

Understanding the Interactions between International and Domestic Conflicts: The Case of Turkey and Greece

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Abstract

There is extensive literature on the causes of war and conditions for peace, but as yet no agreement on why countries go to war, why internal violence occurs and how internal and external conflicts might be interconnected or give rise to common dynamics or dilemmas.

The present study intends to investigate the variables affecting the probability of domestic and international conflict and the interactions between them using a system dynamic model. It proposes extensions to an existing conflict model in the literature along several dimensions, e.g., impacts of regime type, income distribution, assertiveness of the military and dyadic interaction between countries.

Conducting simulation experiments with this model lets the analysts explore the dynamic behavior and scenarios that result from any change in any of the factors. The model may serve as a useful learning tool for decision-makers, e.g., governments in assessing defense and foreign policies, and company executives in foreign direct investment decisions in different regions of the world.

The simulation is run between Turkey and Greece, since Turkey and Greece are the center of attention within the context of the EU enlargement process. One of the simulation results indicate that an international military conflict between Turkey and Greece is highly unlikely in the future, unless both countries increase their military budgets much above the levels in 2000.

Keywords: International Conflict, Domestic Conflict, Regime Type, Gini Coefficient, International Relations, System Dynamics, Turkey, Greece.

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1. Introduction

Conflict within and among nations remains a basic feature of the world's reality. As issues of trade, migration and environment are becoming more important in our increasingly interdependent world, questions of war, peace and conflict also remain of great importance. Companies interested in foreign direct investment in countries in problematic regions of the world are in need of dynamic models to assess the domestic and international conflict risks in those countries.

The earliest literature on war theory accessed by the authors of the present paper is Robinson (1900) in which economic, social and political developments are cited as the causes of war between tribes and nations and states as the history unfolds from Aristotelian times to the end of 19th century. Cause and occasion of war has been distinguished by Howert (1916) by suggesting that while occasions of war are many and varied, the causes are few. The causes of the wars in Europe were reduced to three categories: religious, economic and political. As both religious and political beliefs have an economic basis, hence these three sets of causes may be reduced to one, the economic.

Since 1984 conflict has been studied by various researchers from different perspectives:

1. *democracy* (Forsythe, 1992; Evans and Whitefield, 1995; Oneal et al., 1996; De Mesquita and Siverson, 1997; Milner and Rosendorff, 1997; Reiter and Starn III, 1998; Bennett and Starn III, 1998; Crescenzi and Enterline, 1999; Feng and Zak, 1999; Kugler and Feng, 1999; De Mesquita et al., 1999; Cardoso, 2001; Quinn and Woolley, 2001),
2. *internal and international politics* (Milner and Rosendorff, 1997; Pahre and Papayoanou, 1997; Fred-Mensah, 1999; Rothgeb Jr, 1999; Tose et al., 2000; Lim 2003),
3. *population, trade and economic development* (North, 1984; Saeed, 1994; Homer-Dixon, 1994; Morrow, 1997; Milner and Rosendorff, 1997; Bardhan, 1997; Gomory and Baumol, 1997; Werner, 1998; Tir and Diehl, 1998; Shin and Ward, 1999; Quinn and Woolley, 2001; Ofstad, 2002; Lim, 2003),
4. *impacts of war* (Gartner and Segura 1998; Werner 1998; Gartner 1998; Reiter and Starn III 1998; Smith, 1998; Bennett and Starn III, 1998; Kadera, 1998; Palmer and David, 1999).

The precise scale and scope of violence and its attendant level of damage to the human and social environments remain ambiguous, but it is known that the costs are high and mounting. National governments of modern world strive to attain high standards of living for their citizens. This causes stiff competition among and within nations for scarce natural resources. The interconnections of the causes and consequences of conflicts are likely to be greater when the conflicts become more violent.

This study proposes a system dynamics model of understanding conflict within and between nations, in which we follow Wils et al. (1998)'s conclusion that “*an interesting study would include multiple nations ...*” It proposes extensions to their model along several dimensions, e.g., impacts of *regime type, income distribution, aggressiveness of the military and dyadic interaction between countries.*

This work aims to contribute to the extensive literature on conflict by modeling international conflict between and domestic conflict within Turkey and Greece. These two countries have been chosen because of their important role in the EU enlargement process. The paper is structured as follows: Section 2 is the literature review on factors affecting internal and international conflict. Section 3 gives a brief and schematic overview of the Turkish-Greek relations over 900 years. Section 4 discusses the components of the proposed system-dynamic model. Section 5 includes data used in the model. Section 6 gives and discusses the simulation results. Section 6 concludes the paper.

2. Factors Affecting Internal and External Conflict

2.1. Studies on Conflict Theory

Research on conflict theory (i.e. studies of conflict or war using formal reasoning or mathematics) has been summarized by Intriligator (1982) along two dimensions, analytic approach and area of application (Table 1). He reports that use of a particular analytic approach in a particular area of application entails 64 possible combinations, but research tends to cluster in only certain of these cross-classifications.

