

# Interpreting Results

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# Main Components of a Regression Table

Regression with interaction terms

Cluster Randomization

# Key points for this lecture

- ▶ Look for:
  - ▶ Estimand (what we want to know)
  - ▶ Estimator (procedure applied to data)
  - ▶ Estimate (produced by that procedure)
  - ▶ Standard error and type
  - ▶  $p$ -value
  - ▶ Sample size
  - ▶ Clusters
  - ▶ Blocks
  - ▶ Control group mean
- ▶ Interpret:
  - ▶ Coefficient on treatments
  - ▶ Coefficient on interaction terms

# Regression

$$Y_i = \alpha_0 + \alpha_1 T_i + \epsilon_i$$

- ▶ A technique to estimate the relationship between an outcome variable and predictor variables.
- ▶ Often we propose and estimate a linear relationship because regression without covariates is closely related to the difference-in-means.

# Some Regression Equations

$$Y_i = \alpha_0 + \alpha_1 T_i + \epsilon_i$$

$$Y_i = \gamma_0 + \gamma_1 T_i + \gamma_2 X_i + v_i$$

$$Y_i = \delta_0 + \delta_1 T_i + \delta_2 X_i + \delta_3 T_i X_i + \zeta_i$$

- ▶ Outcome:  $Y_i$
- ▶ Treatment:  $T_i$
- ▶ Covariate/:  $X_i$

## Main Components of a Regression Table

## Overcoming the Political Exclusion of Migrants: Theory and Experimental Evidence from India

NIKHAR GAIKWAD *Columbia University*

GARETH NELLIS *University of California, San Diego*

*M*igrants are politically marginalized in cities of the developing world, participating in destination-area elections less than do local-born residents. We theorize three reasons for this shortfall: migrants' socioeconomic links to origin regions, bureaucratic obstacles to enrollment that disproportionately burden newcomers, and ostracism by antimigrant politicians. We randomized a door-to-door drive to facilitate voter registration among internal migrants to two Indian cities. Ties to origin regions do not predict willingness to become registered locally. Meanwhile, assistance in navigating the electoral bureaucracy increased migrant registration rates by 24 percentage points and substantially boosted next-election turnout. An additional treatment arm informed politicians about the drive in a subset of localities; rather than ignoring new migrant voters, elites amplified campaign efforts in response. We conclude that onerous registration requirements impede the political incorporation, and thus the well-being, of migrant communities in fast-urbanizing settings. The findings also matter for assimilating naturalized yet politically excluded cross-border immigrants.

# The study

- ▶ Rural-to-urban migration in India.
- ▶ Possible explanations for low political integration of internal migrants:
  - ▶ Strong ties to home region
  - ▶ Bureaucratic barriers
  - ▶ Exclusion by local-born residents and elites



# The study

- ▶ Treatment (binary): door-to-door campaign to facilitate voter registration of internal migrants.
- ▶ Three indicators of political integration.

# Table

Table SI16: [Exploratory] T1 experimental results for primary political outcomes. OLS estimates of intent to treat effects. Models do not include covariates. Robust standard errors in parentheses.

	Has City-Based Voter ID (1)	Voted in City in 2019 (2)	Likelihood of Voting in City in Future (3)
T1 treatment	0.243 (0.019)	0.208 (0.019)	0.033 (0.009)
p-value (upper)	0.000	0.000	0.000
Control mean	0.161	0.178	0.856
Observations	2,120	2,120	2,120
Adjusted $R^2$	0.073	0.053	0.007
DV values	{0, 1}	{0, 1}	{0, 0.33, 0.67, 1}

- Each column is a different regression and has a different outcome (indicator).

# The Table

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- For each column  $Y_i = \hat{\alpha}_0 + \hat{\alpha}_1 T_i$
- No covariates

# Outcome variable

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- DV (dependent variable) values = {0,1}

# The estimand

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- The estimand is the intent-to-treat effect (ITT, the effect of assignment to treatment = offer of aid in voter registration).

# The estimator

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- The estimator is OLS (ordinary least squares) regression.

# Intent-to-Treat Effect (ATE of the offer of help)

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- Estimate of the average treatment effect on whether a migrant has a city-based voter ID card: 0.243.

# Robust standard errors

Table SI16: [Exploratory] T1 experimental results for primary political outcomes. OLS estimates of intent to treat effects. Models do not include covariates. **Robust standard errors in parentheses.**

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- Standard error of this estimate : 0.019.



