Measuring Productivity Dispersion:

Lessons From Counting One-Hundred Million Ballots

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November 2018

Motivation

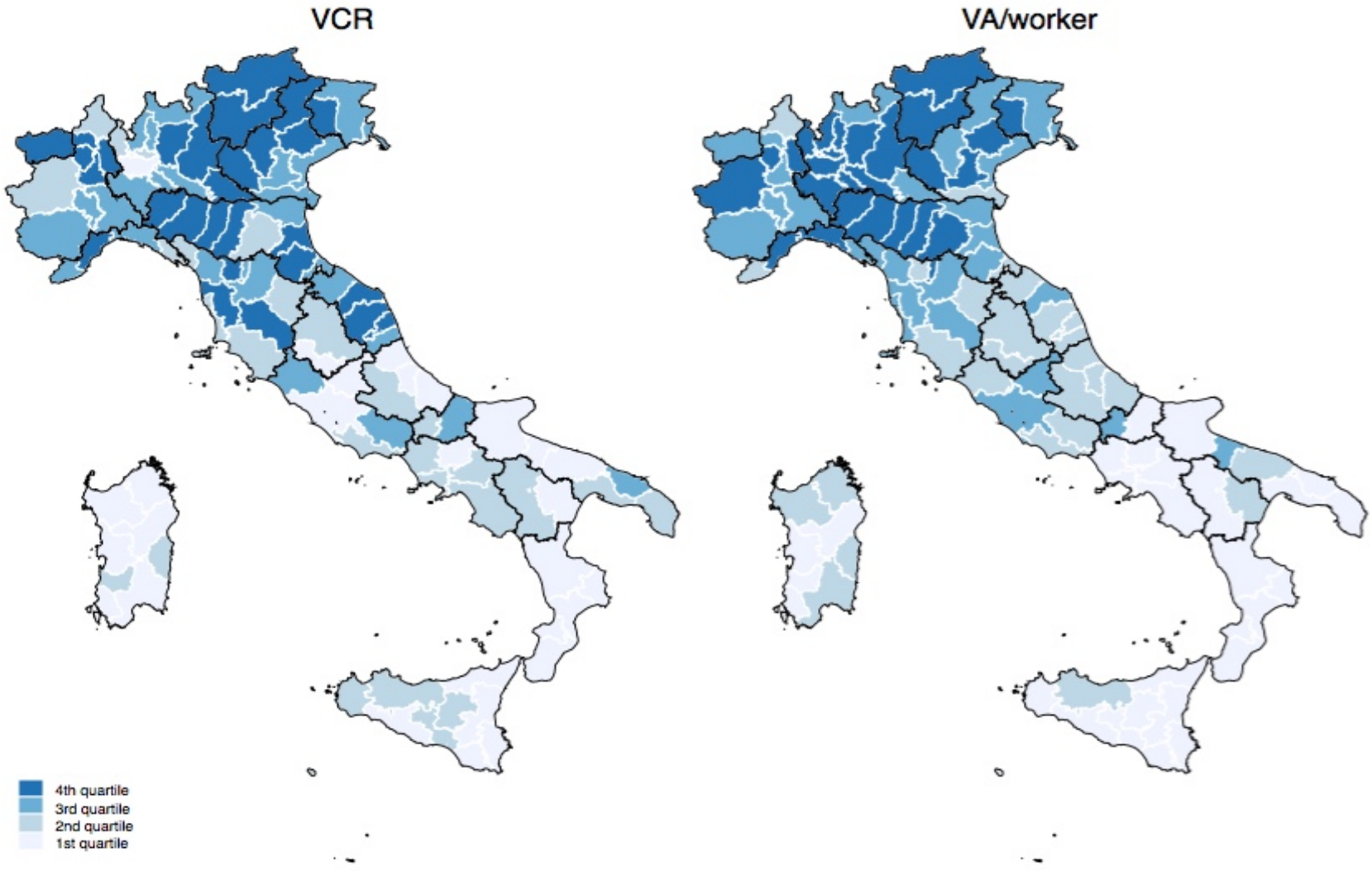
- Broad agreement that labor productivity the main long-run determinant of output per worker/capita + differences across regions.
- But measuring labor productivity is challenging
  - Output rarely observed directly
  - Revenue based measures confound market power
  - Multi-product firms
  - Inputs rarely observed directly
  - Difficult to separate role of particular factor of production
  - Workers' tasks differ greatly
- Micro measures of labor efficiency in uniform task are very localized

What We Do

Measure labor efficiency with data on vote-counting time in three Italian polls

- Output and input quantities observed directly
- Task is uniform across at a national scale
- Technology, capital, infrastructure inputs are minimal $\Rightarrow$ measure labor efficiency directly
- Incentives are uniform + no direct pecuniary incentives
- Institutionally managed at the national level

Vote Counting Efficiency and VA per Worker



Preview of Results

- Differences in measured TFP across Italian firms are largely embedded in labor itself
  - Not technology, capital investment, infrastructure, ect.
- Vote-counting efficiency
  - has a greater dispersion than firm productivity;
  - strongly correlated firm-level productivity,
  - with stronger correlation in labor-intensive industries;
  - accounts for >40% of firm-level productivity differences across provinces;
  - accounts for >40% of IQR firm-level productivity differences;
  - accounts for >50% of N-S productivity gap.
- Show that a culture of trust related to labor efficiency

Literature

- **Studying productivity dispersion** — Syverson 2011
  - Clark 2007, Chong et al 2014
- **Accounting for regional productivity differences** — Hall & Jones 1999; Caselli 2005; Hsieh & Klenow 2010
- **Labor efficiency in smaller controlled settings** — Bandiera, Barankay and Rasul 2011; Finan Olken and Pande 2015

Vote Counting in Italy

The 2013 General Elections in Italy

- General elections held 24 - 25 February 2013
- Determined 630 members of the Chamber of Deputies and the 315 elective members of the Senate.
- Over 40 parties participated: All viable ones in one of four alliances.
- Electoral system: proportional representation with majority bonus.
- Turnout: 35 million; 75%

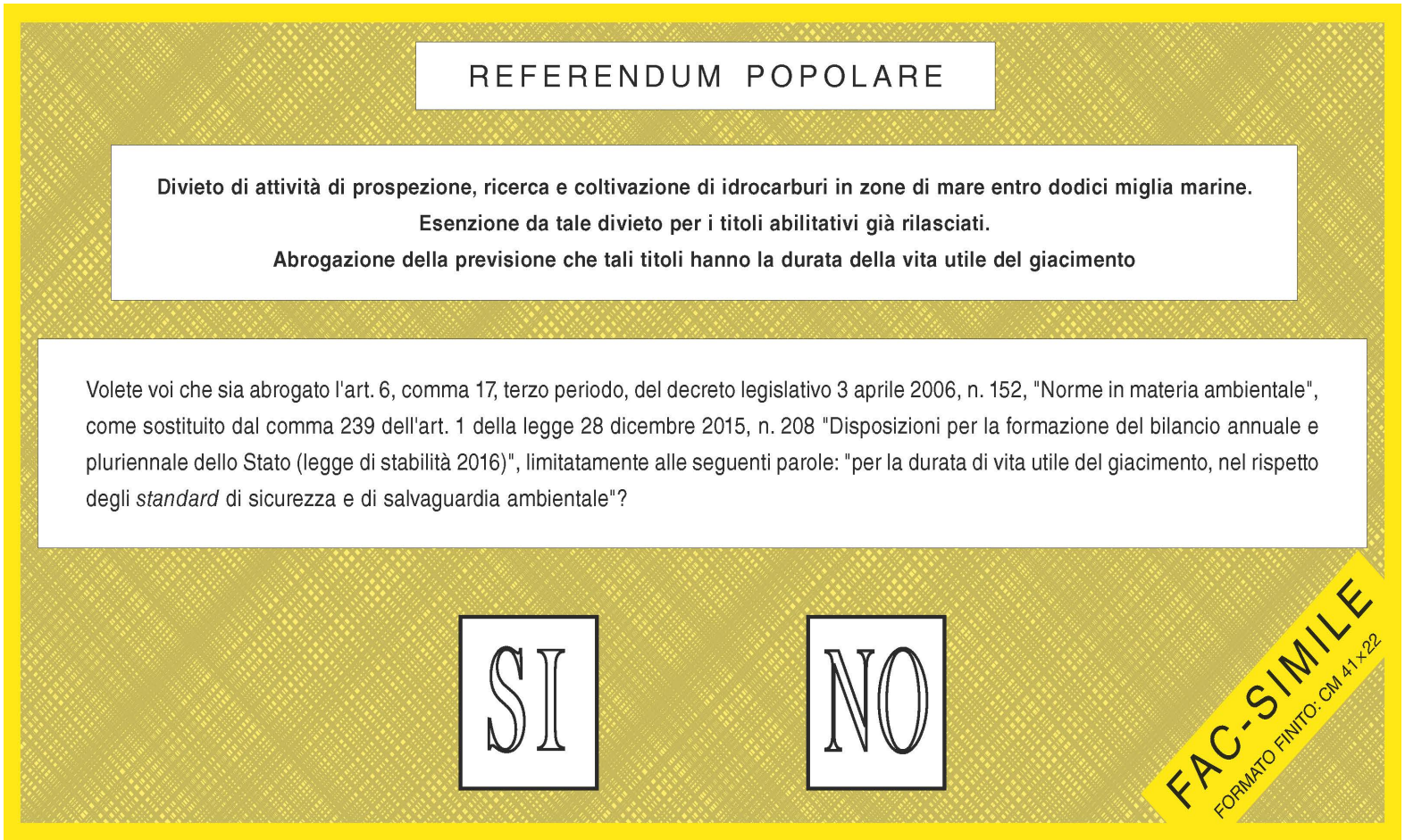
Sample Ballot (Senate, Piemonte)

Sample Ballot (Senate, Sicily)

The April 2016 Referendum

- Oil drilling referendum held 17 April 2016
- Referendum asked whether the government should stop renewing offshore drilling licenses
- The ballot contained two options: “Yes” and “No”
- A turnout of $\geq$ 50% required for referendum to alter existing laws
- Turnout: 16 million; 31%
- Rejected due to insufficient turnout

