12. Model Verification and Validation

12.1. Sensitivity Analysis

As the graphs above have already demonstrated, the revival of Islam, understood as the increasing influence of unofficial Islamic groups, could be simulated without difficulty.

In contrast to the gradual shift in religiosity, terrorist attacks were much more difficult to depict because they happen only occasionally. The main difficulty regarding the attacks was that the reach of the security forces is not supposed to exceed the reach of the terrorist attacks because otherwise no terrorist attacks would ever occur since the terrorists would be arrested 'preventively'. Therefore, I handpicked these parameters using probable empirical values. To arrive close to these, I chose the impact of terrorist attacks slightly greater than the reach of security forces.

The arrest of undesirable agents by security forces was easy to implement and quite similar to Epstein's civil violence model. As with Epstein, I too use a virtual *prison-term* for both detained terrorists (180 ticks) and detained protestors (40 ticks). This refers to around three to fifteen years in prison in the real world. The parameter is the same for all cases although in reality the sentences are not the same length in all countries. Nevertheless, since it is difficult to obtain reliable estimations of the average arrest-time, and also since the parameter does not have a great impact on the outcome, these differences were ignored.

The parameter *protest-time* was chosen for a short time only (5 time-steps) because if it is too long the protestors do not stop protesting if their neighbours are detained for a long time (however, this is gradually the case and therefore no problem with regards to sensitivity – the system should not be discarded because of this.

Representing the probability of *radicalization* of arrested Muslims by the PTS-value of the respective countries was constructive. If I enhance the radicalization rate with a higher PTS the system reacts as it is supposed to: subsequently more terrorist attacks occur. The decision to include PTS as an empirical factor for further radicalization was a good one, as we will see in the next section.

I conclude that on the whole the model is robust, but draw special attention to the ratio of the reach of the security forces versus the reach of terrorist attacks. Diverse context-legitimacy values do not have a fundamental impact on the simulated 'revival of Islam'; rather the tendency is, as intended, either accelerated or decelerated.

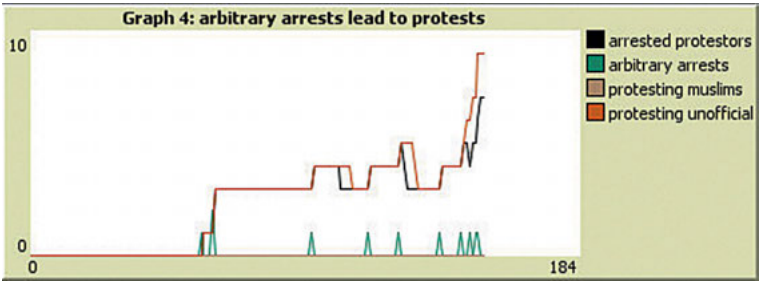
12.2. VERIFICATION: MUTUAL REINFORCEMENT OF SECURITIZATION

The model successfully represents the intended theoretical assumptions. Moreover, it describes the development of an escalating vicious circle of repression against devout Muslims and the radicalization of protestors and arbitrarily arrested individuals. In the eyes of the security forces, the detention of devout Muslims is well justified. Therefore they believe that citizens' protests against these detetions are illegitimate and undermine the authority of the state. As a result, security forces take action against the protestors and round them up. As we can see in the following example, no terrorist attacks or protests will take place unless the government starts to securitize:

Figure 19: No Detentions and No Protests

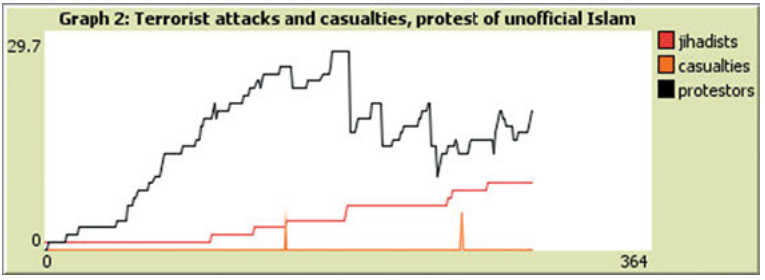
As soon as there are 50 sympathizers of unofficial Islam, however, the security forces start to arrest them arbitrarily, protest breaks out and the vicious circle gains momentum: the protestors themselves are then arrested which leads more individuals to protest:

Figure 20: Detentions and Protests



Here we see that initially the majority of devout Muslims are arrested arbitrarily – but they only act as a trigger. After some time (when the protestors become more numerous), the number of those who protest rises disproportionately to the number of arbitrary arrests: the conflict escalates. As a consequence, the number of protestors arrested and the number of those who are radicalized in prison and subsequently become jihadists increases. This then leads to more terrorist attacks:

Figure 21: Protestors, Jihadists and Casualties



12.3. VALIDATION: SIMULATION RESULTS AND EMPIRICAL DATA

The model represents not only the theoretical assumptions derived from the case studies and from securitization theory, but also has important similarities to the real world, as I will show in this section. The graphs presented here are the outcomes of ten runs for each case only (which is actually insufficient for deriving stochastically representative statements). Although the explanatory power of the simulation would be enhanced with the presentation of statistical analyses from the simulation outputs, to do so here would go beyond the scope of this study.[1]

I present here the correspondence of the simulation results with empirical data for the main reference values of the study:

- Terrorist attacks
- Securitization by state actor
- Violation of human rights by state actor (operationalized as arbitrary arrests of sympathizers of unofficial Islam)

1 For example, it would be possible to combine NetLogo mit R or Mathematica for this purpose.

12.3.1. Terrorist Attacks

The actual number of suicide attacks is highest in Uzbekistan in contrast to Kyrgyzstan, which has recorded no attacks up until today. As terrorist attacks are very rare events, it is very difficult to obtain proper simulation results for them with my model. It was necessary to simulate a cross section of only 5,000 citizens from the total population because the program would not run correctly if the number were any higher. Due to the fact that significantly fewer than one out of 5,000 persons would commit such an attack, it was necessary to constrain ourselves with possible sympathizers of suicide attacks instead of with the terrorists themselves. For these reasons, the simulated terrorist attacks were much too frequent in our model (when extrapolated to the total population) and therefore would be better understood as potential terrorist attacks (because of the encounters between sympathizers of suicide attacks and security forces). However, if I divided my results by 10,000 (assuming that only one out of 10,000 possible attacks would really be executed), the result is very good: Uzbekistan displays the greatest potential for suicide attacks, followed by Kazakhstan, Kyrgyzstan and Tajikistan respectively. The table below shows the empirical and the simulated data for terrorist attacks.

Table 34: Validation of Terrorist Attacks

	Kazakhstan	**Kyrgyzstan**	**Tajikistan**	**Uzbekistan**
Empirical Data				
Number of Suicide Attacks (Incidents) (GTD)	2	0	1	7
Simulation Results				
Extrapolated to the whole Population [2]	5.0	0.4	0.3	8.1

2 Extrapolated for the total population and divided by 10,000.

The comparison of the simulated data with suicide attacks does not take the Tajik civil war into account because many 'conventional' terrorist attacks were reported there during this period which could not be represented in the simulation.

12.3.2. Introduction of Securitization by State Actors

In the real world, securitization by state actors means the introduction of restrictive religious laws. In the simulation here I compare the time span (years) since independence until these laws were introduced with the time-span (ticks) when securitizing behaviour by security forces began.

