

# Persistence of Inequality after Apartheid: Assessing the Role of Geography and Skills

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<sup>a</sup>The views expressed herein are the authors' and do not represent those of the FRB of Chicago or the Federal Reserve System.

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# Rising Inequality Despite Almost 30 Years post Apartheid in South Africa

- **Apartheid** in SA (1948-'94): harsh, institutionalized system of racial segregation



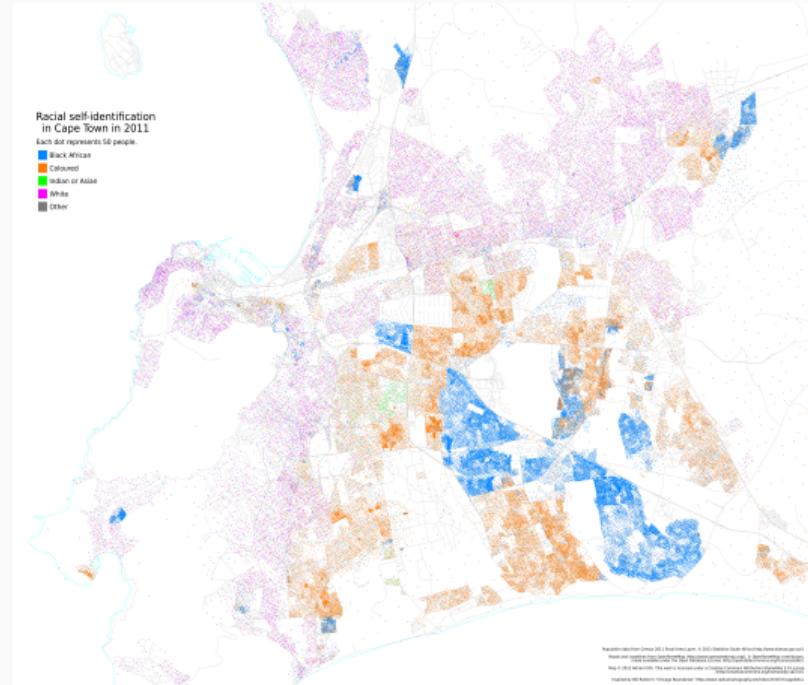
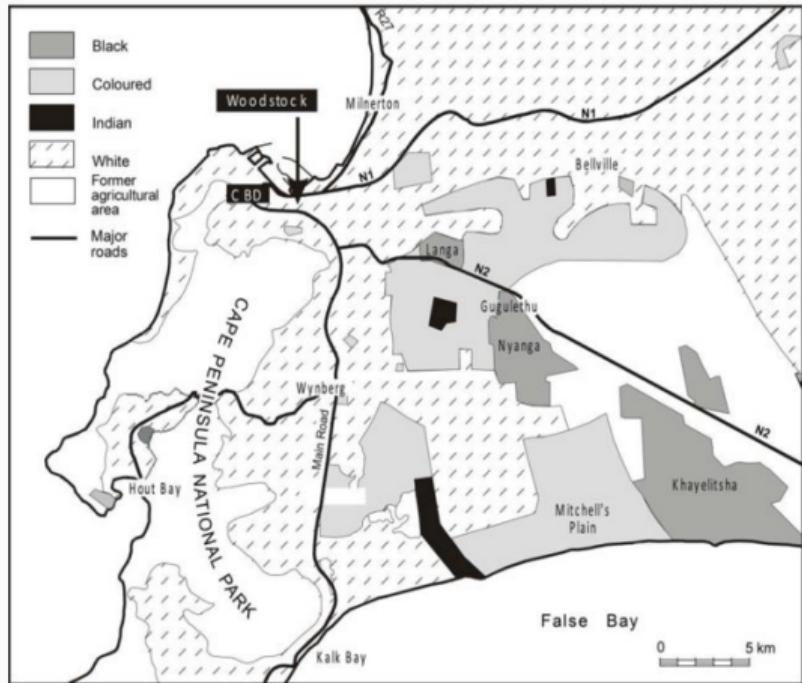
*A racially segregated train station entrance during apartheid. Apartheid Museum*

[Details](#)

# Rising Inequality Despite Almost 30 Years post Apartheid in South Africa

- **Apartheid** in SA (1948-'94): harsh, institutionalized system of racial segregation
- End of Apartheid era => “free” access to education, health, jobs, finance + extensive policies to address inequality:
  - ▶ Inequality and unemployment are very high, mostly for Black
  - ▶ The highest Gini worldwide both for earnings and wealth Plot
  - ▶ Inequality:  $\downarrow$  across racial groups, but  $\uparrow$  within Plot
  - ▶ Average wage income of  $\approx 3/4$  of Black population in Metroareas  $\downarrow$  since '96 Plot
- What drives inequality increase and persistence?  
⇒ Special role of **Townships** – core spatial concept of Apartheid Details

# Modern Cities Still Shaped by Apartheid Policies: Cape Town in 1990s vs 2011



# Spatial Segregation: Townships (More Pictures!!!)



*Photo: Johnny Miller*

*Lake Michelle / Masiphumelele (Cape Town, South Africa)*

## Is South Africa Unique?

- High-quality neighborhoods – important determinant of children/adult outcomes
- Racial segregation and disparities in educational quality are common features of many American cities (e.g. Chicago, St. Louis, Detroit, etc.)
- Developing countries: colonial inheritance (favelas in Brazil) + growing urbanization and development of slums

This paper: Use Apartheid to study role of segregation (broadly!) determined by geography on the rise/persistence of inequality

- **Data:** Compare Townships (exogenous location/assignment) + Calibrate the Model
- **Model:** Slow Transition + Initial Conditions vs. Discrimination/Homophily; Role of Different Channels; Counterfactuals (e.g. Infrastructure improvement)

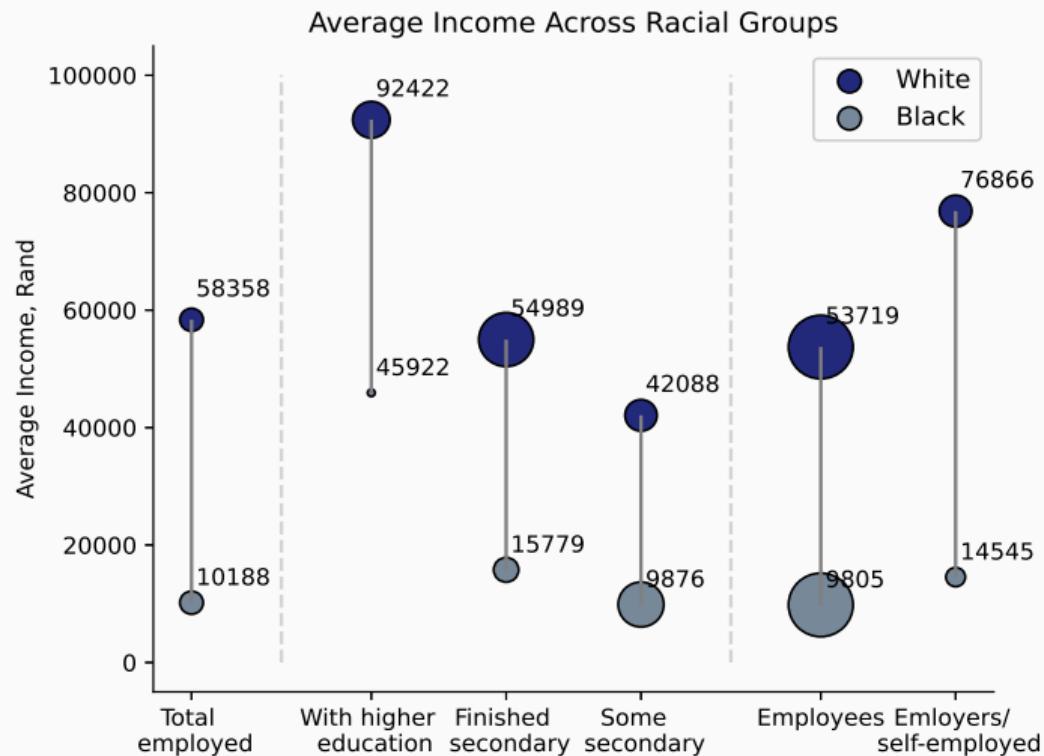
# Plan of the Talk

1. Data: Stylized Facts
2. Model Framework
3. Model Estimation
4. Mechanisms: Model Predictions and Data
5. Model Predictions: Distance to the City

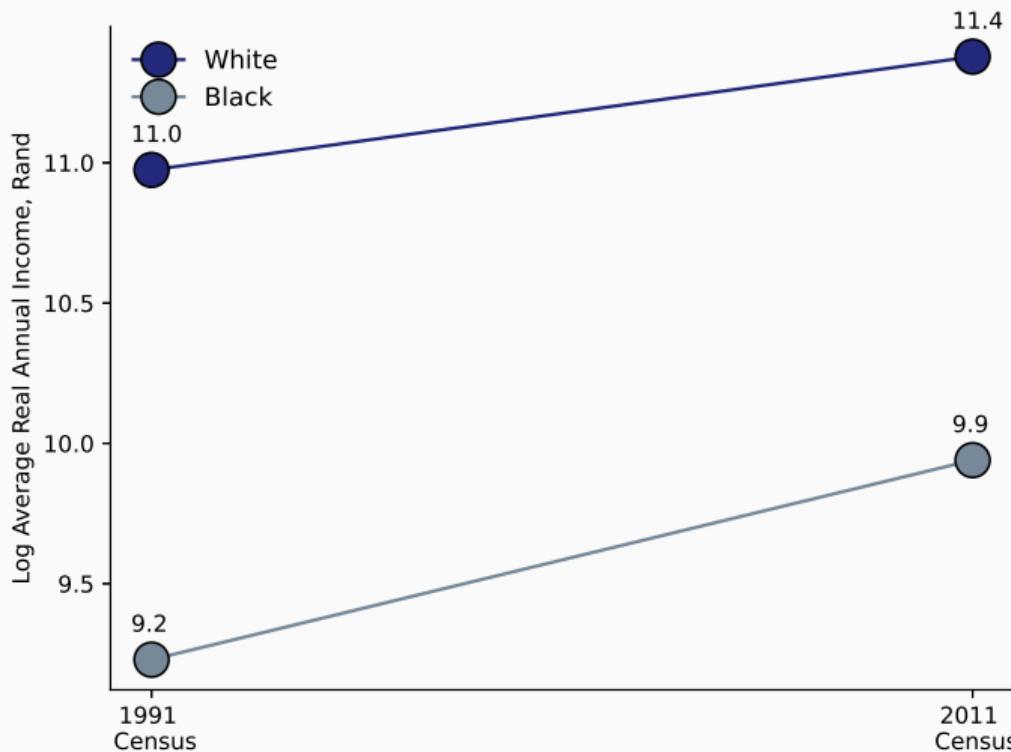
# Various National and Local Data Sources

- Townships Geolocations (Available Online!)
  - ▶ AfricaScope (530) ✓
  - ▶ Manual Historical Data Collection ✓
- GeoData (Map Township, Focus on Metropolitan Areas)
  - ▶ Statistics SA: SAL/EA ✓
  - ▶ DYSTURB historical districts ✓
- Censuses: 1991 ✓ (SA + Independent Bantustans) and 2011 ✓ + Labour Force Surveys ✓
  - ▶ Individual Level Data: Demographics, Education, Employment, Income
  - ▶ Compare dynamics across racial groups
- Censuses: 1996✓, 2001, 2011✓ + General Household Survey 2018 ✓
  - ▶ SAL/EA level: Demographics, Education, Employment, Income Data Mapping Race dist.
  - ▶ Compare dynamics across Townships and Township vs City
- Commuting Survey Data (City of Cape Town, 2013) ✓
  - ▶ Individual data: Demographics, Education, Income, Employment
  - ▶ Commute: Home and Work/Study Location, Time, Cost
- Publicly Available Education Datasets ✓
- Historical Censuses + DYSTURB historical districts (1911, '21, '36, '51, '60, '70, '80) ✓
- Other Sources for Calibration (PSLSD '93, WB, etc) ✓

