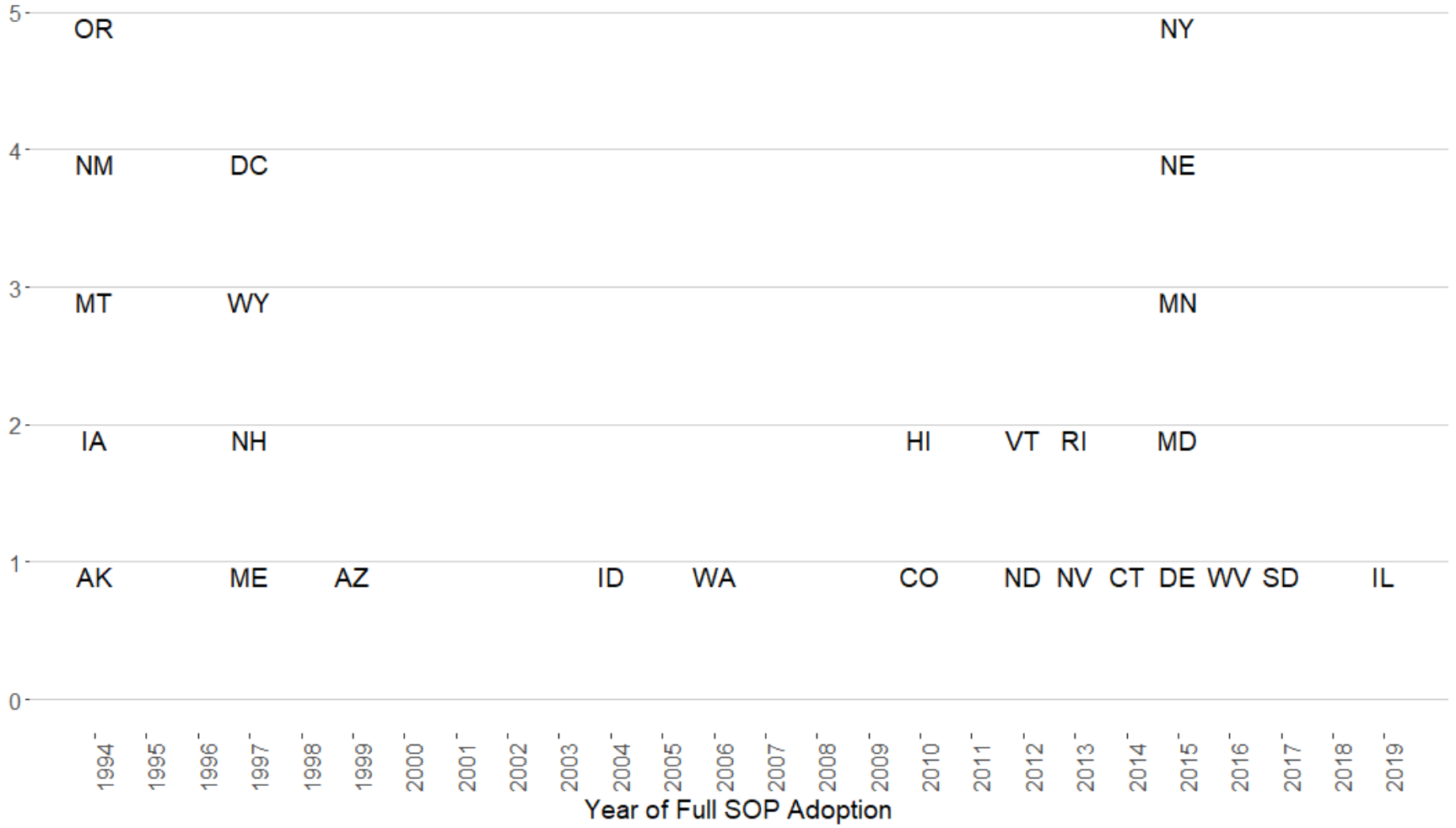
Occupational Regulations and the Nursing Pipeline

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Nurse Practitioner Scope of Practice Reforms 1994 to 2019



How does SOP reform affect the health sector?

Raises the wages and hours worked of NPs, probably because they are more productive and more in demand.

Kleiner et al 2013; Luo et al 2021; Markowitz and Adams 2022;

Increases job postings for NPs and reallocates NPs across employer types, including more self-employment.

Dillender et al 2024

Increases health care utilization

Kleiner et al 2013; Poghosyan et al 2019; Traczynski and Udalova 2018

These changes are real…but kind of small

Markets allocate existing health care workforce more efficiently:

- MDs, NPs, Nurses can do different tasks and types of work
- NPs may be end up in firms or work environments with less supervision
- Wage changes may lead workers to change allocation of time across work vs leisure

In a sense, efficiency gains are a boost in the supply of health care providers.

But does SOP reform actually boost the number of Nurses and Nurse Practitioners?

How to measure extensive margin labor supply to an occupation?

Unit of analysis is state-year college graduation cohort.

Measure how many people from each cohort obtain a first undergraduate degree in nursing.

