The Economic Geography of American Slavery

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How did slavery shape American economic development?

- Divergent opinions on how slavery and geography interacted to shape the American economy.
  - One view: the agricultural suitability for high-value plantation crops in U.S. South drove slave institutions (Engerman and Sokoloff 1996).
  - Another view: slavery drove patterns of specialization (Wright 2006).

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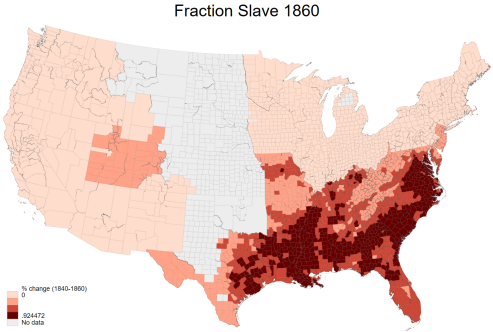
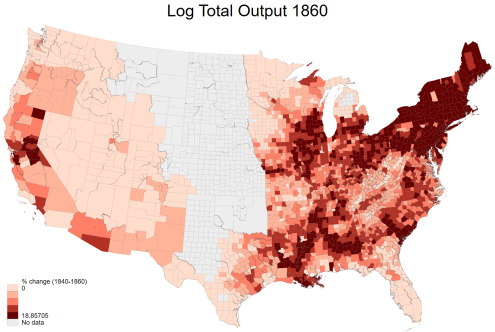
- Difficult question to answer, as slavery was a multifaceted institution:
  - Plantation Agriculture: Distinct slave production function, due to gang labor system, supervision, and coercion (Fogel and Engerman 1976, Acemoglu and Wolitsky 2010).
  - Property Rights: Slave property markets allows output-increasing spatial allocation, ignoring enslaved people's locational preferences (Fleisig 1976, Wright 2006).

The Antebellum American economy

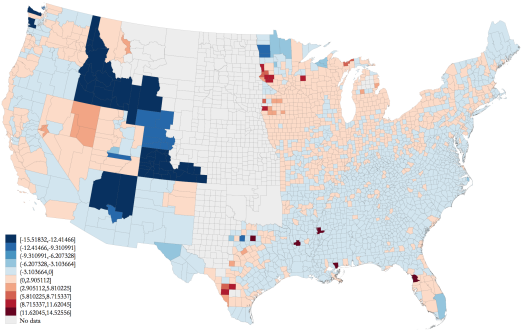


(a) Share of population enslaved

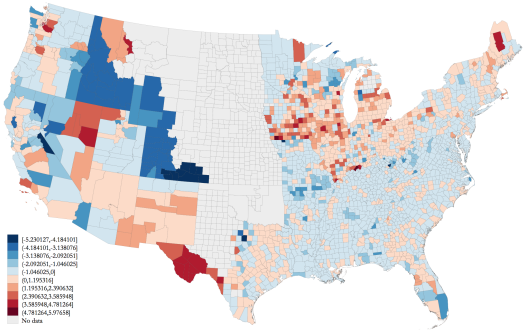


(b) Total economic output

The Effects of Emancipation



(a) Change in output (%): 1860 to 1870



(b) Change in black population (%): 1860 to 1870

The Incidence of Emancipation

Cotton, sugar, rice and tobacco, can be produced for commercial purposes, only in a mild climate, and by such labor as can be controlled; to make a crop of either, and prepare it for market, requires the entire year's work, the least relaxation or neglect, in preparing the land, planting, cultivation, or gathering, insures defeat. Can such labor be found outside of slavery?

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"If Lincoln is elected today, you will have to compete with the labor of four million emancipated negroes....the North will be flooded with free negroes, and the labor of the white man will be depreciated and degraded."
James Gordon Bennett (1860).

This paper: Three Contributions

1. Document a series of *stylized facts* about the geography of the antebellum economy.
   - Higher population in high productivity locations.
   - Enslaved workers differentially sorted into locations and tasks/occupations with comparative advantage in coercive production & *low* amenities.
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2. Develop a *quantitative general equilibrium spatial model* incorporating slavery.
   - Different freedom and objective function in the sorting decision ("property rights").
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3. Use model to answer *three questions*:
   - How did slavery affect the economic geography of the antebellum US?
   - What were the relative impacts of different components of slavery?
   - Quantify non-pecuniary costs of slavery (America, ed. "Wealth of Races" 1990)

Outline of Talk

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Slavery's Comparative Advantage in Southern Agriculture

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  - Slavery concentrated in disease-intensive locations (Esposito 2019) and costly turnover sectors (Hanes 1996)

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- Segregation and discrimination pervasive, with real effects: e.g. black crude death rates 2x white in 1830s Boston and only half in Charleston. Black TB deaths 3x higher than whites in 1844-1860 NYC (Warren 1997).

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- Supplement with arable land, malarial index, and agricultural productivity by crop (FAO GAEZ).
  - Agricultural productivity = first principal component of crop-level data.

