



Department of Economics

**Purchase restrictions as a tobacco control policy:
An analysis of the effect on adverse birth outcomes.**

Funding

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2. No funding was received during the last 10 years from tobacco-related sources.



SECTION 1

Overview

Research Problem

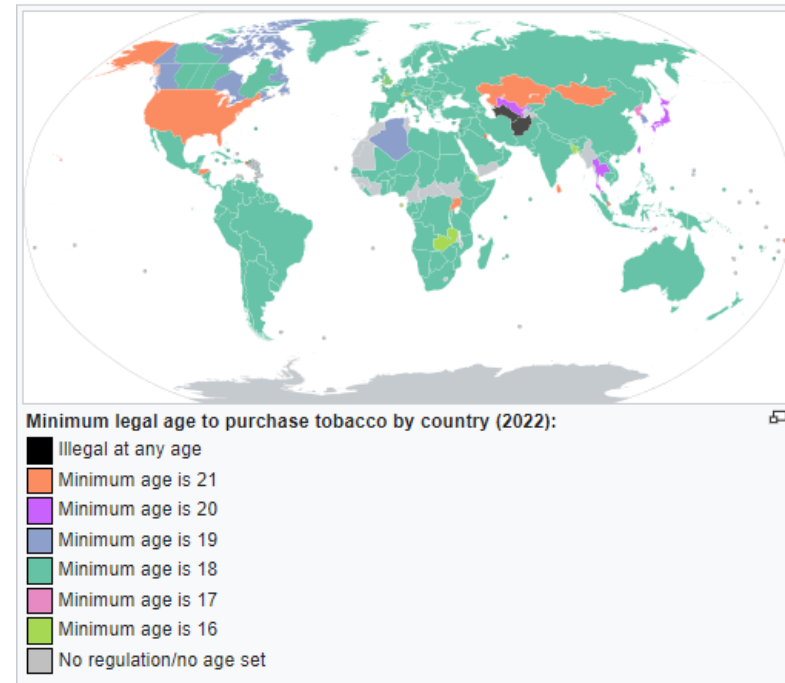
1. The minimum legal sales age (MLSA) for tobacco products has been used as a tobacco control policy tool for decades and targets to discourage smoking initiation.
2. Smoking during pregnancy increases the risk of adverse birth outcomes.
3. What is the effect of a purchase restriction on the risk of adverse birth outcomes?
4. The presentation is based on the following publication:

Tennekoon, Vidhura SBW (2023). Purchase restrictions as a tobacco control policy: An analysis of the effect on adverse birth outcomes. *Economic Analysis and Policy* 78: 967-974. DOI: <https://doi.org/10.1016/j.eap.2023.04.030>.



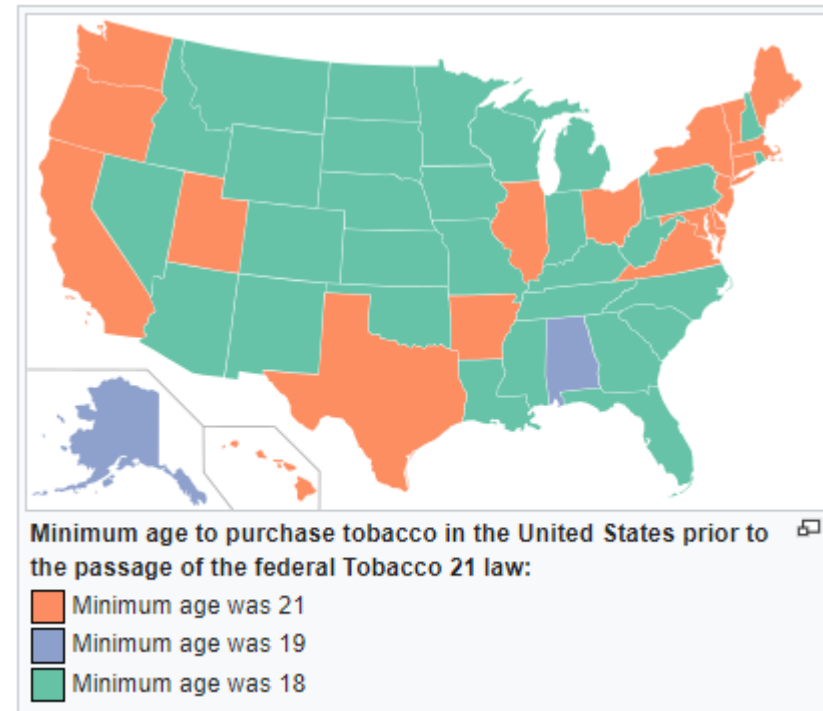
MLSA of tobacco products around the world

