The Development Effect Of The Extractive Colonial Economy: The Dutch Cultivation System In Java

Part 1 Introduction

➢What is the effect of the Colonial System?

Positive

Colonial powers potentially facilitated economic activity

VS

Negative

Extractive colonial system made some places poorer

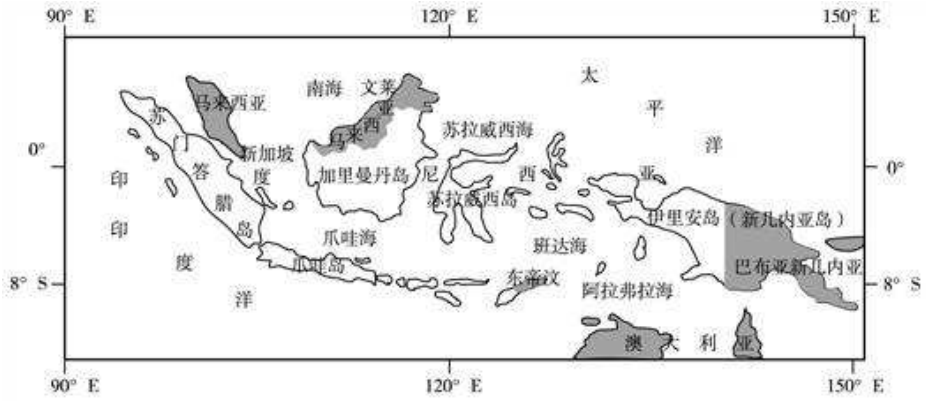
STUDY：

This paper examines the persistent local development effects of the extractive system——by studying the Dutch Cultivation System in Java

Part 1 Introduction

JAVA

The island of Java is the main economic and population center



1 | Change

The colonial state forced peasants to cultivate sugar instead of rice

2 | Impact

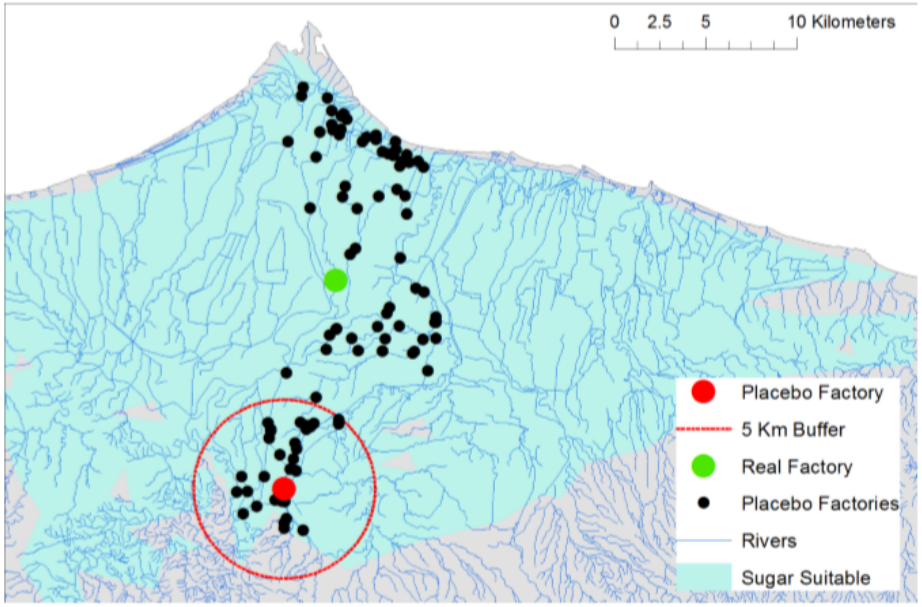
(1)The creation of manufacturing in the previously agricultural heartland

(2)Grow sugar and supply labor for the factories

Part 1 Introduction

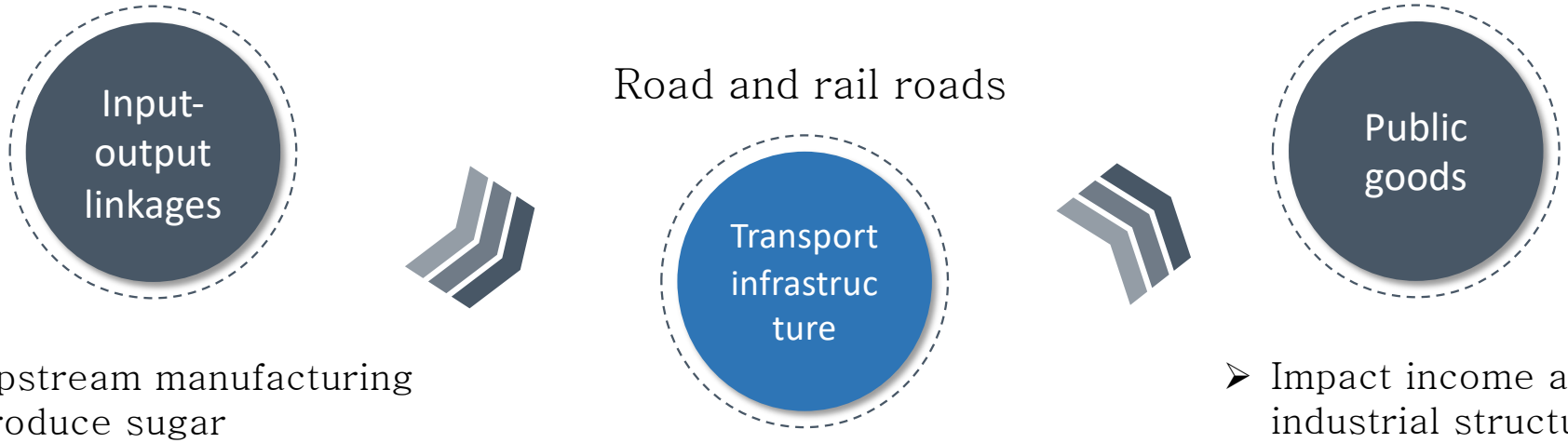
(1)The creation of manufacturing in the previously agricultural heartland
——Counterfactual spatial configuration

(c) Placebo Factories



- Upstream or downstream from the actual factory
- Be similar to the amount of suitable land near actual factory
- Spaced sufficiently far apart
- Geographic characteristics
  - elevation
  - Slope
  - distance to the coast
  - distance to the nearest river
  - flow accumulation
  - distance to the nearest 1830 residency capital
  - distance to the (pre-period) Great Post Road
  - distance to the nearest (pre-period) Dutch East India Company (VOC)

Part 1 Introduction



- Upstream manufacturing produce sugar
- Downstream industries use sugar

- Impact income and industrial structure
- With electricity and high schools

Colonial sugar industry transformed economic activity in contemporary Java.

◆ People living within a few kilometers of historical sugar factories are more likely to be employed in manufacturing or retail and the value of P is significant.

Part 1 Introduction

JAVA

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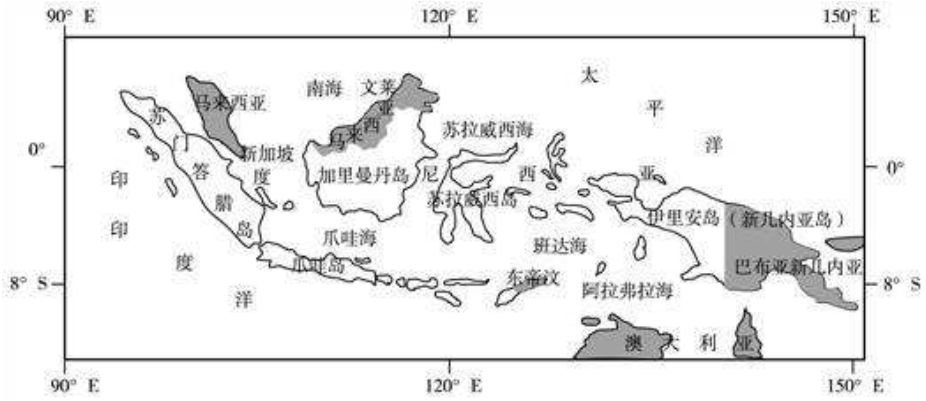

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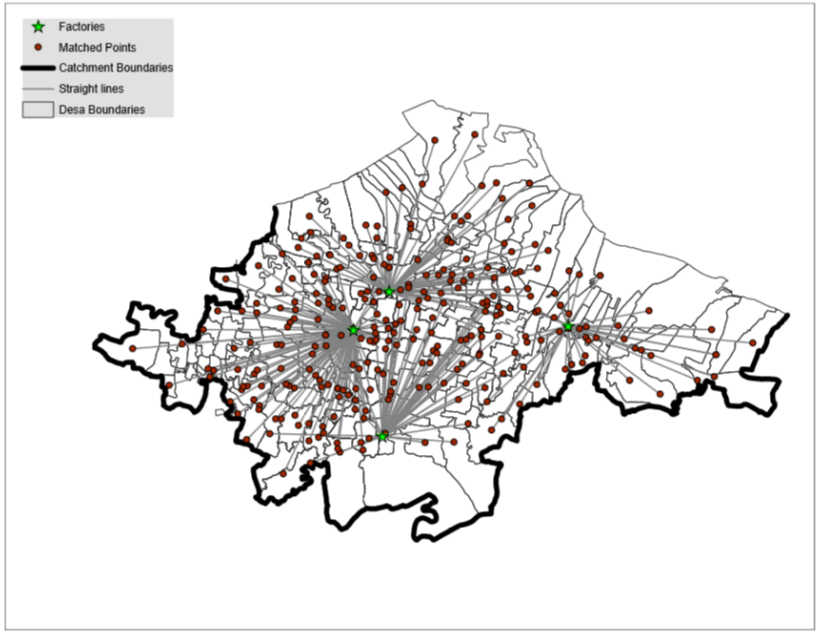
Part 1 Introduction

(2) Grow sugar and supply labor for the factories
—— a special discontinuity across the borders of the catchment areas

Figure 3: Construction of Catchment Areas



- A handwritten list of the over 10000 villages subjected to forced cultivation in Hague
- X: the distance to the nearest factory
  Y: the impact
- Assumption: land allocations, public goods and schools

2 | Impact

(1)The creation of manufacturing in the previously agricultural heartland

(2)Grow sugar and supply labor for the factories

Part 1 Introduction

- Why does the Dutch sugar system lead to positive long-run development outcomes?

The role of manufacture

- The Cultivation System required substantial local manufacturing in order to process sugar cane prior to transport.
- These areas have persisted as manufacturing centers despite the mass exodus of Dutch human.

Investments in infrastructure

- Dutch made important infrastructure investments in both rail and roads to transport the manufactured sugar and these investment have persisted to the present

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The Development Effect Of The Extractive Colonial Economy: The Dutch Cultivation System In Java

Part 2 Historical Background

2.1 An Overview of the Cultivation System

1830	1870	1880	The Great Depression
The Cultivation System was created	Europeans were allowed to rent or purchase land	The Dutch phased out it	The industry collapsed

Part 2 Historical Background

2.1 An Overview of the Cultivation System

SYSTEM

Land & Labor

- Java's Northeast Coast
- 1/5 land
- Free laborers

Factory owner

- Factories were run by private entrepreneurs

Administrative Structure

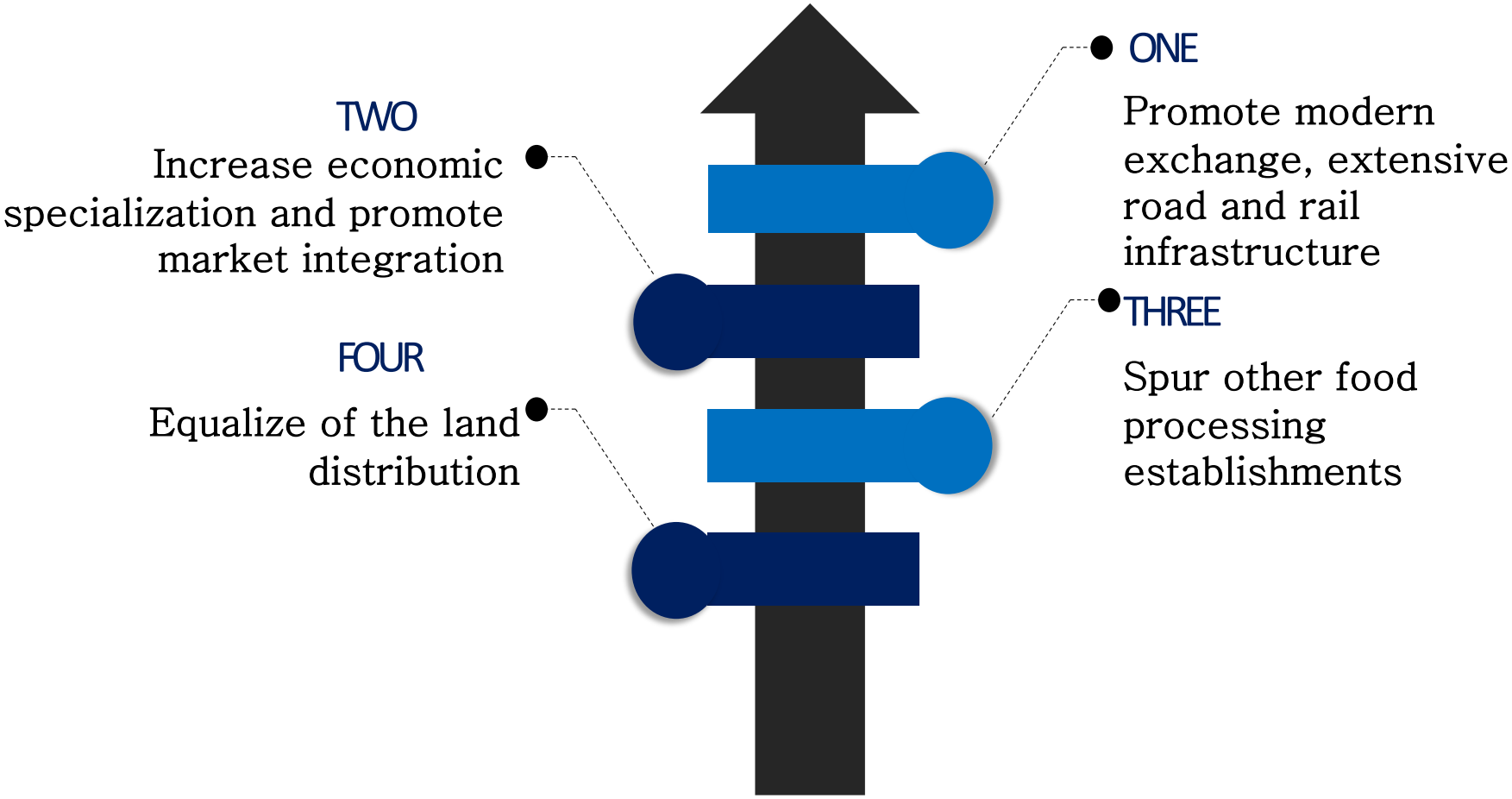
- Javanese officials and village heads
- periodic rotation
- Dutch has the right to replace