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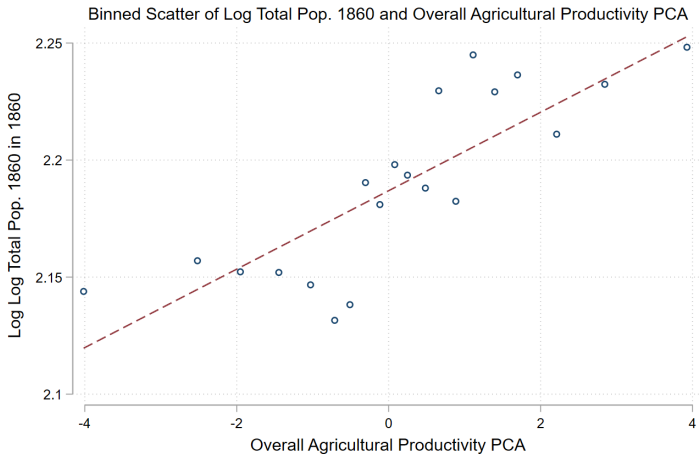
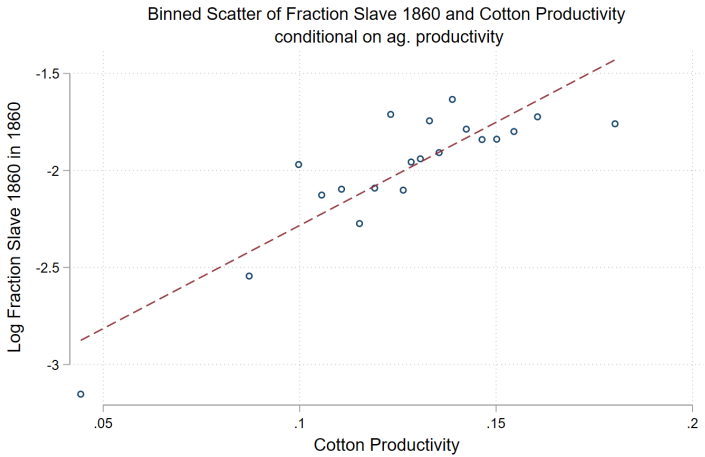
5. All hold with or without state FE.

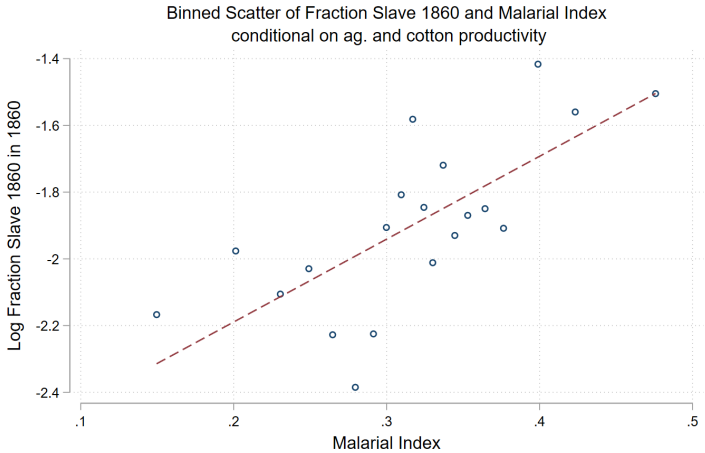
Stylized Fact #1: Total population higher in locations with more productive geography



Stylized Fact #2: Enslaved population differentially sorts into locations with innate comparative advantage in plantation production.

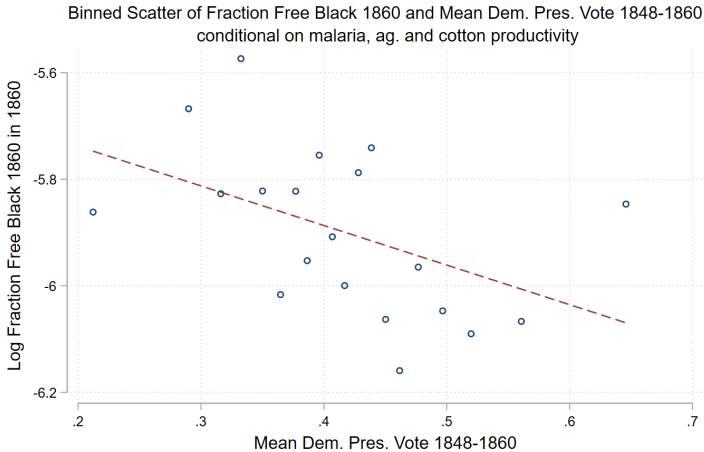


Stylized Fact #3: Enslaved population differentially sorts into locations with worse innate amenities



Not true for free blacks

Stylized Fact #4: Free black population differentially sort away from "racist" locations



Outline of Talk

Model Overview

- Goals of the model:
  - Match stylized facts of spatial sorting of labor
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- Goals of the model:
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  - Disentangle how different aspects of slavery shaped the American economy.
  - Calculate welfare impact of large scale counterfactuals (e.g. emancipation)
- Quantitative GE economic geography model with two key ingredients:
  - Multiple imperfectly substitutable labor types, with varying degrees of labor mobility.
  - Locations that differ in their production structure & allowance of slavery (and racial disamenities).

Outline of Talk

Model Setup: Standard components

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- Each pair of locations $i, j \in \{1, ..., N\}^2$ endowed with (iceberg) trade cost $\tau_{ij} \geq 1$.