Staggered adoption event study design to estimate causal effects of state scope of practice reforms (NP independence) on supply of workers to to the nursing pipeline.

Data - American Community Survey

2009-2019 waves of ACS collects undergraduate degree major from respondents with a college degree.

Also contains information on state of birth and year of birth.

Goal: Combine the ACS waves to construct a data set on cohort level labor supply to nursing occupation.

People working as RNs and NPs mostly have undergraduate degrees in nursing.

Table 1: College Majors of Registed Nurses in the 2009-2019 ACS

		RNs		NPs	
Major	Total Number of Majors	Number of Majors Working as RNs	Share of all RNs	Number of Majors Working as NPs	Share of all NPs
	(a)	(b)	(c)	(d)	(e)
Nursing	303,826	159,990	72.4%	11,631	71.1%
Psychology	337,776	6,059	2.7%	528	3.2%
Biology	248,857	5,665	2.6%	711	4.3%
Business Management	480,516	2,947	1.3%	123	0.8%
General Business	313,854	2,005	0.9%	112	0.7%
General Education	302,232	1,968	0.9%	119	0.7%
General Science	58,153	1,890	0.9%	141	0.9%
English Literature	249,628	1,729	0.8%	150	0.9%
Elementary Education	337,849	1,713	0.8%	102	0.6%
Health and Medical Administrative Services	22,473	1,492	0.7%	96	0.6%
All other majors		35,480	16.1%	2,635	16.1%
Total		**220,938**	**100%**	**16,348**	**100%**

Notes: This table presents the top ten college majors of individuals working as RNs in the 2009-2019 American Community Survey – with the largest majors coming first.

Vertically concatenate the 2009-2019 ACS data into one large file.

Use $i = 1 \ldots N$ to index individual respondents in the stacked file

SOB_i is the person's state of birth

$CGY_i = YOB_i + 24$ is expected college graduation year

UGN_i is a dummy set to 1 if the person has an undergraduate degree in nursing, 0 otherwise.

Cohort Supply Index

$N_{st} = \sum_i 1(s(i) = s) \times 1(CGY_i = t) \times 1(UGN_i = 1)$ is the number of people in the 2009-2019 ACS who graduated with an undergraduate nursing degree back in year t.

Our labor supply index is the log of the number of ACS nursing graduates $\mathrm{Y_{st}} = \ln(N_{st} + 25)$.

Note: small changes in N_{st} lead to big changes in $\ln(N_{st})$ when N_{st} is small. To stabilize, we add 25 to every state x year count.

Staggered Treatment Adoption

Adoption Year	States
1994	AK, IA, MT, NM, OR
1997	ME, NH, WY, DC
1999	AZ
2004	ID
2006	WA
2010	CO, HI
2012	ND, VT
2013	NV, RI
2014	CT
2015	DE, MD, MN, NE, NY
2016	WV
2017	SD
2019	IL

Potential Outcomes for Staggered Adoption

Let A_s be the year that state s reforms its SOP laws to allow NPs to practice independently.

$Y_{st}(0)$ is the log number of people who obtain nursing degrees in state s in year t if the state never allows NP practice independence.

$Y_{st}(a)$ is the log nursing graduates from state s in year t if the state grants NP independence in year a.

Causal effects with Simple DID

$\beta_{st}(a) = Y_{st}(a) - Y_st(0)$ is the causal effect of granting NP independence in year a in year t and state s.

Simple DID of adoption at a evaluated at a:

$$DID(a,a) = E\left[Y_{sa} - Y_{s,a-1} \middle| A_s = a\right] - E[Y_{sa} - Y_{s,a-1} | A_s = Never]$$

Under common trends and No-Anticipation:

$$DID(a) = E[\beta_{sa}(a) | A_s = a] = ATT$$

Event Study

Keep the base period fixed at the period before adoption, $a-1$

Move the focal period forward and backward in event time.

Simple DID of adopting at a evaluated at $a+e$

$$DID(a, a+e) = E\left[Y_{s,a+e} - Y_{s,a-1} \middle| A_s = a\right] - E\left[Y_{s,a+e} - Y_{s,a-1} | A_s = Never\right]$$

Use negative e to investigate pre-treatment effects, positive e to investigate treatment effect dynamics

Stacked event study

Rather than estimate each sub-experiment effect at a time, we used a stacked event study estimator

Build a separate sub-experiment for each policy change. Use never treated states as controls.

Vertically concatenate the collection of sub-experimental datasets.

Impose inclusion criteria to create balanced panel. (We have not done that here, yet.)

Stacked Event Study Regression

$$Y_{ase} = \sum_{h=-6\ldots9} (D_{sa} \times 1(e = \mathrm{h}))\beta_h + b_e + m_s + e_{ase}$$

To improve precision, we pool two years for each event time: [-6,-5], [-4,-3], [-2,-1], [0,1], [2,3], [4,5], [6,7], [8,9]

β_h is an average of group-time ATTs at each event time.

