The gift of a lifetime

The hospital, modern medicine, and mortality

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CHEPS and Department of Economics Seminar Series

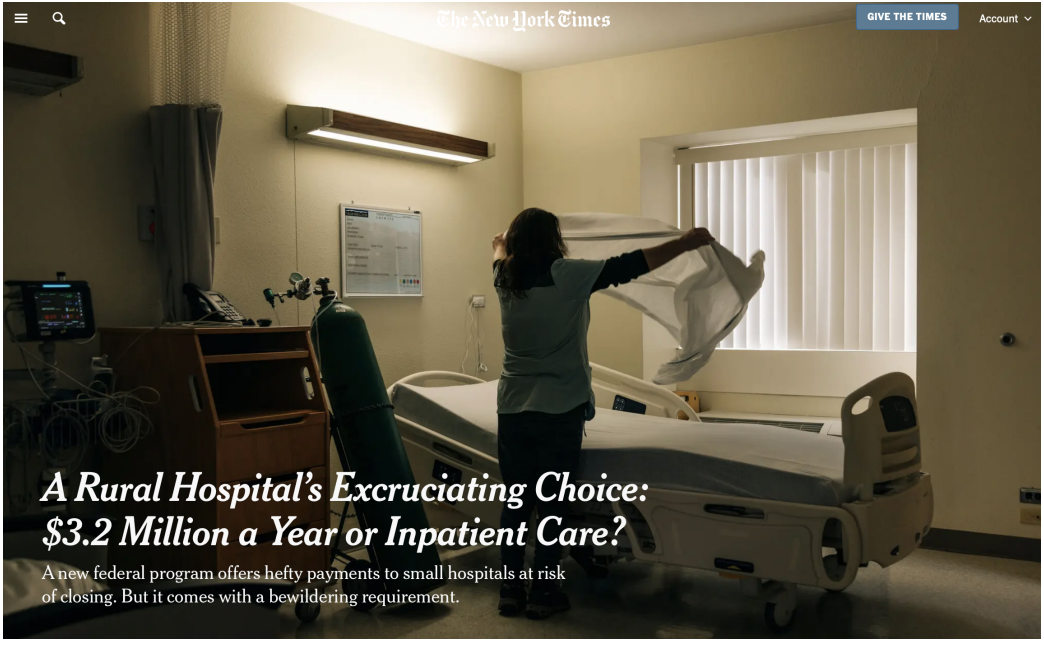
Today's paper is about

- Investments into health of local communities
  - through the hospital
  - ultimate (economic) outcome: mortality
- Long-standing racial gaps in health outcomes
- Understanding health production technology
  - labor-market externalities
  - complementarities between funding and innovation

Why should you care?

- We allocate a large share of resources to healthcare (20%) and hospitals (6%)
- Massive declines in mortality in 20th century
  - common perception “modern medical care” did not matter until 1950, implying importance of technology and regulation in medical progress
- Long-standing racial and socioeconomic gaps in health and mortality
- Structural and financial barriers in access to healthcare are common globally
  - lack of providers in rural areas, financial difficulties and poverty, insufficient insurance, and structural impediments such as a lack of transportation or poor management
  - quality of hospital infrastructure and care varies greatly within and across countries
  - mortality as an ultimate health outcome

What's the value of last available medical provider?



Big picture question

How do hospitals and modern medicine impact short- and long-run health?

More specific questions

- Can improved access to and better quality of hospital care reduce mortality of exposed infants?
  - Given the many racial inequities in health, are these effects similar for Black and white infants?
  - Are these effects limited to infancy or do they persist into later life?

- How do these improvements improve the medial sector?
  - Is their growth in the hospital sector? If so is this growth persistent?
  - Do they attract higher quality physicians?

- Are these infrastructure improvements complements or substitutes of medical innovation?

Research context

- A large-scale hospital modernization effort by The Duke Endowment

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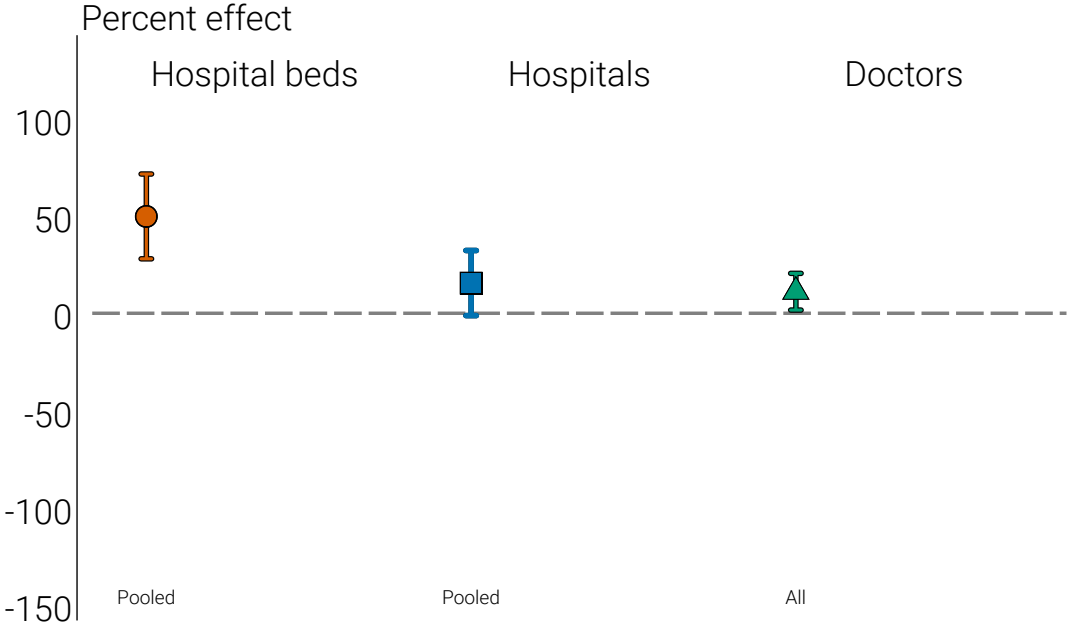
  - North Carolina in first half of twentieth-century
  - **Bundled modernization effort**: build and expand hospitals, obtain state-of-art medical technology, attract qualified medical personnel, and refine management practices

Research context

- A large-scale hospital modernization effort by The Duke Endowment
  - North Carolina in first half of twentieth-century
  - **Bundled modernization effort**: build and expand hospitals, obtain state-of-art medical technology, attract qualified medical personnel, and refine management practices
- Low-levels of health capital
  - high infant mortality rates (9% of Black infants died in first year of life)
  - most physicians educated before the Flexner report
  - hospitals still viewed as place to go to die and just turning the corner

Results preview: effects on the medical sector



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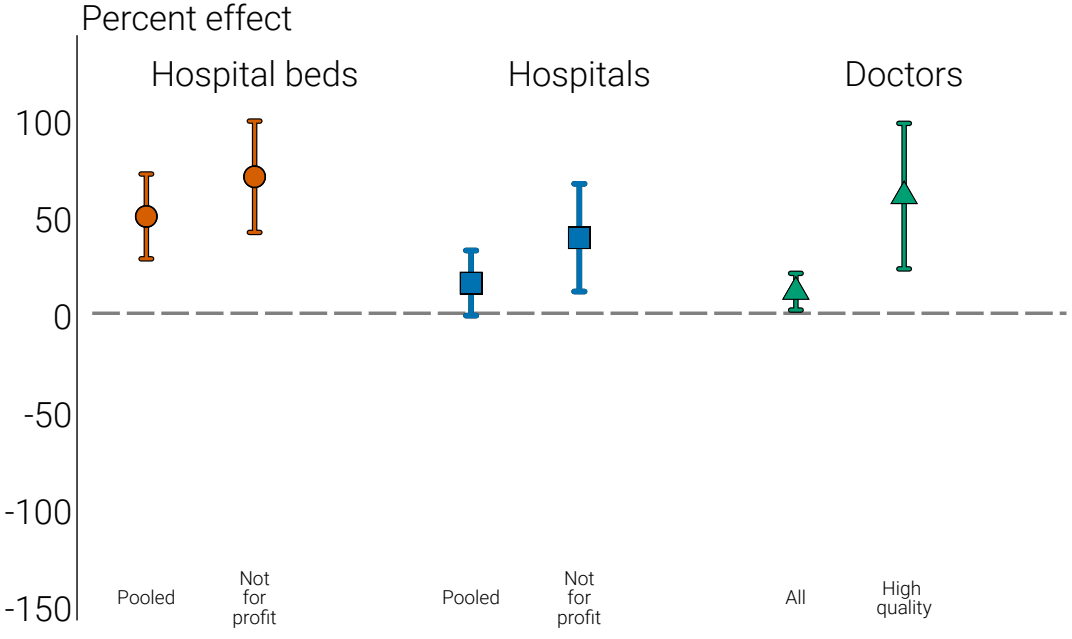

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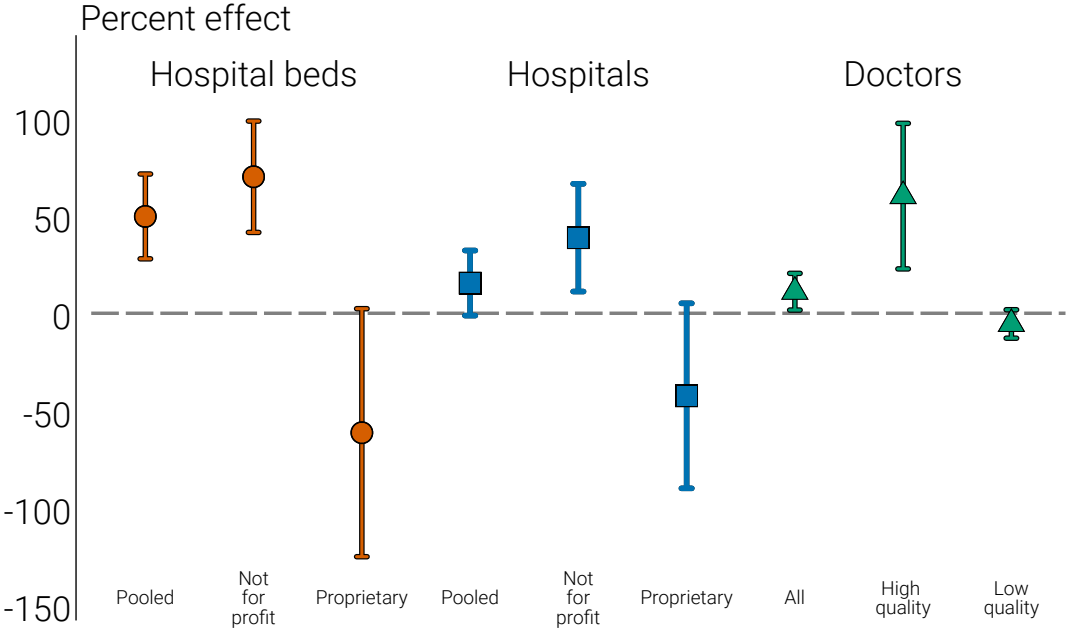
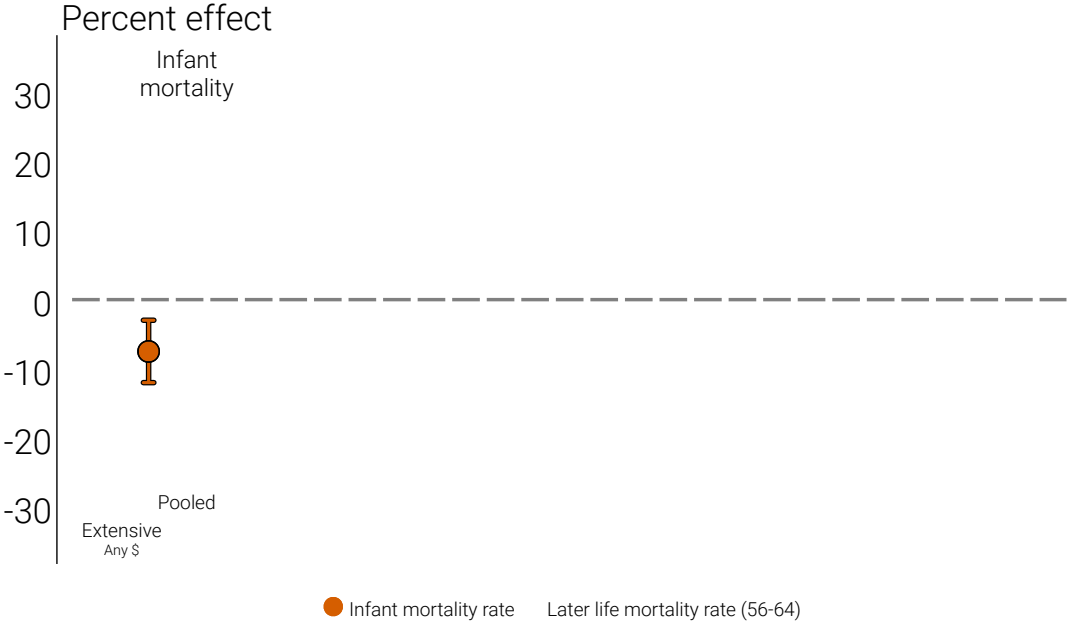


Results preview: effects on health



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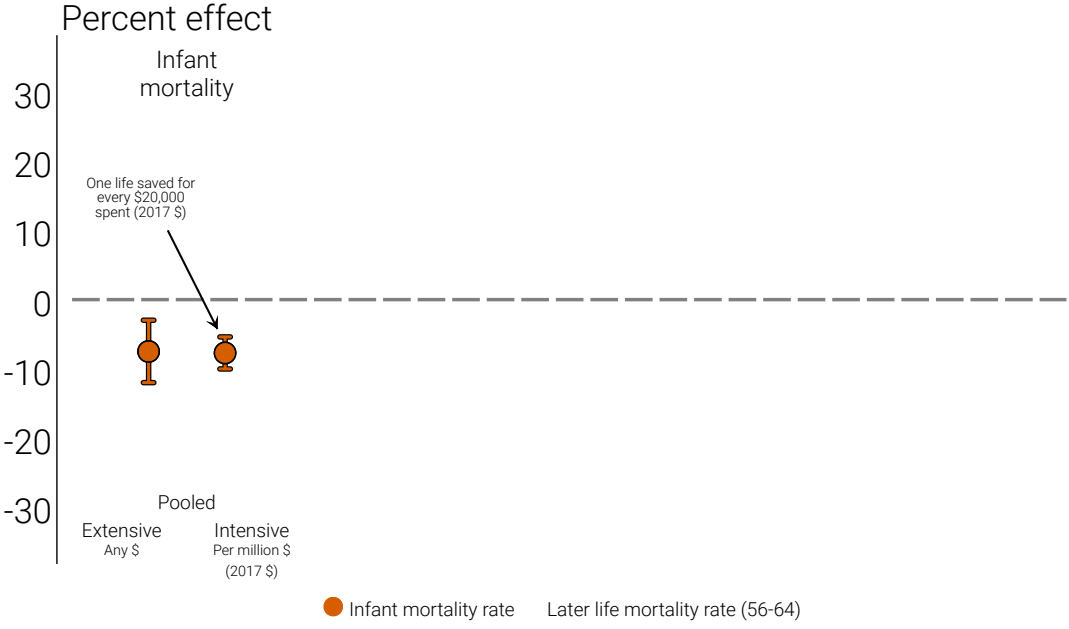

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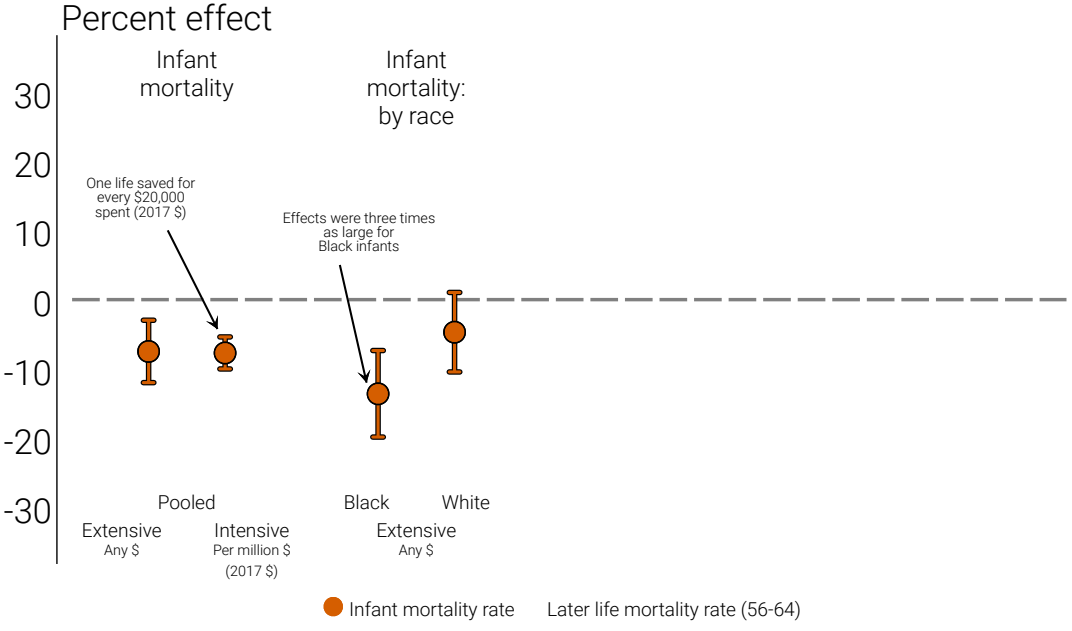