- In December 2019, the minimum legal sales age (MLSA) for tobacco products in the US was raised to 21.
- USA was the first OECD country to increase the MLSA of tobacco products to 21.
- The MLSA was 21 in Kuwait, Honduras, Mongolia, Uganda, Sri Lanka, and Ethiopia by that time.
- A few more countries (Philippines, Kazakhstan and Singapore) raised MLSA to 21 after the US.
- New Zealand and Malaysia have recently announced the intentions to introduce tobacco free generation policies.



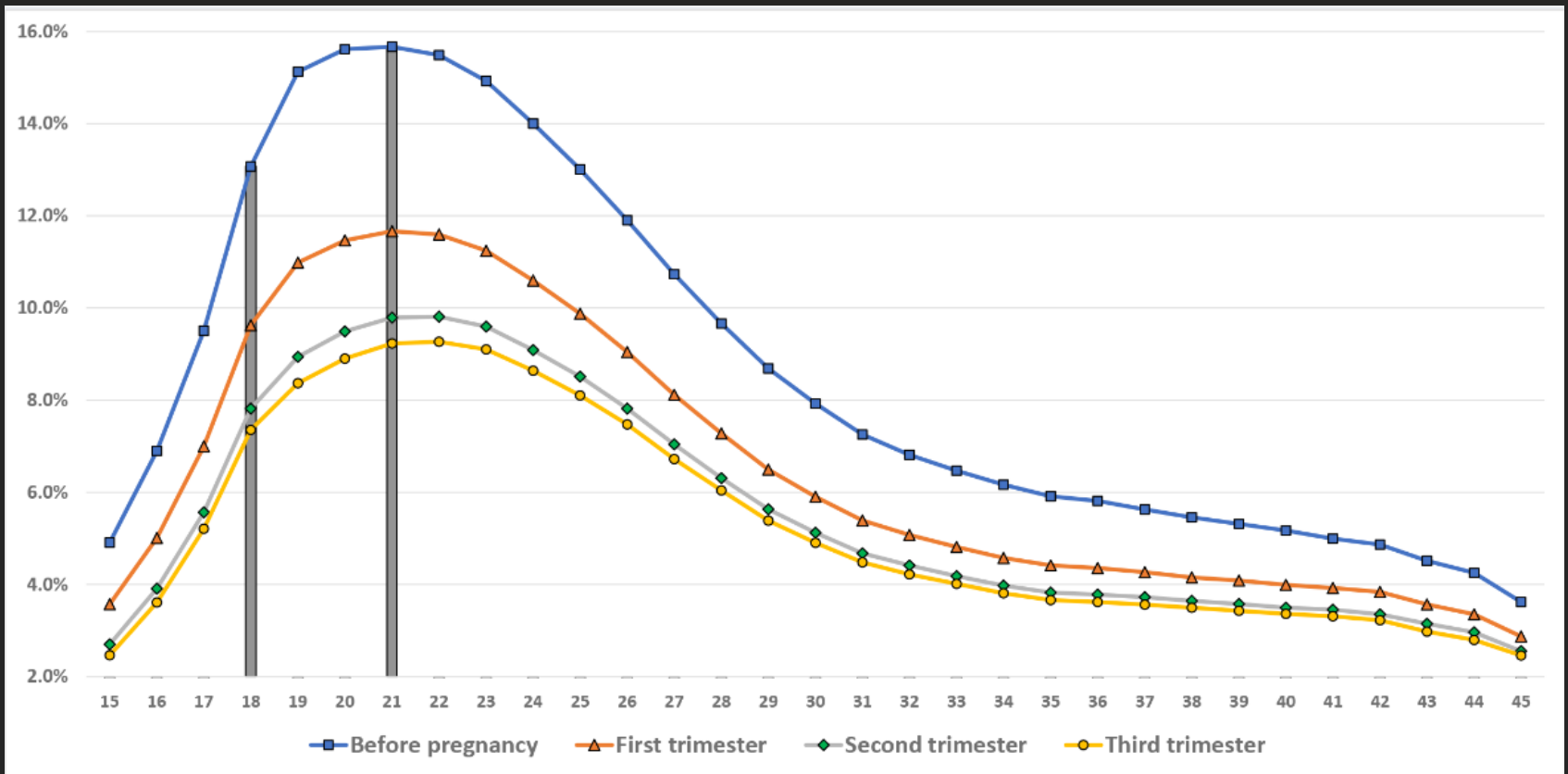
MLSA of tobacco products in the US

- Many US states raised the age limit to 21 before the federal law was passed.
- In addition, several counties and localities raised the limit before a state law was passed.
- This study is based on a period prior to passing the federal law (2013-2018).



Smoking during pregnancy peaks at 21!

(Based on 2011-2019 data)



SECTION 2

Literature

Previous work

T21 Policy and Smoking: Friedman & Wu (2020) has estimated approximately 3.1 PP reduction in smoking in 18-21 age group in response to T21 policies. Two recent working papers make similar conclusions (Abouk et al. and Bryan et al.)

T21 Policy and Smoking during pregnancy: The only previous study (Yan, 2014) which explored the effect of T21 policy on maternal smoking used birth records within the State of Pennsylvania during 1992-2002 in a regression discontinuity research design and showed about a 15% decline in the daily cigarette consumption during pregnancy. The regulation was found to cause a decrease of 2 percentage points in prenatal smoking participation without controls, but no statistically significant effect was found after adding controls.

The effect on birth outcomes: The SimSmoke model employed by the Institutes of Medicine predicted the benefits of T21 laws on maternal smoking in 2015 before these laws were widespread in the US and estimated that a nationwide T21 law would avert 438,000 low birth weight cases, 286,000 preterm births, and 4,000 cases of sudden infant death syndrome between 2015 and 2100.

