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Applied Econometrics for Development: Instrumental Variables II

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Previous Class – Instrumental Variables

$$y = \beta_0 + \beta_1 x_1 + \cdots + \beta_k x_k + u$$

$$Cov(x_k, u) \neq 0$$

- A good IV is a variable that explains variation in x_k but doesn't explain y
- We can use the IV to extract the 'good' variation and replace x_k with only that component
- An IV must satisfy two conditions:
  - Relevance
  - Exclusion

Natural ‘Natural Experiments’ in Economics

- Natural experiments: changes or special variation in rules governing behavior
  - In many cases, assumption of randomness is not credible
- Nature provides randomness with respect to some important variables
- Exploit natural random events as IV’s
  - Twin births, birth date, gender, weather events
- Natural outcomes which are plausibly random with respect to the two major sources of heterogeneity
  - Tastes
  - Abilities

Example: Returns to Human Capital Investments

- Estimates in the returns to schooling and work experience are biased because of unobserved ability
  - Angrist and Krueger (1991): date of birth
  - Butcher and Case (1994): child gender
  - Ashenfelter and Krueger(1994) and Ashenfelter and Rouse(1998): monozygotic twin pairs
- Weakness of these studies:
  - The assumption that if the instruments are perfectly random and relevant for the variable of interest then, the results are conclusive
- Randomness and explanatory power are necessary but not sufficient conditions for identification
- There are implicit assumptions in these studies

Schooling Choice Model

$$\log(y_a) = f(S, \mu) + g(X_a, \mu)$$

$$y_a: earnings\ at\ age\ a$$
$$S: level\ of\ schooling$$
$$X_a: work\ experience$$
$$\mu: ability$$

- The present value of attending school $V_1(s_1 = 1|S_0)$ vs not attending $V_1(s_1 = 0|S_0)$

$$V_1(s_1 = 1|S_0) = \exp[f(S_0 + 1, \mu)] \sum_{a=0}^{A-1} \beta^{a+1} \exp[g(a, \mu)] - c$$

$$V_1(s_1 = 0|S_0) = \exp[f(S_0, \mu)] \sum_{a=0}^{A-1} \beta^{a} \exp[g(a, \mu)]$$

- The decision is to attend school if $V_1(s_1 = 1|S_0) \geq V_1(s_1 = 0|S_0)$

Schooling Choice Model

- Decision to continue schooling
  - $s_1 = 1 \;\; if \; f(S_0 + 1, \mu) - f(S_0, \mu) \geq r + ln\left[\frac{c}{V_1(s_1=0|S_0)} + 1\right]$
  - $s_1 = 0$ otherwise
- If marginal return to schooling increases with ability:

$$\frac{\partial f(S_0 + 1, \mu) - f(S_0, \mu)}{\partial \mu} > 0$$

then, there exists a cut-off value μ^* such that individuals above that value attend to school and individuals below it do not

- Then, the differences in earnings among the two groups will reflect, in part, ability differences
- Returns to schooling will be different by ability group

Schooling, Age, and Experience

- Existence of a theoretically valid IV does not mean that the specification of the equation of interest does not matter for identification
- Given our model, we should control for experience rather than age
  - If experience is also a function of ability, return to schooling cannot be identified even with a valid instrument (there are two endogenous variables)
  - Return to an additional year of schooling could be understated because of earning loss of one less year of experience

$$[f(S_0+1,\mu_1)-f(S_0,\mu_1)]-[g(a-a_K-1,\mu_1)-g(a-a_K,\mu_1)]$$

  - Return to an additional year of schooling could be overstated by returns to experience of high ability group

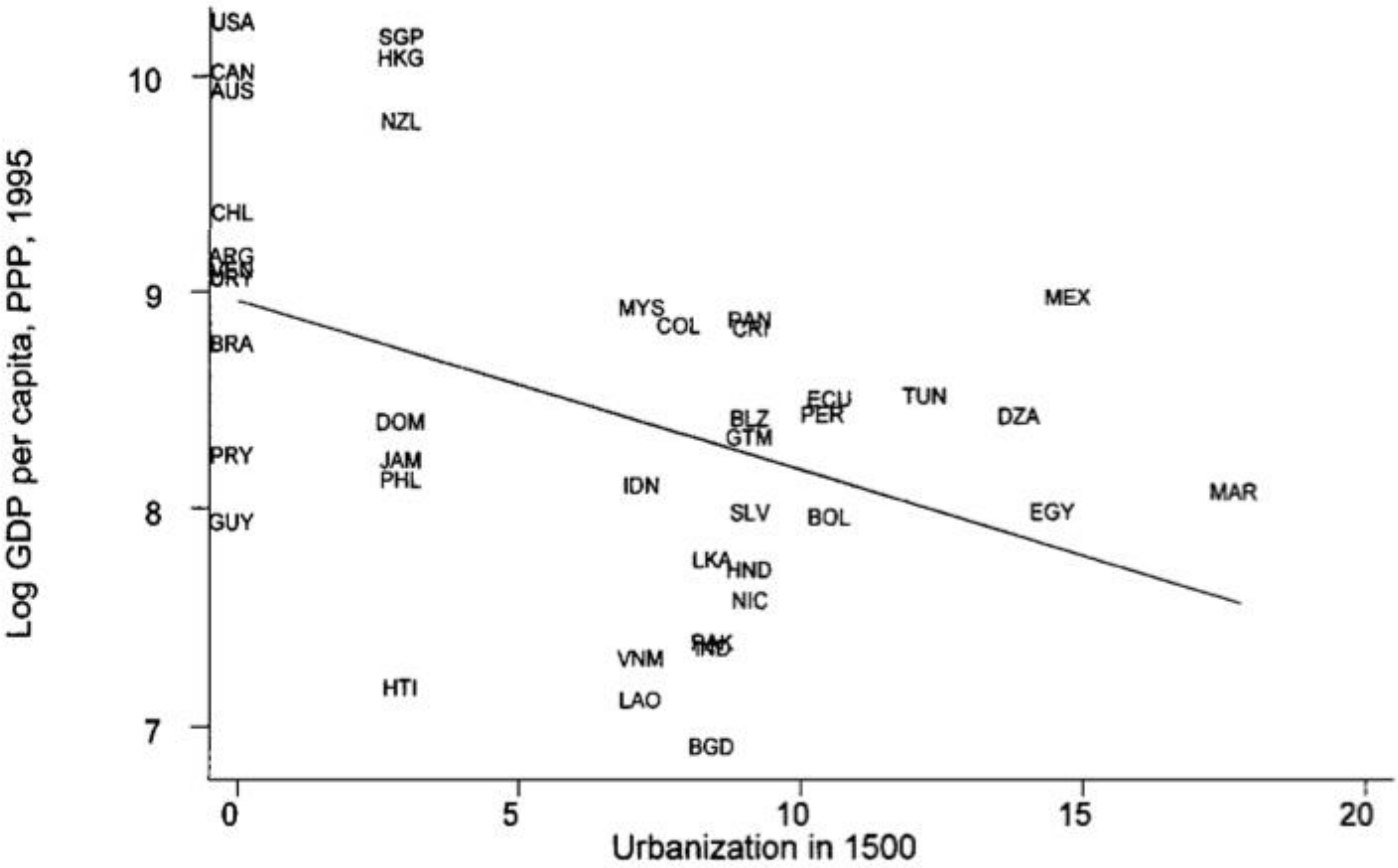
$$E[\ln(y_a)\,|A_r]-E[\ln(y_a)\,|A_n]$$
$$=\pi_1[g(a-a_K,\mu_1)-g(a-a_K-1,\mu_1)]+(1-\pi_1)[f(S_0+1,\mu_2)-f(S_0,\mu_2)]$$

Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution

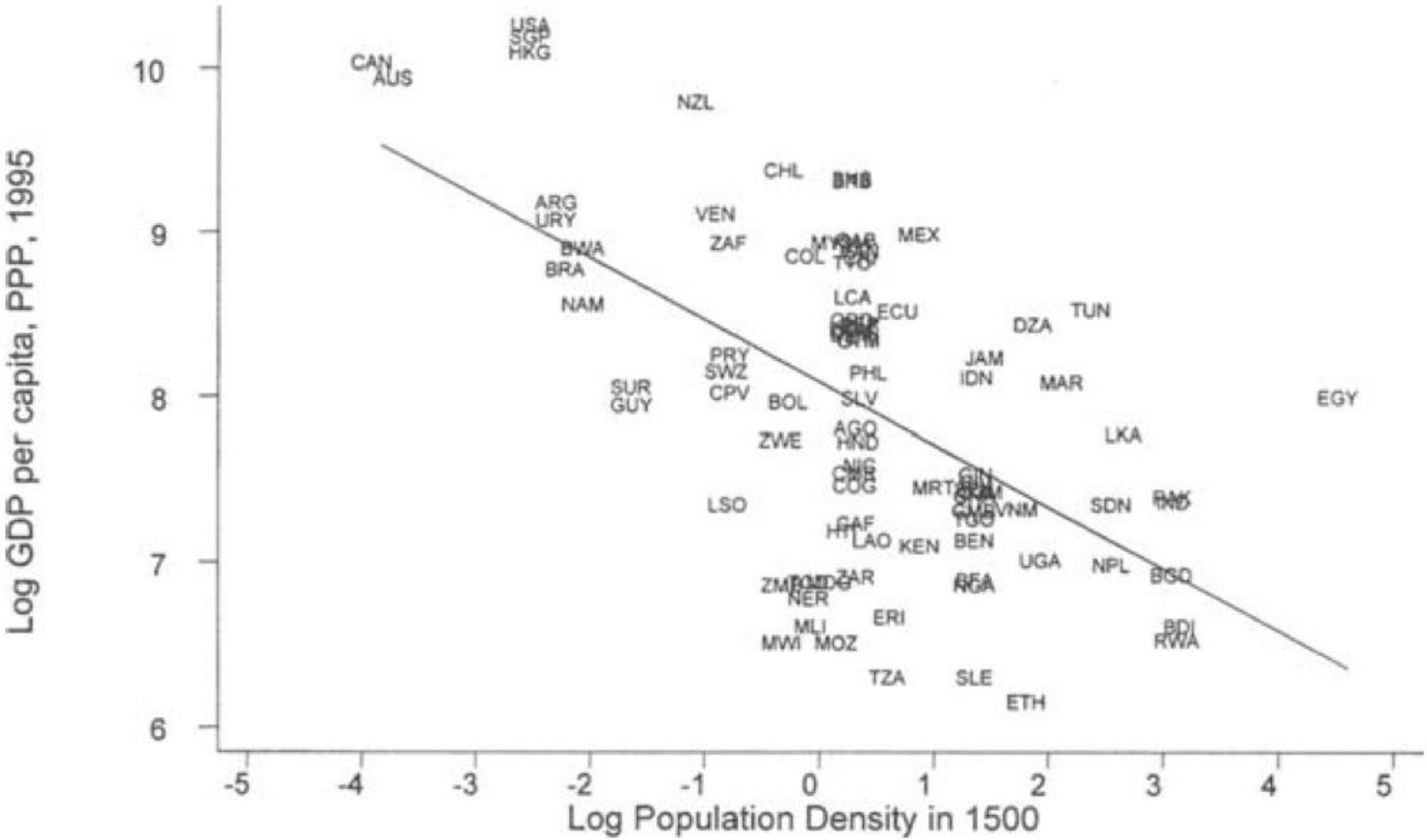
Daron Acemoglu, Simon Johnson and James Robinson

(Quarterly Journal of Economics 2002)

Negative Association between Economic Prosperity in 1500 and 1995



Negative Association between Economic Prosperity in 1500 and 1995



Determinants of Long-Run Development

- Competing theories:
  - The <u>geography</u> hypothesis
    - Geographic variables (climate and diseases, presence of natural resources) affect work effort and productivity
    - Certain geographic characteristics that were not useful or harmful for economic success in 1500 may be beneficial today
    - None of these theories explain the reversal that occurred during the late 18th Century.
  - The <u>institutions</u> hypothesis
    - Economic performance is related with the organization of society
    - Opportunities for investment leads to richer societies
    - Institutions of private property vs extractive institutions
    - Two different strategies from European Colonialism

Determinants of Long-Run Development

- The institutions hypothesis
  - Relatively poor regions were sparsely populated which induced Europeans to settle in large numbers
  - They developed institutions to encourage investment
  - Large populations and prosperity made extractive institutions profitable for the colonizers
  - Expansion of European empires overseas combined with these institutions is consistent with the reversal in relative incomes
  - Institutional differences should matter more when new technologies that require large investments become available
    - Interactions between institutions and opportunities to industrialize during the 19th century played a central role in the long-run development

Urbanization and Population Density as Proxies for Prosperity

- Why urbanization and income are positively related?
  - Existence of urban centers presupposes a surplus of agricultural product and the possibility of using it for trade
  - A regression of income per capita on urbanization implies that a country with 10% higher urbanization has on average 46% greater income per capita
- Why population density and income are positively related?
  - This relationship is less clear
  - Intuitively, only rich areas could afford dense populations
  - Because of demographic transitions, in recent data this cross-sectional relationship is no longer true (relationship between income and number of children has changed)
  - Still use this because data is more extensively available and population density is closely related to urbanization

