The Effect of the WHO FCTC Ratification: An Analysis Using ITSA with Synthetic Control Groups

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Once published all databases and codes will be publicly available.

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Introduction

- A few studies have assessed the effect of FCTC on smoking outcomes.
- Gravely et al. (2017) studies the number of FCTC's measures implemented at the highest level between 2007 and 2014 and the association with prevalence between 2005 and 2015.
- Results show that an increase in the number of implemented measures is significantly associated with a decrease in prevalence:
  - They do not use control groups, so results cannot be directly attributed to FCTC
  - Studies FCTC's measures, not the treaty itself
  - The study does not consider the implementation of measures pre-FCTC in most countries

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Introduction

- Anderson et al. (2016) studies the trends of policy percentages scores between 2007 and 2014 and the association with prevalence between 2010 and 2015.

- Association between higher policy scores and a decrease in prevalence

  - They do not use control groups, so results cannot be directly attributed to FCTC.

  - Studies policy scores in general, not the FCTC

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Introduction

- Dubray et al. (2014) studies the relationship between 2008 MPOWER composite score and changes in smoking prevalence between 2006 and 2009.

- Countries with higher MPOWER composite scores showed a greater decrease in smoking prevalence

  - They do not use control groups, so results cannot be directly attributed to FCTC.

  - Studies FCTC's measures, not the treaty itself

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Introduction

- Hoffman et al (2019) assess the effect of FCTC using single group ITSA with the per capita cigarette consumption. The study has some important limitations:

  - First, the intervention year is 2003 (most countries ratified in 2005 and 2006) and use around 70 countries (heavily unbalanced set of countries)
  - Second, they use the first differences of the dependent variable (absolute variations, which do not consider the initial level)
  - Third, dependent variable do not consider total consumption but registered consumption. Illicit trade is not considered (which may be endogenous to policy change)
  - Fourth, “long tail” of pre-ratification data (since 1970) which may bias results.

Introduction

- Paraje et al. (2024) use the log of smokers, the log of the prevalence of smokers for the 10-24 group, and the log of the quit ratio for the 45-59 group. The analysis is for 170 countries by income group (excludes China) using single group ITSA.

- Intervention is the year of ratification of each country, so data is “regrouped” to consider that.

- Results show strong effects, especially in post-intervention trends. The cumulative reduction of young smokers after ten years of ratification is about 24 million. Some limitations:

  - They do not use control groups, so results cannot be directly attributed to FCTC.
  - They use GBD data, which has modelled data. That may be inappropriate to use with ITSA.

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Introduction

- This work extends Paraje et al (2024) by using a synthetic control group with ITSA.

- It also analyses the effect by sex and countries' income groups for the 10-24 population and for the 25 and older population.

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Data

- Current smoker data between 1990-2020 from the IHME (Institute for Health Metrics and Evaluation), University of Washington
- Data for the population 10 years and older, in 5 years age group by sex
- Countries that don´t have 10 years after their ratification were excluded
- For this reason, only countries that ratified between 2005 and 2010 were included, representing 96% of the total population
- Excluded countries: Andorra, Czechia, El Salvador, Ethiopia, Mozambique, Saint Kitts and Nevis, Zimbabwe, Tajikistan, Turkmenistan, Uzbekistan

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Methods

- Interrupted Time Series Analysis (ITSA) with synthetic control group
- Dynamic intervention point (year of ratification for each country)
- Estimated difference between the treatment and control groups after 10 years of ratification
- Quadratic or lineal effect of treatment is chosen by the Akaike criterion

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Synthetic control group

- Synthetic control groups formed using lasso (SCUL)
- Donor pool are never-ratifying countries: Argentina, Cuba, Dominican Republic, Eritrea, Haiti, Indonesia, Malawi, Monaco, Morocco, Somalia, South Sudan, Switzerland and the Unites States of Americas
- Countries must be separated by their ratification year because of the dynamic intervention point. Otherwise, no ratification year would be assigned to the donor pool
- Thus, we generate a synthetic control group for each ratification year (from 2005 to 2010).