ACHIEVEMENT

- To Dutch: One of the world's most financially lucrative colonies
- To Java: 1/4 native Javanese population was involved

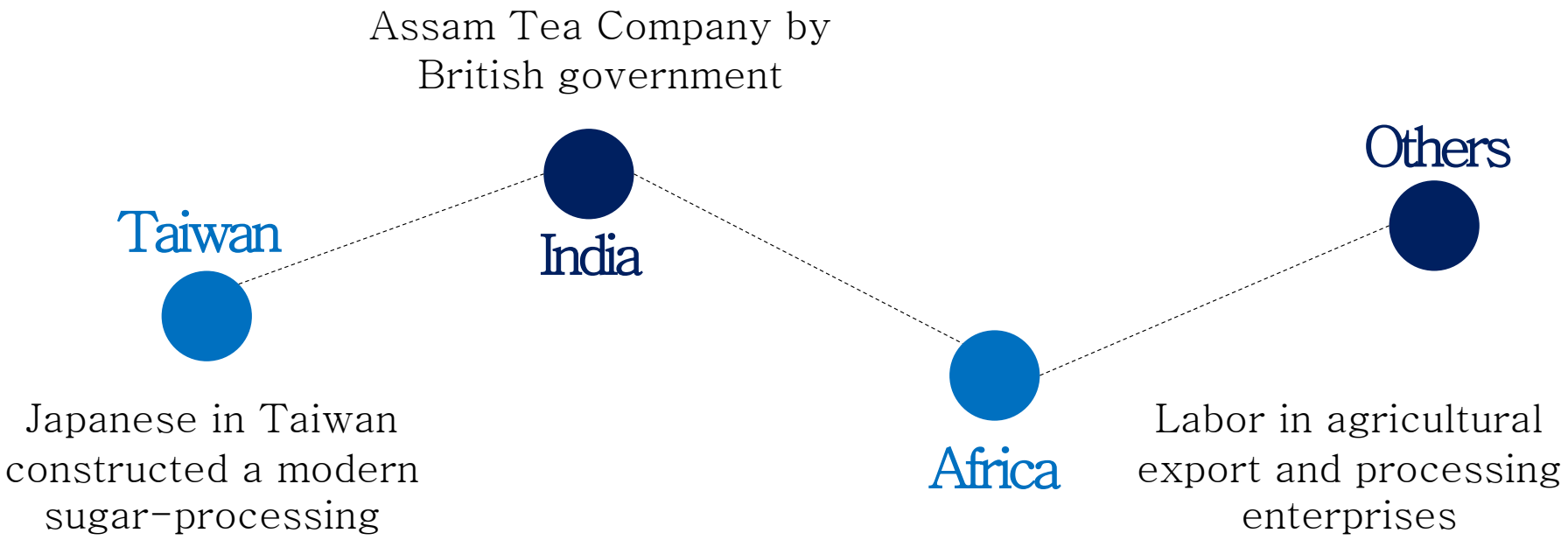
Part 2 Historical Background

2.2 The Cultivation System's Historical Impacts

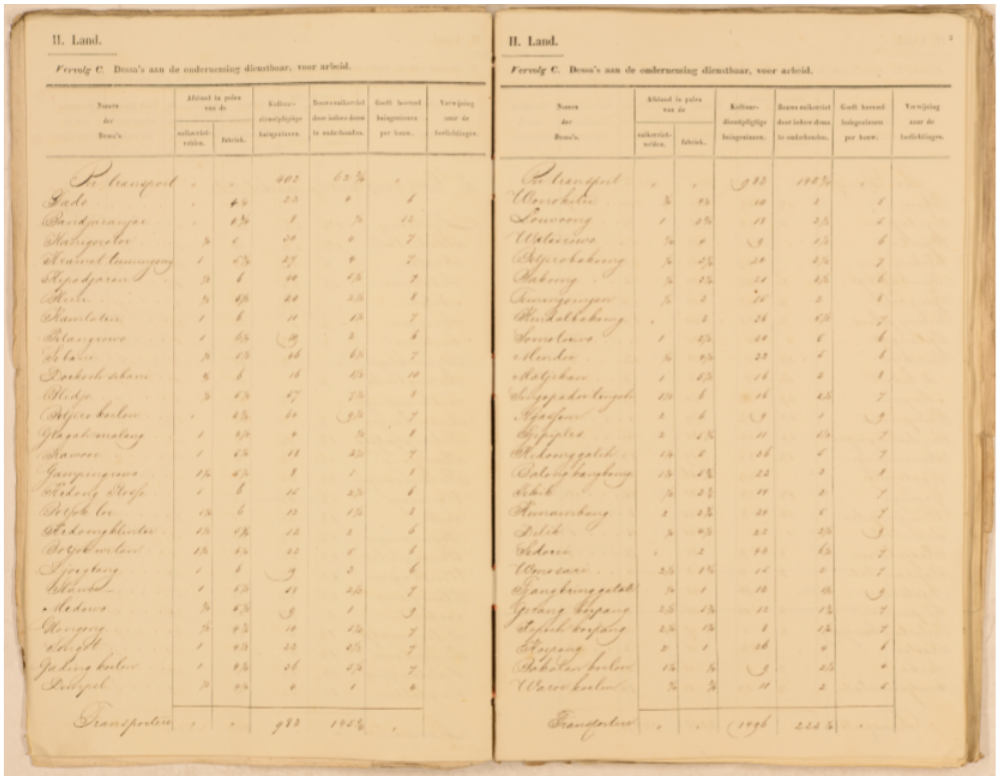


Part 2 Historical Background

2.3 Other Historical Examples



Part 3 Data
3.1 The Cultivation System


II. Land.

Vervolg C. Dessa's aan de onderneming dienstbaar, voor arbeid.

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—10000 subjected villages

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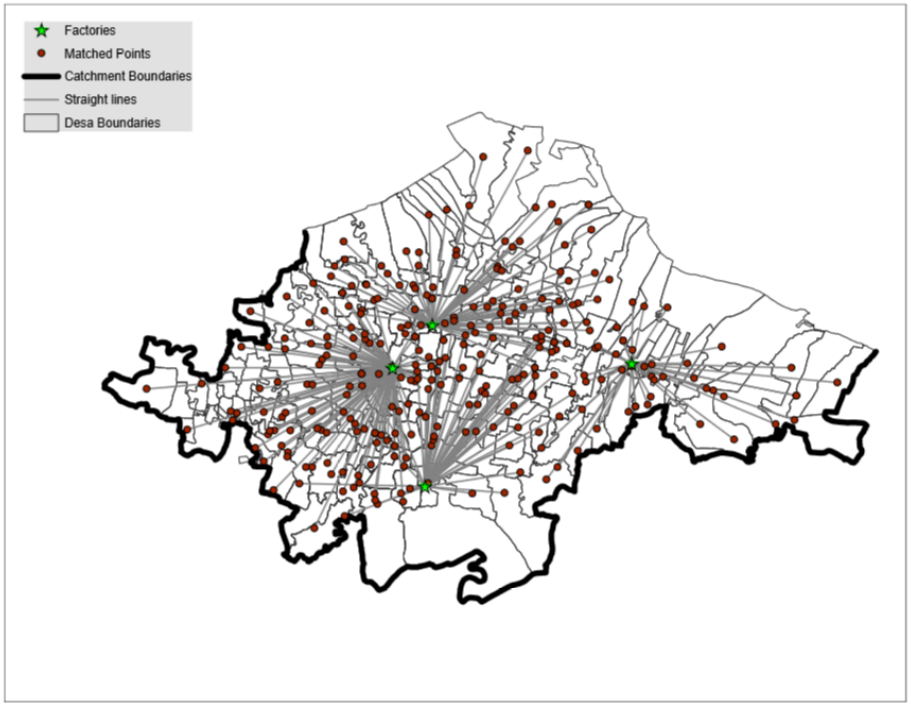
Figure 3: Construction of Catchment Areas



1| The handwritten manuscript archival records held by the Hague
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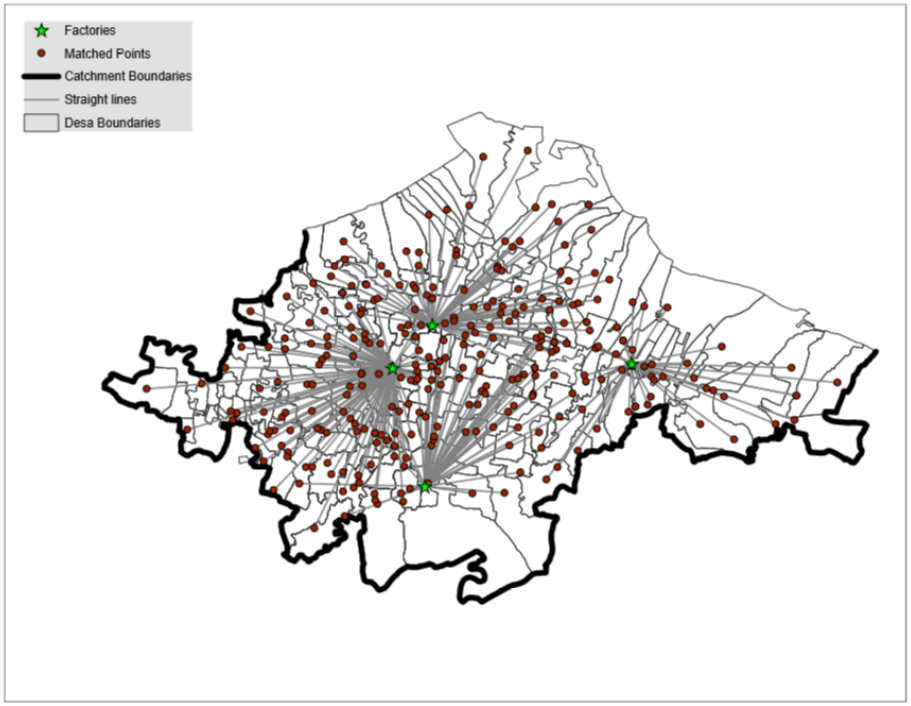
2| U.S. National Geospatial Intelligence Agency's Geonames database
—a detailed list of populated places

Part 3 Data
3.2 Outcome Data

Figure 3: Construction of Catchment Areas



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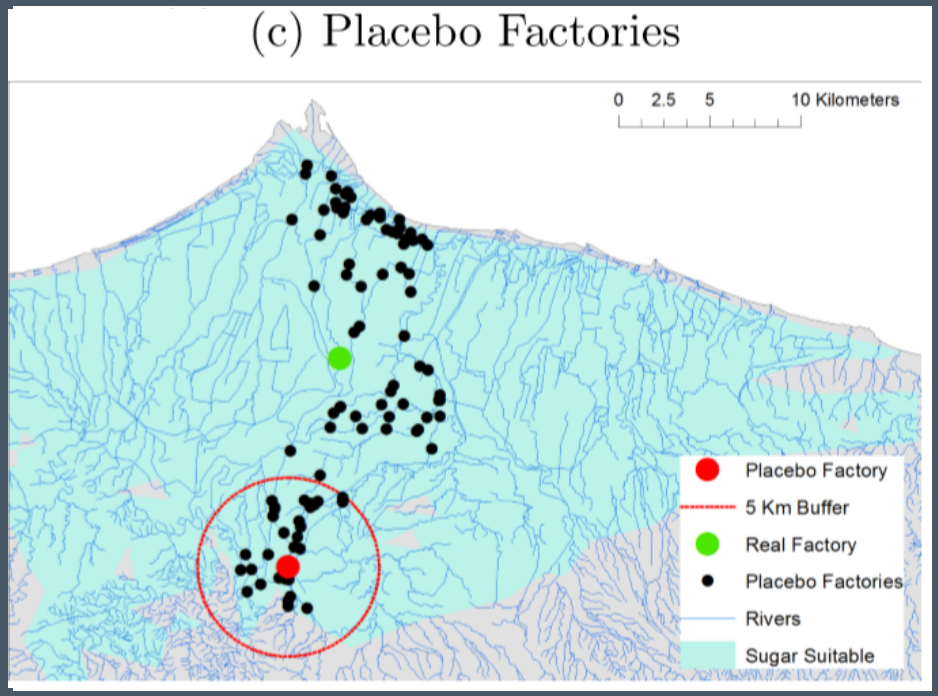
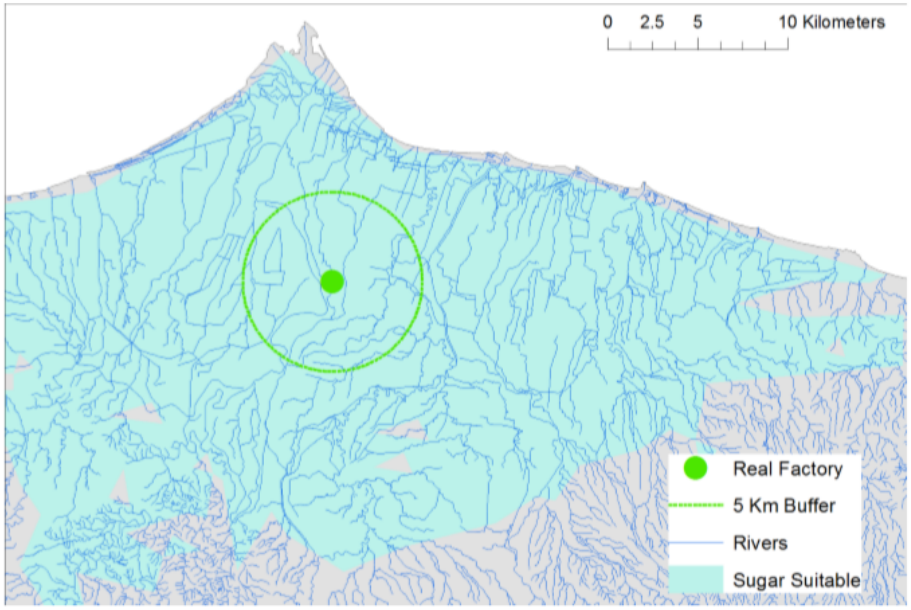
3| The Indonesian government's Central Bureau of Statistics
—population, industrial, agricultural and village census and household survey