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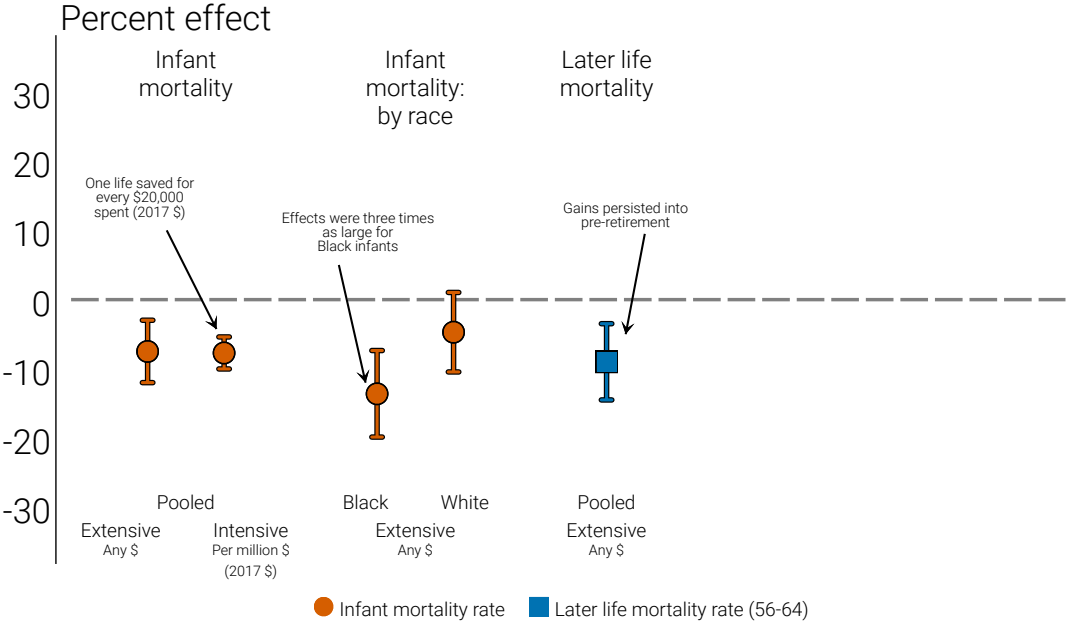

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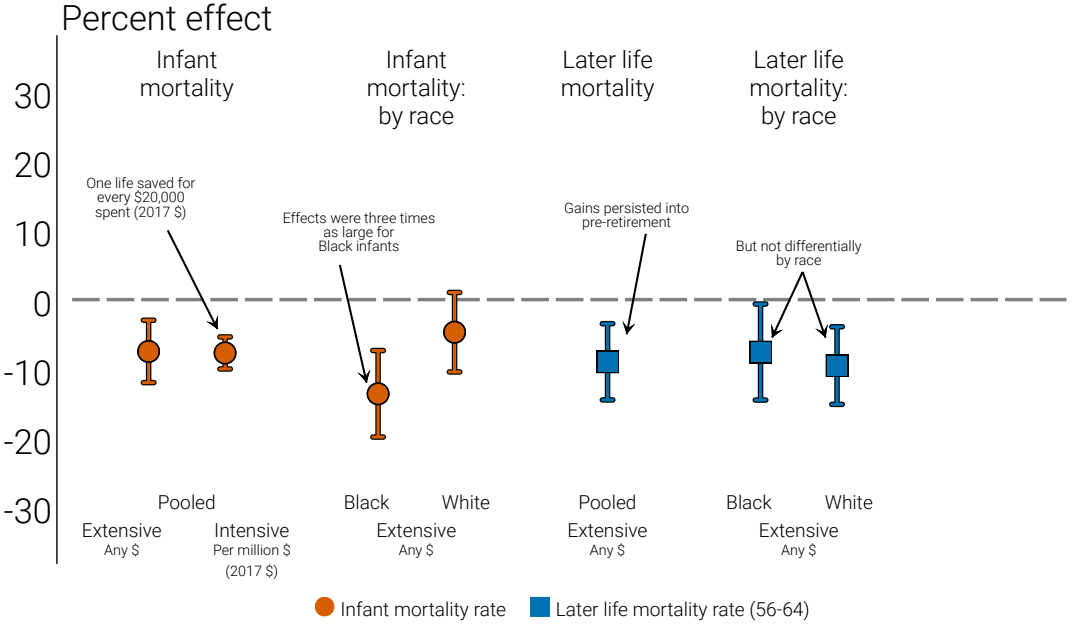

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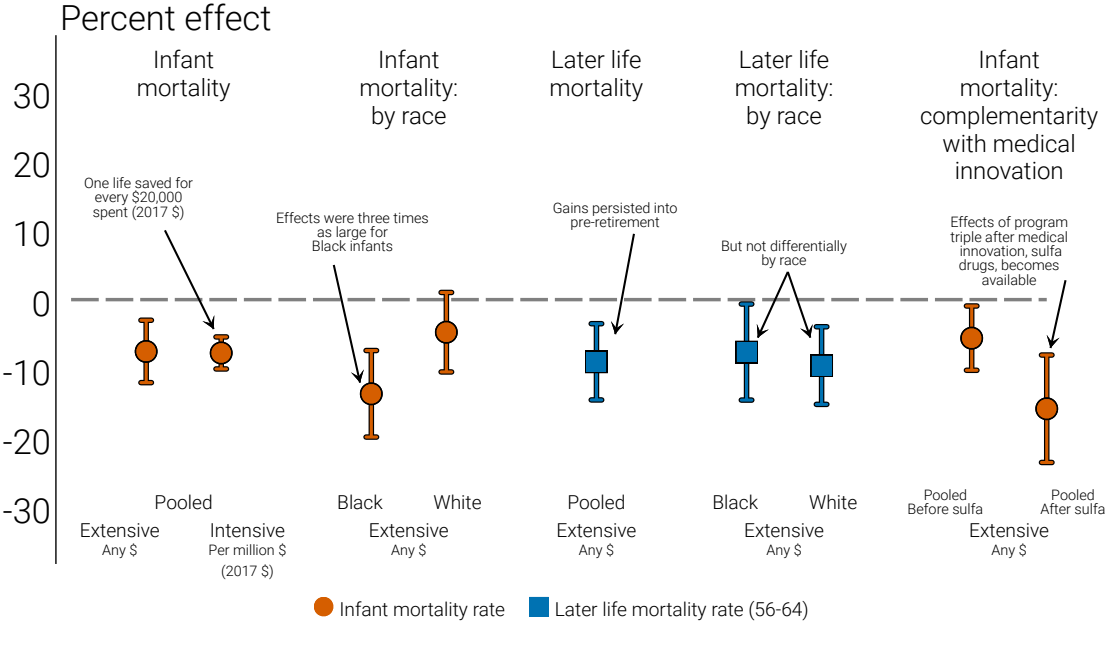
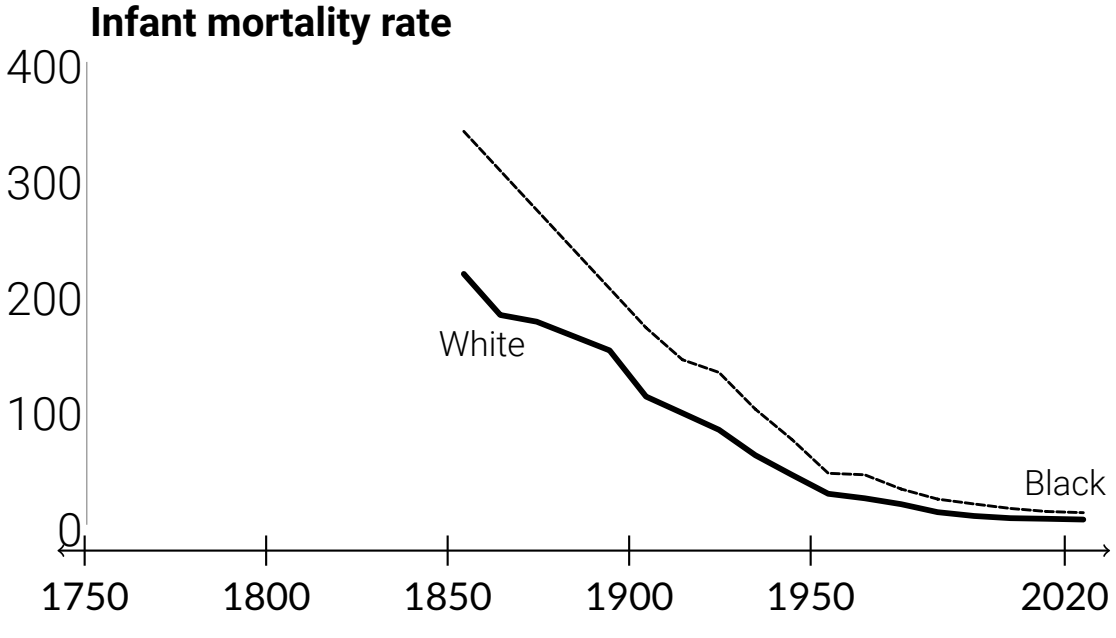


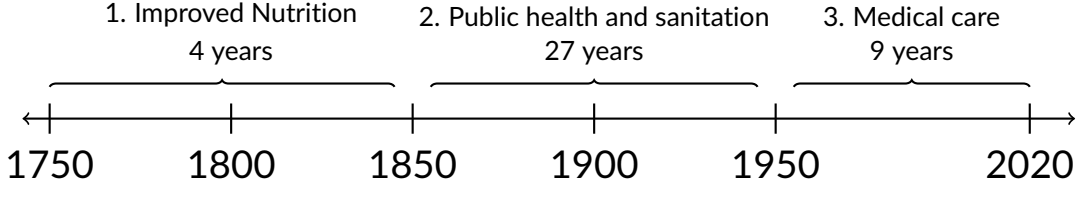
Health has improved dramatically over the past few centuries

“An underappreciated moonshot”



Three eras of improvement

- Cutler, Deaton, and Lleras-Muney (2006) divide past 200 years into three eras
- "Formal medicine played almost no part in better health in 1900 and only a small part through 1950. Today, it is a major part." (Cutler 2005)



Three eras of improvement

1. Improved Nutrition

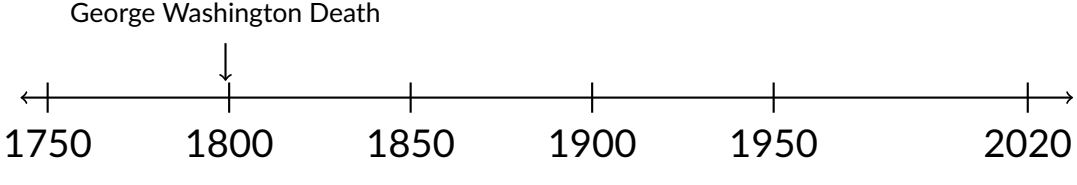
- Low-level of medical knowledge
- Few innovations
- Hospitals are places where poor went to die.

2. Public health and sanitation

- Growing level of medical knowledge
- Innovations, incomplete adoption
- Period of transformation for hospitals

3. Medical care

- High level of medical knowledge
- Rapid innovations and adoption
- Hospital central to practice of medicine



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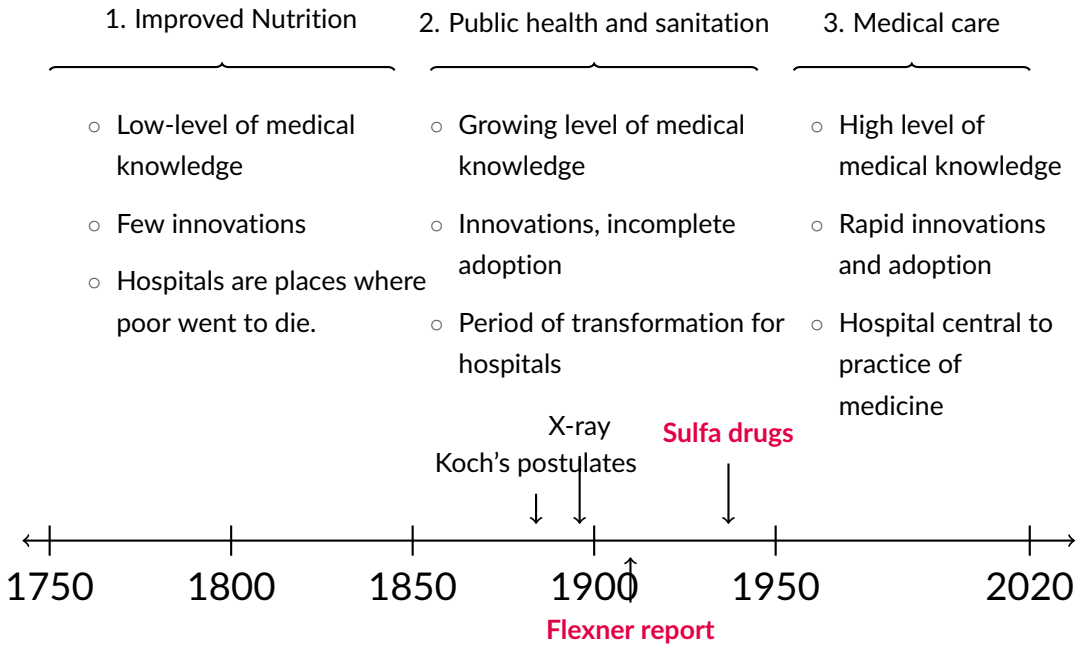

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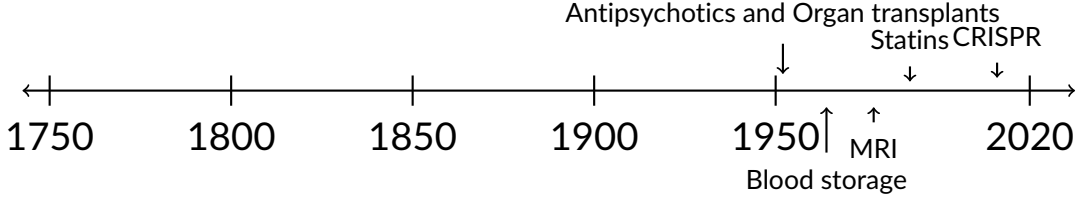
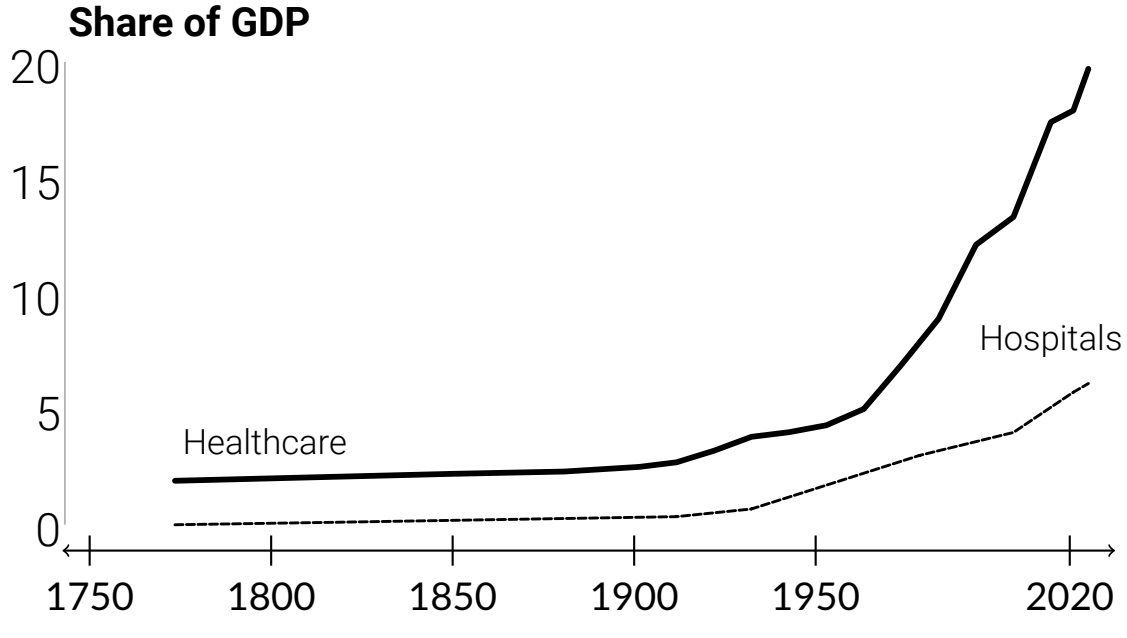
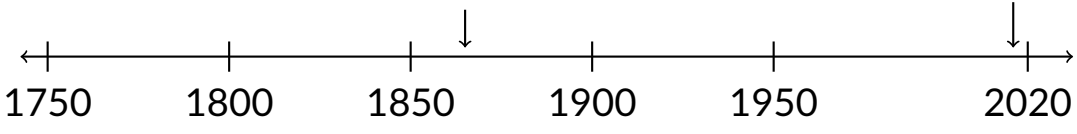


From the fringes to a central role



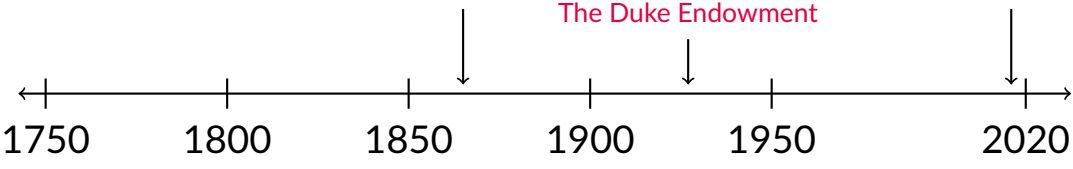
From the fringes to a central role

Hospitals transformed “from places of dreaded impurity and exiled human wreckage into awesome citadels of science and bureaucratic order” (Starr 2017)



From the fringes to a central role

The Duke Endowment accelerated this transition for hospitals in North Carolina



Background

The Duke Endowment

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- $40 million ($640 million in 2021 $) legal mandate with financial obligation to improve lives of poor in North Carolina
  - supplemented by another $ 67 million after his unexpected death in October 1925
- Strong focus on improved access to healthcare (32%)
- Targeted mission with “quite definite ideas as to how the annual income from his charitable trust was to be distributed.” (Durden 1998)
- Unlike other foundations it is a trust with specific, legally mandated financial obligations.