## Control group mean

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- % of migrants without treatment who have a city-based voter ID card: 0.161.

## Control group mean

Sometimes you will see

	Has City-based Voter ID
Treatment	0.243 (0.019)
Intercept	0.161 (s.e.)

- ▶ With one treatment group and one control group, without covariates: intercept = control group mean.

## $p$ -value

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- $p$ -value (upper bound):  $p < 0.001$

# Sample Size ( $n$ )

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► Observations ( $n$ ) = 2120

## Regression with covariates

**TABLE 2. [Pre-Registered] T1 Experimental Results For Primary Political Outcomes**

	Has city-based voter ID	Voted in city in 2019	Likelihood of voting in city in future
	(1)	(2)	(3)
T1 treatment	0.236 (0.019)	0.203 (0.019)	0.031 (0.009)
<i>p</i> -value (upper)	0.000	0.000	0.000
Control mean	0.161	0.178	0.856
Observations	2,120	2,120	2,120
Adjusted $R^2$	0.084	0.065	0.011
DV values	{0, 1}	{0, 1}	{0,0.33,0.67,1}

*Note:* Outcomes are whether respondent (1) currently has a voter ID card allowing them to vote in city elections, (2) voted in the city during the 2019 Lok Sabha elections, and (3) intends to vote in the next state elections held in the city. OLS estimates of intent to treat effects.

Models include covariates. Robust standard errors in parentheses.

- ▶ What is the estimate of the ATE on the first outcome?
- ▶ Is it different from the estimate of the ATE without covariates?

# Regression with covariates

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Models include covariates. Robust standard errors in parentheses.

- ▶  $Y_i = \gamma_0 + \gamma_1 T_i + \gamma_2 X_i + v_i$
- ▶ Estimate of the average treatment effect:  $\hat{\gamma}_1 = 0.236$

## Coefficients on the covariates

- ▶ You can generally ignore coefficients on the covariates. They are not even reported here.
- ▶ If they are reported, do not interpret them as the causal effect of the covariate.

## Regression with interaction terms



## Regression with interaction terms

$$Y_i = \hat{\delta}_0 + \hat{\delta}_1 T_i + \hat{\delta}_2 \text{PrimEduc}_i + \hat{\delta}_3 T_i \cdot \text{PrimEduc}_i$$

- ▶ We often use regressions with interaction terms when we want to estimate the ATE for different subsets of units (conditional average treatment effect, CATE).
- ▶ For example: The ATE for people who have completed primary education and the ATE for people who have not completed primary education.

## Regression with interaction terms

$$Y_i = \hat{\delta}_0 + \hat{\delta}_1 T_i + \hat{\delta}_2 \text{PrimEduc}_i + \hat{\delta}_3 T_i \cdot \text{PrimEduc}_i$$

- ▶ Average  $Y_i$  if  $T_i = 0$  and  $\text{PrimEduc}_i = 0$  :  $\hat{\delta}_0$
- ▶ Average  $Y_i$  if  $T_i = 1$  and  $\text{PrimEduc}_i = 0$  :  $\hat{\delta}_0 + \hat{\delta}_1$
- ▶ Average  $Y_i$  if  $T_i = 0$  and  $\text{PrimEduc}_i = 1$  :
- ▶ Average  $Y_i$  if  $T_i = 1$  and  $\text{PrimEduc}_i = 1$  :

# Regression with interaction terms

**TABLE 4. [Pre-registered] Estimates of Heterogeneous Effects of T1 Treatment**

	<i>Dependent variable:</i>	
	Has city-based voter ID	Voted in city in 2019
	(1)	(2)
T1 × Primary education	0.083** (0.041)	0.057 (0.042)
T1 × Muslim	-0.114** (0.048)	-0.018 (0.049)
T1 × SC/ST	-0.113*** (0.042)	0.081* (0.042)
T1 × High income	0.028 (0.038)	0.041 (0.038)
T1 × Long-term migrant	-0.019 (0.038)	-0.007 (0.038)
T1	0.248*** (0.049)	0.183*** (0.049)
Primary education	-0.058** (0.025)	-0.059** (0.026)
Muslim	0.001 (0.029)	0.004 (0.030)
SC/ST	-0.004 (0.025)	-0.008 (0.026)
High income	0.038* (0.022)	0.009 (0.023)
Long-term migrant	0.065*** (0.023)	0.052** (0.024)
Constant	0.149*** (0.028)	0.188*** (0.029)
Observations	2,120	2,120
Adjusted $R^2$	0.087	0.059