Part 4 Impacts of Sugar Fac ories

4.1 Empirical Strategy

Assignment to Sugar Cultivation





in the distribution of it

- Geographically symmetric

Part 4 Impacts of Sugar Factories

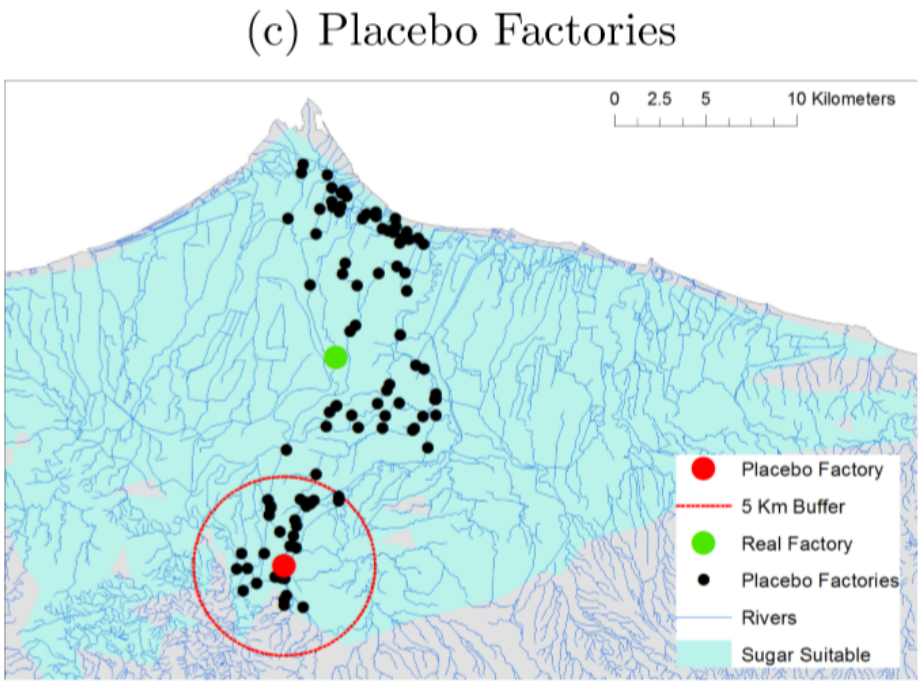
4.1 Empirical Strategy

$$out_v = \alpha + \sum_{i=1}^{20} \gamma_i dfact_v^i + \beta X_v + \sum_{j=1}^{20} fact_v^j + \epsilon_v \quad (1)$$

- out_v is an outcome of interest in village v
- $dfact_v^i$ are indicators equal to 1 if village v is 0–1km from the nearest factory
- X_v includes geographic characteristics

Part 1 Introduction

2| (1)The creation of manufacturing in the previously agricultural heartland ——Counterfactual spatial configuration



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Part 4 Impacts of Sugar Factories

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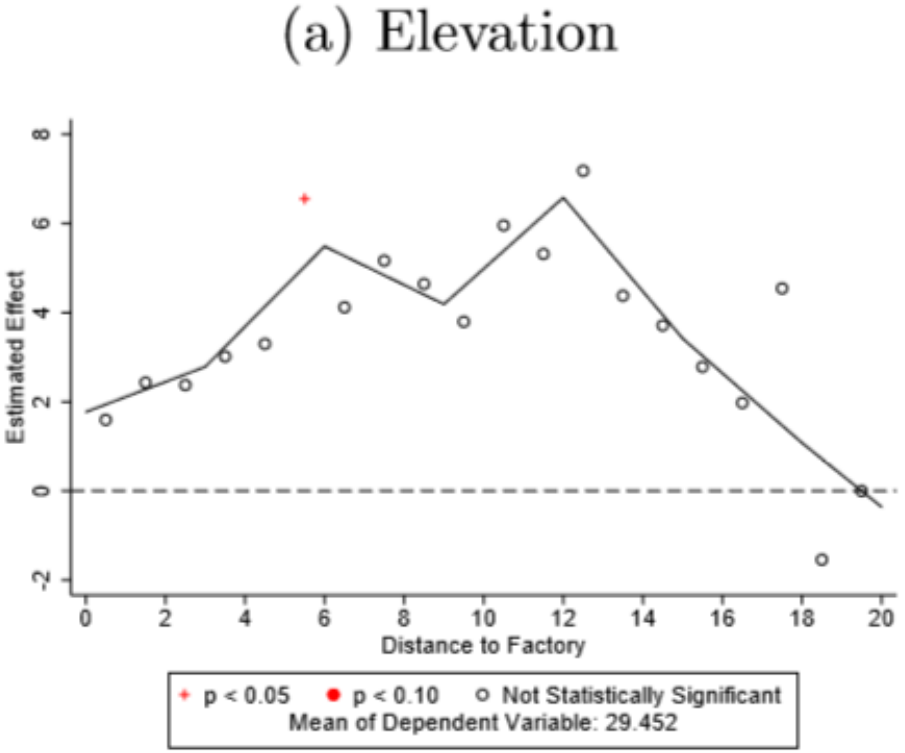
- $dfact_v^i$ are indicators equal to 1 if village v is 0-1km from the nearest factory
- X_v includes geographic characteristics
- $fact_v^j$ are nearest factory fixed effects

- Point estimate & p-value
- Subtract the mean of some unobserved factors

Part 4 Impacts of Sugar Factories

4.1 Empirical Strategy

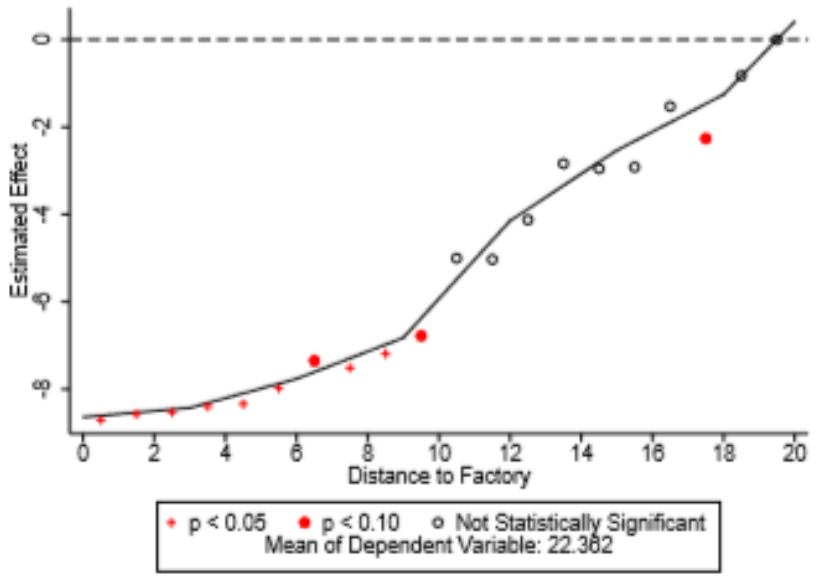


- Crosses indicate coefficients that are above the 95th percentile of the counterfactual distributions
- solid dots denote coefficients above the 90th percentile
- hollow dots indicate coefficients below the 90th percentile

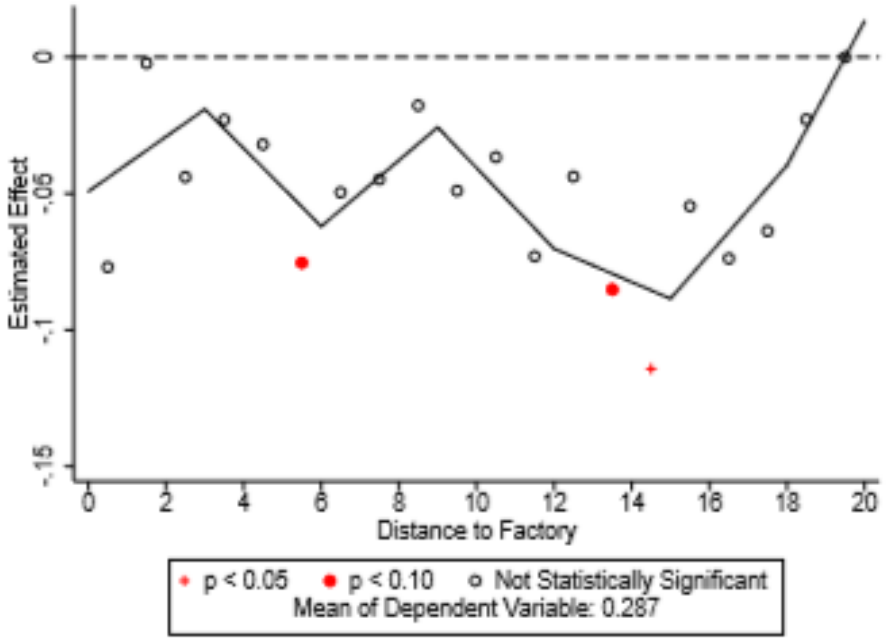
Part 4 Impacts of Sugar Factories

4.1 Empirical Strategy

(g) Distance to Nearest 1830 Residency Capital



(f) Distance to River



Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

$$out_v = \alpha + \sum_{i=1}^{20} \gamma_i dfact_v^i + \beta X_v + \sum_{j=1}^{20} fact_v^j + \epsilon_v$$

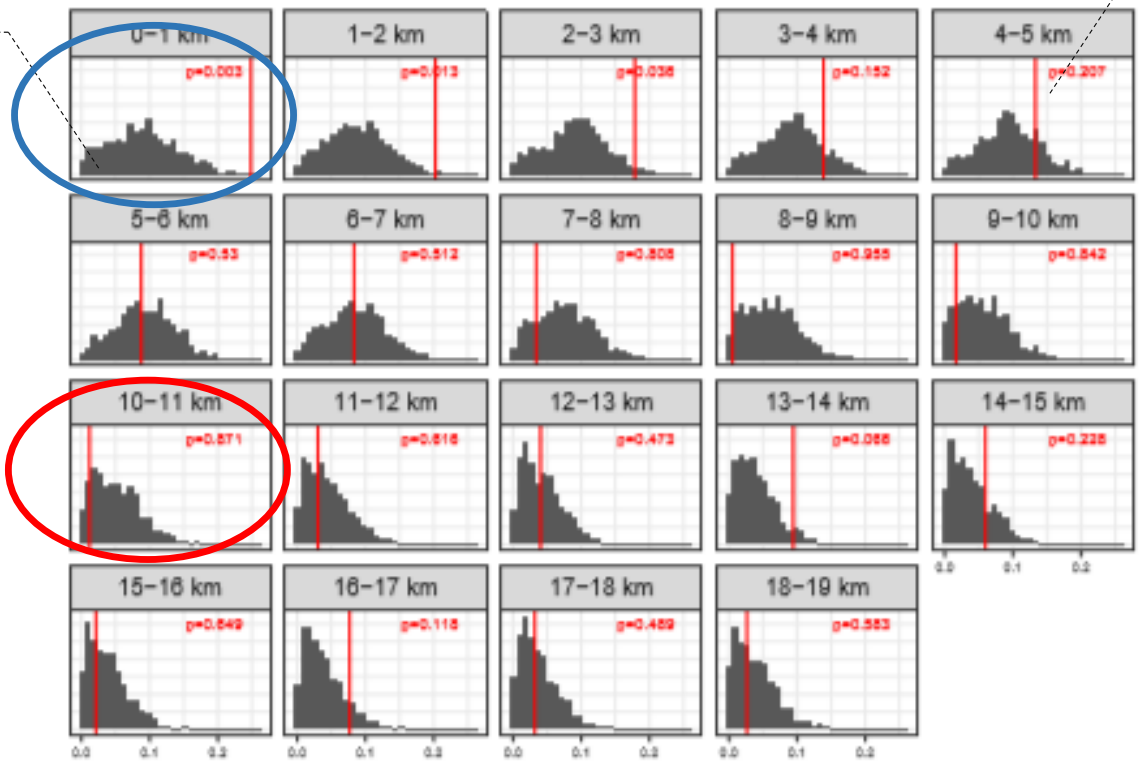
- Using as a dependent variable an indicator for whether the individual works in the agricultural sector
- The sample includes prime age males aged 18 to 55 to avoid confounding labor market participation

Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

(a) Independent Shifts: Counterfactuals

1| Counterfactual of distribution coefficients



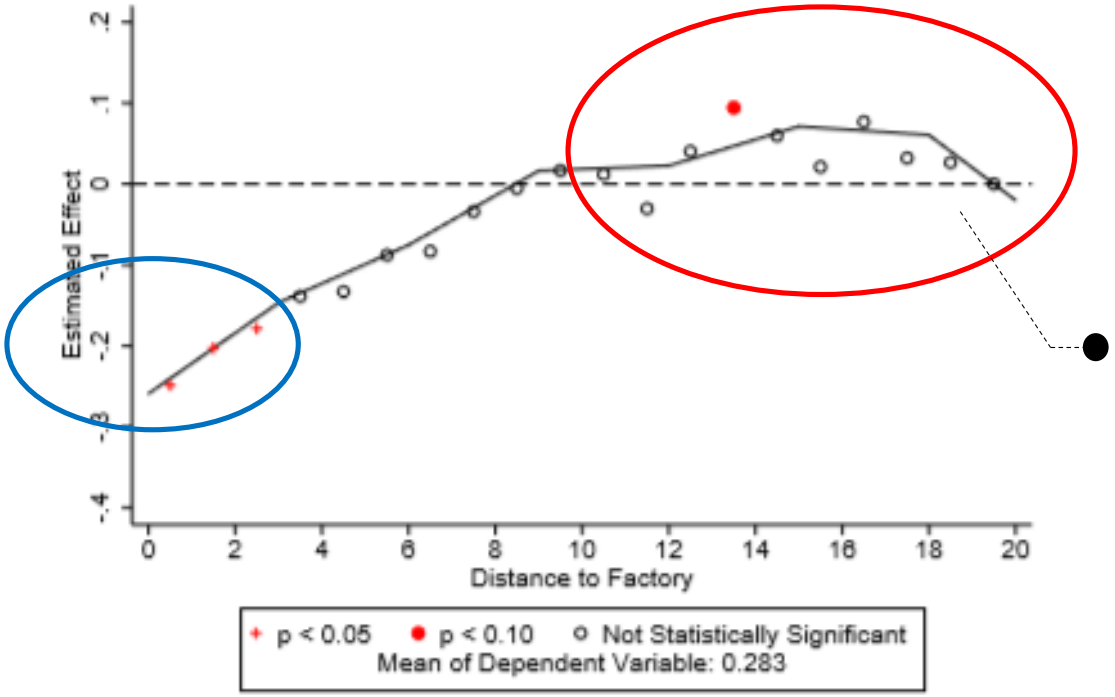
2| Coefficients of actual factories

3| Effects dissipate within five kilometers

Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

(b) Independent Shifts: Plotted Coefficients

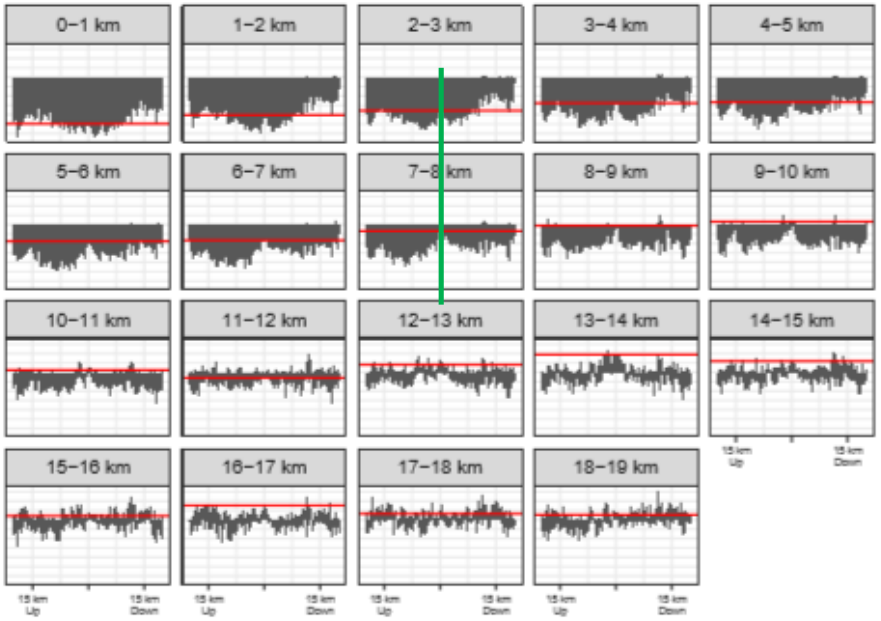


- Individuals within a few kilometers of a historical factory are around 18 percentage points less likely to work in agriculture than those 10 to 20 kilometers away