Indenture of Trust

A unique charitable organization

Background

In the Indenture of Trust:

> *I have selected hospitals as another of the principal objects of this trust because I recognize that they have become indispensable institutions, not only by way of ministering to the comfort of the sick but in increasing the efficiency of mankind and prolonging human life. The advance in the science of medicine growing out of discoveries, such as in the field of bacteriology, chemistry and physicians, and growing out of inventions such as the X-ray apparatus, make hospital facilities essential for obtaining the best results in the practice of medicine and surgery. So worthy do I deem the cause and so great do I deem the need that I very much hope the people will see to it that the adequate and convenient hospitals are assured in their respective communities, with especial reference to those who are unable to defray such expenses of their own.*

A historical health care intervention

Background

- The Duke Endowment's Hospital Section funded capital and operating expenditures
  - Constructed new hospitals
  - Expanded and improved equipment in existing hospitals
  - Required uniform accounting procedures
  - Required fastidious uniform accounting procedures, with follow-up
  - Some "screening"/ "oversight"
  - Focused on underprivileged populations
  - **Clear bi-racial policy**: Assistance should be given "whether white or colored"
- Served as the **"both the inspiration and model"** for Hill-Burton post WWII (Durden 1998)

The “inspiration and model” for Hill-Burton

Background

- Third largest charity in the US
- Remains one of the largest charitable foundations in the world
- Virtually no one has studied this organization (aside from historians)
- Private charitable funding can serve as a model for future public expenditures and programs (Berkes and Nencka, 2022)

Data

Data sources

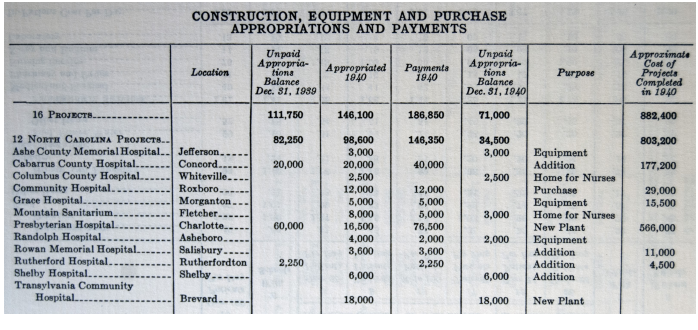
- Annual reports of the Duke Endowment Hospital Section
  - Capital appropriations for hospital funding
- Duke Endowment financial returns
- Individual North Carolina death certificates
  - We assign treatment based on place of birth
- Social Security Administration NUMIDENT Data (2007 version)
  - Individual-level records with date and county of birth. Same treatment as infant mortality.
  - Allows for observing a balanced panel of mortality from ages 56 to 64
- Doctors listed in American Medical Directory
- Hospitals listed in American Medical Directory and the Journal of the American Medical Association
- North Carolina county-year Vital Statistics

Duke Endowment Archives

Digitizing Data

Annual report from hospital section of Duke Endowment

Data



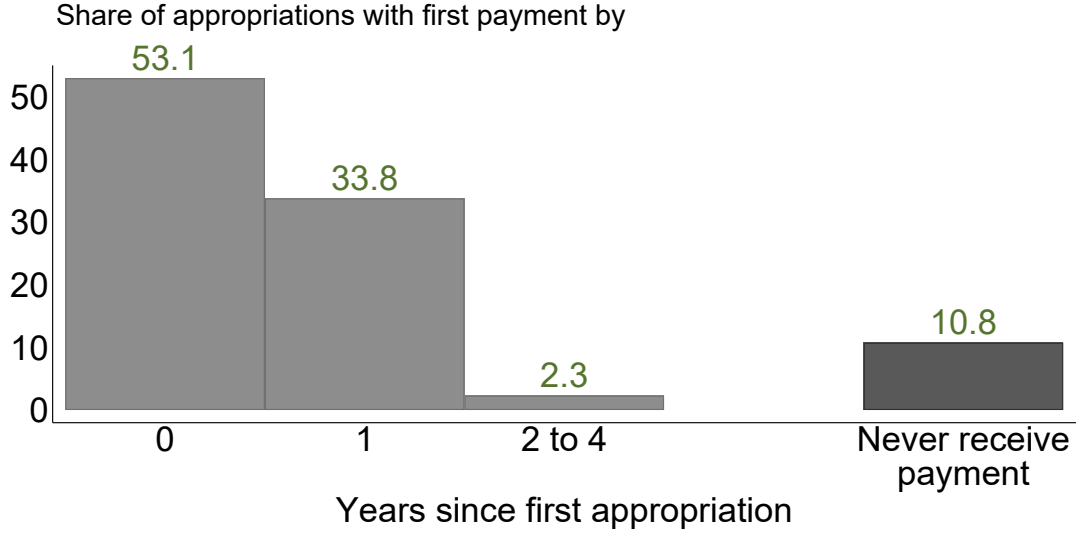
CONSTRUCTION, EQUIPMENT AND PURCHASE APPROPRIATIONS AND PAYMENTS

	Location	Unpaid Appropriations Balance Dec. 31, 1939	Appropriated 1940	Payments 1940	Unpaid Appropriations Balance Dec. 31, 1940	Purpose	Approximate Cost of Projects Completed in 1940
16 PROJECTS		111,750	146,100	186,850	71,000		882,400
12 NORTH CAROLINA PROJECTS		82,250	98,600	146,350	34,500		803,200
Ashe County Memorial Hospital	Jefferson		3,000		3,000	Equipment	
Cabarrus County Hospital	Concord	20,000	20,000	40,000		Addition	177,200
Columbus County Hospital	Whiteville		2,500		2,500	Home for Nurses	
Community Hospital	Roxboro		12,000	12,000		Purchase	29,000
Grace Hospital	Morganton		5,000	5,000		Equipment	15,500
Mountain Sanitarium	Fletcher		8,000	5,000	3,000	Home for Nurses	
Presbyterian Hospital	Charlotte	60,000	16,500	76,500		New Plant	566,000
Randolph Hospital	Asheboro		4,000	2,000	2,000	Equipment	
Rowan Memorial Hospital	Salisbury		3,600	3,600		Addition	11,000
Rutherford Hospital	Rutherfordton	2,250		2,250		Addition	4,500
Shelby Hospital	Shelby		6,000		6,000	Addition	
Transylvania Community Hospital	Brevard		18,000		18,000	New Plant	

- We conservatively consider the first year a county has a **capital appropriation** from the Duke Endowment to be the first treatment year.
- This is an intent to treat
- We also consider amount of $ paid and appropriated

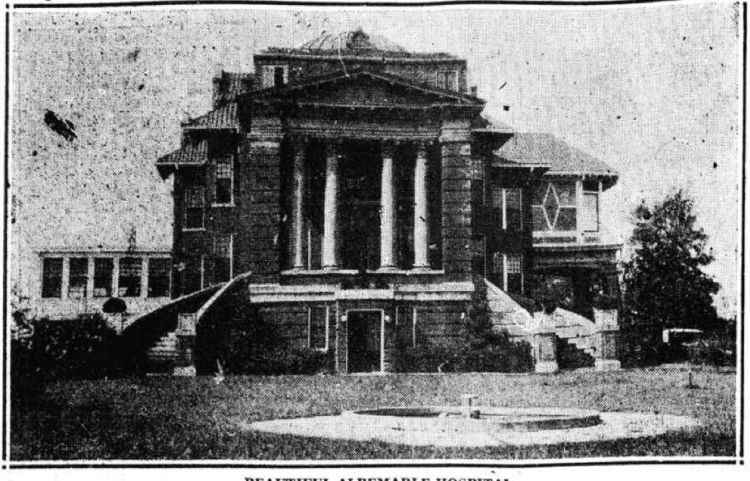
Time from appropriation to payment

Data



Albemarle Hospital

Your Hospital—Visit It On May 12



BEAUTIFUL ALBEMARLE HOSPITAL

May 12th, anniversary of the birth of Florence Nightingale, is observed in America and other English speaking countries as National Hospital

cheerful and most efficiently operated hospitals of its size in this or any other State. Under the superintendency of Miss Charlotte Gordon

ful hospital site in the Carolinas.

Albemarle Hospital is operated under The Duke Endowment and subject to the constant inspection

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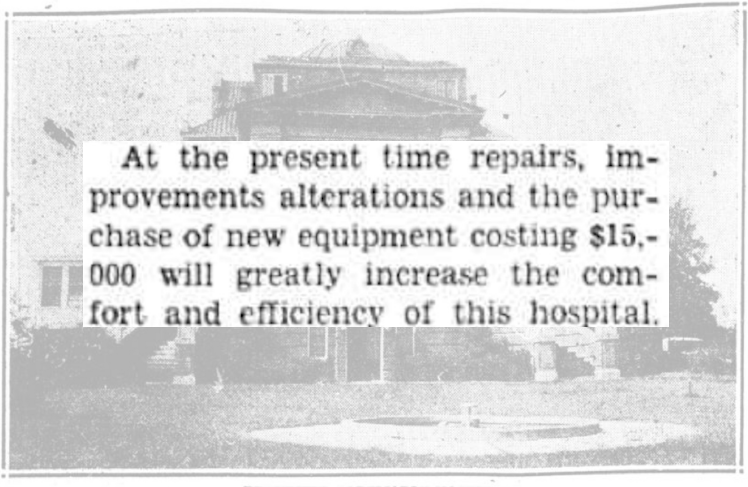

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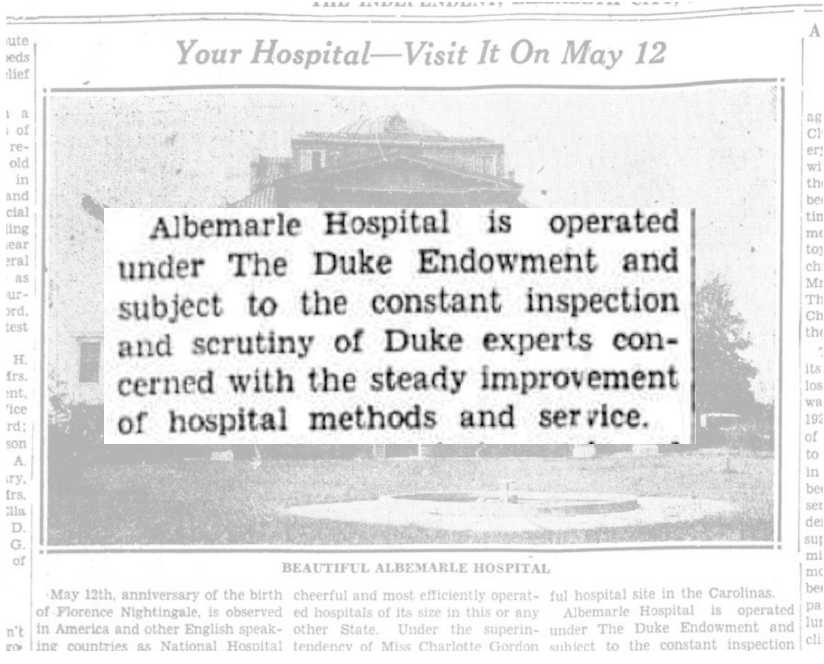

Your Hospital—Visit It On May 12

Albemarle Hospital is operated under The Duke Endowment and subject to the constant inspection and scrutiny of Duke experts concerned with the steady improvement of hospital methods and service.

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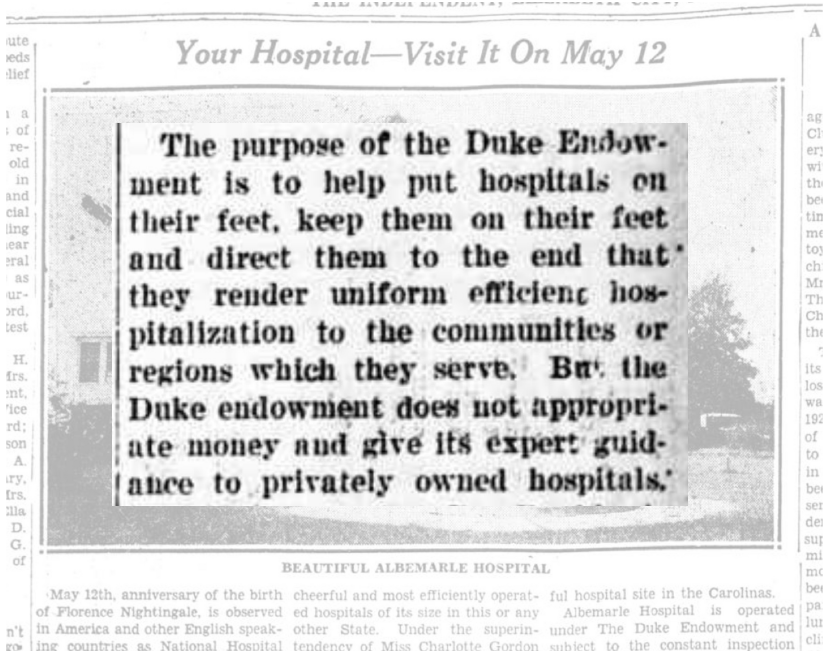

Your Hospital—Visit It On May 12

The purpose of the Duke Endowment is to help put hospitals on their feet, keep them on their feet and direct them to the end that they render uniform efficient hospitalization to the communities or regions which they serve. But the Duke endowment does not appropriate money and give its expert guidance to privately owned hospitals.

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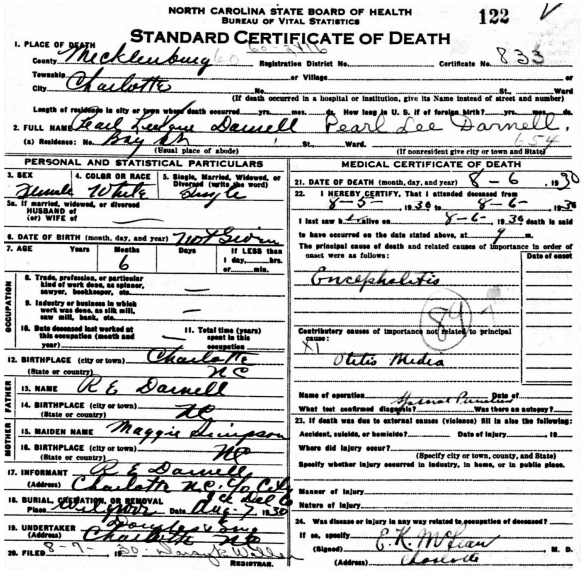
Albemarle Hospital

Year	Institution	Appropriation	Payments	Purpose
1930	Albemarle Hospital	37,500		Purchase
1931	Albemarle Hospital	37,500	37,500	Purchase
1932	Albemarle Hospital	37,500		Purchase

North Carolina death certificates, 1909-1976

Data

- Existing tabulations of infant mortality reported by **place of occurrence**
- No prior data on births and deaths by race
- **New measure:** infant mortality by **county of birth** from **Certificates of Death**
- Courtesy of John Parman (Cook, Logan, Parman 2014; 2016)



NORTH CAROLINA STATE BOARD OF HEALTH
BUREAU OF VITAL STATISTICS

122

STANDARD CERTIFICATE OF DEATH

1. PLACE OF DEATH
County Mecklenburg 60 Registration District No. ____ Certificate No. 833
Township ____ or Village ____ or
City Charlotte No. ____ St. ____ Ward
(If death occurred in a hospital or institution, give its Name instead of street and number)
Length of residence in city or town where death occurred ____ yrs. ____ mos. ____ ds. How long in U. S. if of foreign birth? ____ yrs. ____ mos. ____ ds.