Note – impose trimming rules to keep composition fixed

The Plan – Main Results

1. Effects of NP Independence on log number of nursing majors.

2. Effects of NP Independence on log number of nursing majors who obtain a graduate degree – suggesting NP training.

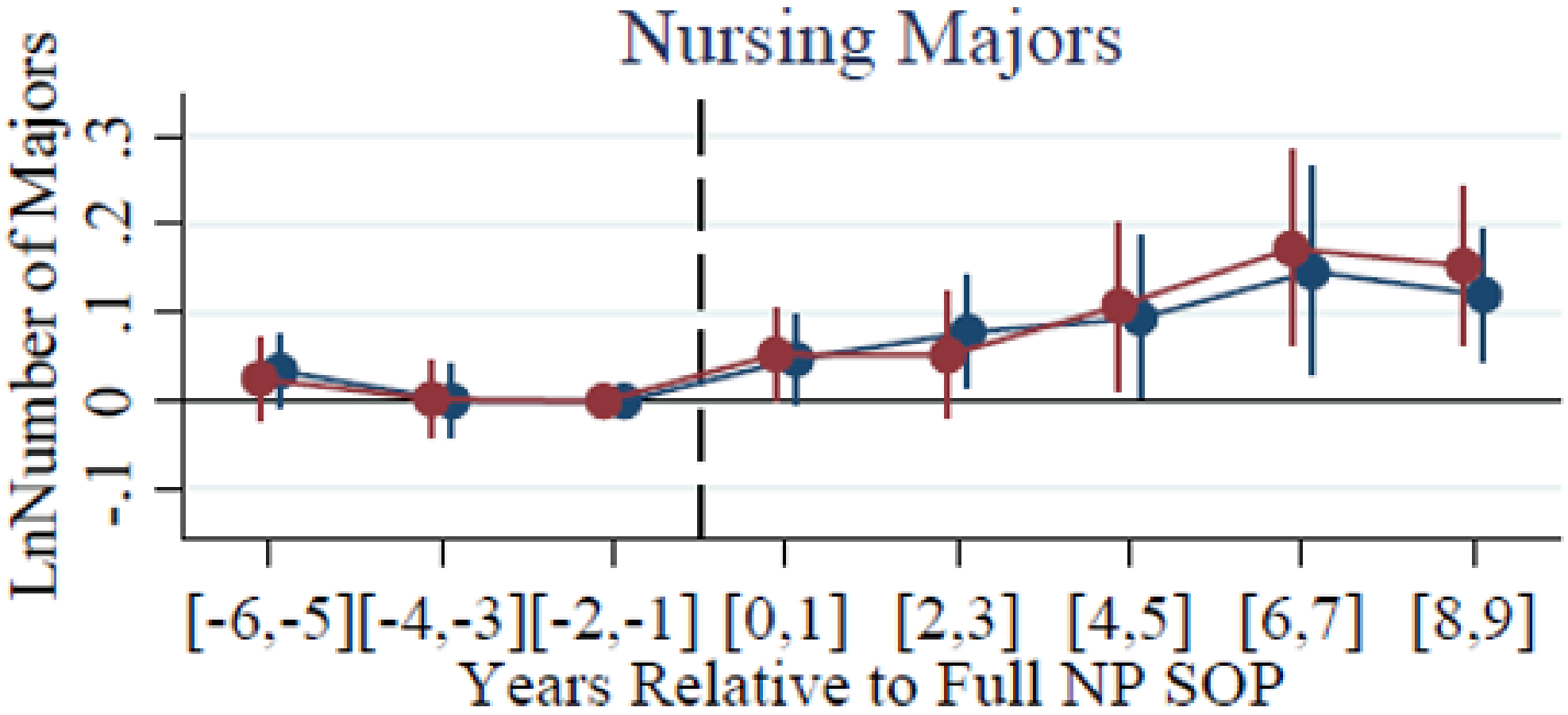
3. Effects of NP Independence on log number of nursing majors and “health majors” who are working as NPs.