Model Setup: New components

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  - Enslaved blacks ($\bar{L}^S$).
  - Free blacks ($\bar{L}^B$).
  - Free whites ($\bar{L}^W$).

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- Three types of locations:
  - Slave locations with coerced (say "plantation") production ($\mathcal{N}^{slave,plantation}$).
  - Slave locations without slave production [counterfactual]. ($\mathcal{N}^{slave,noplantation}$)
  - Free locations ($\mathcal{N}^{free}$).

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Model Setup: Consumption

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- Yields a Dixit-Stiglitz price index P_i.

Model Setup: Production

- Quantity of good i produced in location i (with labor input L_i and land input H_i) is:

$$Q_i = A_i L_i^{\alpha} H_i^{1-\alpha},$$

where:

$$L_i = \left(F_i^{\frac{\rho-1}{\rho}} + \mu_i S_i^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

  - F_i is the total efficiency units of free labor.
  - S_i is the total efficiency units of unfree labor.
  - μ_i is the relative productivity of unfree labor (due to coercion). Task-based microfoundations
  - q_i^F is marginal product of free white labor.
  - κq_i^F is marginal product of free black labor.
  - q_i^S is marginal product of slave labor.

Outline of Talk

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- Enslaved person welfare in location i=fixed consumption times amenity/relative slave productivity: $W^S = \frac{s}{P_i} \frac{u_i \lambda_i}{\mu_i}$

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- (Absentee) slave owner flow of income from slave wealth $V^S$is $rV_i^S = q_i^S - s/P_i$ (ignore for now).

Location choice

- Free whites choose location to maximize welfare:

$$\max_{i \in \{1,\ldots,N\}} \frac{q_i^F}{P_i} u_i \varepsilon_i \implies \pi_i^W \propto \left(\frac{q_i^F}{P_i} u_i \right)^{\theta} \implies F_i^W \propto \left(\pi_i^W \right)^{\frac{\theta-1}{\theta}} \bar{L}^W$$

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- Enslaved blacks *have location chosen* to maximize real output:

$$\max_{i\in\mathcal{N}^{slave}} \frac{q_i^S}{P_i} \varepsilon_i(\nu) \implies \pi_i^S \propto \left(\frac{q_i^S}{P_i}\right)^{\nu\theta} \implies S_i \propto \left(\pi_i^S\right)^{\frac{\nu\theta-1}{\nu\theta}} \kappa \bar{L}^S$$

Equilibrium

For any geography $(\tau_{ij}, A_i, u_i, \lambda_i, \mu_i)$, equilibrium is a set of prices $\left(q_i^F, q_i^S, p_i\right)$ and quantities (L_i^W, L_i^B, L_i^S) such that:

1. Goods markets clear:

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2. Trade is balanced:

$$P_i^{\sigma-1} = \sum_j \tau_{ji}^{1-\sigma} p_j^{1-\sigma}$$

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For any geography $(\tau_{ij}, A_i, u_i, \lambda_i, \mu_i)$, equilibrium is a set of prices $\left(q_i^F, q_i^S, p_i\right)$ and quantities (L_i^W, L_i^B, L_i^S) such that:

1. Goods markets clear:

$$p_i Q_i = \sum_j \tau_{ij}^{1-\sigma} p_i^{1-\sigma} P_j^{\sigma-1} p_j Q_j$$

2. Trade is balanced:

$$P_i^{\sigma-1} = \sum_j \tau_{ji}^{1-\sigma} p_j^{1-\sigma}$$

3. Workers (or owners of enslaved labor) are paid marginal product:

$$q_i^F = w_i L_i^{\frac{1}{\rho}} F_i^{-\frac{1}{\rho}}, \; q_i^S = w_i \mu_i L_i^{\frac{1}{\rho}} S_i^{-\frac{1}{\rho}},$$

where:

$$w_i = \left(\left(q_i^F\right)^{1-\rho} + \mu_i^\rho \left(q_i^S\right)^{1-\rho}\right)^{\frac{1}{1-\rho}}, \; p_i = \frac{1}{\alpha}\frac{w_i}{A_i}\left(\frac{L_i}{H_i}\right)^{1-\alpha}$$

Explaining the stylized facts

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- L_i^B increasing in λ_i (but L_i^W is not) $\implies \frac{L_i^B}{L_i^W+L_i^B+L_i^S}$ increasing in λ_i (Stylized Fact #4)

Outline of Talk

Overview

- Core part of model needs 2 parameters: elasticity of substitution ρ and elasticity of migration θ.
- Parameters map into coefficients from changes in white/black free population shares on
  - Price index (access to other counties).
  - Enslaved population share
- But need instruments.
  - Use Westward expansion and Fugitive Slave Law.
  - Counties change proximity to other populations because of addition of new territory from 1848 Mexican War
  - Enslaved population becomes relatively more profitable near the border after 1850 due to FSL.
- Use these to estimate ρ and θ, use literature to guide other parameters
- Recover estimates of A_i (productivity), μ_i (slave productivity), u_i(amenity) and λ_i (racial discrimination).