Friedman AS, Wu RJ. Do local tobacco-21 laws reduce smoking among 18 to 20 year-olds? *Nicotine Tob. Res.* 2020 Jul;22(7):1195-201.

Abouk R, De P, Pesko M. Estimating the Effects of Tobacco-21 on Youth Tobacco Use and Sales (December 28, 2021). Available at SSRN: <https://ssrn.com/abstract=3737506> or <http://dx.doi.org/10.2139/ssrn.3737506>.

Bryan C, Hansen B, McNichols D, Sabia JJ. Do State Tobacco 21 Laws Work? National Bureau of Economic Research; April 2021. <https://www.nber.org/papers/w28173> [accessed June 12, 2022].

Yan J. The effects of a minimum cigarette purchase age of 21 on prenatal smoking and infant health. *East. Econ. J.* 2014 Jun;40(3):289-308.



SECTION 3

The Model

The Mechanism

Purchase Restrictions



Smoking during Pregnancy



Birth Outcomes



Research Problem

The target measure:

$$E[Y_i | (R_i = 1, \mathbf{X}_i) - Y_i | (R_i = 0, \mathbf{X}_i)]$$

The econometric model:

$$Y_{ijkl} = \alpha + \beta R_{jkl} + \sum_{k=2}^K \gamma_k C_k + \sum_{l=2}^L \delta_l M_l + \theta \mathbf{X}_i + \varepsilon_i$$

- In above operational model, Y_{ijkl} is the observed outcome of birthing person i aged j living in county k during the calendar month l .
- R_{jkl} is equal to “1” if those who were aged j and living in county k during the calendar month l were not legally allowed to purchase tobacco products from any seller within the county and equal to “0” if no such restriction was in place. (If not known with certainty, we assigned a probability)

SECTION 4

Data and Outcome Variables

Data

1. We used **restricted-use** US birth records data which includes all births in the US during 2013-2018.
2. Only the records of live births by mothers who were 18-21 years old at delivery were used for our analysis.
3. Sample size: 2,657,277
4. The main outcome variable we are interested in is the incidence of an adverse birth outcome (ABO_{ijkl}), defined as a live birth resulting low birthweight (LBW), small for gestational age (SGA) or preterm birth (PTB).
5. Each of these three adverse outcomes were also analyzed individually.
6. Additionally, the effect of purchase restrictions on smoking before and during pregnancy.