The Plan – Sensitivity Analysis

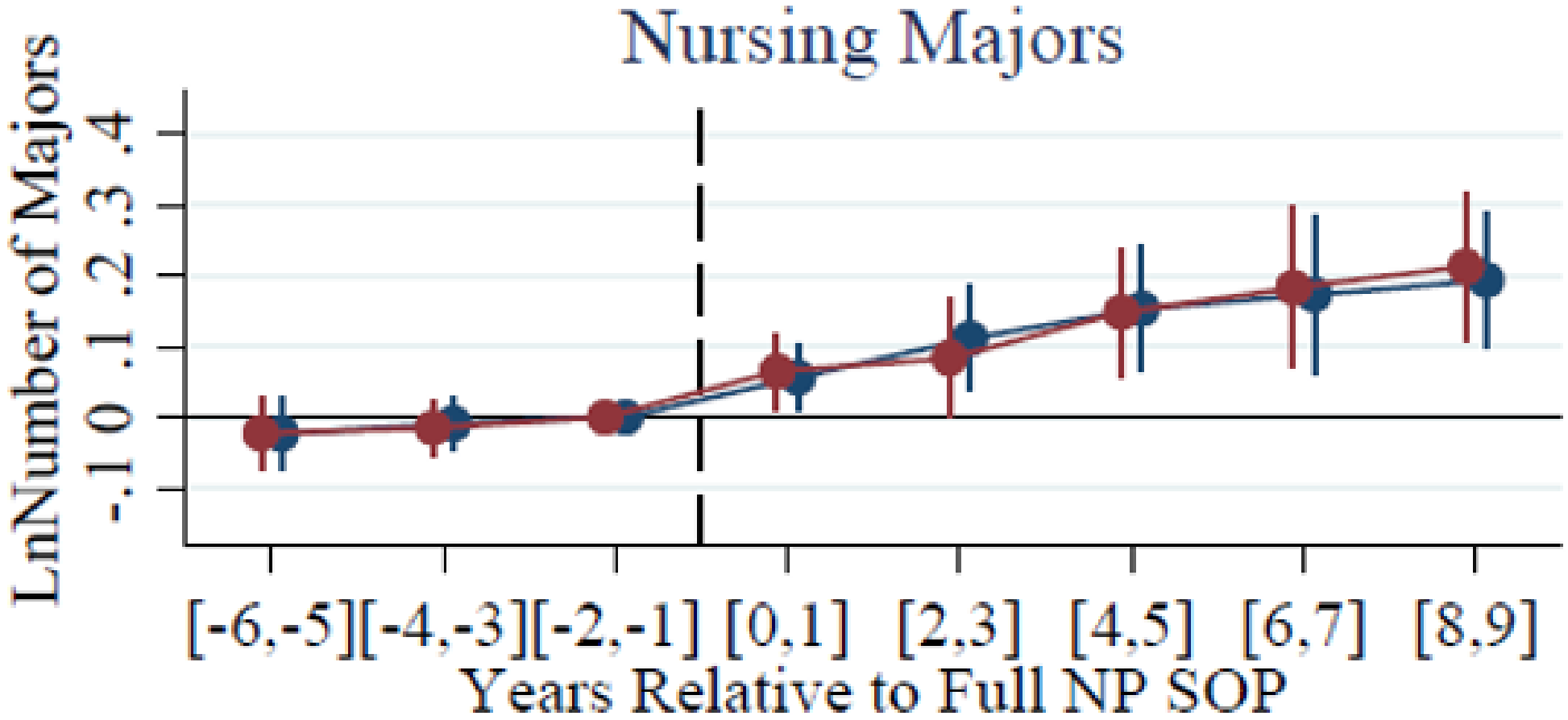
1. Does NP independence seem to affect graduation from non-nursing related majors?

2. Does NP independence seem to affect graduate degree attainment among non-nurse undergraduate majors?

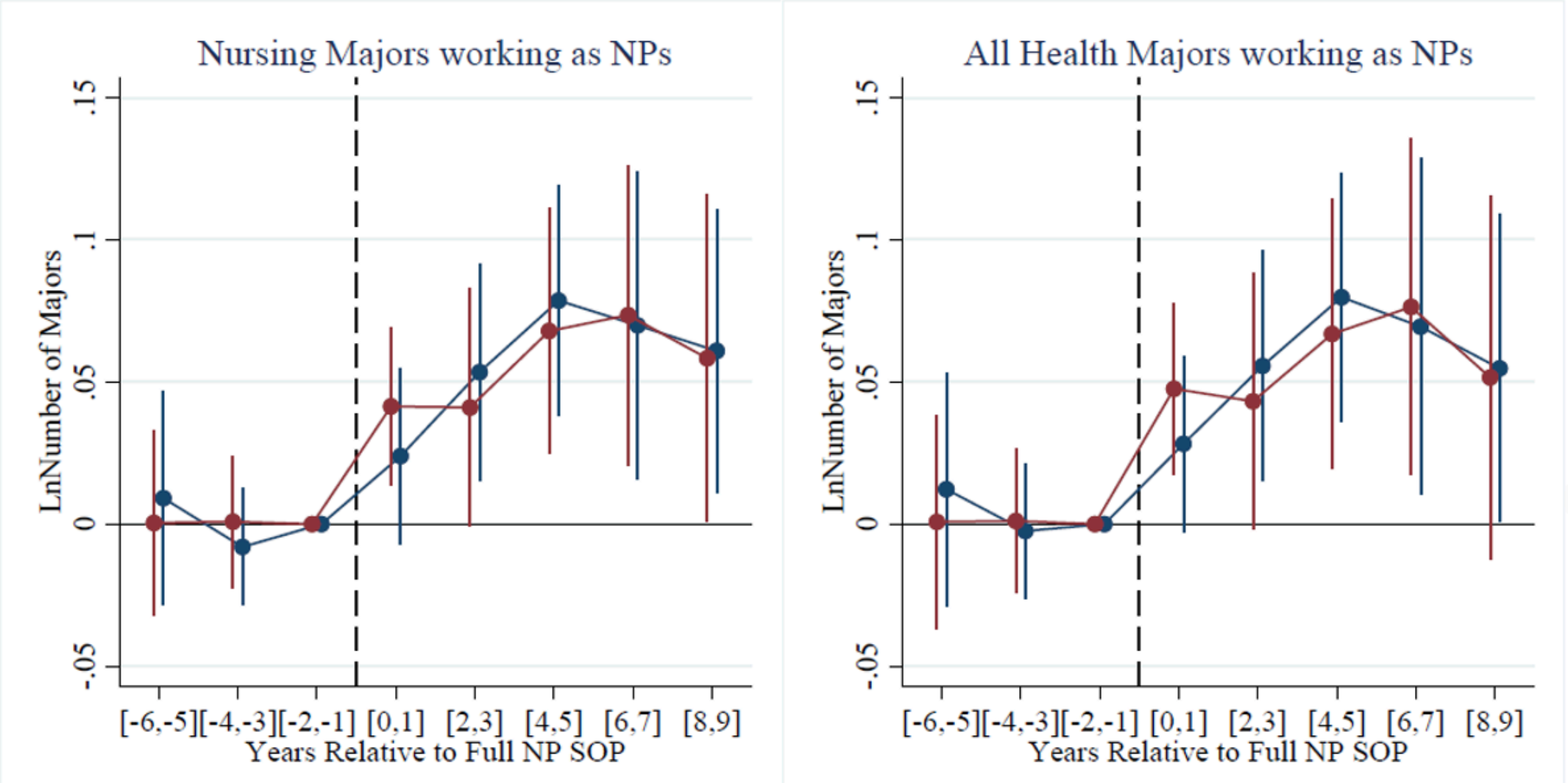
NP Independence increases undergraduate nursing degrees by about 10-15%