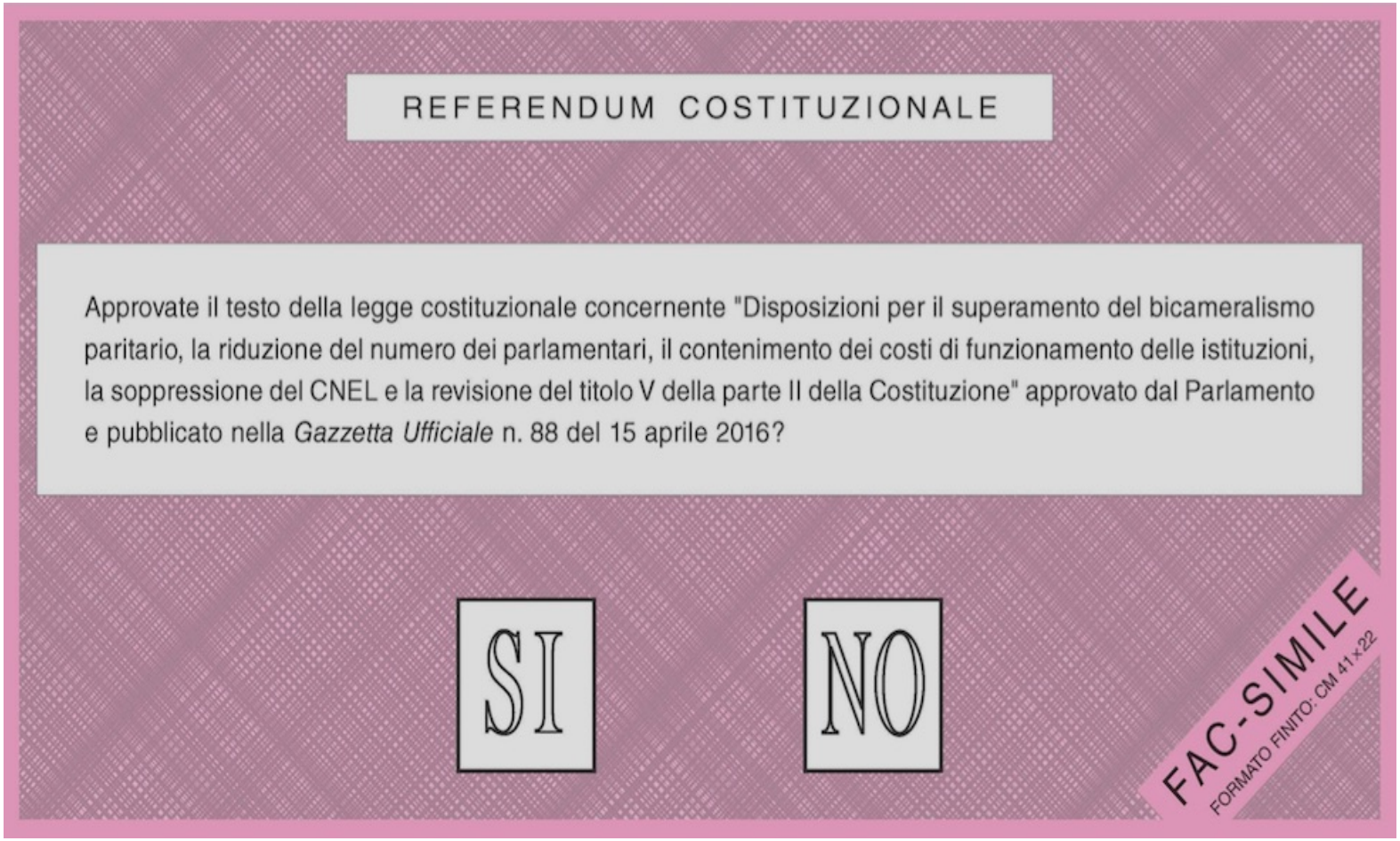
Sample Ballot



The December 2016 Referendum

- Constitutional Referendum held 4 December 2016
- Bundle of constitutional reforms re: size of parliament, separation of powers, other
- The ballot contained two options: “Yes” and “No”
- Turnout: 33 million; 65%
- Rejected because 59% voted “no”

Sample Ballot



Polling Stations I

- Italy is divided into 20 regions, 110 provinces, and around 8000 municipalities (*communes*)
- Each commune is divided into polling stations (*sezioni*)
- Clear rules regulate the number of registered voters per *sezione*
  - Between 750, 850 or 900 depending on municipality size
  - Very small municipalities may have 500 to 1200

Polling Stations II

- Each *sezione* has a committee of 6 (5) members for the election (referenda):

  1 president; 4 (3) scrutatori for the election (referenda); 1 secretary.

- In addition, political parties may appoint observers

- Several *sezioni* may be in a single location (e.g. school), headed by a *messo comunale*

Committee Member Appointment

- ***Scrutatori*** selected by the *commissione elettorale comunale* from a list of volunteers with $\geq$ 8 years of education
- **President** selected by the court of appeal from a list of volunteers with $\geq$ 12 years of education
- **Secretary** is selected by the president and must have completed $\geq$ 8 years of education
- **Financial compensation** is lump-sum of €145 (€104) for the *scrutatori* and the secretary and €187 (€130) for the president in the election (referenda)

The Vote Counting Process I

General election

- Polls closed 3pm on Mon February 25th in all *sezioni*
- Procedure
  1. Preliminaries: computing turn-out, sending list of voters
  2. Senate votes counted and reported to the commune
  3. Lower house votes counted and reported to the commune

Referendum

- Polls closed 11pm on Sun April 17th in all *sezioni*
- Polls closed 11pm on Sun December 4 in all *sezioni*
- Procedure
  1. Preliminaries: computing turn-out, sending list of voters
  2. Referendum votes counted and reported to the commune

The Vote Counting Process II

For each election

- Committee counts and records votes one at a time
- Contested votes are temporarily assigned and recorded
- *Messo communale* reports **unofficial** results to *commune* by phone, fax, or–in a small number of locations–PDA app.
- Commune communicates results to the Home Office
- Official results brought physically to *commune*

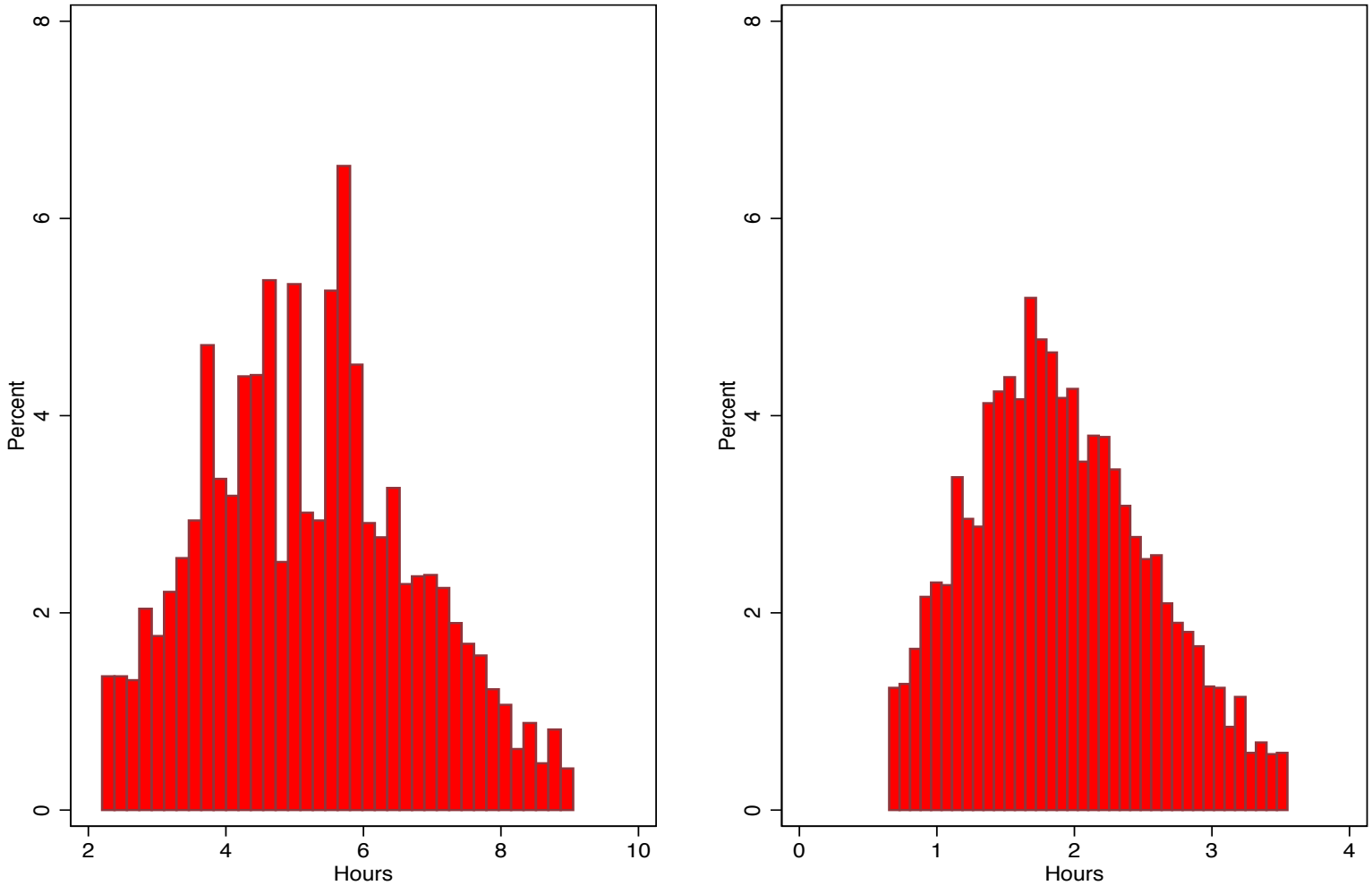
Data

Vote Counting Time

- Data at the **municipality** level
- We observe time when the **unofficial** results of the **last** polling station in a municipality is registered with the home office
- **Senate time** = Senate registration time minus 3pm
- **Total time** = Lower House registration time minus 3pm
- **Referendum time** = Referendum registration time minus 11pm

Vote Counting Times

Election 2013, Total Time (Left) & December Referendum (Right)



Vote Counter Characteristics

- We conducted a survey of all Italian municipalities to obtain characteristics of vote counters in 2013 election.
- Response rate was high at 19% of municipalities, covering 22% of all polling stations.