Taking the model to the data: Details

- Data we observe:
  - Values: Y_i (total income)
  - Quantities: H_i (total land), L_i^W (free white population), L_i^B (free black population), L_i^S (enslaved population)
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    - For now fix $\nu = 1$ and take $\sigma = 5$ from Donaldson and Hornbeck.
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  - Geography: A_i (total productivity), μ_i (relative slave productivity), u_i (total amenity), λ_i (relative amenity of blacks)
- Two step procedure:
  1. Estimate model parameters simultaneously using structural IV regression in differences.
  2. Recover unobserved geography through model inversion.

Step #1: Estimating model parameters

- In the U.S. North, we have the following equilibrium relationship:

$$\ln \frac{\pi_i^W}{\pi_i^B} = \beta_0^N + \beta_1^N \ln \frac{Y_i/P_i}{\pi_i^B} + \varepsilon_i^N,$$

  - where $\beta_1^N \equiv \theta$ and ε_i^N is a function of only exogenous structural parameters and geography.
  - Note: Only a function of observables.
  - Intuition: how much free white labor responds to increases in (race composition adjusted) real output identifies migration elasticity.

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- Need an instrument that shifts $Y_i/\ \pi_i^B P_i$ that are uncorrelated with local geography.

Step #1: Estimating model parameters (ctd.)

- In the U.S. South, we have the following equilibrium relationship:

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  - where $\beta_1^S \equiv \frac{\theta+\rho-1}{\rho}$, and ε_i^S is a function of only exogenous structural parameters and geography.
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- Take advantage of big expansion in US territory during 1840 and 1860.
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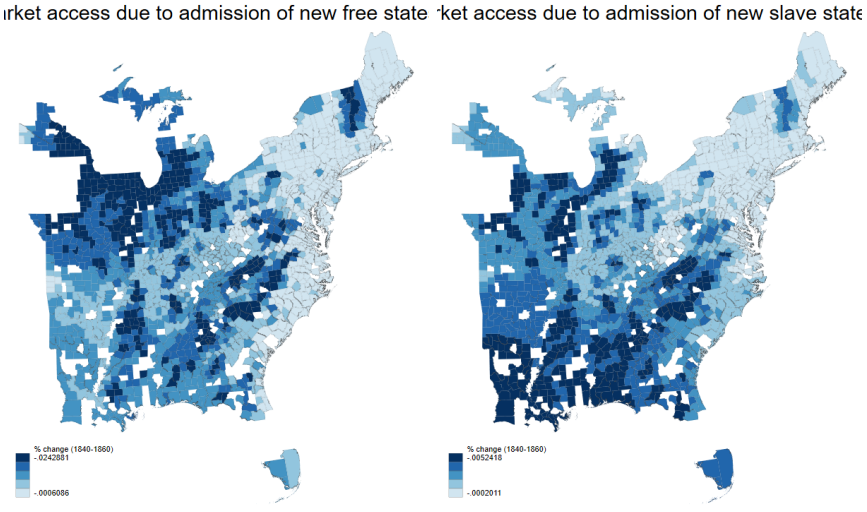
Westward Expansion Effect on Price Index



(a) Free states

(b) Slave states

First Stages: Real Output/Free Black

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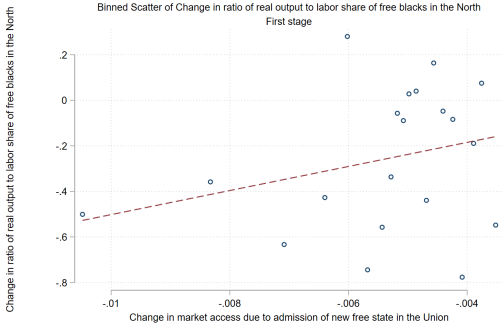
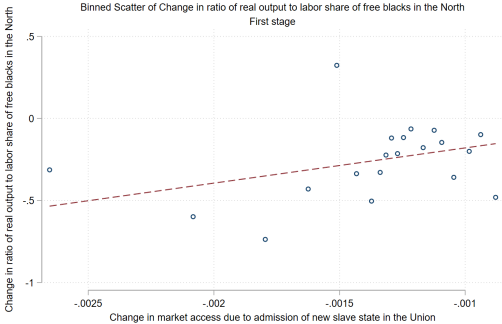


(a) Addition of Free States



(b) Addition of Slave States

Reduced Form: Free White/Free Black

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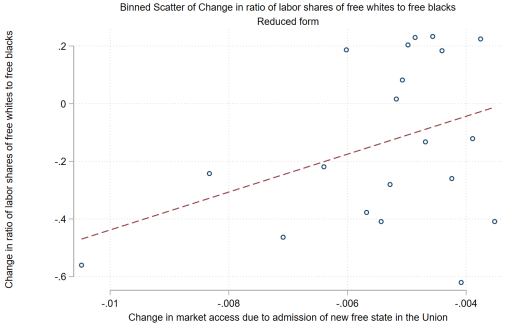

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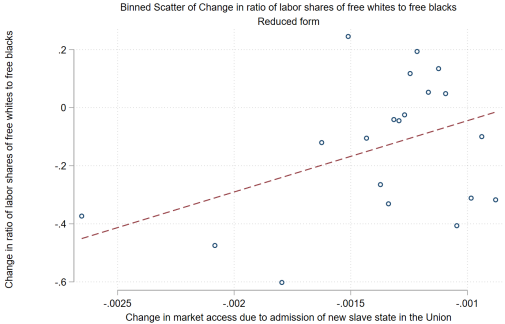