OLS Results with Urbanization

	Dependent variable is log GDP per capita (PPP) in 1995								
	Base sample (1)	Without North Africa (2)	Without the Americas (3)	Just the Americas (4)	With continent dummies (5)	Without neo-Europes (6)	Controlling for latitude (7)	Controlling for climate (8)	Controlling for resources (9)
Urbanization in 1500	−0.078 (0.026)	−0.101 (0.032)	−0.115 (0.051)	−0.053 (0.029)	−0.083 (0.030)	−0.046 (0.026)	−0.072 (0.025)	−0.088 (0.030)	−0.058 (0.029)
Asia dummy					−1.33 (0.61)				
Africa dummy					−0.53 (0.77)				
America dummy					−0.96 (0.57)				
Latitude							1.42 (0.92)		
P-value for temperature								[0.51]	
P-value for humidity								[0.40]	
P-value for soil quality								[0.96]	
P-value for resources									[0.16]
R^2	0.19	0.22	0.26	0.13	0.32	0.09	0.24	0.53	0.45
Number of observations	41	37	17	24	41	37	41	41	41

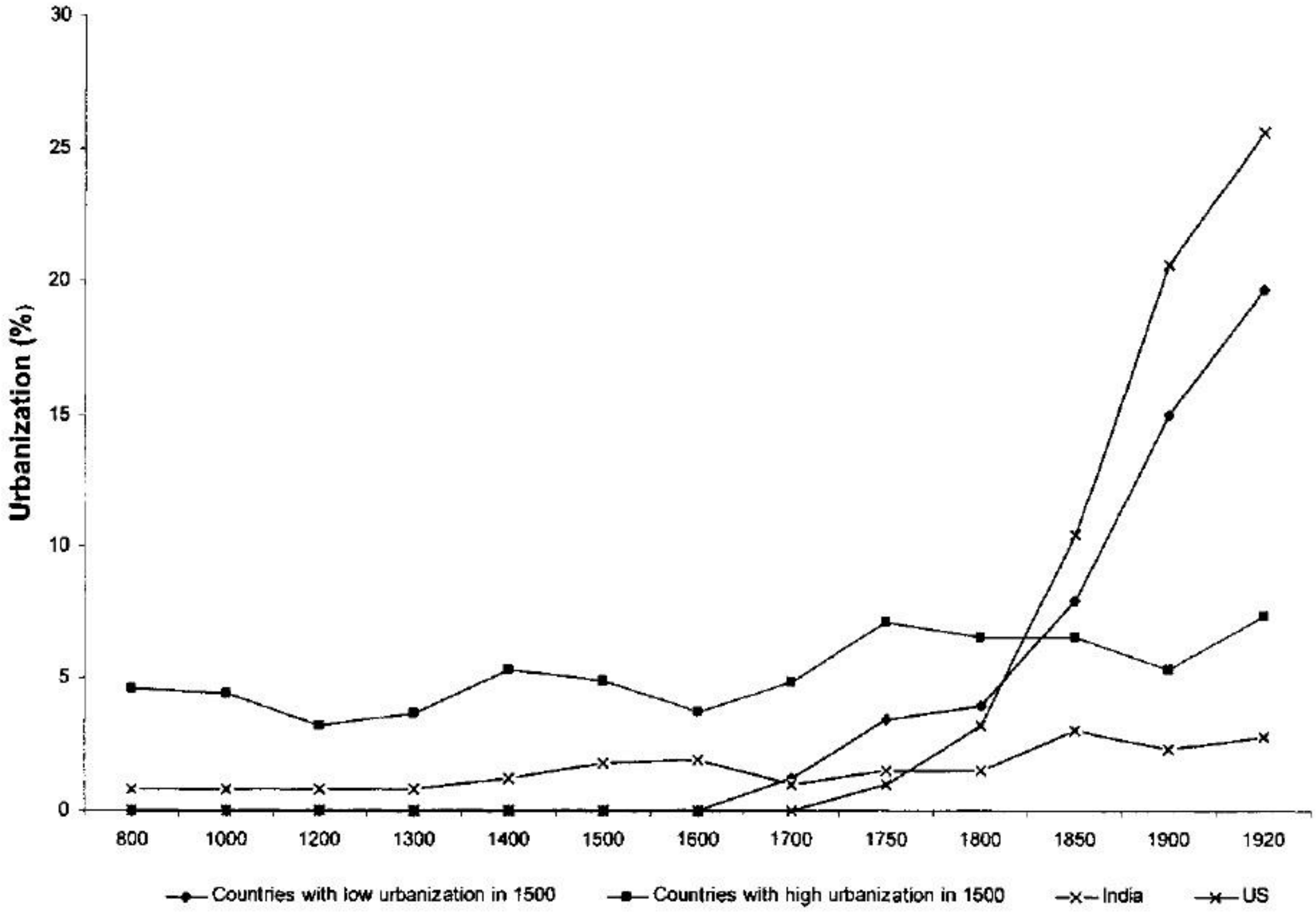
OLS and IV Results with Population Density

	Dependent variable is log GDP per capita (PPP) in 1995								
	Base sample (1)	Without Africa (2)	Without the Americas (3)	Just the Americas (4)	With continent dummies (5)	Without neo-Europes (6)	Controlling for latitude (7)	Controlling for climate (8)	Controlling for resources (9)
Panel A: Log population density in 1500 as independent variable									
Log population density in 1500	−0.38 (0.06)	−0.40 (0.05)	−0.32 (0.07)	−0.25 (0.09)	−0.26 (0.05)	−0.32 (0.06)	−0.33 (0.06)	−0.31 (0.06)	−0.30 (0.06)
R^2	0.34	0.55	0.27	0.22	0.56	0.24	0.40	0.59	0.54
Number of observations	91	47	58	33	91	87	91	90	85
Panel C: Using population density in 1000 A.D. as an instrument for population density in 1500 A.D.									
Log population density in 1500	−0.31 (0.06)	−0.4 (0.06)	−0.15 (0.08)	−0.38 (0.11)	−0.18 (0.07)	−0.22 (0.08)	−0.27 (0.06)	−0.26 (0.07)	−0.22 (0.07)
Number of observations	83	43	51	32	83	80	83	83	78