Table 1. Classification of Research on Conflict Theory – (Intriligator 1982)

Analytic Approaches	Application Areas
Differential Equations	Arms races
Decision theory	War initiation/war termination/timing of conflict
Bargaining theory	Military strategy/conduct of war
Uncertainty theory	Threats/crises/escalation
Stability theory	Qualitative arms race/arms control
Action-reaction model	Alliances
Control theory	Nuclear proliferation
Organization theory	Defense bureaucracy/budgets

In the present work, system dynamics modeling which uses differential equations is employed.

2.2. *Military Spending and Trade*

Discussing possible answers of “*when is peaceful trade possible under military competition?*” Morrow (1997) argues that security concerns are unlikely to undermine trade. States can allocate more to their militaries to compensate for any enlarged threat to their security. Since such additional allocations are likely to be smaller than the gain from trade, trade increases national consumption even in the face of security concerns.

In Werner (1998), we find the answers to the following questions: “*Why do some wars end in extreme terms as total political capitulation while others merely reinstate the antebellum status quo? What settlement terms will the belligerents agree to in order to end the war?*” She explores the possible impact of regime type on the terms of settlement. She measures the regime type by institutionalized democracy variable, coded on an 11-point scale and indicating both the public accountability of the leader and the degree to which political competition is institutionalized.

Kadera (1998) reports a formal dynamic model based on three components that regulate interactions among regionally defined groups of states:

1. *transmission mechanisms, such as proximity or defense pacts, facilitate the spread of war.*
2. *transmission barriers, such as distance or non-aggression pacts, slow or prevent war diffusion.*
3. *constraints on the spread of war are imposed by states’ inability to expend an infinite amount of resources on fighting wars.*

She introduces the concept of “*the minimum level of military spending necessary for survival*”. Her “*level of war*” is similar to the “*level of conflict*” of the present work.

The impact of the local and regional context of arms spending and economic productivity on the link between guns and growth in each nation has been studied by Shin and Ward (1999). Trying to understand whether regional patterns and proclivities play an important role in the understanding of the link between guns and growth, they illustrate that changes in economic output and military spending are tightly coupled, but they fail to report a distinctive and universal relationship.

2.3. *Democracy, War and International Relations*

Weede (1992) states that “*theoretically, it makes sense to be much more confident about the peaceful effects of democracy on relations between and among democracies than on international relations in general*”. Forsythe (1992) puts forward the same idea “*it is now well established that stable industrialized democracies do not engage in overt international war with each other*”. Oneal et al. (1996) point out that “*many researchers have shown that democracies virtually never go to war against other democracies, a generalization confirmed by two centuries of experience*”.

Starr (1997) tries to find an answer to the question. *“Why democracies do not fight each other?”* He looks from the perspective of “democracy and transparency”. He states that “transparency means that leaders and population of other states can see that a country provides for the political and civil liberties which permit the regularized and legal contestation for political power. In democratic dyads this means both sides can see into each other. On one simple level, this makes war between democracies much more difficult than war between a democracy and an authoritarian regime”.

According to the lateral pressure theory, internal pressure, which is formed within the country, impacts democracy. Midlarsky (1998) argues the relationship between democracy and internal pressure. He states that *“specifically, if democracy affects the environment in positive ways, then the minimization of soil degradation, fouling of freshwater supplies and other forms of scarcity could lessen the tendency toward civil conflict over scarce resources. Democracy clearly is required for the equitable distribution of economic largesse or equitable redistribution in the absence of economic growth. Without the pluralism associated with liberal democracy, certain groups may be denied access to the policy-making process, thus making civil conflict more likely at some point in the future”*.

Using quantitative data drawn from interstate wars between 1816 and 1990, Bennett and Stam III (1998) demonstrate that the wartime advantages that accrue to democratic states are fleeting. In the short-run, democracies are reported to be more likely to win than are their autocratic opponents. However, autocracies are less likely to quit as time passes. This willingness to continue fighting ultimately leads to the result that after roughly 18 months have passed, the advantage passes to the autocrat. They also find that relationship between war outcomes and a number of control variables such as military-industrial capacity and military strategy vary over time. It is interesting that democracies carefully select wars that are more likely to be short and therefore have low costs.

Crescenzi and Enterline (1999) state that *“as the proportion of democracies in the international system increases, the number of interstate system members engaged in war decreases. Democratization may very well decrease conflict, but that this relationship may be contingent upon the neighborhood in which the process takes place”*.

By studying the U.S.-China (1979 – 1992) and U.S.-Soviet (1972 – 1981) relations, Langlois and Langlois (1999) report that states react to each other’s past moves and that bilateral relations begin with the widest tolerance of the other’s behavioral choice and the adoption of countervailing strategies. In the case of U.S.-China relations prior to 1987 they report that 5-months of past history describe the relationship best, whereas the lag is 6 months after 1987. The lag length that best captures the interaction between the U.S. and the former Soviet Union is reported again 6 months during *détente*, dropping to 3 months after 1976.