Sample is Representative

		Surveyed Municipalities				All Municipalities			
		Mean	SD	Min	Max	Mean	SD	Min	Max
North West	VCR	218.5	68.5	61.5	396.6	202.0	68.3	60.3	397.5
	# Pol. Sta.	6.3	31.8	1	653	5.1	31.8	1	1248
North East	VCR	238.4	67.6	83.5	397.6	234.0	66.3	63.0	397.5
	# Pol. Sta.	7.2	15.9	1	187	8.5	23.7	1	445
Center	VCR	213.9	65.9	82.1	365.4	193.2	61.6	60.6	379.2
	# Pol. Sta.	8.6	14.8	1	103	12.4	90.0	1	2600
South and Islands	VCR	151.1	47.6	61.1	318.3	153.7	46.4	60.5	370.8
	# Pol. Sta.	5.8	8.5	1	71	8.9	28.7	1	886

- 1, 452 (19%) municipalities sent at least some data, for a total of 12, 966 (22%) polling stations

Vote Counter Characteristics

	Presidents	Secretaries	*Scrutatori*
Age	43.79	36.39	34.51
% Male	0.57	0.39	0.39
Years of education	14.54	13.34	11.90
% With experience	0.90		
% Not working	0.22	0.39	0.61
% Students	0.11	0.26	0.37
% Unemployed	0.03	0.05	0.09
% Working	0.78	0.61	0.39
% Dependent workers	0.60	0.50	0.34
% Self employed	0.18	0.11	0.05

Vote Counting Rates

Vote Counting Rate

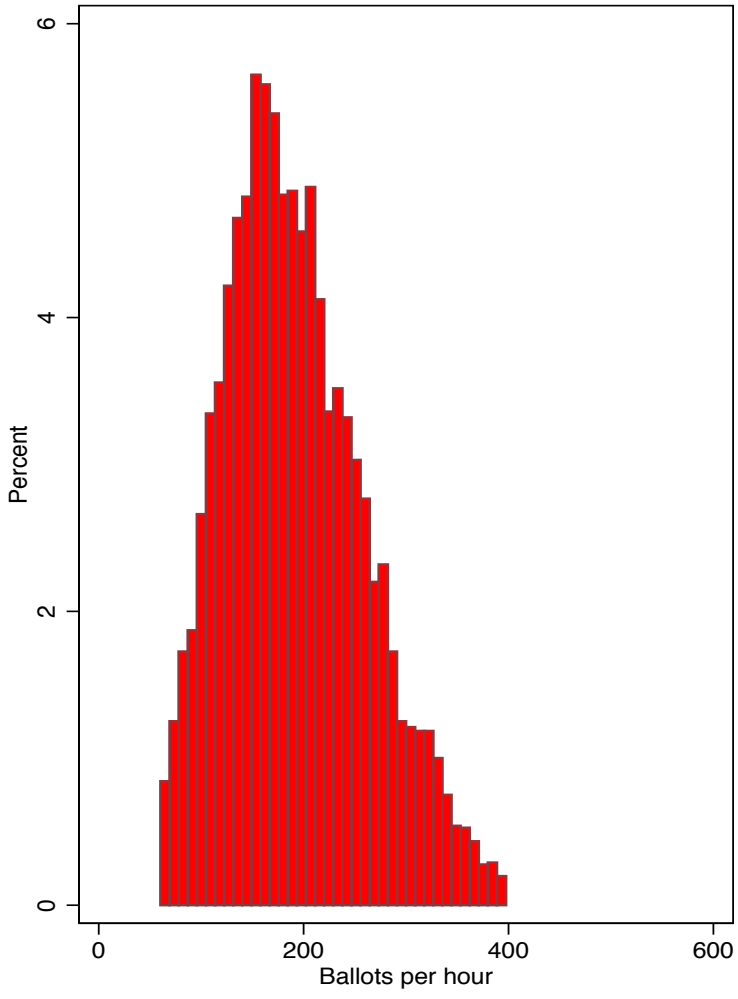
Vote Counting Rate (VCR): number of votes counted per hour

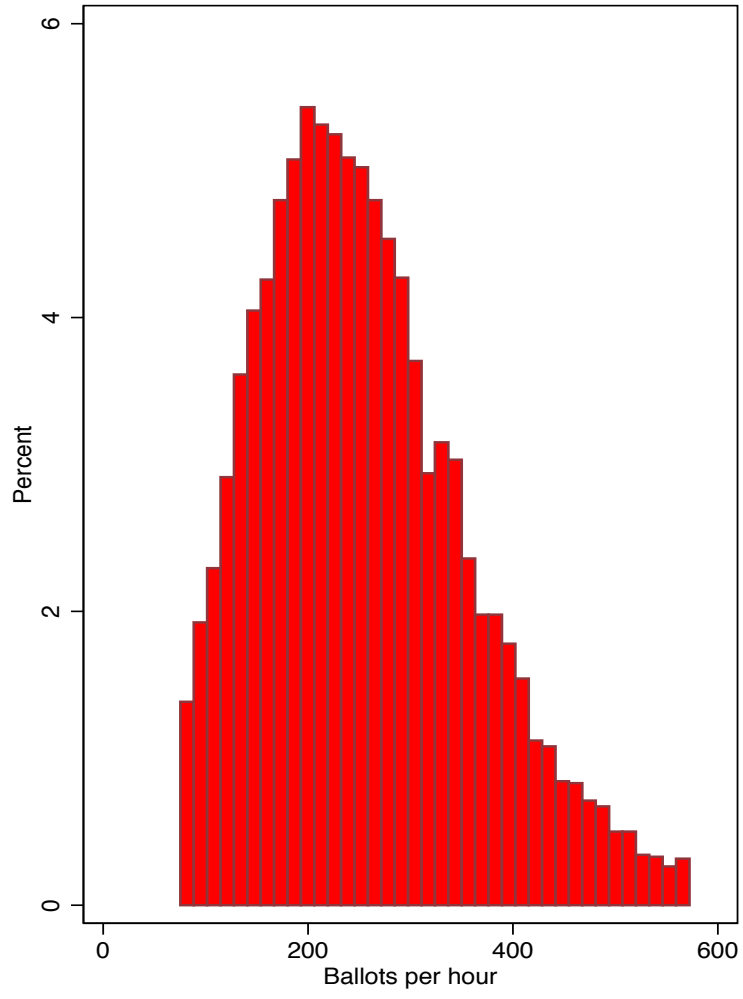
$$VCR_{m,s} \equiv \frac{\tau_{m,s} v_{m,s}}{\sigma_m h_{m,s}}$$

- $\tau_{m,s}$: municipal-level turnout
- $v_{m,s}$: number of registered voters in municipality m
- $h_{m,s}$: vote-counting time
- σ_m: number of polling stations in municipality m

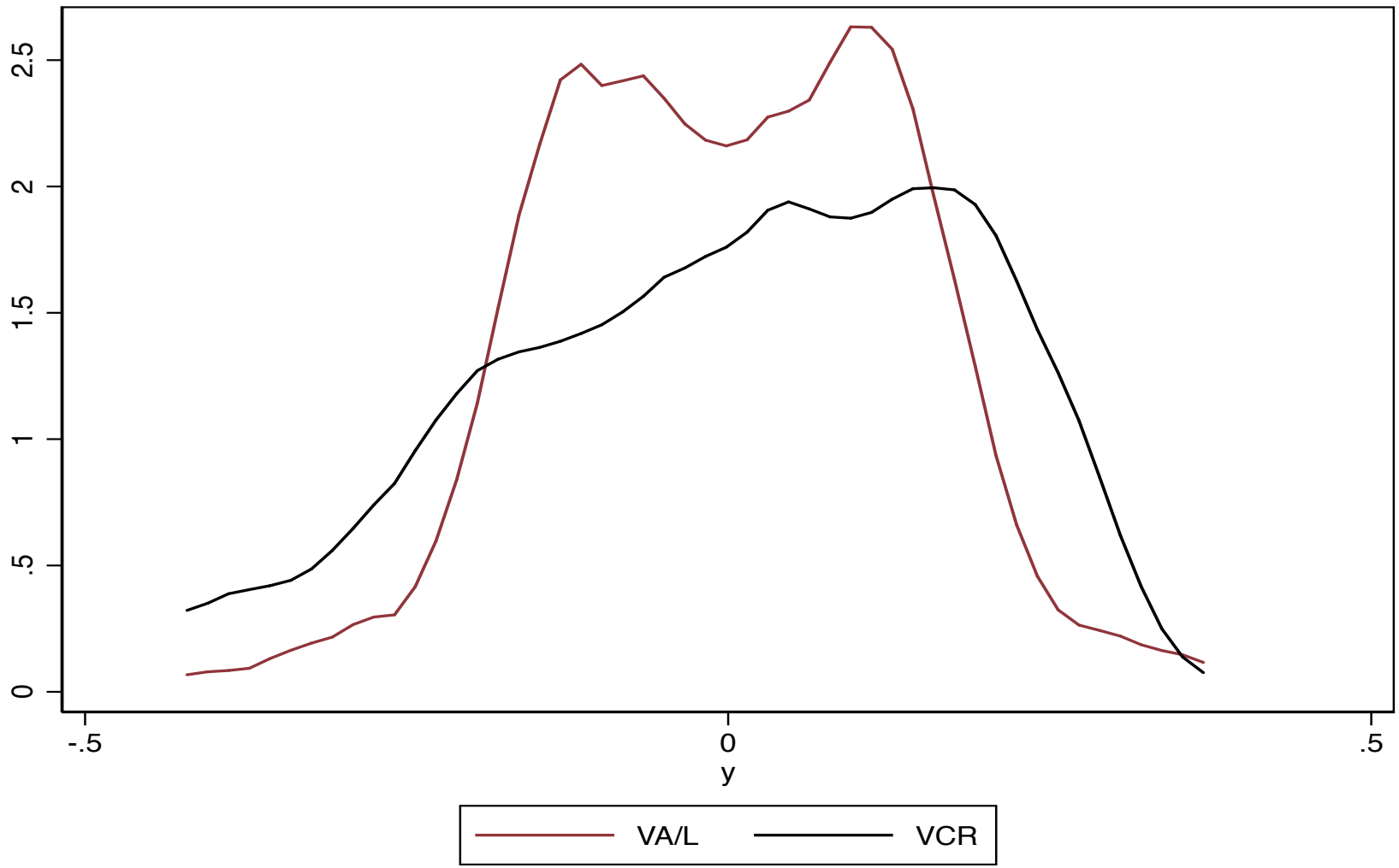
Vote Counting Rates

Election 2013, total time (lhs) & Referendum December 2016 (rhs)