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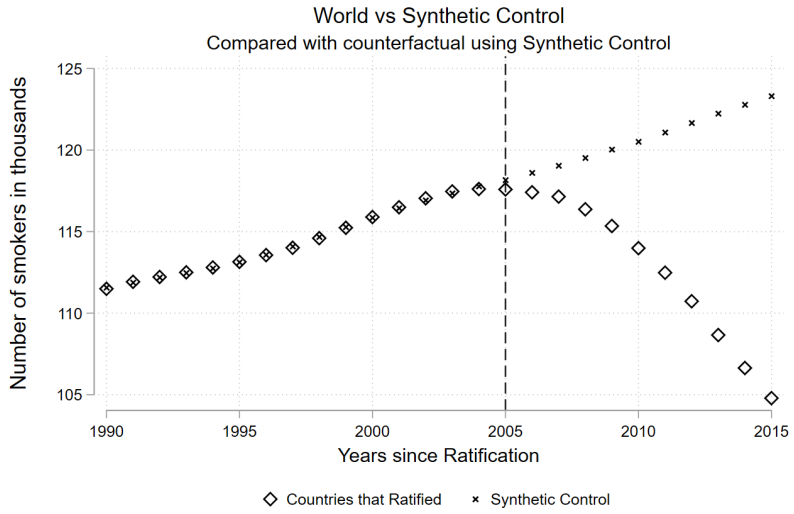
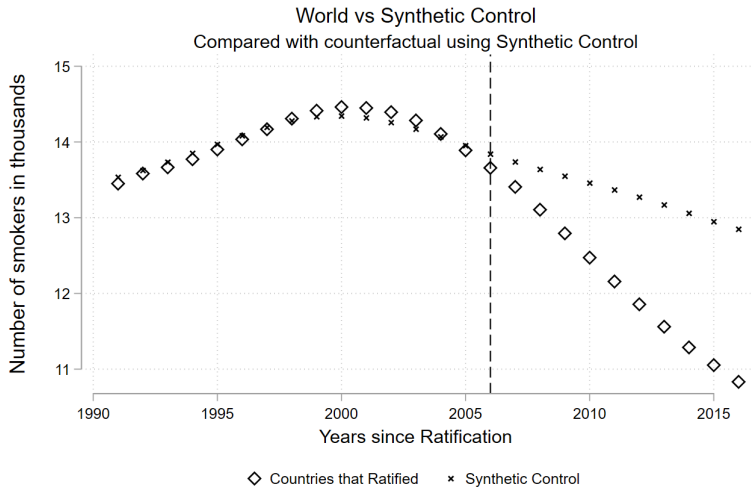
Two examples: ratification years 2005, 2006 for 10-24 years





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Synthetic Control Group using Lasso

Abadie et al (2010)

$$\widehat{\omega}_{Synth} = \omega(V^*) = arg\ min_{\omega} \left(\sum_{t=1}^{T_0} (y_{0t} - x_t \omega)^2 \right)$$

Hollingsworth and Wing (2020)

$$\widehat{\omega}_{lasso} = arg\ min_{\omega} \left(\sum_{t=1}^{T_0} (y_{0t} - x_t \omega)^2 + \lambda |\omega|_1 \right)$$

ω Ponderator

λ Penalty Parameter

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Example of weighs:
Countries ratifying in 2010, population 25+

Country	Ponderator
Argentina	0.1319359
Cuba	-0.002568
Dominican Republic	-0.0079379
Eritrea	1.982873
Haiti	-0.362093
Indonesia	0.0776737
Malawi	0.0007937

Country	Ponderator
Monaco	53.14688
Morocco	0.0471283
Somalia	0
South Sudan	4.294908
Switzerland	0.0416102
United States of America	-0.0073755