2. FULL NAME Pearl Lee Darnell Pearl Lee Darnell.
(a) Residence: No. Bay St. St. ____ Ward. 654
(Usual place of abode) (If nonresident give city or town and State)

PERSONAL AND STATISTICAL PARTICULARS

3. SEX Female
4. COLOR OR RACE White
5. Single, Married, Widowed, or Divorced (write the word) Single
5a. If married, widowed, or divorced HUSBAND of (or) WIFE of ____
6. DATE OF BIRTH (month, day, and year) Not Given
7. AGE Years ____ Months 6 Days ____ If LESS than 1 day, ____ hrs. or ____ min.

OCCUPATION
8. Trade, profession, or particular kind of work done, as spinner, sawyer, bookkeeper, etc. —
9. Industry or business in which work was done, as silk mill, saw mill, bank, etc. —
10. Date deceased last worked at this occupation (month and year) ____
11. Total time (years) spent in this occupation ____

12. BIRTHPLACE (city or town) Charlotte
(State or country) NC

FATHER
13. NAME R E Darnell
14. BIRTHPLACE (city or town) NC
(State or country)

MOTHER
15. MAIDEN NAME Maggie Simpson
16. BIRTHPLACE (city or town) NC
(State or country)

17. INFORMANT R E Darnell
(Address) Charlotte N.C. Co. City
18. BURIAL, CREMATION, OR REMOVAL Place Wilgrove Date Aug. 7, 1930
Cook Del Co
19. UNDERTAKER Douglas & Ewing
(Address) Charlotte NC
20. FILED 8-7 1930 Douglas Wilson
REGISTRAR.

MEDICAL CERTIFICATE OF DEATH

21. DATE OF DEATH (month, day, and year) 8-6, 1930
22. I HEREBY CERTIFY, That I attended deceased from 8-5-, 1930 to 8-6-, 1930
I last saw her alive on 8-6-, 1930 death is said to have occurred on the date stated above, at 9 m.
The principal cause of death and related causes of importance in order of onset were as follows:

	Date of onset
Encephalitis	

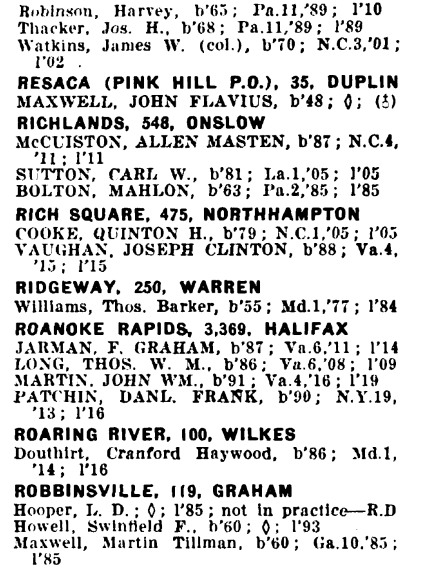
Contributory causes of importance not related to principal cause:
Otitis Media

Name of operation ____ Date of ____
What test confirmed diagnosis? ____ Was there an autopsy? ____
23. If death was due to external causes (violence) fill in also the following:
Accident, suicide, or homicide? ____ Date of injury ____ 19__
Where did injury occur? ____
(Specify city or town, county, and State)
Specify whether injury occurred in industry, in home, or in public place.
Manner of injury ____
Nature of injury ____
24. Was disease or injury in any way related to occupation of deceased? ____
If so, specify ____
(Signed) E. K. McLean M. D.
(Address) Charlotte

Doctors

Data

- **American Medical Directory**: Medical school + graduation year for universe of U.S. doctors
- **High-quality doctors:** Two-year degree as admission pre-requisite (Moehling et al. 2020)



Robinson, Harvey, b'65; Pa.11,'89; l'10
Thacker, Jos. H., b'68; Pa.11,'89; l'89
Watkins, James W. (col.), b'70; N.C.3,'01; l'02

RESACA (PINK HILL P.O.), 35, DUPLIN
MAXWELL, JOHN FLAVIUS, b'48; ◊; (2)

RICHLANDS, 548, ONSLOW
McCUISTON, ALLEN MASTEN, b'87; N.C.4, '11; l'11
SUTTON, CARL W., b'81; La.1,'05; l'05
BOLTON, MAHLON, b'63; Pa.2,'85; l'85

RICH SQUARE, 475, NORTHHAMPTON
COOKE, QUINTON H., b'79; N.C.1,'05; l'05
VAUGHAN, JOSEPH CLINTON, b'88; Va.4, '15; l'15

RIDGEWAY, 250, WARREN
Williams, Thos. Barker, b'55; Md.1,'77; l'84

ROANOKE RAPIDS, 3,369, HALIFAX
JARMAN, F. GRAHAM, b'87; Va.6,'11; l'14
LONG, THOS. W. M., b'86; Va.6,'08; l'09
MARTIN, JOHN WM., b'91; Va.4,'16; l'19
PATCHIN, DANL. FRANK, b'90; N.Y.19, '13; l'16

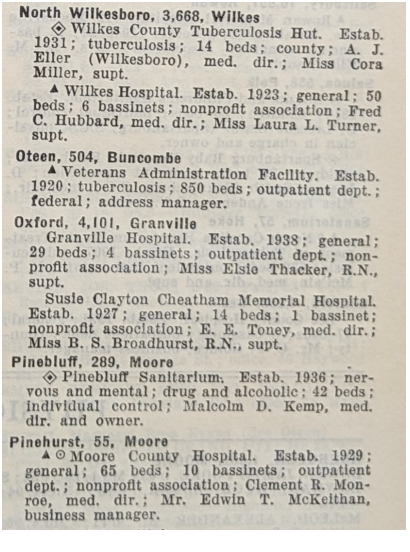
ROARING RIVER, 100, WILKES
Douthirt, Cranford Haywood, b'86; Md.1, '14; l'16

ROBBINSVILLE, 119, GRAHAM
Hooper, L. D.; ◊; l'85; not in practice—R.D
Howell, Swinfield F., b'60; ◊; l'93
Maxwell, Martin Tillman, b'60; Ga.10,'85; l'85

Hospitals

Data

- **American Medical Directory**: Hospitals, beds, type of service and ownership school
- **American Medical Association**: Hospitals, beds, type of service and ownership school



North Wilkesboro, 3,668, Wilkes

◈ Wilkes County Tuberculosis Hut. Estab. 1931; tuberculosis; 14 beds; county; A. J. Eller (Wilkesboro), med. dir.; Miss Cora Miller, supt.

▲ Wilkes Hospital. Estab. 1923; general; 50 beds; 6 bassinets; nonprofit association; Fred C. Hubbard, med. dir.; Miss Laura L. Turner, supt.

Oteen, 504, Buncombe

▲ Veterans Administration Facility. Estab. 1920; tuberculosis; 850 beds; outpatient dept.; federal; address manager.

Oxford, 4,101, Granville

Granville Hospital. Estab. 1938; general; 29 beds; 4 bassinets; outpatient dept.; nonprofit association; Miss Elsie Thacker, R.N., supt.

Susie Clayton Cheatham Memorial Hospital. Estab. 1927; general; 14 beds; 1 bassinet; nonprofit association; E. E. Toney, med. dir.; Miss B. S. Broadhurst, R.N., supt.

Pinebluff, 289, Moore

◈ Pinebluff Sanitarium. Estab. 1936; nervous and mental; drug and alcoholic; 42 beds; individual control; Malcolm D. Kemp, med. dir. and owner.

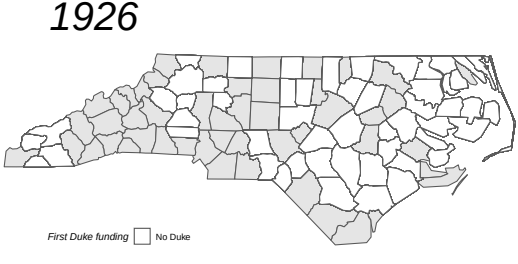
Pinehurst, 55, Moore

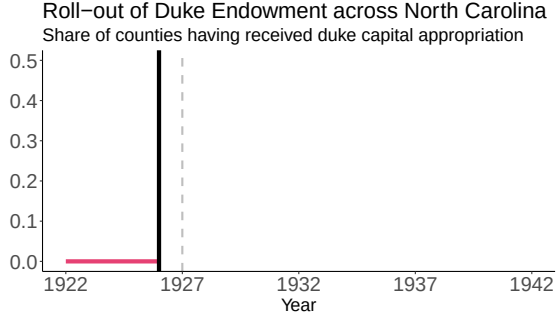
▲ ⊙ Moore County Hospital. Estab. 1929; general; 65 beds; 10 bassinets; outpatient dept.; nonprofit association; Clement R. Monroe, med. dir.; Mr. Edwin T. McKeithan, business manager.

Visual overview of variation

Roll-out of assistance, across space and time

Visual overview





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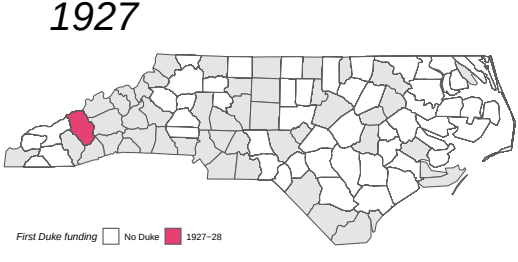
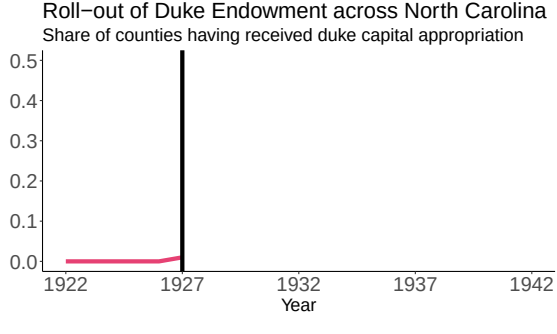
Visual overview





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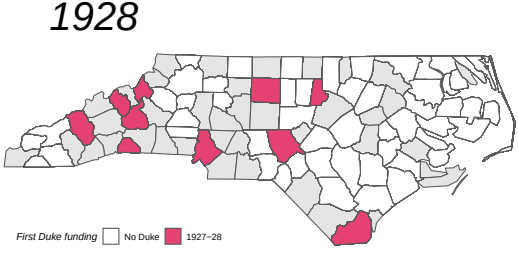
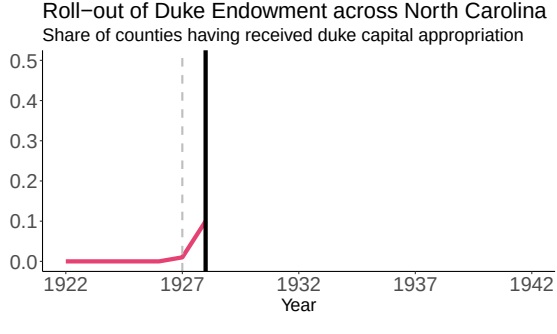
Visual overview





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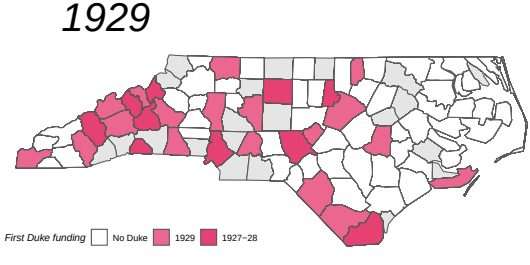
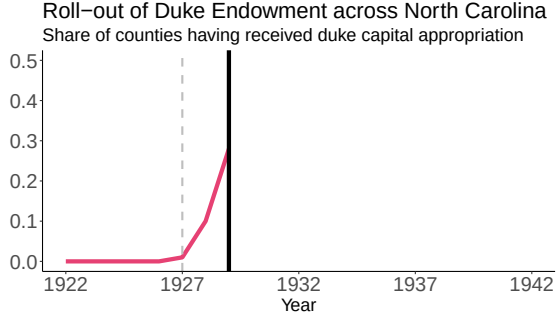
Visual overview





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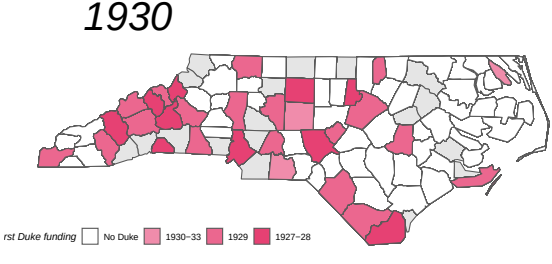
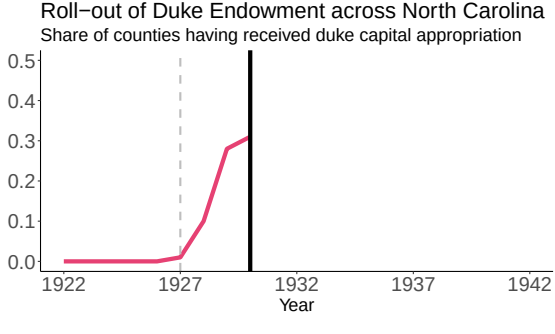
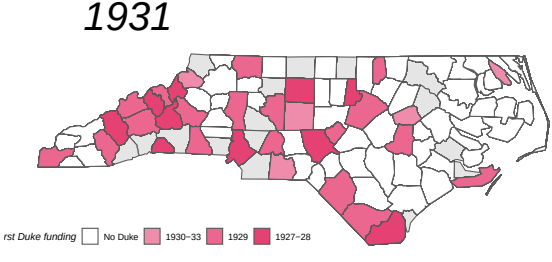
Visual overview

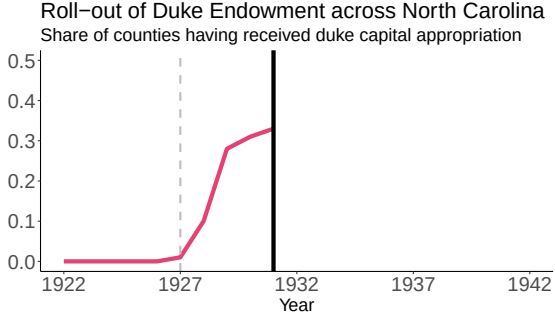




Roll-out of assistance, across space and time

Visual overview





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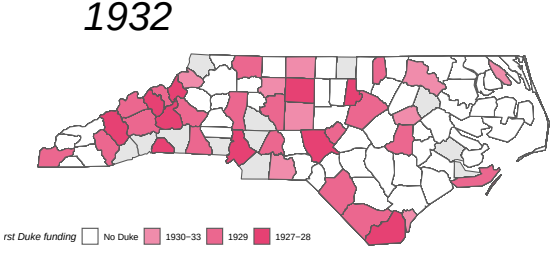

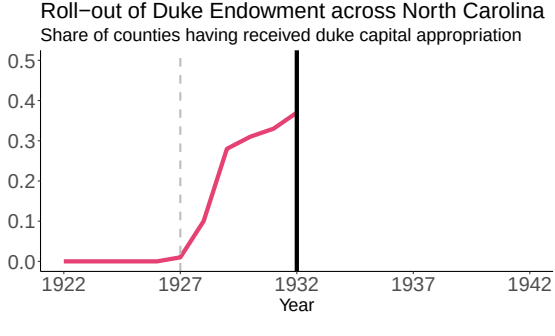

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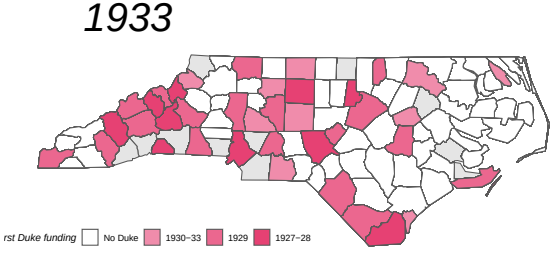

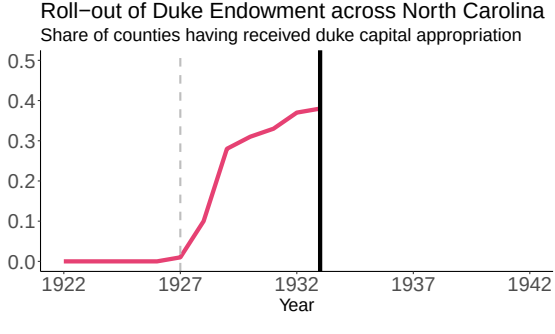

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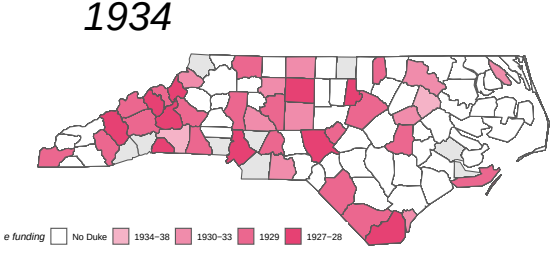

