How Big is the Big Push?
The Macroeconomic Effects of a Large-Scale Regional Development Program

Andrea Cerrato

Federal Reserve Bank of Boston

New Thinking in Industrial Policy – Columbia University

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This paper

- Long-term aggregate effects of the Italian CasMez on MFG output
  - Industrialization program targeting the South `CasMez Jurisdiction`
  - 1950-1992: 6×1950 South GDP, 3.5×Marshall Plan
  - Center-North vs. South divide → factor reallocation `Details`

- Reduced-form evidence
  - Impact on local employment and value added
  - Source of local population gains → labor reallocation

- Multi-region one-sector growth model
  - Public capital + agglomeration → Increasing returns
  - Factor mobility → Crowding out effects

- Calibration matching reduced-form estimates
 - Regional vs. aggregate effects on industrial production

1. Reduced-Form Evidence

Data

- ▶ Administrative data from historical archives (ASET)
    - ▶ Universe of geo-localized CasMez projects (1950-1992)
    - ▶ Info on type of project, approval date, cost, and location
    - ▶ CasMez balance sheets and other administrative docs

- ▶ Decennial Census data at the municipality level (1951-2011)
    - ▶ Labor market outcomes
    - ▶ Demographic characteristics

- ▶ Province-level data (1951-2011)
    - ▶ Migration matrix from population registries
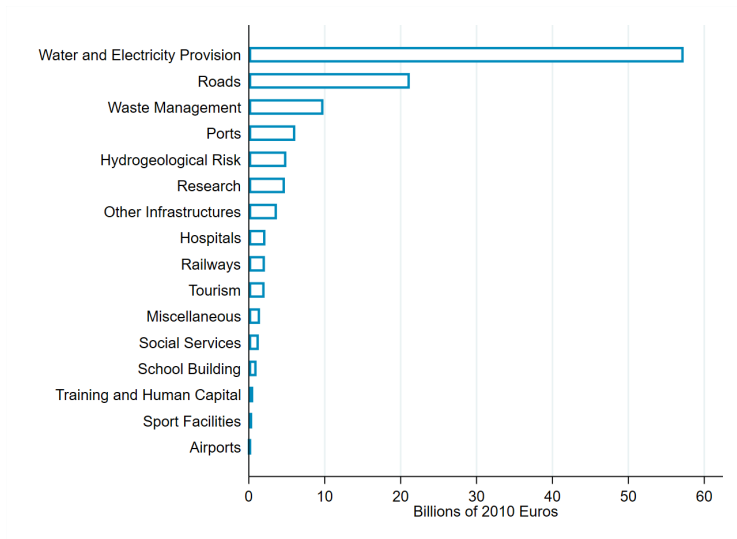   - ▶ Total and sectoral value added (Istituto Tagliacarne)

CasMez Interventions

Figure: Time Series of CasMez Investments
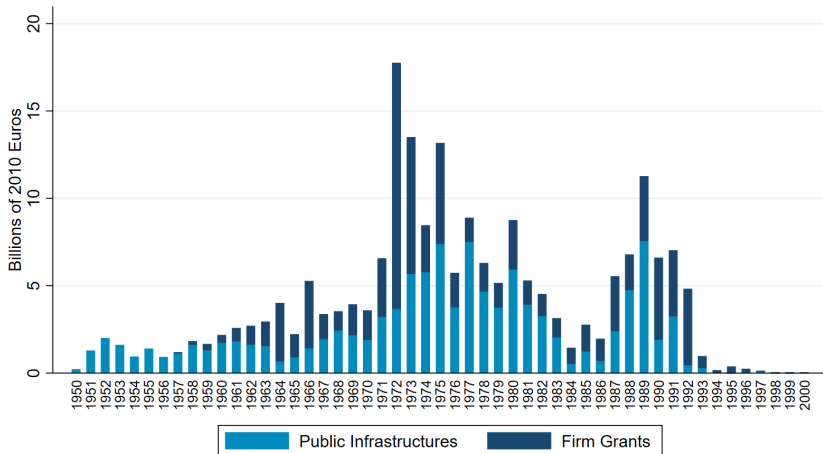
CasMez Interventions

Figure: CasMez's Public Infrastructure Investments

Institutional Features and Identification

- 1950-1992: CasMez activity

    - Basic infrastructure investments + grants (from 1957)
    - 20% of installation costs and 10% of machinery costs

- 1960-1974: Formation of Industrial Development Areas (IDAs)

    - 50% co-financing of MFG-oriented infrastructure investments
    - 48 consortia made of 879 municipalities established

- Three distinct sources of identification:

    1. IDAs vs. non-IDAs matching on pre-treatment trends
    2. Location just South vs. North of CasMez's jurisdiction border
   3. Early vs. late IDAs

Identification I: IDAs vs. non-IDAs

▶ Many municipalities not in IDA but in CasMez jurisdiction

▶ 1-to-1 match each IDA municipality with one non-IDA municipality
   ▶ 14 covariates: 1951 characteristics and 1951-1961 trends

▶ Effective control for characteristics and trends determining eligibility
   Propensity Score Histogram   Balance

▶ Compare IDA vs. non-IDA municipalities before and after 1961
   $\rightarrow$ Two-way FE diff-in-diff

$$Y_{it} = \alpha_i + \delta_t + \sum_{k \neq 1961} \beta_k D_{it}^k + \varepsilon_{it}$$

Map of IDA vs. non-IDA Matched Municipalities

Figure: Treatment and Matched Control Municipalities

Matched Control
IDAs
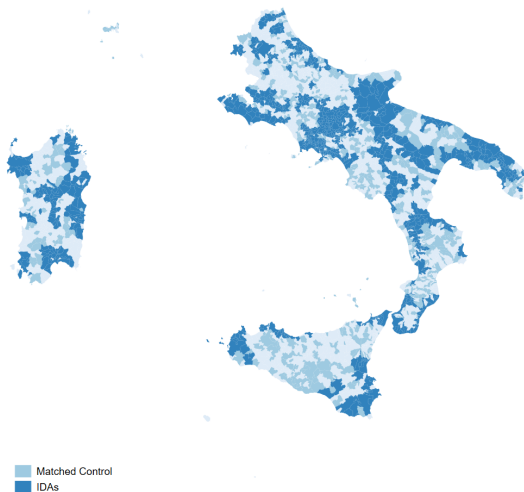
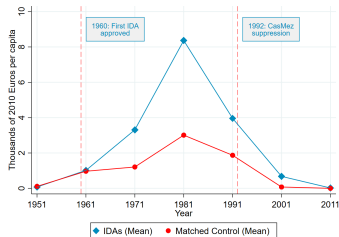# IDAs vs. non-IDAs: First stage
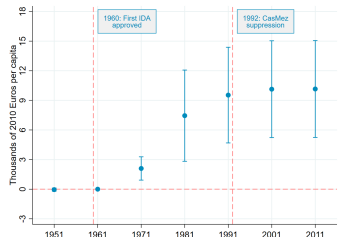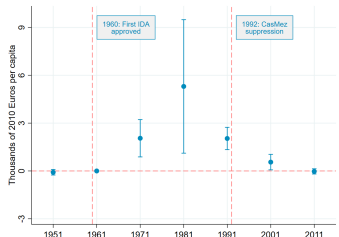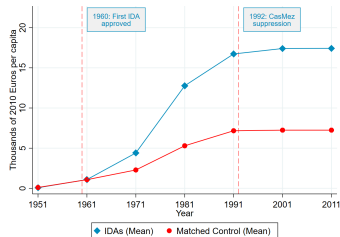
Figure: Investment Flows