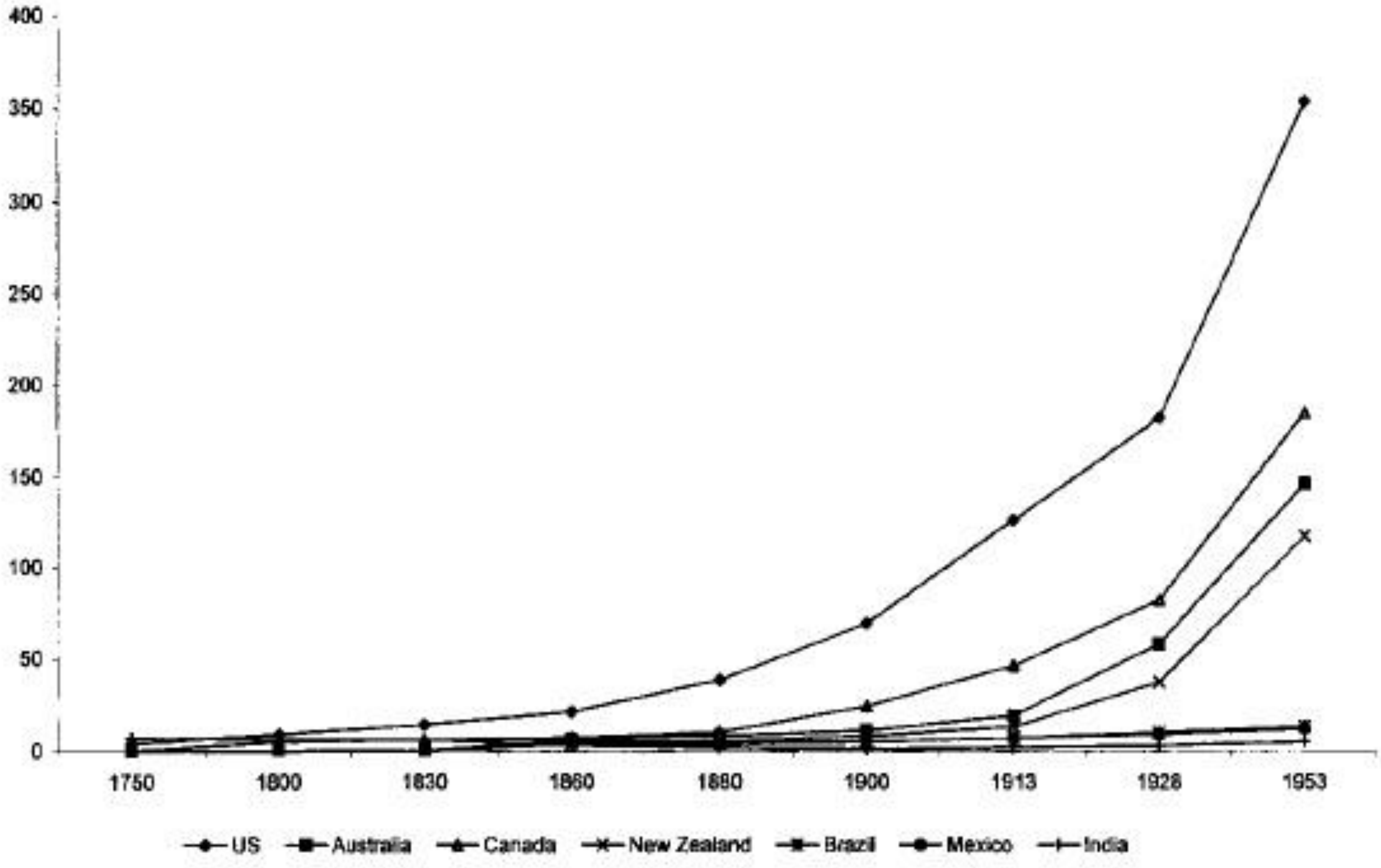
Pop. density in 1500 A.D. instrumented with pop. density in 1000 A.D. Why?

- Differences in long-run population density are likely to be better proxies of income per capita

Timing of the Reversal: Urbanization Rate



Timing of the reversal: Industrial Production



The Institutional Explanation

- Societies that encourage investment will prosper
- Importance of property rights, where those with productive opportunities expect to receive the returns from their investments
- Europeans were more likely to develop institutions of private property when they settled in large numbers
  - They were affected by these institutions
  - Europeans could easily settle in large numbers in sparsely inhabited areas
- When these conditions were not guaranteed there was an “institutional reversal” that caused the “income reversal”
  - If this is true, then accounting for the role of institutions in the regressions should make the income reversal disappear

The Institutional Explanation

- Given the model

$$Y = \alpha X + \beta Z + \epsilon$$

  - Y is income today,
  - X are institutions
  - Z is population density / urbanization in 1500 A.D.
  - Endogeneity bias due to omitted variables and measurement error

- The solution is to use an instrument M for the variable X

First stage: $X = cM + dZ + u_3$

Second stage: $\mathrm{Y} = a\hat{X} + bZ + u_2{}'$

- Instrument: mortality rates faced by settlers between the 17^{th} and 19^{th} centuries

The Institutional Explanation: Instrument

- Is this instrument appropriate?
- Instrument's relevance: Explains settlements of Europeans in the colonies and the subsequent institutional development of these countries
  - Europeans did not settle in areas with high mortality and were more likely to develop extractive institutions
- Exclusion restriction: mortality rates of Europeans over 100 years ago have no effect on GDP per capita today, except through institutions
  - In this case this restriction is plausibly valid because mortality rates were higher for Europeans than for natives
  - Natives developed high degree of immunity to malaria and yellow fever, the main killers of Europeans

2SLS Results

- Three measures of institutions

GDP per Capita and Institutions

	Dependent variable is log GDP per capita (PPP) in 1995					
Institutions as measured by:	Average protection against expropriation risk, 1985–1995		Constraint on executive in 1990		Constraint on executive in first year of independence	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Second-stage regressions						
Institutions	0.52 (0.10)	0.88 (0.21)	0.84 (0.47)	0.50 (0.11)	0.37 (0.12)	0.46 (0.16)
Urbanization in 1500	−0.024 (0.021)		0.030 (0.078)		−0.023 (0.034)	
Log population density in 1500		−0.08 (0.10)		−0.10 (0.10)		−0.13 (0.10)

First Stage

	Dependent variable is log GDP per capita (PPP) in 1995					
Institutions as measured by:	Average protection against expropriation risk, 1985–1995		Constraint on executive in 1990		Constraint on executive in first year of independence	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel B: First-stage regressions					
Log settler mortality	−1.21	−0.47	−0.75	−0.88	−1.81	−0.78
	(0.23)	(0.14)	(0.44)	(0.20)	(0.40)	(0.25)
Urbanization in 1500	−0.042		−0.088		−0.043	
	(0.035)		(0.066)		(0.061)	
Log population density in 1500		−0.21		−0.35		−0.24
		(0.11)		(0.15)		(0.17)
R^2	0.53	0.29	0.17	0.37	0.56	0:26
Number of observations	38	64	37	67	38	67