2.4. *Interaction of Internal and International Conflict*

The most detailed study within the concept of “System Dynamics” is made by Wils et al. (1998). The conceptual and theoretical bases of this effort have been derived from research on the theory of lateral pressure. Their analysis is based on initial differentiation among three variables groups:

- A. Master variables in the attributes of states and their interaction:
 - 1. population,
 - 2. resources,
 - 3. technology,
- B. Intervening behavioral variables (in terms of propensities for external behavior, trade, and military activities); and
- C. Outcome variables (in terms of internal and external conflict).

Specific feedback dynamics are incorporated to represent the impacts of conflict upon the internal characteristics of nations (which serve as the initial sources of conflict). The importance of these feedback dynamics lies in the need to recognize the patterns derived from the consequences of conflict, over and above those related to the sources of conflict.

In their study, Wils et al. (1998) present an integrated model, connecting the theory of internal conflict to the theory of lateral pressure by adding the internal conflict variables to that framework. Lateral pressure can be manifested in many different types of activity, depending on the nature of the demands that are not being satisfied domestically and on the capabilities that are available. Lateral pressure is not likely to be expressed unless both demands and capabilities are above some threshold. Lateral pressure within a state makes it likely to expand to where its economic or territorial aspirations collide with those of other pressured states, with international militarized conflict as the result. Those states said to be the most conflict-prone are those with high populations, high technology and inadequate resources.

The theory of lateral pressure argues that interaction among three master variables shape the national profiles of states and under certain conditions, generate pressures that result in expansion of activities outside national boundaries, possibly leading to competition, conflict and eventually overt violence. Wils et al. (1998) developed an important addition to the earlier lateral pressure theory by specifying internal tension that generates internal disruptions. This contribution stems from the notion that the same material variables that cause lateral pressure can also be factors of internal destabilization (Saeed, 1994).

The theory argues that the roots of conflict can be traced to the constellation of needs and wants of populations, given level of technology and the availability of

natural resources. If resources are limited relative to population demands and technology levels, the country will expand its behavior outside national boundaries. Lateral pressure refers to the propensity for extension of behaviors outside territorial boundaries.

Tir and Diehl (1998) categorize population pressure in two groups, static pressure as *“a high population density that may lead states to acquire new territory or resources contained in other territories in order to deal with the attendant spatial and environmental problems associated with overcrowding”*, and dynamic pressure as *“significant population growth, which may put increasing strains on states as they seek to accommodate the demands of the growing population”*.

The formulation for internal tension draws upon the population density emphasis found in arguments presented in anthropology and economics. Such arguments state that as population density relative to resource base rises, societies need to change their technological and social base, in general towards higher levels of complexity and sophistication –by devising intensified agricultural methods, industries, class differentiation, and such. High levels of population density and high levels of technology can result in internally stable societies, if access to resources is assumed; conversely, low population density requires only low levels of technology for stability. Independence movements, civil strife and revolutions are expressions of conflicts that emerge from internal tension and sometimes from external support to domestic groups as has been the case in Turkey.

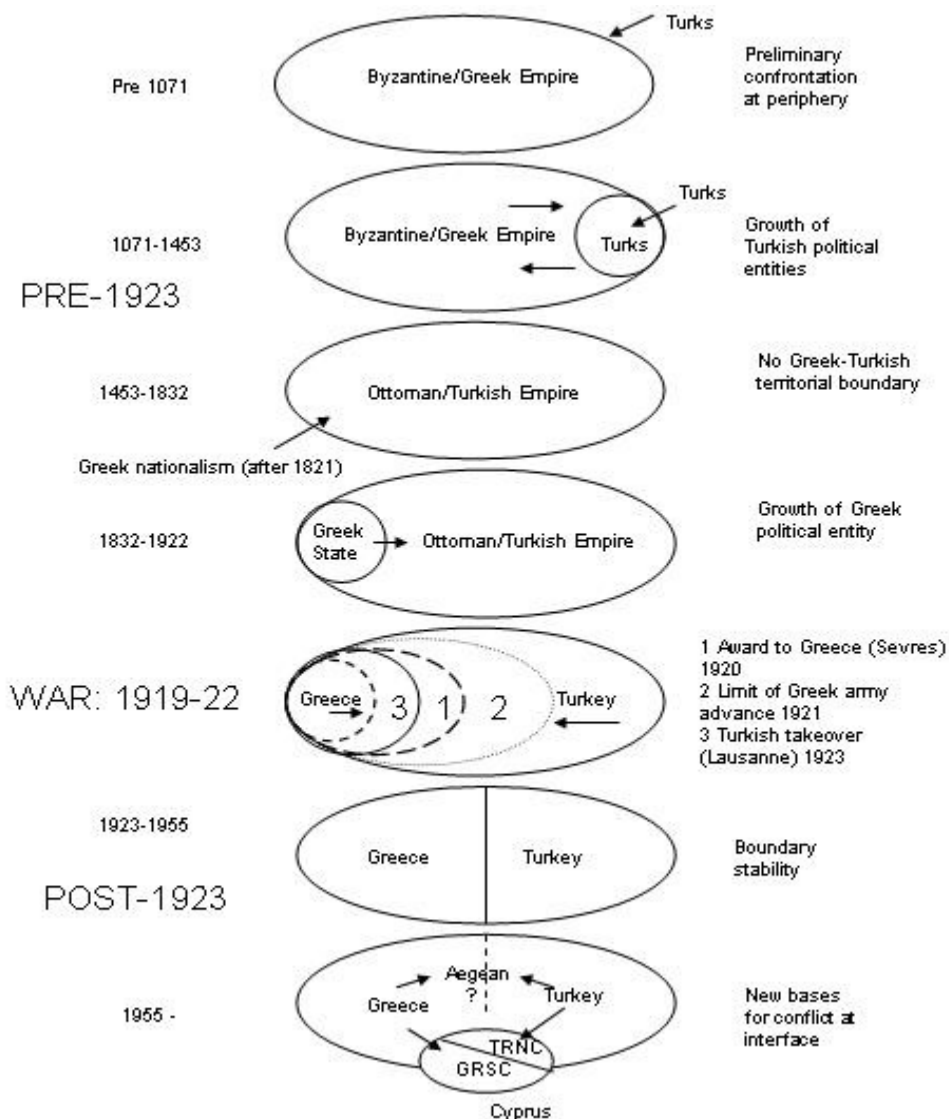
3. Brief Overview of Turkish – Greek Relations