Restrictions on data

1. Location: Country level
2. Delivery date: Year and Month
3. Age: In years



Outcome variables

1. LBW_{ijkl} - birthweight was less than 2500 grams.
2. SGA_{ijkl} - birthweight was below the 10th percentile conditional on gestation age and gender.
3. PTB_{ijkl} - gestation period was less than 37 weeks.



SECTION 5

Policy Indicator

Policy Indicator

1. We first prepared a dataset of localities where MLSA of tobacco products was changed due to T21 or T19 policies during our study period, together with the **effective dates of these policy changes**.
2. This information was gathered mostly from tobacco21.org but also from various other sources through internet searches.
3. Second, we used this information to find the extent of coverage of T21 or T19 laws in each county during each month based on the proportion of the population living in covered areas to the county population.
4. Third, we derived the probability that each birthing person is banned from purchasing tobacco products in that person's locality based on the person's county of residence and age at pregnancy.
5. Age at pregnancy, however, was not available in the dataset and was derived using the age at delivery and the gestation period.
6. While the gestation period was available in weeks, the age at delivery was rounded to the nearest year which complicated the derivation of the probability of facing a purchase ban. The expected value of this probability was calculated based on the expected range of age at conception.
7. This also required considering the effect of grandparenting clauses in some jurisdictions. i.e., whether the new law exempted those who were already 18 (or 19) and were allowed to purchase tobacco legally when the bar was raised.



Statewide T21 Policies during the study period

State	Effective Date
Hawaii	1/1/2016
California	6/9/2016
Washington DC	12/29/2016
New Jersey	11/1/2017
Oregon	1/1/2018
Maine	7/1/2018
Massachusetts	12/30/2018