Figure: Cumulative Investments

IDAs vs. non-IDAs: Log MFG and Services Employment
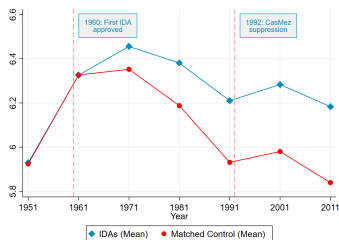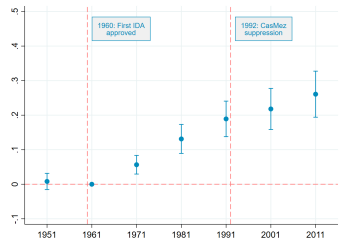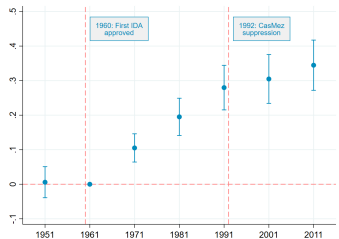
Figure: Log MFG Employment

Figure: Log Services Employment
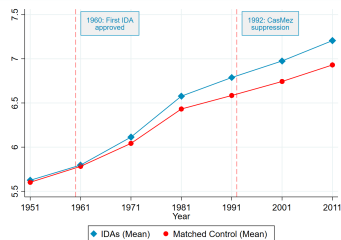
IDAs vs. non-IDAs: Employment and Population

Figure: Log Employment
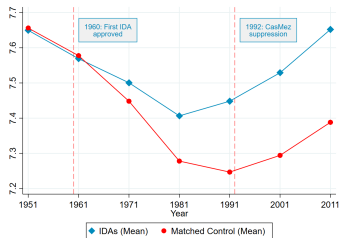
Figure: Log Population
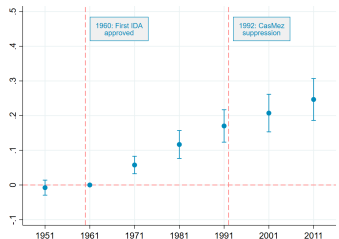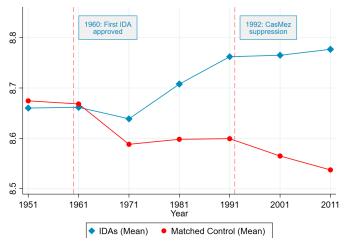
IDAs vs. non-IDAs: Agriculture Emp. and Emp. Rate

Figure: Log Agriculture Emp.
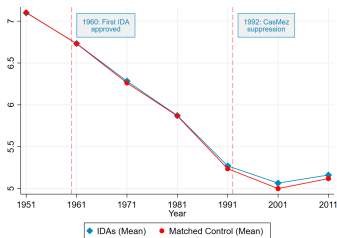
Figure: Emp. Rate

Summary of Results

Table: Effect of €1,000 Investments Per Capita - 2SLS Estimates

Outcome Variables	(1) Municipality-Level	(2) Province-Level
Log MFG Employment	.031*** (.008)	
Log Employment Services	.021*** (.006)	
Log Agr. Employment	.004 (.005)	
Log Total Employment	.023*** (.007)	
Log Population	.021*** (.006)	
Employment Rate	.135 (.093)	
Observations	12,194	
Units	1,414	
First Stage Coeff.	7.90***	
First Stage F-Stat	55.90	

Alternative Identification Strategies

1. South vs. North of CasMez jurisdiction's border `Details`
   - ▶ CasMez's jurisdiction characterized by sharp borders
   - ▶ Compare long differences in outcomes (Albanese et al., 2023)
   - ▶ Long difference-in-discontinuities design
     `First Stage` `Reduced Form: MFG Employment`

2. Early vs. Late IDAs `Details`
   - ▶ Timing of IDA status adoption affects cumulative investments
   - ▶ Compare early vs. late IDA municipalities before and after 1961
   - ▶ TWFE difference-in-differences design with controls
     `First Stage` `Reduced Form: MFG Employment`

- ▶ Same results qualitatively, slightly different coefficients `Table`

Province-Level Analysis

- Three reasons motivate province-level analysis
  1. Within-province crowding-out effects (Criscuolo et al., 2019)
  2. Cross-province crowding-out effects (migration matrix)
  3. Effects on value added (sectoral VA measures)

  $\rightarrow$ Diff-in-diff with controls for heterogeneous trends

  $$Y_{pt} = \alpha_p + \delta_t + \beta(D_p \times T_t) + \mathbf{X}'_{p1951}\Gamma_t + \varepsilon_{pt}$$

  where:

  - D_p = dummy taking value 1 if part of CasMez jurisdiction
  - T_t = dummy taking value 1 if year > 1961

- Identifying assumption: conditioning on $\mathbf{X}_{p1951}\Gamma_t$, $(D_p \times T_t)$ does not correlate with ε_{pt}

Within-Province Crowding-Out Effects
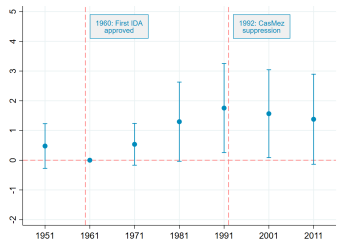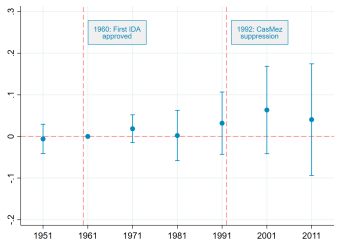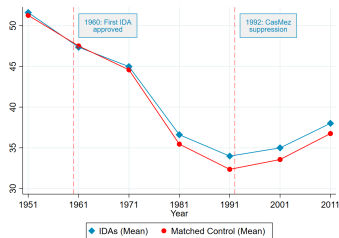
Table: Effect of €1,000 Investments Per Capita - 2SLS Estimates

