Physician financial incentives and caesarean section delivery

(Gruber & Owings, 1996)

Presentation by: Swati Asnani

September 24, 2020

Introduction

- Central feature of medical marketplace is the agency relationship between physicians and patients.
- Physicians are **induced** to provide excess care to patients to maintain their incomes in face of negative income shocks.
- Modeled as **'induced demand model'** in health literature.

Motivation

- Impact on policy making
  - Important for design of private-sector insurance policies and optimal government response to rising medical costs.
- Financial environment of gynecologists/obstetricians in 1970-1982 era
  - Fall in fertility of 13.5 percent in the period of 1970-1982 led to a shift from normal child births to more cesarean deliveries.

Contribution

Traditional tests considered the impact of following changes in the inducement model:-

- Reduction in fee paid to physicians
- Variation in physician density across areas

Difficult to identify inducement due to either contemporaneous change in demand or due to unobserved area characteristic.

Contribution

- This paper proposes a new means of identifying the effect of induced demand on procedure utilization.
- Exploits an exogenous change in the financial environment of obs/gyn during 70's : **Declining fertility in the United States**

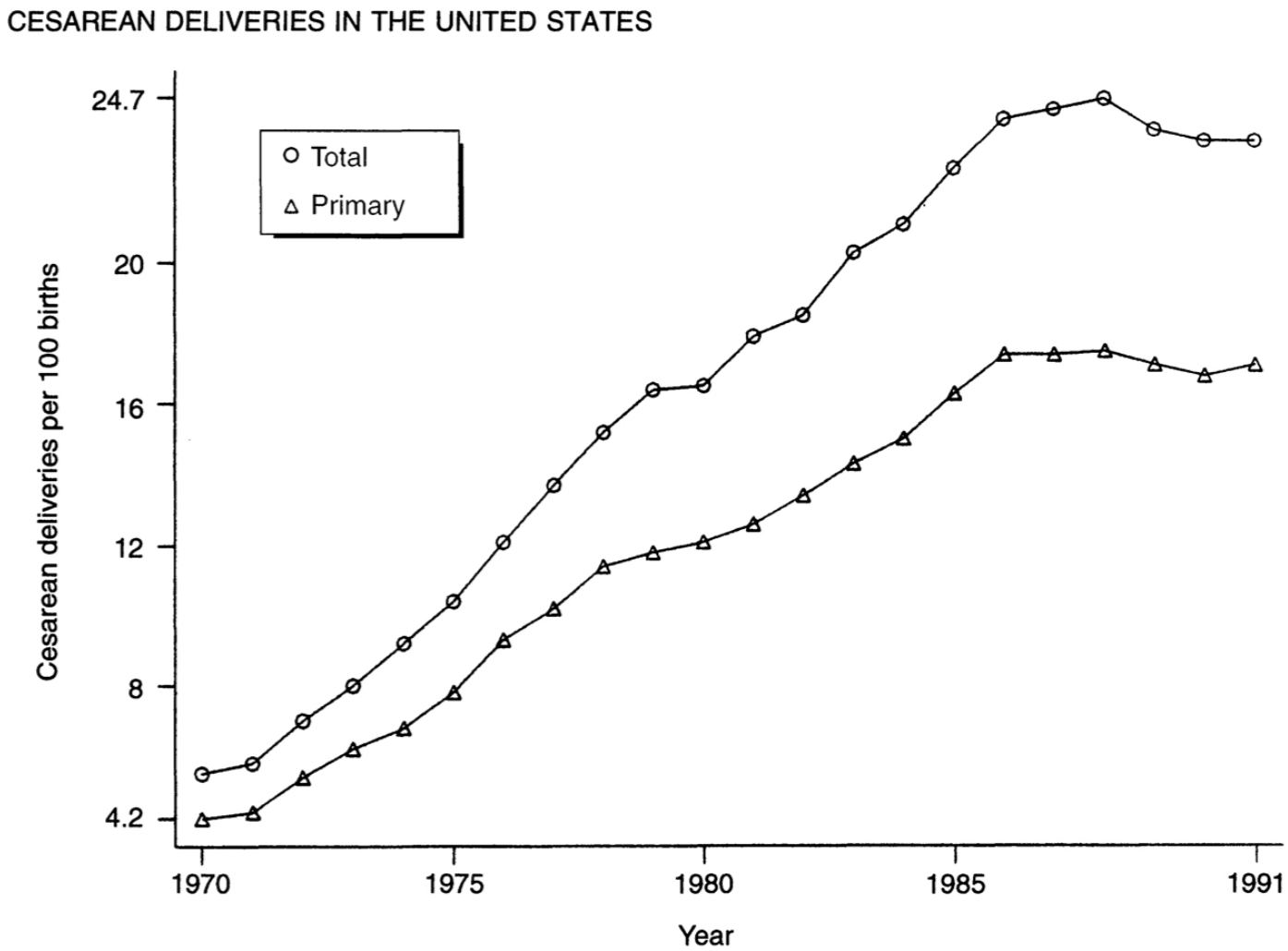
Primary goal and Research question

Primary goal: Test for a causal role of financial incentives in the use of cesarean delivery in the period of 1970-1982.

- Done by exploiting the change in fertility patterns across the US states.
- Statewide fertility change provides an exogenous measure of financial pressure on obs/gyns in that state.

In the states where fertility was falling the most in the period of 1970-1982, did cesarean delivery rise the most?

Background on cesarean delivery



Potential causes of the rise in cesarean delivery

- Most cited explanations:
  1. Introduction of technology to diagnose fetal distress
  2. Threat of malpractice suit to the physicians
  3. Efficient and can be scheduled in advance
  4. Financial incentives: Differential insurance coverage for C-sections and normal delivery

Findings

- **No consensus view** as to the cause of this rapid increase.