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Constructing an instrument (2): Fugitive Slave Law

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Change in Distance to Freedom Induced by FSL

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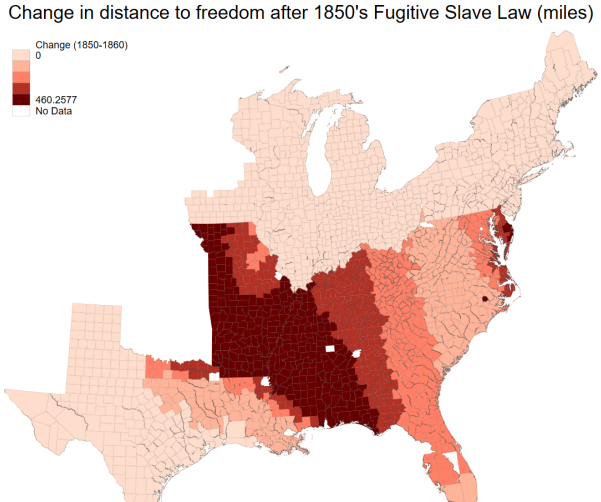
Figure: Change in Distance to Freedom between 1850 and 1860



First Stage For Slave-Free Black Ratio

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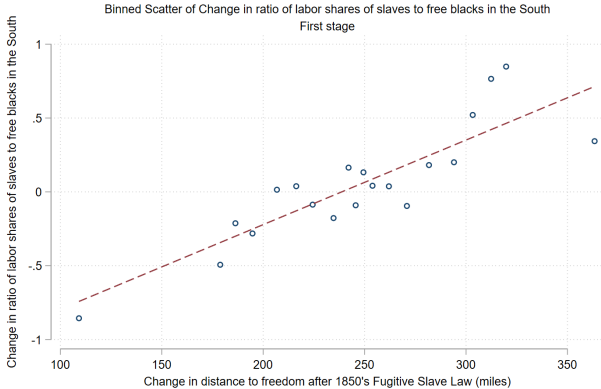
Figure: Increase in market accessibility increases change in real output, conditional on state FE



Reduced Form For Fugitive Slave Law

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Figure: Increase in real output /black ratio increases with change in distance to freedom, conditional on state FE

Estimation system

Pool instruments and endogenous variables interacted with region in one specification :

$$\Delta \ln \frac{\pi_i^W}{\pi_i^B} = North_i + \beta_1^N \Delta \ln \frac{Y_i/P_i}{\pi_i^B} \times North_i + \beta_1^S \Delta \ln \frac{\pi_i^S}{\pi_i^B} \times South_i + \varepsilon_i,$$

$$\Delta \ln \frac{Y_i/P_i}{\pi_i^B} = \gamma(log(P_j^{1-\sigma,1860}) - log(P_j^{1-\sigma,1840})) + e_i^N$$

$$\Delta \ln \frac{\pi_i^S}{\pi_i^B} = \Gamma(DistanceFreedom_{i,1860} - DistanceFreedom_{i,1840}) + e_i^S$$

Estimating Model Parameters

	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
Regression coefficients						
Change in ratio of	0.799***	0.138	0.791***	0.978***	0.784***	0.884***
Real Output to Labor Share of Free Blacks in the North	(0.031)	(0.174)	(0.036)	(0.108)	(0.037)	(0.108)
Change in ratio of	0.823***	0.703***	0.807***	0.550***	0.821***	0.644***
Labor Shares of Slaves to Free Blacks in the South	(0.019)	(0.044)	(0.020)	(0.058)	(0.021)	(0.065)
Implied elasticities						
Migration elasticity	0.799***	0.138	0.791***	0.978***	0.784***	0.884***
(θ)	(0.031)	(0.174)	(0.036)	(0.108)	(0.037)	(0.108)
EoS: Slave vs. Free	1.139***	2.904***	1.086***	0.049	1.208***	0.325
labor (ρ)	(0.217)	(0.657)	(0.222)	(0.241)	(0.248)	(0.322)
Change in ratio of	0.823***	0.703***	0.807***	0.550***	0.821***	0.644***
labor shares of slaves to free blacks in the South	(0.019)	(0.044)	(0.020)	(0.058)	(0.021)	(0.065)
Fixed Effect	None	None	Census division	Census division	Census division	Census division
Lat Long Control	No	No	No	No	Yes	Yes
First-stage F-test		7.200		15.350		12.921
R-squared	0.757	0.531	0.778	0.737	0.785	0.771
Observations	1599	1590	1599	1590	1599	1590

Model Parameters (for now!)

