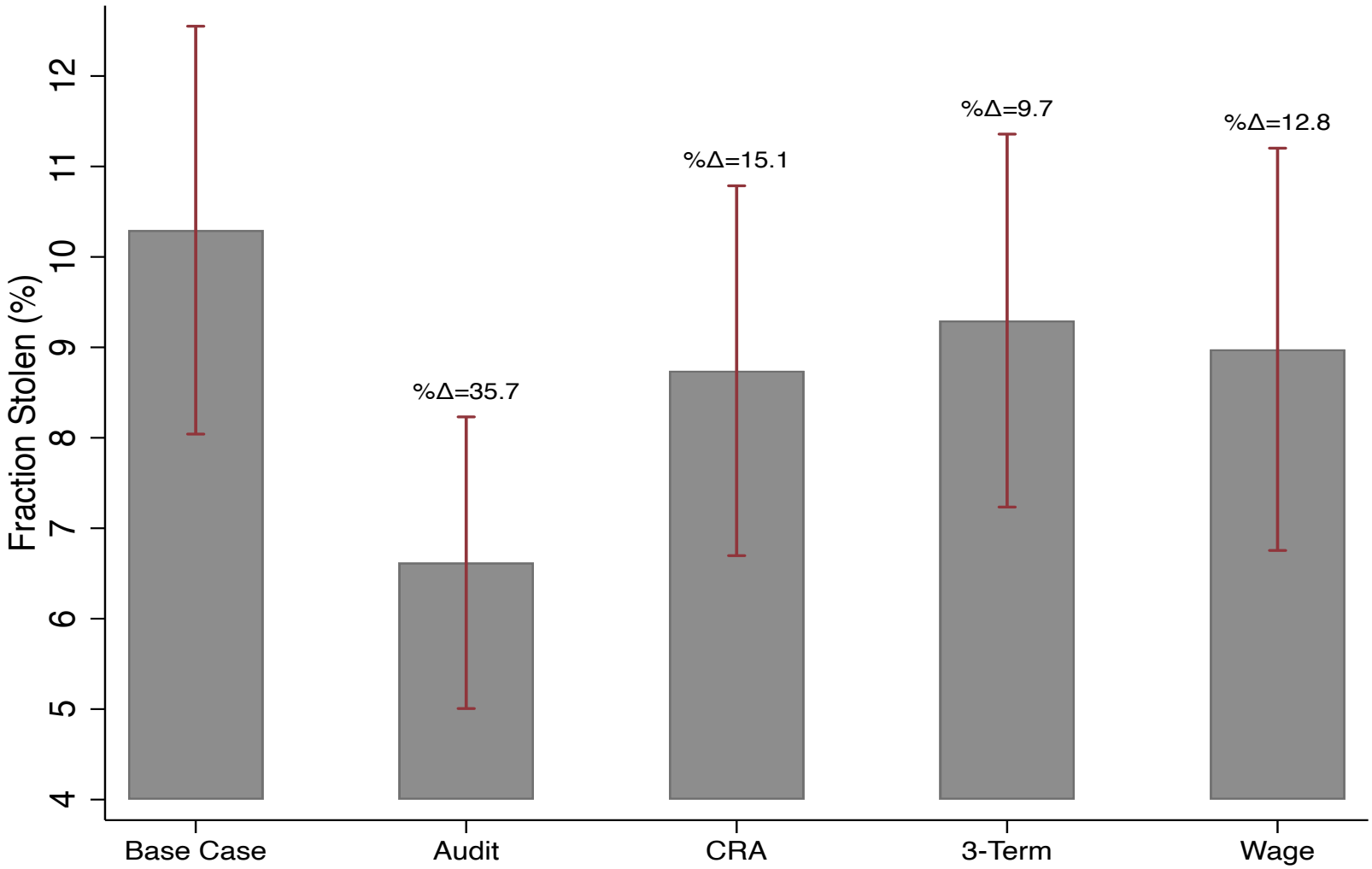
# Policy Results

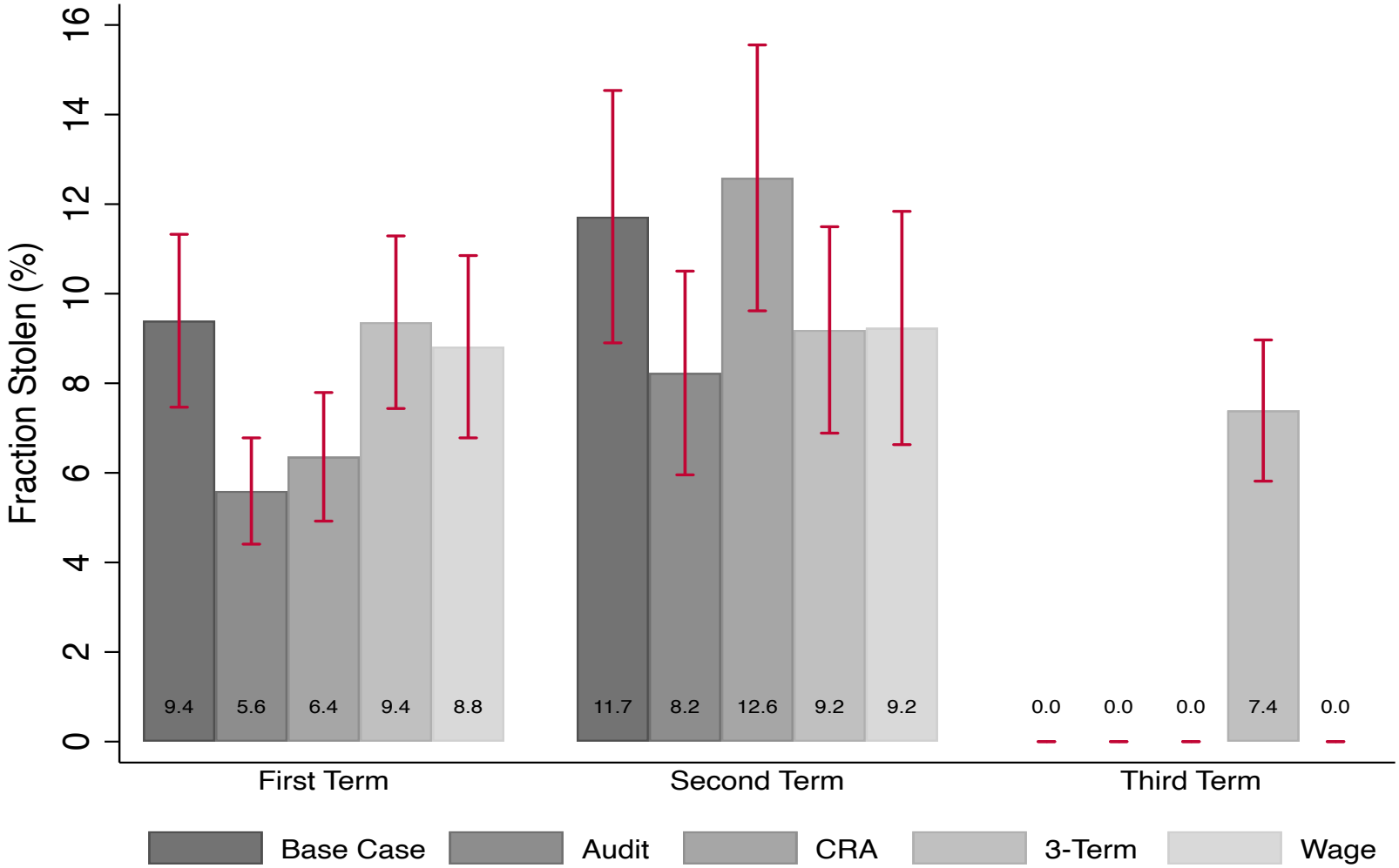
We start by evaluating four individual anti-corruption policies:

1. An increase in the probability that a politician is audited (audit policy)
2. A rise in the politicians' wages (wage policy)
3. An increase in term limits (term-limit policy)
4. Banning a convicted politician from participating in the elections (no-run/CRA policy)