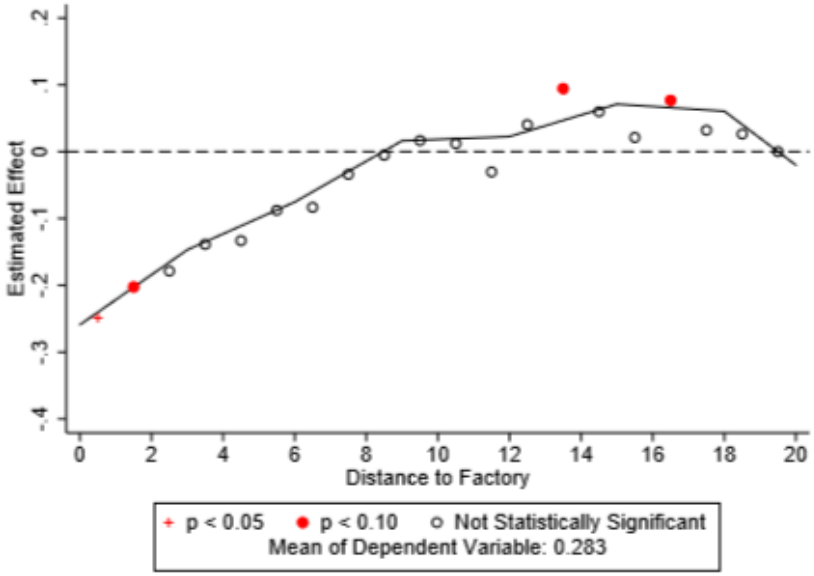
Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

(c) Common Shifts: Counterfactuals



(d) Common Shifts: Plotted Coefficients

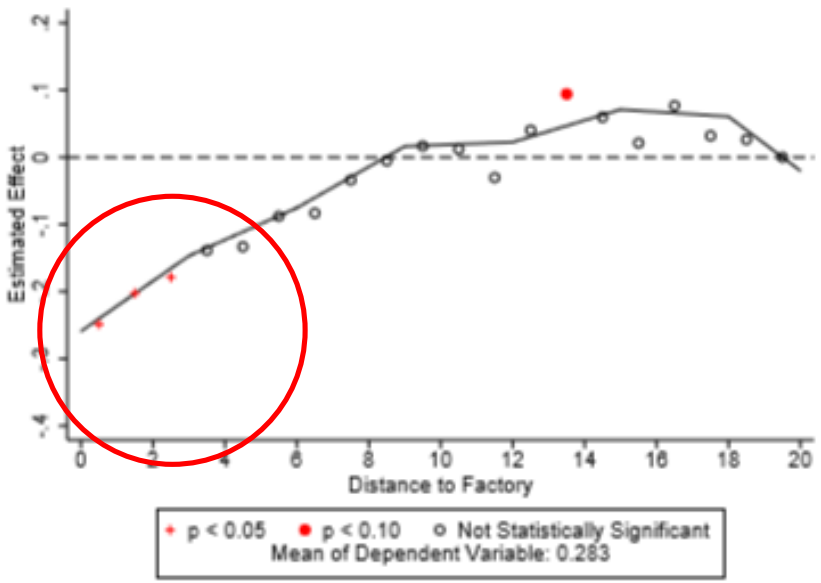


- We also conduct an exercise that shifts all the historical factories up or down the river by the same distance and then estimates equation (1) for each of these common shifts. We would expect the γ_i to be largest for shifts around 0 km

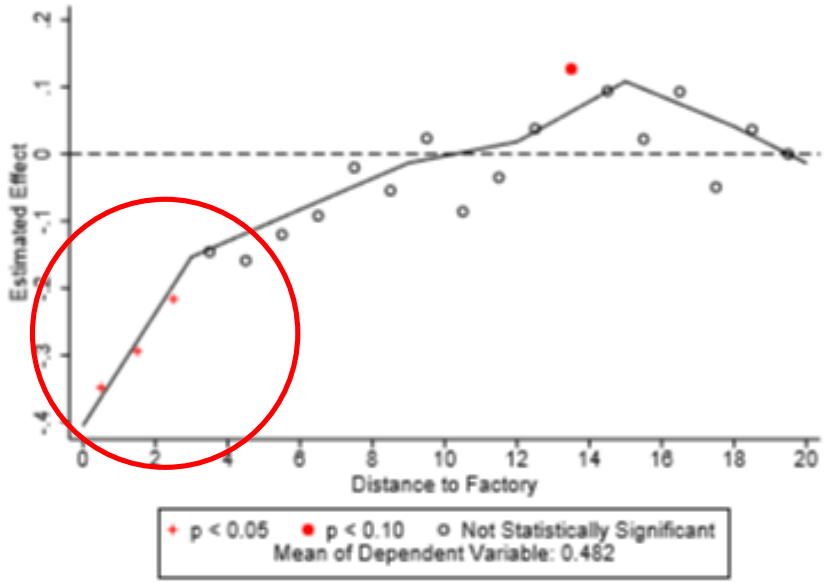
Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

(a) Agriculture (Susenas 2001-11)



(b) Agriculture (Census 1980)

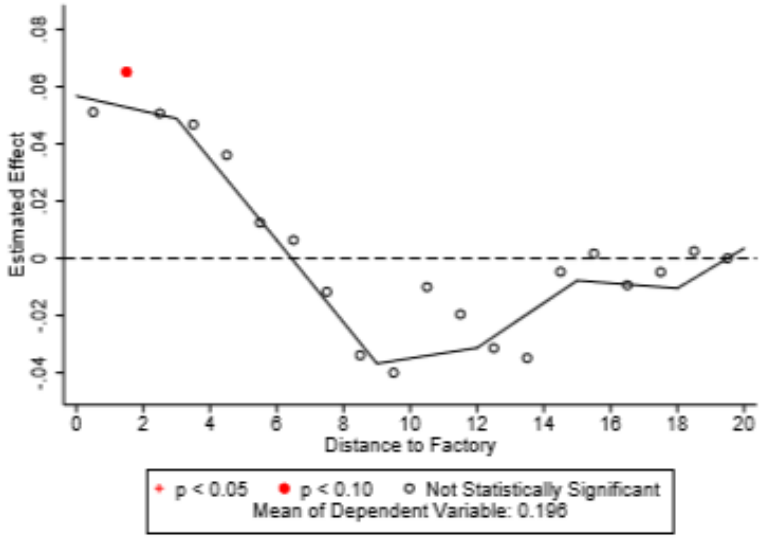


- The patterns are similar to those from 2001-2011, but the effects are even larger than in the more recent period. Places in close proximity to a factory are 25 to 30 percentage points less agricultural than those just ten to twenty kilometers away

Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

(c) Manufacturing (Susenas 2001-11)



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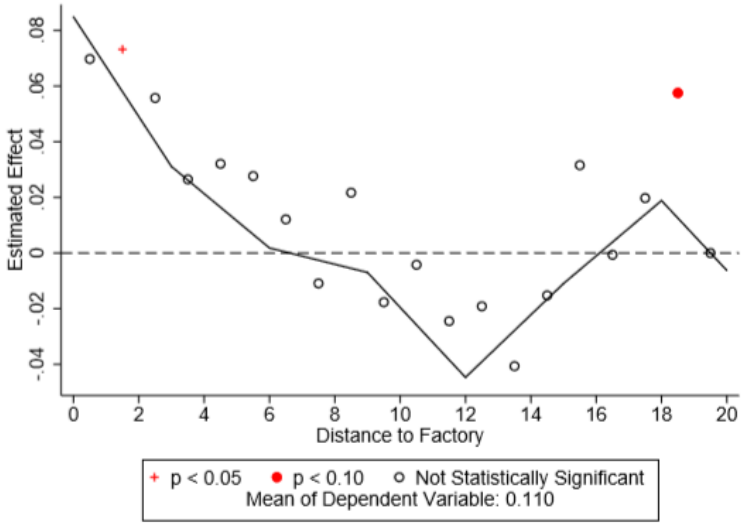


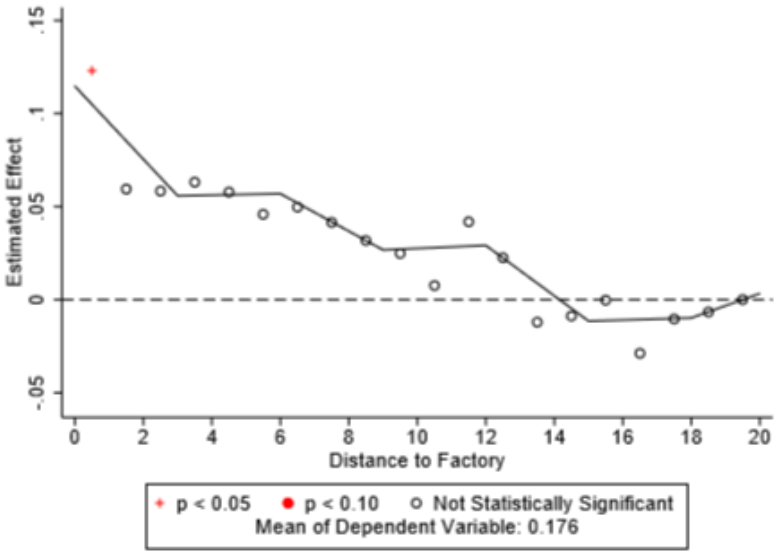
1| The pattern is the inverse of that for agriculture, with around 6% more individuals working in manufacturing in the immediate vicinity of historical factories relative to further away

2| Places near a historical factory had around seven percentage points more individuals working in manufacturing

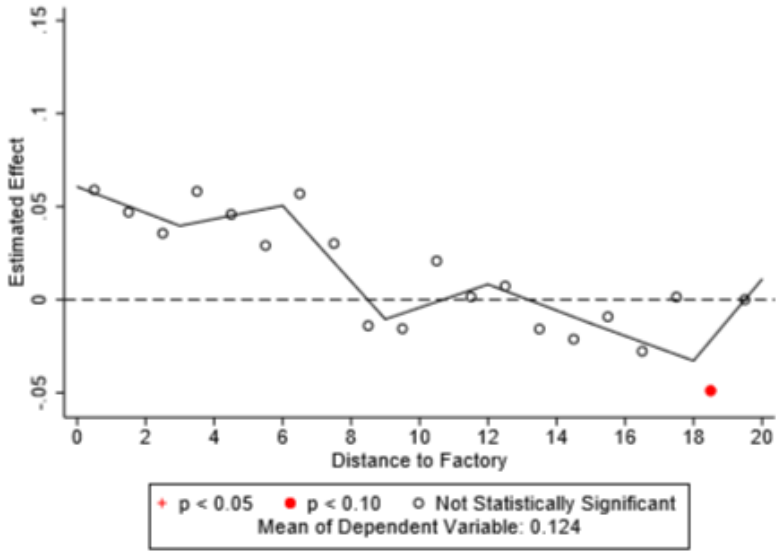
Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

(e) Retail (Susenas 2001-11)



(f) Retail (Census 1980)

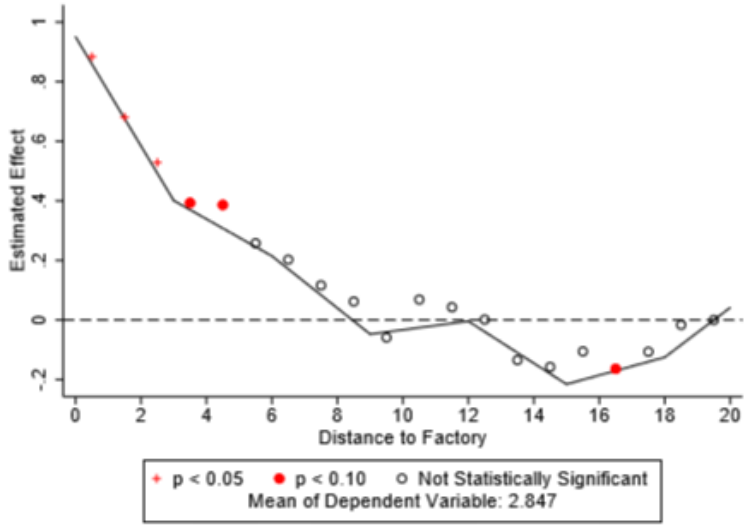


- For 2001-2011, places in the immediate vicinity of a factory have around 9 percentage points more employment in retail relative to places ten to twenty kilometers away. In contrast to manufacturing, the retail effects are somewhat higher today than in 1980.