Beeley (1978) gives a very neat summary of Turkish-Greek relations since 1071, when Byzantine defeat at Malazgirt in easternmost Anatolia opened up the peninsula to accelerated penetration from Turkish-speaking tribes from central Asia, establishing a clear political interface between them and the Greeks of the Byzantine empire. According to him the stability obtained by the separation of *actual or potential adversary groups into politically discreet territories* cannot be guaranteed in the long-term because the strategic, demographic and other elements taken into account in a “settlement” are themselves likely to change, perhaps radically and rapidly. The Turkish – Greek interface shows a variety of types of boundary/frontier at different stages over the course of time (Figure 1).

The dispute between Greece and Turkey concerning the continental shelf in the Aegean is discussed by Gross (1977) from a legalistic perspective.

Coufoudakis (1985) discusses the Greek-Turkish relations during the period 1973 – 1983 from the Greek perspective with special emphasis on Cyprus issue.

Figure 1. The Greek-Turkish interface (modified from Beeley, 1978)



4. The Proposed System Dynamics Model of Conflict

The contribution of the present work to the model of Wils et al. (1998) is summarized below, before discussing the details of the model in the following subsections:

Military Buildup and Trade Bargaining

1) The military force (MF) is redefined to have “*level of assertiveness*” which may affect the probability of international conflict in different ways.

2) The variable “*trade and bargain leverage*” is a dyadic interaction point between two countries. *International conflict* is another common variable for both countries. *International conflict* for a country has *potential of international conflict* of the other country as input.

Dynamics of Conflict

3) The level of international and domestic conflict is defined by differentiating between 0 and 1 by steps of 0.2 (Table 2a and Table 2b).

Tables 2a and 2b define levels of conflicts and the assumed impact on *population* and *technology*.

Table 2a. Level of international conflict and its impact on population and technology

LEVEL	INTERNATIONAL CONFLICT	population	technology
0.801 - 1.000	War	X	X
0.601 - 0.800	Low Intensity Armed Conflict	X	X
0.401 - 0.600	Military Alarm		X
0.201 - 0.400	Diplomatic Conflict		
0.000 - 0.200	None		

Table 2b. Level of domestic conflict and its impact on population and technology

LEVEL	DOMESTIC CONFLICT	population	technology
0.801 - 1.000	Coup d'etat; countrywide terrorism	X	X
0.601 - 0.800	Regional Terrorism	X	X
0.401 - 0.600	Clash involving Demonstrations		X
0.201 - 0.400	Demonstrations		
0.000 - 0.200	None		

4) The intensity of conflict is defined as the proportion of the military forces of the countries under consideration.

5) “*Consequences of conflict*” variable is redefined. It is obvious that each level of conflict has different impact on master variables. This consideration is another important contribution of this study.

Effect of Technology on Lateral Pressure

6) The effect of technology on lateral pressure is redefined.

Effect of Level of Democracy

7) The “*Regime Type*” variable is added to the model. By defining the level of democracy of the country under consideration, the effect of regime type on both lateral and internal pressure has been put forth for consideration.

Effect of Income Inequality

8) The “*Gini coefficient*”, a measure of the income equality, has been added to the model.

The model was run with variables of Turkey and Greece. Vensim Professional has been used for system dynamics modeling and simulation.

List of conflicts involving Greece and Turkey are given in Appendix-A.

The stock and flow diagram of the model is presented in Figure 1. To clarify the implications of the linkages at hand, there are a number of propositions representing the causal logic in terms of dynamic feedback relationships. The propositions are rooted in the theory of lateral pressure and taken from it (Wils et al., 1998). In the following sections, components of the model are explained briefly.