Institutions and Industrialization

- Hypothesis: the income reversal occured during the time of industrialization
- Countries with extractive instructions were not interested (and actually may have blocked) industrialization
  - Elites were not the potential beneficiaries
  - Elites feared political turbulence and loss of political power
  - Entrepreneurs were afraid of being expropiated
- Empirical test: effect of the opportunity to industrialize on income per capita and industrial output per capita

$$y_{it} = \mu_t + \delta_i + \pi X_{it} + \phi X_{it} UKIND_t + \epsilon_{it}$$

  - μ_t and δ_i are time and country fixed effects
  - X_{it} are the constraints on the executive as measure of institutions
  - $UKIND_t$ is the industrial output un the UK (opportunity to industrialize)

Institutions and Industrialization

THE INTERACTION OF U. K. INDUSTRIALIZATION AND INSTITUTIONS

	Former colonies, using only pre-1950 data (1)	Former colonies, using data through 1980 (all data) (2)	Former colonies, using only pre-1950 data (3)	Former colonies, using only data pre-1950 and for independent countries (4)	Former colonies, with average institutions for each country, using only pre-1950 data (5)	Former colonies, with average institutions for each country, using only pre-1590 data (6)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (7)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (8)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (9)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (10)
Panel A: Dependent variable is industrial production per capita										
U. K. industrialization *institutions	0.132 (0.026)	0.132 (0.027)	0.145 (0.035)	0.160 (0.048)	0.202 (0.019)	0.206 (0.022)	0.168 (0.030)	0.169 (0.032)	0.156 (0.065)	0.158 (0.065)
Institutions	8.97 (2.30)	−3.36 (4.46)	10.51 (3.50)	7.48 (9.51)						
Independence			−14.3 (22.9)			−6.4 (11.4)		1.1 (12.6)		2.0 (14.2)
U. K. industrialization *independence			−0.12 (0.21)			−0.042 (0.12)		0.046 (0.13)		0.06 (0.17)
U. K. industrialization *latitude									0.13 (0.50)	0.12 (0.48)
R^2	0.75	0.74	0.75	0.84	0.89	0.89	0.88	0.88	0.87	0.87
Number of observations	59	75	59	32	59	59	59	59	59	59

Conclusion

- The intervention of Europe through colonization altered the income pattern
  - The income reversal is inconsistent with the simple geography hypothesis, and also with the time-varying effects of geography
  - The reversal appears to reflect the effect of institutions on income today
- Alternative colonization strategies were implemented according to their profitability given the environment
  - In prosperous or dense areas the extractive institutions were mantained or introduced
  - More sparse areas favored the introduction of private property
- These institutions affected the likelihood of industrialization

Dams

Esther Duflo and Rohini Pande

(Quarterly Journal of Economics 2007)

Do dams cause development and reduce poverty?

- Half of the world’s rivers are obstructed by a dam
  - Dams generate 19% of electricity and 30% of irrigation, worldwide
  - But, they displaced 40 million people and increase the salination and waterlogging of arable land
- Distributional vs productivity implications of public policy
- How are distributed the benefits of dam construction?
  - To what extent the rural poor have benefited

Do dams cause development and reduce poverty?

- Downstream populations benefit from the dam
  - Reducing dependency on rainfall
  - Enabling irrigation
  - Providing water and hydropower
- Populations in the vicinity of the dam and upstream bear the costs
  - Reduction of agricultural and forest land
  - Reduction of productivity of land because of salinity and waterlogging
  - Restricted access to water
- How to compensate upstream populations?

Dam Construction in India

- Third most prolific dam builder
  - Justification for such investments: agricultural growth and poverty alleviation
- How to evaluate the economic impact of dam construction?
  - Comparison of regions with and without dams unlikely to provide causal estimates of the effects. Why?
- IV strategy: use the gradient at which the river flows
  - It affects non-monotonically the suitability for dam construction
  - Low gradients are suitable for irrigation dams
  - High gradients are suitable for electricity dams

Dam Construction Background

- Dam's construction involves federal and state governments
  - A federal body set water storage and irrigation targets
  - Given the targets and topological surveys the states propose dam projects
  - The federal body selects the final projects
- Government bought the land of displaced population
  - This compensation does not cover the landless and those without a formal land title
- Data availability at the district level
  - 466 districts with an average population of 1.5 million
  - Interest in the upstream and downstream district for each dam
  - Useful to deal with within-district migration (the most common according to survey data)