NP Independence increases number of undergraduate nursing majors who go on to a graduate degree by 10-20%

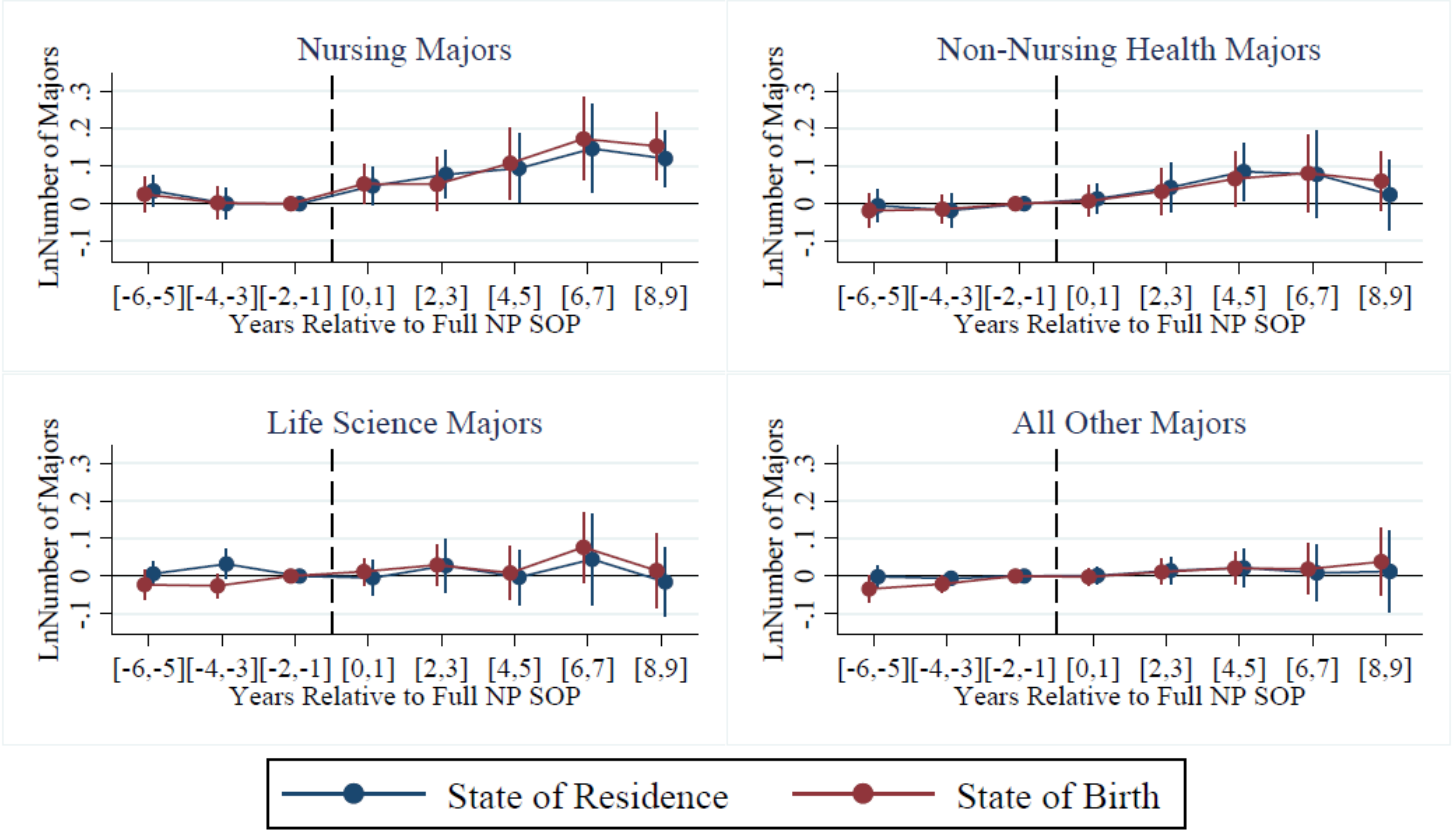


NP Independence increases employment as an NP among nurses and other health majors by about 5-8 percent



Sensitivity -- How did NP independence affect graduation from other majors?

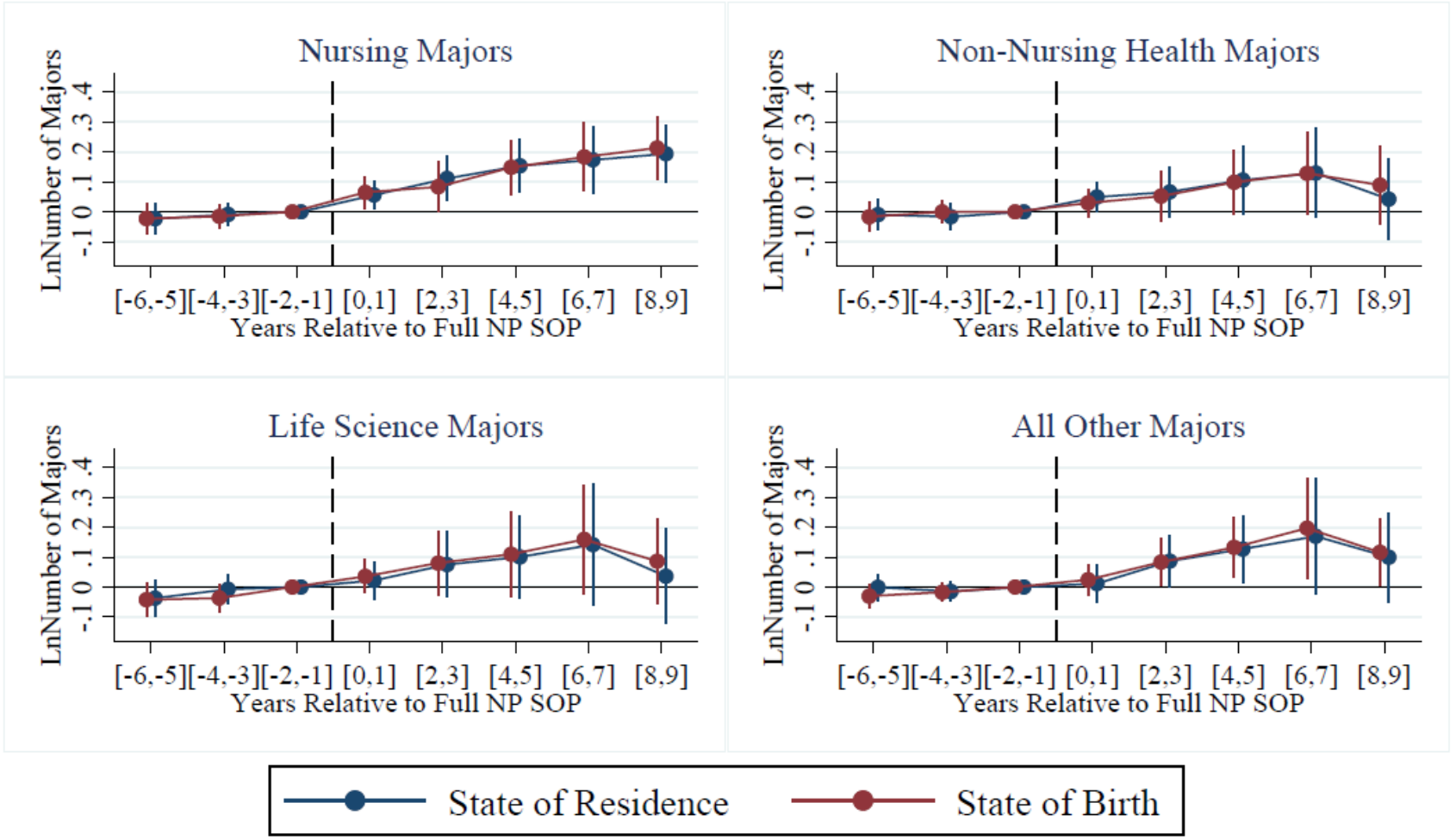
Figure 1: Impact of Full NP SOP on College Major Choice



Note: This figure plots the stacked event study estimates and 95 percent confidence intervals of the impact of full NP SOP adoption on the number of different college majors. All college graduates in the ACS are assumed to complete their undergraduate degree at age 24, the average age of completion for nursing majors. Individuals are then assigned to states based on their state of residence (when interviewed) or their state of birth.