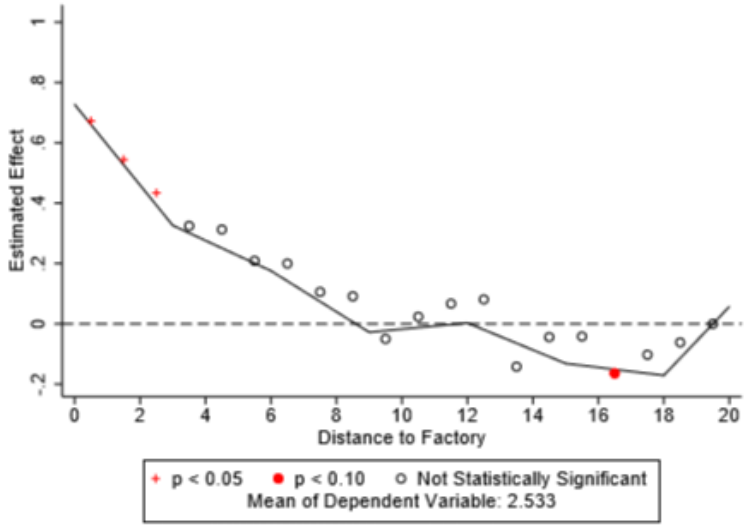
Part 4 Impacts of Sugar Factories

4.2 Results—Economic Structure

(g) Log Pop. Density (PODES 2003)



(h) Log Pop. Density (PODES 1980)

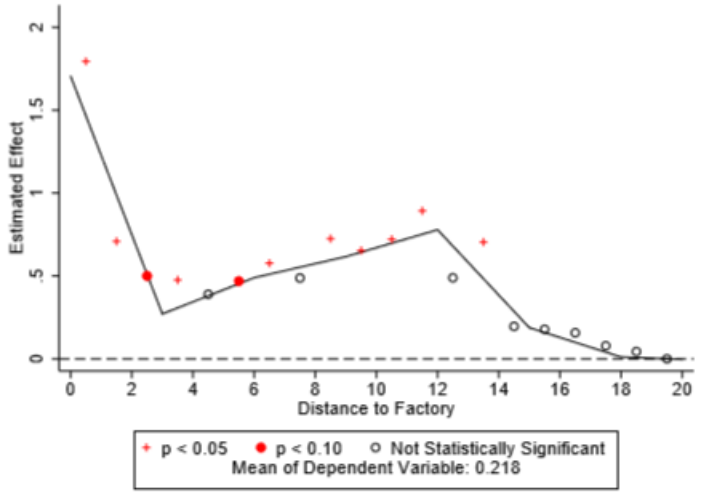


- Areas within 1 kilometer of a factory are much more densely populated than areas 10 kilometers away in both 1980 and today
- The effects relative to the 20 kilometer bin flatten out within a few kilometers

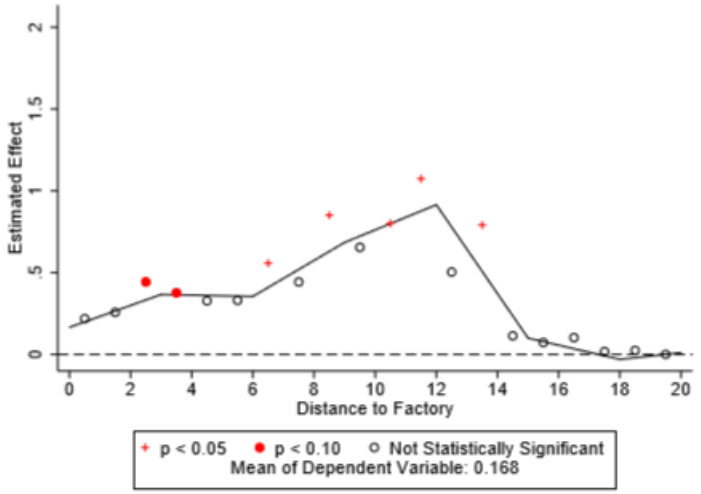
Part 4 Impacts of Sugar Factories

4.2 Results—Sugar and Linked Industries

(a) Log Value Sugar Processed (Full Sample, Economic Census 2006)



(b) Log Value Sugar Processed (No Modern Factories, Econ Census 2006)



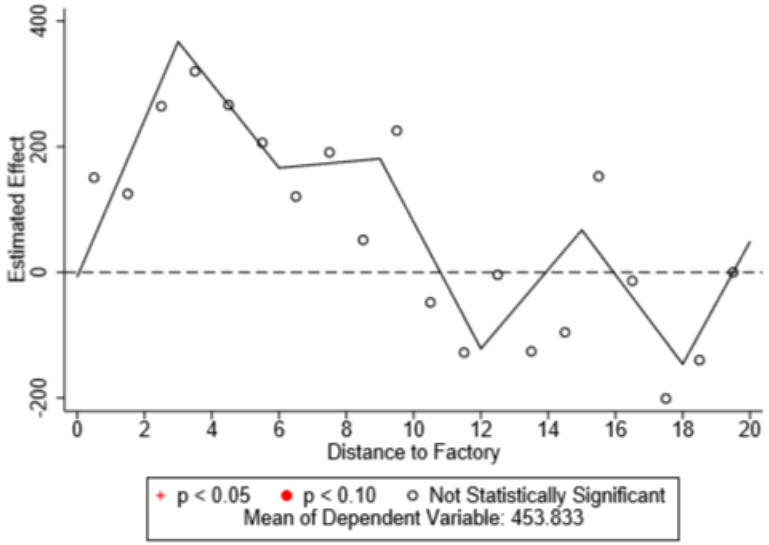
1| shows – using the full sample of historical factories – that indeed places near a historical factory, produce substantially more processed sugar today than places further away

2| documents that once we drop the 19% of historical factories within 2 kilometers of a modern sugar factory, the relationship between distance and modern sugar production flattens out

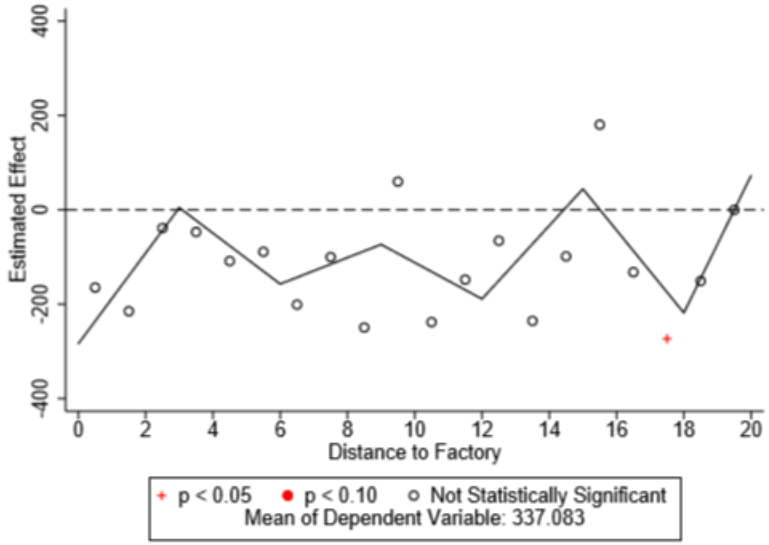
Part 4 Impacts of Sugar Factories

4.2 Results—Sugar and Linked Industries

(c) Tons of Cane Grown (Full Sample, PODES 2003)



(d) Tons of Cane Grown (No Modern Factories, PODES 2003)



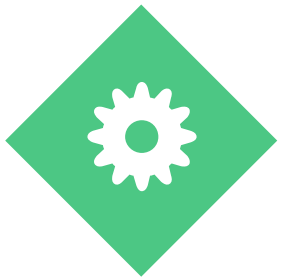
1| shows that there is little relationship in the full sample between raw cane production and distance to a historical factory

2| The relationship between modern sugar cultivation and distance to a historical factory remains flat in the restricted sample

Part 4 Impacts of Sugar Factories
4.2 Results—Sugar and Linked Industries

Input-output linkages

an important driver of agglomeration around sugar factories historically



upstream & downstream

we construct weighted average employment shares for narrow manufacturing industries upstream and downstream from sugar processing

The weights

The weights are from the Leontief inverse of the 2006 Indonesian Input-Output Table

Part 4 Impacts of Sugar Factories

4.2 Results—Sugar and Linked Industries

Upstream

The main manufacturing sectors upstream from sugar processing are farm machinery, used to harvest cane, and capital equipment, used to process cane

Sugar proce-ssing

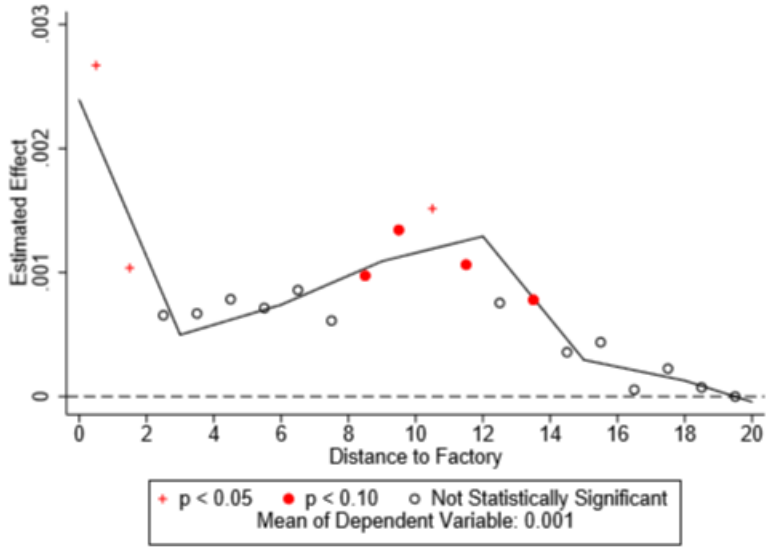
Downstream

The main manufacturing industries downstream are in food processing, as sugar is an additive to many other foods. Many types of services are also its downstream

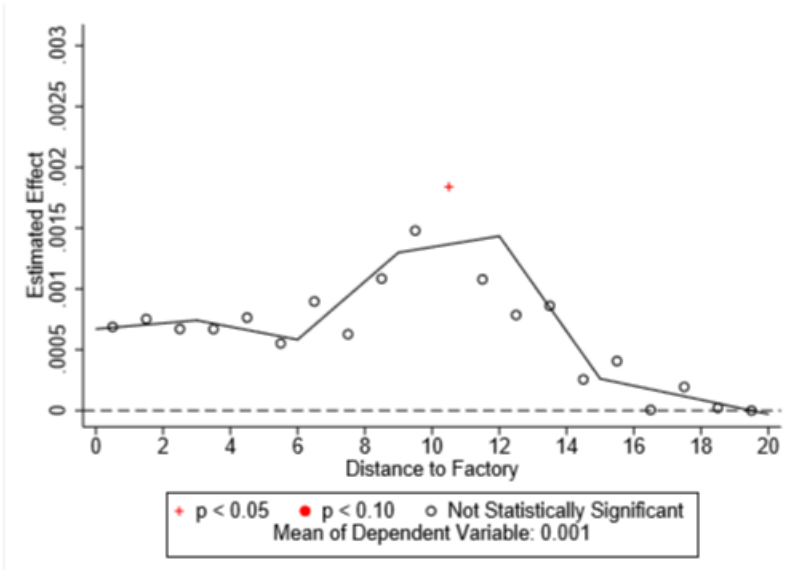
Part 4 Impacts of Sugar Factories

4.2 Results—Sugar and Linked Industries

(e) Employment Share Upstream (Full Sample, Economic Census 2006)



(f) Emp Share Upstream (No Modern Factories, Economic Census 2006)



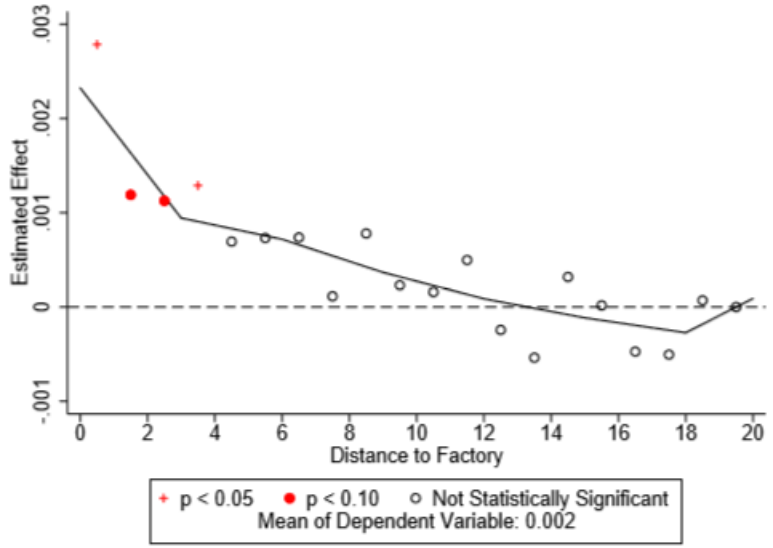
1| shows that the weighted average share of employment in upstream manufacturing industries is about three times higher relative to the mean within one kilometer of historical factories

2| This relationship flattens out when we exclude historical factories that are located near modern ones

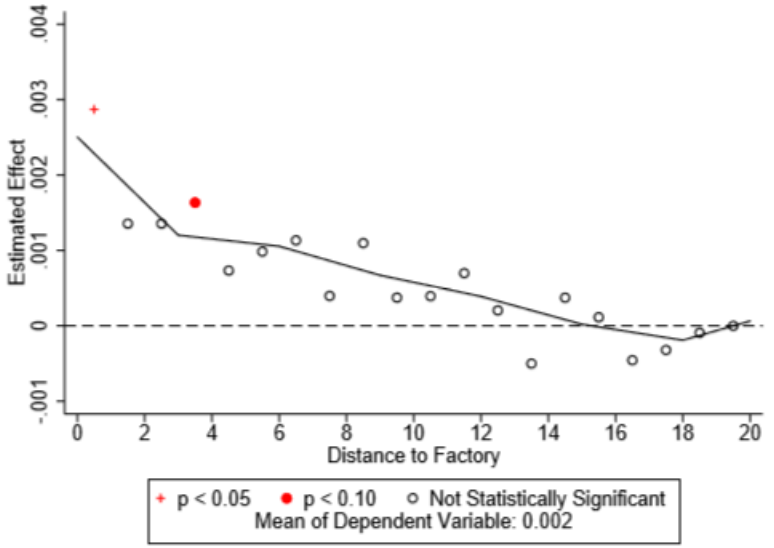
Part 4 Impacts of Sugar Factories

4.2 Results—Sugar and Linked Industries

(g) Employment Share Downstream (Full Sample, Economic Census 2006)



(h) Emp Share Downstream (No Modern Factories, Economic Census 2006)

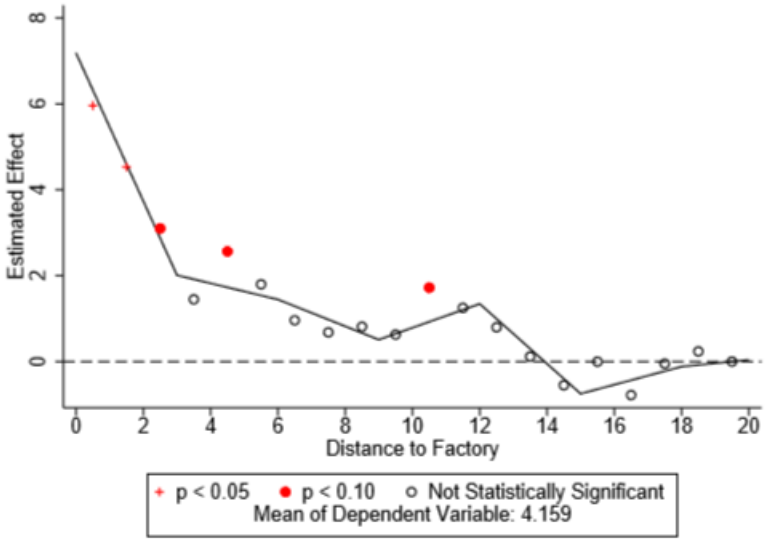


- In contrast, even when we limit the sample to historical factories that are not near modern ones, employment in manufacturing industries downstream from sugar is much higher near the historical factories. This is particularly true for places within 0 to 1 kilometer of a historical factory, and the effect is large