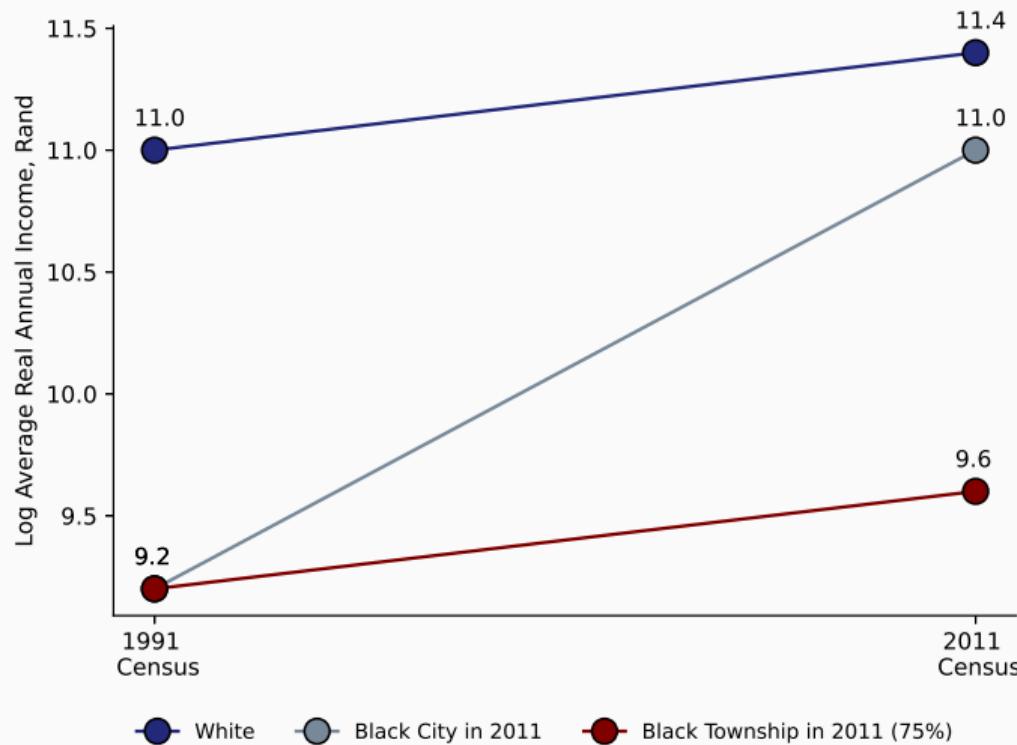
# Six-fold Black-White Income Gap in Apartheid South Africa (1991 Census)



# Black-White Gap in Income and Education Has Shrunk



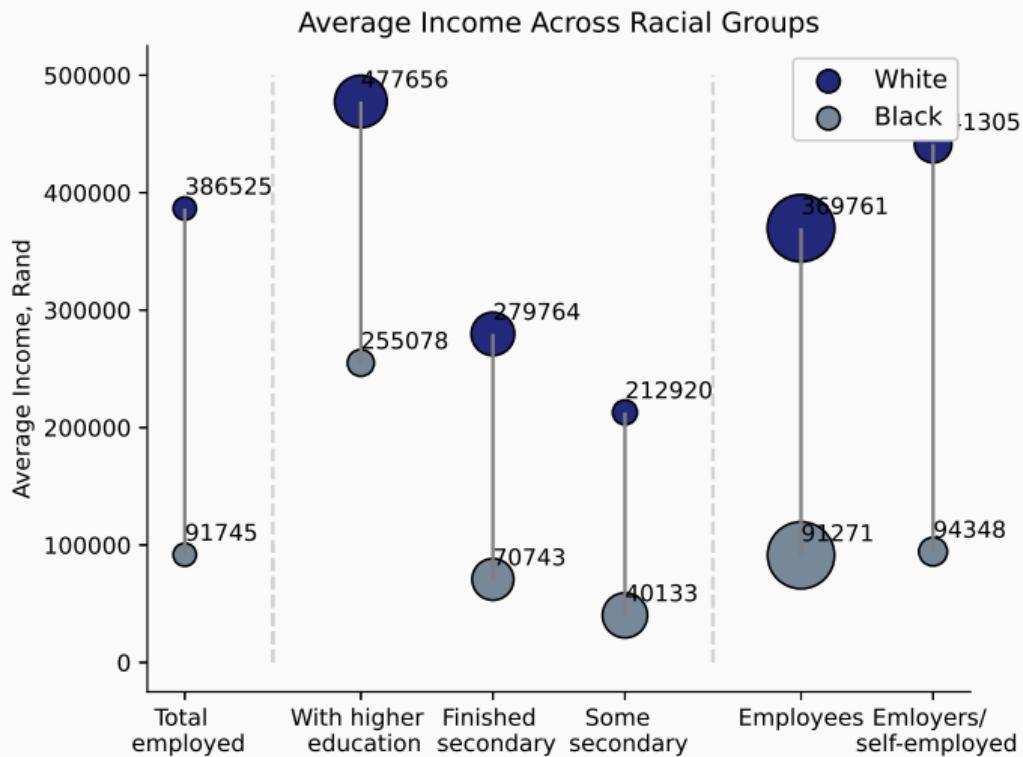
## Yet...Income Growth and Level of Education in Townships are Lagging Behind



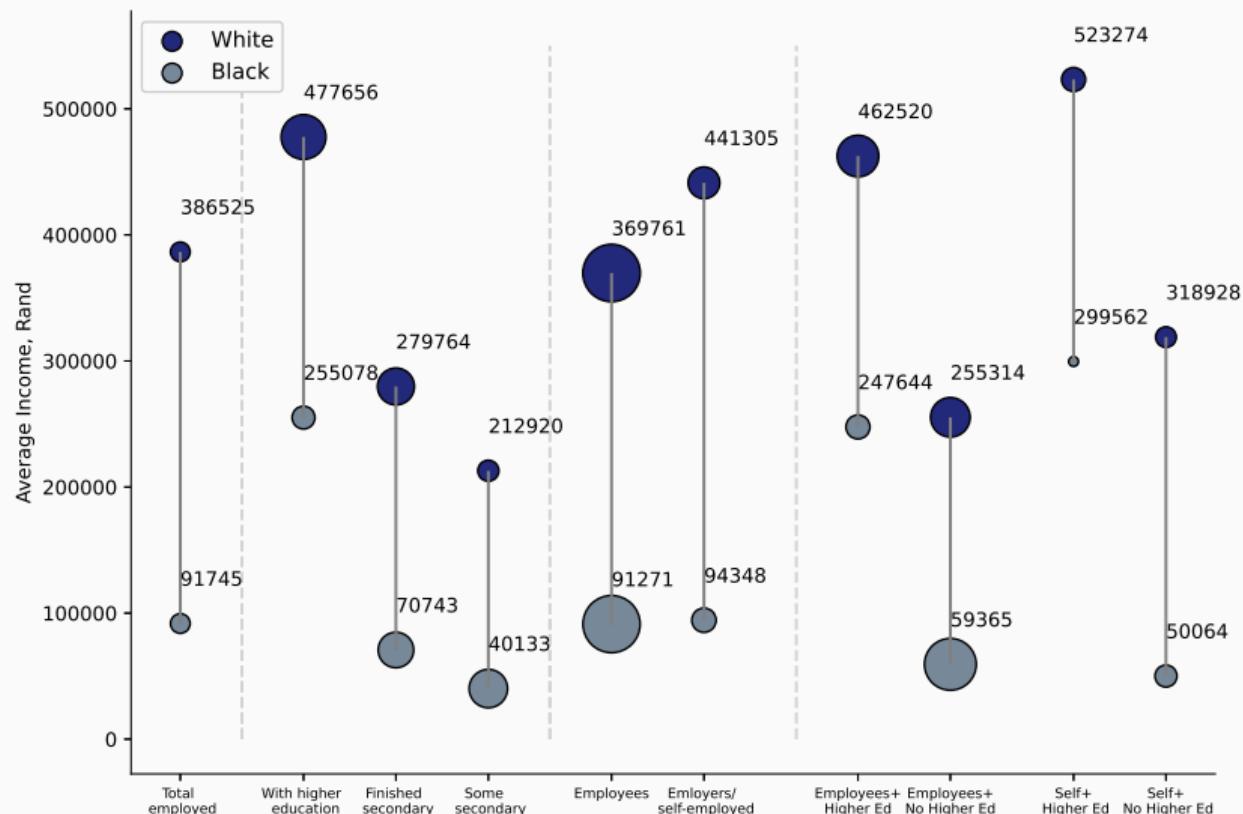
## Share of Individuals by Location of Home and Work/Education Place

	Live in City		Live in Township	
	work	education	work	education
Commute to City	93.4%	92.1%	73.1%	26.4%
Commute to Township	6.6%	7.9%	26.9%	73.6%

# Average Individual Income: 2011 Census



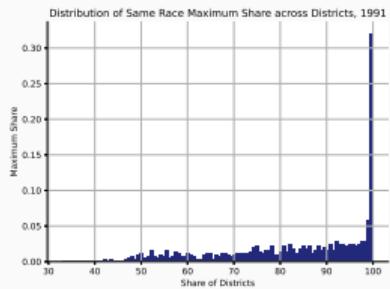
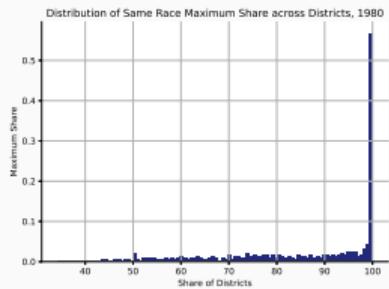
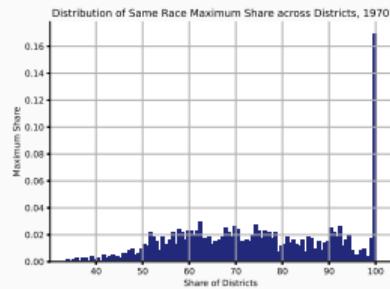
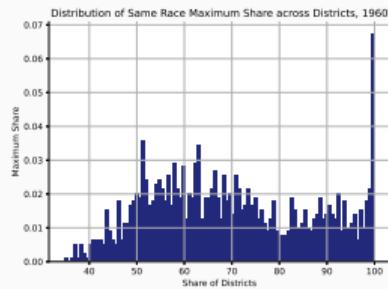
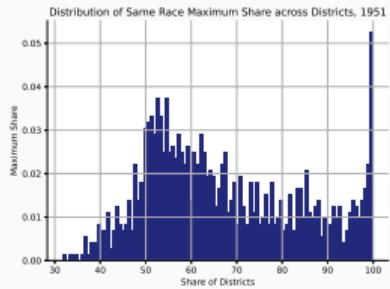
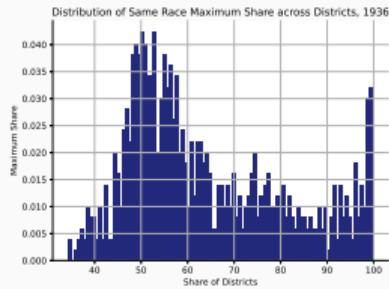
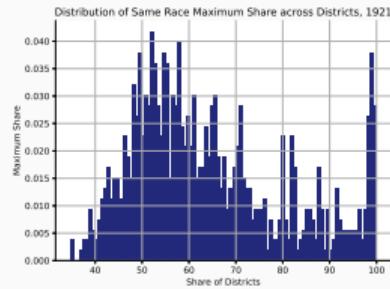
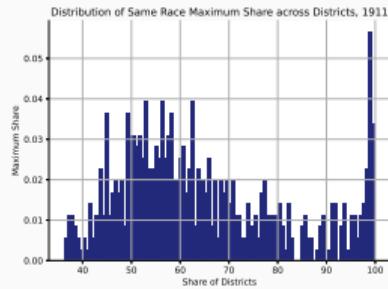
# Average Individual Income by Employment and Education, 2011 Census



## Apartheid Allocated Blacks to Townships Based on Ethnolinguistic Groups

- Apartheid created townships to segregate blacks away from city centers
- Allocation of blacks to townships was based on **ethnolinguistic groups**
  - ⇒ allocation is orthogonal to economic forces
  - ▶ 1991 Census: EA are mostly language homogenous
- Townships separated by natural/artificial buffer zone
- Allocation ~ **natural experiment** to identify effect of distance to city center
  - ▶ In 2011 > 50% of Townships have one predominant language (70%)
  - ▶ Movement across townships is limited: migration to city 2X migration to townships
  - ▶ Control by distance to closest city besides CBD ~ control mov't across townships

# Historical Race Distribution Across Districts: 1911 – 1991



Same MD Districts

## Township Outcomes Using Individual Data from Cape Town

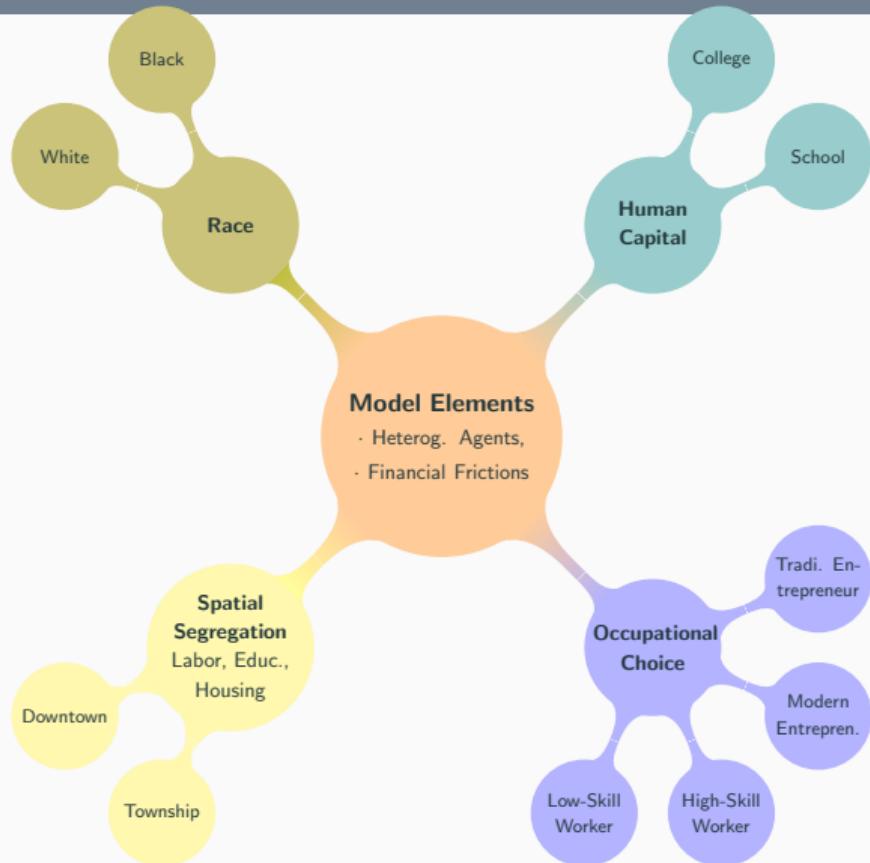
	Education				HH Assets		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Distance to Cape Town	-0.19 (0.03)	-0.20 (0.03)	-0.14 (0.03)	-0.13 (0.02)	-0.15 (0.04)	-0.11 (0.04)	-0.09 (0.03)
Individual Controls	—	✓	✓	✓	✓	✓	✓
Dist. Near City to CT	—	—	✓	✓	—	✓	✓
Black Dummy	—	—	—	✓	—	—	✓
Observations	7,725	7,649	7,649	7,649	7,706	7,706	7,706

Notes: Individual Controls are age, gender, household size, number of adults in the household, number of employed. Std. err. clustered at enumeration area. Variables have been standardized to mean zero and std. dev. of one. Unnormalized std. dev.: Dist. to CT 11.7 Km, Education, 1.14, Assets, 1.19.