Outcome Variables	(1) Municipality-Level	(2) Province-Level
Log MFG Employment	.031***	.028**
	(.008)	(.008)
Log Employment Services	.021***	.021**
	(.006)	(.007)
Log Agr. Employment	.004	.009
	(.005)	(.012)
Log Total Employment	.023***	.020**
	(.007)	(.006)
Log Population	.021***	.018***
	(.006)	(.004)
Employment Rate	.135	-.108
	(.093)	(.150)
Observations	12,194	644
Units	1,414	92
First Stage Coeff.	7.90***	11.05***
First Stage F-Stat	55.90	61.62

Cross-Province Crowding-Out Effects

Table: Effect of €1,000 Investments Per Capita - 2SLS Estimates

	(1) Log Population	(2) ↑ in-migration from South	(3) ↓ out-migration to Center-North
Investments Per Capita	.018***	.0055**	.0035*
	(.006)	(.002)	(.002)
Observations	644	644	644
Units	92	92	92

▶ Population gains explained by ↑ cross-province net migration flows

▶ High plausibility

  ▶ Higher in-migration from the South
  ▶ Lower out-migration to the Center-North

Effects on VA vs. Employment

Table: Effect of €1,000 Investments Per Capita - 2SLS Estimates

	(1) Log Employment	(2) Log Value Added
Manufacturing	.028*** (.008)	.030** (.013)
Services	.020*** (.007)	.016** (.007)
Agriculture	.009 (.012)	.006 (.013)
Total	.020*** (.006)	.026*** (.007)
Observations	644	644
Units	92	92
First Stage Coeff.	11.08***	11.08***
First Stage F-Stat	61.68	61.68

▶ Effects on VA align with effects on employment

2. Model

Setup

- Multi-region, one-sector (MFG) growth model
    - Solow (1956), Roback (1982), Kline and Moretti (2014)

- Workers: hand-to-mouth, supply labor inelastically, choose location
  $\rightarrow$ Labor allocation (Blanchard and Katz, 1992)

- Landlords: immobile, save, consume
  $\rightarrow$ Capital accumulation + capital allocation (Kleinman et al., 2023)

- Production: $y_{it} = z_{it} k_{it}^{\alpha} F_i^{\beta} \ell_{it}^{1-\alpha-\beta}$
    - Increasing returns: public capital and agglomeration $\rightarrow z_{it}$
    - Fixed factor F_i rules out unlikely equilibria

- Exogenous public capital allocation across regions

Regional Big Push and Change in MFG Output

▶ Define regional productivity:

$$\ln(z_{it}) = z_i + \theta_t + \eta \ln(k_{it}^P) + \gamma_i \ln\left(\frac{\ell_{it-1}}{A_i}\right) + \varepsilon_{it}$$

▶ Steady-state approximation of the model with two regions (S, N):

$$\frac{\mathrm{d}Y}{\mathrm{d}k_S^P} = \frac{\eta}{1-\alpha}\frac{y_S}{k_S^P} + \frac{1}{1-\alpha}\frac{\mathrm{d}\ell_S}{\mathrm{d}k_S^P}\left[\frac{y_S}{\ell_S}(1-\alpha-\beta+\gamma_S)\right]$$

$$+ \frac{1}{1-\alpha}\frac{\mathrm{d}\ell_N}{\mathrm{d}k_S^P}\left[\frac{y_N}{\ell_N}(1-\alpha-\beta+\gamma_N)\right]$$

▶ Effects of regional big push $\mathrm{d}k_S^P$ on aggregate MFG output Y depend on:

  ▶ First-order effect through productivity
  ▶ Second-order crowding-in effect
  ▶ Crowding-out effect

3. Quantification of Macroeconomic Effects

Aggregate Effects of the Regional Big Push

- ▶ Recall:

$$\frac{\mathrm{d}Y}{\mathrm{d}k_S^P} = \frac{\eta}{1-\alpha}\frac{y_S}{k_S^P} + \frac{1}{1-\alpha}\frac{\mathrm{d}\ell_S}{\mathrm{d}k_S^P}\left[\frac{y_S}{\ell_S}(1-\alpha-\beta+\gamma_S)\right]$$

$$+ \frac{1}{1-\alpha}\frac{\mathrm{d}\ell_N}{\mathrm{d}k_S^P}\left[\frac{y_N}{\ell_N}(1-\alpha-\beta+\gamma_N)\right]$$

- ▶ Measure: y_S, y_N, ℓ_S, ℓ_N (SVIMEZ, 2011)

- ▶ Calibrate:
  - ▶ $\alpha = 0.3$ (Griliches, 1967)
  - ▶ $(1-\alpha)/\beta = 1.5$ (Kline and Moretti, 2014)
    $\rightarrow \beta = 0.47$

- ▶ Remaining parameters: γ_S, γ_N, and η/k_S^P

- ▶ Remaining quantities: $\mathrm{d}\ell_S/\mathrm{d}k_S^P$ and $\mathrm{d}\ell_N/\mathrm{d}k_S^P$

Estimate Agglomeration Elasticities

▶ From equilibrium regional employment:

$$\ln(\ell_{it}) = \kappa_i + \delta_t + \frac{\eta}{\beta} \ln(k_{it}^P) + \frac{\gamma_i}{\beta} \ln\left(\frac{\ell_{it-1}}{A_i}\right) + \omega_{it}$$

▶ Two-way FE regression of log MFG employment on its decade lag:

$$\ln(\ell_{pt}) = \psi_p + \phi_t + \frac{\gamma_S}{\beta} \ln\left(\frac{\ell_{pt-1}}{A_p}\right) + \mathbf{X}_p'\Gamma_t + \nu_{pt}$$

▶ Identification:
  ▶ Control for heterogeneous time trends
  ▶ Instrument with 2-period lagged MFG density
    $\rightarrow$ MFG prod. shocks independent over a 20-year horizon

Estimate Agglomeration Elasticities

Table: IV Estimates of Agglomeration Elasticities

	(1) CasMez	(2) Non-CasMez
$(\hat{\gamma_i/\beta})$	0.35***	0.57***
	(0.13)	(0.07)
Observations	195	265
Units	39	53
First Stage F-Stat	20.54	201.58

▶ With $\beta = 0.47 \rightarrow \gamma_S = 0.16$ and $\gamma_N = 0.27$

▶ Agglomeration elasticities not constant across regions

Remaining Elements

Semi-Elasticity of Regional Productivity: η / k_S^P

- From steady-state approximation of regional employment:

$$\frac{\eta}{k_i^P} = \frac{\mathrm{d}\ell_i}{\ell_i} \frac{1}{\mathrm{d}k_i^P} (\beta - \gamma_i)$$