- Financial incentives as the cause:
  - High reward from C-section on the privately insured
  - Can't draw causal inference it causes rise in C-sections. (eg. birth severity condition of the privately insured)
- High obs/gyn density in some areas as the cause:
  - Data shows no such evidence.

Consequences of C-section diffusion

1. Physiological costs
   - Maternal mortality is 2 to 4 times higher for cesarean than for normal.
   - More risk of infections.
   - Adverse effects on infants. (eg. respiratory issues)
2. Financial costs
   - In 1989, total cost of C-section was 66 percent higher than normal.
   - Total 93,80,000 C-sections in the U.S. in 1989.
   - Huge increase in medical spending.

Induced demand: Theory and Evidence

An inducement model

- Building block: Physicians are agents of uniformed patients.
- Determine the demand of their product.

Physicians' utility depends on :

- income and leisure
- **"appropriate amount of care":** Enters through physicians' "internal conscience" (McGuire and Pauly,1991) or through reputation process (Dranove,1988)

Theory and Assumptions

When there is a deviation from a treatment level that equates marginal benefits and costs to a patient, it is defined as inducement (Fuchs,1978)

Natural Implication of inducement model

- Fall in birth rates $\Longrightarrow$ highly reimbursed C-sections.

Assumptions

- Number of births given to obs/gyns.
- Only margin for inducement is to shift from normal to cesarean.

Theory and Assumptions

Utility function of obs/gyns: $U = U(Y, I)$

- Y : Full income - forgone leisure
- I: Extent of "inducement" that causes physician disutility through "conscience" or "demand reduction" channel.
- $U_Y > 0, U_I < 0, U_{YY}, U_{II} < 0$
- Number of births: B
- Level of inducement per birth is i
- $I = Bi$
- Fraction of cesarean deliveries: $a(i), a' > 0$

Theory and Assumptions

Budget constraint:

- $Y = Y_n N + Y_c \mathrm{C}$
- $C = Ba(i)$
- $N = B(1 - a(i))$ where N: number of normal births

  C: number of cesarean births

  Y_n: Full income from normal delivery

  Y_c: Full income from cesarean delivery

- Assume: $Y_c > Y_n$

Physician type, mobility and entry

Assumptions:

- All births are delivered by obs/gyns and only a nontrivial share by other practitioners.
- Obs/gyns are immobile across different states.