Parameter	Notation	Value	Source
Productivity heterogeneity	θ	1.05	"Estimation"
Elasticity of substitution of sectors	ρ	0.2	"Estimation"
Elasticity of substitution for goods	σ	9	Donaldson and Hornbeck (2014)
Relative productivity heterogeneity	ν	1	Assumption
Share of labor in the production function	α	0.32	Gallman-Parker production function estimation
Average relative productivity of plantation workers	$E[\mu_i]$	1.85	Gallman-Parker production function estimation

Step #2: Recover unobserved geography

Proposition

For any set of model parameters $(\theta, \rho, \nu, \sigma, \kappa, \alpha, E[\mu_i])$*, trade frictions* $(\{\tau_{ij}\})$*, and observed data* $\left(\left\{Y_i, H_i, L_i^W, L_i^B, L_i^S\right\}\right)$*, there exists a unique (to-scale) set of location fundamentals* $(A_i, \mu_i, u_{i,}, \lambda_i)$*.*

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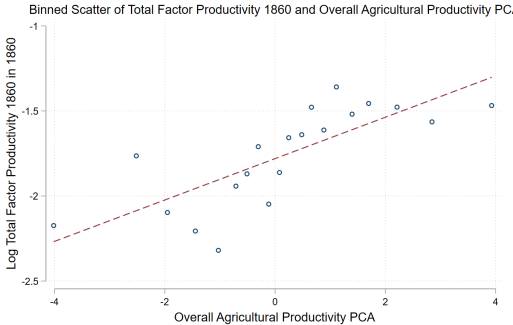
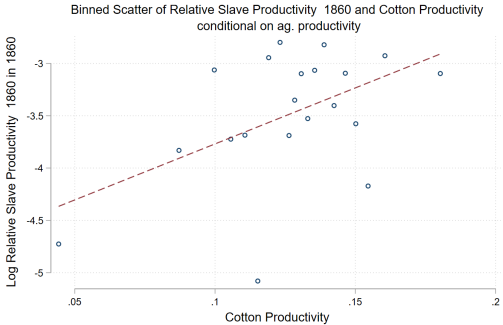
  - Amenity u_i is higher if L_i^W is higher, conditional on P_i and Y_i.
  - Relative black amenity λ_i is higher if $\left(\frac{L_i^B}{L_i^W}\right)$ is higher.

Checking Stylized Facts

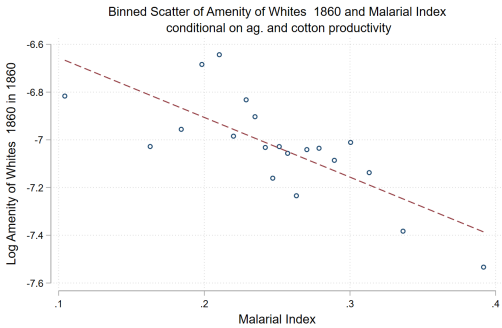


(a) Agricultural productivity and TFP A_i

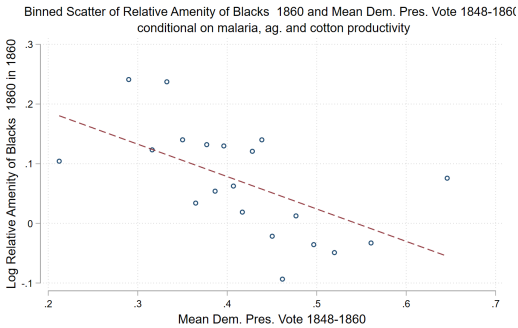


(b) Relative cotton productivity and relative slave productivity μ_i

Checking Stylized Facts (ctd)



(a) Malaria and amenity u_i



(b) Democratic vote share and relative black amenity λ_i

Outline of Talk

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We consider 5 counterfactuals that progressively eliminate specific institutional features of slavery:

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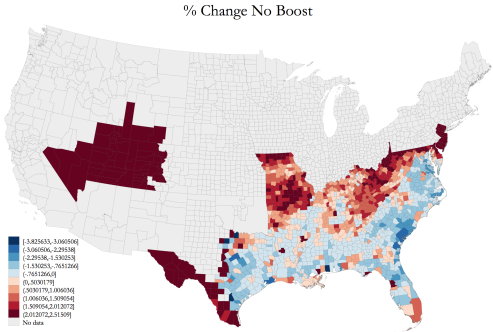
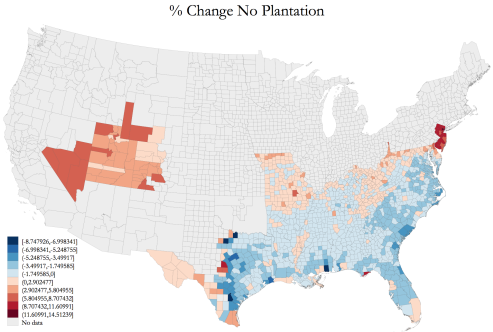
5. ... + Eliminating racial differences in amenities across locations ($E[\lambda_i] = 1$, "No racial disamenity").