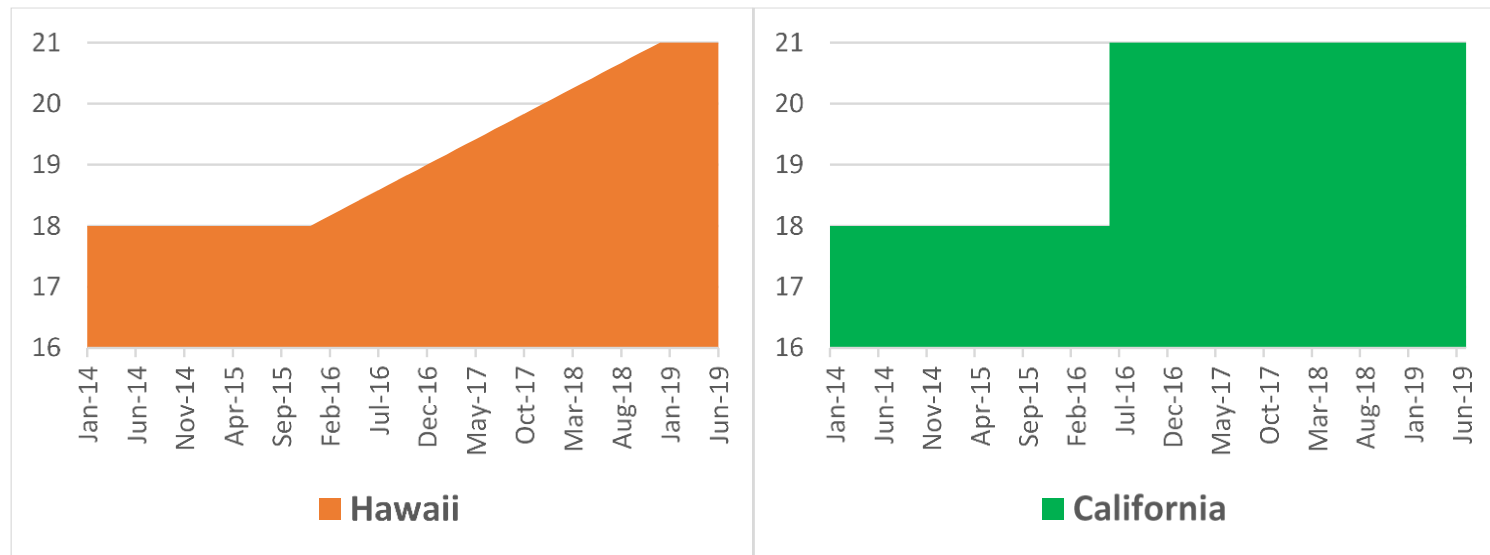


Grandparenting clauses

1. Even though Hawaii raised MLSA from 18 to 21 to be effective from January 1, 2016, the law excluded those who were already 21 by that date. Consequently, the policy affected the 18-21 age group gradually over a 3-year period and everyone below 21 was not covered by the law until January 1, 2019.
2. California law, however, affected everyone who was below 21 by June 9, 2016, including those who were legally allowed to purchase tobacco products until that date.
3. Following Hawaii, some states like Maine included a “grandparenting clause” excluding those who were already allowed to purchase tobacco products when introducing their T21 laws.
4. Other states like New Jersey and Oregon, however, followed California and did not include a grandparenting clause.
5. When the law included a grandparenting clause, the coverage of a given birthing person by a purchase restriction on a specific date not only depended on that person’s jurisdiction but also on the exact age of the person.
6. Considering these differences, we assigned a value of 1 to every birthing person in a county aged 18-21 when that person’s jurisdiction enforced a T21 law without a grandparenting clause. When a law included a grandparenting clause, we assigned a value of 1 only after that person’s 21st birthday.



Minimum legal sales age of tobacco products in Hawaii and California



County level restrictions

1. Many counties in the above 6 states did not wait until a statewide T21 law was passed to implement a countywide T21 law.
2. Some examples are Hawaii county in Hawaii, Kern and San Francisco counties in California and Lane county in Oregon.
3. Several other counties in the states of Alaska, Arizona, Colorado, Kansas, Minnesota, Missouri, Mississippi, and New York also implemented countywide T21 laws during our study period.
4. Moreover, these counties varied in their approach towards grandparenting clauses. Following the same approach as for states, we changed the policy indicator of birthing people in these counties after the applicable effective date.



Localities within counties

1. Many localities within one or more counties also implemented T21 laws within their jurisdictions.
2. However, in our data, we identify the county of residence of a birthing person but not the exact location.
3. Therefore, we had to estimate the probability that a birthing person is covered by our policy of interest based on the percentage of population of relevant age covered by a purchase restriction in the relevant county.