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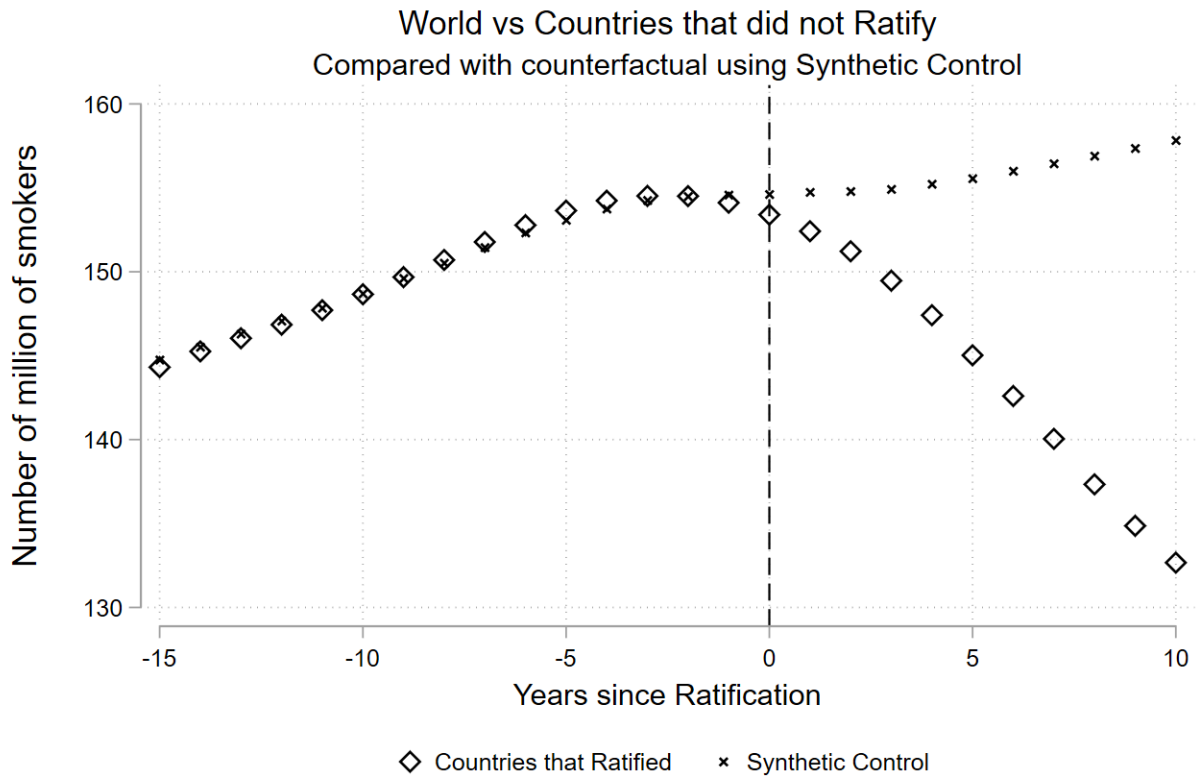
Global population 10-24 years old



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Synthetic control group

- Due to non-linearities (especially in the pre-ratification period) we subtract the treated and control groups, obtaining a single group.

- The group represents the difference in smokers between the treated and the control groups for each year before and after ratification.