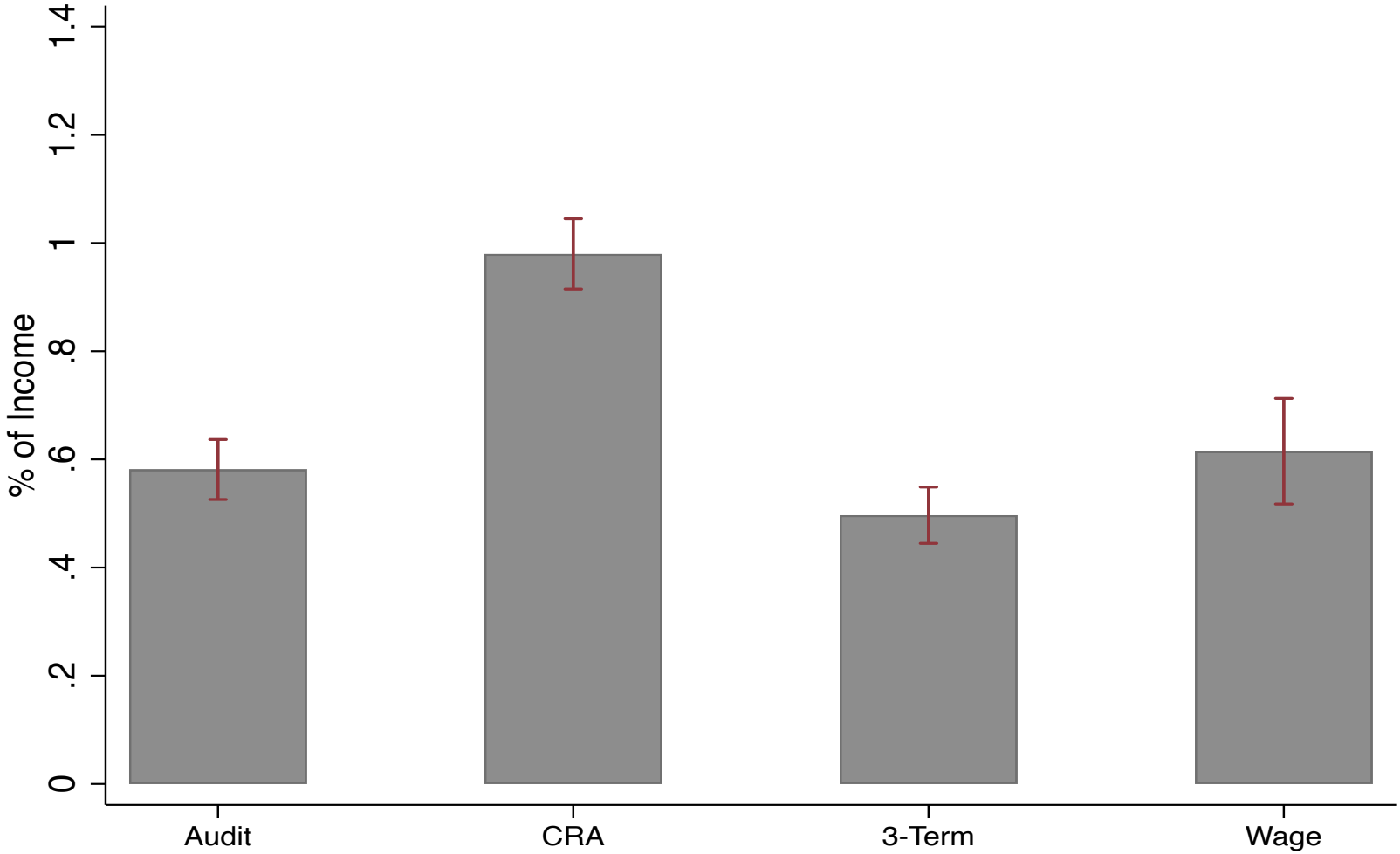
# Policy Results: Effect on Corruption



# Policy Results: By Term



# Policy Results: Willingness to Pay