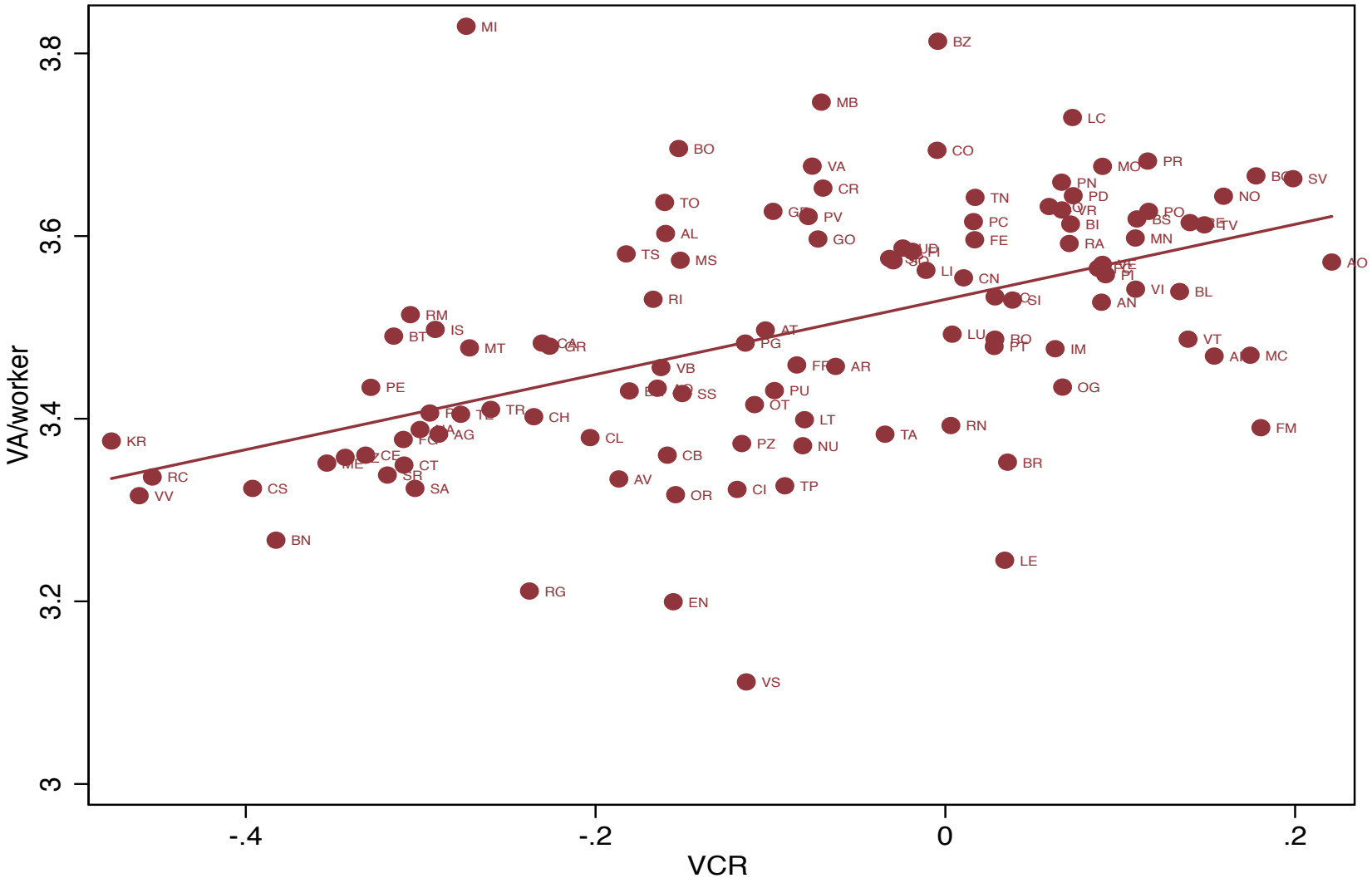




Dispersion of VCR and Value Added per Worker



Correlation Between VCR and Firm-Level Productivity



Firm Level Data

Labor Efficiency in Firms

Firm j in Province p and industry i, produces using the production technology:

$$Y_{ijp} = \left(e_p^K K_{ijp}\right)^{\alpha_i} \left(e_p^L L_{ijp}\right)^{1-\alpha_i}$$

- L: workers; K: capital
- α_i: capital intensity of industry i

VCR as Labor Efficiency

Vote counting extreme example of labor intensive “industry”.
Assuming $\alpha = 0$:

$$Y_{vp} = e_p^L L_{vp}$$

So VCR_p is a direct measure of labor efficiency e_p^L

Relevance of VCR as Labor Efficiency

We estimate the following regression

$$y_{ijp} = \delta_i + \delta_p + \beta_k \alpha_i k_{ijp} + \beta_h (1 - \alpha_i) \gamma_i h_p + \beta_1 I(\alpha_i < \bar{\alpha}) \times VCR_p + \beta_2 I(\gamma_i > \bar{\gamma}) \times VCR_p + \varepsilon_{ijp}$$

- α_i: one minus the ratio of the total wages to value added in industry i in the US in 1996
- γ_i: ratio of nonproduction worker wages to total wages in industry i in the US in 1996
- h_p: years of schooling in Province p

Relevance of VCR as Labor Efficiency

	(1)	(2)	(3)
Capital Intensity$\times$Capital	0.16***	0.16***	0.16***
	(0.01)	(0.01)	(0.01)
Labor Intensity$\times$ Skill Intensity$\times$Schooling	0.53	0.80	0.56
	(1.21)	(1.23)	(1.20)
Labor Intensive Sector dummy$\times$ VCR (β_1)		0.09***	0.07**
		(0.03)	(0.03)
Skill Intensive Sector dummy $\times$ VCR (β_2)			-0.16**
			(0.07)
Adjusted R^2	0.23	0.23	0.23
Province FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Observations	62,411	62,411	62,411

Measurement Concerns

- Task differs across municipalities
- Selection bias: Vote counters differ across municipalities
- We observe last, not average, vote counting time
- VCR driven by the opportunity cost of time

Labor Efficiency and Measured TFP: Development Accounting

Production Technology

- Representative firm in province i operates with technology

$$Y_i = A_i (K_i)^{\alpha} \left(H_i \tilde{L}_i \right)^{1-\alpha}$$

- $\tilde{L}_i \equiv e_i L_i$: Efficiency units of labor
- Human capital: $H_i = e^{\frac{\phi}{1-\alpha} \chi_i}$
- χ_i : years of schooling (ISTAT)

Development Accounting

- We use VCR to measure labor efficiency e_i and see how far it goes to account for differences output per worker across provinces.
- Variance decomposition following Klenow and Rodriguez-Clare, 1997:

$$\text{Accounted Variation}\left(X_i\right) = \frac{cov\left(f\left(X_i\right), y_i\right)}{var(y_i)}$$

- Three values for the return to education, spanning the "reasonable" range.

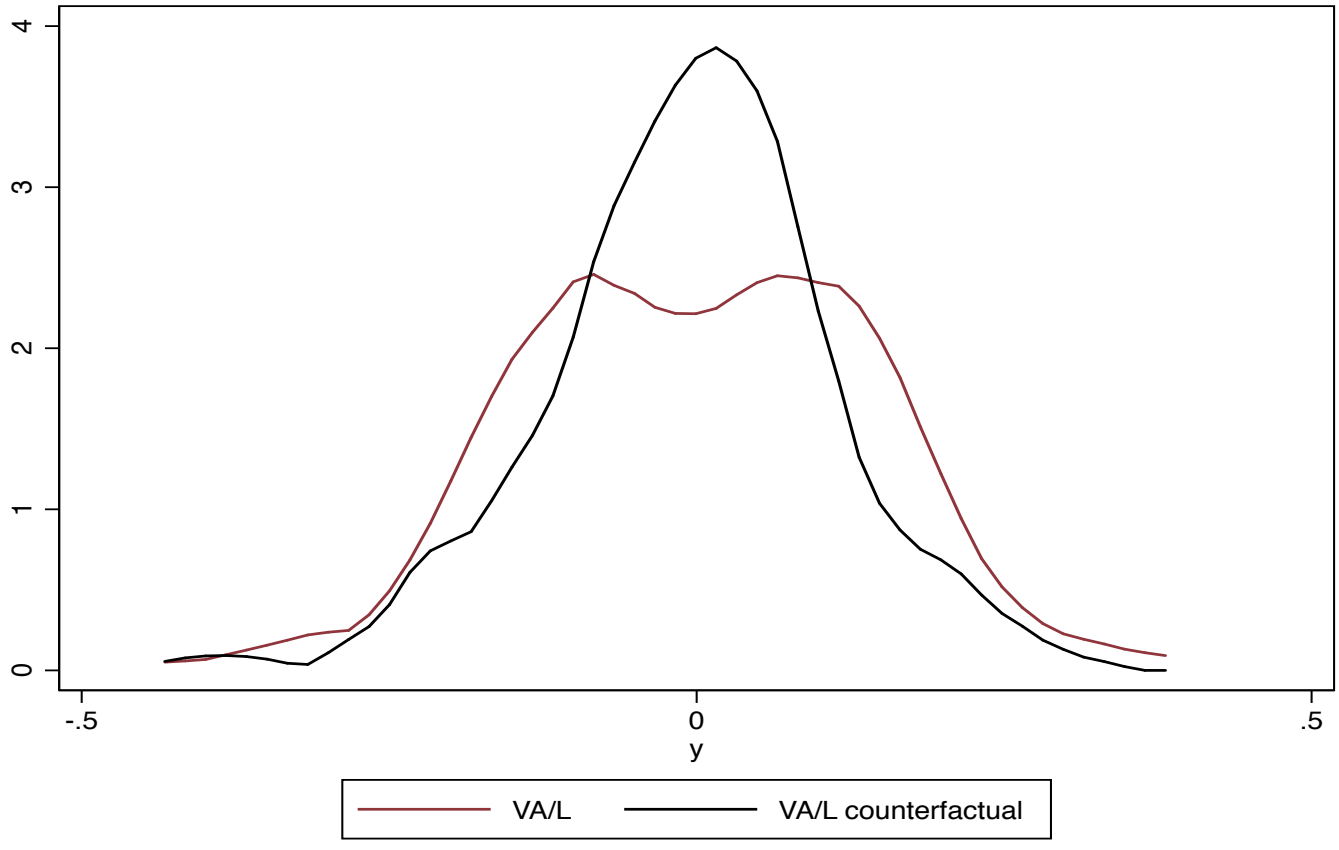
Variance Decomposition of Output per Worker

Labor efficiency accounts for close to 50% of Variance in Output per Worker

	k	H,k	H,k,e	A
Human Capital $\phi = 0.035$	0.21	0.25	0.72	0.28
Human Capital $\phi = 0.095$	0.21	0.31	0.78	0.22
Human Capital $\phi = 0.15$	0.21	0.37	0.83	0.17

Value Added per Worker and Value Added per Efficiency Unit

Labor efficiency accounts for bimodal productivity distribution and large part of disperssion