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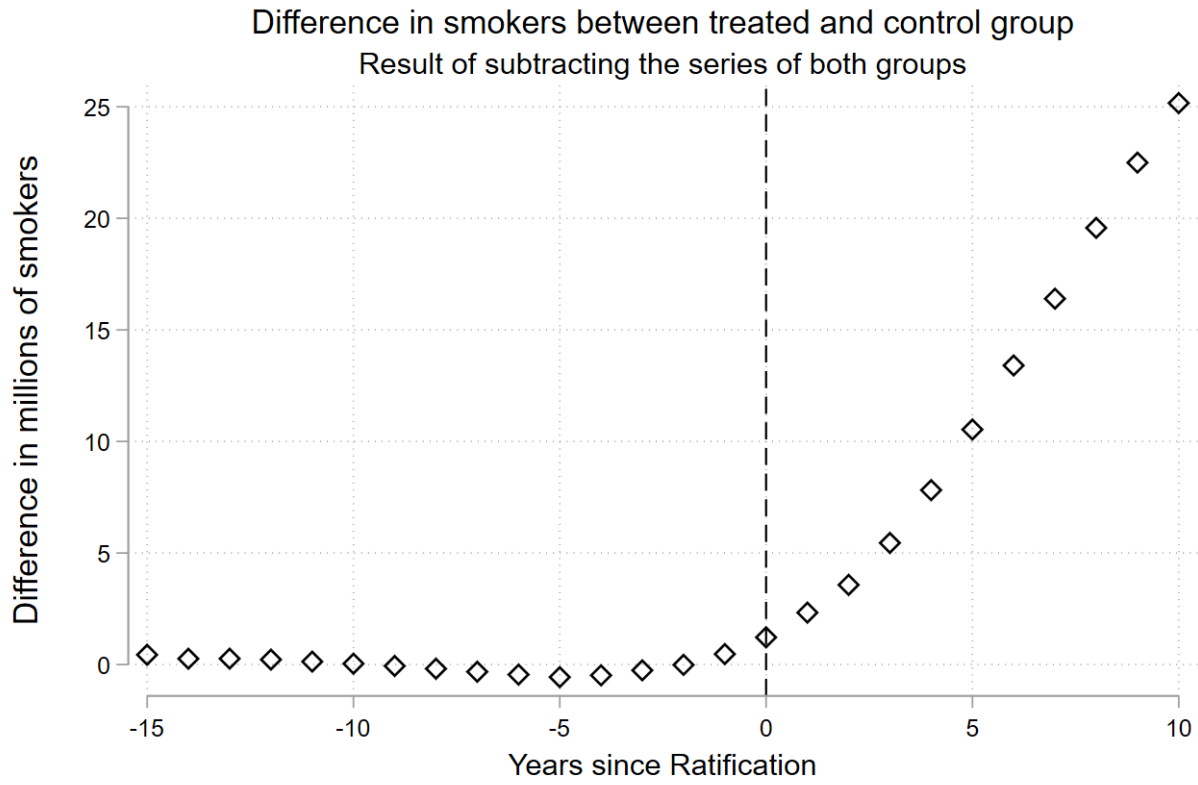
Global population 10-24 years old



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Interrupted Time Series Analysis

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \beta_4 X_t T_t^2$$

Y_t	Dependent variable
T_t	Years since Ratification
X_t	Treatment Dummy
$X_t T_t$	Interaction Term

β_0	Initial intercept
β_1	Pre-intervention Trend
β_2	Change in Level immediately after intervention
β_3	Change in Trend after intervention
β_4	