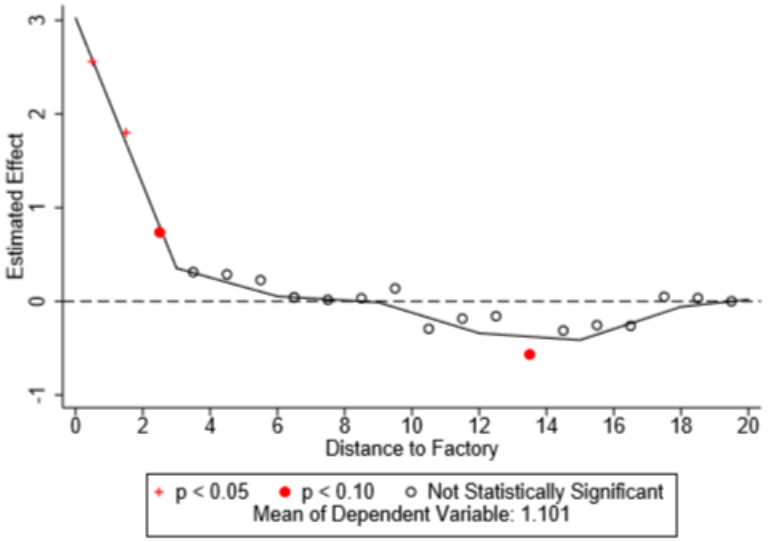
Part 4 Impacts of Sugar Factories

4.2 Results—Transport Infrastructure

(a) Colonial Road Density (1900)



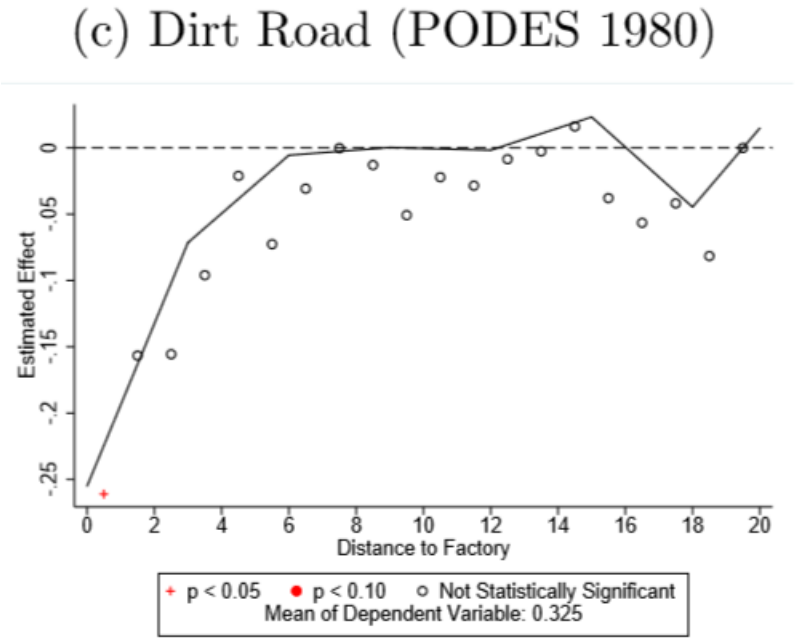
(b) Colonial Railroad Density (1900)



- Both colonial road and rail density are substantially higher near historical sugar factories. When comparing the 0–1 km bin to places 5–20 km away, the difference in colonial railroad density is more than twice as large as the sample mean. The difference in road density is also substantial

Part 4 Impacts of Sugar Factories

4.2 Results—Transport Infrastructure

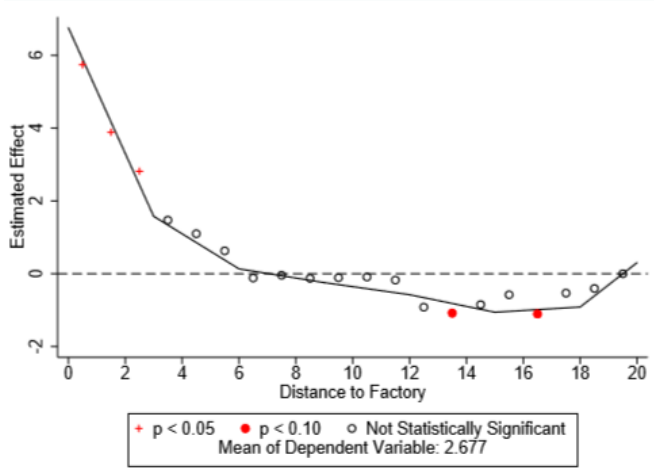


- Data from the 1980 Podes, a census of village governments, show that villages in the immediate vicinity of the historical factories were less likely to only be accessible via a dirt road historically

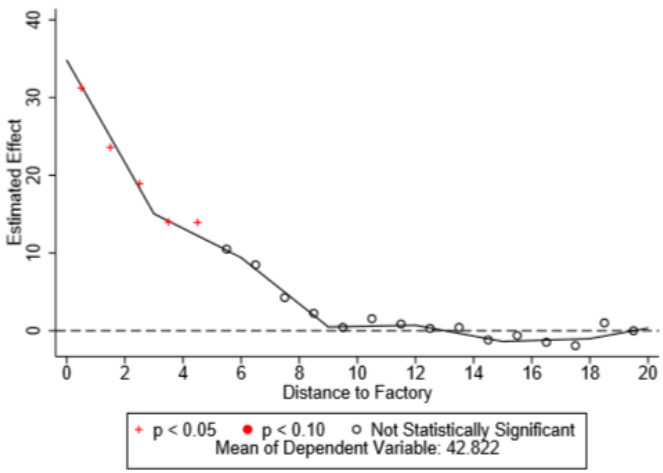
Part 4 Impacts of Sugar Factories

4.2 Results—Transport Infrastructure

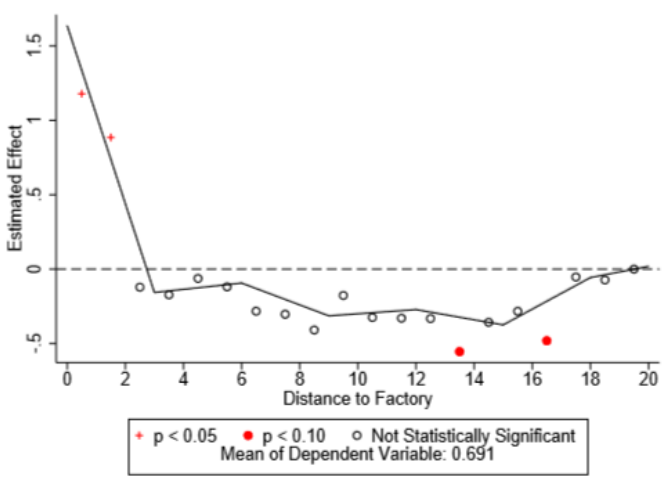
(d) Intercity Road Density (2017)



(e) Local Road Density (2017)



(f) Railroad Density (2017)

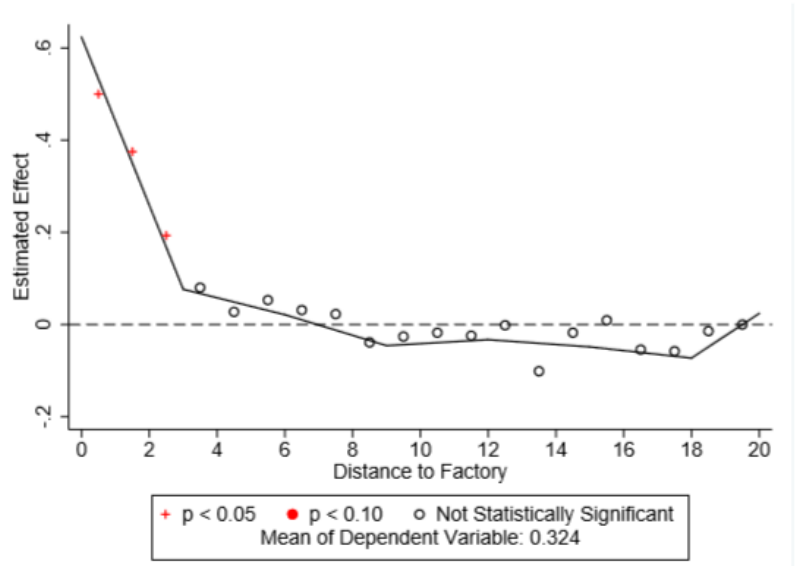


- Today, both intercity and local road density are higher near historical factories. When comparing the 0-1 km bin to places 5-20 km away, the difference in intercity road density is about twice as large as the sample mean. Differences in local road density and railroad density today are likewise large

Part 4 Impacts of Sugar Factories

4.2 Results—Other Public Goods

(a) Village Has Electricity (PODES 1980)

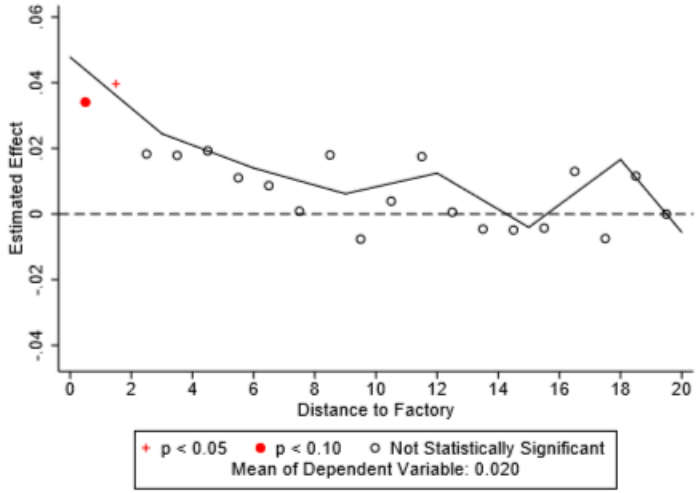


- 1980 Podes data reveal that places in the immediate vicinity of the historical factories were about 45 percentage points more likely to have electricity than places ten to twenty kilometers away

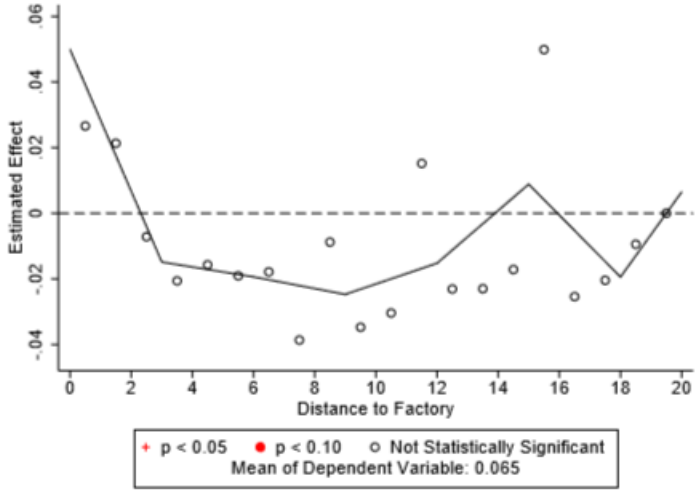
Part 4 Impacts of Sugar Factories

4.2 Results—Other Public Goods

(b) High Schools (PODES 1980)



(c) High Schools (PODES 1996-2011)

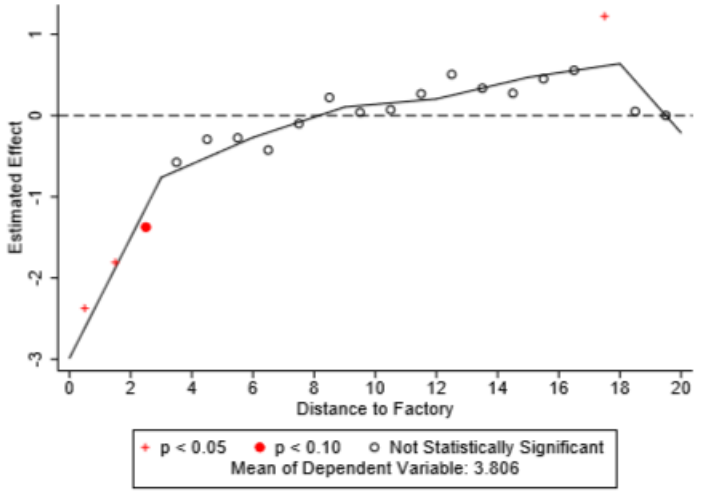


- We find that in 1980, areas in the immediate vicinity of a factory were four percentage points more likely to have a high school than places ten to twenty kilometers away, relative to a sample mean of only two percent of villages with high schools. While high schools are more common today, the effect remains

Part 4 Impacts of Sugar Factories

4.2 Results—Other Public Goods

(d) Distance to Subdistrict Capital (2011 PODES)

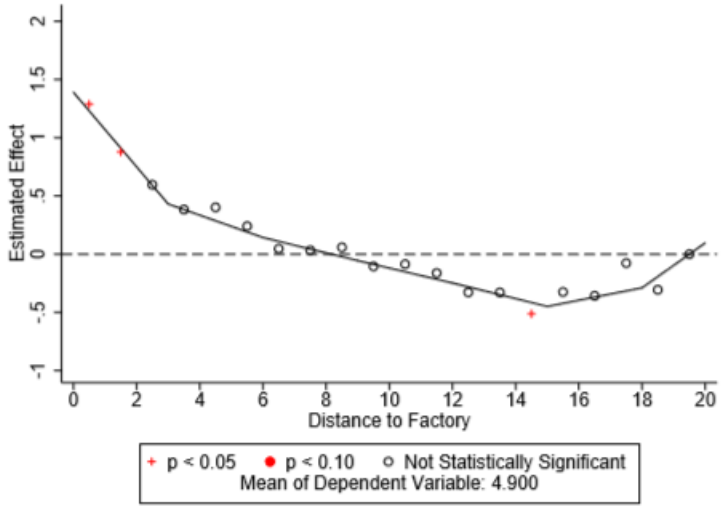


- High schools were mostly built in administrative centers, and indeed places near factories are around two kilometers closer to the nearest sub-district capital, relative to a sample mean distance of 3.8 kilometers

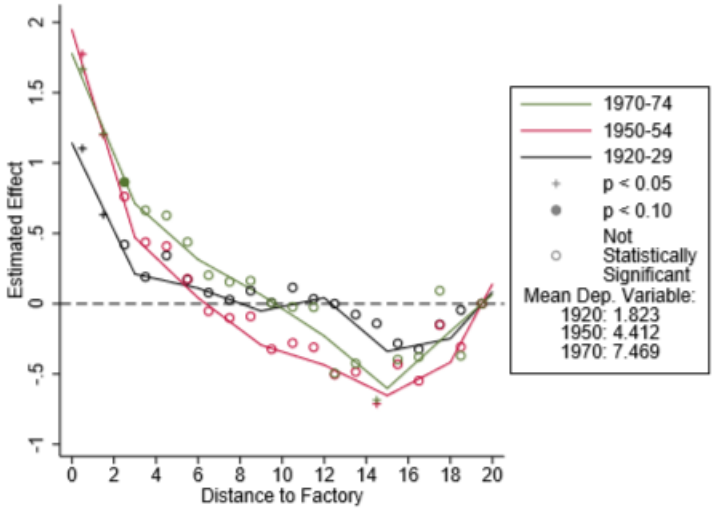
Part 4 Impacts of Sugar Factories

4.2 Results—Other Public Goods

(a) Years Education (2000 Census)