Counterfactual Exercises using VCR as Labor Efficiency

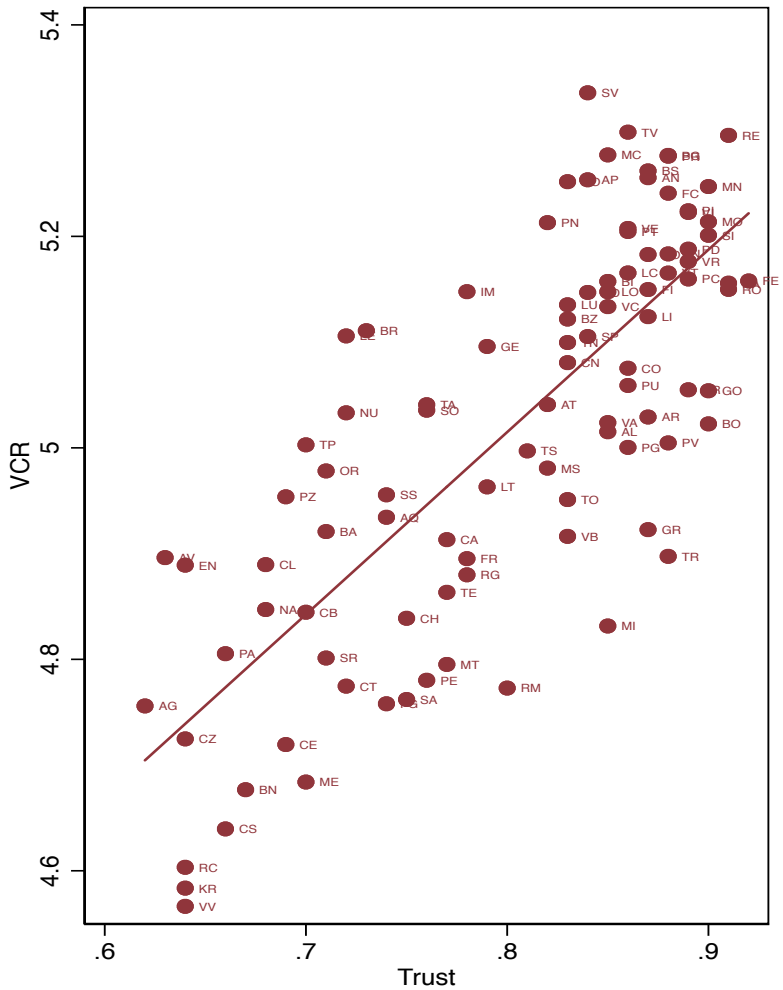
- The 75%-25% VA/L gap is 21% but only 12% for VA/eL
- Labor productivity gap between North and South Italy would declined from 20% to 7% if the South had Northern labor efficiency by our measure

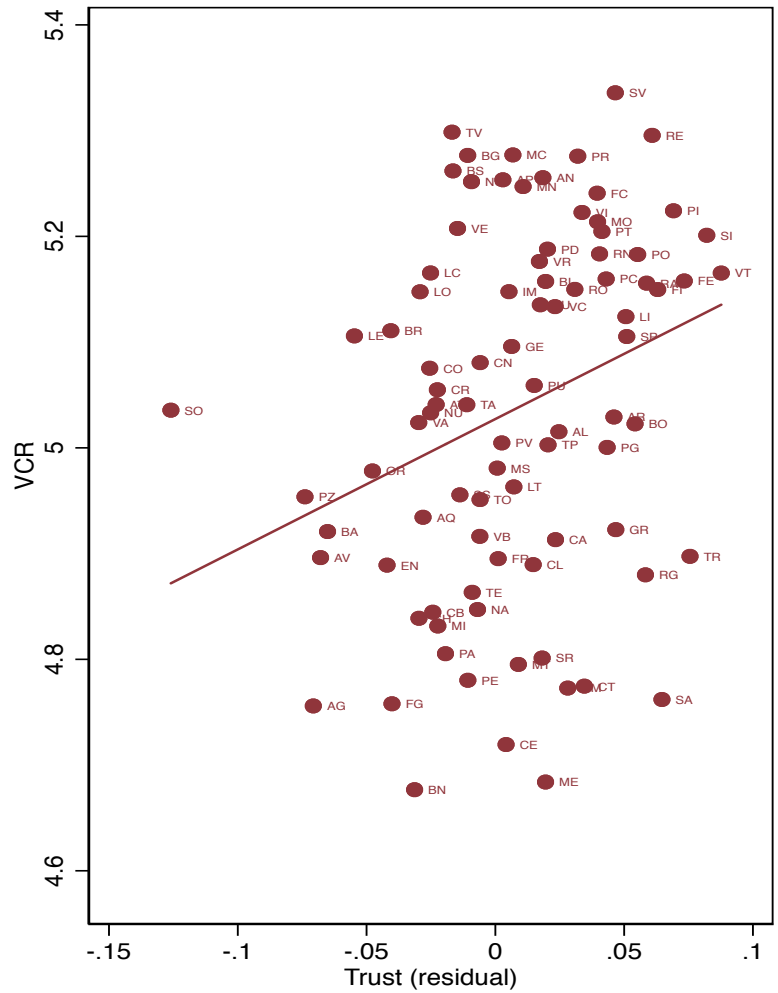
Robustness

	IQR (%)	North-South (%)	Dev. Accounting Resid. (%)
Value Added per Worker	0.21	0.20	0.69
Baseline	0.12	0.07	0.22
Election 2013	0.11	0.04	0.06
Referendum April	0.13	0.09	0.42
Referendum December	0.11	0.07	0.19
Controls for # Polling Stations	0.12	0.10	0.25
1-2 Polling stations	0.12	0.08	0.18
Adjusted VCR	0.13	0.08	0.26
Controlled VCR	0.14	0.08	0.40

Labor Efficiency and Trust in Conflictual Task

Labor Efficiency and Trust





Full Regression

The Role of Trust in a Contentious Task

	(1)	(2)	(3)
South-Center × Challenged	-24.05***	-23.39***	
	(7.43)	(7.33)	
North × Challenged	0.59	1.11	
	(3.20)	(2.84)	
South-Center × Blank		-4.96***	-4.21***
		(0.85)	(0.96)
North × Blank		-7.86***	-7.64***
		(0.76)	(0.93)
South-Center × Invalid		-6.09***	-4.96***
		(0.82)	(0.89)
North × Invalid		-6.47***	-5.57***
		(0.74)	(0.73)
Trust			1.50***
			(0.21)
Challenged			-125.56***
			(42.83)
Challenged × Trust			143.10***
			(51.99)
North	0.20***	0.21***	0.05
	(0.04)	(0.04)	(0.04)
Adjusted R^2	0.29	0.34	0.37
Province	110	110	99
Observations	22763	22763	21445

Conclusions

- Measure vote counting productivity in Italy 2013, 2016
- Shows greater dispersion than, and high correlation with, firm productivity at province level
- Higher correlation with productivity in labor-intensive industries, suggesting a measure of labor efficiency
- Efficiency gap in this simple labor task large enough to halve N-S productivity differences.
- Suggestive evidence: trust important in conflictual task

Labor Productivity

Orbis database: firm level balance sheet data

- 1.1 million firms (1/6 of firms)
- 11.8 milllion workers (>50% of private sector employment)
- Value added of €580 billion (40% of GDP)

VA/worker

- Employment-weighted average across firms in province *i* from 2004 - 2013
- Robustness 1: Corrected for industrial composition of province
- Robustness 2: Top 10%, 20%, 50% of firm distribution (by VA) curtailed.

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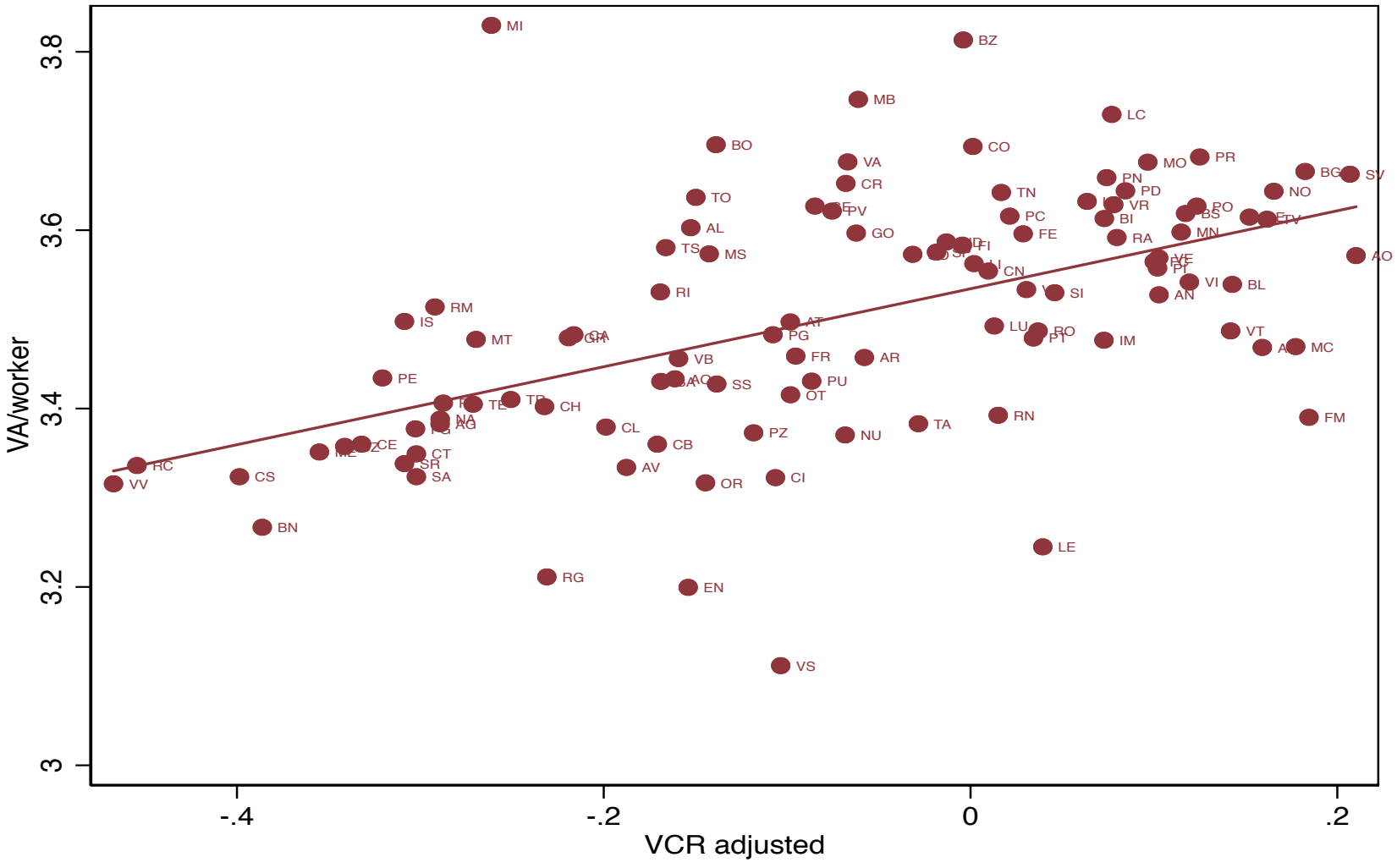
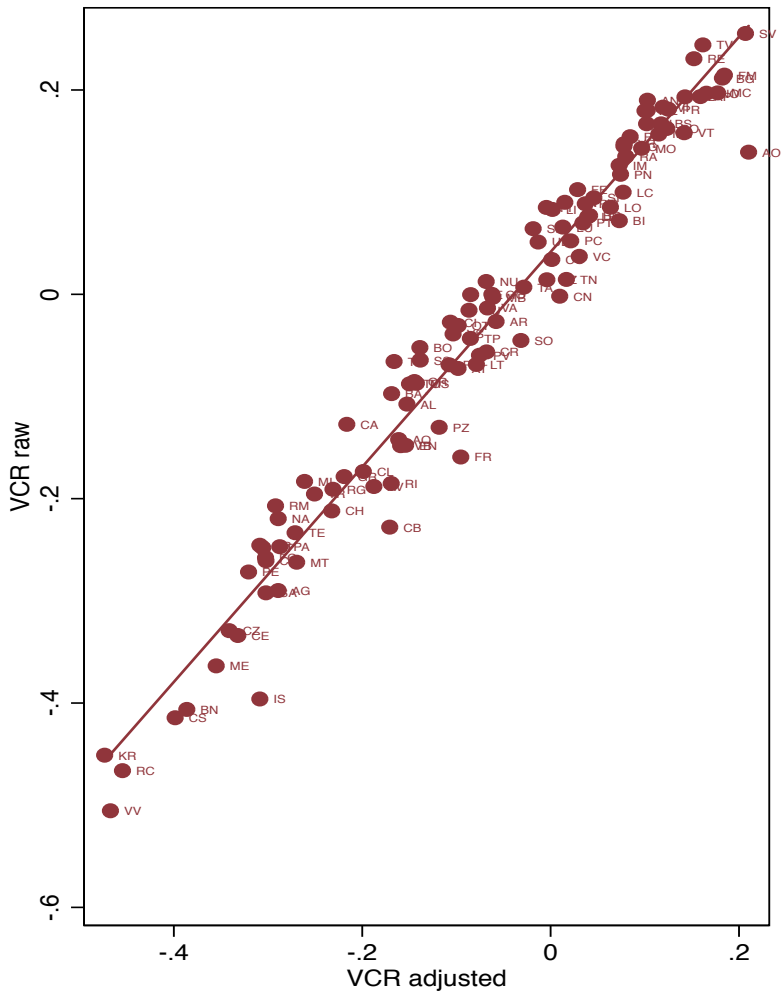
Adjusting for Task Complexity