Entry into the obstetrics/gynaecology

- Continued during the era of fertility decline.
- Suggests relative rewards in the field as compared to other medical professions.

Induced demand: Preview of findings

Fee reductions

- Rice's(1984) study showed that a 10 percent decline in physician reimbursements led to 6.1 percent increase in the intensity of medical services.

- A similar study by Hurley, Labelle and Rice(1990) found mixed responses to fee changes across procedures.

Induced demand: Preview of findings

Variations in physician density across areas

- In Fuchs(1978), evidence of use of surgery in response to increase in surgeons.
- Birch(1988) and Grytten, Holst, and Laake(1990) found string positive relationship between dentists per capita and utilization of dental services.

These methodologies faced identification problems.

Data

Primary data source:

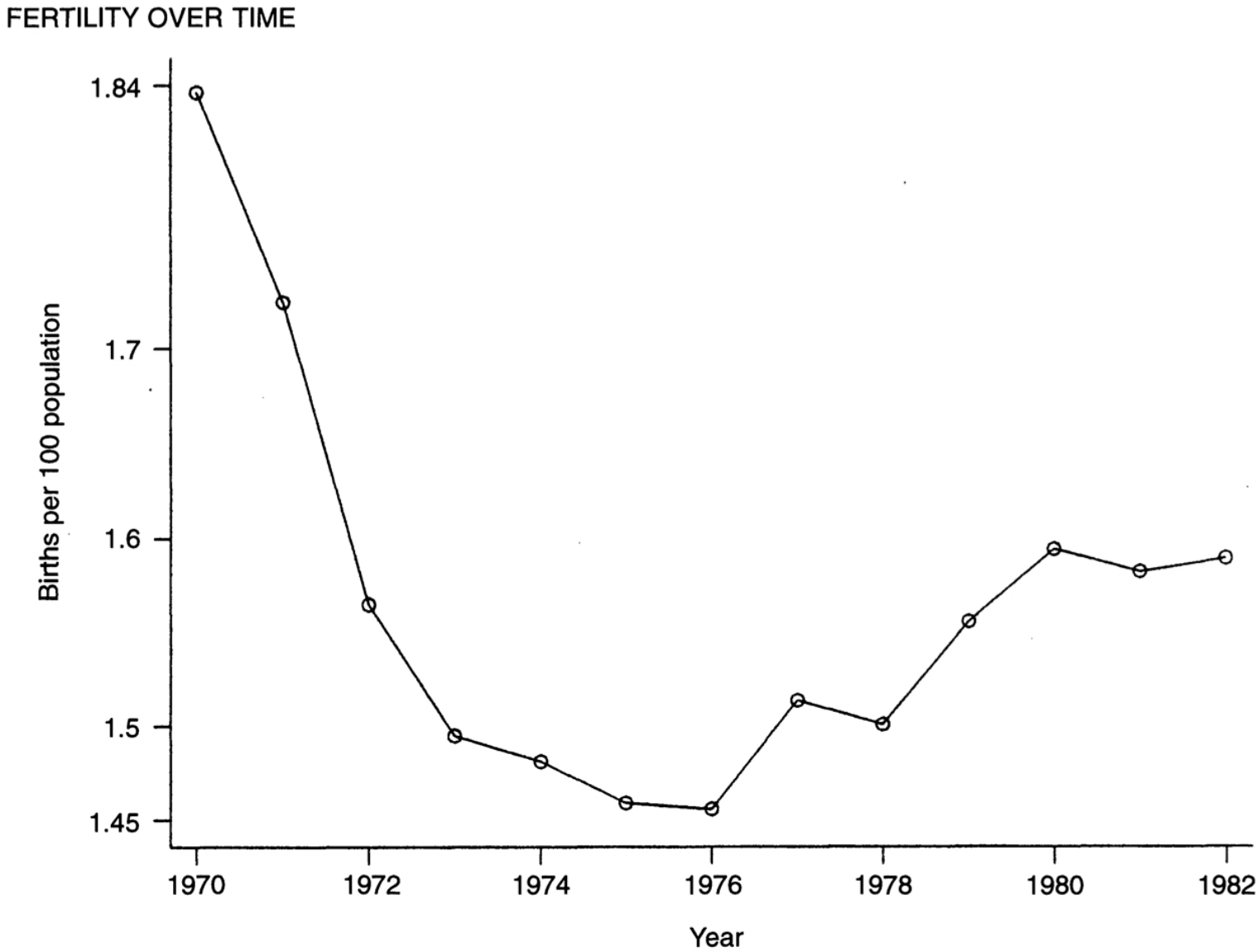
- National Hospital Discharge Survey (NHDS) conducted annually since 1965 by NCHS
- Survey of over 400 hospitals and 200,000 discharges in each year.
- Used information of patients with a primary diagnosis of childbirth in 1970-82.
- Final sample consists of 250,000 births.
- Data augmented with state identifiers, based on given hospital regions.