4.1. Population, Technology and Resources

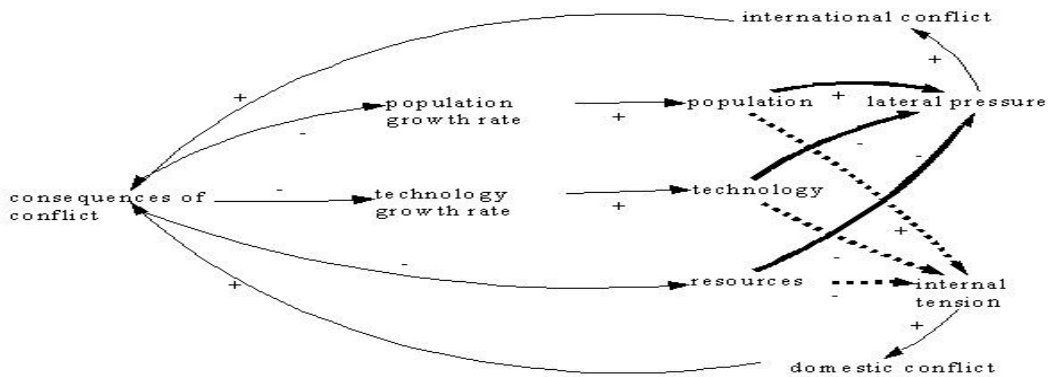
The variables population, technology, and resources provide the basic impulse which sets in place the causal mechanisms contributing to emergence of conflict at various levels, and conflicts change the relative values of these variables.

According to the theory of lateral pressure, *population* and *technology* are positively related to *lateral pressure*, which increases *international conflict*; in turn, conflict and violence reduce the prevailing *growth rates of population* and *technology*. The effect of technology (defined as “*GNP (purchasing power parity adjusted) per capita*”) is considered as negatively related to lateral pressure. When the technology increases *Gross Domestic Product* increases, consequently *Military Expenditure* rises also. Enhanced *military force* increases the *probability of international conflict*. This indirect effect of *technology* is considered as the positive effect of technology. But the direct effect of technology on lateral pressure is accepted as a negative relation. The positive effect of technology is explained in the next section.

By contrast, the theory states that natural resources are negatively related to lateral pressure, which reduces *international conflict*, but that if *conflict* occurs, the *consequences* negatively influence *natural resources*; this results in a reinforcing feedback loop.

Population increases *internal pressure*, which leads to more *domestic conflict*, and the consequences reduce *population growth*. On the other hand, *technology* reduces *internal pressure* and going around the conflict loop, this reinforces *technology*. The same logic is valid for *natural resources*.

Figure 2. Impact of population and technology on conflict (Choucri et al., 1998)



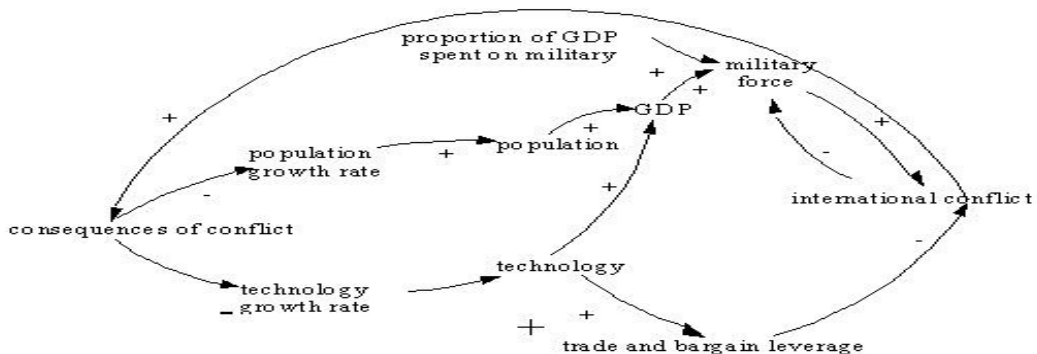
4.2. Military Buildup and Trade Bargaining

The intervening processes or variables may affect propensity for international conflict. Such processes include military build-up (i.e. increased likelihood of ‘paths’ to violence) or trade and bargaining (i.e., less violent ways of access to resources).

The military build-up is modeled in terms of a balancing feedback relationship. *Military expenditure* is taken as a user-defined proportion of real gross national product. When the GNP increases, absolute military expenditures rise also. The higher expenditures accumulate in greater military force. Enhanced military force, in turn, increases the probability of conflict. Military force is drained through depreciation of obsolete weaponry and through destruction during a conflict. If conflict occurs on national territory, it reduces GNP.

Trade and commercial interactions are involved in a reinforcing feedback relationship. Trade is positively influenced by the level of technological development and reduces the probability of conflict. The lower the level of conflict, the more positive are the implications for increased technological development.