Sensitivity – How did NP Independence affect graduate degree attainment across majors?

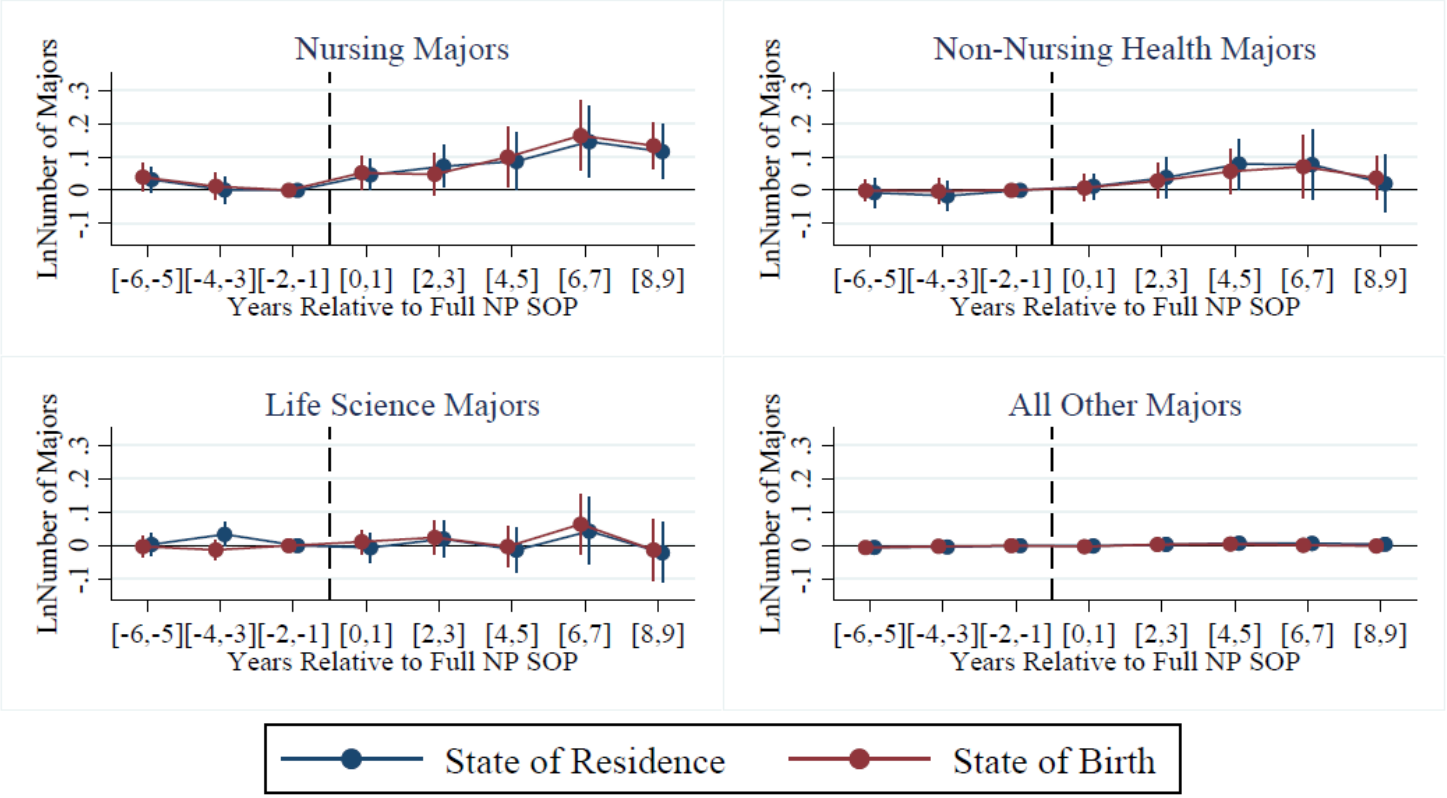
Figure 2: Impact of Full NP SOP on Graduate Degree Attainment by Major



Note: This figure plots the stacked event study estimates and 95 percent confidence intervals of the impact of full NP SOP adoption on graduate degree attainment by college majors. All college graduates in the ACS are assumed to complete their undergraduate degree at age 24, the average age of completion for nursing majors. Individuals are then assigned to states based on their state of residence (when interviewed) or their state of birth.