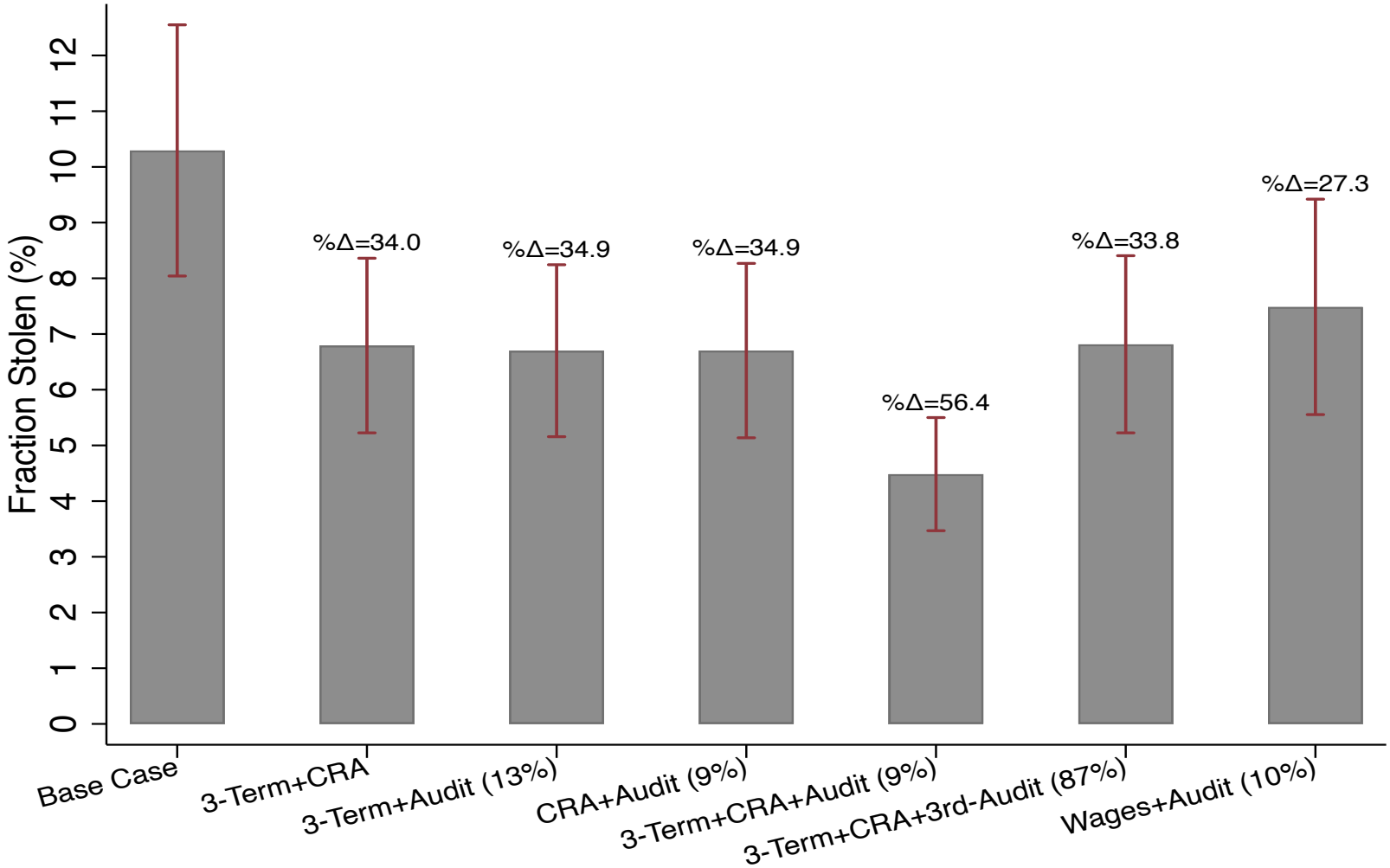


# Policy Results

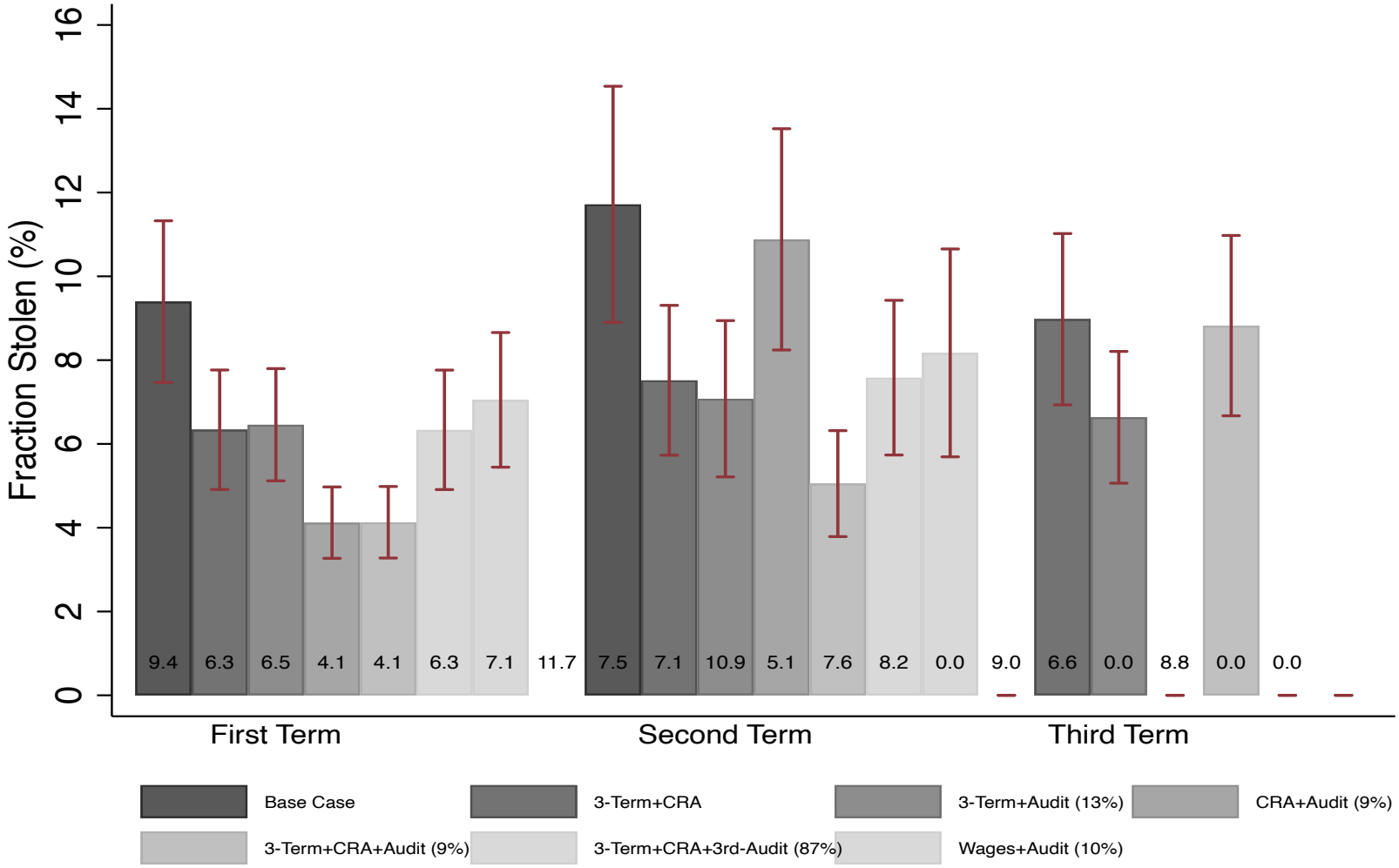
- We evaluate possible solutions by considering six policies bundles:

1. 3-term + CRA
2. 3-term + Audit
3. CRA + Audit
4. 3-term + CRA + Audit
5. 3-term + CRA + Audit Only 3rd Term
6. Wages + Audit