Figure 3. Impact of military and trade on conflict (Choucri et al., 1998)

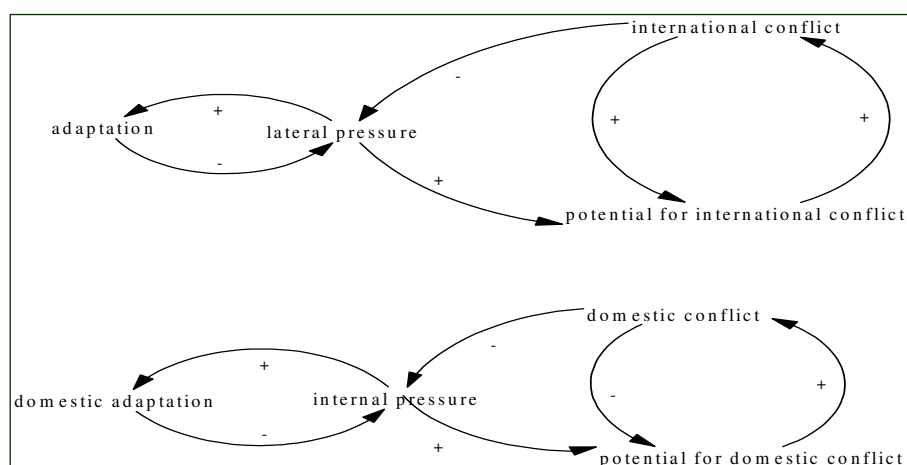


4.3. Dynamics of Conflict

In the dynamics of conflict itself, as lateral pressure and internal pressure increase, there are internal feedback mechanisms of adaptation that reduce the potential for conflict. While conflict acts as a pressure release valve, it also increases the risk of continued conflict, creating the possibility of a spiral of conflict. These are shown in Figure 4.

Domestic and international conflict affects population and technology in different ways depending on the level of conflict. These impacts are operationalized in different ways in model equations in the present study.

Figure 4. Dynamics of conflict (Choucri et al., 1998)



4.4. Effect of Technology on Lateral Pressure

Technology is one of the key variables relating human activities to the environment. The sophistication and the type of technology used in a particular society determine which natural resources are useful and exploited; and to what measure. As the level of technology increases, the number of resources and the intensity of use increase also. This has two effects. The first is that the total need for natural resources rises. The second is that the dependence on a specific natural resource, such as land, declines.

This dual effect explains the paradoxical nature of technology. Technology has enabled a release from the dependence on a specific resource, namely land. Yet, technology has also increased the use of natural resources overall, including the use of the environment through pollution.

The dual effect of technology is reflected in the specifications for lateral pressure and internal pressure. While the tendency for technology to increase the overall need is expressed in lateral pressure; the effect of reducing dependence on the specific resource, land, is reflected in internal pressure.

4.5. *Effect of Level of Democracy*

One of the most important variables, which affects lateral and internal pressure, is the type of the regime within the country. In the literature it is generally named as the *level of democracy* since there are many countries named as democracy but no relation with democracy in practice.

Democratization is the process of building or creating democracy. Viewed from another angle, democratization may be either intensive or extensive. By intensive (or vertical) democratization the change in the quality of the democratic experience in a given community should be understood. Extensive (or horizontal) democratization, on the other hand, measures the quantitative extension of democratic communities and their global spatial reach.

The empirical finding that democracies do not fight each other has long suggested that regime type influences international behavior. States with more democratic characteristics tend to behave more cooperatively and less conflictually in the international system. Non-democracies, however, tend to have more conflictual and less cooperative behavior. It makes sense to be much more confident about peaceful effects of democracy on relations between and among democracies.

As argued in the lateral pressure theory the other aspect of the pressure is internal pressure, which is formed within the country. Democracy within the country is clearly required for the equitable distribution of economic values, equal access to the policy-making process, equal and high level of human rights between citizens.

