

Notes Presentation MSSSM

Ethnic Violence – Introduction

- Many very bloody conflicts in human history were due to ethnical tensions
- Also many current conflicts have their roots there
- If they should be prevented efficiently in the future, their dynamics have to be understood
- Model-driven project: use of existing model and modification to make it more realistic
- Global sensitivity analysis to assess the effects of the model parameters quantitatively

Base Model: Agents

- The investigated model is a agent-based model
- Interactions take place on a 2D map
- Two types of agents: civilians and law enforcement officers (LEOs), civilians are divided into two ethnic groups
- The civilians decide based on their characteristics (shown on the right) and their environment, if they should become active (commit violence) or stay quiet
- Hardship and risk aversion drawn from $U(0,1)$
- Perceived legitimacy and violence threshold global quantities in the base model, not very realistic

Base Model: Iteration

- Agent (LEO or civilian) is randomly selected and moved to an empty position within his vision
- There, he inspects his new environment
- If the moved agent is a LEO he arrests a random active civilian (if there is one)
- If the agent is a civilian he makes the decision whether to become active or stay quiet
- When he wants to become active, he tries to kill a civilian of the other ethnic group
- Simple population dynamics: All civilians clone themselves onto an empty neighboring position on the map in each iteration. They die if they reach their life expectancy.
- Civilians that have served their sentence in prison are released in a quiet state to empty position on the map

Modified Model

- L and T are made heterogeneous across the population of civilians
- It is unrealistic that they are uniformly distributed, are drawn from truncated normal distributions
- The perceived legitimacy should change, when violence occurs or agents are arrested
- Violence is assumed to have always the same effect on the legitimacy, is always taken serious (when directly observed)
- The effect of arrests is assumed to show some saturation for extreme values of the legitimacy

Visualization of the Simulation

- Left: ethnic group 1 (yellow), ethnic group 2 (green), LEOs (black), active civilians (red border)
- Right: grievance product of the perceived illegitimacy and the individual hardship
- Modified model, mean L was set to 0.75 and mean T to 0.1, standard deviations were set to 0.1
- Grievance locally increases around active civilians due to update

Dependence on L and T

- Std. dev. = 0.1, $k_L = 0.1$
- Base model and modified model showed qualitatively the same behavior
- 200 iterations, cumulative number of killings is measure for the extent of ethnic violence (model output)
- The (mean) value of T is more important than the (mean) value of L
- For medium to high values of T, the (mean) value of L has an influence, this is the situation in most societies
- T can be interpreted as the utility to not publicly express one's private grievance
- Heterogeneity of L and T introduces slightly more violence compared to the base model, explained by the presence of few extreme individuals, this is realistic

Dependence on Standard Deviation

- $L = 0.8$, $T = 0.1$, $k_L = 0.1$
- Both parameters were varied simultaneously (always same value), saving computational time, could be varied independently in the future to extend the analysis
- When the society is very heterogeneous, there is a lot of violence, as expected
- This heterogeneity describes real societies better

Dependence on k_L

- $L = 0.8$, $T = 0$, std. dev. = 0.1
- Parameter seems to have no influence in the current modification of the model
- Probably due to the limited range in which the legitimacy is updated, range should be extended

Summary and Outlook

- The modifications make the model more realistic
- For societies with a medium to high average T, the mean value of L plays a role
- Heterogeneity introduces more violence compared to the base model, this is realistic, because even in tolerant societies there are extremists
- The new mechanism for the update of L has to be further improved: range, constant effect of violence, two different constants, etc.
- Finally, the global sensitivity analysis has to be repeated properly, this would dramatically increase the quality and quantity of statements that could be made about the influence of the parameters on the model output