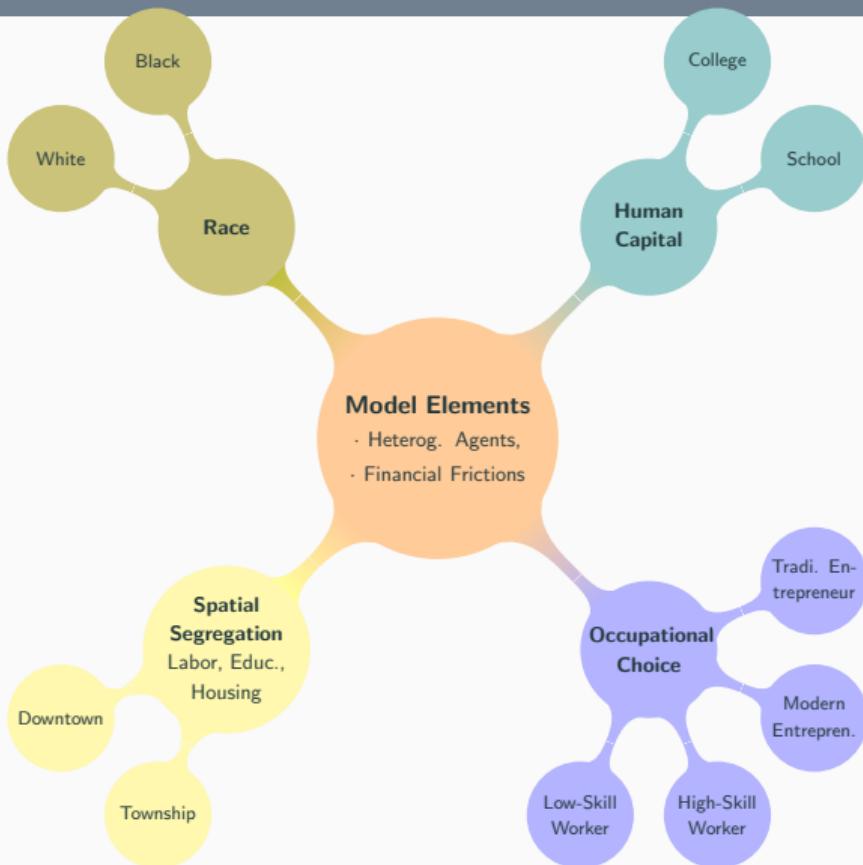
# **Plan of the Talk**

1. Data: Stylized Facts
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# Model Incorporates Spatial, Educational and Occupational Regularities



# Model Incorporates Spatial, Educational and Occupational Regularities



- Model features:
  - ▶ Forward-looking OLG dynasties
  - ▶ General Equilibrium (Comp.Eq.)
- Modeling strategy:
  1. Calibrate Apartheid Steady State to early 90s
  2. Compute transition to Race-Blind Equilibrium

## Model: Main Features

- Household's state has **five** dimensions:
  1. Race – Black and White,  $j \in \{B, W\}$     **Important Only for Apartheid Steady State**
  2. Innate talent of parent and kid:  $z_k = \rho z_p + \epsilon$  (AR1 in logs)
  3. Human capital of parent:  $h_p = \text{talent} + \text{education}$
  4. Level of assets,  $a \geq \underline{a}$
- Household lives for 2 periods (25 years each)
- Household consists of a young,  $Y$ , and an old,  $O$ , member
- When young becomes old, has 1 kid, old dies (OLG structure)

## HH Problem: Choose Consumption, Savings, Location, Occupation, Education

$$V^{HH}(a, z_p, z_k, h_p) = \max_{\{c_p, c_k, a', \textcolor{red}{h_k}, \textcolor{red}{I^e, o}, I_H, k\}} U^{HH}(c_p, c_k) + \chi \epsilon_{I_H} + \beta \mathbb{E}_{z'_k, \epsilon'_{I_H}} [V^{HH}(a', z_k, z'_k, h_k)]$$

subject to:

$$U^{HH} = \lambda \frac{c_p^{1-\sigma}}{1-\sigma} + (1-\lambda) \frac{c_k^{1-\sigma}}{1-\sigma}, \quad (\text{Household utility})$$

$$c_p + c_k + \textcolor{red}{c_H} + \textcolor{red}{e_{educ}} + a' \leq a(1+r) + \textcolor{red}{y_p} + y_k - \tau (\mathbb{1}_{e \neq H} + \mathbb{1}_{w \neq H}), \quad (\text{Bdgt cstr.})$$

$$k \mathbb{I}_{o=entrep.} + P_c \mathbb{I}_{college} \leq \textcolor{red}{\lambda_k} a, \quad (\text{Colateral constraint } \text{Financial Markets})$$

$$\epsilon_{I_H} \sim \text{Gumbel iid}$$

## Spatial Component: Two locations – Township, $T$ , and City Downtown, $D$

- Household consumes one unit of housing in either location at price  $P_H^I$
- Supply of housing is perfectly elastic in Township (normalize  $P_H^T = 0$ )
- Supply of housing is isoelastic in housing price in Downtown,  $HS_D = \alpha_H(P_H^D)^{\frac{1}{\gamma_H}}$
- HH chooses each period location of a *house, work and kid's school*
- To work or study in location other than the house – transportation cost,  $\tau$

# Occupational Choice and Segmented Labor Markets

- There are four possible occupations in each location:
  1. Low-skilled Workers
  2. High-skilled Workers (requires college degree)
  3. Traditional Entrepreneurs,  $y_T(\theta) = zA_e k(\theta)^{\alpha_T} L(\theta)^{\gamma_T}$
  4. Modern Entrepreneurs,  $y_M(\theta) = h k(\theta)^{\alpha_M} (I_H(\theta)^\omega L(\theta)^{1-\omega})^{\gamma_M}$ , with  $\alpha_M > \alpha_T$
- Segmented labor markets for Township and non-Township areas
- Wage depends on the level of human capital and location ( $w = h \cdot w_S^{I^w}$ )
- Entrepreneurs operate businesses where reside
- Youth out of school is employed as Low-skilled workers where reside

Data on Entrepreneurs

## Educational Choice for the Kid: School and College

- Decide on the level ( $S, C$ ) and location of school ( $T, D$ ):  $\{ST, CT, SC, CC\}$
- Human capital: talent + education

$$h_k = \begin{cases} z_k h + \textcolor{red}{h}_D \mathbb{1}_{\{I^s=D\}} & \text{if school} \\ (h^{school})^\eta & \text{if college} \end{cases}$$

- School is free, but opportunity cost ( $y_k = n_k \cdot w_L^{I^h}$ ) + transportation cost,  $\textcolor{red}{\tau}$ ,  $\mathbb{1}_{\{I^s \neq I^h\}}$
- College is only in the city + the fee  $P_c$  + transportation cost,  $\textcolor{red}{\tau}$ ,  $\mathbb{1}_{\{I^h=T\}}$

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## Estimation Strategy

1. **Apartheid Steady State: total segregation by definition**
2. Compute counterfactual SS without Apartheid constraints (race-blind): sorting on assets and education
3. Compare transitions/SS for different township-city pairs with different  $\tau$
4. Compute transition between the SS and compare with data  
→ Policy analysis: Effect of public housing (RDP) over transition (Picarelli, 2019)

## Estimate Model Starting with Steady State in Apartheid

- Blacks live in Townships, Whites in non-Townships
- Blacks can't go to college or city school
- Blacks can't be entrepreneurs
- Blacks can't borrow

Location Distribution 1991

Education in 1991

Employment in 1991

## Model's Calibration Combines estimates from HH data and Target Moments

Moments (Whites)			Model Parameters		
Description	Target	Model	Var.	Value	Description
Ratio Income White College/School	1.8	1.9	1.2	$\eta$	Return to College
Ratio Income White Entr./Worker	1.4	1.3	$\sigma_\varepsilon$	0.8	Variance of a Talent
Share of Modern Entrepreneurs	2%	3%	$\underline{h}$	1.05	School Human Capital
Share of Trad. Entrepreneurs	5%	5%	$A_e$	1.25	Trad. entr. productivity
Share of College Educated	10%	7%	$P_c$	0.6	Price of College

Notes: Statistics computed from household heads in 1991 South Africa Census

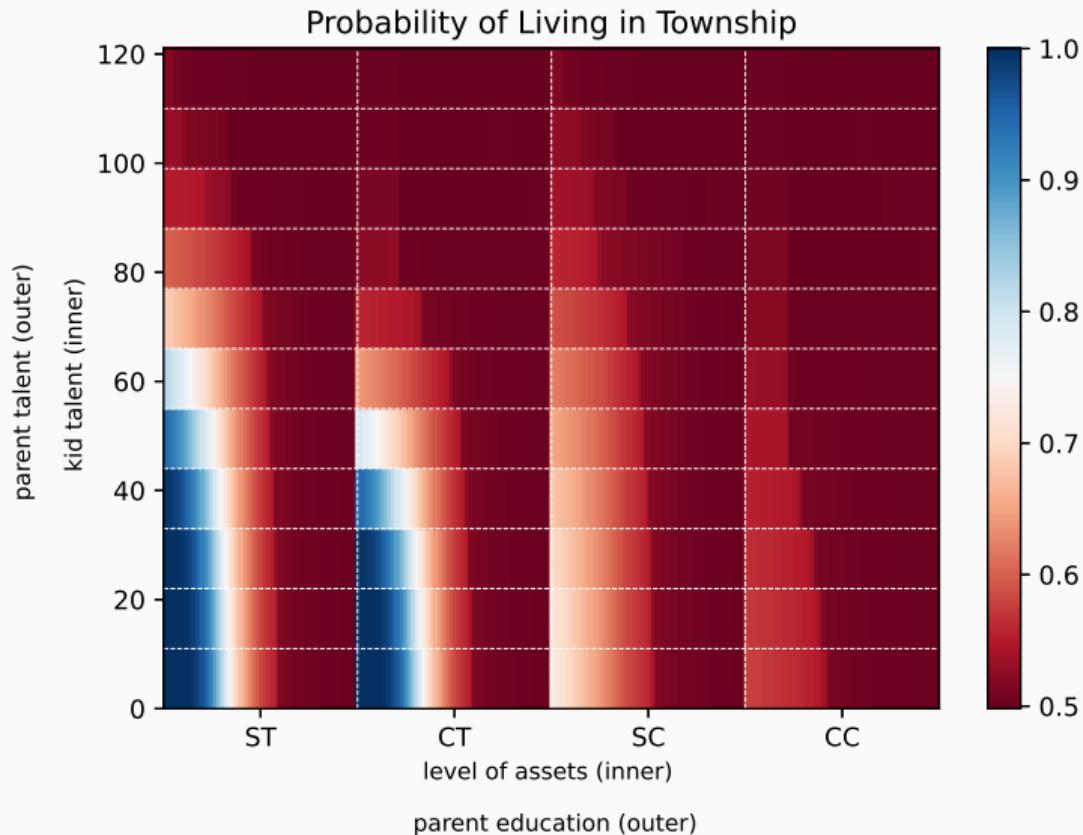
- Estimated outside of the model:
  - Transportation costs  $\tau = 0.103w_L$  (PSLSD, SA for 1993)
  - Production function, school quality [Parameter Values](#)
  - Collateral constraint  $\lambda_k = 1.87$  (Collateral to loan value, WB, SA for 2020)

+ Off-the-shelf from lit.:  $\sigma = 1.5$ ,  $\lambda = 0.7$ ,  $\rho = 0.47$ ,  $\delta = 6\%$ ,  $\beta = 0.36$ ,  $\gamma_h = 0.5$ ,  $\kappa = 0.12$

## Estimation Strategy

1. Apartheid Steady State: total segregation by definition
2. **Compute counterfactual SS without Apartheid constraints (race-blind):**  
sorting on assets and education
3. Compare transitions/SS for different township-city pairs with different  $\tau$
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→ Policy analysis: Effect of public housing (RDP) over transition (Picarelli, 2019)

# Race-Blind Equilibrium: Poor & Less Educated Live in Township



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## Model Predictions and Data: Household's Choices

- **Location:** Rich & Educated => city + in GE labor opportunities/income (salary/profit) vs transportation cost/ housing price
- **Work/School Location:** Home location => school location ( $\tau$ ) + availability of jobs & salary and human capital => work loc.

