

Regional firearm homicide rates in the US: Convergence patterns and background factors

Extended abstract

Firearm homicides and gun violence continue to appear as popular items in the news of US frequently. Although in political debates the focus has often been on gun laws in US states, recent studies have also suggested that social background factors unrelated to gun-ownership may be prominent drivers of gun violence and therefore, of firearm homicide rates (Christopoulos, 2023). The space-time pattern of such incidences is by no means stable, so that various drivers may play a role.

This study seeks to explore the existence of converge patterns of firearm homicide rates in US states and test whether convergent or divergent clubs may be identified which differ in socioeconomic and gun-related factors that may be linked to the aforementioned cause of mortality in these states.

To map out the space-time evolution of firearm incidences in the US, detailed geographical data over a long time period are needed. Data for the firearm homicides and respective populations were extracted from the Wide-ranging ONline Data for Epidemiologic Research (WONDER) database of the Centers for Disease Control and Prevention (CDC, 2021). The ICD-10 codes used for the deaths were: X93 (Assault by gun discharge), X94 (Assault by rifle, shotgun and larger firearm discharge), and X95 (Assault by other and unspecified firearm discharge). The data concern the 50 US states and the District of Columbia (DC) for the years 1999–2020. Rates were calculated per 100,000 inhabitants.

The hypothesis to be tested in the present study is that, next to command-and-control measures (in particular, legal regulations and gun laws per state), various socio-economic background factors may provide a significant explanation for space-time variations in gun-related homicides. For the social factors, social capital, structural racism and violent crime rates were studied. Social capital serves as a measure of social health and was extracted from the Joint Economic Committee of the U.S. Congress (JEC, 2018). The structural racism index was extracted from Mesic et al. (2018). Violent crime rates were extracted from the Federal Bureau of Investigations (FBI, 2019). For the economic factors, income inequality (measured by the Gini index) and the percentage of population living below the poverty level were extracted from the American Community Survey (ACS, 2020). The unemployment rate was extracted from the Bureau of Labour Statistics (BLS, 2020). The two gun-related variables are gun ownership percentage and gun policy strength (0–100 index). These were extracted from the RAND corporation (2020) and Everytown Support Fund (ESF, 2024), respectively.

For the convergence analysis we employ the Phillips and Sul methodology (Phillips and Sul, 2007, 2009). Mortality data were logged and applied the Hodrick-Prescott filter using *R* package ‘*mFilter*’ (Balcilar, 2018). The series were then tested for full convergence using the log t-test. The clustering and club merging algorithm (Phillips and Sul, 2009) was then applied in order to identify potential convergent clubs. The convergence analysis was performed using the *R* package ‘*ConvergenceClubs*’ (Sichera and Pizzuto, 2019). For a more thorough exposition of the methods see Christopoulos and Eleftheriou (2020).

Simple generalized linear models with Binomial family and logit link were employed to obtain odds ratios for the associations between the firearm homicide convergence club membership and potential drivers. The values of the variables concern the mean of the available corresponding time-series for which the analysis was performed (1999–2020) with the exceptions of the structural racism, gun law strength, and social capital index, which

are cross-sectional data.

The first question was whether US states showed a uniformly converging evolution. However, the log t-test strongly rejected the null ($p < 0.001$) of full state convergence. The clustering algorithm initially identified three convergent clubs. After the club merging algorithm Clubs two and three were merged leaving a total of two clubs. States in Club 1 appear to converge to a higher firearm homicide rate than Club 2. States in the club with smaller firearm homicides rates are mainly in the West and NorthEast with the exception of Nebraska, Minnesota, and Virginia. Club 1 entails all Southern states with the exception of Virginia, all well as most of the Midwest.

The next question is of course, why such differences in club convergence emerge. Logistic regressions revealed statistically significant differences in gun ownership, poverty, social capital, and violent crime rates. A one standard deviation increase was associated with almost half the odds of belonging to the higher firearm homicide rate club for social capital and almost triple the odds for gun ownership, poverty, and violent crime rates. It is noteworthy that gun law strength index, on the other hand, was inversely significantly associated with Club 1 membership. No significant associations were found for unemployment, income inequality, and structural racism.

In conclusion, firearm homicides should be dealt with a holistic social science approach in order to ensure that the general loss of life decreases. Policy interventions that focus on gun control may change this statistic but tend to ignore the root cause of the problem.

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