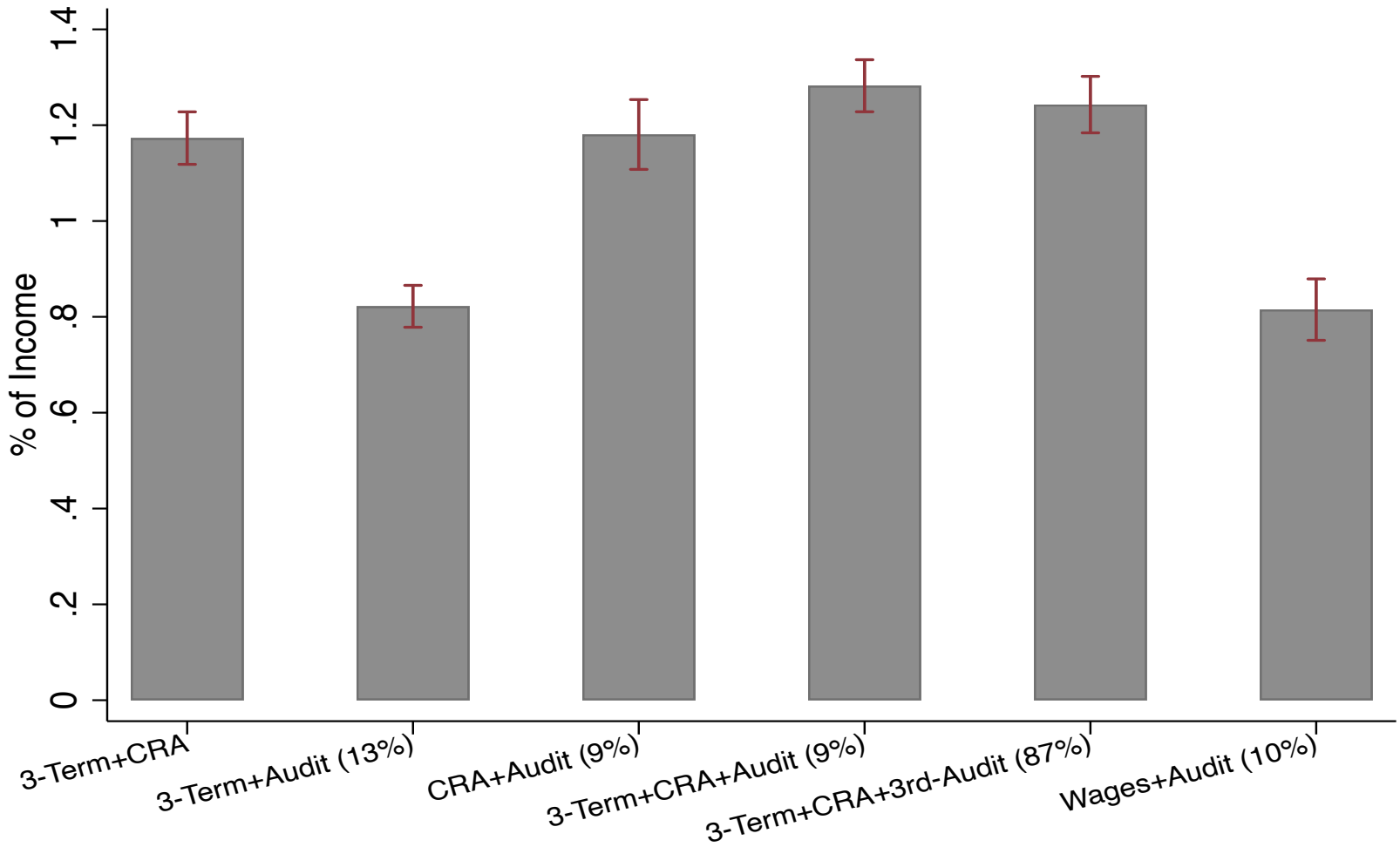
# Policy Results: Policy Bundles and Corruption



# Policy Results: Policy Bundles and Corruption by Term



# Policy Results: Policy Bundles and Willingness to Pay



# Conclusions

- We develop a dynamic model of decisions for local politicians who can engage in corruption.
- Using data from Brazil, including objective measures of local corruption, we estimate it to quantify the importance of the incentives and constraints politicians face
- The model offers important insights into what determines corruption and how we can design policy to combat it

# Conclusions

- We find that the most effective individual intervention in terms of willingness to pay is the no-run policy

- Combining the policies that enhance re-election incentives (i.e. the 3-term and the Clean Record Act) together with the audit policy achieves a greater reduction in corruption at lower cost and higher willingness to pay