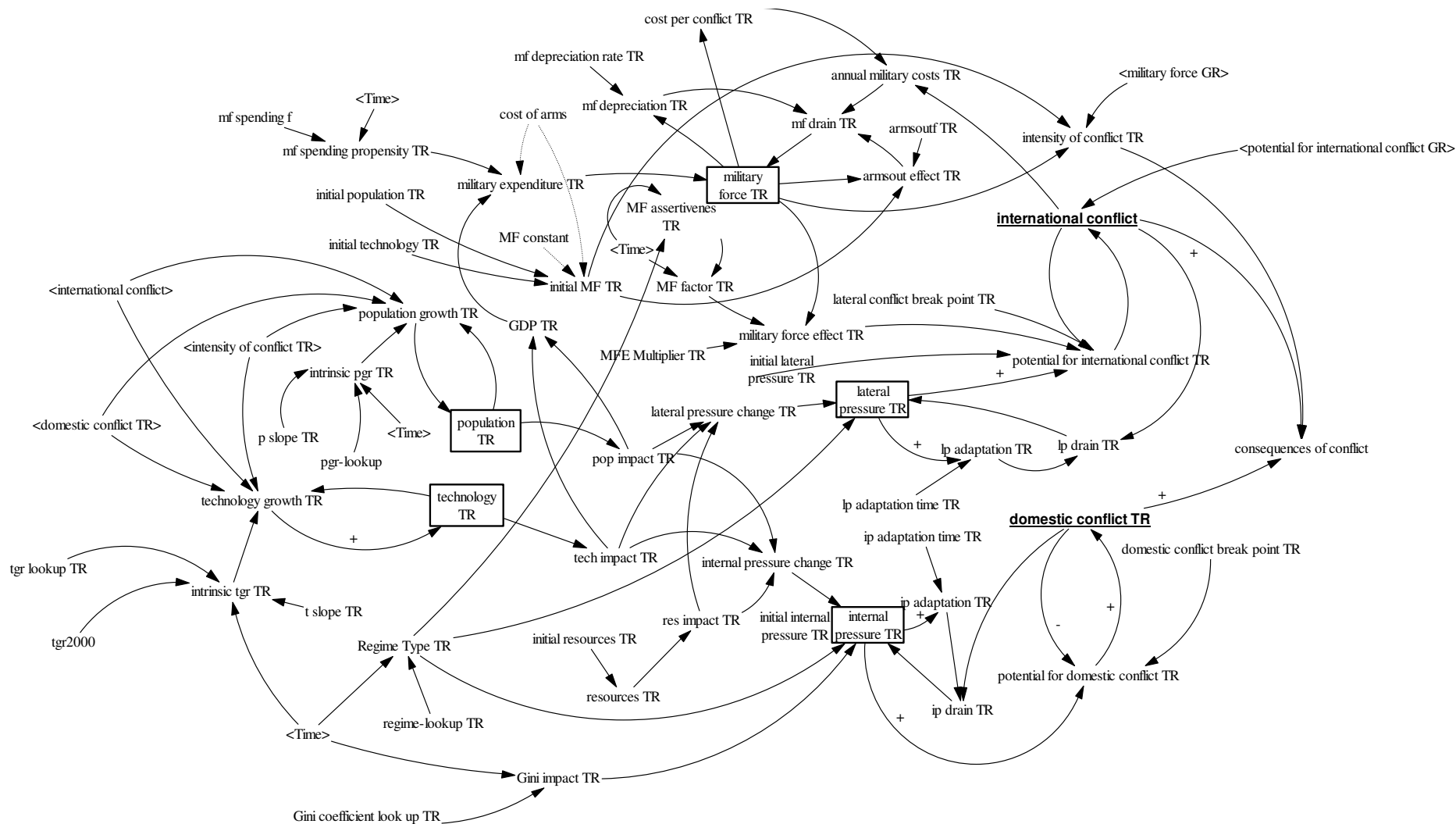
A non-governmental organization, Freedom House in the U.S., has been publishing an annual assessment of state of freedom since 1972, by assigning each country and territory the status of “free”, “partly free” or “not free” by averaging their political rights and civil liberties ratings. Countries are receiving a rating between 1 and 7 (1 the best and 7 the worst).

4.6. *Effect of Income Inequality*

Income equality is an important factor, which plays a significant role in creating internal pressure. By its increasingly social nature, income equality is inseparable from the field of domestic politics.

Countries, in which there is an important income inequality, may face several social fluctuations from *trouble* to *domestic conflict* dependent on the level of inequality. The term in economic literature used to measure income equality is “Gini Coefficient”. It is defined as “*a measure of dispersion within a group of values, calculated as the average difference between every pair of values divided by two times the average of the sample*”. The larger the coefficient, the higher the degree of dispersion. It is a statistical measure of income equality ranging from 0 to 1. A measure of 1 indicates great inequality; i.e., one person has all the income and the rest have none. A measure of 0 indicates perfect equality; i.e., all people have equal shares of income.

Figure 5. Overview of the Model



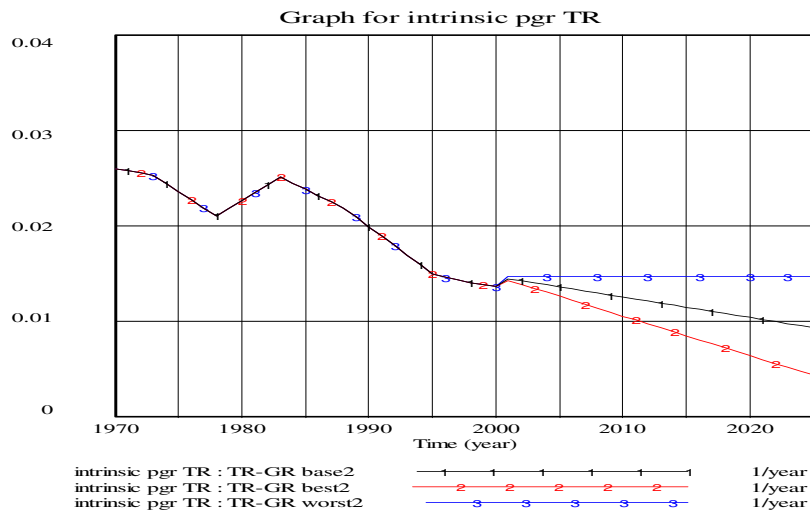
5. Data

In this section, we will present data used in the model in tabular or graphical form.