*Note:* Models do not include additional covariates. All independent variables are dichotomous and are described in the text. Robust standard errors in parentheses.\* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

# Regression with interaction terms

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T1	0.248*** (0.049)	0.183*** (0.049)
Primary education	-0.058** (0.025)	-0.059** (0.026)
Muslim	0.001 (0.029)	0.004 (0.030)
SC/ST	-0.004 (0.025)	-0.008 (0.026)
High income	0.038* (0.022)	0.009 (0.023)
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## Regression with interaction terms

With/  $Muslim_i = 0$ ,  $SC/ST_i = 0$ ,  $HighIncome_i = 0$ , and  $LongTermMigrant_i = 0$ :

- ▶  $Y_i = \delta_0 + \delta_1 T_i + \delta_2 X_i + \delta_3 T_i X_i + \zeta_i$
- ▶  $Y_i = \delta_0 + \hat{\delta}_1 T_i + \hat{\delta}_2 \text{PrimEduc}_i + \hat{\delta}_3 T_i \cdot \text{PrimEduc}_i$
- ▶  $Y_i = 0.149 + 0.248 T_i - 0.058 \text{PrimEduc}_i + 0.083 T_i \cdot \text{PrimEduc}_i$

## Regression with interaction terms

$$Y_i = 0.149 + 0.248 T_i - 0.058 \text{PrimEduc}_i + 0.083 T_i \cdot \text{PrimEduc}_i$$

- ▶ What is the average treatment effect (ATE) for  $\text{PrimEduc}_i = 0$ ?
- ▶ What is the average treatment effect (ATE) for  $\text{PrimEduc}_i = 1$ ?
- ▶ Are these conditional average treatment effects different?

# Conditional average treatment effects

Are these conditional average treatment effects different?

**TABLE 4. [Pre-registered] Estimates of Heterogeneous Effects of T1 Treatment**

	<i>Dependent variable:</i>	
	Has city-based voter ID	Voted
	(1)	
T1 × Primary education	0.083** (0.041)	

Note: Models do not include additional covariates. All independent variables are dichotomous and are described in the text. Robust standard errors in parentheses \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

# Cluster Randomization



## Second treatment in the India study

- ▶ Possible explanations for low political integration of internal migrants:
  - ▶ Strong ties to home region
  - ▶ Bureaucratic barriers →  $T1$
  - ▶ Exclusion by local-born residents and elites →  $T2$
- ▶ Approximately 2000 people around 87 polling stations in 4 blocks: Delhi/Lucknow
  - \* above/below median number of experimental subjects at polling station

## Second treatment in the India study

- ▶ Letters, Whatsapp messages, and emails in 2-4 weeks before election to incumbent MP, MP candidates, other local officials informing them that a voter registration drive among migrants had recently been carried out.

# The outcomes

**TABLE 5. [Index Outcome Pre-Registered; Index Component Analyses Exploratory] T2 Experimental Results for Exposure to Campaigning during the 2019 Lok Sabha Elections**

	Index components					
	Campaigning exposure index	Basti visits by politicians	Home visit by politician or party worker	Gifts	Migrant-focused campaigning	Perceived campaign intensity
	(1)	(2)	(3)	(4)	(5)	(6)
T2 treatment	0.101 (0.058)	0.066 (0.078)	0.036 (0.038)	0.017 (0.012)	0.014 (0.047)	0.073 (0.031)
p-value (upper)	0.043	0.203	0.174	0.073	0.384	0.010
Control mean	-0.039	0.559	0.550	0.013	0.425	0.676
Observations	1,969	1,969	1,969	1,969	1,969	1,931
No. of clusters	87	87	87	87	87	87
Adjusted $R^2$	0.056	0.070	0.047	0.019	0.008	0.021
DV values	[-0.96,3.65]	{0,...,4}	{0,1}	{0,1,2}	{0,1}	{0,0.33,0.67,1}

*Note:* Campaign exposure index (1) based on whether respondent reports that politicians or party workers (2) visited their basti around the 2019 Lok Sabha election campaign, (3) came to the door to request votes, (4) offered gifts, (5) tried to specifically win votes of recent migrants to the city, and (6) campaigned hard to win votes in the basti. Weighted least squares estimates of intent to treat effects. Clusters weighted equally. Models include block fixed effects and individual covariates. Cluster-robust standard errors in parentheses.