		Live in City		Live in Township	
		school	college	school	college
Commute to City		90.8%	97.1%	18.8%	85.0%
Commute to Township		9.2%	2.9%	81.2%	15.0%

## Model Predictions and Data: Household's Choices

- **Kid's Education:** Rich, college educated, productive => college/city school  
(income + opportunity cost + financial constraint +  $\tau$  + human/physical capital)

	(1)	(2)	(3)	(4)
Distance Cape Town	-0.75 (0.12)	-0.59 (0.11)	-0.29 (0.08)	-0.36 (0.011)
Dist. Cape Town $\times \mathbb{1}_{\text{Township}}$	-0.053 (0.022)	-0.069 (0.020)	-0.071 (0.016)	-0.058 (0.018)
Household Assets			0.31 (0.010)	0.33 (0.014)
Household Income				0.018 (0.011)
Individual Controls	—	✓	✓	✓
Observations	28,815	24,065	24,065	15,366

Notes: Individual Controls are age, gender, household size, number of adults in the household, number of employed. Std. err. clustered at enumeration area. Variables have been standardized to mean zero and std. dev. one.

## Model Predictions: Household's Choices

- **Kid's Education:** Rich, college educated, productive => college/city school  
(income + opportunity cost + financial constraint +  $\tau$  + human/physical capital)
- **Work/School Location:** Home location => school location ( $\tau$ ) + availability of jobs & salary and human capital => work loc.
- **Location:** Rich & Educated => city + in GE labor opportunities/income  
(salary/profit) vs transportation cost/ housing price
- **Occupation:**
  - ▶ School only: Low-skilled labor or entrepreneurship (wealth, productivity/human capital)
  - ▶ College: High-skilled labor or *modern entrepreneurship* (in GE some trad. entrep.)
- Plots (high  $\tau$ ): Kid's Education, Occupational Choice, Home Location, Assets

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## Estimation Strategy

1. Apartheid Steady State: total segregation by definition
2. Compute counterfactual SS without Apartheid constraints (race-blind): sorting on assets and education
3. **Compare transitions/SS for different township-city pairs with different  $\tau$**
4. Compute transition between the SS and compare with data + Counterfactuals

## Township Outcomes 1996 vs 2011: Higher Growth for Closer Townships

	Education		HH Income	
	(1)	(2)	(3)	(4)
Distance to City	-2.722 (1.047)	-2.109 (0.931)	-0.131 (0.052)	-0.124 (0.066)
Major City FE		✓		✓
Observations	148	148	148	148

Notes: Columns (1), (2) use the change in share of individuals with completed secondary and higher education. Columns (3), (4) use the change in average HH income and control for change in average education level. Distance to city is a dummy for townships with higher than median distance to the city (similar for absolute distance). St. errors (in parenthesis) are clustered at MN level.

Same for individuals residing in **closer** Townships: assets/income, education

## Township Outcomes: Model Predictions for Steady State

Vary  $\tau$  for post-Apartheid st. state, with closer Township to the City:

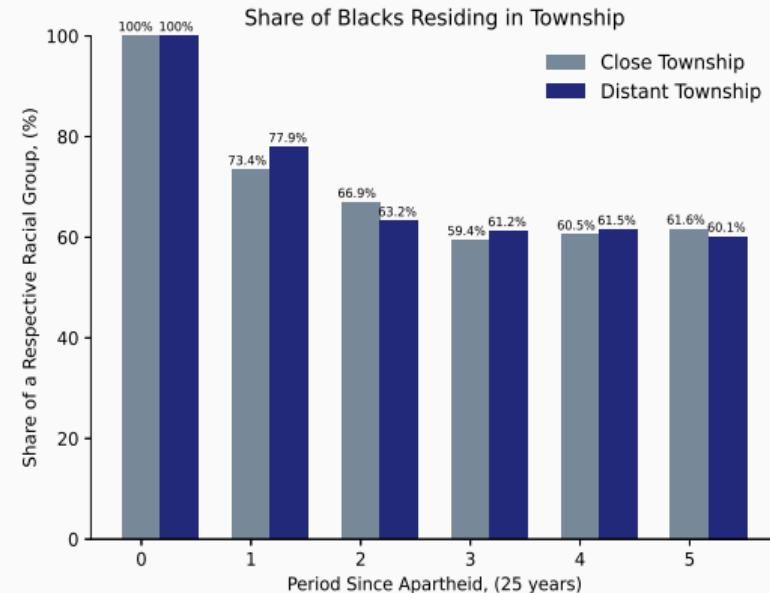
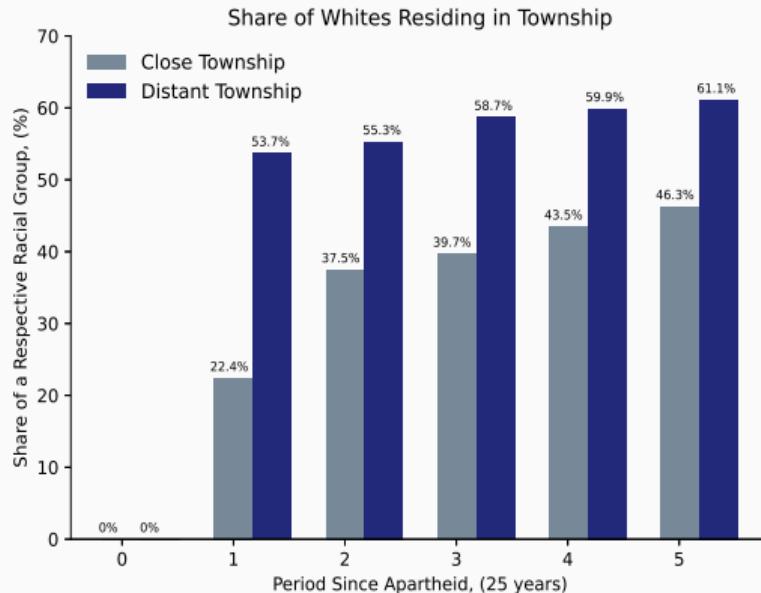
- Richer in assets and income
- More educated (college) and higher human capital
- More entrepreneurship

=> **Higher Inequality** in education and income and wealth when **Distance/Cost Larger**

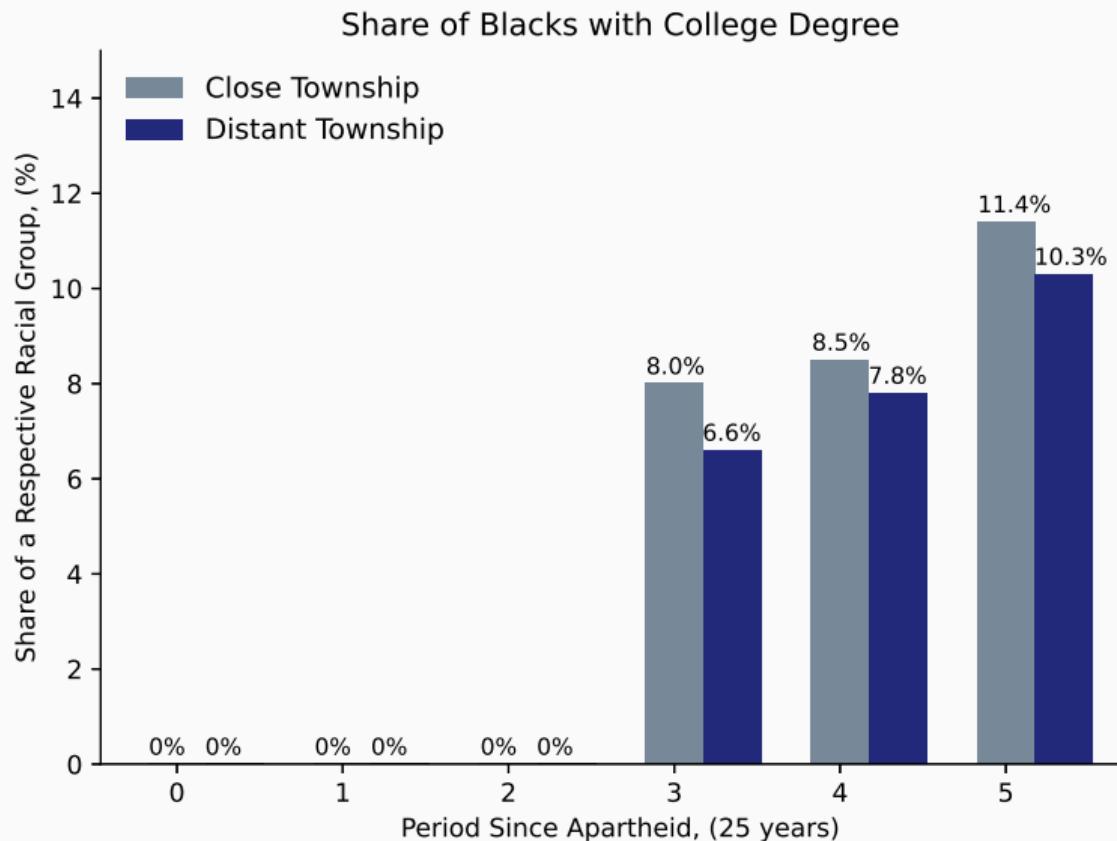
- Investment in Infrastructure + More Housing in City
- SA Policy in Place: Housing in “New” Townships even further + Zoning

What about *transition dynamics*?

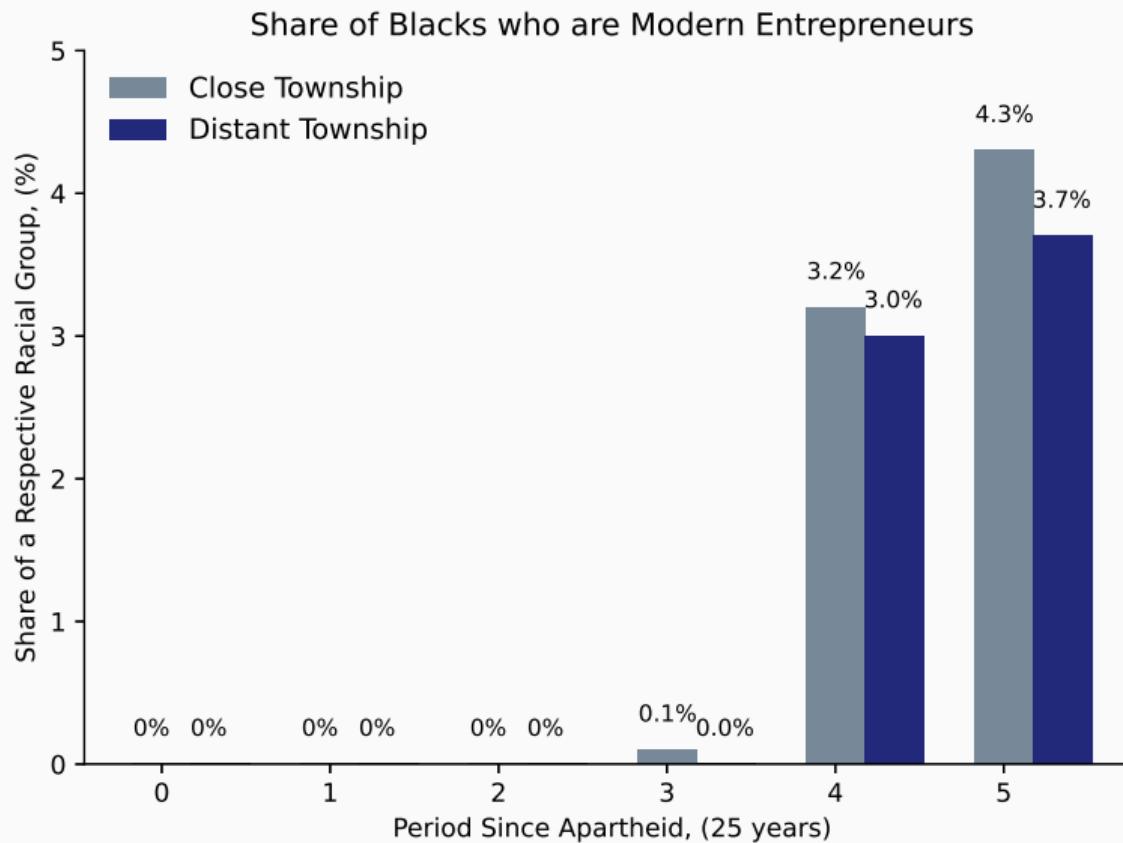
# Transition Dynamics Preliminary Analysis: Residence Location