Dam Construction Background

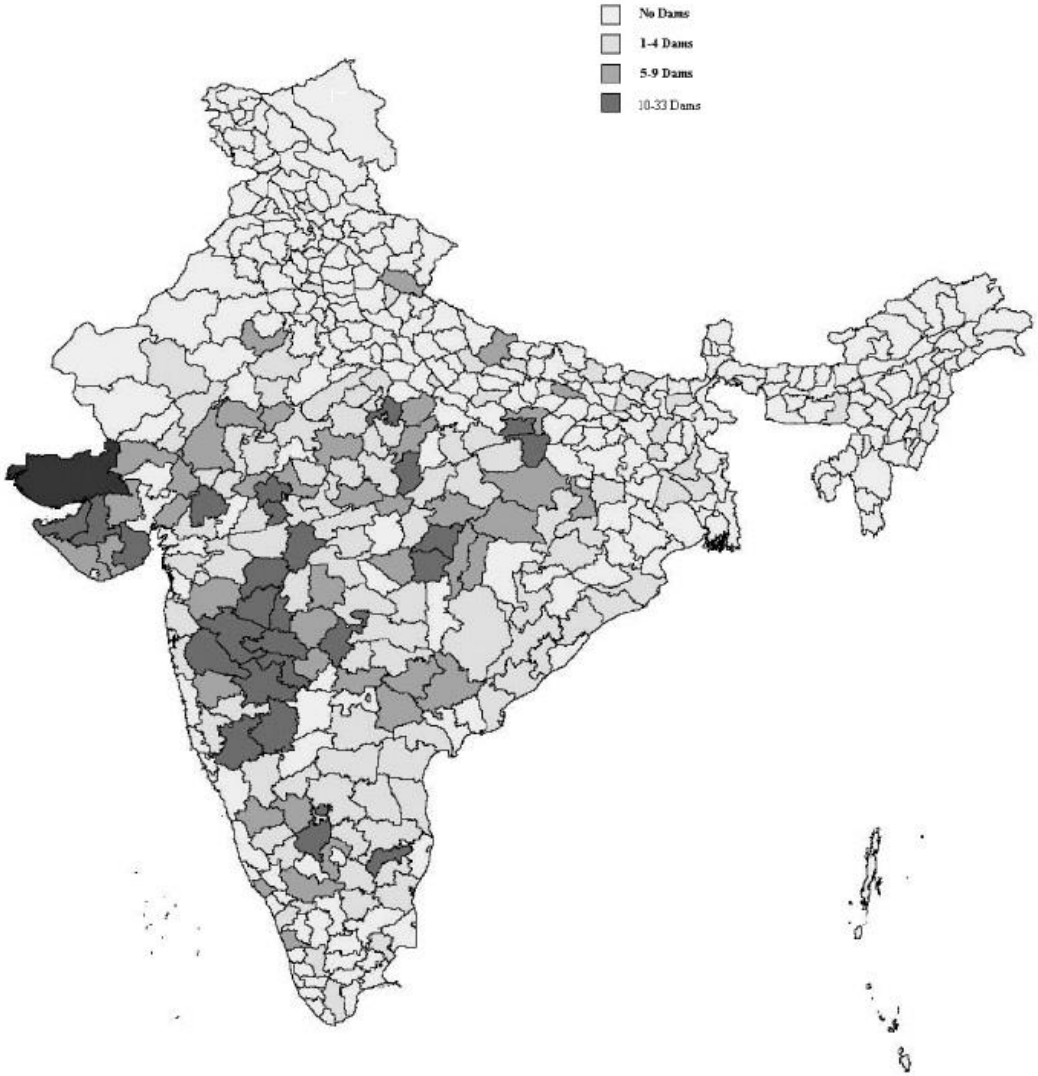


FIGURE I
Distribution of Dams across Indian Districts, 1970

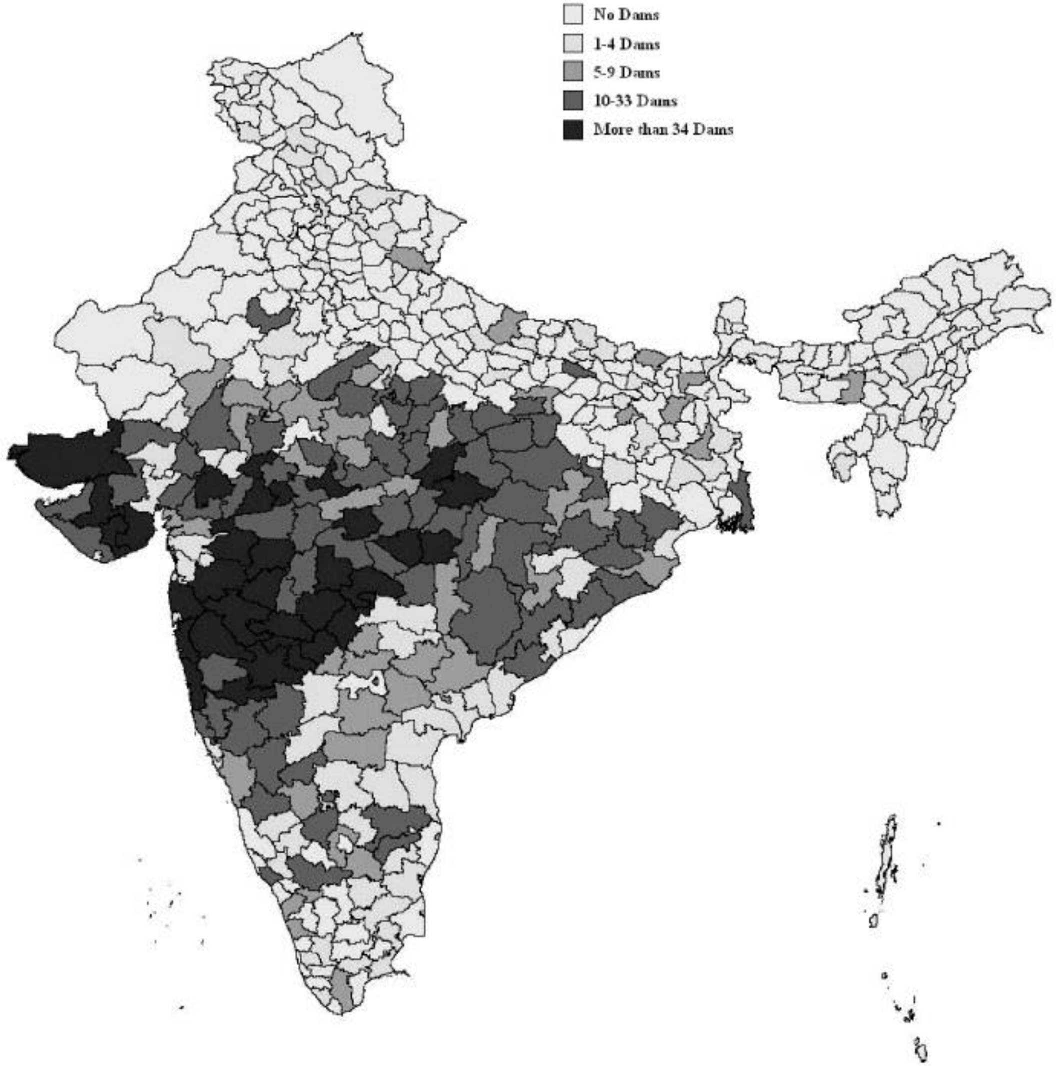


FIGURE II
The Distribution of Dams across Indian Districts, 1999

Empirical Strategy

- Use Indian district panel data on geography, dam placement and poverty and agricultural outcomes
  - Rise in dam construction in the 70's and 80's but slowed down in the 90's
- The OLS regression is unlikely to be consistent: richer and growing states can build relatively more dams
- Identification is based on within-state differences on dam construction.

$$y_{ist} = \beta_1 + \beta_2 D_{ist} + \beta_3 D_{ist}^U + \beta_4 Z_{it} + \beta_5 Z_{it}^U + \nu_i + \mu_{st} + \omega_{ist}$$

  - D_{ist} and D_{ist}^U : number of dams in district i and upstream from district i
  - Z_{ist} and Z_{ist}^U time variant controls from the district and upstream districts
  - ν_i : district fixed effect
  - μ_{st}: state year interaction

Instrumental Variable Strategy

- Fraction of districts on four categories of steepness (flat, moderate, steep, very steep)