TABLE 1 Means of the Dataset

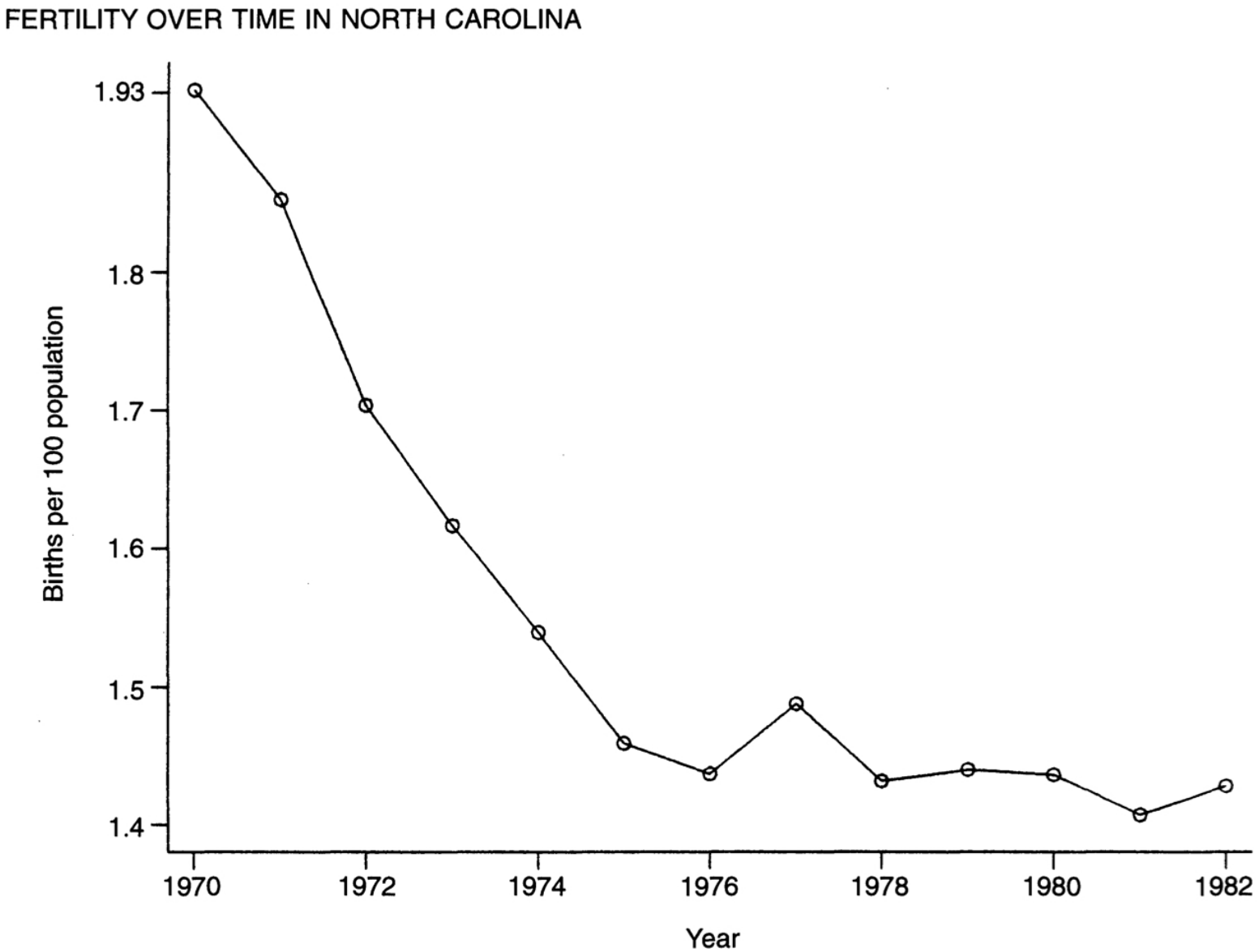
	All Births	No C-Section	C-Section
Cesarean delivery	.119	0	1
Age <20	.177	.183	.134
Age 20–25	.341	.346	.308
Age 25–30	.296	.293	.321
Age 30–35	.132	.128	.165
Age 35–40	.041	.039	.055
Age 40–45	.010	.009	.014
Age 45+	.002	.002	.003
Married	.793	.792	.798
White	.693	.692	.698
Black	.163	.163	.167
Number of beds	360.5 [301.2]	356.8 [302.5]	388.2 [389.4]
For-profit	.035	.035	.041
Government	.261	.264	.237
Previous cesarean	.035	.001	.286
Breech presentation	.028	.017	.107
Fetal distress	.045	.015	.272
Maternal distress	.022	.014	.083
Other complications	.329	.305	.509
Ob/gyns per 100 births	.621 [.248]	.614 [.246]	.671 [.261]
Ob/gyns per 100 population ($\times 10^2$)	.954 [.304]	.946 [.301]	1.020 [.319]
Births per 100 population	1.59 [.23]	1.60 [.24]	1.57 [.23]
Number of observations	255,593	225,202	30,391