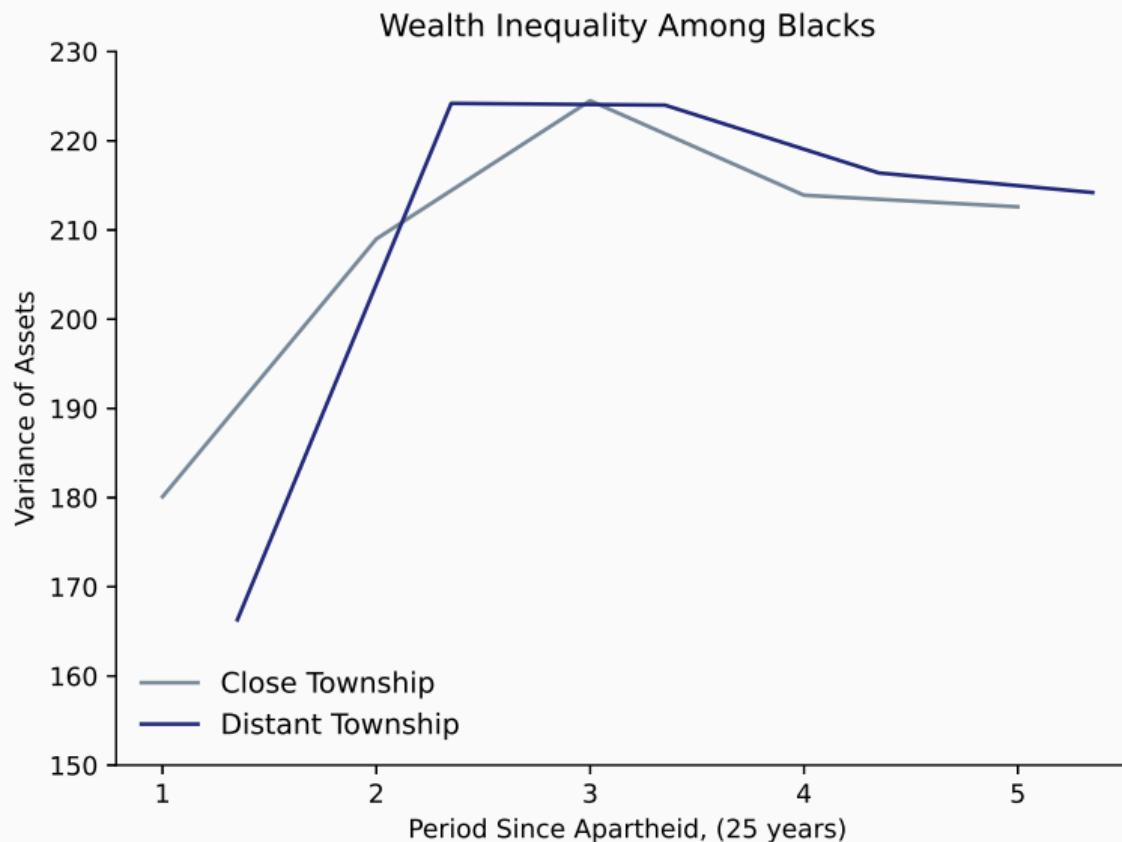
# Transition Dynamics Preliminary Analysis: Higher Education



# Transition Dynamics Preliminary Analysis: Entrepreneurship



# Transition Dynamics Preliminary Analysis: Inequality



## Transition Dynamics: Preliminary Analysis Main Outcomes

Vary *only*  $\tau$  for post-Apartheid transition, closer Township to the City:

- Faster entry of Blacks into college and entrepreneurship
- Faster residential mixing
- Faster assets accumulation

=>  $\uparrow$  Within Group Inequality in education/income/wealth when Distance/Cost  $\uparrow$

- Make labor and education markets more accessible, i.e.  $\downarrow$  Cost
- Bring business and education into Township

Still hard to explain lack of mixing in Townships: *other factors?*

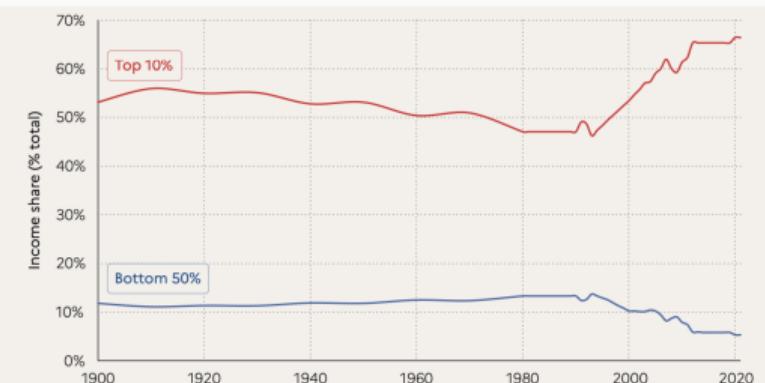
- Different financial constraint
- Amenities

## South Africa: Context

- Starting from 1948 the system of legislation that enforced racial segregation, political and economic discrimination was implemented [Apartheid]
- Apartheid is the period of white supremacy:
  - ▶ More than 80 percent of the country's land for white minority
  - ▶ Black South Africans were forcibly reallocated to areas separated from white
  - ▶ Most social contracts between the races were forbidden
  - ▶ Separate educational standards, restrictions for each race to certain types of jobs and access to credit
- A new constitution that enfranchised blacks and other racial groups was adopted in 1993 and took effect in 1994

# Income and Wealth Inequality in South Africa

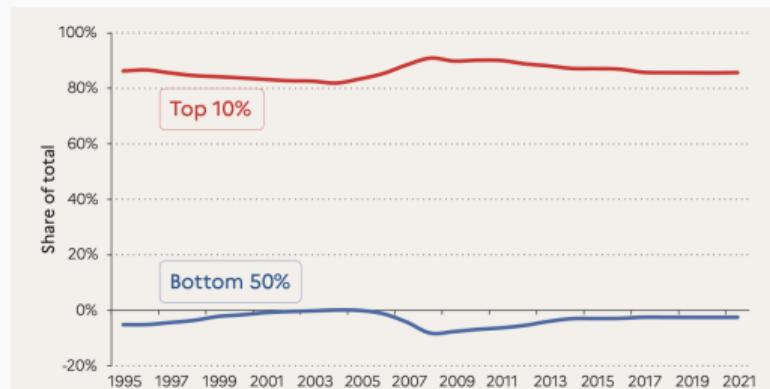
## Top 10% and bottom 50% Income Shares



**Interpretation:** The Top 10% income share is equal to 67% in 2021. Income is measured after the operation of pensions and unemployment insurance systems and before income tax.

**Sources and series:** see [wir2022.wid.world/methodology](http://wir2022.wid.world/methodology), and Chancel and Piketty (2021).

## Wealth Distribution

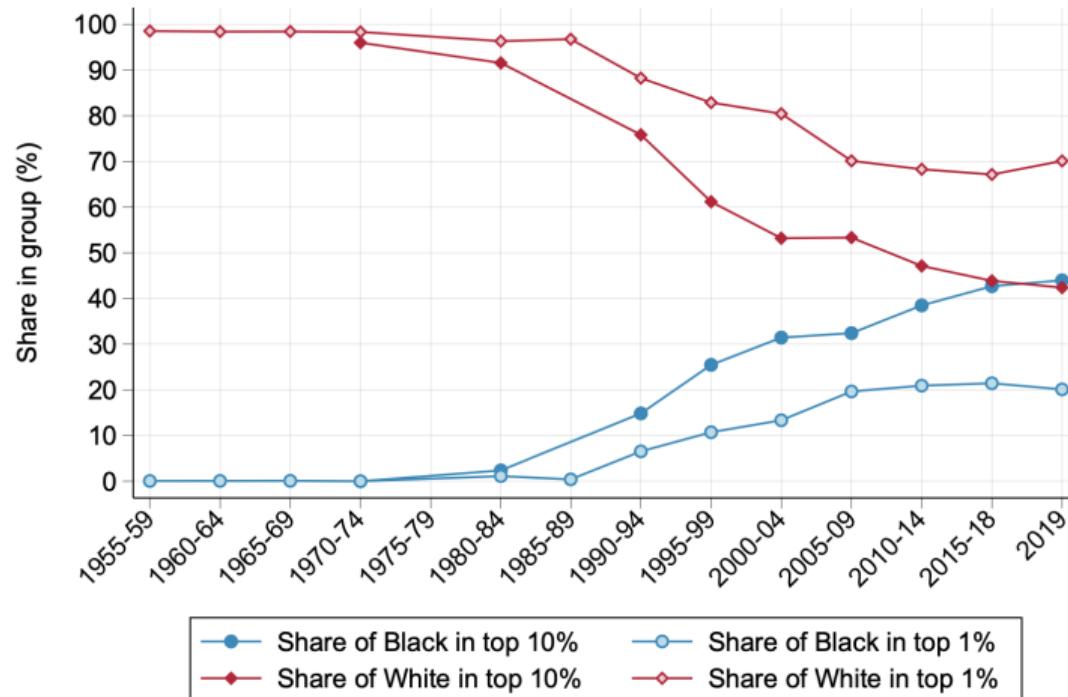


**Interpretation:** In 2021, the wealthiest 10% of the population own 87% of total household wealth. Household wealth is the sum of all financial assets (e.g. stock, bonds) and non-financial assets (e.g. housing), net of debts.

**Sources and series:** [wir2022.wid.world/methodology](http://wir2022.wid.world/methodology).

# Inequality Across Racial Groups Declined

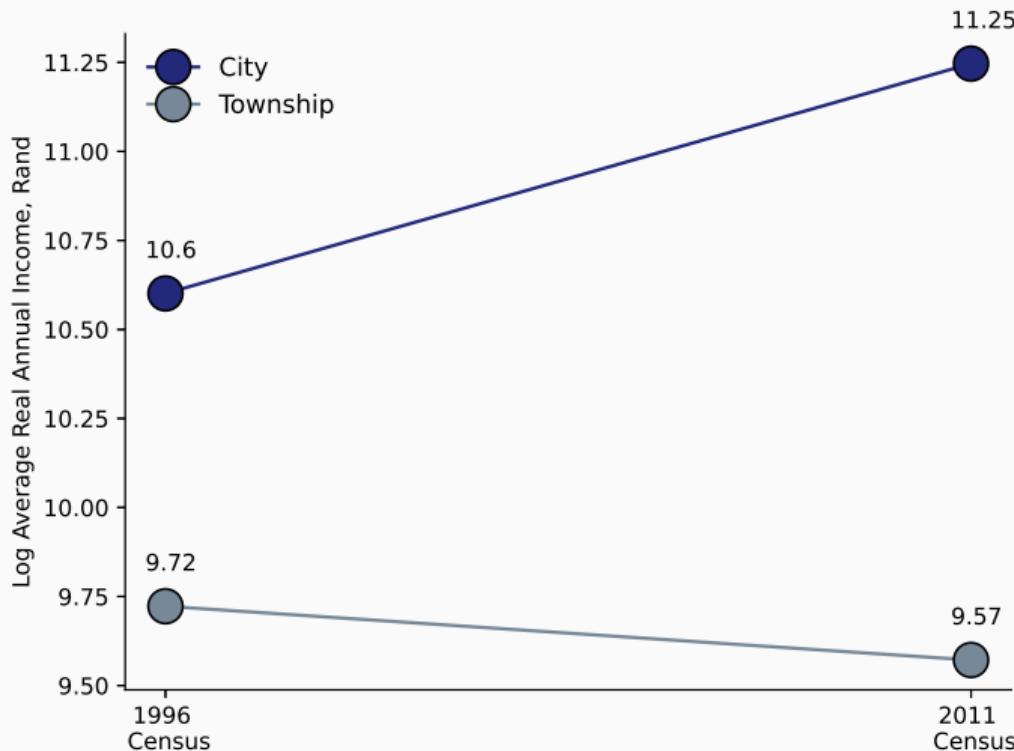
(a) Share of Black versus White earners in top factor income groups, 1955-2019



Source: Chatterjee et. al. ('23)

back

## Inequality Between Townships and Rest has Increased Since 1996



Source: 1996 and 2011 Census [back](#)

## Spatial Segregation: Townships

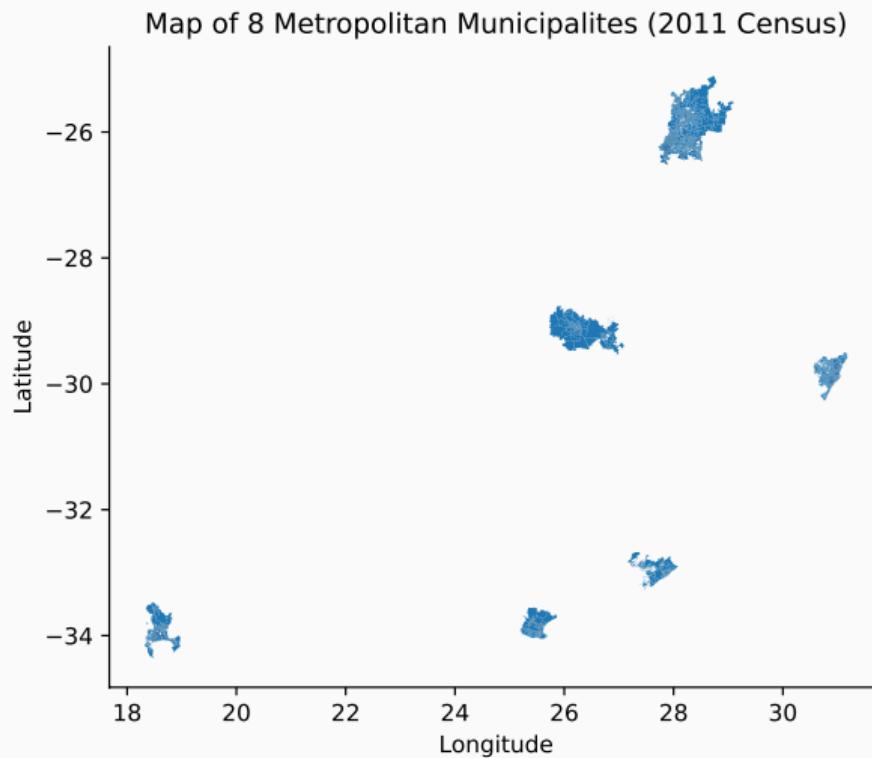
- Township – non-white neighborhoods, a core spatial concept of Apartheid
- Located on city peripheries, separated by natural/artificial buffer zone [26km]
- ≈ slums: slightly better amenities, more distant from urban economic centers
- Job search and other forms of economic integration very expensive
- Schools' quality is lower
- During Apartheid entrepreneurship was forbidden for most parts
- Banking sector mostly for transaction rather than for business expansion