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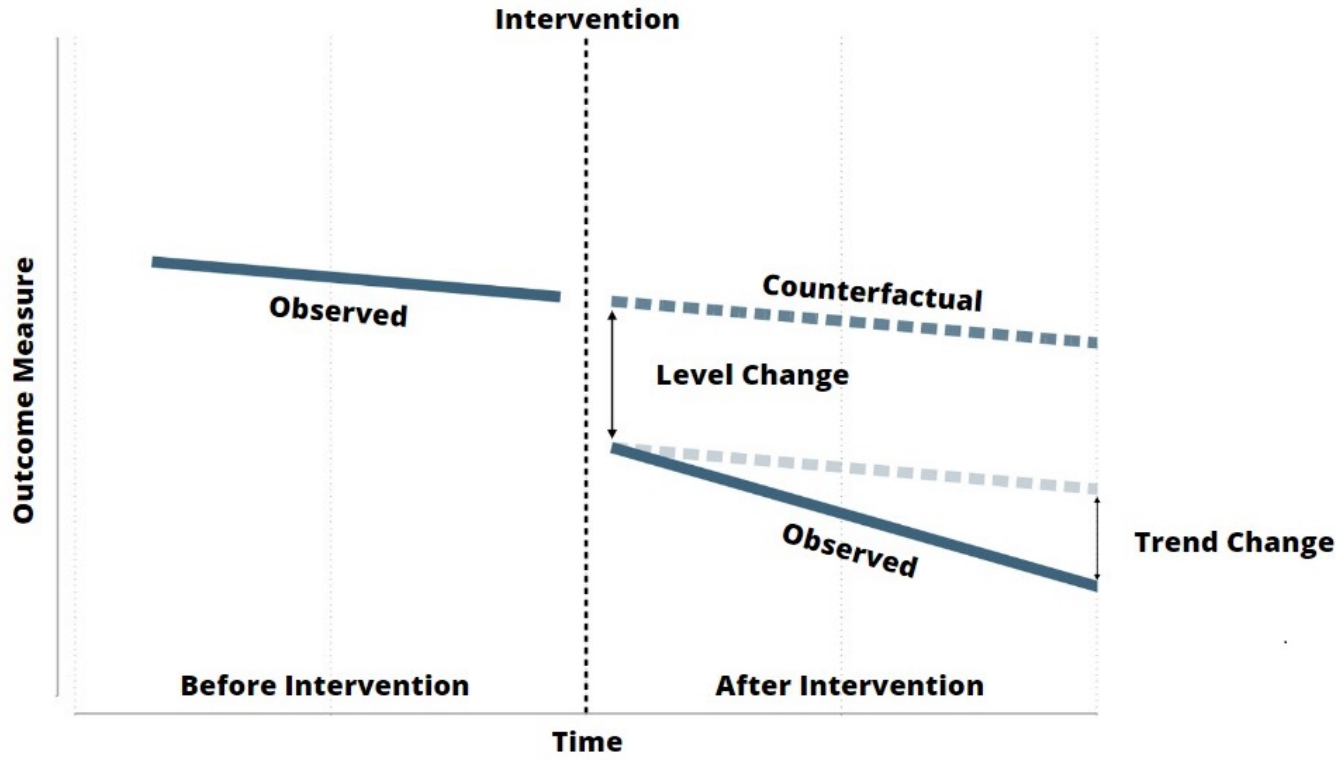
Interrupted Time Series Analysis



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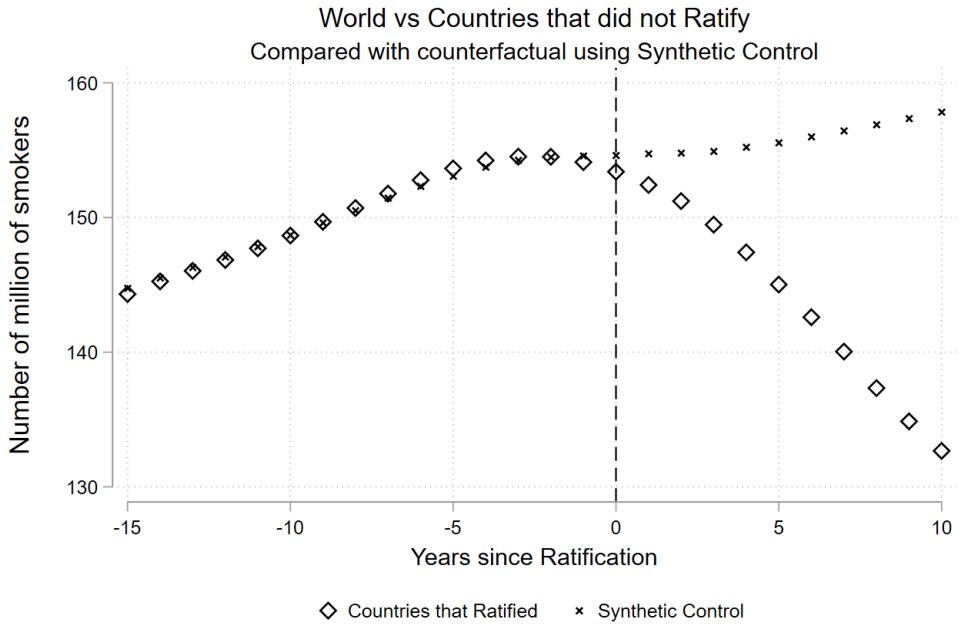
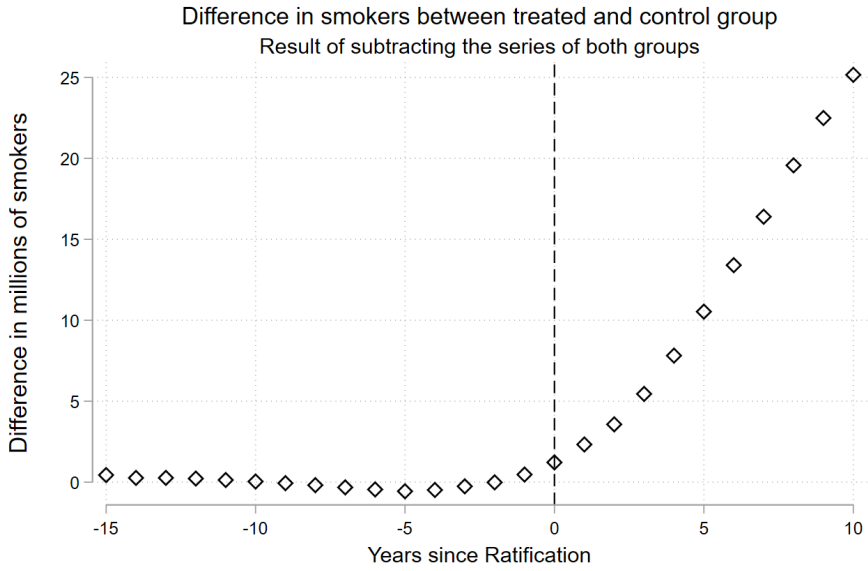
Global population 10-24 years old