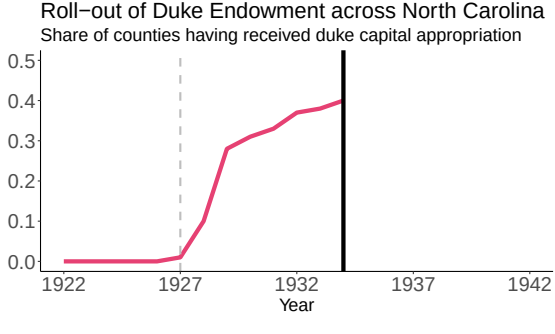

Roll-out of assistance, across space and time

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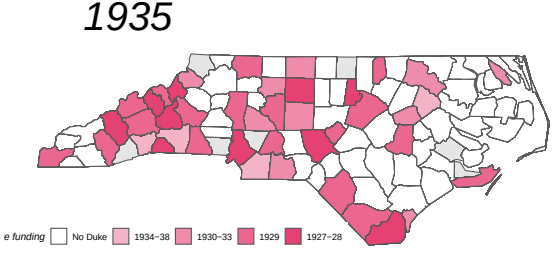

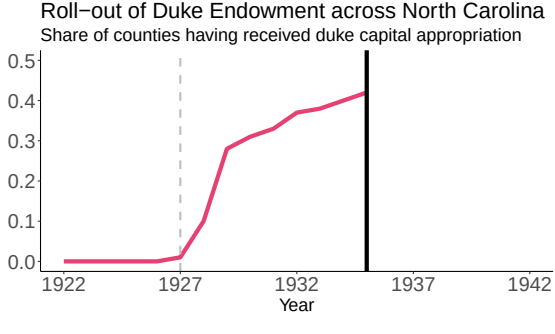

Roll-out of assistance, across space and time

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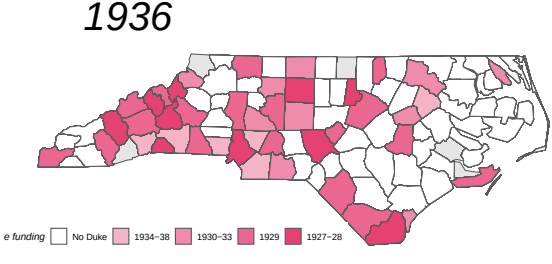

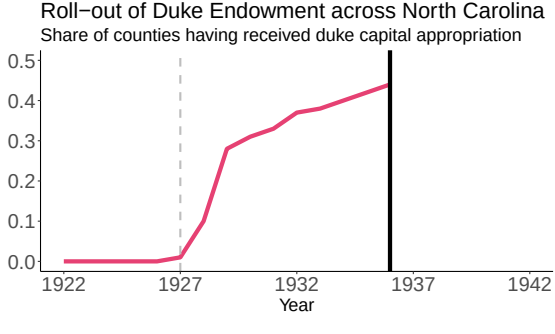

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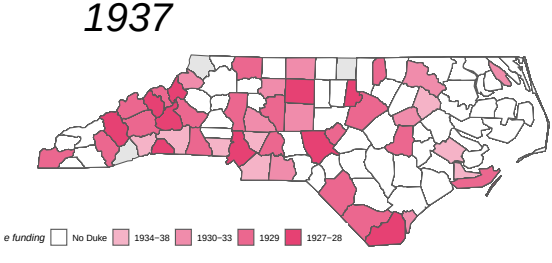

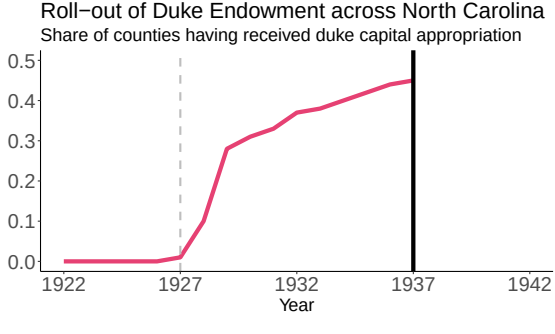

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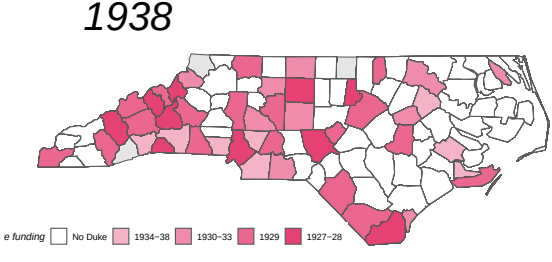

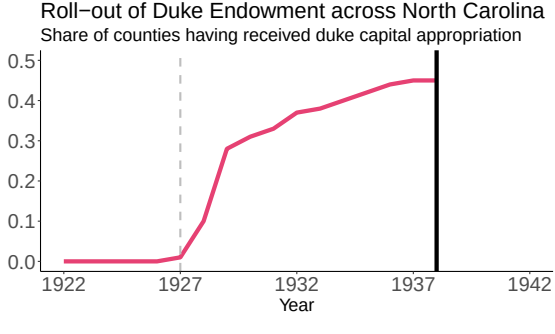

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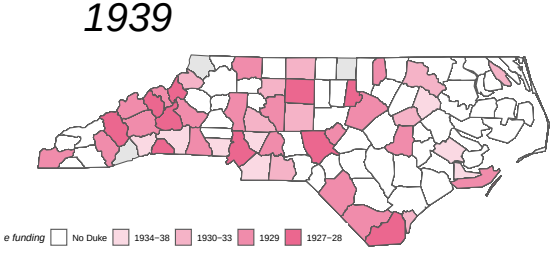

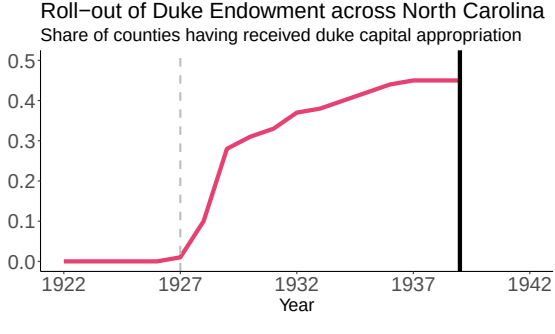

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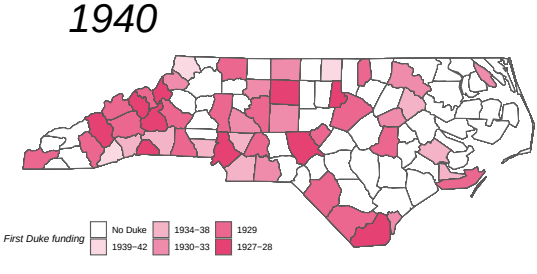
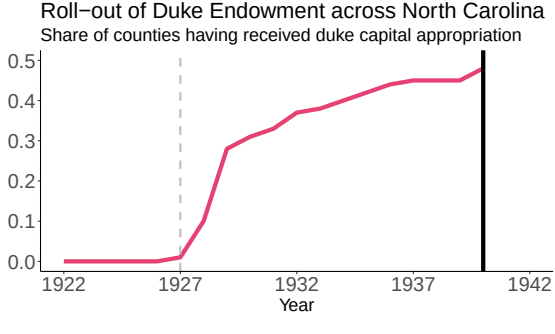
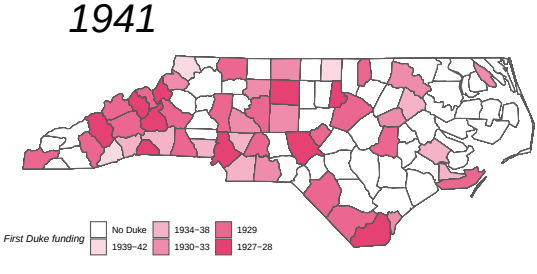
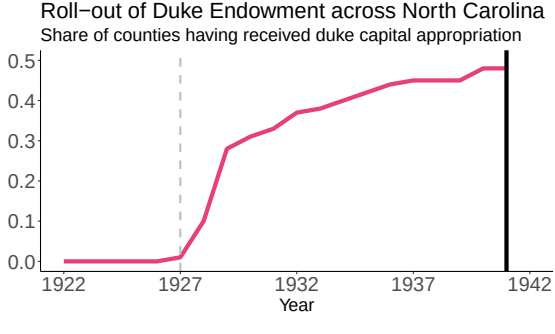




Roll-out of assistance, across space and time

Visual overview





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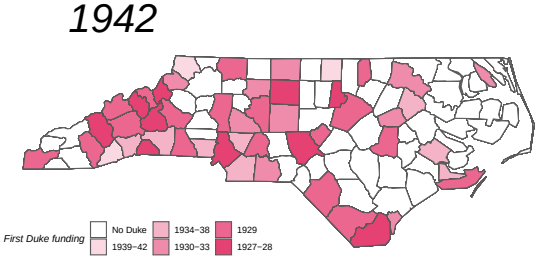
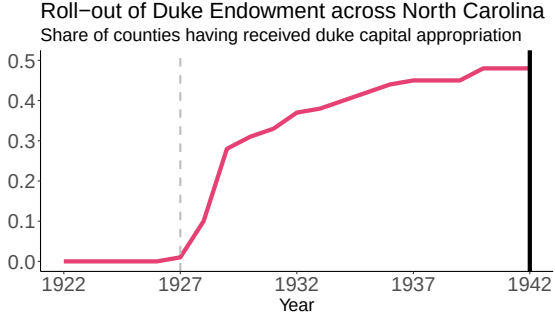




Methods

Diff-in-Diff

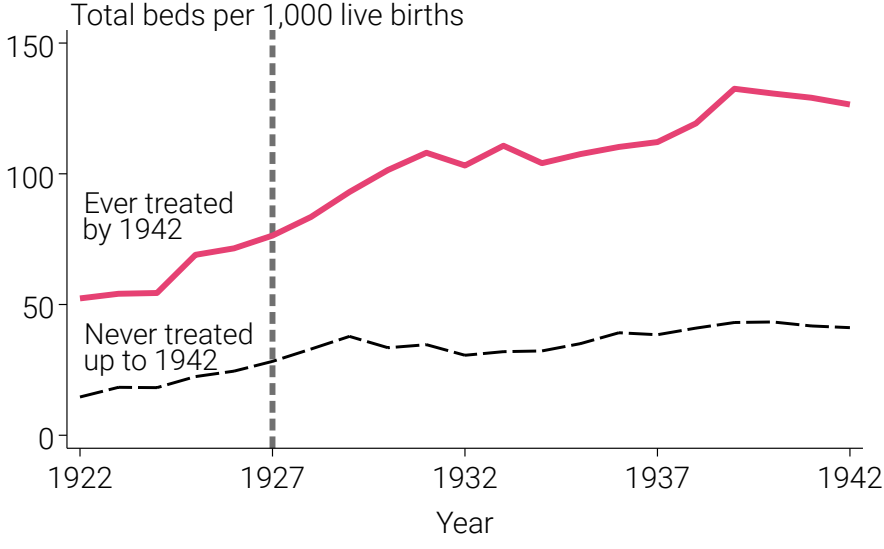
Methods

- County of birth and year of birth fixed effects
- Exposure is based on year and place of birth
  - True for both short- and long-run analyses
- Estimate medical sector using linear models
- Estimate mortality using Poisson pseudo-maximum likelihood
  - **Growing baseline mortality:** mortality rates vary with age; Poisson allows for proportional analysis when baseline mortality rate changes in the long-run
  - **Zeros:** handles data with zeroes on LHS well
  - **Robust:** to linear model, $log(Y)$, many other estimators, instrumental variables

First-stage

Treated counties saw increases in all hospital beds

First-stage



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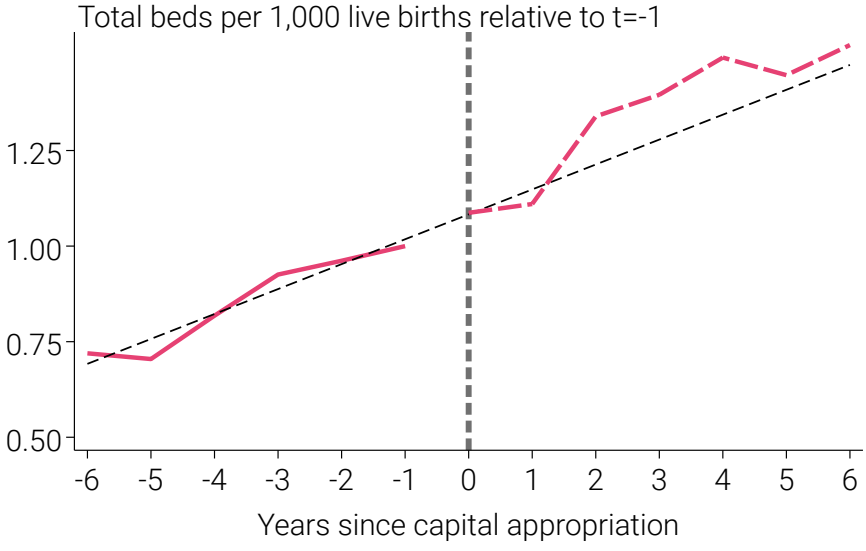
First-stage



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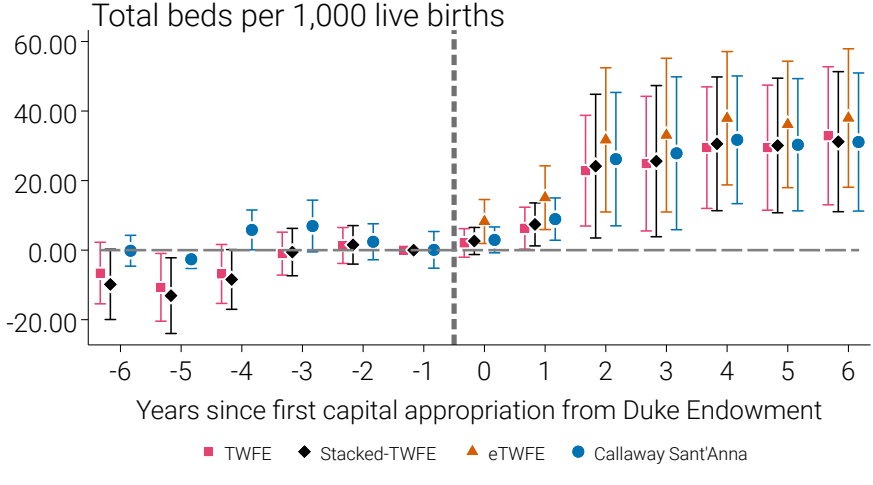
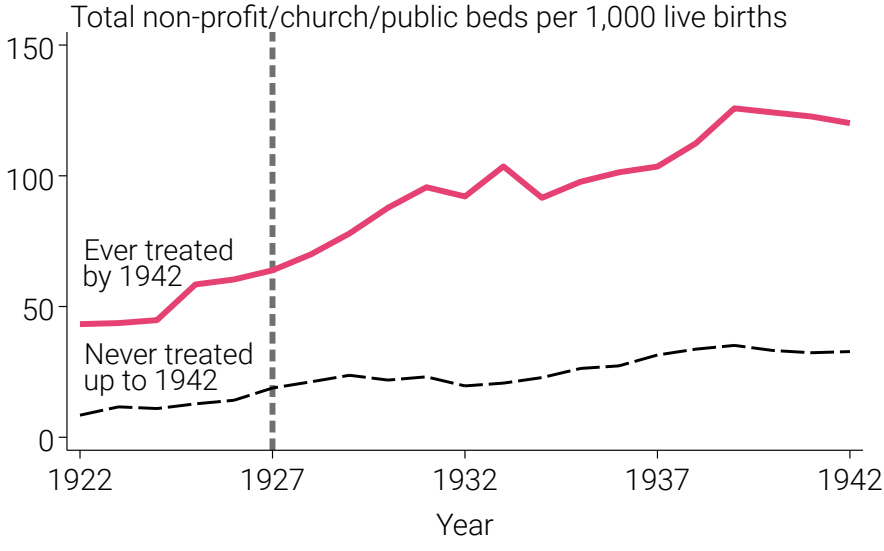
First-stage



This is driven by increases in not-for-profit hospital beds

First-stage



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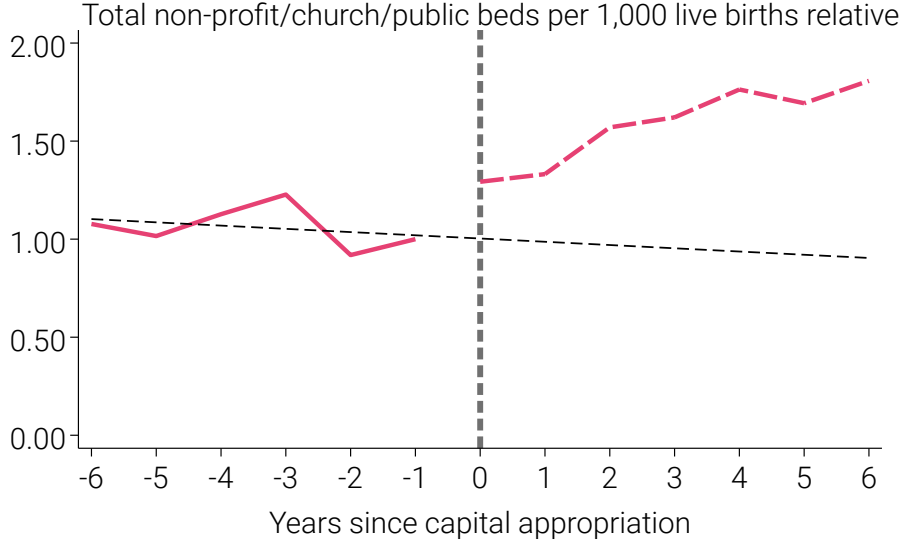