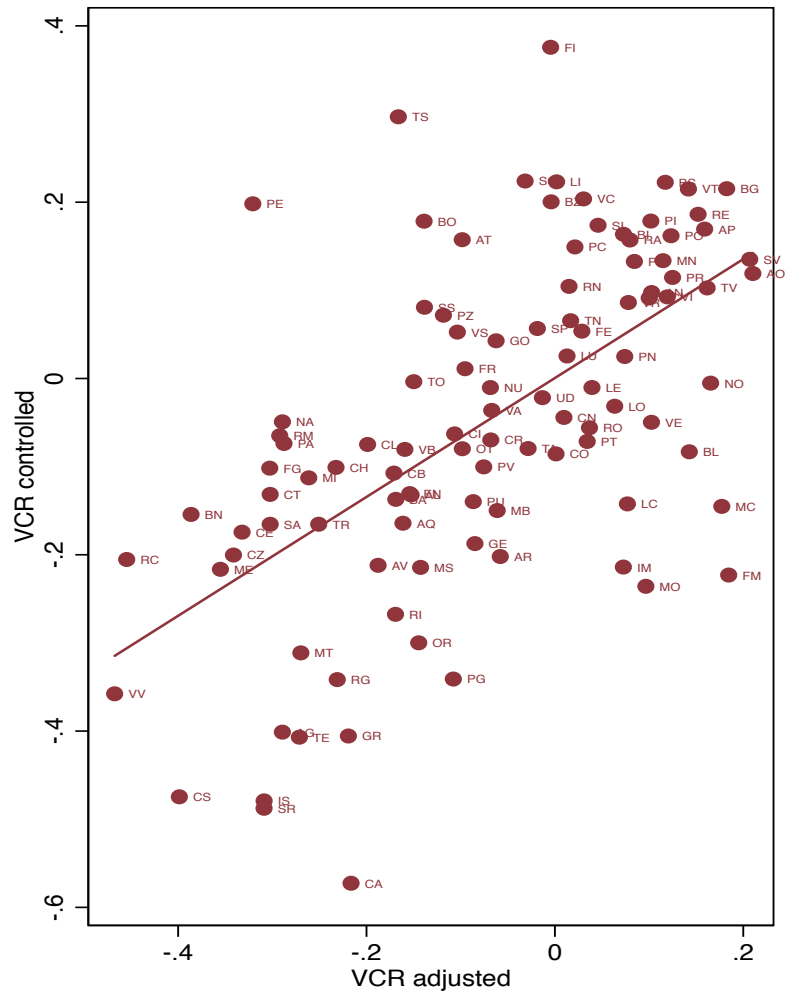
	Election 2013 - Total			Election 2013 - Senate		
	(1)	(2)	(3)	(4)	(5)	(6)
Challenged	-11.03	-10.45	-8.02	-18.35	-16.49	-29.59***
	(8.64)	(9.16)	(12.10)	(12.23)	(11.85)	(10.63)
Blank	-7.37***	-7.04***	-5.47***	-4.64***	-4.39***	-3.97***
	(1.16)	(1.10)	(0.94)	(1.03)	(0.81)	(0.79)
Invalid	-4.88***	-5.07***	-2.97***	-4.13***	-4.34***	-3.02***
	(0.83)	(0.72)	(0.51)	(0.83)	(0.68)	(0.64)
Close Chamber		-0.19	-0.30			
		(0.33)	(0.35)			
Close Senate		0.22*	0.12		0.19	-0.12
		(0.12)	(0.13)		(0.14)	(0.15)
HHI Chamber		-0.36	-0.28			
		(0.43)	(0.56)			
HHI Senate		0.06	0.29		-0.22	0.37
		(0.39)	(0.43)		(0.29)	(0.34)
# parties (Chamber)		0.01	0.03***			
		(0.00)	(0.01)			
# parties (Senate)		-0.01***	-0.01***		-0.01***	-0.00
		(0.00)	(0.00)		(0.00)	(0.00)
Adjusted R^2	0.13	0.15	0.13	0.06	0.08	0.05
Province	110	110	102	110	110	103
Observations	7589	7589	3318	7589	7589	3332

Adjusting VCR for Task Complexity



VCR, Adjusted, and Controlled





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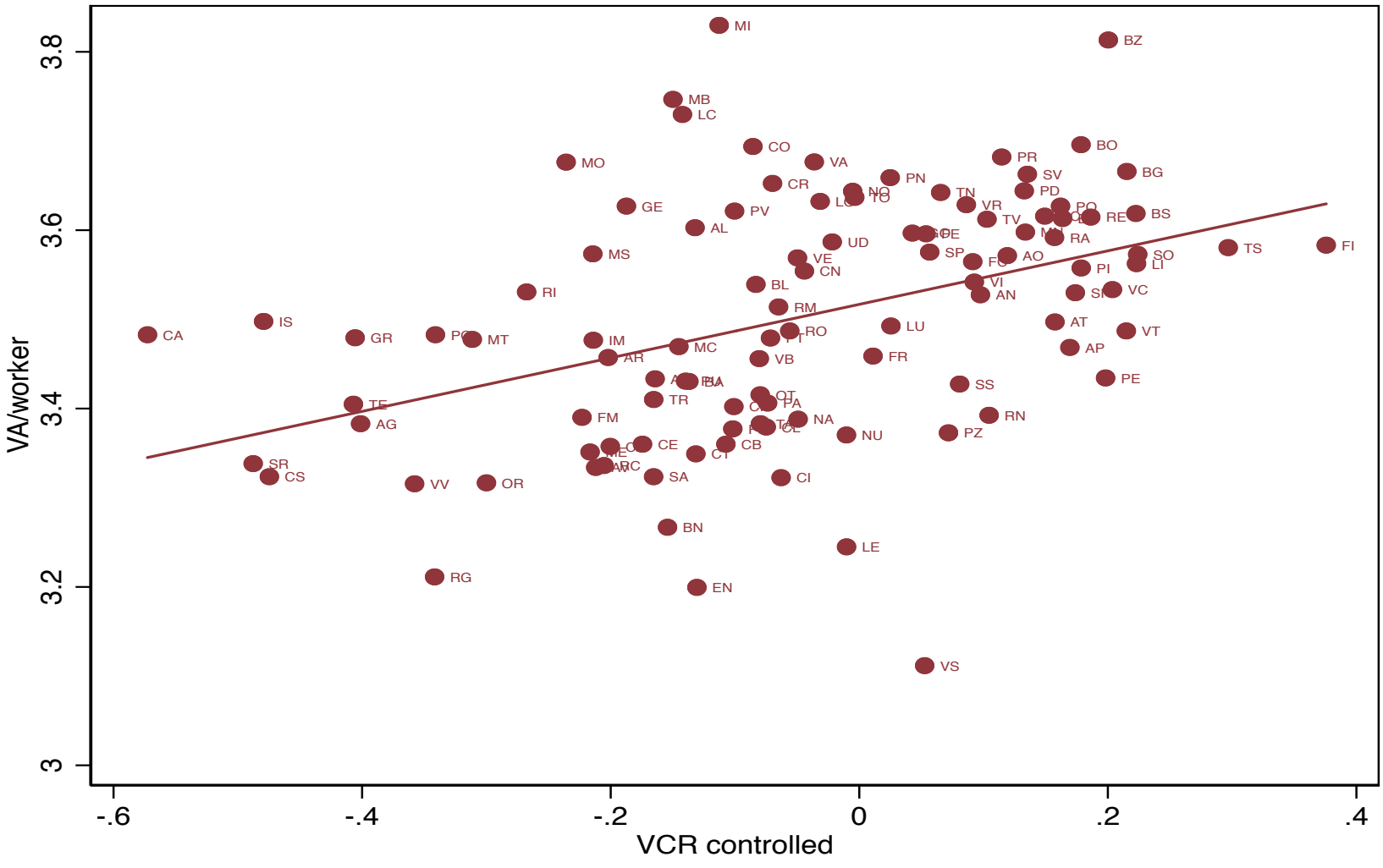
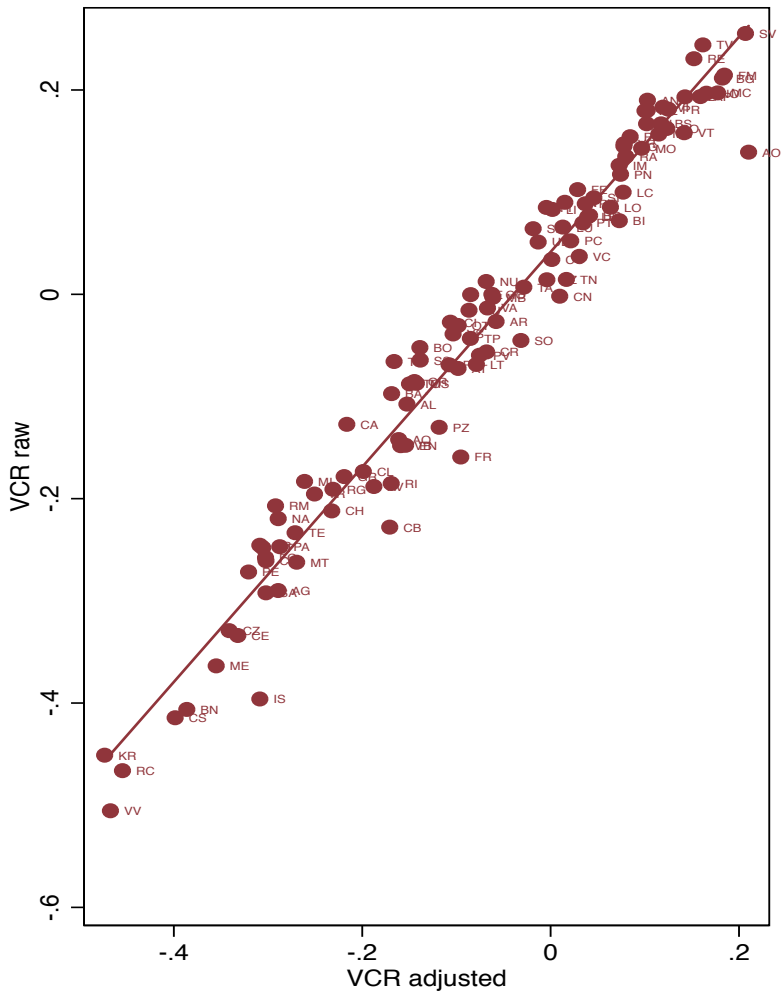
Controlling for Vote Counter Characteristics