Table 35: Validation of Timing of Securitizaton by State Actors

	Kazakhstan	**Kyrgyzstan**	**Tajikistan**	**Uzbekistan**
Empirical Data				
Name of Law	Law on Religious Activity and Religious Associations N 483-IV 3PK	On Freedom of Conscience and Religious Organizations	No 489. Law on Freedom of Conscinece and Religious Associations	On Freedom of Conscience and Religious Organizations
In force since	2011	(2009) Amendments 2012	2009	1998
Simulation Results				
Simulated time-steps until securitizing move by state actor starts	46.6	59.3	1.1	1.0

As in the real world, so too in the simulation were those two states with the most significant religious populations the first to begin the securitization of unofficial Islam. The comparison of the order in which securitization commenced is therefore represented correctly. However, the simulated difference in time between them could be more accurate – Tajikistan is actually closer to Kazakhstan although it was the second government to introduce securitizing religious policies. An important fact in this regard is that the fatwas of the Tajik Muftiate started to be very restrictive in the early 2000s already. (I consider here only the 2012 law in Kyrgyzstan because it is much more restrictive than the 2009 law.) Tajikistan is a special case anyway as it witnessed a civil war between secular forces and an opposition with Islamist participation in the early 1990s.

12.3.3. Arbitrary Arrests, Religious Persecution and Banned Groups

Although Kazakhstan was the second last government to begin the securitization of Islam, in reality it catches up to Tajikistan in terms of the number of people detained on religious grounds. As the simulation displays, albeit in a slightly exaggerated form, this is also the case in the real world. This exaggerated effect does not pose a problem because it may even come closer to reality if I measure state repression against unofficial Islam not only by calculating the number of arbitrary arrests in the real world but also by using the ARDA religious persecution index. Kazakhstan receives a three point grade by this index after Uzbekistan (six points) with Kyrgyzstan and Tajikistan, which are much less restrictive, receiving only one point. (I assume here that restrictions on religion have a direct impact on the number of arrests on religious grounds as the main restriction in these countries is the banning of religious groups whose sympathizers are subsequently imprisoned for being sympathizers of an illegal organization.) If we compare the ARDA index to my simulation results of arbitrary arrests (as an indicator of the actual state repression of religious groups), we see that it corresponds to it perfectly. However, the data in the table below are the simulation outputs divided by 1,000. Here too the same problem we encountered with the attacks persists: the very low numbers cannot be represented correctly in a simulation of only 5,000 citizens.

Table 36: Validation of Constraints on Religious Freedom

	Kazakhstan	**Kyrgyzstan**	**Tajikistan**	**Uzbekistan**
Empirical Data				
Religious persecution Index (ARDA) [3]	3	1	1	6
Estimations of current detentions on religious grounds	350	50	350	7,000
Simulation Results				
arbitrary arrests, extrapolated for the whole population (total)	374	41	50	719

These results furthermore are in agreement with my findings which show that Kyrgyzstan and Tajikistan are more open to non-traditional or political Islamic groups than the other two countries, although Kazakhstan is still less restrictive than Uzbekistan in this regard as well. The replication of the approximations of religiously motivated arrests provided by Memorial member of staff Vitaly Ponomarev is not totally correct. Whereas these estimations for the real world refer to the number of current detainees on religious grounds, my simulated data refer to the total number of arrests since the beginning of the simulated process (as the detention time for alleged terrorists is very long, this does not disturb the comparison too much, though). Although the 'ranking' of the countries is once again correct, the measure for Tajikistan is too low and should be closer to Kazakhstan not Kyrgyzstan. Furthermore, the exceptionally high figures for Uzbekistan cannot be adequately accounted for. Despite this, a representation of state restrictions on religion using the simulated data on arbitrary arrests can be said to be quite successful overall.

3 Lower means less persecution.

Some concluding remarks on the validity of my model:

- A clear representation in the simulation of restrictions on religious freedom by means of arbitrary arrests.
- In a comparison of the four cases, terrorist attacks are correctly represented in the model although too frequently for a population of 5,000.
- The introduction of the securitizing move by governments is clearly explained by a minimum-number of sympathizers of unofficial Islam. Tajikistan is the least well represented case in this regard but this depends on the interpretation: if we take the civil war – with the antecedent criminalisation of the IRPT – into account, the result might even be correct in this case.