- ▶ Index = average of z scores
- ▶ z-score for indicator  $k$  for individual  $i$ :  $z_i^k = (y_i^k - \text{control group mean}) / \text{control group standard deviation}$

# Units and Clusters

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- ▶ Number of observations =
- ▶ Number of clusters =

# The estimator

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- Estimator: weighted least squares, with clusters weighted equally, with block fixed effects and individual covariates.

# Cluster-robust standard errors

**TABLE 5. [Index Outcome Pre-Registered; Index Component Analyses Exploratory] T2 Experimental Results for Exposure to Campaigning during the 2019 Lok Sabha Elections**

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# Estimation

**TABLE 5. [Index Outcome Pre-Registered; Index Component Analyses Exploratory] T2 Experimental Results for Exposure to Campaigning during the 2019 Lok Sabha Elections**

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	(1)	(2)	(3)	(4)	(5)	(6)
T2 treatment	0.101 (0.058)	0.066 (0.078)	0.036 (0.038)	0.017 (0.012)	0.014 (0.047)	0.073 (0.031)
<i>p</i> -value (upper)	0.043	0.203	0.174	0.073	0.384	0.010
Control mean	-0.039	0.559	0.550	0.013	0.425	0.676
Observations	1,969	1,969	1,969	1,969	1,969	1,931
No. of clusters	87	87	87	87	87	87
Adjusted $R^2$	0.056	0.070	0.047	0.019	0.008	0.021
DV values	[-0.96,3.65]	{0,...,4}	{0,1}	{0,1,2}	{0,1}	{0,0.33,0.67,1}

*Note:* Campaign exposure index (1) based on whether respondent reports that politicians or party workers (2) visited their basti around the 2019 Lok Sabha election campaign, (3) came to the door to request votes, (4) offered gifts, (5) tried to specifically win votes of recent migrants to the city, and (6) campaigned hard to win votes in the basti. Weighted least squares estimates of intent to treat effects. Clusters weighted equally. Models include block fixed effects and individual covariates. Cluster-robust standard errors in parentheses.

- What is the estimated average effect of  $T2$  on the outcome index?

# Hypothesis testing

**TABLE 5. [Index Outcome Pre-Registered; Index Component Analyses Exploratory] T2 Experimental Results for Exposure to Campaigning during the 2019 Lok Sabha Elections**

	Index components					
	Campaigning exposure index	Basti visits by politicians	Home visit by politician or party worker	Gifts	Migrant-focused campaigning	Perceived campaign intensity
	(1)	(2)	(3)	(4)	(5)	(6)
T2 treatment	0.101 (0.058)	0.066 (0.078)	0.036 (0.038)	0.017 (0.012)	0.014 (0.047)	0.073 (0.031)
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- On which components of the index does  $T2$  have a statistically significant effect?



# Interpretation

**TABLE 5. [Index Outcome Pre-Registered; Index Component Analyses Exploratory] T2 Experimental Results for Exposure to Campaigning during the 2019 Lok Sabha Elections**

	Index components					
	Campaigning exposure index	Basti visits by politicians	Home visit by politician or party worker	Gifts	Migrant-focused campaigning	Perceived campaign intensity
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T2 treatment	0.101 (0.058)	0.066 (0.078)	0.036 (0.038)	0.017 (0.012)	0.014 (0.047)	0.073 (0.031)
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Observations	1,969	1,969	1,969	1,969	1,969	1,931
No. of clusters	87	87	87	87	87	87
Adjusted $R^2$	0.056	0.070	0.047	0.019	0.008	0.021
DV values	[-0.96,3.65]	{0,...,4}	{0,1}	{0,1,2}	{0,1}	{0,0.33,0.67,1}

Note: Campaign exposure index (1) based on whether respondent reports that politicians or party workers (2) visited their basti around the 2019 Lok Sabha election campaign, (3) came to the door to request votes, (4) offered gifts, (5) tried to specifically win votes of recent migrants to the city, and (6) campaigned hard to win votes in the basti. Weighted least squares estimates of intent to treat effects. Clusters weighted equally. Models include block fixed effects and individual covariates. Cluster-robust standard errors in parentheses.

- Are these results positive or negative for internal migrants?