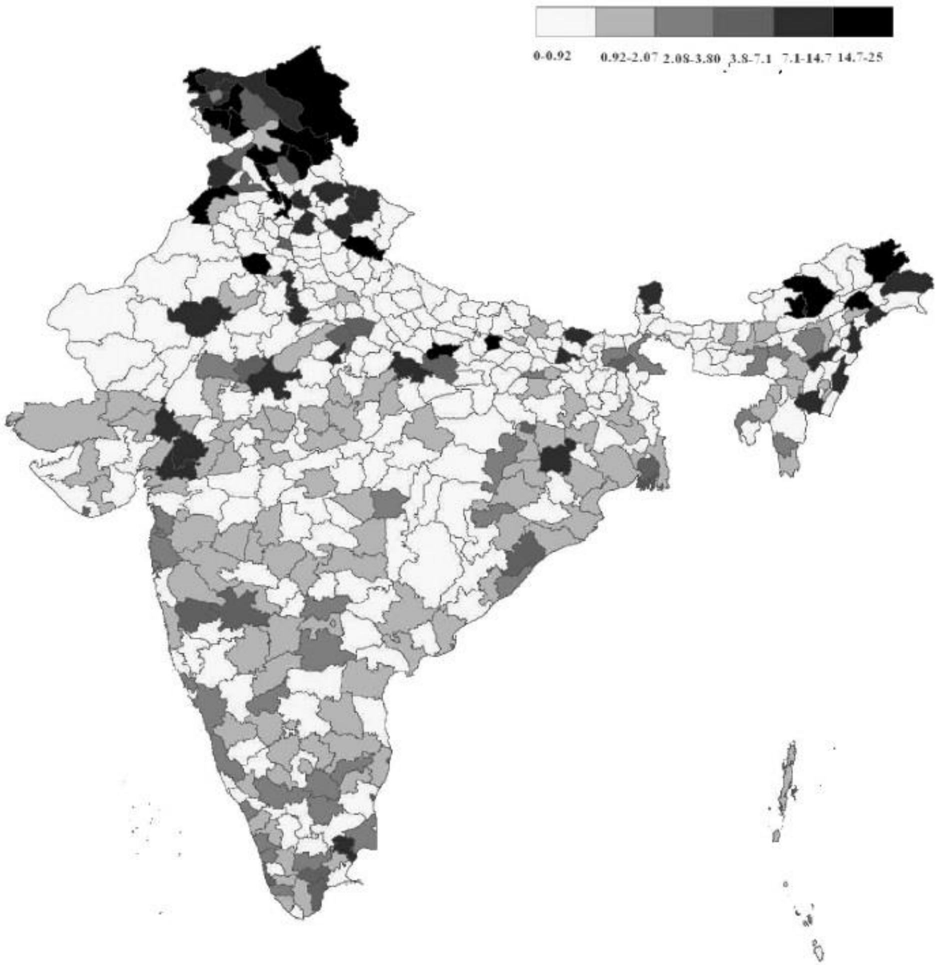


FIGURE IV
Average River Gradient (in Percentage), by District

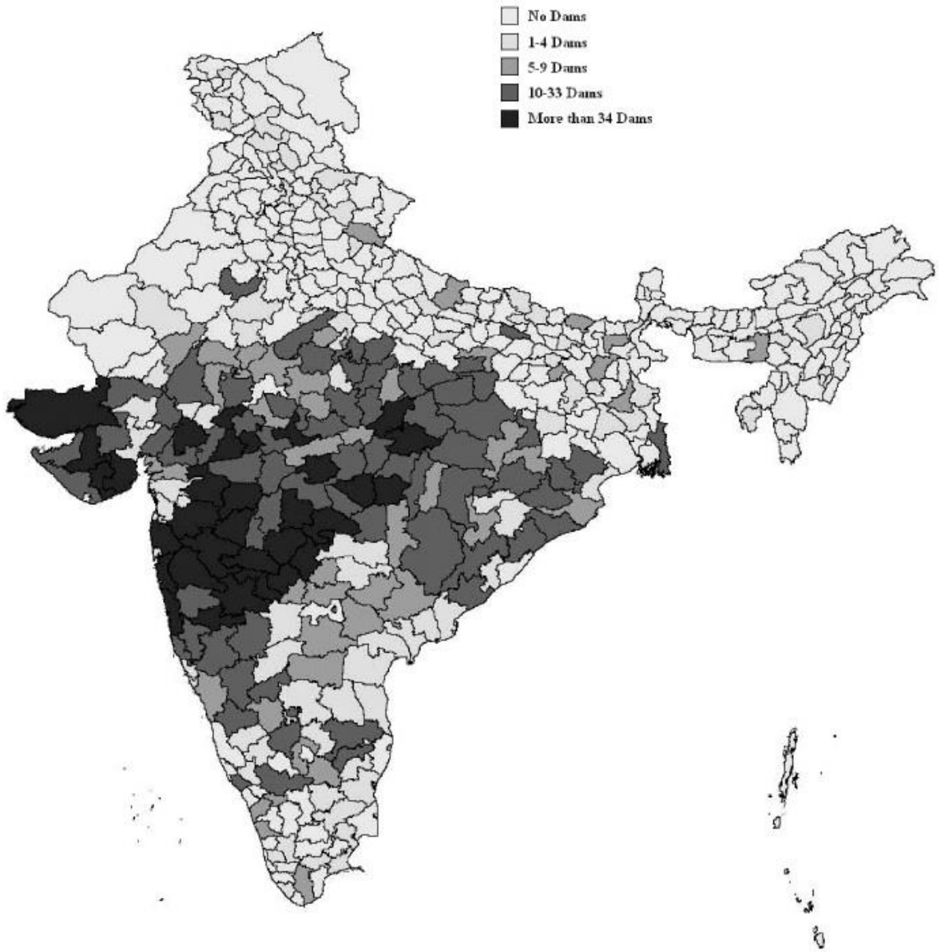


FIGURE II
The Distribution of Dams across Indian Districts, 1999

Instrument's Relevance

GEOGRAPHY AND DAM CONSTRUCTION

	Number of dams		
	Cross-section (1999)	Poverty sample	Production sample
	Not interacted	Interacted with predicted number of dams in the state	
	(1)	(2)	(3)
Fraction river gradient 1.5–3%	0.278	0.153	0.176
	(0.122)	(0.040)	(0.094)
Fraction river gradient 3–6%	−0.210	−0.191	−0.219
	(0.127)	(0.065)	(0.128)
Fraction river gradient above 6%	0.014	0.075	0.097
	(0.033)	(0.031)	(0.043)
F-test for river gradient	1.764	6.372	7.68
[*p*-value]	[0.15]	[0.000]	[0.053]
Geography controls	Yes	Yes	Yes
State*year and river gradient*year interactions	No	Yes	Yes
Fixed effects	State	District	District
N	374	1855	7743

Predicted Dams

$$D_{ist} = \alpha_1 + \sum_{k=2}^{4} \alpha_{2k} \left(RGr_{ki} \cdot \overline{D_{st}}\right) + \alpha_3\left(M_i \cdot \overline{D_{st}}\right) + \sum_{k=2}^{4} \alpha_{4k} \left(RGr_{ki} \cdot l_t\right) + \nu_i + \mu_{st} + \omega_{ist}$$

- D_{ist} is the number of dams
- RGr_{ki} is the river gradient variable
- $\overline{D_{st}}$ is the predicted dam incidence in 1970 in state s
- $RGr_{ki} \cdot l_t$ accounts for national time-varying fixed effects of river-gradient on the outcomes of interest
- M_i is a vector of district-specific time-invariant control variables
- ν_i is a district fixed effect and μ_{st} a state year interaction
- ω_{ist} is the district year error term