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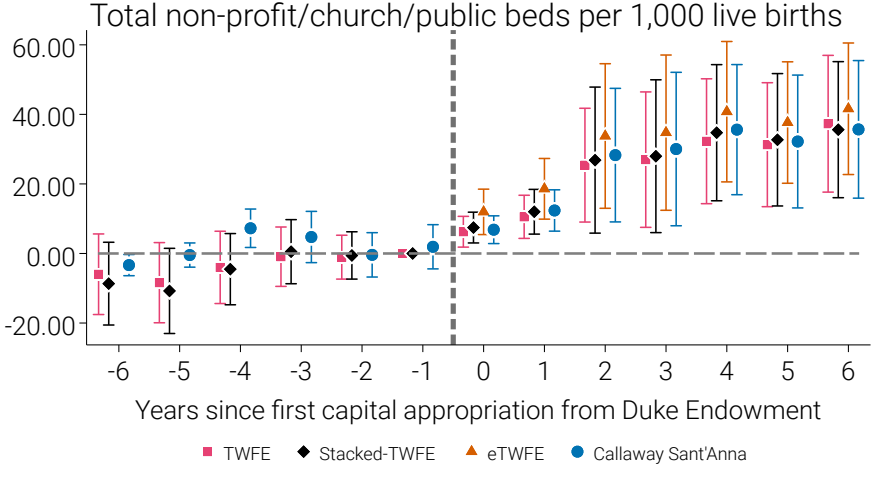
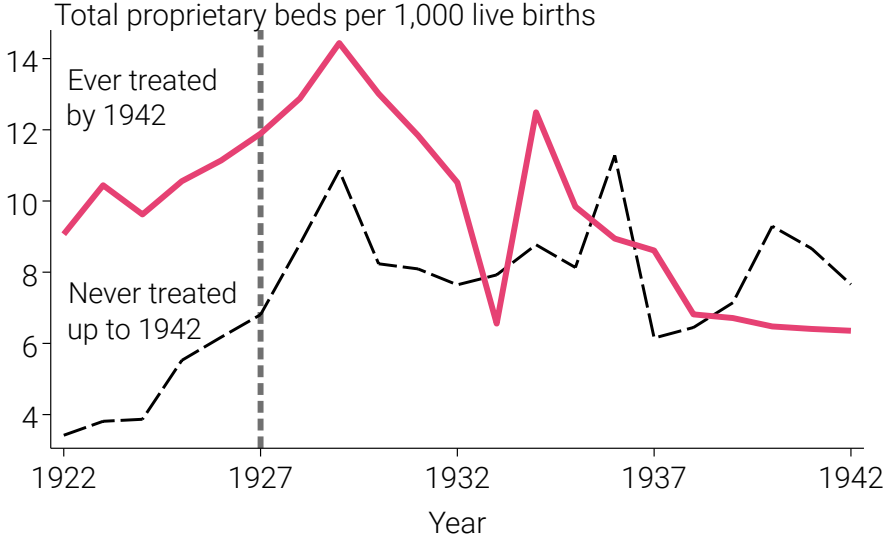
First-stage



And partially offset by decreases in beds not eligible for Duke funding

First-stage



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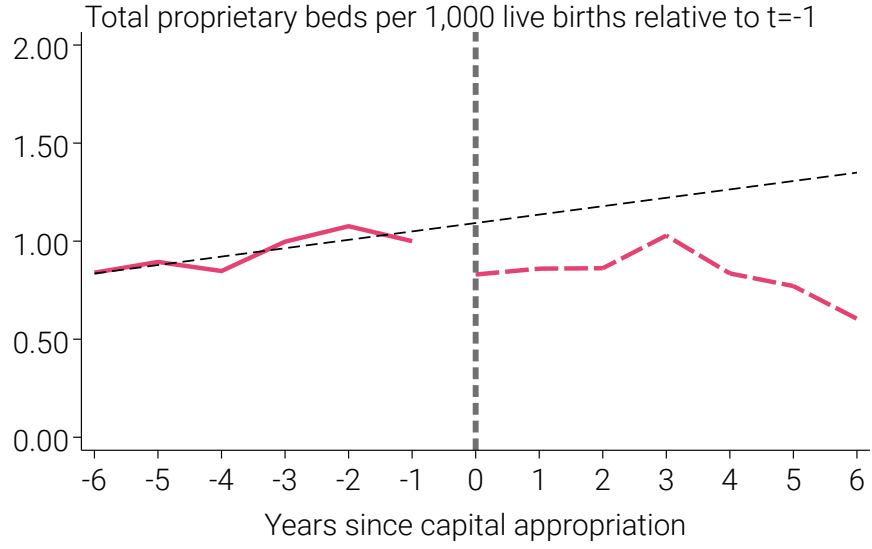
First-stage



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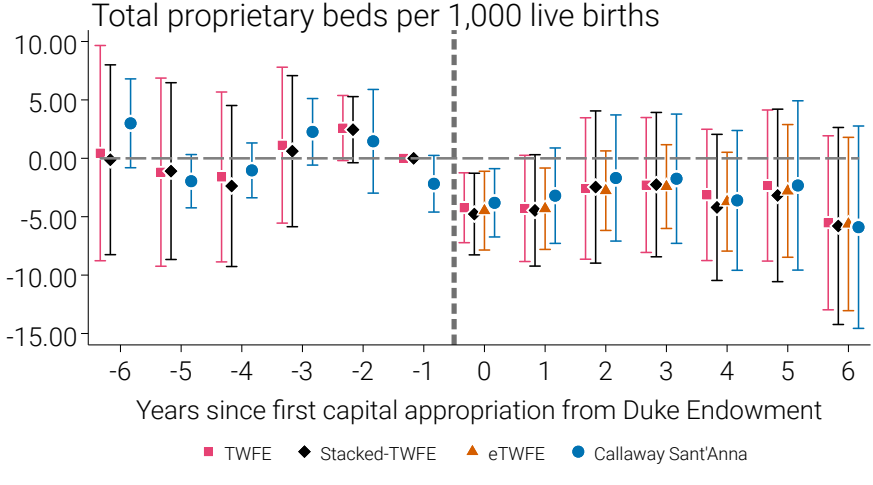
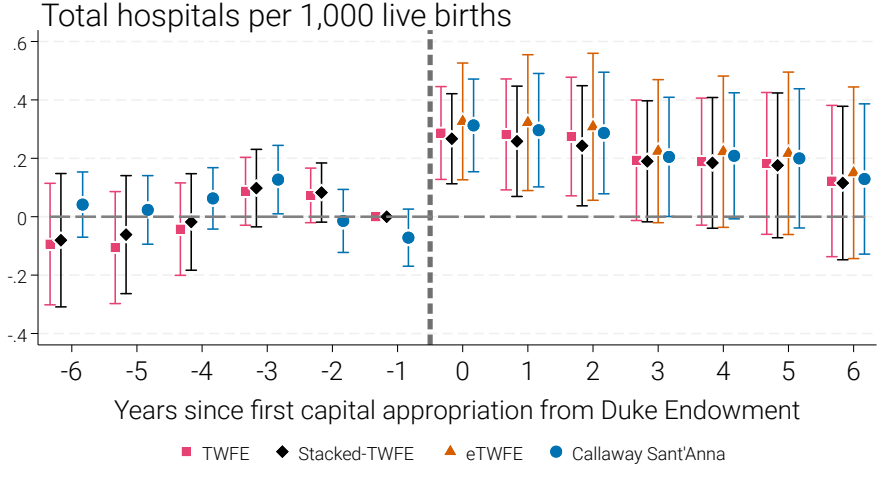
First-stage



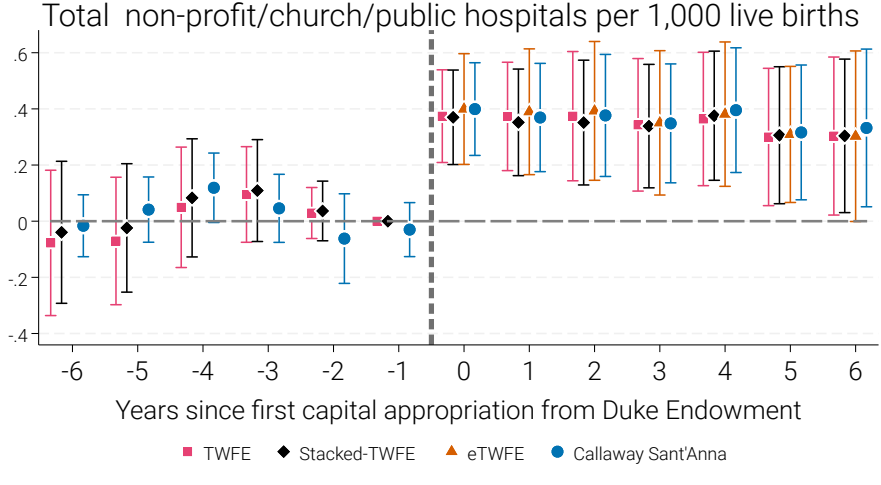
The number of hospitals increased as well

First-stage



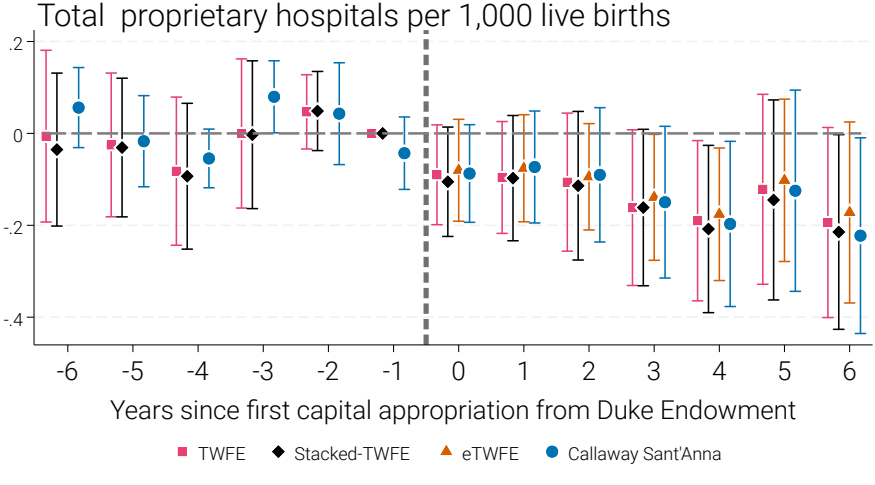
Again driven by not-for-profit hospitals

First-stage



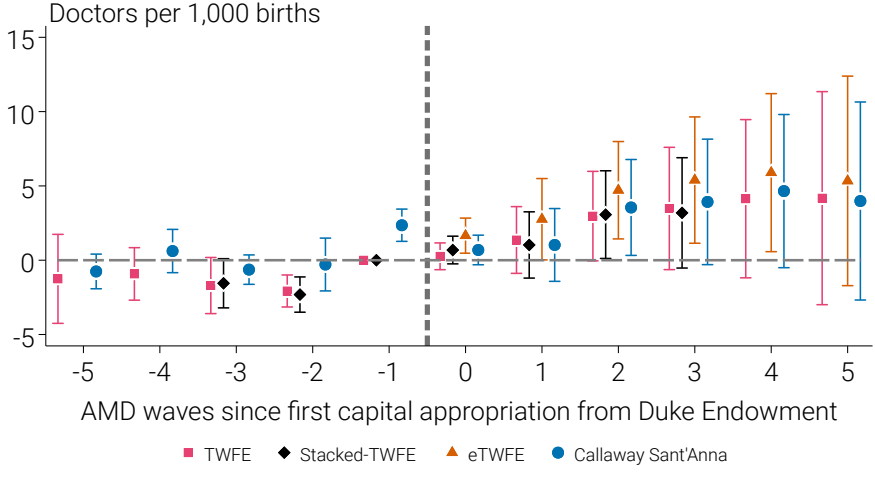
And mitigated by closures of proprietary hospitals

First-stage



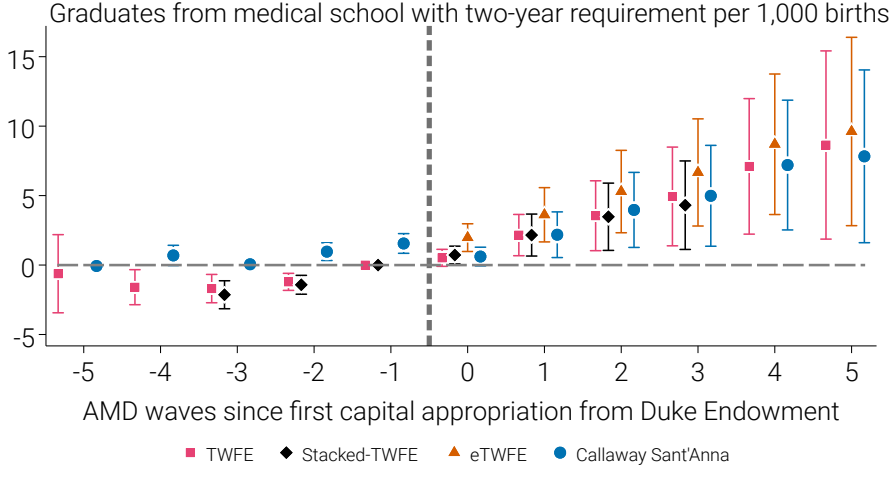
The number of doctors increased as well

First-stage



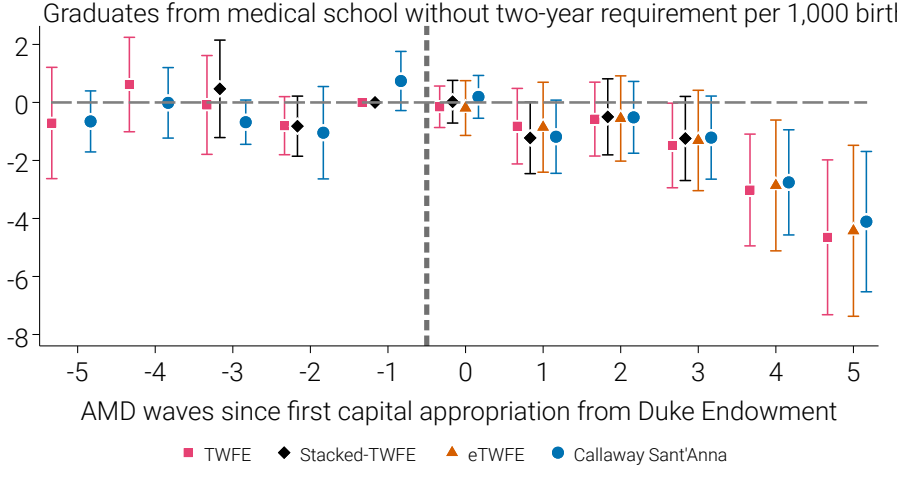
Driven by an increase in high-quality doctors

First-stage



And a bit offset by a decrease in lower-quality doctors

First-stage



Our measure of quality doesn't matter too much

First-stage

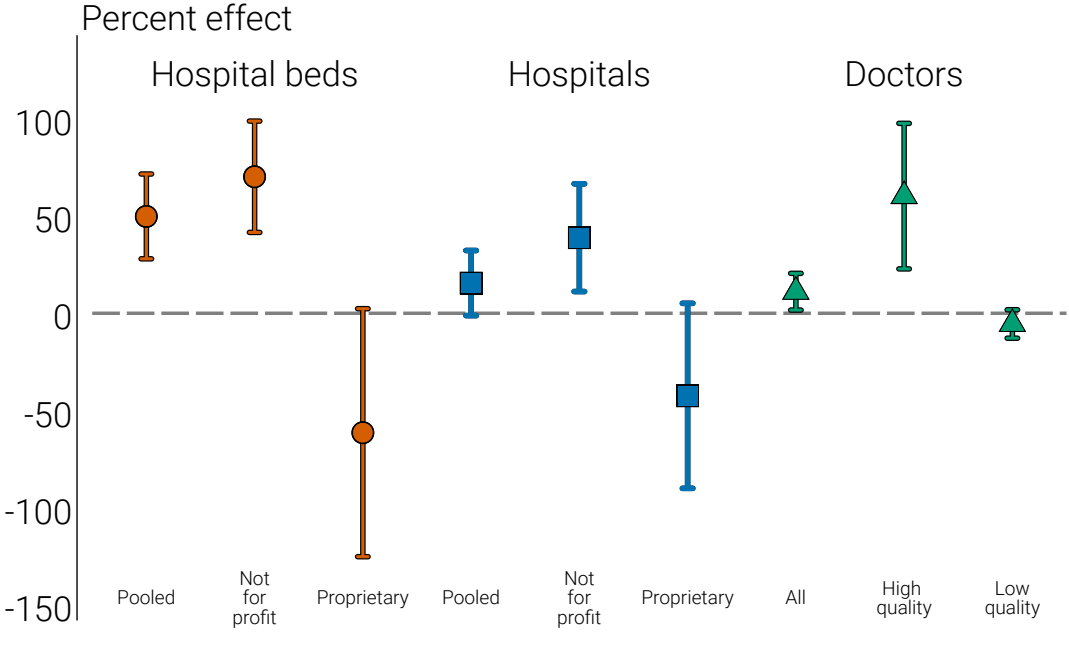
	Y_{ct}^{R} = Doctors	Y_{ct}^{R} = Doctors per 1000 births
	(1)	(2)
A. Pooled - High Quality		
Graduates from medical school with two-year requirement	9.02***	3.88***
	(2.58)	(1.23)
Graduates from medical school ever with A/A+ AMA rating	6.29***	3.02***
	(1.96)	(0.96)
Graduates from medical school that exists and is approved in 1942	7.48***	3.27***
	(2.55)	(1.23)
Graduates from medical school that remains open	7.77***	3.43***
	(2.66)	(1.28)
Observations	1,100	1,100