(b) Years Education by Cohort

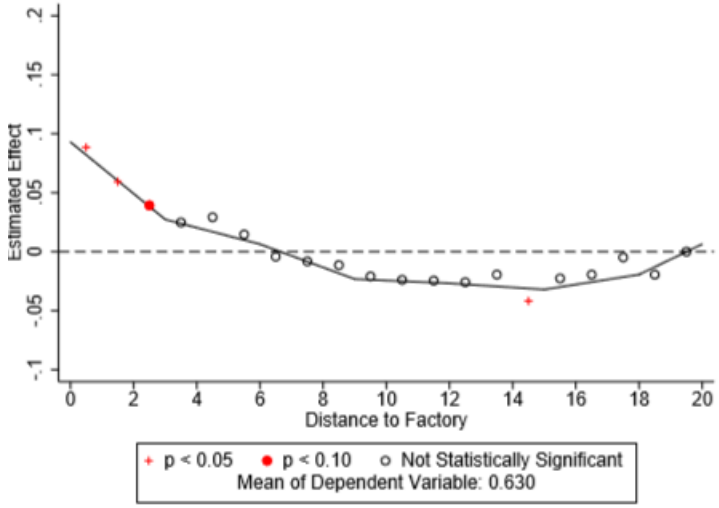


- Panel a) documents that individuals within the vicinity of a historical factory have around a year more schooling than those located ten to twenty kilometers away, relative to a sample mean of 4.9 years of schooling. Moreover, these effects hold across all three cohorts

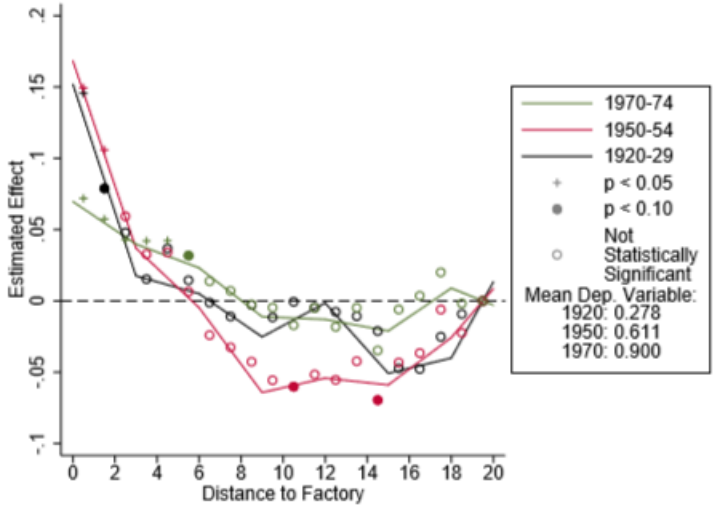
Part 4 Impacts of Sugar Factories

4.2 Results—Other Public Goods

(c) Primary (2000 Census)



(d) Primary by Cohort

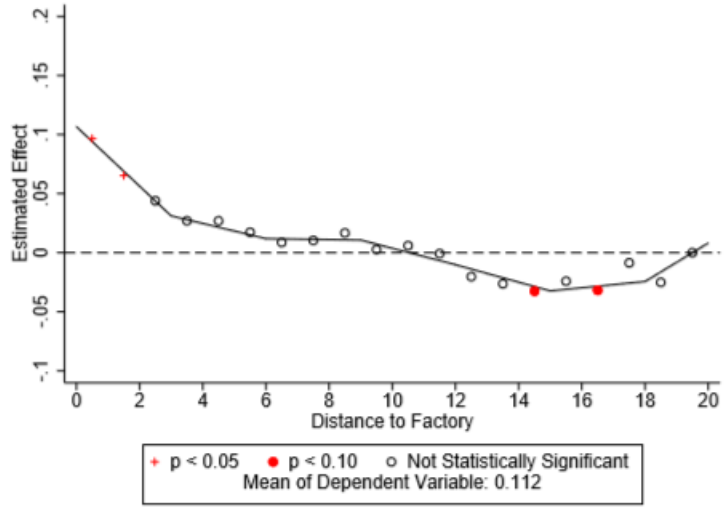


- It is much higher in close proximity to the historical factories, and this is particularly true for the two older cohorts, whose schooling occurred at a time when primary access was far from universal

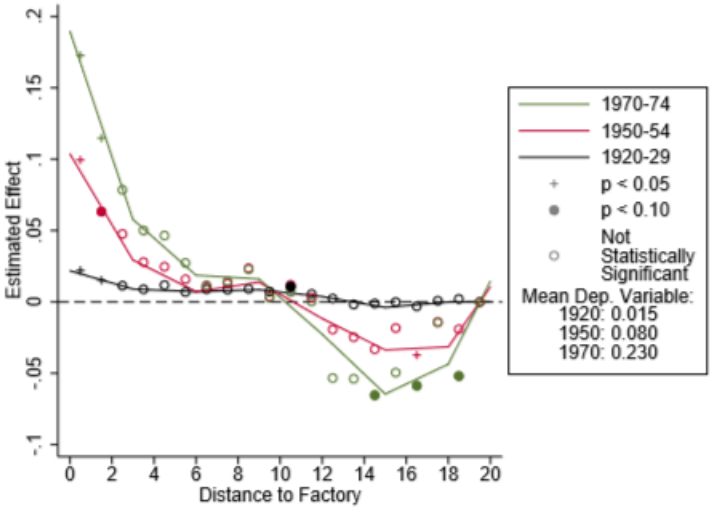
Part 4 Impacts of Sugar Factories

4.2 Results—Other Public Goods

(e) High School (2000 Census)



(f) High School by Cohort

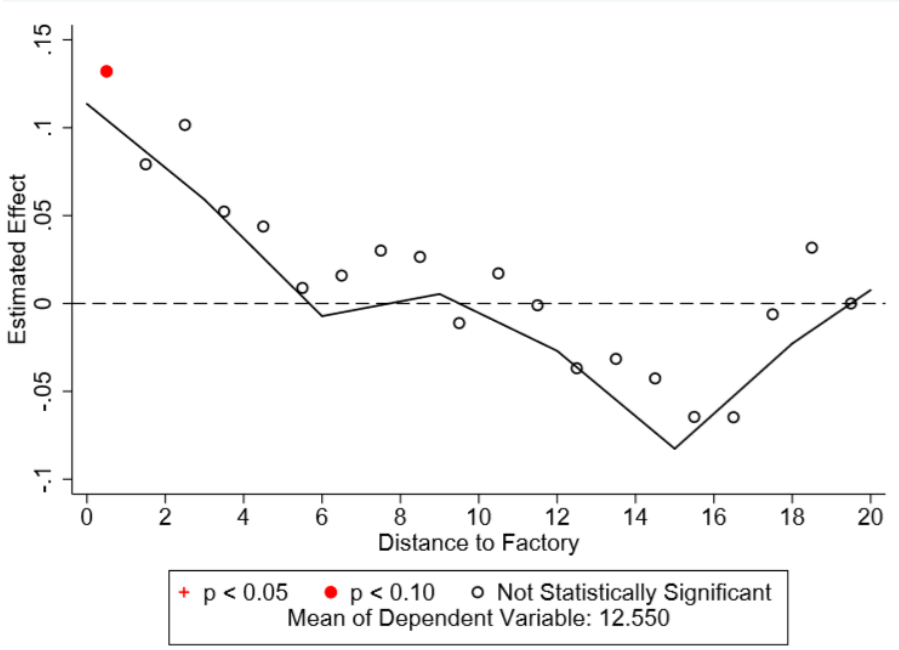


- Effects are largest for younger cohorts, who received schooling at a time when high school was more common, but impacts are still positive and statistically significant even for the oldest cohort, educated during the Dutch era

Part 4 Impacts of Sugar Factories

4.2 Results—Household Consumption

Figure 11: Expenditure (2001-11)



- Figure 12 shows that consumption levels in areas immediately adjacent to the historical factories are around 10 percent higher than areas 5 kilometers further away
- People living adjacent to a historical factory have about 1.25 more years of education, and an 8 percent return to schooling (Duflo, 2001) would yield the observed consumption differences

Part 5 Impacts of Sugar Factories

5.1 Empirical Strategy

$$out_v = \alpha + \gamma cultivation_v + f(geographic\ location_v) + g(dfact_v) + \beta X_v + \sum_{i=1}^{n} seg_v^i + \epsilon_v \quad (2)$$

- $out_v$is an outcome in village v
- $\mathbf{cultivation}_v$ is an indicator equal to 1 if the village grew cane for the Cultivation System and equal to zero otherwise
- $f(geographic\ location_v)$is the RD polynomial, which controls for smooth functions of geographic location
- $g(dfact_v)$controls for a linear spline in distance to the nearest historical sugar factory, with kink points estimated every three kilometers
- $\mathbf{X}_v$ contains the same exogenous geographic characteristics
- The $\mathbf{seg}_v^i$ split each catchment area boundary into 10 kilometer segments, equaling one if village v is closest to segment i and zero otherwise

- To estimate the effects of forced cultivation, we exploit the discontinuous change in exposure at the borders of the subjected catchment areas

Part 5 Impacts of Sugar Factories

5.1 Empirical Strategy— Pre-characteristic Balance

1

Assumption

relevant factors besides treatment vary smoothly at the Cultivation System boundaries

Part 5 Impacts of Sugar Factories

5.1 Empirical Strategy— Pre-characteristic Balance

Table 1: Geographic Characteristics: Subjected Villages

	Elevation	Slope	Log Flow Accumulation	On Coast	Distance To Coast	Distance To River	Distance To Natural Harbor	Distance To 1830 Residency Capital
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cultivation	-1.908	-0.017	-0.041	-0.013	0.117	0.001	0.126	0.062
	(0.744)	(0.013)	(0.160)	(0.016)	(0.106)	(0.012)	(0.107)	(0.133)
Obs	4,553	4,553	4,549	4,553	4,553	4,553	4,553	4,553
Clusters	383	383	383	383	383	383	383	383
Mean	31.17	0.26	2.56	0.06	24.90	0.29	33.26	24.80

Notes: The unit of observation is the village. Regressions include boundary segment fixed effects, a spline in distance to the nearest historical factory with kinks each 3km, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Robust standard errors, clustered by subdistrict, are in parentheses.

- Column (1) examines elevation. The point estimate on cultivation is negative and statistically significant but is only 2 meters, a small difference. Indeed, the entire sample is in the plains, close to sea level (the mean elevation in the sample is 31 meters)

Part 5 Impacts of Sugar Factories

5.1 Empirical Strategy— Pre-characteristic Balance

Table 1: Geographic Characteristics: Subjected Villages

	Elevation	Slope	Log Flow Accumulation	On Coast	Distance To Coast	Distance To River	Distance To Natural Harbor	Distance To 1830 Residency Capital
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Mean	31.17	0.26	2.56	0.06	24.90	0.29	33.26	24.80

Notes: The unit of observation is the village. Regressions include boundary segment fixed effects, a spline in distance to the nearest historical factory with kinks each 3km, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Robust standard errors, clustered by subdistrict, are in parentheses.

- There is a statistically significant difference in distance to the nearest VOC port - subjected villages are if anything further - though given the number of characteristics examined this difference may arise by chance

Part 5 Impacts of Sugar Factories

5.1 Empirical Strategy— Pre-characteristic Balance

1

Assumption

relevant factors besides treatment vary smoothly at the Cultivation System boundaries

&

Assumption

individuals did not selectively sort around the threshold while the Cultivation System was in force

2

- In historical Java, individuals who migrated to an already established village were not eligible to hold land, and disempowered movers would have plausibly borne the brunt of forced labor

Part 5 Impacts of Sugar Factories

5.2 Results—Land

ONE

- we begin by examining the allocation of land in more contemporary periods, focusing on village-owned land as well as land inequality among privately held land

TWO

- The estimates show that the Cultivation System left a substantial mark on village-owned land

Part 5 Impacts of Sugar Factories

5.2 Results—Land

Table 2: Land Tenure: Subjected Villages

	Village Land 2003		Village Land 1980		99th Pctile ÷	90th Pctile ÷	90th Pctile ÷	50th Pctile ÷
	Total Land	Land Share	Total Land	Land Share	90th Pctile	10th Pctile	50th Pctile	10th Pctile
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cultivation	2.235	0.014	3.473	0.012	0.018	13.289	0.378	1.793
	(0.852)	(0.004)	(1.538)	(0.005)	(0.262)	(8.469)	(0.272)	(2.007)
Obs	4,550	4,550	4,205	4,107	4,089	4,080	4,088	4,080
Clusters	383	383	380	380	381	381	381	381
Mean	18.61	0.09	23.95	0.11	3.53	38.58	4.34	7.84

Notes: The unit of observation is the village. Regressions include geographic controls, boundary segment fixed effects, linear splines in distance to the nearest historical factory and residency capital, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Robust standard errors, clustered by subdistrict, are in parentheses.

- In 2003, about 1.5 percentage points more land was owned by the village in Cultivation System areas, relative to a sample mean of 9% of total land owned by villages

Part 5 Impacts of Sugar Factories

5.2 Results—Land

Table 2: Land Tenure: Subjected Villages

	Village Land 2003		Village Land 1980		99th Pctile ÷	90th Pctile ÷	90th Pctile ÷	50th Pctile ÷
	Total Land	Land Share	Total Land	Land Share	90th Pctile	10th Pctile	50th Pctile	10th Pctile
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Notes: The unit of observation is the village. Regressions include geographic controls, boundary segment fixed effects, linear splines in distance to the nearest historical factory and residency capital, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Robust standard errors, clustered by subdistrict, are in parentheses.

- Coefficients tend to be positive but fall short of statistical significance and are small compared to the mean

Part 5 Impacts of Sugar Factories

5.2 Results—Public goods

Table 3: Schools (1980): Subjected Villages

	Public Non-INPRES Primary		INPRES Primary		Junior High	High
	Buildings	Teachers	Buildings	Teachers	Schools	Schools
	(1)	(2)	(3)	(4)	(5)	(6)
Cultivation	0.009	0.169	-0.035	-0.207	0.019	0.007
	(0.019)	(0.104)	(0.020)	(0.080)	(0.009)	(0.006)
Obs	4,205	4,205	4,205	4,205	4,205	4,205
Clusters	380	380	380	380	380	380
Mean	0.43	2.81	0.36	1.37	0.06	0.02

Notes: The unit of observation is the village. Regressions include geographic controls, boundary segment fixed effects, linear splines in distance to the nearest historical factory and residency capital, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Robust standard errors, clustered by subdistrict, are in parentheses.