- Combine reduced-form estimate of $\frac{\mathrm{d}\ell_i}{\ell_i} \frac{1}{\mathrm{d}k_i^P}$ with calibrated $\beta = 0.47$

$\rightarrow \eta / k_S^P = 0.028 \times (0.47 - 0.16) = 0.009$

Regional Employment Gains vs. Losses: $\mathrm{d}\ell_S / \mathrm{d}k_S^P$ and $\mathrm{d}\ell_N / \mathrm{d}k_S^P$

- Employment gains: reduced-form estimate of $\frac{\mathrm{d}\ell_i}{\ell_i} \frac{1}{\mathrm{d}k_i^P}$

- Crowding-out effects: $\mathrm{d}\ell_j / \mathrm{d}k_i^P = (\mathrm{d}P_j / \mathrm{d}k_i^P) \times (\ell_j / P_j)$

Summary of CasMez Effects

- Estimate long-run regional and aggregate multiplier:
    - Assume 3% annual discount rate $\rightarrow$ PDV of costs and benefits
    - Multiplier in the South (2011): 1.7
    - Aggregate multiplier (2011): 1.2

- Large impact on the reallocation of workers across macro-regions
    - $\downarrow$ 800,000 migrants from the South to the Center-North
    - South MFG emp. below post-WWII levels without CasMez

- Simulated counterfactual: place-blind allocation of resources
    - Assumption I: $\eta/k_N^P = 1/2 \times \eta/k_S^P$
    - Assumption II: same spatial labor reallocation response
    - Aggregate multiplier: $1.6 > 1.2$

Cost-Benefit Analysis: MFG Output

Figure: PDV of MFG Output Gains and Costs (2011)
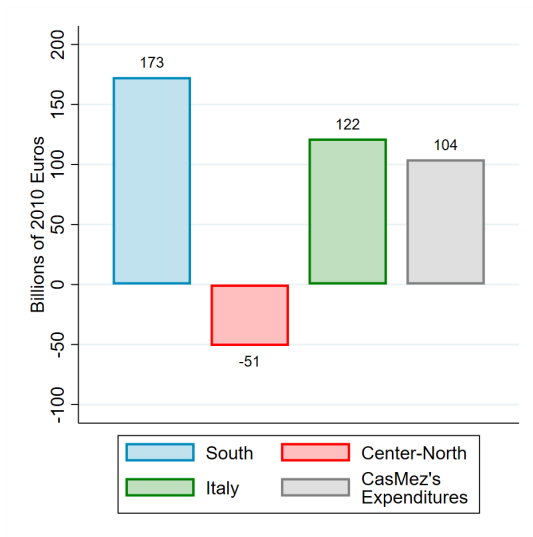
Counterfactual: Place-Blind Allocation

Figure: PDV of MFG Output Gains and Costs (2011)
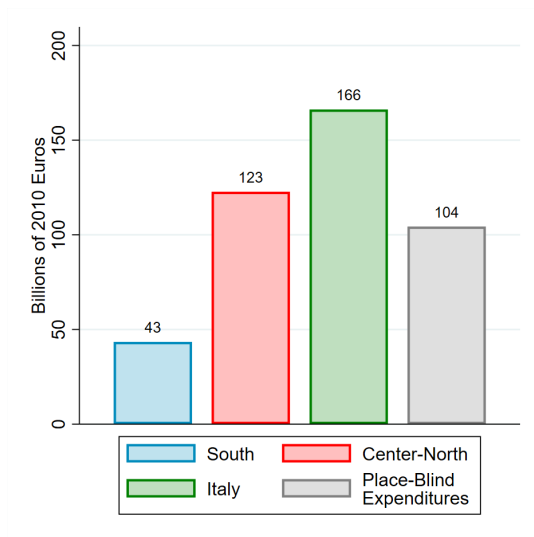
Conclusion

▶ Study one of the largest big push of the past century

    ▶ Large South vs. Center-North divide in post-WWII Italy

▶ Sizeable and persistent regional effects $\rightarrow$ New long-run equilibrium

    ▶ Self-sustaining productivity gains $\rightarrow$ Agglomeration economies
    ▶ Regional long-run MFG output multiplier: 1.7

▶ Sizeable crowding-out effects on the rest of the country

    ▶ Regional employment gains $\rightarrow$ lower out-migration
    ▶ Regional differentials $\rightarrow$ amplification of crowding-out effects
    ▶ Aggregate long-run MFG output multiplier: 1.2

▶ Place-blind allocation: larger long-run aggregate multiplier

Thank You!

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Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics 70*(1), 65–94.

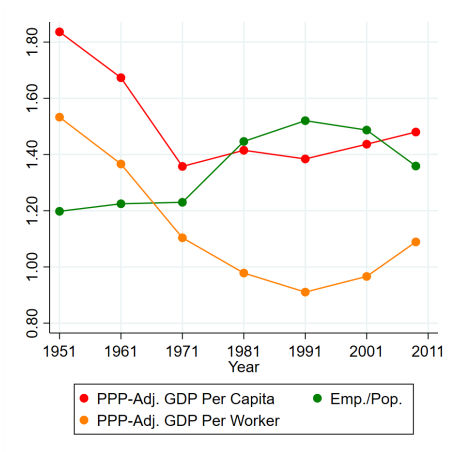SVIMEZ (2011). *150 Anni di Statistiche Italiane: Nord e Sud, 1861-2011*. Il mulino.

Regional Divide: GDP per capita

Figure: GDP Per Capita: Ratio Center-North vs. South
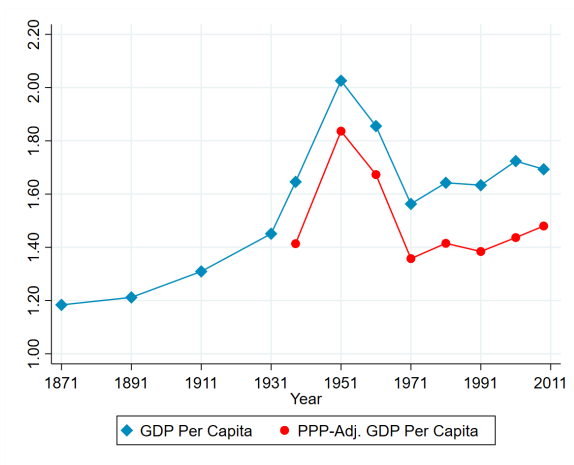
Decomposition of GDP per capita

Figure: GDP Per Capita Decomposition: Ratio Center-North vs. South

Regional Divide in the Press

Figure: *The North vs. South divide will be closed only in 2020*, September 13th, 1972, Corriere della Sera