# Census Data 1996 and 2011

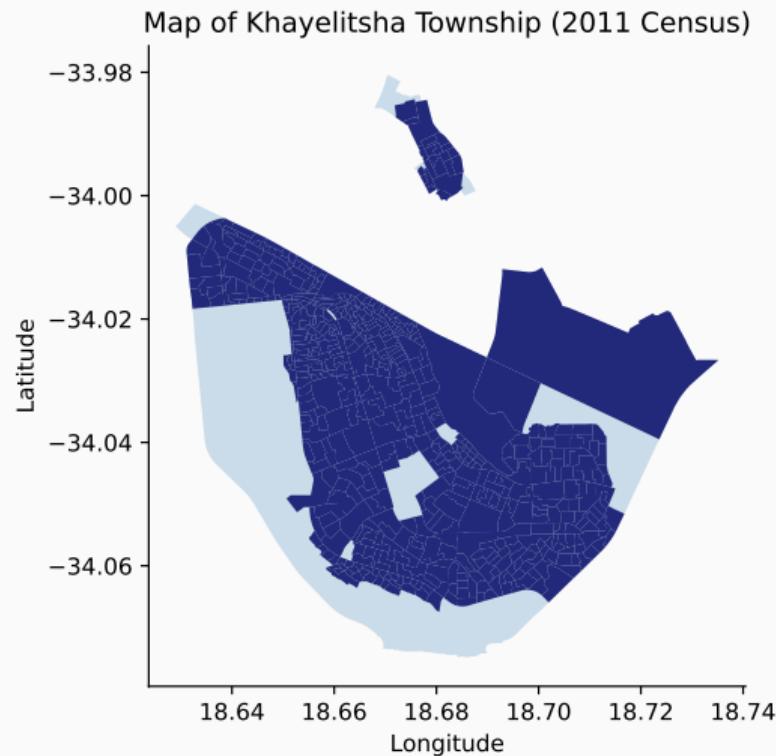
Map

- Focus on Metropolitan Municipalities
  - ▶ Correspond to 8 largest cities: Jo'burg, Cape Town, Pretoria, Durban, etc.
  - ▶ In 2011/1996: 20mln/13mln people or 40%/32% of SA population, 95% Urban
- Map Townships (172) to SALs/EAs in Census using geospatial data
- Compute distance from SAL/EA/Township (centroid) to closest/large city center
- Available Variables
  - ▶ Demogr.: age, sex, HH size, marital status, race, birth place, migration/year moved
  - ▶ Education: highest level
  - ▶ Income: brackets (individual and HH)
  - ▶ Amenities: dwelling type, N room, water, electricity, internet
  - ▶ Assets: tenure of house, computer, motor vehicle, fridge, washing machine, vacuum

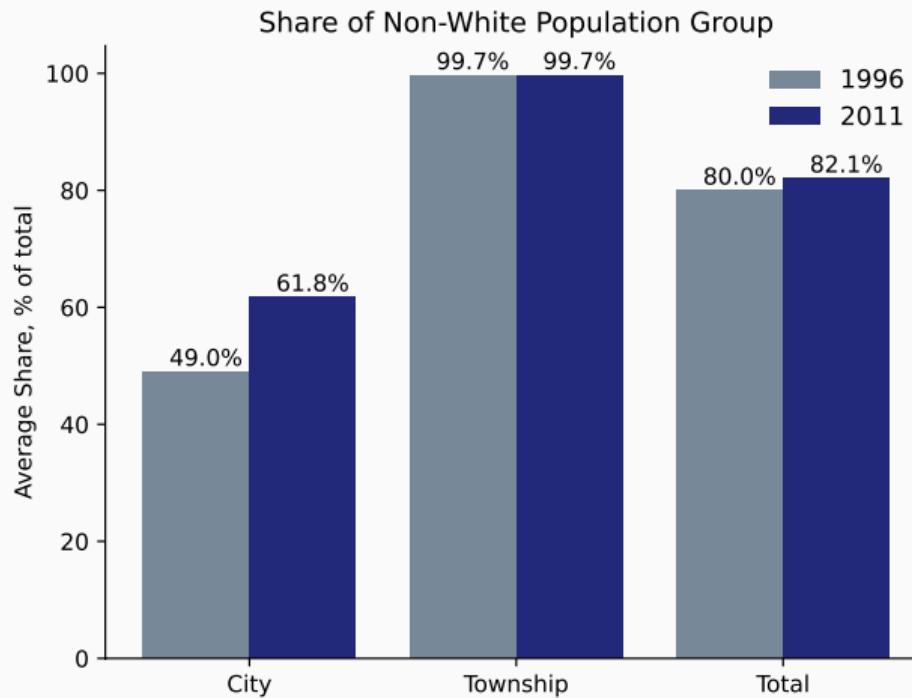
# Map of Municipalities



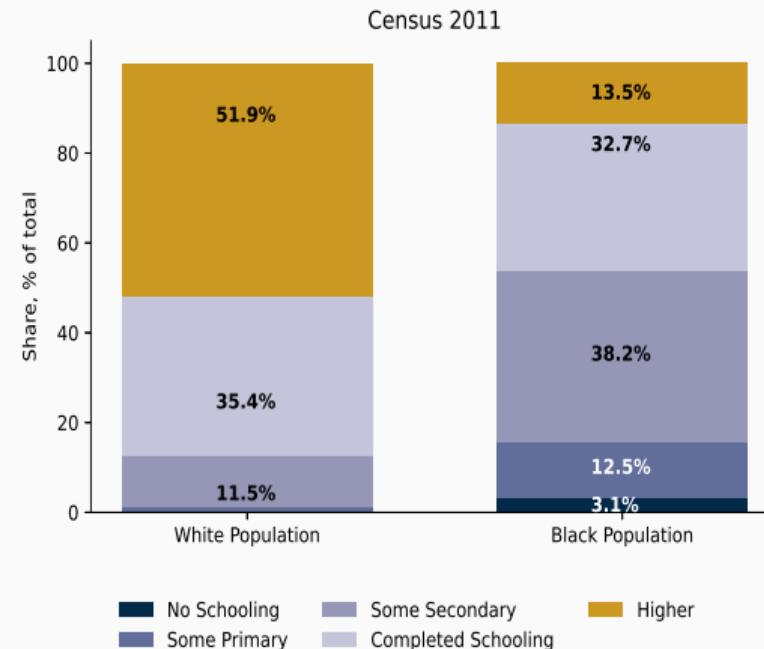
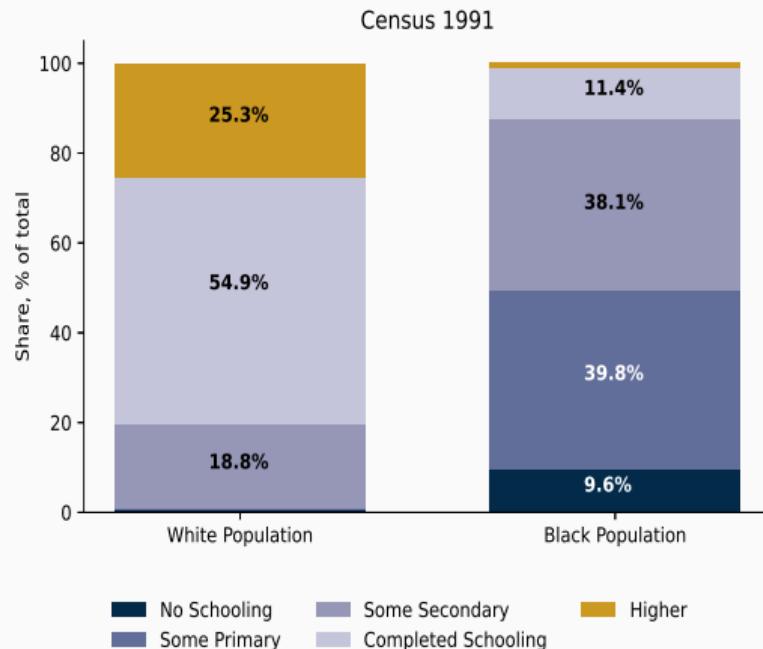
# Map Data SAL/EA => Township Variables



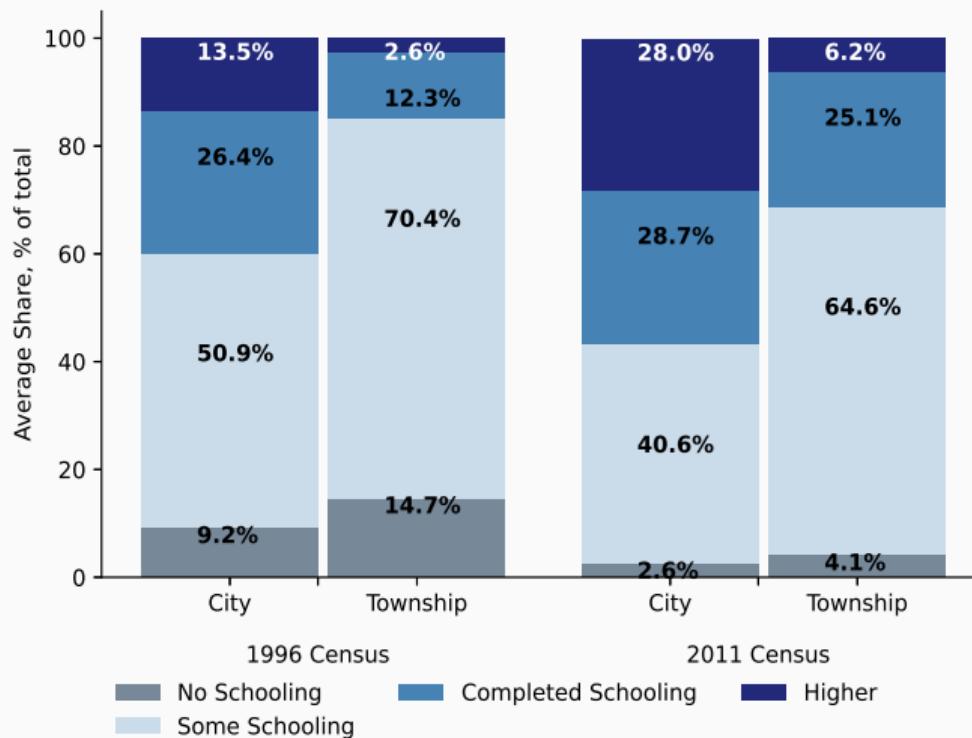
# Share of Non-White Population: Townships vs Non-Townships



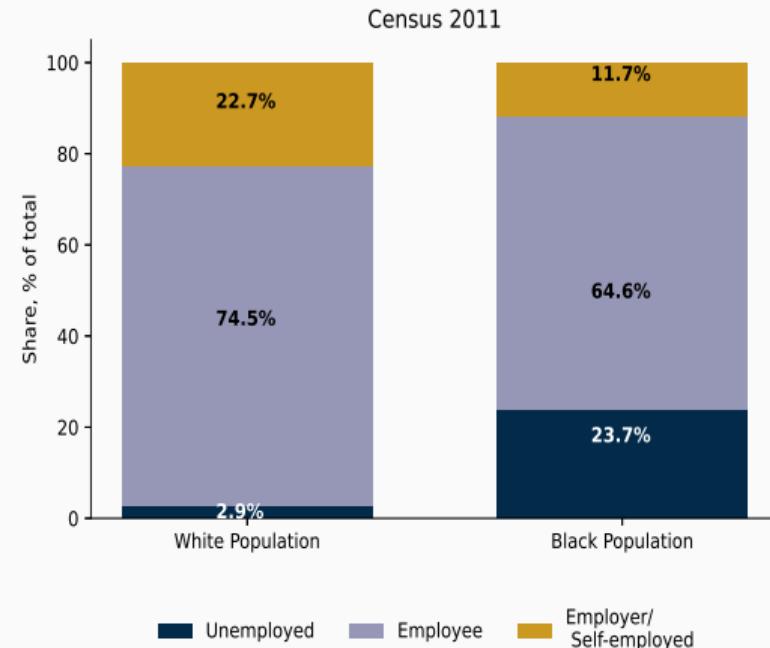
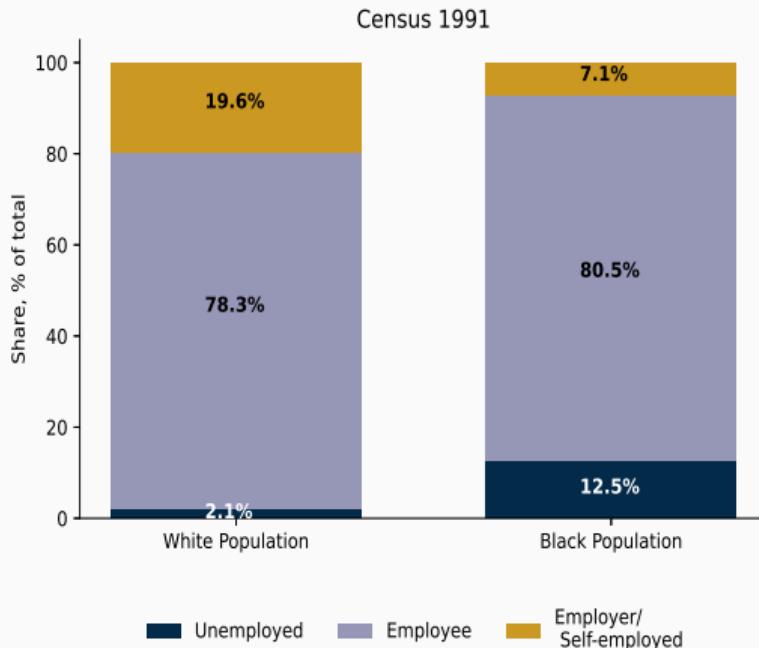
# Narrowed Education Gap Between Blacks and Whites