- Column (1) documents that individuals in subjected villages have around 0.22 years more schooling, relative to a sample mean of 5 years, and the effect is statistically significant at the 1% level. They are also more likely to complete primary school and junior high

Part 5 Impacts of Sugar Factories

5.2 Results—Public goods

Table 3: Schools (1980): Subjected Villages

	Public Non-INPRES Primary Buildings (1)	Teachers (2)	INPRES Primary Buildings (3)	Teachers (4)	Junior High Schools (5)	High Schools (6)
Cultivation	0.009	0.169	-0.035	-0.207	0.019	0.007
	(0.019)	(0.104)	(0.020)	(0.080)	(0.009)	(0.006)
Obs	4,205	4,205	4,205	4,205	4,205	4,205
Clusters	380	380	380	380	380	380
Mean	0.43	2.81	0.36	1.37	0.06	0.02

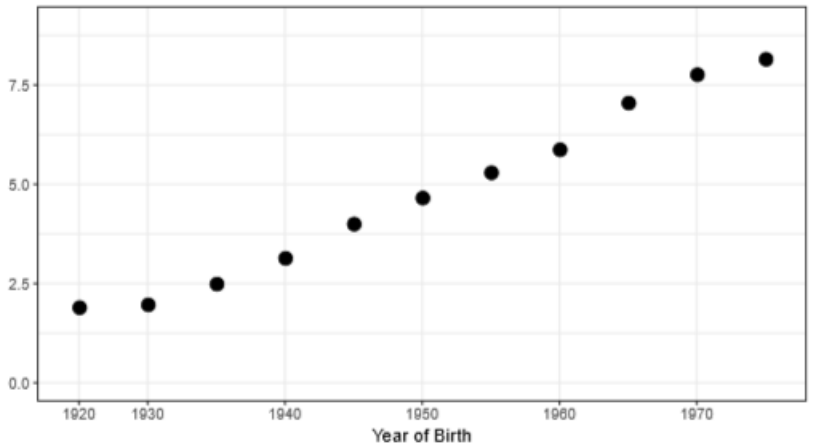
Notes: The unit of observation is the village. Regressions include geographic controls, boundary segment fixed effects, linear splines in distance to the nearest historical factory and residency capital, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Robust standard errors, clustered by subdistrict, are in parentheses.

- There is not a statistically significant impact on high school completion, though only 13% of the sample completed high school. Individuals in subjected villages are 1.8 percentage points less likely to have no schooling, relative to a sample mean of 41%. There is not an effect on primary completion, with only 19% of the sample in 1980 completing primary school

Part 5 Impacts of Sugar Factories

5.2 Results—Public goods

(b) Years of Schooling Levels

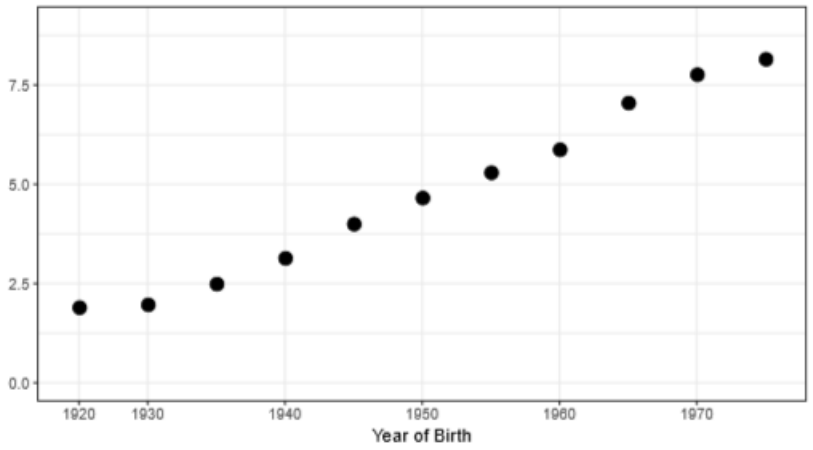


- Impacts on years of schooling are large and positive across cohorts, even going as far back as the cohort born in the 1920s who completed their education under the Dutch

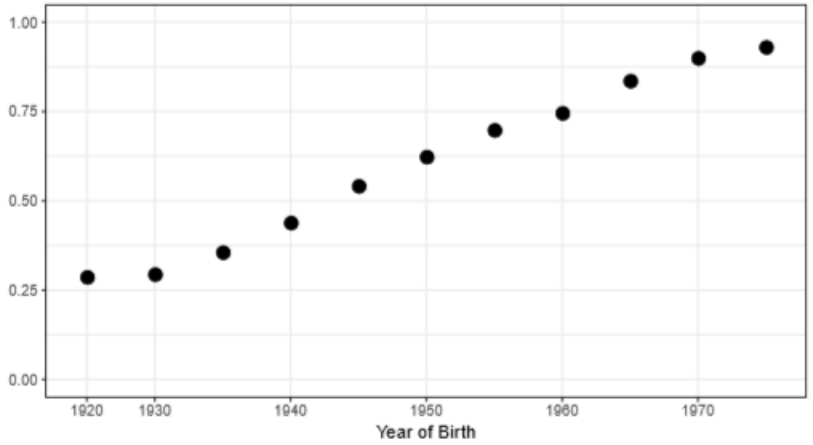
Part 5 Impacts of Sugar Factories

5.2 Results—Public goods

(b) Years of Schooling Levels



(d) Primary Completion Levels

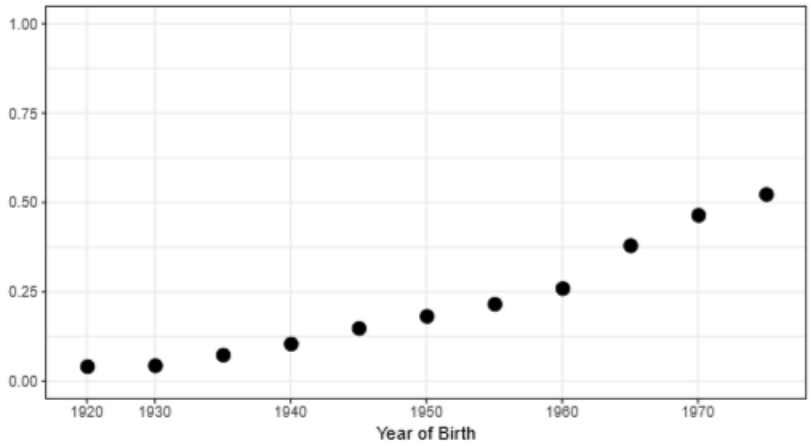


- Effects on primary completion peak for cohorts born when primary was rapidly expanding – in particular for cohorts born in the 1950s and 60s. The impact decreases somewhat as primary completion becomes more universal, though is still present in the most recent cohorts

Part 5 Impacts of Sugar Factories

5.2 Results—Public goods

(f) Junior High Completion Levels



(h) High School Completion Levels

- Impacts on junior high completion are zero for the older cohorts, whose junior high completion rates were close to zero, and then become large and positive as cohorts born from the 1950s onward begin to complete junior high at more appreciable rates. Impacts on high school completion show a similar pattern

Part 5 Impacts of Sugar Factories

5.2 Results—Public goods

Table 4: Education: Subjected Villages

	2000 Population Census				1980 Census		Village Head	
	Years Education (1)	Primary School (2)	Junior High (3)	High School (4)	No School (5)	Primary School (6)	Years Education (7)	High School (8)
Cultivation	0.238	0.026	0.017	0.008	-0.017	-0.003	0.106	0.029
	(0.075)	(0.006)	(0.007)	(0.005)	(0.009)	(0.010)	(0.087)	(0.013)
Obs	16,125,747	16,125,747	16,125,747	16,125,747	653,313	653,188	26,630	26,630
Clusters	383	383	383	383	358	358	383	383
Mean	5.10	0.64	0.27	0.13	0.41	0.19	11.87	0.74

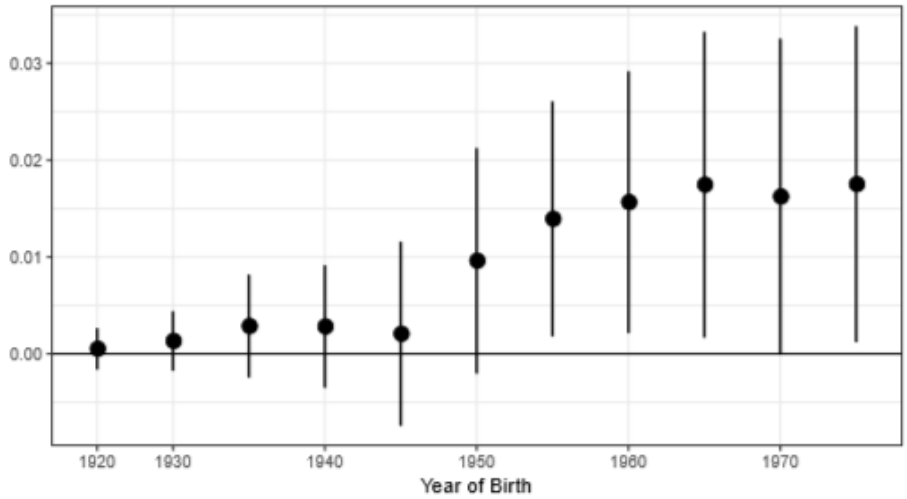
Notes: The unit of observation is the individual. Regressions include boundary segment fixed effects, linear splines in distance to the nearest historical factory and residency capital, geographic controls, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Columns (1) through (6) include gender dummies, and columns (7) and (8) include survey year fixed effects. Robust standard errors, clustered by subdistrict, are in parentheses.

- While there is not a statistically significant impact on years of schooling, village heads in subjected areas are three percentage points more likely to have completed high school, relative to a sample mean of 74%

Part 5 Impacts of Sugar Factories

5.2 Results—Public goods

(g) High School Completion



- The effect on village heads is about double the average effect for cohorts of similar age shown in Figure 13, panel g)

Part 5 Impacts of Sugar Factories

5.2 Results—Economic structure

Table 4: Industrial Structure: Subjected Villages

	SUSENAS (2001-11)			1980 Population Census			Num. Manuf.	Log Equiv.
	Ag.	Manuf.	Retail	Ag.	Manuf.	Commerce	Firms	Consumption
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cultivation	-0.042	0.031	0.012	-0.036	0.008	0.027	21.734	0.006
	(0.012)	(0.010)	(0.007)	(0.021)	(0.013)	(0.010)	(8.639)	(0.011)
Obs	130,335	130,335	130,335	127,873	127,873	127,873	4,549	144,046
Clusters	381	381	381	358	358	358	383	381
Mean	0.27	0.21	0.18	0.48	0.11	0.12	71.72	12.55

Notes: The unit of observation is the individual in columns (1) through (6), the village in column (7), and the household in column (8). The sample is restricted to men age 18-55 in columns (1) through (6). Regressions include geographic and pre-period characteristics, boundary segment fixed effects, a linear spline in distance to the nearest historical factory, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Columns (1) through (3) include survey year fixed effects. Robust standard errors, clustered by subdistrict, are in parentheses.

- We find that in subjected villages, individuals are 4 percentage points (15 percent) less likely to work in agriculture, 3 percentage points (14 percent) more likely to work in manufacturing, and 1.2 percentage points (7 percent) more likely to work in retail

Part 5 Impacts of Sugar Factories

5.2 Results—Economic structure

Table 4: Industrial Structure: Subjected Villages

	SUSENAS (2001-11)			1980 Population Census			Num. Manuf.	Log Equiv.
	Ag.	Manuf.	Retail	Ag.	Manuf.	Commerce	Firms	Consumption
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cultivation	-0.042	0.031	0.012	-0.036	0.008	0.027	21.734	0.006
	(0.012)	(0.010)	(0.007)	(0.021)	(0.013)	(0.010)	(8.639)	(0.011)
Obs	130,335	130,335	130,335	127,873	127,873	127,873	4,549	144,046
Clusters	381	381	381	358	358	358	383	381
Mean	0.27	0.21	0.18	0.48	0.11	0.12	71.72	12.55

Notes: The unit of observation is the individual in columns (1) through (6), the village in column (7), and the household in column (8). The sample is restricted to men age 18-55 in columns (1) through (6). Regressions include geographic and pre-period characteristics, boundary segment fixed effects, a linear spline in distance to the nearest historical factory, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Columns (1) through (3) include survey year fixed effects. Robust standard errors, clustered by subdistrict, are in parentheses.

- The coefficient on employment in agriculture is similar in magnitude to that from the more modern SUSENAS data. The effect on manufacturing, which was a much smaller share of the Indonesian economy in 1980, is close to zero and statistically insignificant. However, we cannot rule out a similar proportionate increase in manufacturing to that in the more recent data. Individuals in subjected villages were 2.7 percentage points (23 percent) more likely to be employed in commerce

Part 5 Impacts of Sugar Factories

5.2 Results—Economic structure

Table 4: Industrial Structure: Subjected Villages

	SUSENAS (2001-11)			1980 Population Census			Num. Manuf.	Log Equiv.
	Ag.	Manuf.	Retail	Ag.	Manuf.	Commerce	Firms	Consumption
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cultivation	-0.042	0.031	0.012	-0.036	0.008	0.027	21.734	0.006
	(0.012)	(0.010)	(0.007)	(0.021)	(0.013)	(0.010)	(8.639)	(0.011)
Obs	130,335	130,335	130,335	127,873	127,873	127,873	4,549	144,046
Clusters	381	381	381	358	358	358	383	381
Mean	0.27	0.21	0.18	0.48	0.11	0.12	71.72	12.55

Notes: The unit of observation is the individual in columns (1) through (6), the village in column (7), and the household in column (8). The sample is restricted to men age 18-55 in columns (1) through (6). Regressions include geographic and pre-period characteristics, boundary segment fixed effects, a linear spline in distance to the nearest historical factory, and a linear polynomial in latitude and longitude estimated separately for each catchment area. Columns (1) through (3) include survey year fixed effects. Robust standard errors, clustered by subdistrict, are in parentheses.

- We find that subjected villages have around 22 percent more manufacturing firms than non-subjected villages

Part 5 Impacts of Sugar Factories

5.2 Results—Economic structure

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- There is not a statistically significant difference in household consumption. However, the confidence intervals include the possibility of consumption being around 2 percent higher, about what we would expect given differences in schooling

Part 6 Conclusion

1. A sugar processing infrastructure in colonial Java persistently increased industrialization, education, and consumption

2. Infrastructure, input-output linkages and human capital accumulation are important channels

3. The counterfactual is also important. The Dutch made large-scale investment to overcome barriers for extracting a large surplus

4. The Dutch and the Java were not the only example and these results plausibly inform a variety of contexts.


Thank you for listening!
Zhai Ruijing & Zhanmu Ounan