Mercoledì 13 settembre 1972   *CORRIERE DELLA SERA*

LE PROSPETTIVE DI UN PROBLEMA CHE TORMENTA L'ITALIA

Il divario fra Nord e Sud verrà colmato solo nel 2020

La previsione è del professor Pasquale Saraceno ed è espressa in un rapporto per il ministero del bilancio Lo sviluppo del Sud è avvenuto in modo disordinato, aggiungendo ai vecchi motivi di arretratezza nuove cause di disorientamento - Dualismo in Puglia fra costa ed entroterra - Investimento immobiliare, burocrazia e piccoli commerci invece di una spinta all'industrializzazione - Piramidi sulle sabbie mobili

La foto accanto riproduce i due altiforni del Centro siderurgico Italsider di Taranto. Gli altiforni sono alimentati da nastri trasportatori controllati automaticamente. Un aspetto di alta tecnologia, dunque. Siderurgia e petrolchimica hanno rappresentato finora le espressioni più avanzate dell'industrializzazione del Sud, ma — come osserva Antonio Spinosa — si tratta di attività produttive a scarso tasso d'occupazione. Avrebbero potuto costituire, comunque, lo spunto ad un'iniziativa privata che, nella misura in cui smobilitava in agricoltura, trovasse nuovi campi d'espansione. Così non è stato: esiste una mentalità arcaica che crede
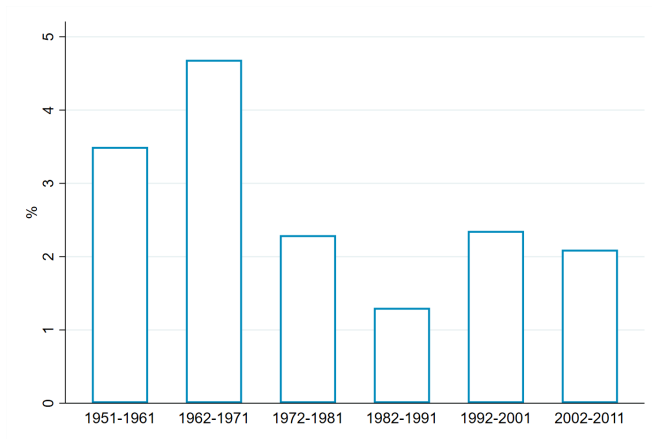
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CasMez Jurisdiction

Figure: Territorial Coverage of CasMez's Jurisdiction

Outside CasMez's Jurisdiction
Inside CasMez's Jurisdiction

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Mass Migration Era
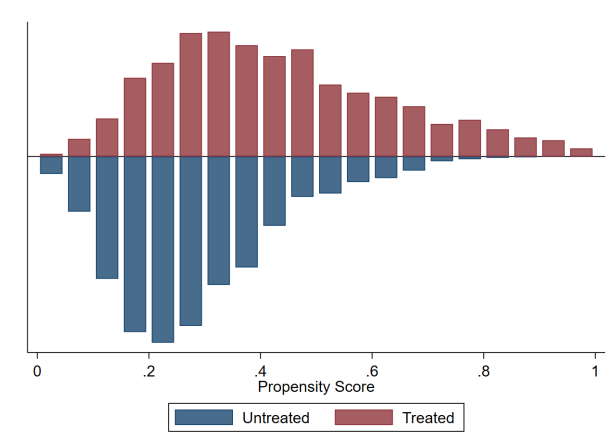
Figure: Net South to Center-North Out-Migration Rate, by decade

1-to-1 Match: Propensity Score Histogram

Figure: Propensity Score Histogram: Treated vs. Untreated

IDAs vs. non-IDAs: Balance

Table: 1-to-1 Match: Balance Table

	(1) Treated	(2) Matched Control	(3) Difference
1951 Sh. of Illiterate Pop.	25.12	25.51	-0.38
	(7.28)	(8.42)	(10.88)
1951 Employment Rate	51.60	51.26	0.34
	(10.53)	(11.68)	(14.97)
1951 Sh. Industry Emp.	21.47	21.20	0.27
	(12.96)	(12.80)	(15.01)
1951 Log Population	8.66	8.67	-0.01
	(1.02)	(1.03)	(0.80)
1951 Log Employment	7.65	7.66	-0.01
	(0.98)	(0.96)	(0.81)
1951 Log Industry Emp.	5.93	5.92	0.01
	(1.32)	(1.30)	(0.92)
1951 Log Agriculture Emp.	7.10	7.10	-0.00
	(0.87)	(0.89)	(1.06)

IDAs vs. non-IDAs: Balance

	(1) Treated	(2) Matched Control	(3) Difference
1951-1961 Change Sh. of Illiterate Pop.	-8.05	-8.30	0.25
	(3.43)	(3.47)	(4.91)
1951-1961 Change Employment Rate	-4.25	-3.76	-0.49
	(6.11)	(6.40)	(8.86)
1951-1961 Change Sh. Industry Emp.	10.31	10.27	0.04
	(8.24)	(8.59)	(11.53)
1951-1961 Change Log Population	0.00	-0.01	0.01
	(0.15)	(0.13)	(0.15)
1951-1961 Change Log Employment	-0.08	-0.08	-0.00
	(0.20)	(0.18)	(0.22)
1951-1961 Change Log Industry Emp.	0.40	0.40	-0.01
	(0.39)	(0.41)	(0.55)
1951-1961 Change Log Agriculture Emp.	-0.37	-0.37	0.01
	(0.31)	(0.29)	(0.41)
Observations	864	864	864

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IDAs vs. non-IDAs: First stage Composition
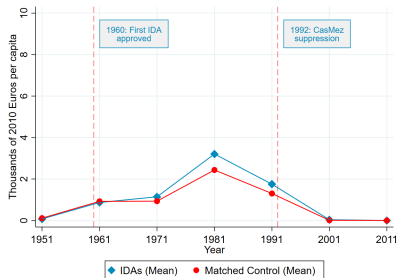
Figure: Public Infrastructure Flows
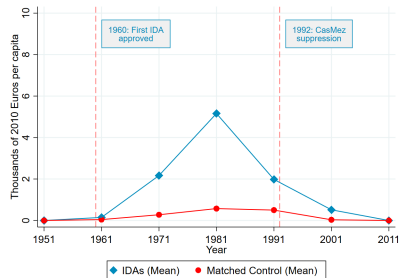
Figure: Firm Grants Flows