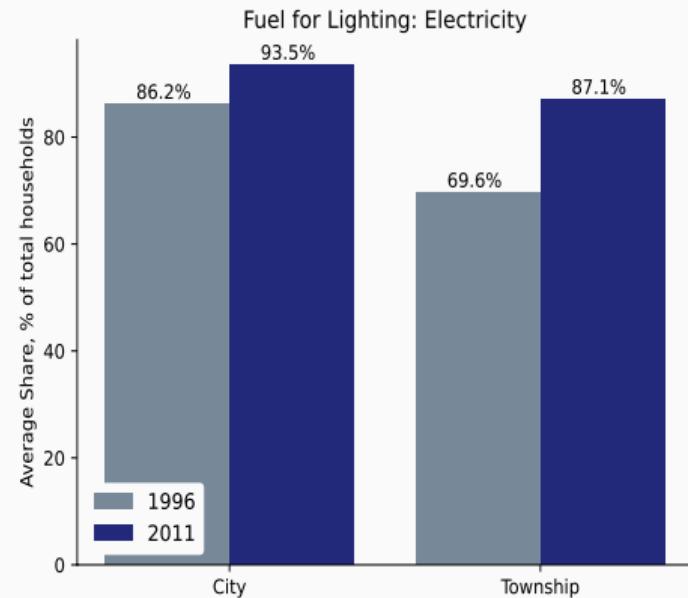
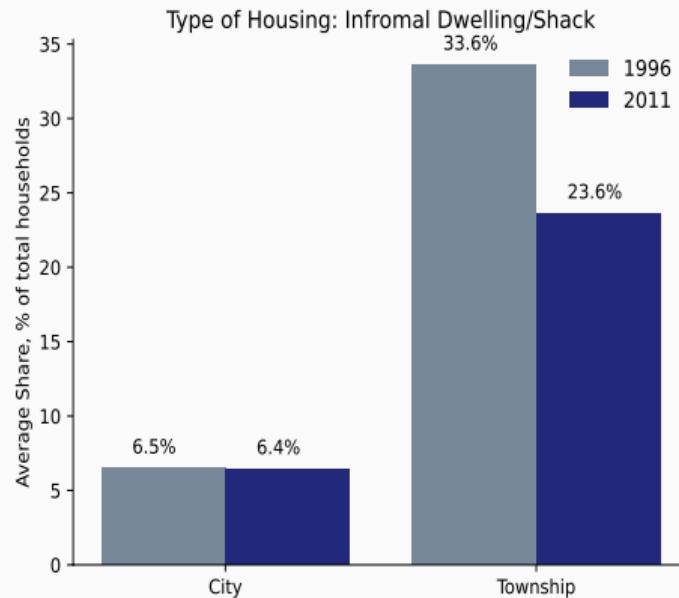
## Townships: ↑ School, Little Higher, Low Quality (stud/teach ⇒ 28.5 vs 34.3)



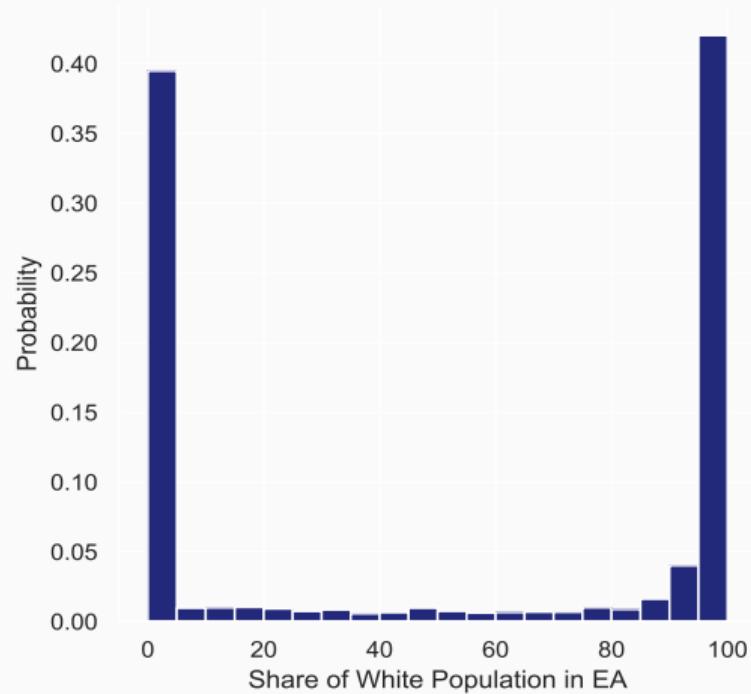
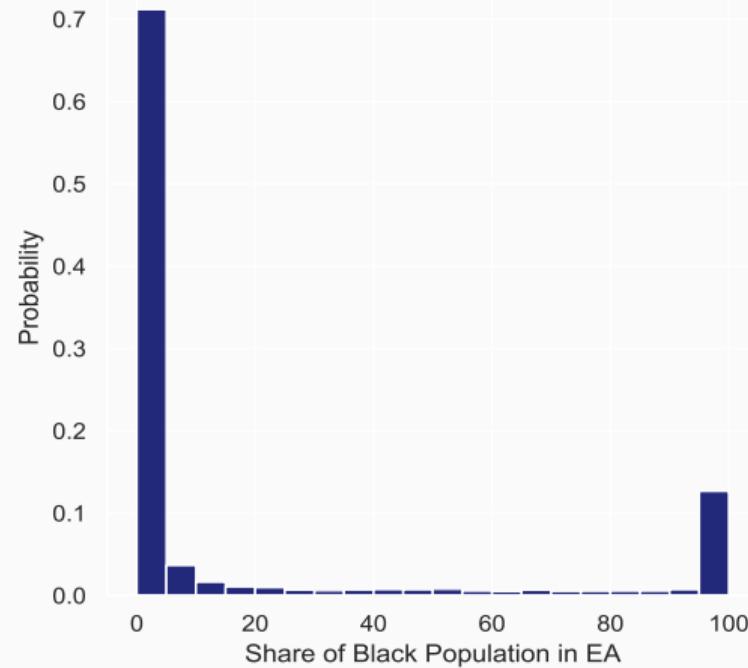
# Higher Level of Entrepreneurship Among Blacks



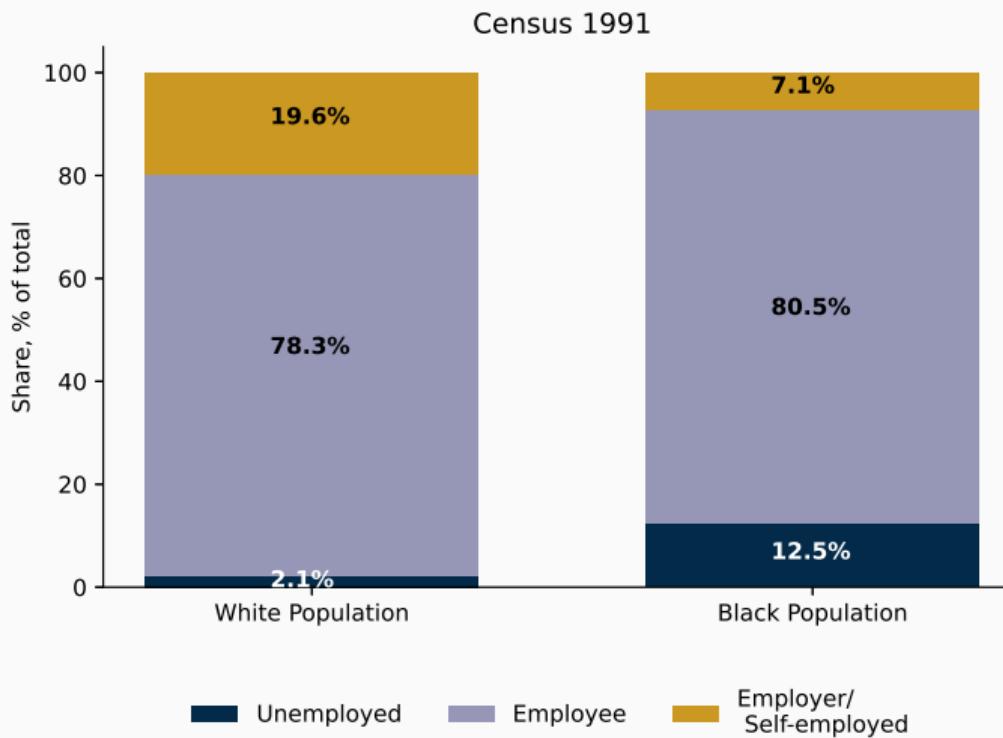
# Townships: Lower Cost of Housing & Worse Amenities



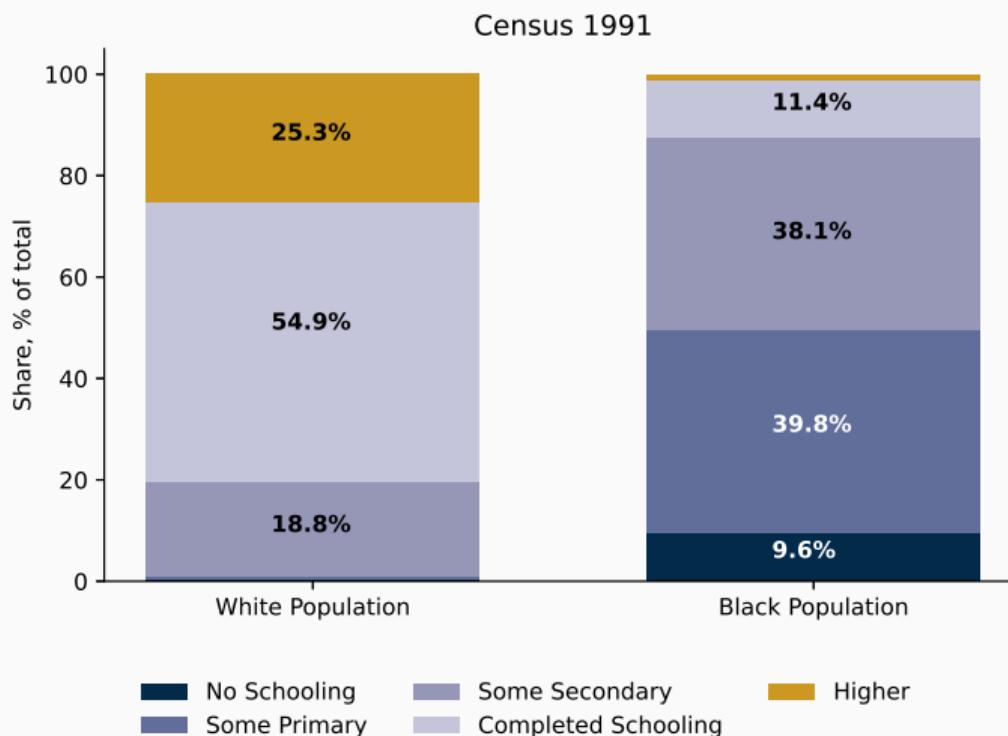
# Distribution of Individuals Across EAs by Population Groups: 1991



# Adults by Employment Status: 1991



# Adults by Highest Level of Education: 1991



## Labour Force Survey, Q2 2011

- 1/3 of Black Adults Employed in Informal Sector (only 6.5% among Whites)
- 13% of Black are self-employed or own a business (vs. 18% for Whites)
- Black entrepreneurs: 71.5% are self-employed, 3.9% own a firm with > 10 empl.
- White entrepreneurs: 34.3% are self-employed, 20.9% own a firm with > 10 empl.
- Most owners of larger firms are highly educated

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- No state contingent bonds (kid productivity) and financial wealth is non-negative.
- Financial intermediary receives deposits and makes within-period loans to finance capital/education,
  - ▶  $r$  lending rate for schooling,
  - ▶  $r(1 + \delta)$  lending rate in the production market where  $\delta$  is the depreciation rate.
- Collateral constraint,

$$k\mathbb{I}_{o=\text{entrep.}} + P_c\mathbb{I}_{\text{college}} \leq \lambda_k a.$$