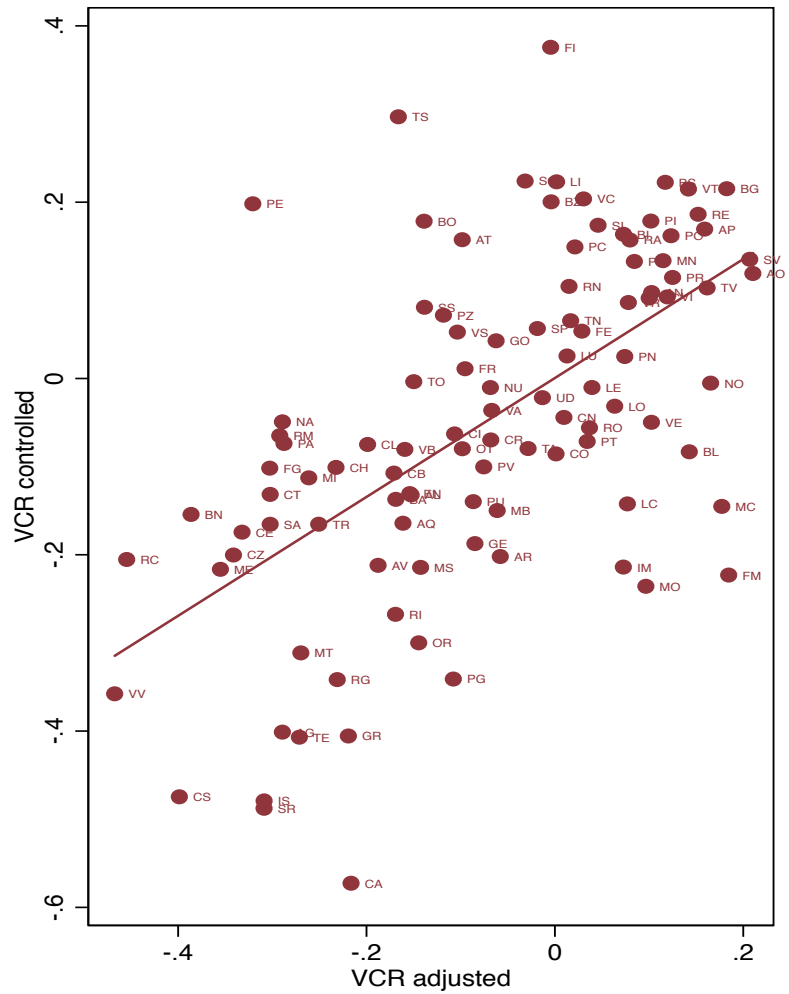
	Election 2013 - Total			Election 2013 - Senate		
	(1)	(2)	(3)	(4)	(5)	(6)
% male	-0.05	-0.04	-0.02	-0.18*	-0.17*	-0.12
	(0.09)	(0.09)	(0.09)	(0.10)	(0.09)	(0.09)
Age	0.00	0.00	0.00	0.01	0.01	0.01*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Education (years)	0.07***	0.07***	0.07***	0.09***	0.09***	0.09***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
% students	0.48***	0.44***	0.45***	0.41***	0.37***	0.41***
	(0.08)	(0.07)	(0.08)	(0.11)	(0.11)	(0.11)
% employed	0.27***	0.25***	0.25***	0.13	0.08	0.09
	(0.07)	(0.08)	(0.08)	(0.10)	(0.10)	(0.10)
% previous experience	0.09**	0.08*	0.08	0.18***	0.16***	0.15**
	(0.04)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)
Other controls	No	Yes	Yes	No	Yes	Yes
Adjusted R^2	0.23	0.24	0.24	0.13	0.14	0.16
Province	104	104	104	104	104	104
Observations	920	920	920	917	917	917

Controlling for Vote Counter Characteristics



VCR, Adjusted, and Controlled





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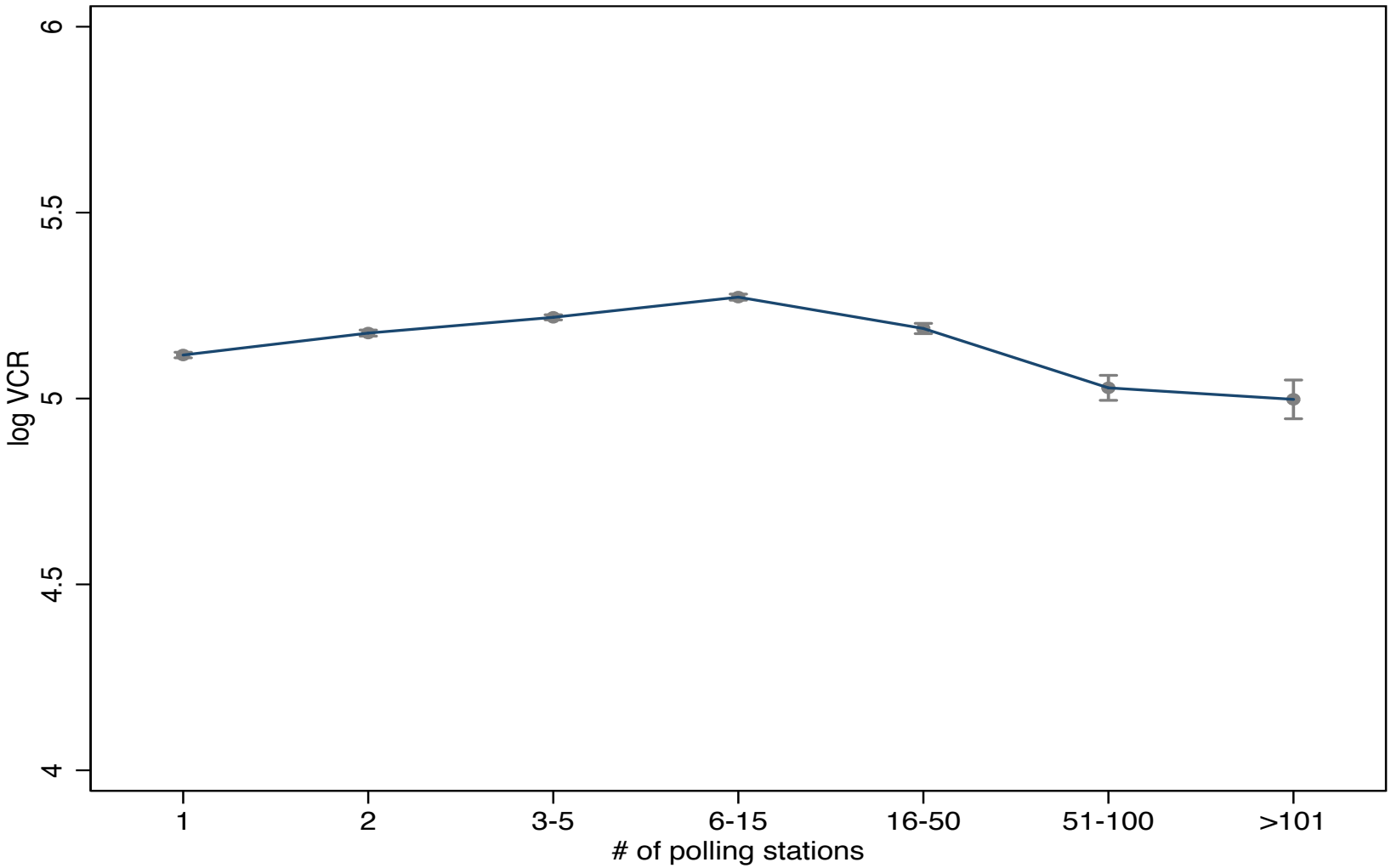
Last Polling Station Time

- We observe last, not average, polling station time
- Potential bias: larger municipalities more likely to draw extreme values from VCT distribution.
- Two ways to control