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IDAs vs. non-IDAs: Human Capital
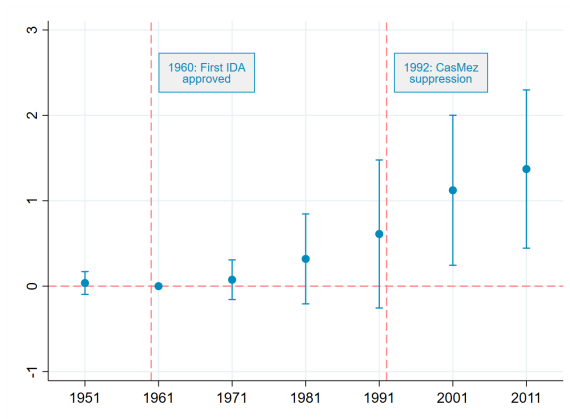
Figure: Share of College-Educated Population

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Identification II: Long Diff-in-Disc

- ▶ CasMez's jurisdiction characterized by sharp borders

- ▶ Compare changes in outcomes of municipalities at the North vs. South of the border (Albanese et al., 2023)

$$\Delta^{1951} Y_{it} = \sum_{k=1961}^{2011} \left[\beta_k D_{it}^k + \sum_{j=1}^{3} \eta_{jk} R_i^j + \sum_{j=1}^{3} \gamma_{jk} R_i^j D_i \right] + \delta_t + \mathbf{X}_{i1951}' \Gamma_t + \varepsilon_{it}$$

where:
- ▶ D_i = dummy for being in CasMez jurisdiction
- ▶ R_i = distance from the border
- ▶ $\mathbf{X}_i$ = vector of baseline characteristics

- ▶ Threat to identification: sharp time-varying discontinuity affecting Y_{it} or with time-varying impact on Y_{it}

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Long Diff-in-Disc: Continuity in 1951

Table: RD coefficients in 1951

	(1) Constant	(2) RD coefficient
1951 Sh. of Illiterate Pop.	17.21	1.09
	(0.66)	(0.99)
1951 Employment Rate	51.79	-1.19
	(1.09)	(1.63)
1951 Sh. Industry Emp.	17.29	-0.97
	(1.39)	(2.08)
1951 Population	4205.24	1746.36
	(948.36)	(1420.81)
1951 Employment	1549.16	654.97
	(348.52)	(522.15)
1951 MFG Emp.	442.79	5.33
	(118.26)	(177.17)
1951 Agriculture Emp.	770.66	586.48***
	(146.05)	(218.81)
Observations	776	776

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Map of Treated and Control Municipalities

Figure: 100 km Above vs. Below CasMez Jurisdiction Border

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Long Diff-in-Disc: 1951-1991
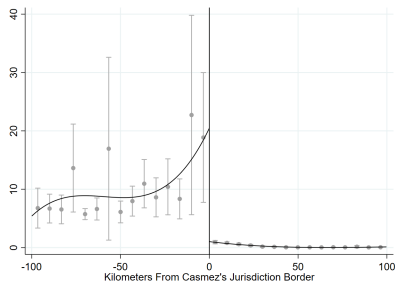
Figure: Cumulative Investments
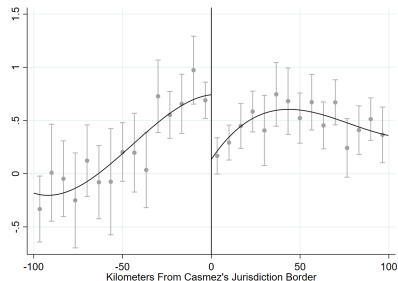
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Figure: Change in log MFG Emp.

Long Diff-in-Disc: First stage
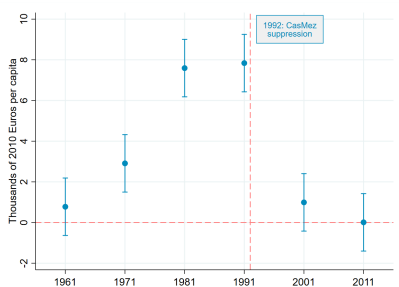
Figure: Investment Flows
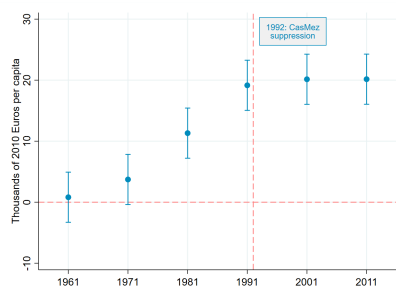
Figure: Cumulative Investments

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Long Diff-in-Disc: First stage Composition
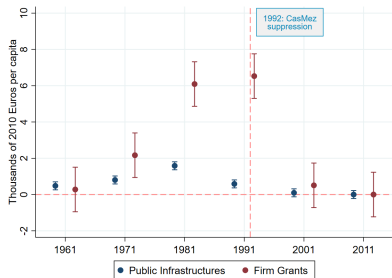
Figure: Investment Flows
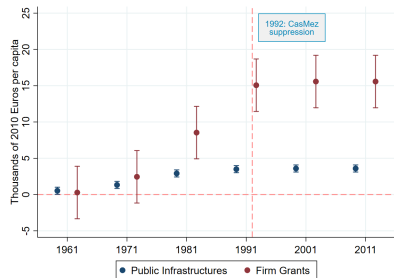
Figure: Cumulative Investments

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Long Diff-in-Disc: Log MFG Employment

Figure: Long Diff-in-Disc Estimates: Log MFG Employment
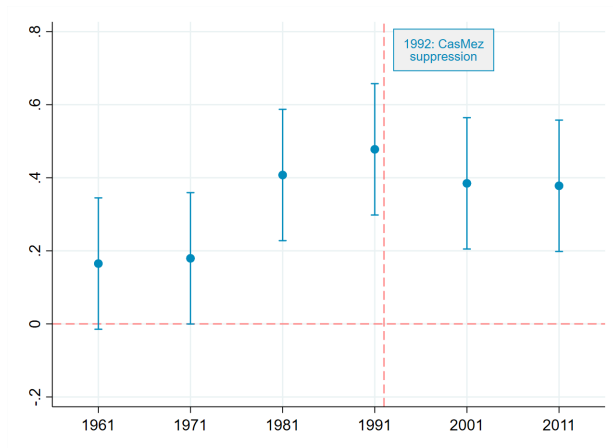
Back

Long Diff-in-Disc: Employment and Population
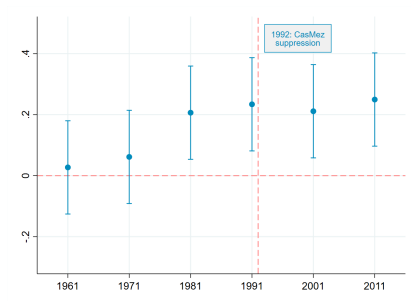
Figure: Log Employment
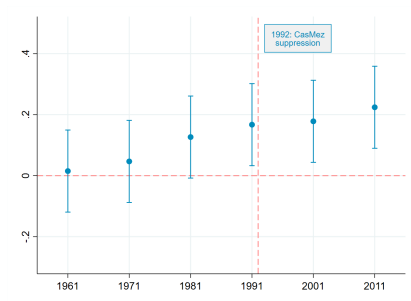
Figure: Log Population