**THE END**

**THANK YOU**

# Description of the Model: Value Function of Past Mayor

- The value function of a past mayor has a standard form:

$$V_{PM}^{i}\left(S_{t}^{PM},t\right)=\max_{c_{t}^{i},b_{t}^{i}}\ u^{i}\left(c_{t}^{i},\bar{Q}_{t}\right)+\beta E\left[V_{PM}^{i}\left(S_{t+1}^{PM},t+1\right)\right]$$

subject to:

$$c_{t}^{i}+b_{t}^{i}=w_{t}^{i}\bar{h}+R_{t}b_{t-1}^{i}-1_{\{\delta_{el,t-1}^{i}=1,\delta_{au,t-1}^{i}=1\}}g\left(s_{t-1}^{i}\right),$$

# Description of the Model: Value Function of a Mayor

- For a current mayor, we have to consider two cases:
  - The mayor decides to run for re-election
  - The mayor decides not to run for re-election

# Description of the Model: Value Function of a Mayor

- If the mayor decides to run, he wins with probability $p\left(S_t^M\right)$ and the value function is:

$$V_{WM}^i\left(S_t^M, t\right) = \max_{c_t^i, b_t^i, s_t^i} u^i\left(c_t^i, Q_t\right) + \rho - \kappa + \beta E\left[V_M^i\left(S_{t+1}^M, t+1\right)\right]$$

$$c_t^i + b_t^i = w_t^i \bar{h} + 1_{\{\delta_{el,t}^i = 1\}} s_t^i + R_t b_{t-1}^i - 1_{\{\delta_{el,t-1}^i = 1, \delta_{au,t-1}^i = 1, \delta_{c,t-1}^i = 1\}} g\left(s_{t-1}^i\right)$$

$$z_t^{pu} + s_t^i = f_t^{pu}$$

$$\frac{Q_t}{d_t} = \left(\frac{z_t^{pu}}{d_t}\right)^{\alpha_1} \left(z_t^{pr}\right)^{\alpha_2} a_i,$$

# Description of the Model: Value Function of a Mayor

- If he decides to run, the election is won by the challenger with probability $1 - p\left(S_{i,t}^{M}\right)$
- In this case, the incumbent's value function corresponds to the value function of a past mayor

# Description of the Model: Value Function of a Mayor

- If he decides to run, the election is won by the challenger with probability $1 - p\left(S_{i,t}^{M}\right)$
- In this case, the incumbent's value function corresponds to the value function of a past mayor
- Hence,

$$V_{RM}^{i}\left(S_{t}^{M}, t\right) = pV_{WM}^{i}\left(S_{t}^{M}, t\right) + (1-p)\, V_{PM}^{i}\left(S_{t}^{PM}, t\right)$$

# Description of the Model: Value Function of a Mayor

- If the mayor decides not to run, his value function corresponds to the value function of a past mayor

- Thus, a mayor chooses to run for releection if

$$V_{RM}^{i}\left(S_{t}^{M},t\right)\geq V_{PM}^{i}\left(S_{t}^{PM},t\right)$$

# Description of the Model: Value Function of a Mayor

- If the mayor decides not to run, his value function corresponds to the value function of a past mayor
- Thus, a mayor chooses to run for releection if

$$V_{RM}^{i}\left(S_{t}^{M},t\right)\geq V_{PM}^{i}\left(S_{t}^{PM},t\right)$$

- The value function of an individual that enters the period as the incumbent can therefore be computed as follows:

$$V_{M}^{i}\left(S_{t}^{M},t\right)=\max\left\{V_{RM}^{i}\left(S_{t}^{M},t\right),V_{PM}^{i}\left(S_{t}^{M},t\right)\right\}.$$

Back

# Brazil's Anti-Corruption Program

**Evidência:**

| | |
|---|---|
|  |  |
| 1- Detalhe das casas em construção. | 2- Detalhe das casas em construção. |

**Evidência:**

| | |
|---|---|
|  |  |
| 1- Passagem molhada em Jaburuna. | 2- Passagem molhada em Boi Morto. |

Back

**Evidência:**

Visita à Escola, entrevista à professora e fotografias anexas.

**Sala da Escola Joaquim Gomes Bezerra**

**Sala da Escola Joaquim Gomes Bezerra**

**Vista Frontal da Escola Joaquim G. Bezerra**