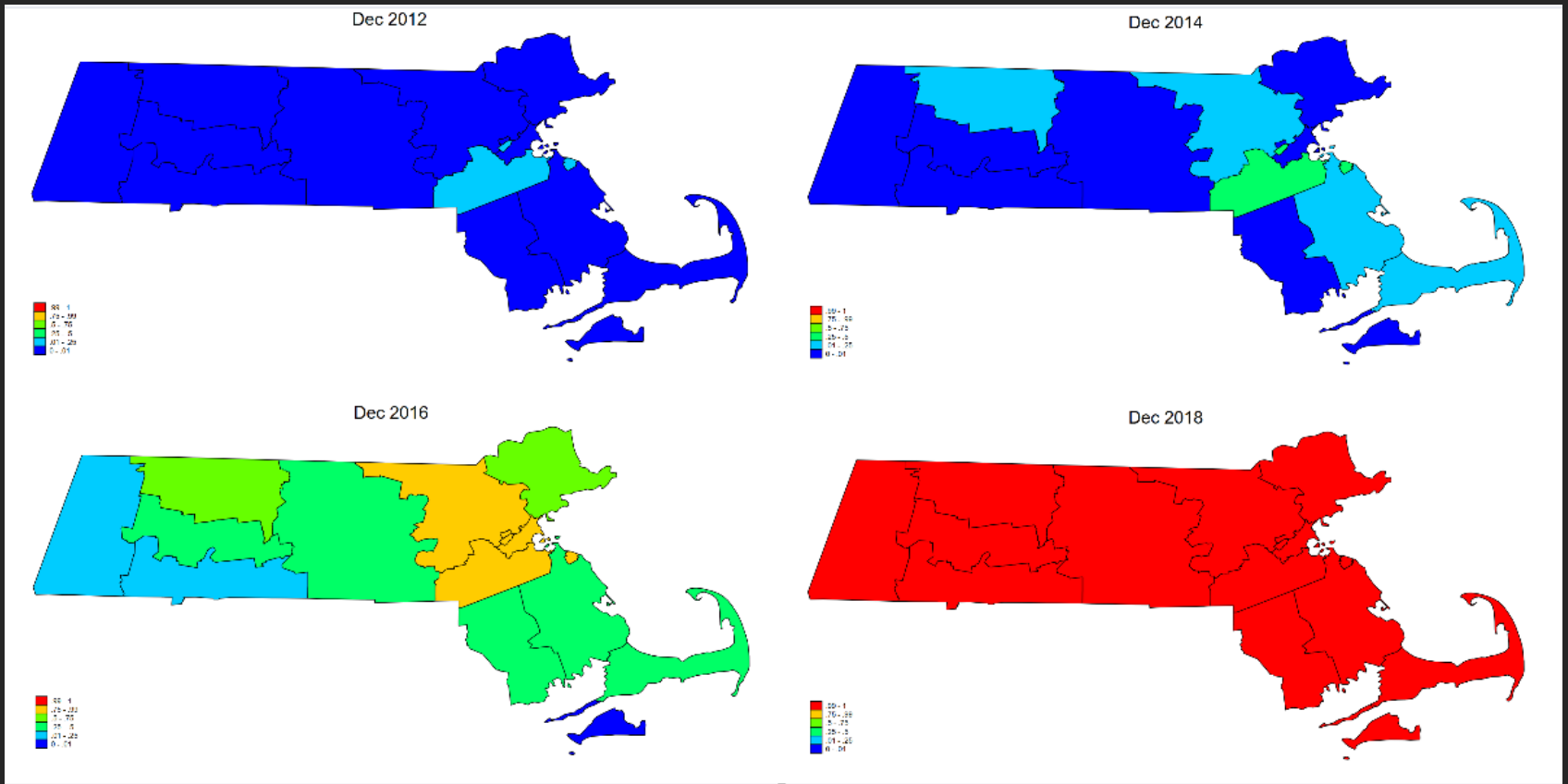


Coverage of T21 laws in Barnstable County in Massachusetts

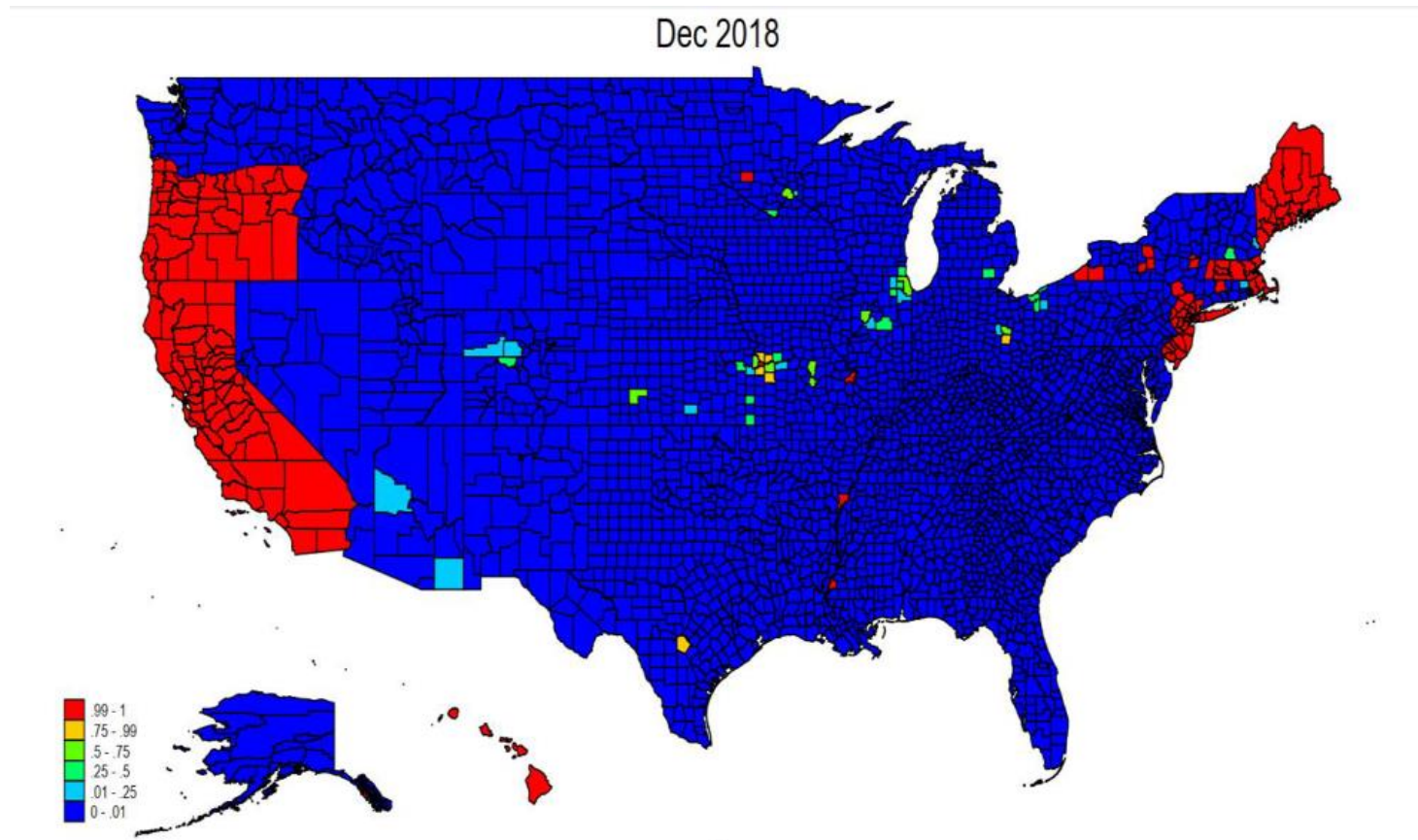
Locality	Effective Date	Population	Population %	T21 coverage
Yarmouth	7/1/2014	22,467	10.52%	10.52%
Brewster	9/1/2015	9,918	4.65%	15.17%
Eastham	9/30/2015	16,030	7.51%	22.68%
Provincetown	3/1/2016	2,994	1.40%	24.08%
Falmouth	5/23/2016	31,524	14.77%	38.85%