Notes: Data from the NHDS dataset and other sources are described in the text. Standard deviations are in square brackets.

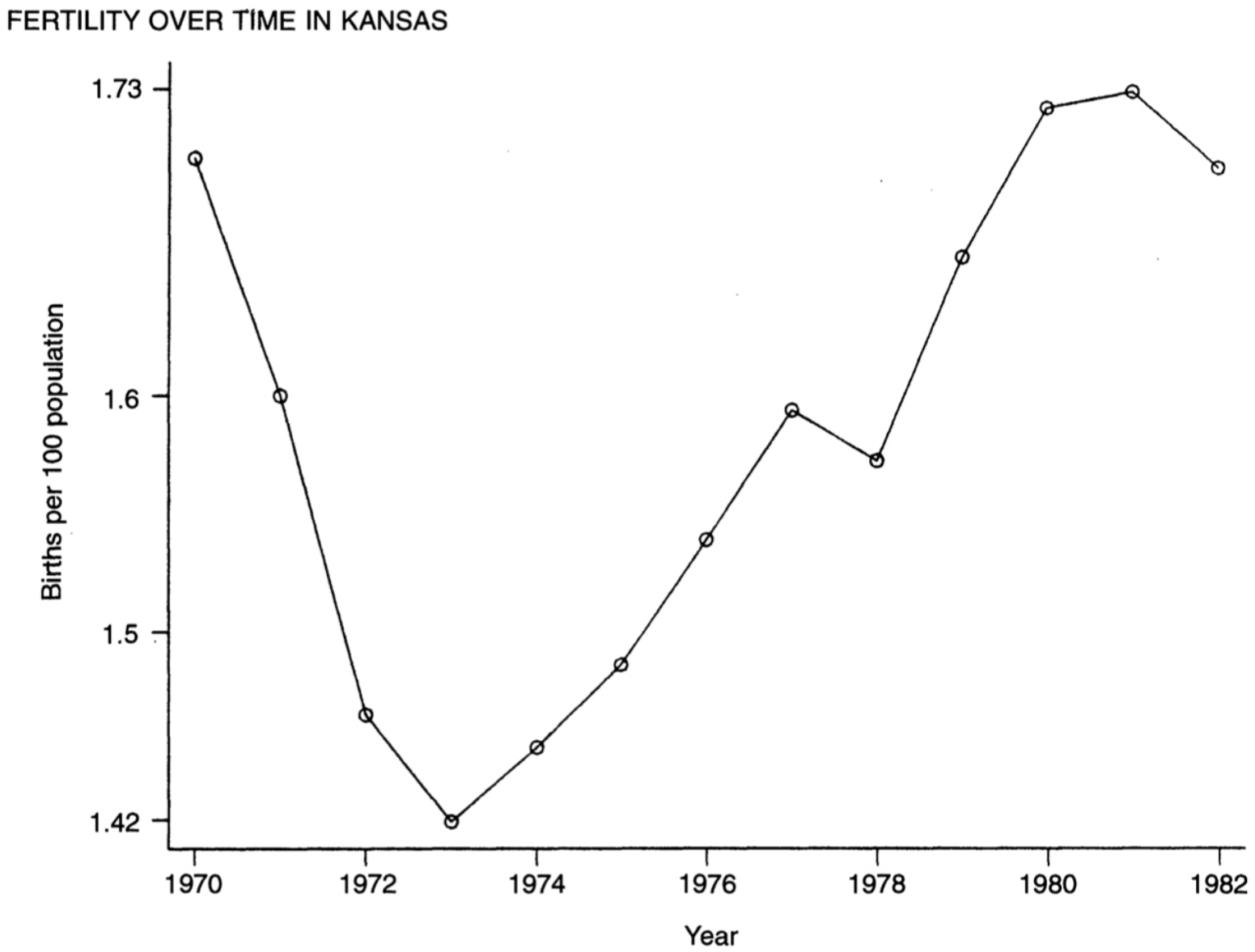
Average fertility rate, births per 100 population from 1970-82



Fertility changes within North Carolina from 1970-82



Fertility changes within Kansas from 1970-82



How large is the financial incentive arising from these differential fertility changes?

- Half of ob/gyn income is from obstetrics.
- Fertility fell by 13.5 percent nationally during the 1970-82 period.
- Assuming no behavioural response,the implied fall in ob/gyn income is 6.75 percent, which is nontrivial.

Empirical framework

Specification 1: with LOBKID as an exogenous variable

$$CSEC_{ihjt} = f(\alpha + \beta_1 X_{ihjt} + \beta_2 PREV_{ihjt} + \beta_3 Z_{hjt} + \beta_4 LOBKID_{jt} + \beta_5 \delta_j + \beta_6 \tau_t + \epsilon_{ihjt}),$$

- $CSEC_{ihjt} = 1$ if individual i in hosp h in state j in year t got a C-section, otherwise zero
- X: set of individual demographic characteristics