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Long Diff-in-Disc: Agriculture Emp. and Emp. Rate
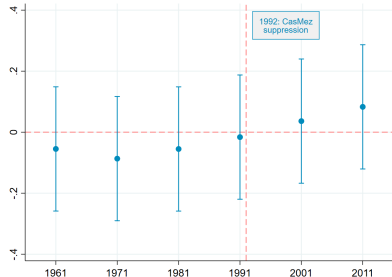
Figure: Log Agriculture Emp.
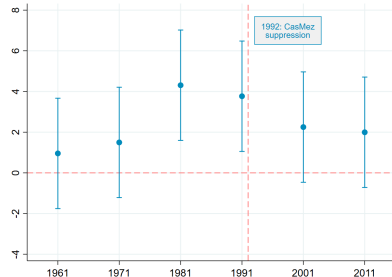
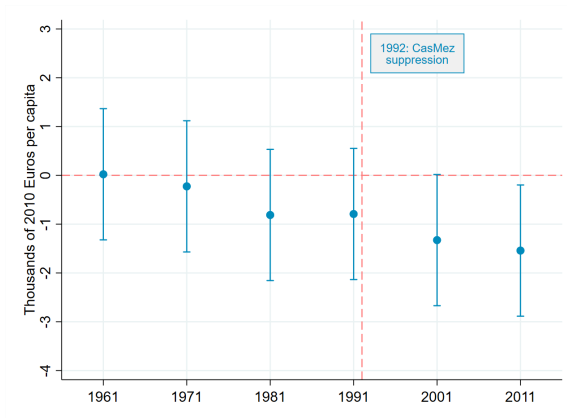Figure: Emp. Rate

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Long Diff-in-Disc: Human Capital

Figure: Share of College-Educated Population

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Identification III: Early vs. Late IDAs

▶ 1960-1974: Establishment of Industrial Development Areas (IDAs)

  ▶ Two waves: 1960-1965 and 1966-1974 `Details`
  ▶ Define treatment as early establishment of IDA

▶ Pros: control for trends common across eventually treated areas

▶ Cons: selection on timing $\rightarrow$ control for heterogeneous trends
  `Unbalanced Characteristics`

▶ Compare early vs. late IDAs before and after 1961
  $\rightarrow$ Two-way FE difference-in-differences

$$Y_{it} = \alpha_i + \delta_{rt} + \sum_{k \neq 1961} \beta_k D_{it}^k + \mathbf{X}'_{i1951} \Gamma_t + \varepsilon_{it}$$

▶ Identifying assumption: parallel trends in potential outcomes

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IDA Adoption Over Time

Figure: Number of municipalities obtaining IDA status
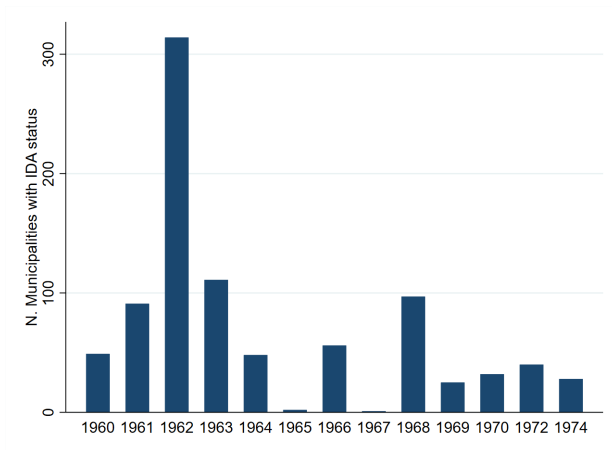
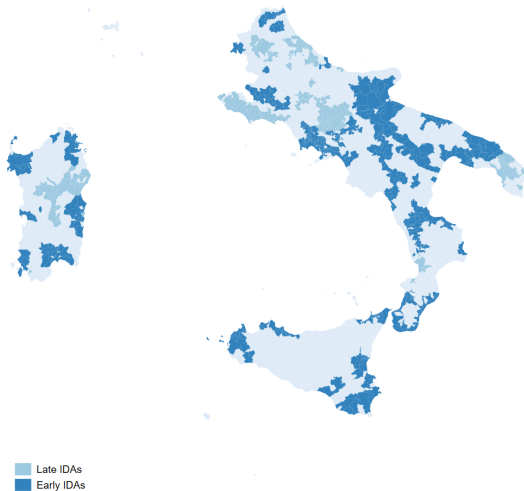

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Early vs. Late IDAs: Unbalanced Characteristics

Table: Early vs. Late IDAs: Unbalanced Characteristics in 1951

	(1) Log Pop.	(2) MFG Emp. Sh.	(3) Sh. Illiterate
Constant	8.358***	18.540***	24.360***
	(0.065)	(0.846)	(0.443)
Early IDA	0.438***	4.268***	1.124**
	(0.081)	(1.055)	(0.552)
Observations	879	879	879

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Map of Early vs. Late IDAs

Figure: Early vs. Late IDAs

Late IDAs
Early IDAs

Early vs. Late IDAs: First stage
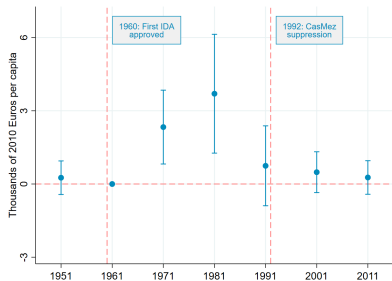
Figure: Investment Flows
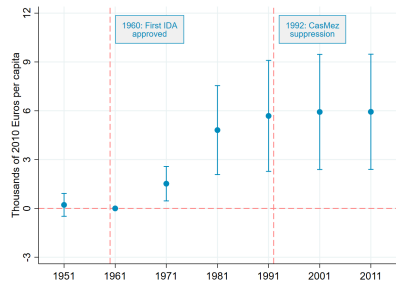
Figure: Cumulative Investments