Mashpee	7/1/2016	14,154	6.63%	45.48%
Orleans	11/1/2016	5,846	2.74%	48.22%
Chatham	6/29/2017	8,977	4.21%	52.42%
Harwich	9/1/2017	12,145	5.69%	58.11%
Wellfleet	1/1/2018	2,750	1.29%	59.40%
Bourne	12/28/2018	19,879	9.31%	68.71%
All remaining localities	12/31/2018	22,624	10.60%	100.00%



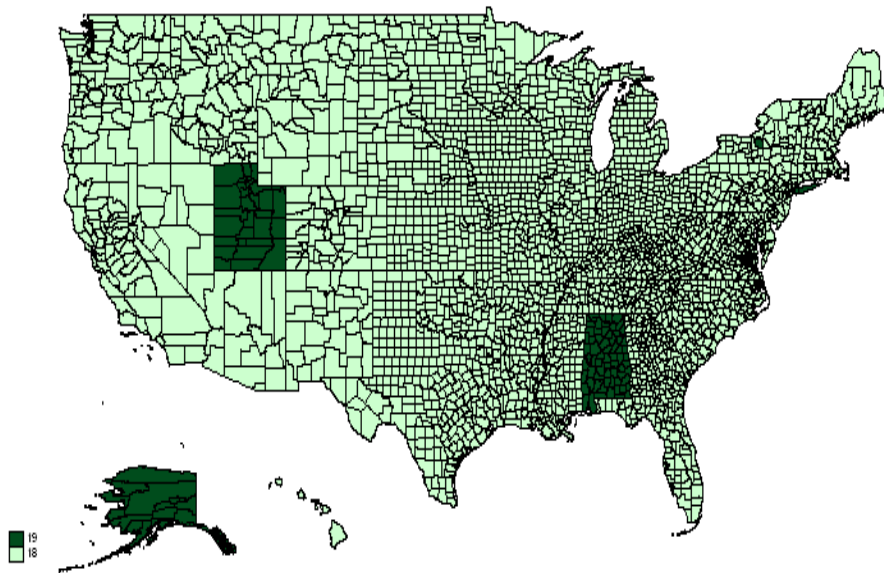
The coverage of T21 laws in each county in MA