- PREV: an indicator for previous cesarean delivery
- Z: set of hospital characteristics

Empirical framework

Specification 1: with LOBKID as an exogenous variable

$$CSEC_{ihjt} = f(\alpha + \beta_1 X_{ihjt} + \beta_2 PREV_{ihjt} + \beta_3 Z_{hjt} + \beta_4 LOBKID_{jt} + \beta_5 \delta_j + \beta_6 \tau_t + \epsilon_{ihjt}),$$

- LOBKID: log of the number of ob/gyns per birth in a state
- δ_j: full set of state dummies
- τ_t: full state of year dummies

Drop LOBKID due to identification problem. There may be a hidden area characteristic like average coinsurance rate.

Empirical framework

Specification 2: with LFERT as an exogenous variable

$$CSEC_{ihjt} = f(\alpha + \beta_1 X_{ihjt} + \beta_2 PREV_{ihjt} + \beta_3 Z_{hjt} + \beta_4 LFERT_{jt} + \beta_5 \delta_j + \beta_6 \tau_t + \epsilon_{ihjt}),$$

- LFERT: log of the state/year fertility rate (births per 100 population)
- Identify the effect of financial pressure solely from changes in fertility.
- Normalize births by population, as pop growth is an exogenous indicator of trend growth in ob/gyns density.