## Externally Calibrated Parameters

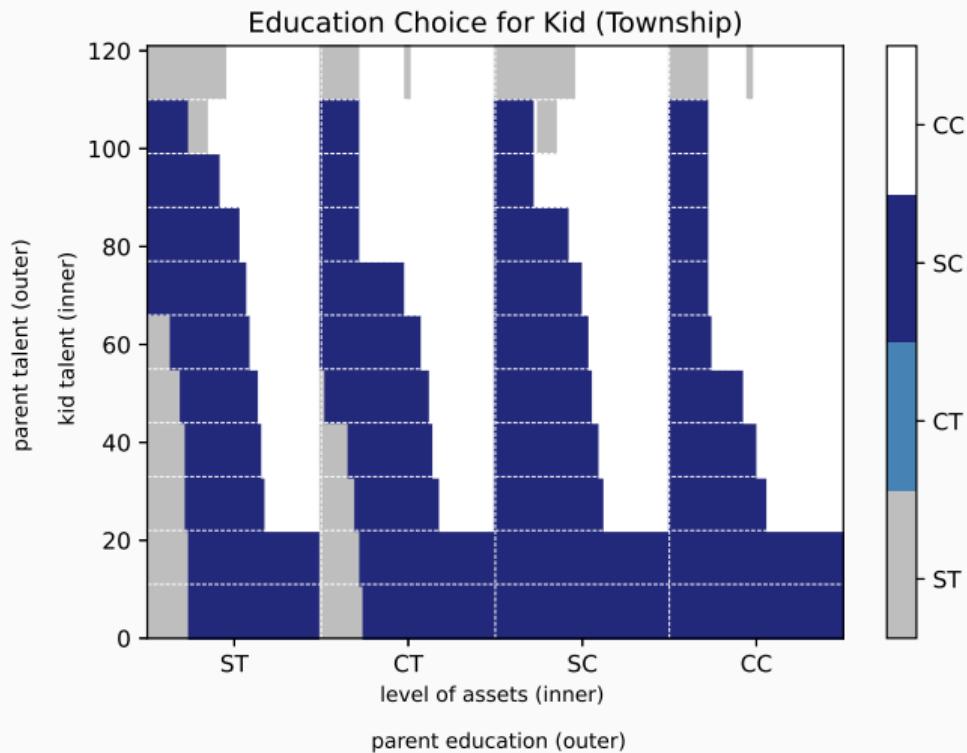
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Share of Blacks	60%	Census (SA, 1991)
$\gamma_T$	$2\alpha_T$	[Buera and Shin, 2013]
$\gamma_T$	0.41	Labor Share Trad Tech
$\alpha_T$	0.20	Capital Share Trad Tech
$\gamma_M$	0.41	Labor Share Modern Tech
$\alpha_M$	0.30	Capital Share Modern Tech
$\omega$	0.65	Low-skill Share in Mod. Wage Bill
$h_D$	1.05	School in the City Premium Income difference of city workers living in $T, D$ (Cape Town Survey, '13)

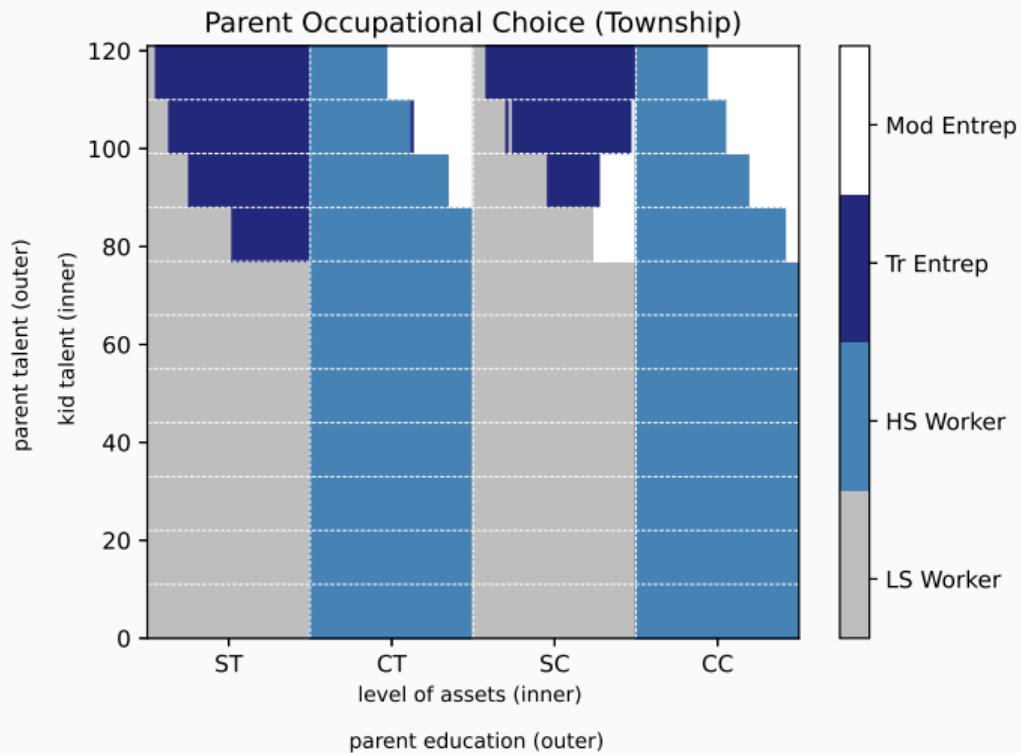
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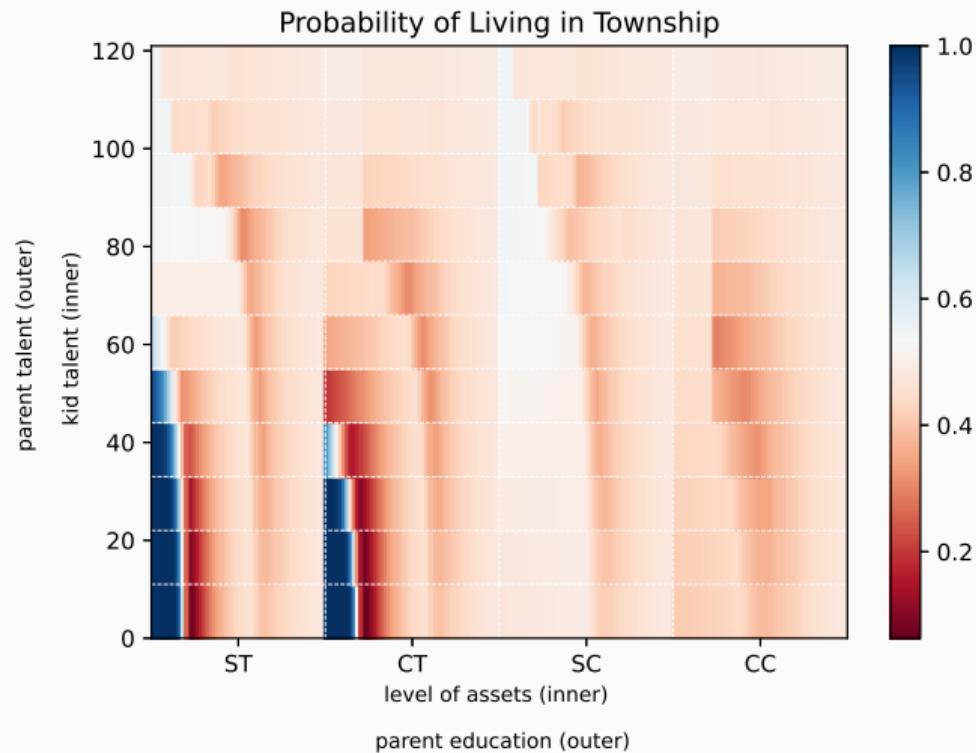
# Household Policy Function: Education of Kid



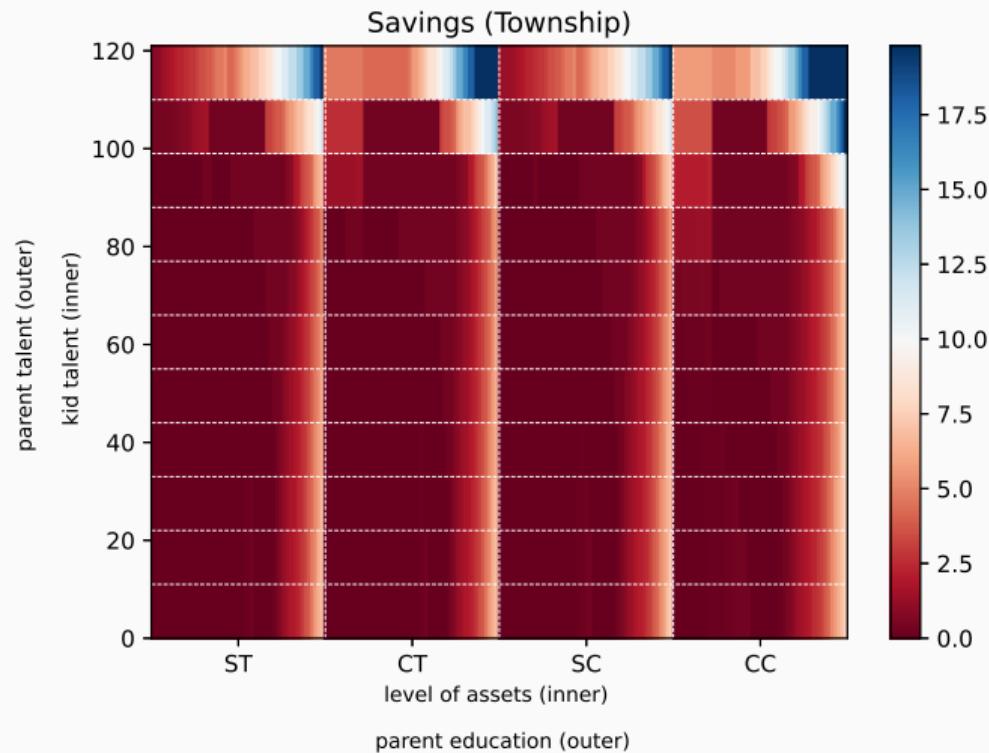
# Household Policy Function: Occupational Choice



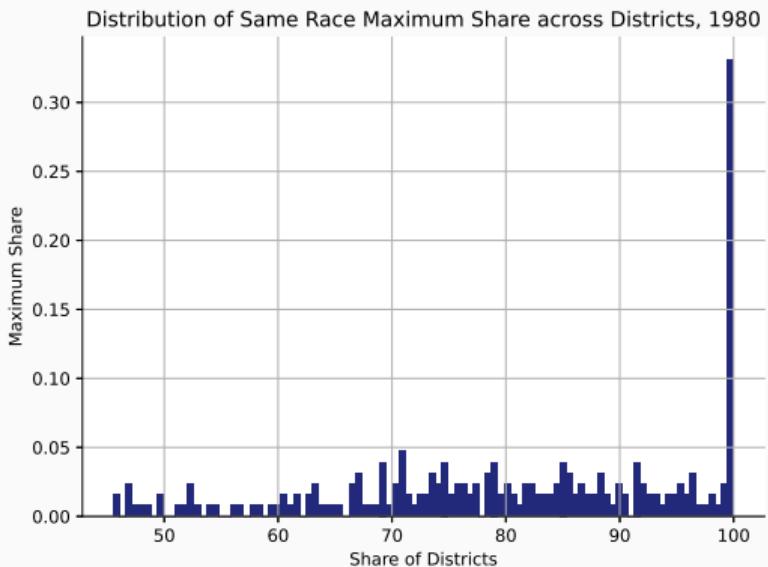
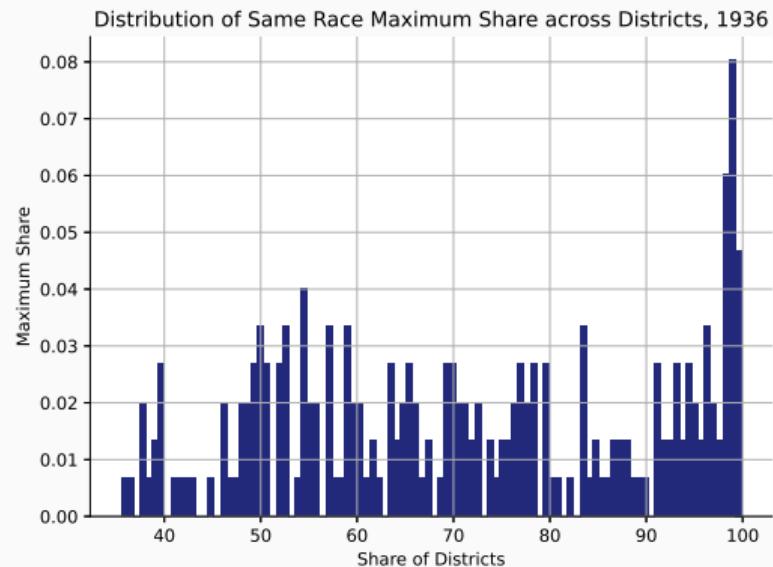
# Household Policy Function: Home Location



# Household Policy Function: Assets



# Historical Race Distribution Across Districts: Same Districts 1936 & 1980



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