Our measure of quality doesn't matter too much

First-stage

	Y^R_{ct} = Doctors			Y^R_{ct} = Doctors per 1,000 births		
	(1)	(2)	(3)	(4)	(5)	(6)
Surgeons	0.82***	1.11***	0.96***	0.86***	0.72***	0.75***
	(0.19)	(0.33)	(0.23)	(0.19)	(0.17)	(0.17)
Specialists	3.34***	5.63***	3.70***	1.99***	2.49***	1.97***
	(1.04)	(1.86)	(1.13)	(0.55)	(0.68)	(0.54)
AMA Fellows	1.96**	3.09**	1.62*	1.00*	1.12*	0.72
	(0.77)	(1.33)	(0.83)	(0.56)	(0.59)	(0.48)
AMA Members	2.42**	4.78**	2.93**	1.28	1.91**	1.38*
	(1.15)	(2.04)	(1.33)	(0.81)	(0.89)	(0.74)
Doctors from N.C. medical school	−0.06	0.01	0.01	−0.35	−0.15	−0.15
	(0.53)	(0.72)	(0.64)	(0.36)	(0.41)	(0.37)
Doctors under 40	2.11	3.18	2.51	0.92	1.51	1.29
	(1.57)	(2.31)	(1.76)	(1.07)	(1.26)	(0.95)
Doctors licensed after Flexner report	7.00***	11.24***	7.72***	2.54**	4.26***	3.36***
	(1.89)	(3.22)	(2.03)	(0.98)	(1.11)	(0.94)
Doctors licensed before Flexner report	−2.89***	−3.92***	−2.71***	−1.21**	−1.17**	−0.75
	(0.78)	(1.15)	(0.82)	(0.50)	(0.50)	(0.50)
Observations	1,100	1,100	1,100	1,100	1,100	1,100
County FE	Yes	Yes	Yes	Yes	Yes	Yes
AMD Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Weights	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes

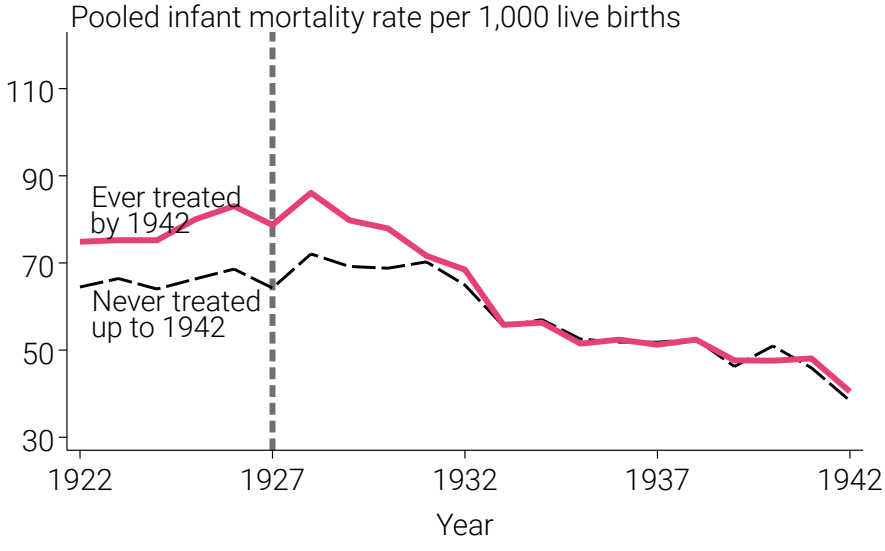
Effects on the medical sector



Short-run mortality

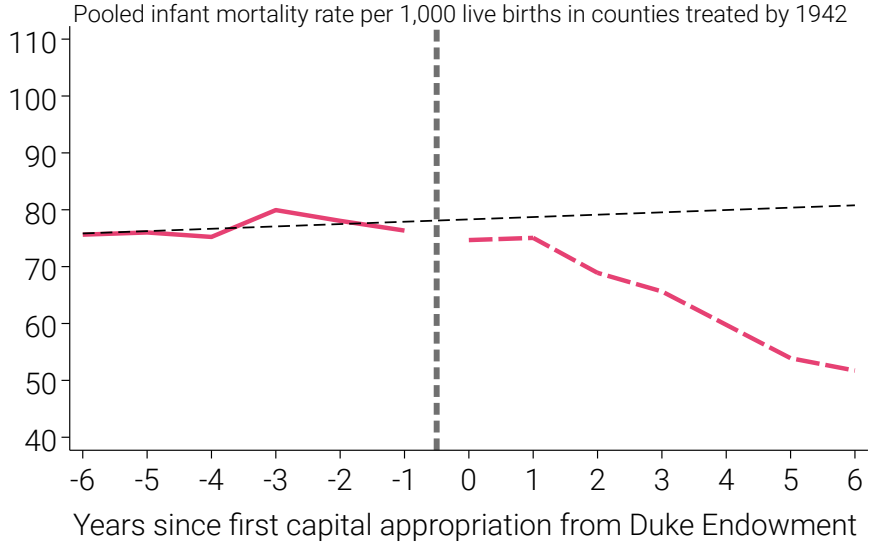
Treated counties saw greater improvements in infant mortality rate

Short-run mortality



Treated counties saw greater improvements in infant mortality rate

Short-run mortality



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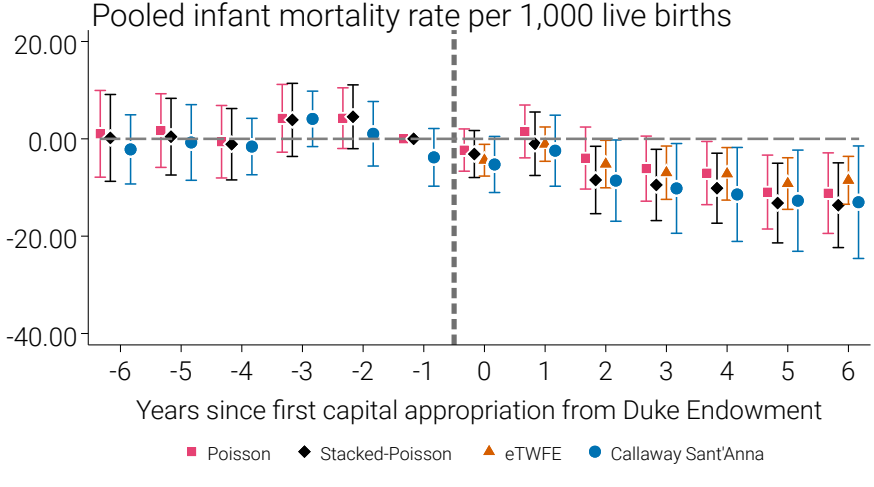

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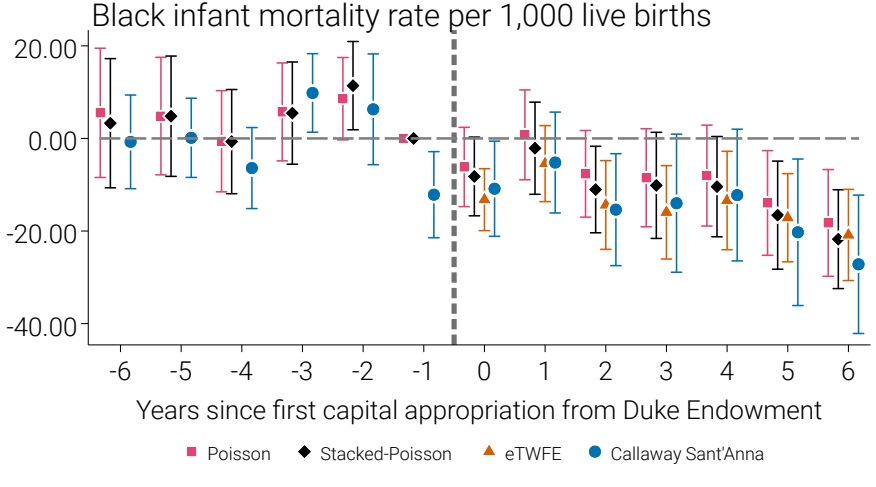

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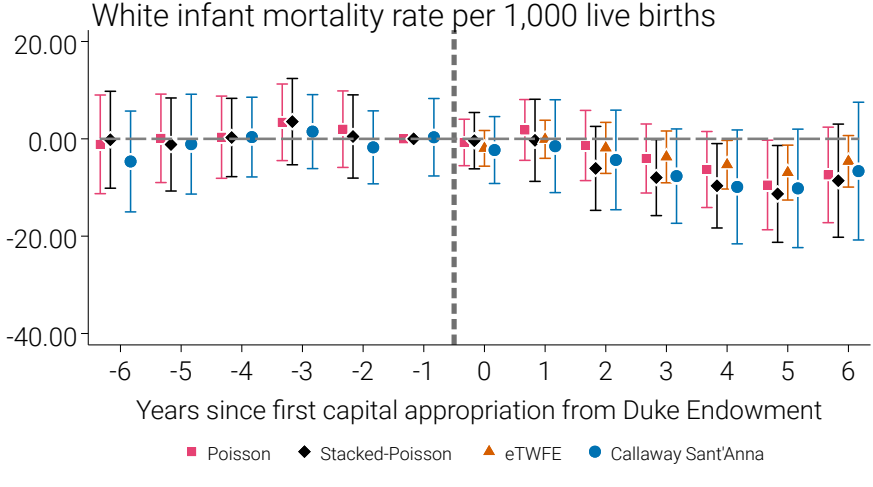
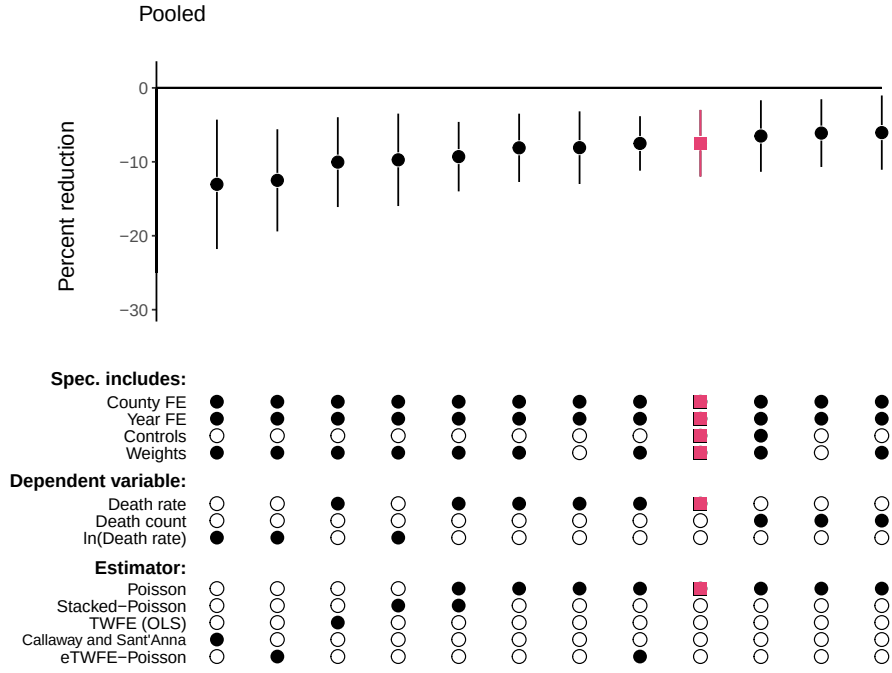
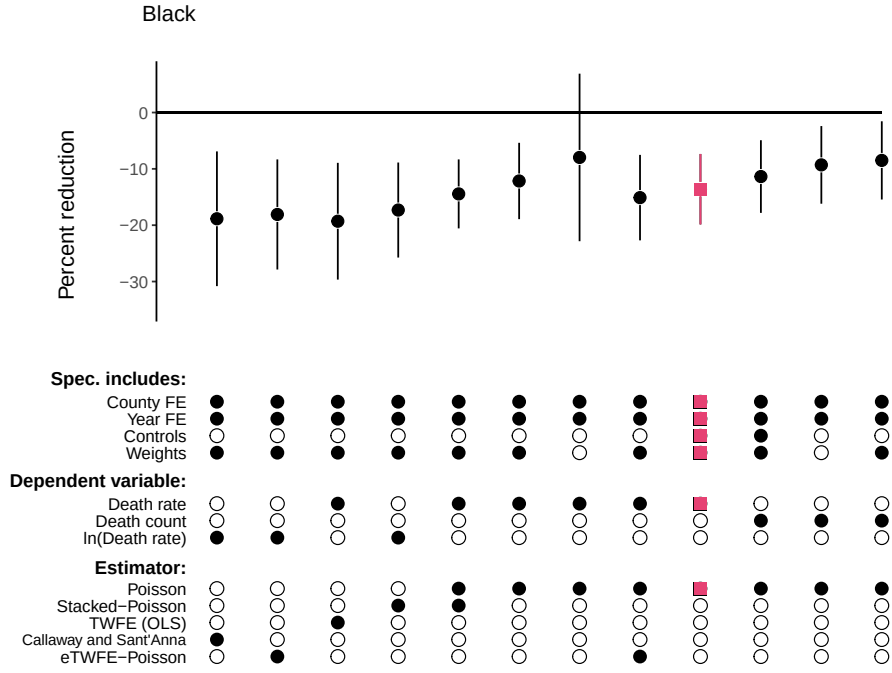


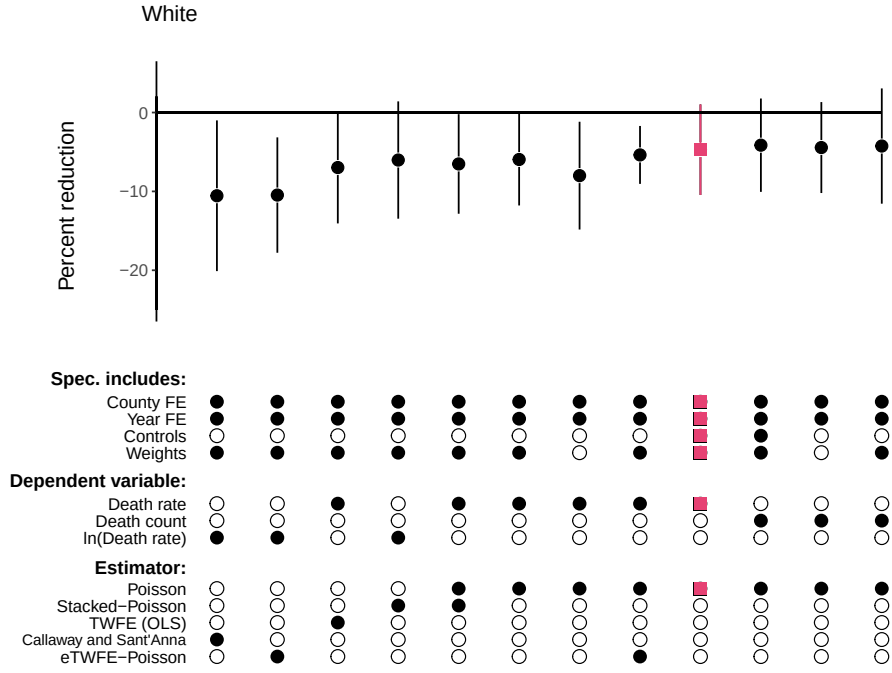
Point estimates: Pooled infant mortality