Counterfactual Change in Enslaved Population

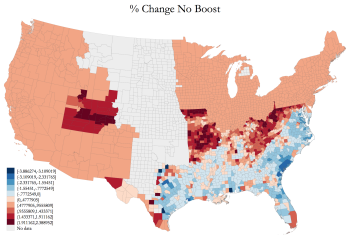


(a) % Change: Same Tasks Amenities

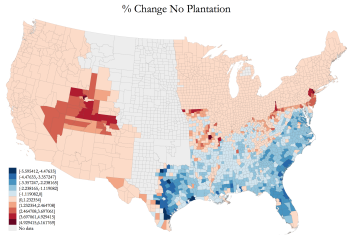


(b) % Change No Plantation

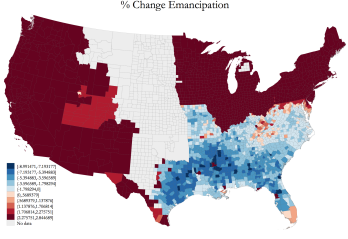
Counterfactual Change in Total Black Population



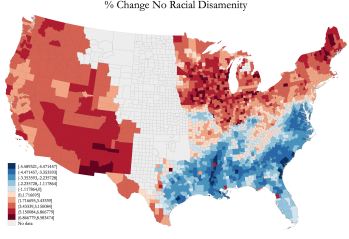
(a) % Change: Same Tasks Amenities



(b) % Change No Plantation



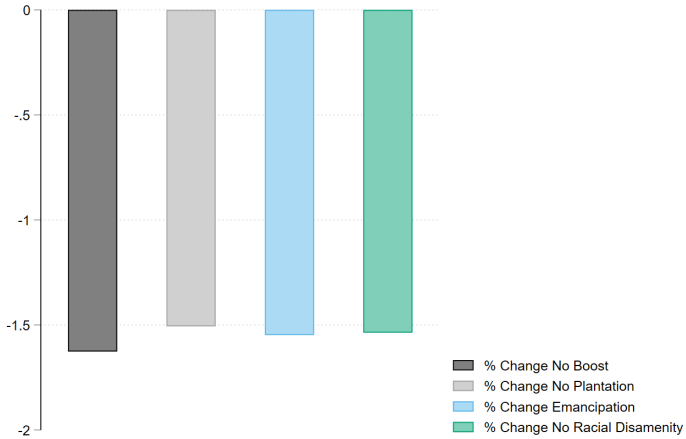
(c) % Change Emancipation



(d) % Change No Racial Disamenity

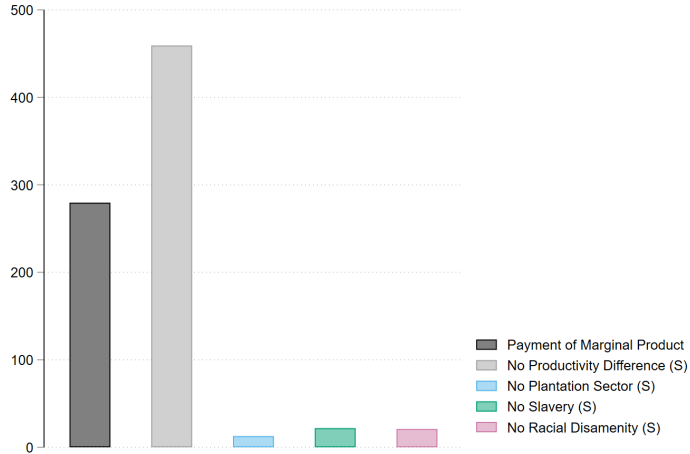
Aggregate Output Falls With Emancipation

Figure: Counterfactual % changes in aggregate real output relative to 1860 baseline

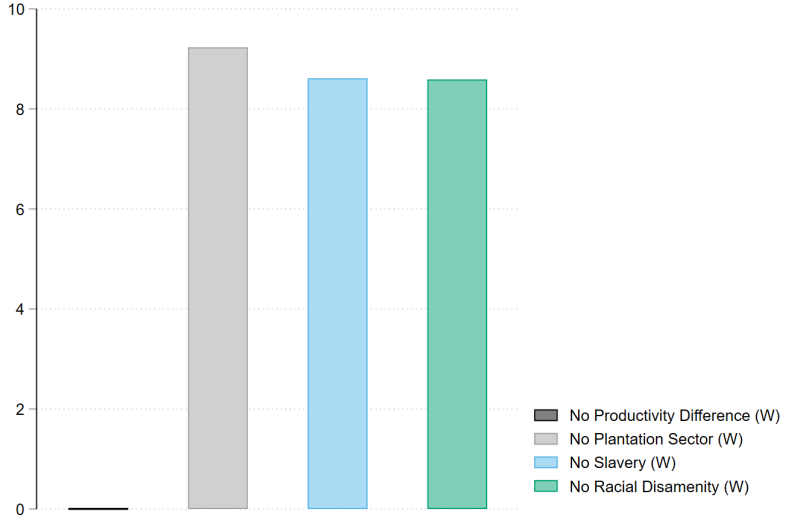


Welfare Effects of Emancipation for Enslaved People

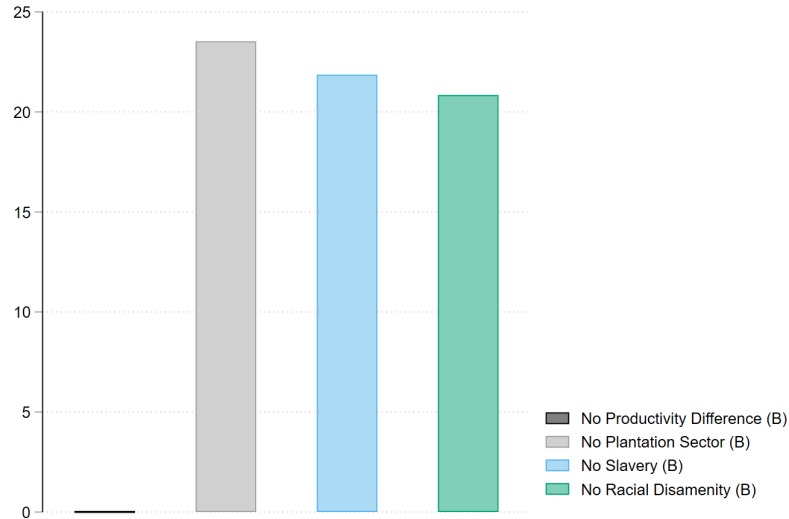
Figure: Counterfactual changes in welfare relative to 1860 baseline