TABLE 2 **Basic Regression Results**
Dependent Variable is a Dummy for Cesarean Delivery

	(1)	(2)	(3)	(4)
Log ob/gyn per 100 births	.578			
	(.126)			
Log fertility (births per 100 population)		−.888	−.923	
		(.202)	(.201)	
Log ob/gyn per 100 population		.342		.410
		(.174)		(.174)
Age 20–25	.001	.001	.001	.001
	(.022)	(.022)	(.022)	(.022)
Age 25–30	.081	.081	.082	.082
	(.023)	(.023)	(.023)	(.023)
Age 30–35	.153	.153	.153	.154
	(.027)	(.027)	(.027)	(.027)
Age 35–40	.419	.418	.418	.419
	(.037)	(.037)	(.037)	(.037)
Age 40–45	.616	.616	.616	.615
	(.065)	(.065)	(.064)	(.064)
Age 45+	.341	.341	.342	.342
	(.143)	(.143)	(.143)	(.143)
Married	.018	.019	.019	.018
	(.020)	(.020)	(.020)	(.020)
White	.025	.026	.026	.024
	(.022)	(.022)	(.022)	(.022)
Black	−.003	−.003	−.003	−.004
	(.030)	(.030)	(.030)	(.030)
Previous cesarean	5.760	5.761	5.761	5.760
	(.064)	(.064)	(.064)	(.064)
Number of beds ($\div 10^3$)	.263	.264	.263	.264
	(.025)	(.025)	(.025)	(.025)
For-profit	.091	.092	.094	.093
	(.039)	(.039)	(.039)	(.039)
Government	−.197	−.198	−.198	−.197
	(.020)	(.020)	(.020)	(.020)

Notes: Standard errors are in parentheses. Regressions are run as logits. All regressions include a full set of state and year dummies. N = 255,593.

Basic results

- Findings support the hypothesis that ob/gyns responded to falling fertility in this era by performing more cesarean deliveries.
- Results are a striking evidence for inducement.

Robustness checks: Inclusion of birth severity and order controls

Inclusion of birth risk factors:

- Neonatal mortality, Low birthweight, High birthweight

Inclusion of diagnosis indicators

- Breech presentation, Fetal distress and maternal distress, other complications

Inclusion of birth order controls

- First order, Fifth order

These data are reported by state and year in Vital Statistics(U.S. DHHS)

Specification checks: Birth Severity and Birth Order

TABLE 3 Specification Checks: Birth Severity and Birth Order

Dependent Variable	(1) Cesarean	(2) Cesarean	(3) Fetal Distress	(4) Maternal Distress	(5) Cesarean
Log fertility	−.934	−1.015	−.695	−.951	−.883
	(.205)	(.250)	(.274)	(.347)	(.211)
Neonatal mortality	−.018	.015	−.031	.022	−.019
	(.012)	(.015)	(.016)	(.023)	(.014)
Low birthweight (<2,500 grams)	14.12	7.152	7.654	13.50	15.52
	(4.671)	(5.713)	(6.213)	(8.388)	(4.706)
High birthweight (>4,200 grams)	12.10	18.65	.674	−3.131	12.32
	(7.481)	(9.173)	(9.691)	(13.48)	(7.505)
Previous cesarean	5.761	7.421	−.483	−.476	5.761
	(.064)	(.066)	(.060)	(.088)	(.064)
Breech presentation		2.951			
		(.032)			
Fetal distress		4.368			
		(.028)			
Maternal distress		2.001			
		(.037)			
Other complications		1.997			
		(.021)			
Fraction 1st births					.500
					(.652)
Fraction 5th or more births					−.722
					(1.570)

Notes: Standard errors are in parentheses. All regressions include the set of regressors presented in Table 2, along with a full set of state and year dummies. All regressions are run as logits. $N = 255{,}593$.