The coverage of T21 laws in each county in the US by December 2018



Minimum legal purchase age of tobacco products in December 2012



- In four states (Alabama, Alaska, Utah and New Jersey), three counties in New York (Nassau, Onondaga and Suffolk) and several localities in Massachusetts the MLPA was 19 at the beginning of our study period and therefore the treatment indicator of a woman aged below 19 who lived in one of these regions was “1” throughout out study period.
- Any T21 policy implemented in one of these regions only affected those who were 19-21.

Age at pregnancy?

1. The final obstacle is to address the measurement error in age variable.
2. Age in years is known but not the month which can be one of 12 possible months.
3. We considered all 12 possibilities to get an average.



SECTION 6

Results

Change in Restrictions and Outcomes...

1. In our data sample, 14.5% were facing an age-based restriction when purchasing tobacco at pregnancy. This rate increased from 10.9% in 2013 to 23.1% in 2018.
2. Parallel to this, their smoking prevalence at the beginning of pregnancy decreased from 17.1% in 2013 to 12.1% in 2018 and from 12.7% to 8.8% during the first trimester of pregnancy.
3. 19.0% of these birthing people were living in a county where at least 50% of the county population were living in a locality with a T21 law. Birth outcomes in those “restrictive counties” were noticeably better than in other areas.
4. For example, the prevalence of LBW in restrictive counties was only 8.0% compared to 9.3% in other counties while the prevalence of PTB was 10.6% compared to 12.5%. The gap in the prevalence of SGA across restrictive and nonrestrictive counties was also positive (10.3% compared to 9.7%).
5. The prevalence of an ABO based on the aggregate measure in restrictive counties was 20.1% while that statistic was 21.3% in other counties.



Estimated Effects of Purchase Restrictions on Smoking

	Estimate (percentage points)	Mean	Percentage change
Smoking at pregnancy	-0.0545*** (0.0087) N= 2,461,407 R2=0.1619	0.1469	-37.12
Smoking during first trimester	-0.0496*** (0.0102) N= 2,461,440 R2=0.1367	0.1071	-46.28
Smoking during second trimester	-0.0405*** (0.0142) N= 2,461,079 R2=0.1239	0.0880	-46.09
Smoking during third trimester	-0.0060 (0.0067) N= 2,458,950 R2=0.1195	0.0825	-7.31



Estimated Effects of Purchase Restrictions on Birth Outcomes)

	Estimate (percentage points)	Mean	Percentage change
Adverse birth outcome	-0.0201*** (0.0018) N= 2,563,060 R2=0.0812	0.2110	-9.53
Low birthweight	-0.0121*** (0.0011) N= 2,563,060 R2=0.1100	0.0908	-13.27
Preterm birth	-0.0191*** (0.0014) N= 2,564,707 R2=0.0829	0.1212	-15.78
Small for gestation age birth	-0.0033*** (0.0012) N= 2,563,060 R2=0.0282	0.0982	-3.32



Limitations

1. **Assumed a homogeneous effect.**
2. **Other tobacco control policies:** The main assumption is that no other factor except the implementation of an age-based purchase restriction policy affected the birth outcomes, on average, at the exact point in time. This assumption could be invalid if other tobacco control policies also were implemented together with purchase age restrictions. This has happened in some jurisdictions.
3. To circumvent this issue, some of the previous researchers have employed a triple difference research design and the target group of this intervention has also been compared with an older cohort who were not subject to the intervention. Since our treatment indicator is not binary, our research design does not allow this robustness check. However, we included state tobacco taxes and state level smoke-free laws, the other most common tobacco control measures implemented in some jurisdictions together with purchase age restrictions, as controls.
4. **Border crossing:** Another, somewhat stronger, assumption implicit in our model is there is no border crossing. A robustness check which excludes the Washington D.C. area, where border-crossing is more likely compared to the other treated states, suggests that any bias due to border-crossing may not be large.
5. **Smoking status is self-reported.**



SECTION 7

Future work

Future work

1. What has happened after enacting the Federal Law?
2. The effect on different groups?



Thank you!



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