Nursing Major Effects, adjusting for number of college graduates

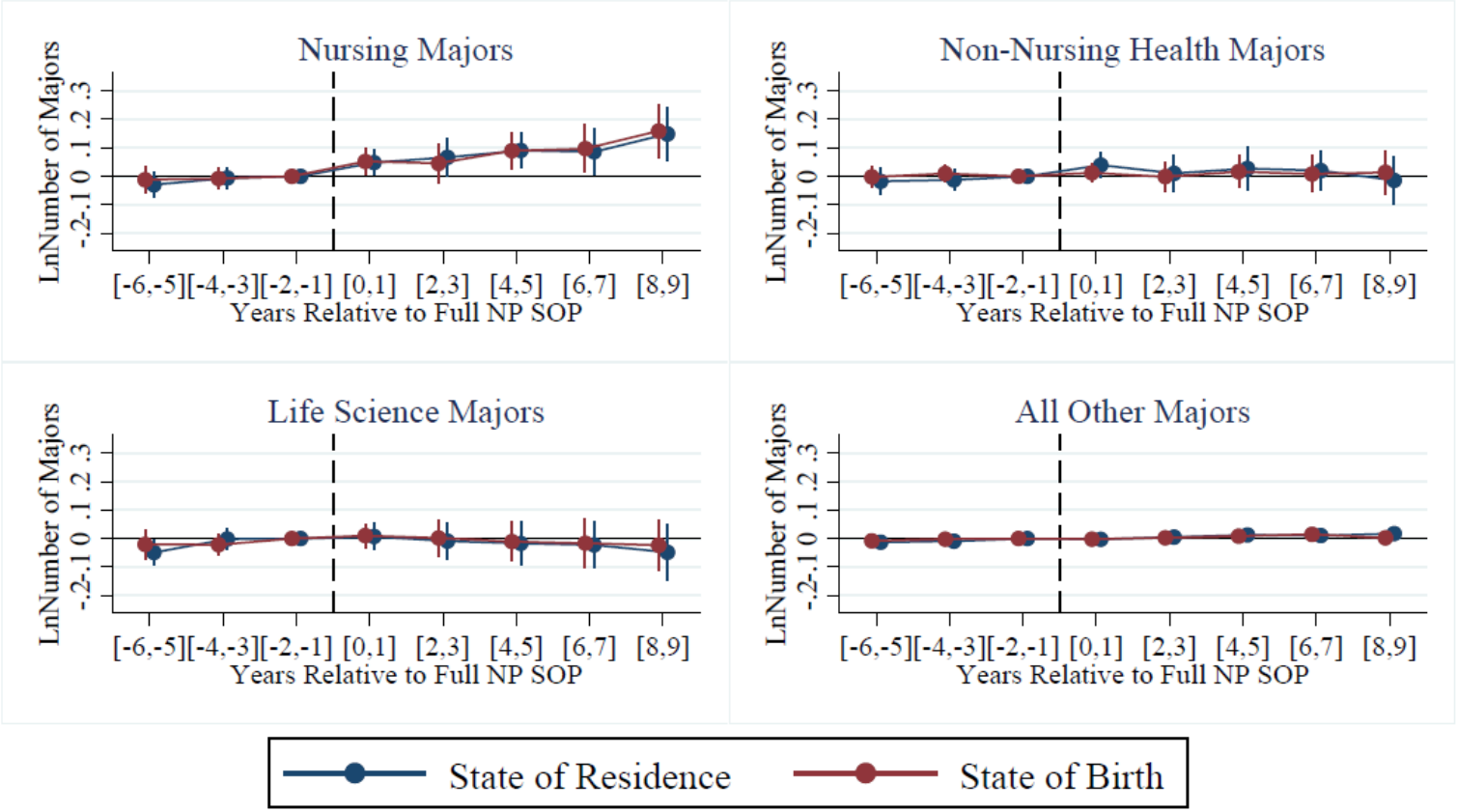
Figure 3: Impact of Full NP SOP on College Major Choice II



Note: This figure plots the stacked event study estimates and 95 percent confidence intervals of the impact of full NP SOP adoption on the number of different college majors. All college graduates in the ACS are assumed to complete their undergraduate degree at age 24, the average age of completion for nursing majors. Individuals are then assigned to states based on their state of residence (when interviewed) or their state of birth. Estimates are conditional on the number of college graduates in a state year.

Graduate School Attainment, adjusting for number of college graduates

Figure 4: Impact of Full NP SOP on Graduate Degree Attainment by Major II



Note: This figure plots the stacked event study estimates and 95 percent confidence intervals of the impact of full NP SOP adoption on graduate degree attainment by college majors. All college graduates in the ACS are assumed to complete their undergraduate degree at age 24, the average age of completion for nursing majors. Individuals are then assigned to states based on their state of residence (when interviewed) or their state of birth. Estimates are conditional on number of graduate degrees received in a state year.

Summary of Results (Tentative)

State SOP reforms that allow NPs to practice independently increase do seem to affect the Nurse Training Pipeline

Over the 9 years following the policy change:

- Undergraduate nursing majors increase by 10-15 percent
- Graduate degree attainment of nurses increases by 15-20 percent
- NP employment among undergraduate nurses and health majors rises by 5-8%

Some evidence that SOP reforms also induce increase in non-nursing health majors. Unclear to us if this is evidence of a spillover effect or a kind of confounding trend.

Discussion

Effects of SOP reforms are larger in the long run than the short run.

They don’t only affect how the existing health care workforce is used.

Also induce extensive margin increase in supply of labor to the nursing training pipeline and to the NP labor market