Composition Back
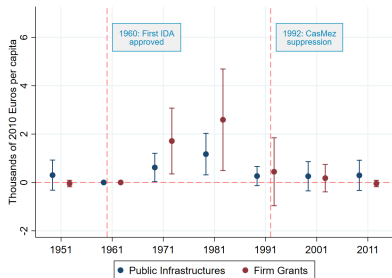
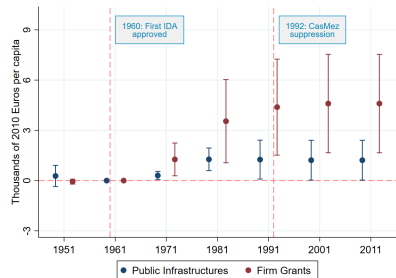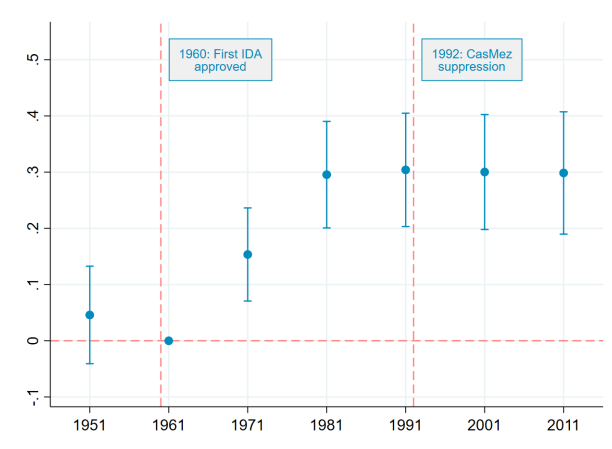# Early vs. Late IDAs: First stage Composition

Figure: Investment Flows

Figure: Cumulative Investments

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Early vs. Late IDAs: Manufacturing Employment

Figure: Log Manufacturing Employment: Diff-in-Diff Estimates

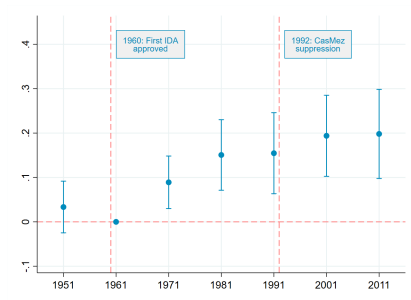Back

Early vs. Late IDAs: Total Employment and Population
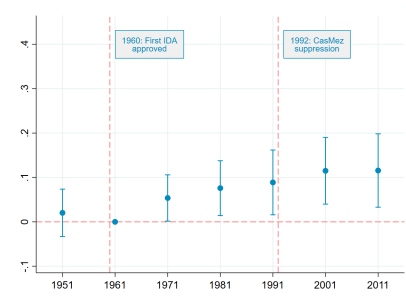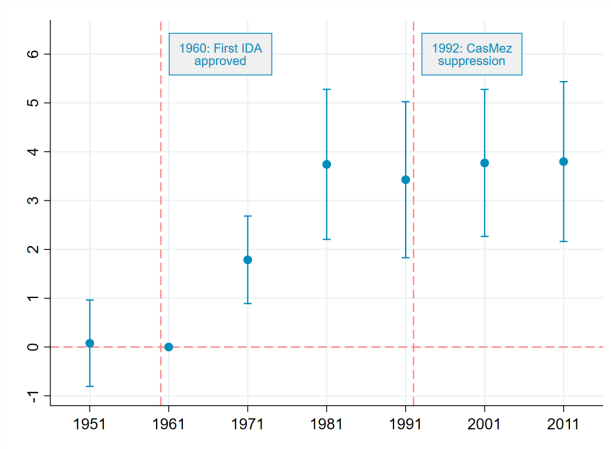

Figure: Log Employment

Figure: Log Population

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Early vs. Late IDAs: Employment Rate

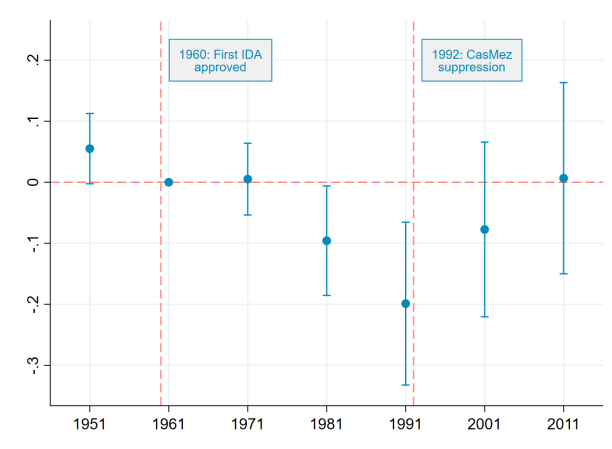Figure: Employment Rate: Diff-in-Diff Estimates

Effect on Agriculture Emp.   Effect on Human Capital   Back

Early vs. Late IDAs: Log Agriculture Employment

Figure: Log Agriculture Employment: Diff-in-Diff Estimates
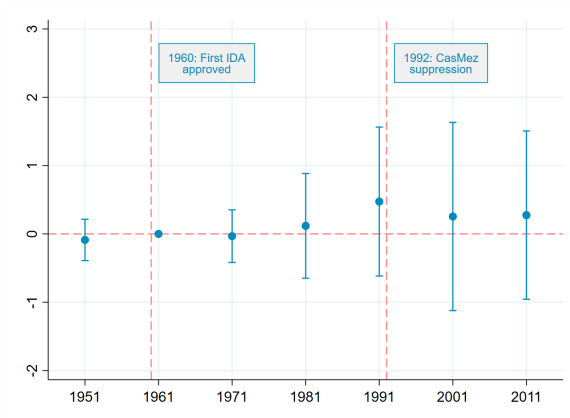
Early vs. Late IDAs: Human Capital

Figure: Share of College-Educated Population

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Summary of Results at the Municipality Level

Table: Effect of €1,000 Investments Per Capita - 2SLS Estimates

Outcome Variables	(1) Identification I	(2) Identification II	(3) Identification III
Log MFG Employment	.031***	.024***	.051***
	(.008)	(.007)	(.015)
Log Services Employment	.021***	.012**	-.004
	(.006)	(.006)	(.008)
Log Agr. Employment	.004	-.002	-.023
	(.005)	(.007)	(.015)
Log Total Employment	.023***	.012**	.029***
	(.007)	(.005)	(.010)
Log Population	.021***	.009**	.016**
	(.006)	(.005)	(.007)
Employment Rate	.135	.170*	.721***
	(.093)	(.096)	(.257)
Observations	12,194	4,656	6,153
Municipalities	1,414	776	879
First Stage F-Stat	55.90	211.63	10.56

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Cost per job and MFG job multiplier

Table: Cost Per Job and MFG Job Multiplier

	(1) Identification I	(2) Identification II	(3) Identification III
Municipality-level			
Additional jobs per MFG job	1.2	1.2	0.6
Cost per job	€145,946	€222,541	€119,632
Province-level			
Additional jobs per MFG job	1.3		
Cost per job	€154,381		

▶ Positive cross-sectoral spillovers: 1.4 in line with Moretti (2010)

▶ High cost per job but persistent employment gains

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