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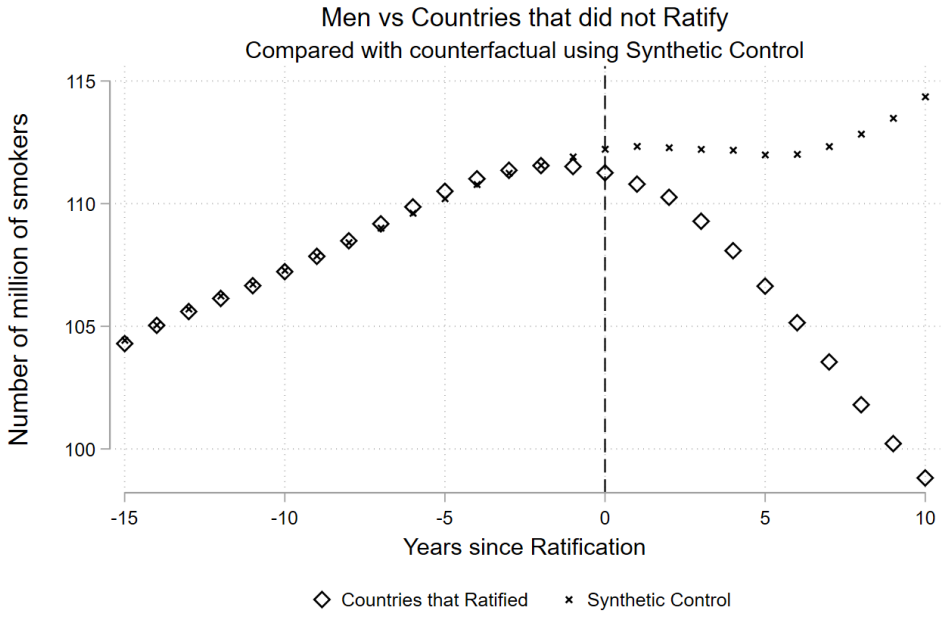
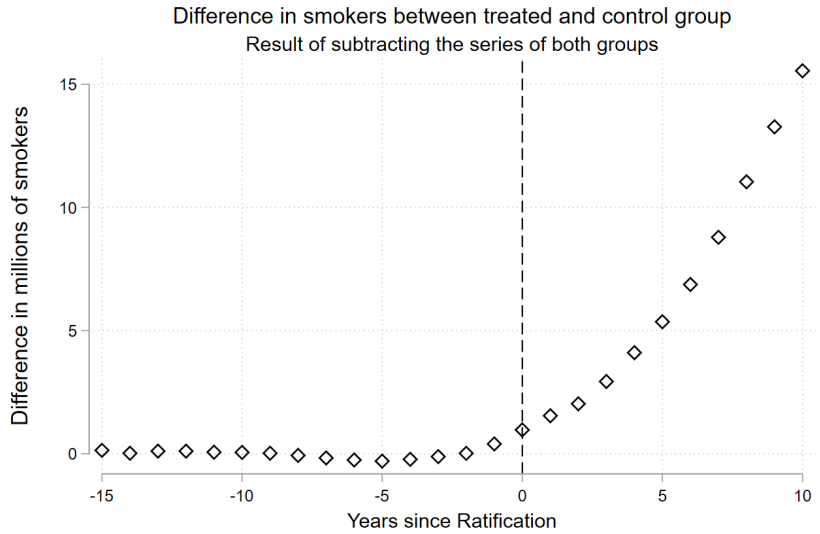
Male population 10-24 years old