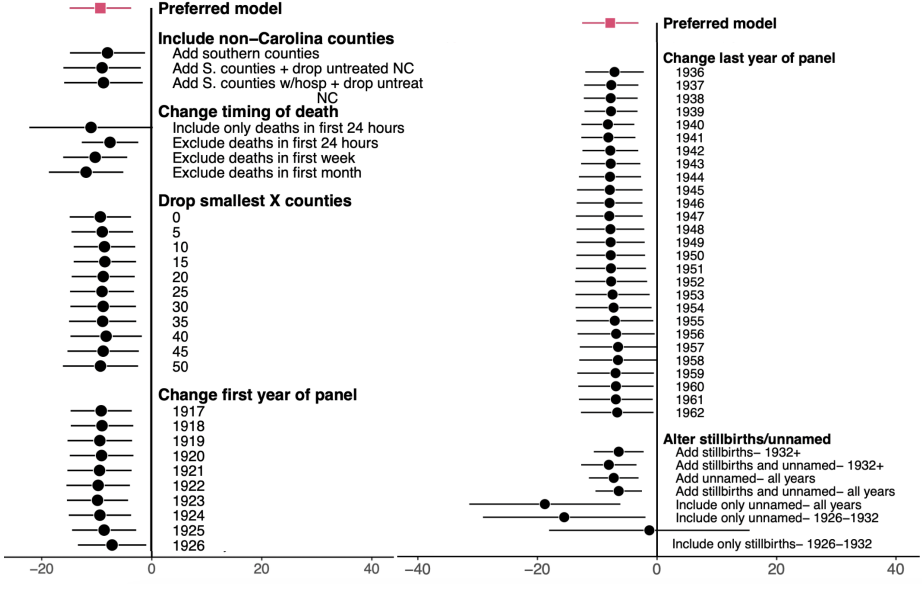
Point estimates: Black infant mortality



Point estimates: White infant mortality



Pooled point estimates: Changing sample

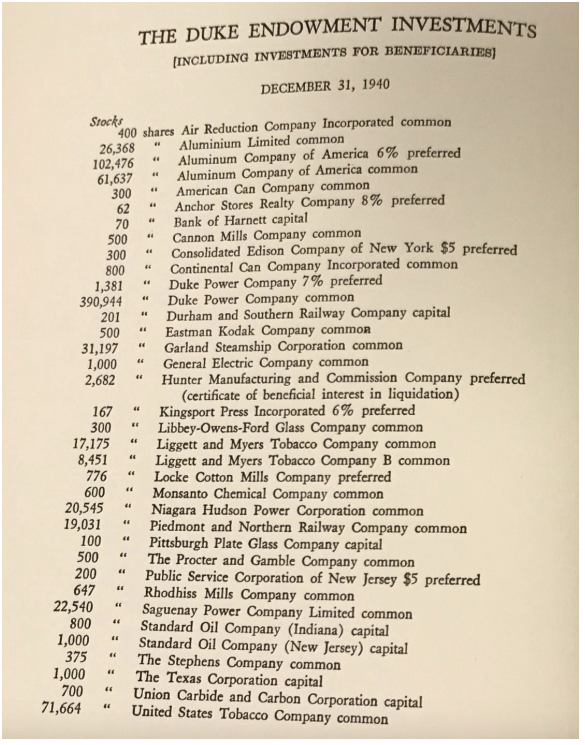


Instrumental variable specification

Instrumental variable

Results

- Some counties were ineligible for funding
  - Any county outside of North or South Carolina
  - Any county without a non-profit hospital
- In years where The Endowment earned more on the market, a larger share was available to disburse



THE DUKE ENDOWMENT INVESTMENTS

[INCLUDING INVESTMENTS FOR BENEFICIARIES]

DECEMBER 31, 1940

Stocks		
400	shares	Air Reduction Company Incorporated common
26,368	"	Aluminium Limited common
102,476	"	Aluminum Company of America 6% preferred
61,637	"	Aluminum Company of America common
300	"	American Can Company common
62	"	Anchor Stores Realty Company 8% preferred
70	"	Bank of Harnett capital
500	"	Cannon Mills Company common
300	"	Consolidated Edison Company of New York $5 preferred
800	"	Continental Can Company Incorporated common
1,381	"	Duke Power Company 7% preferred
390,944	"	Duke Power Company common
201	"	Durham and Southern Railway Company capital
500	"	Eastman Kodak Company common
31,197	"	Garland Steamship Corporation common
1,000	"	General Electric Company common
2,682	"	Hunter Manufacturing and Commission Company preferred (certificate of beneficial interest in liquidation)
167	"	Kingsport Press Incorporated 6% preferred
300	"	Libbey-Owens-Ford Glass Company common
17,175	"	Liggett and Myers Tobacco Company common
8,451	"	Liggett and Myers Tobacco Company B common
776	"	Locke Cotton Mills Company preferred
600	"	Monsanto Chemical Company common
20,545	"	Niagara Hudson Power Corporation common
19,031	"	Piedmont and Northern Railway Company common
100	"	Pittsburgh Plate Glass Company capital
500	"	The Procter and Gamble Company common
200	"	Public Service Corporation of New Jersey $5 preferred
647	"	Rhodhiss Mills Company common
22,540	"	Saguenay Power Company Limited common
800	"	Standard Oil Company (Indiana) capital
1,000	"	Standard Oil Company (New Jersey) capital
375	"	The Stephens Company common
1,000	"	The Texas Corporation capital
700	"	Union Carbide and Carbon Corporation capital
71,664	"	United States Tobacco Company common

Instrumental variable

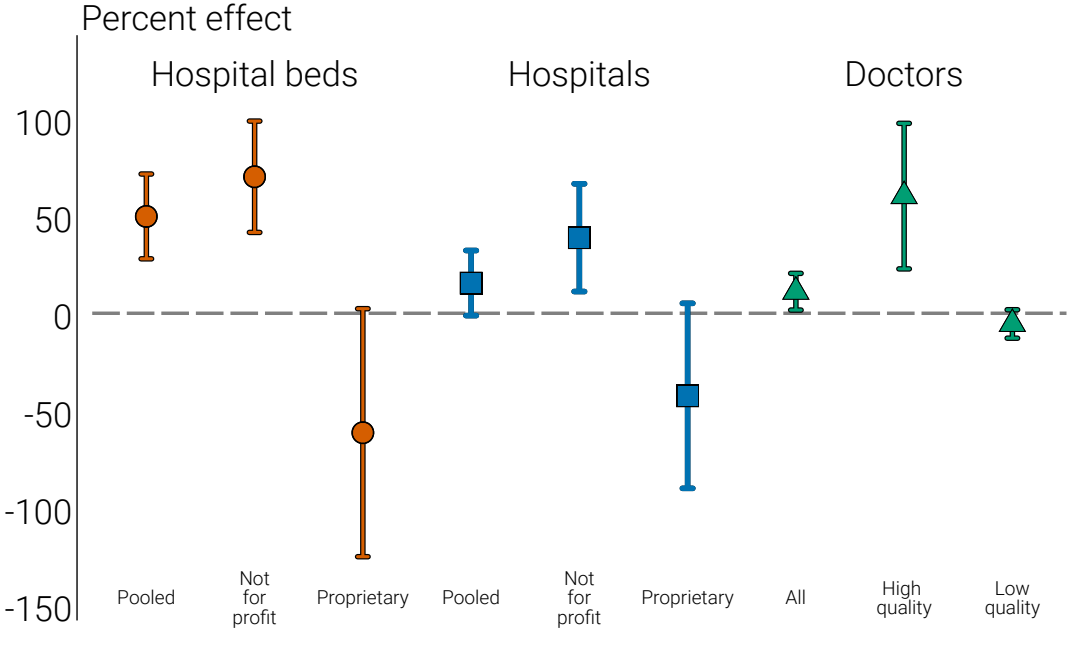
Results

Specification:	Poisson (1)	OLS (2)	Appropriations: First stage (3)	Appropriations: Reduced form (4)	IV (5)
Y_{ct}^{R}:	IMR	ln(IMR)	Appropriations	ln(IMR)	ln(IMR)
A. Southern counties with non-profit hospital (1922-1940)					
Percent effect from $1 million of Duke support	-7.84***	-7.28***			-14.58***
	(1.12)	(1.36)			(4.00)
Anderson-Rubin 95% Confidence Set					[-25.88, -6.52]***
tF 95% Confidence Interval					[-25.06, -2.65]**
(Endowment returns, billions) X 1(Non-profit hospital before Duke)			0.21***	-2.95***	
			(0.06)	(0.89)	
Observations	2,965	2,961	2,965	2,961	2,961
B. All NC counties (1922-1940)					
Percent effect from $1 million of Duke support	-6.92***	-6.77***			-17.42***
	(1.19)	(1.31)			(6.53)
Anderson-Rubin 95% Confidence Set					[-36.91, -5.08]**
tF 95% Confidence Interval					[-34.56, 4.20]
(Endowment returns, billions) X 1(Non-profit hospital before Duke)			0.18***	-3.06***	
			(0.05)	(1.11)	
Observations	1,900	1,900	1,900	1,900	1,900

Mechanisms

Changes in the quality and size of medical sector

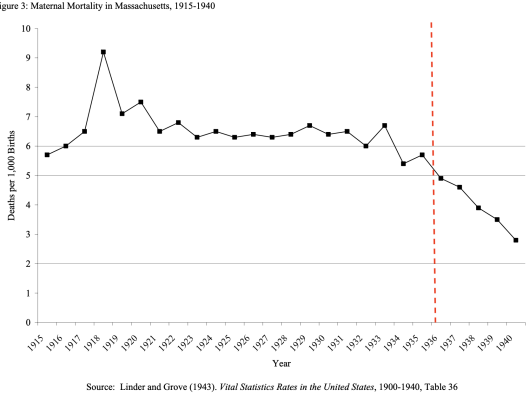
Effects on the medical sector



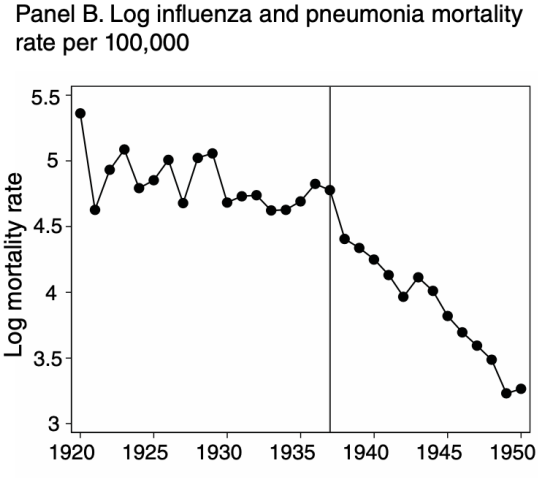
Complementarities between hospital funding and medical innovation

Advent of sulfa drugs affected mortality

Mechanisms



Thomasson and Treber (2004)



Jayachandran et al. (2010)

Larger effects of hospital funding after advent of sulfa drugs

Complementarities

Table 5. Interaction of rollout of Duke support and discovery of sulfa drugs

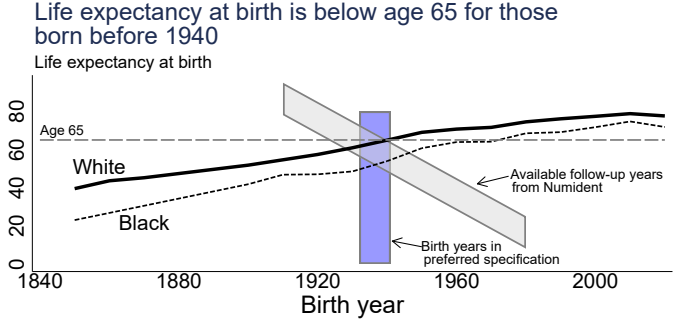
	Pooled	Black	White
	(1)	(2)	(3)
A. Interaction of Duke rollout × sulfa shift-share DiD			
Post-pre sulfa Pneumonia$_{.75}$ – Post-pre sulfa Pneumonia$_{.25}$ (γ_5)	−15.09***	−12.57*	−16.20***
	(4.94)	(6.54)	(5.32)
B. Duke vs. no Duke			
Post-Sulfa, Pneumonia$_{.75}$ $\gamma_1+\gamma_2+\eta_{.75}\times(\gamma_3+\gamma_5)$	−15.77***	−19.44***	−14.82***
	(3.96)	(5.58)	(4.07)
Post-Sulfa, Pneumonia$_{.25}$ $\gamma_1+\gamma_2+\eta_{.25}\times(\gamma_3+\gamma_5)$	1.51	−4.07	2.47
	(7.05)	(9.29)	(7.43)
Pre-Sulfa, Pneumonia$_{.75}$ $\gamma_1+\eta_{.75}\times\gamma_3$	−5.57**	−11.60***	−2.72
	(2.37)	(2.75)	(3.34)
Pre-Sulfa, Pneumonia$_{.25}$ $\gamma_1+\eta_{.25}\times\gamma_3$	−3.37	−7.96	−1.93
	(3.29)	(4.81)	(4.15)

Long-run mortality

Accounting for survival bias in our data

Long-run mortality

- Compare the death rate by **age later in life** by treatment status around birth
  - We have reliable data on mortality attached to county of birth from 1988 to 2005
  - Restrict to 1932 to 1941 cohorts
- Flexibly account for changing risk of mortality by age
  - Age of death FE
  - Poisson coefficients are interpreted as semi-elasticity



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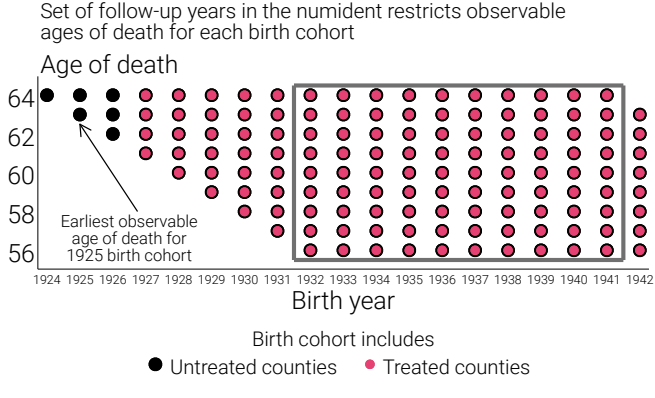
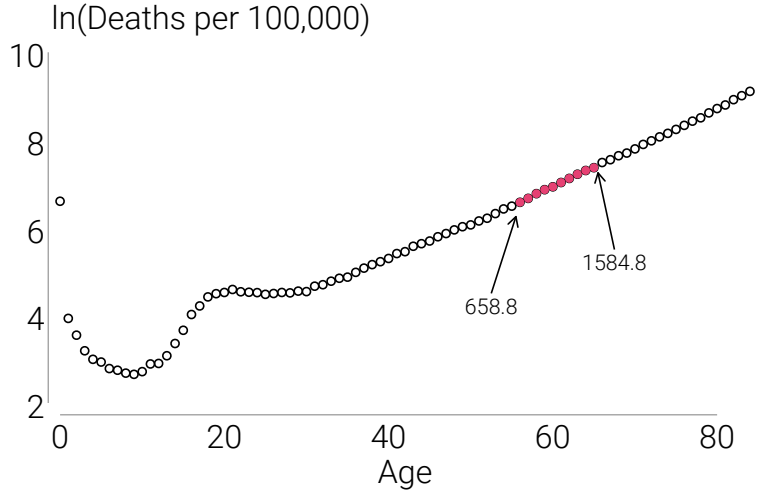


What does the death rate by age look like?

Long-run mortality

- Compare the death rate by **single year of age** by treatment at birth
- Flexibly account for changing risk of mortality by age
  - Age of death FE
  - Poisson coefficients are interpreted as semi-elasticity



Effect of duke endowment treatment at birth on mortality aged 56 to 65, conditional on living to age 55

Long-run mortality

	Y^R_{ct} = Long-run deaths		
	(1)	(2)	(3)
A. Pooled long-run deaths			
Percent effect from Duke (=1)	−7.66**	−10.07***	−8.99***
	(3.08)	(2.66)	(2.81)
Observations	9,000	9,000	9,000
B. Black long-run deaths			
Percent effect from Duke (=1)	−8.04**	−8.77***	−7.58**
	(3.57)	(2.80)	(3.54)
Observations	8,150	8,150	8,150
C. White long-run deaths			
Percent effect from Duke (=1)	−6.93*	−10.56***	−9.53***
	(3.83)	(2.92)	(2.86)
Observations	8,630	8,630	8,630
P-value for difference by race	0.82	0.61	0.63
County of birth X Age FE	Yes	Yes	Yes
Year of birth X Age FE	Yes	Yes	Yes
Weights	No	Yes	Yes
Controls	No	No	Yes

Conclusion

Conclusions

- Evidence that increased access to and quality of hospital care improves mortality outcomes
  - Economically large and significant effects for both short-run and long-run mortality
  - Almost three times the effect for Blacks vs. Whites for infant mortality
  - Even without advanced technologies it is possible to improve health
  - It is not solely money - rather it's money + reinforcing changes + oversight
    - BUT: the oversight was possible from private foundation with limited resources compared to the governments

- Mechanisms
  - Better and more accessible (via reduced financial pressure and lessened discrimination) hospitals
  - Plausibly improved working conditions attracted higher quality doctors
    - if you build it, and it's of good quality, they will come
  - Compounding role of technological change in gains from health care

Policy implications

- Our findings support the idea that bundling healthcare access with treatments such as changing management style and increasing oversight can have complementary effects
  - We expect to see larger and longer-lasting health improvements in developing countries when donations targeted for health infrastructure are accompanied by reinforcing policies and oversight.

- Private charitable funding can represent a blueprint for future public expenditures

- Potential costs of opening closing hospital/clinic today and the importance of attracting physicians to practice to underserved communities.

- Our findings are NOT about marginal dollar in today's setting, but speak to marginal health care when alternative is zero healthcare.

Thank you!

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