1. Exclude municipalities with >2 polling stations
2. Control non-parameterically for number of polling stations.

Number of Polling Stations



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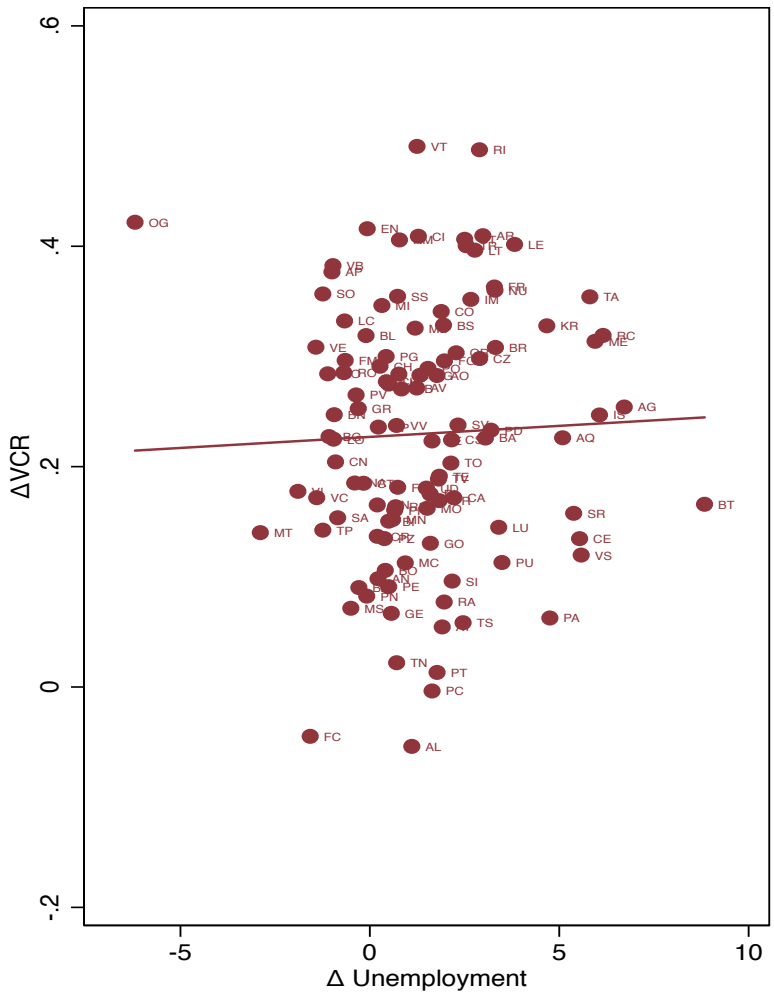
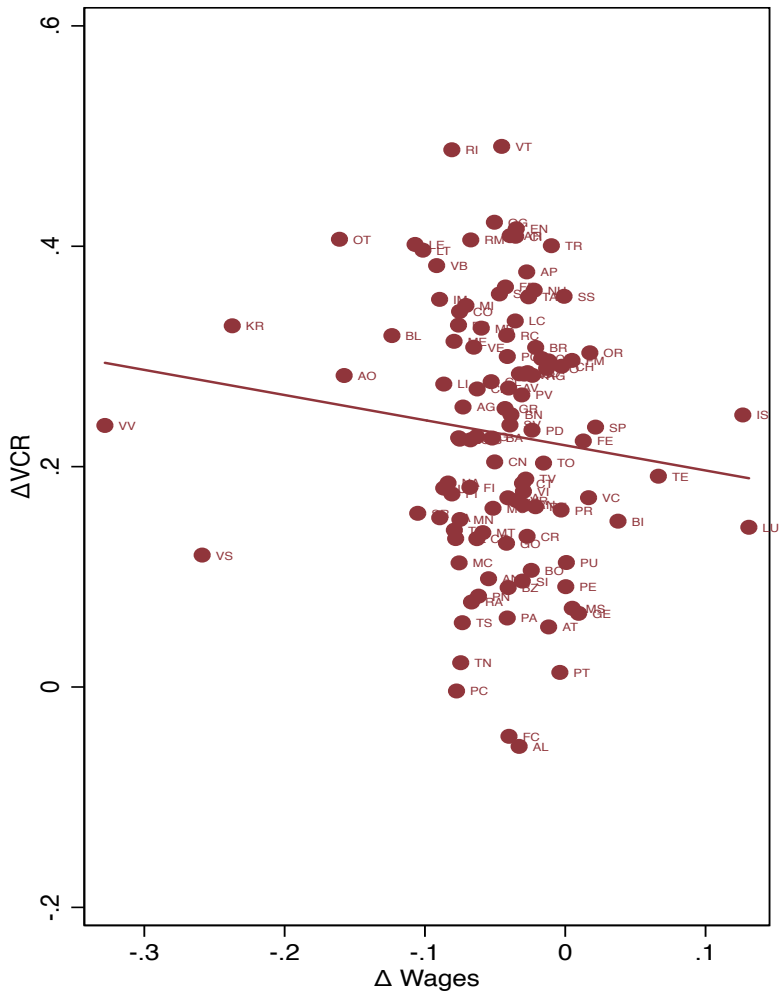
Opportunity Cost of Time Uncorrelated with VCR





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Correlates with VCR

	(1)	(2)	(3)	(4)	(5)	(6)
Absenteeism	-0.02***	-0.02***	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Blood Donations		2.24	-0.41	-0.66	-0.28	-0.45
		(1.57)	(1.26)	(1.23)	(1.29)	(1.27)
Trust			1.64***	1.01***	1.06***	1.00***
			(0.25)	(0.36)	(0.35)	(0.35)
PISA test score				1.57**	0.86	0.62
				(0.69)	(0.72)	(0.66)
Management Quality					-0.05	-0.05
					(0.05)	(0.05)
Mafia						-0.03
						(0.04)
Corruption						-0.01
						(0.01)
Referendum Apr16	-0.30***	-0.31***	-0.31***	-0.31***	-0.31***	-0.31***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Referendum Dec16	0.27***	0.26***	0.26***	0.26***	0.26***	0.26***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Area FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.34	0.35	0.39	0.39	0.37	0.37
Province	103	93	93	93	88	88
Observations	17758	16721	16721	16721	15717	15717

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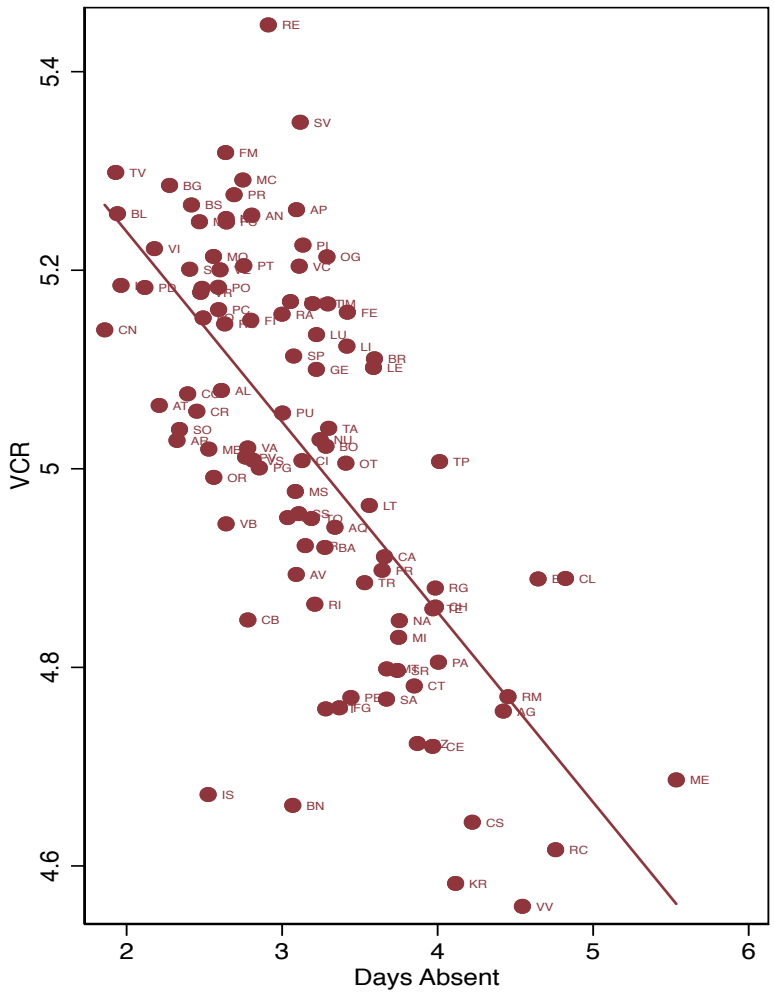
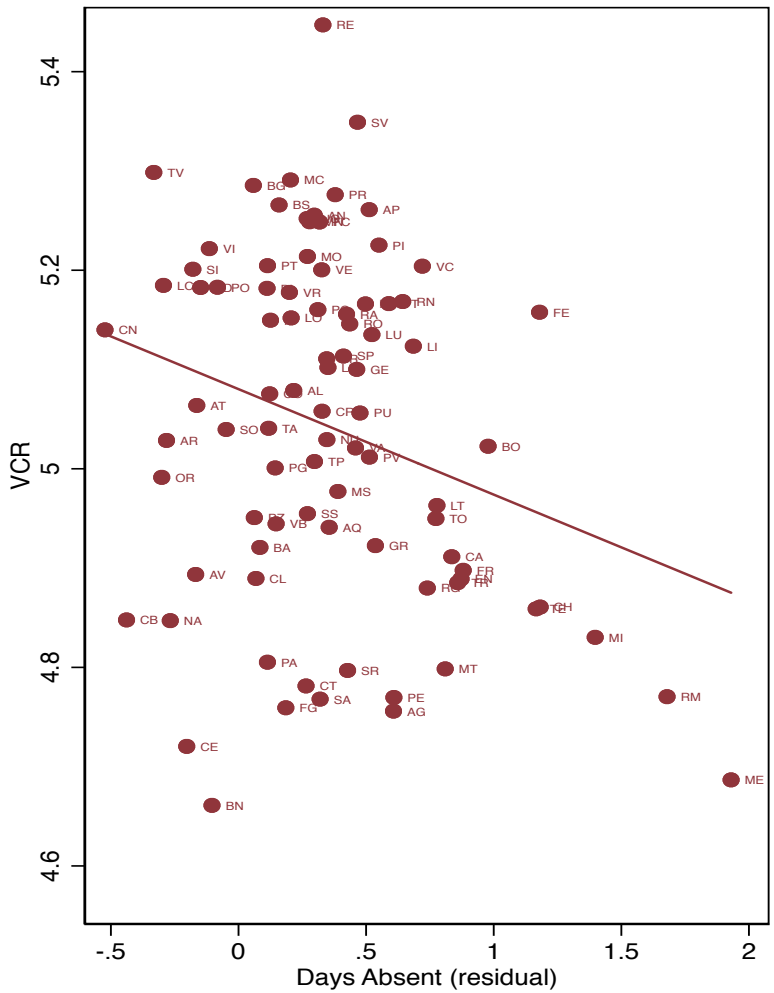
Labor Efficiency and Absenteeism





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