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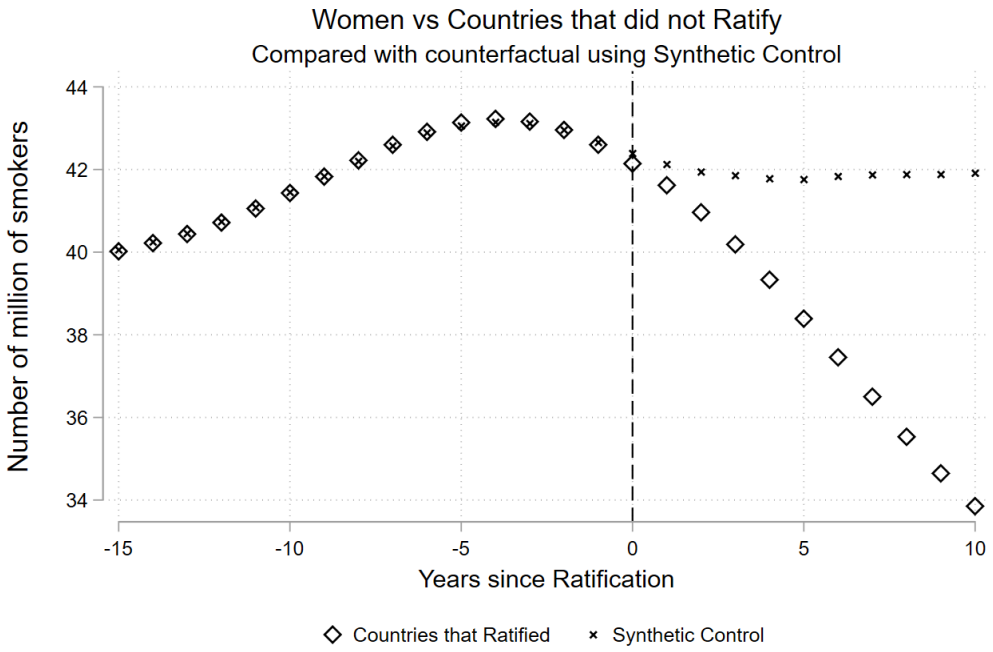
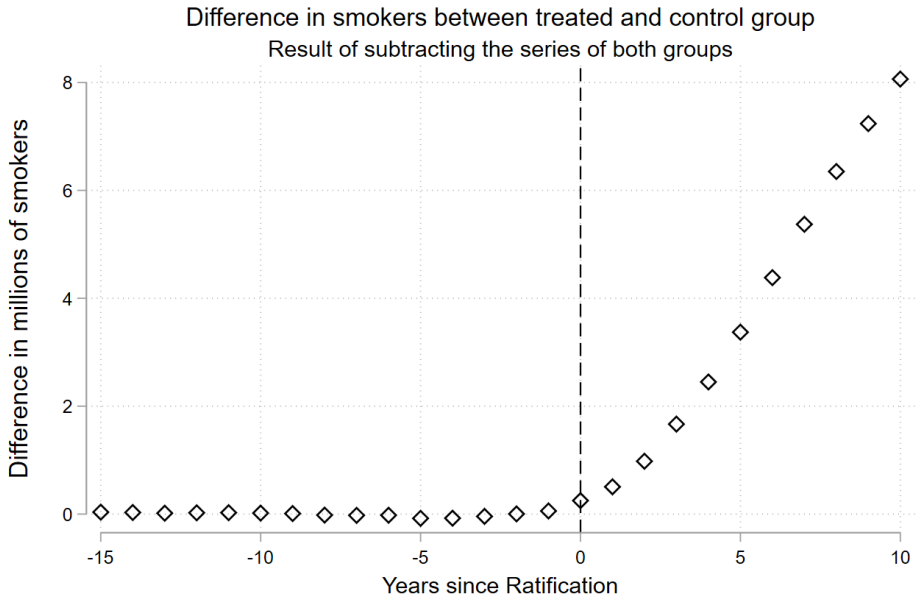
Female population 10-24 years old