Welfare Effects of Emancipation for Free White Workers

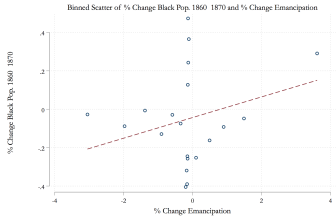


Welfare Effects of Emancipation for Free Black Workers

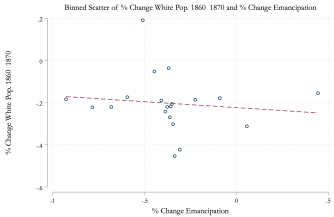


Outline of Talk

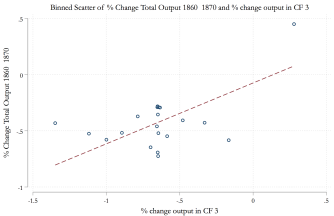
Emancipation: Counterfactual vs. observed



(a) Change in black population



(b) Change in white population



(c) Change in output

Why is the fit so bad?

- Preliminary!
  - But well known historical puzzle that black outmigration does not happen for a long time.
  - Jim Crow might indeed have restricted black mobility so that emancipation's reallocation didn't happen.
  - Or model misspecification!

Outline of Talk

Conclusion and next steps

- This project:
  - Document differential spatial sorting patterns for enslaved, free blacks, free whites in Antebellum South.
  - Develop a GE spatial model consistent with patterns that incorporates multiple facets of slavery.
  - Conduct counterfactual analyses to decompose welfare impact of different aspects of slavery.

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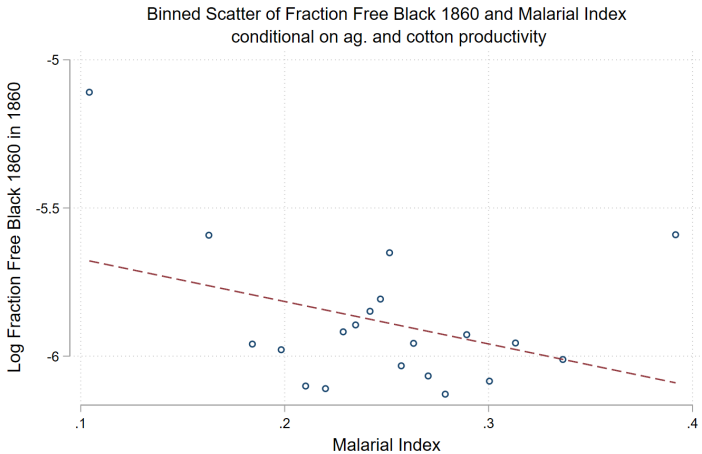
  - Document differential spatial sorting patterns for enslaved, free blacks, free whites in Antebellum South.
  - Develop a GE spatial model consistent with patterns that incorporates multiple facets of slavery.
  - Conduct counterfactual analyses to decompose welfare impact of different aspects of slavery.
- Next steps:
  - Ideally improve instruments and use microdata more.
  - Have linked censuses, slave occupations, wealth distribution data to work with.
  - Target land value changes after emancipation as a out-of-sample moment.

Free Black Population Sorts Away from Malaria



Back

Model Setup: Tasks Under Coercion

- Think of labor as a composite of tasks, indexed 0 to 1 $L_i = (\int_0^1 l(s)^{\frac{\rho-1}{\rho}} ds)^{\frac{\rho}{\rho-1}}$
- Labor linear in free and slave labor $l(s) = l_f(s) + A l_s(s)$
- Enslaved people work more intensely: $A > 1$
- Tasks are differentiated by "amenities" $a(s) \in (0, 1)$, $a'(s) > 0$
- Have to pay free labor in county i higher wage, $w_i(s) = \frac{w_i}{a(s)}$ to get labor on unpleasant tasks.

Model Setup: Tasks Under Coercion

- Given wages and slave price p and additional coerced hours A, get cutoff $\frac{w_i}{a(l_i)} = A/p$ below which use slave labor, above which use free labor.
- Slaves both exert too much labor, and are allocated to least pleasant tasks and occupations.
- Let $\mu_i = \frac{l_i}{1-l_i}$ be share of tasks done by slaves=relative productivity of slave labor in county i.
- Also will be relative uncompensated disutility of work of slave vs free labor.
- Yields "endogenous" CES production function:
- $$L_i = \left(F_i^{\frac{\rho-1}{\rho}} + \mu_i S_i^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}$$

Back

Decomposing the welfare changes for the total black population

Figure: Changes in real consumption vs. re-sorting to higher amenity locations