Robustness checks

Checking for state outliers:

- Removal of five states with largest fertility fall and largest fertility rise
- Correlation between fertility and cesarean delivery was found to be robust.

Checking for insurance coverage information:

- We include the data on payer source for the period from 1977 to examining the effect of omitting insurance type from our regression.
- Data missing before 1977 (Threat)

Specification checks: Payer status

TABLE 4 Specification Checks: Payer Status

	Log Fertility	Private Pay	Uninsured	Private Pay × Log Fertility	Uninsured × Log Fertility	Severity Controls?
(1)	−.901					No
	(.430)					
(2)	−.967	.159	−.016			No
	(.431)	(.027)	(.034)			
(3)	−.830	.088	−.057			Yes
	(.548)	(.034)	(.043)			
(4)	−.855	−.839	.966	−.240	.239	No
	(.452)	(.719)	(.956)	(.172)	(.231)	
(5)	−.758	−1.190		−.326		No
	(.440)	(.590)		(.142)		
(6)	−.989		1.523		.398	No
	(.432)		(.792)		(.191)	
(7)	−.574	−1.893	1.241	−.476	.318	Yes
	(.574)	(.891)	(1.187)	(.213)	(.289)	
(8)	−.463	−2.249		−.568		Yes
	(.560)	(.736)		(.177)		
(9)	−.914		2.594		.657	Yes
	(.549)		(.989)		(.240)	

Notes: Standard errors are in parentheses. All regressions include the set of regressors presented in Table 2, along with a full set of state and year dummies. All regressions are run as logits, for the 1977–1982 period only. Dependent variable is a cesarean section dummy. Severity controls are the four diganosis indicators used in Table 3. $N = 114{,}917$.

Is there any asymmetric response to fertility change?

- If the fertility rate rises, will there be a switch from cesarean to normal deliveries?
  - Accepted mode of delivery for a given type of birth
  - Evolution of malpractice rules

Asymmetric response of the use of cesarean delivery to rising and falling fertility rates

- Create for each state two subperiods: a "falling" period and a "non falling" period.
- Tratement of "turning point"

$$CSEC_{ihjt} = f(\alpha + \beta_1 X_{ihjt} + \beta_2 PREV_{ihjt} + \beta_3 Z_{hjt} + \beta_4 FALL_{jt} + \beta_5 FERT_{jt} + \beta_6 FERT_{jt} XFALL_{jt} + \beta_7 \delta_j + \beta_8 \tau_t + \epsilon_{ihjt}),$$

- FALL: dummy that equals 1 if state "j" is in the falling sample in year t, otherwise zero
- β_6: differential effect of fertility on cesarean delivery in the period when fertility is falling
- β_5: equal to previous estimates when symmetric effect
- β_6: 0 if symmetric response

Specification check: Asymmetric response

TABLE 5 **Asymmetric Response?**

Treatment of Turning-Point Year	(1) Include in Fall	(2) Include in Rise	(3) Drop
Log fertility	−.929	−.874	−.881
	(.202)	(.207)	(.212)
Falling?	.234	−.029	−.005
	(.580)	(.634)	(.650)
Fertility × falling	.055	.002	.003
	(.137)	(.150)	(.153)
Number of observations	255,593	255,593	236,950

Notes: Standard errors are in parentheses. All regressions include the set of regressors presented in Table 2, along with a full set of state and year dummies. All regressions are run as logits. Dependent variable is a cesarean section dummy. Regression specification is equation (7) in text.

Results

- No asymmetric response.
- Response to fertility is equally strong in the period when fertility is rising and falling.

Conclusion

- Demonstration that cesarean utilization was quite responsive to financial incentives.
- Although the magnitude of this response is fairly small.
- Response to fertility is equally strong in the period when fertility is rising and falling.

Beyond the scope of the paper

- Similar tests could be carried out for more expensive medical technologies.
- General sense in the medical literature, cesarean levels are "too high". Little evidence on its benefits.