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Results for the population 10-24 years old

	All	Sex		Income	
		Male	Female	High	LMIC
β_0: Gap in level	221.77*	50.66	25.86*	-120.57**	2.96
β_1: Gap in pre-intervention trend	-36.49	-8.99	-4.02	17.26 ***	-0.35
β_2: Gap in immediate change	1064.65**	1102.23***	32.85	565.52 ***	-579.27
β_3: Gap in change in trend post-ratification	1447.26***	300.22***	527.89***	113.60***	264.78
β_4: Gap in change in trend post-ratification ^2	109.71***	117.49***	30.74***	48.98**	198.9341***
Effect after 10 years	**26,508.1*** **	**15,854.3*** **	**8,385.3*** **	**6,599.8*** **	**21,961.9*** **
Average change in trend	**2,654.1*** **	**1,592.7*** **	**865.9*** **	**652.4*** **	**2,453.1*** **

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Results for the population 10-24 years old

- About 26,5 million fewer smokers after ten years of ratification
- About 15.8 million male and 8,4 million female fewer smokers
- This is equivalent to a reduction of 20%, 16% and 24.8% in current smokers after ten years since ratification, respectively
- About 6.6 million fewer smokers in high-income countries and 22 million fewer smokers in low and middle-income countries
- This is equivalent to a reduction of 26,1% and 20,5% in current smokers after ten years since ratification, respectively

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Results for the population 25 years and older

	All	Sex		Income	
		Male	Female	High	LMIC
β_0: Gap in level	85.76	85.18	290.68***	-1.33	13.15
β_1: Gap in pre-intervention trend	-12.51	-12.38	-41.35***	0.42	-1.89
β_2: Gap in immediate change	-1634.94	-2072.66**	-337.06**	1006.59***	-1304.95
β_3: Gap in change in trend post-ratification	523.19	905.76***	-136.00**	242.77***	926.71***
β_4: Gap in change in trend post-ratification ^2	190.99**	/	87.68***	113.216***	/
Effect after 10 years	**22696.5*** **	**6985*** **	**7071.3*** **	**14756*** **	**7962.2*** **
Average change in trend	**2,624.1*** **	**1,592.7*** **	**828.5*** **	**4,488.2*** **	**926.7*** **

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Results for the population 25 years and older

- About 22.7 million fewer smokers ten years after ratification
- About 7 million male and 7 million female fewer smokers
- This is equivalent to a reduction of 4.2%, 1.7% and 6.1% in current smokers after ten years since ratification, respectively
- About 14.8 million fewer smokers in high-income countries and 8 million fewer smokers in low and middle-income countries smokers
- This is equivalent to a reduction of 10.9% and 2% in current smokers after ten years since ratification, respectively

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Questions

- What is the effect of using modelled data?
- Is it reasonable to subtract treated and control groups?

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Preliminary conclusions

- If the countries had not ratified, the global current smoker prevalence would have been about 2 percentage points higher ten years after ratification.
- In terms of sex, that would have been 2.3 and 1.3 percentage points higher for men and women, respectively
- In terms of income groups, that would have been 4.8 and 1.8 for high-income countries and low- and middle-income countries, respectively
- FCTC was successful in controlling the evolution of tobacco users

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Thank you !!!

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