First stage

- The values $\widehat{D_{ist}}$ and $\widehat{D_{ist}^{U}}$ are used as an instrument for D_{ist} and D_{ist}^{U}
- Why not use the gradient directly?
  - To avoid averaging information when there are multiple upstream districts
  - If each district has another single upstream district there will be no problem, and it will be identical to the 2SLS estimator
- Intuition? Both $\widehat{D_{ist}}$ and $\widehat{D_{ist}^{U}}$ are used as instruments, but they are computed without using yet the information of upstream districts
- The first stage regression is

$$\Delta_{ist} = \phi_1 + \phi_2 \widehat{D_{ist}} + \phi_3 \widehat{D_{ist}^{U}} + \phi_4 Z_{it} + \phi_5 Z_{it}^{U} + \nu_i + \mu_{st} + \omega_{ist}$$

  - With $\Delta_{ist} = D_{ist}$ or D_{ist}^{U}
  - Identification assumption: in absence of dams district with different gradients would not have systematically differ across states with more dams with respect to those with less dams in 1970

Results

- Dams increase downstream district's irrigated area and production of water-intensive crops. The effects are insignificant in own district.

TABLE III
DAMS AND AGRICULTURE

	Area				Inputs	Agricultural production			
	Gross irrigated area		Gross cultivated area		Fertilizer use	Production	Yield	Production	
	Level	Log	Level	Log		All crops		Water-intensive crops	Non–water-intensive crops
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Part A. FGLS									
Dams									
Own district	14.528	0.131	114.493	0.094	0.231	0.184	0.152	0.063	0.640
	(13.300)	(0.156)	(47.838)	(0.059)	(0.342)	(0.334)	(0.196)	(0.334)	(0.585)
Upstream	17.830	0.198	77.641	0.028	0.256	0.530	0.227	0.569	0.801
	(12.639)	(0.162)	(48.233)	(0.054)	(0.339)	(0.155)	(0.141)	(0.243)	(0.307)
Part B. Feasible Optimal IV									
Dams									
Own district	232.092	0.728	325.358	0.875	0.563	0.085	−0.033	0.366	−0.105
	(235.847)	(1.002)	(263.509)	(0.590)	(1.244)	(0.699)	(0.451)	(0.782)	(1.349)
Upstream	49.754	0.328	58.602	0.088	0.169	0.341	0.193	0.470	0.181
	(22.339)	(0.154)	(35.674)	(0.062)	(0.175)	(0.118)	(0.097)	(0.154)	(0.307)
N	4,536	4,536	4,522	4,522	4,521	7,078	7,077	7,143	6,786
First stage *F*-statistic (own district)	8.48	8.48	8.51	8.51	8.5	9.22	9.22	9.03	9.14

Results

- In Panel A is verified that the effect does not come from neighboring districts not located upstream.
- In Panel B is verified that the effect came from constructed dams (dummy for dams under construction the last 5 years)

TABLE IV
THE REACH OF DAMS: 2SLS ESTIMATES

	Agricultural production	Headcount ratio	Poverty gap
	(1)	(2)	(3)
Part A. Neighboring districts			
Dams			
Own district	0.345	0.594	0.223
	(1.148)	(0.306)	(0.101)
Upstream	0.665	−0.170	−0.045
	(0.220)	(0.078)	(0.023)
Downstream	−0.107	0.073	0.022
	(0.260)	(0.060)	(0.021)
Neighboring but not upstream/ downstream	−0.175	0.013	−0.008
	(0.203)	(0.072)	(0.026)
N	7,078	1,799	1,799
Part B. Time Effects			
Dams			
Own district	0.109	0.888	0.417
	(1.266)	(0.444)	(0.194)
Own district, completed in next 5 years	0.891	2.004	0.963
	(3.376)	(1.213)	(0.433)
Upstream	0.187	−0.156	−0.049
	(0.323)	(0.154)	(0.058)
Upstream, completed in next 5 years	−1.127	0.061	−0.025
	(0.683)	(0.372)	(0.137)
N	4,992	1,443	1,443

Results

- In the own district there is a positive effect of rain shocks, but not in the upstream district
  - Interpreted in the opposite direction means that districts are more vulnerable to rain shocks

TABLE VI
DAMS AND RAINFALL SHOCKS

	Agricultural production		Headcount ratio		Poverty gap	
	(1)	(2)	(3)	(4)	(5)	(6)
Rainshock	0.065	0.008	−0.041	−0.036	−0.012	−0.0001
	(0.030)	(0.044)	(0.019)	(0.026)	(0.007)	(0.010)
Dams	−0.011	0.109	0.765	0.713	0.294	0.255
	(1.227)	(1.228)	(0.324)	(0.320)	(0.111)	(0.108)
Dams*rainshock		0.898		−0.243		−0.203
		(0.364)		(0.191)		(0.088)
Upstream dams	0.722	0.734	−0.149	−0.130	−0.038	−0.030
	(0.197)	(0.195)	(0.067)	(0.068)	(0.019)	(0.019)
Upstream dams*rainshock		−0.184		0.109		0.034
		(0.092)		(0.059)		(0.022)
N	7,078	7,078	1,799	1,799	1,799	1,799

Institutions and Dams

- During the colony, in ``landlord'' districts an intermediary appointed by the British collected taxes in exchange for property rights. Landed gentry emerged in these districts

TABLE IX
INSTITUTIONS AND DAMS: 2SLS ESTIMATES

	Agricultural production	Headcount ratio	Poverty gap
	(1)	(2)	(3)
Dams	−0.439	1.072	0.332
	(2.129)	(0.539)	(0.178)
Dams*nonlandlord dummy	−0.125	−0.639	−0.193
	(1.067)	(0.309)	(0.102)
Dams*tribal population share	1.354	0.711	0.087
	(2.637)	(0.790)	(0.276)
Upstream dams	1.015	−0.393	−0.131
	(0.708)	(0.293)	(0.102)
Upstream dams* Nonlandlord dummy	0.160	0.196	0.061
	(0.705)	(0.264)	(0.085)
Upstream dams*tribal population share	−0.609	−0.057	−0.015
	(0.701)	(0.191)	(0.060)
N	4,090	914	914

Conclusion

- The evaluation of constructed dams tends to have endogeneity issues
  - The location, rather than random, is driven by regional wealth and expected returns
  - This works exploits the geographic suitability of the dams
- Costs and benefits have an unequal distribution
  - Downstream populations get benefits from large dams
  - Those in the vicinity of the dam bear the costs and are more exposed to weather shocks
- In areas with political inequalities large dam construction is associated with a greater increase in poverty

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