5.1. Population and Resources

In the model we took population of the year 1970 (35,605,000) as initial population level for Turkey. Actual 1970-2000 population growth rate and assumed values for three scenarios are depicted in the Figure 6.

Figure 6. Rates of Population Increase in Turkey (1970-2025).



Population and other data of Turkey and Greece are given in Table 3.

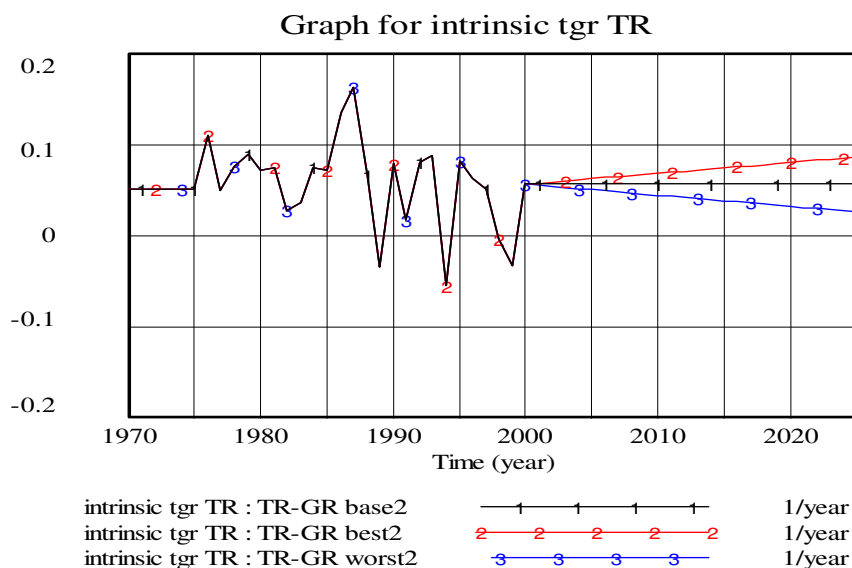
Table 3. Country resources data

	Population	Life Expectancy	GDP per capita (ppp) (US \$)	Military Expenditure (% of GDP)	Military Force (Active)	Land Area (km ²)
	2000		2000			
TURKEY	65,700,000	72.8	6,300	4.20%	639,000	780.580
GREECE	10,600,000	78.1	14,800	4.60%	162,300	131.957

5.2. Technology

In the technology equation, the intrinsic technology growth rate takes a constant value of 0.077 between the years 1970-2000 and then decreases with a constant slope reaching a value of 0.002 by the year 2025.

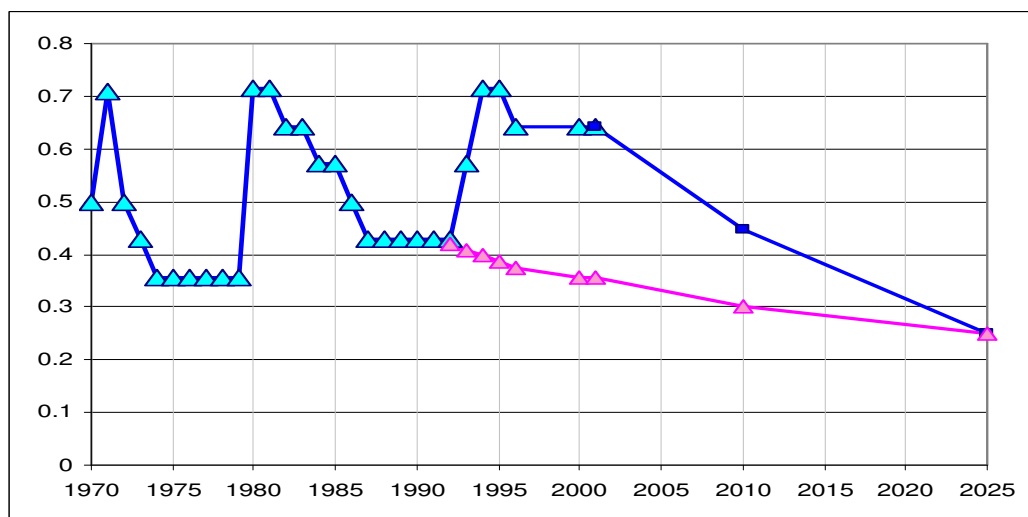
Figure 7. Intrinsic Technology Growth Rate for Turkey



5.3. Regime Type and Democracy

Data published by Freedom House have been used in the first part of Figure 5. The model will be run using two different sets of data for the 1992-2025 (assumed) and 2000-2025 (extrapolated from Freedom House data). With possible EU membership materializing in 2014 it is a safe assumption that level of democracy will reach that of average EU level by 2025 (Figure 8).

Figure 8. Level of Democracy (Freedom House data for 1970-2000; assumed values for 1992-2025).

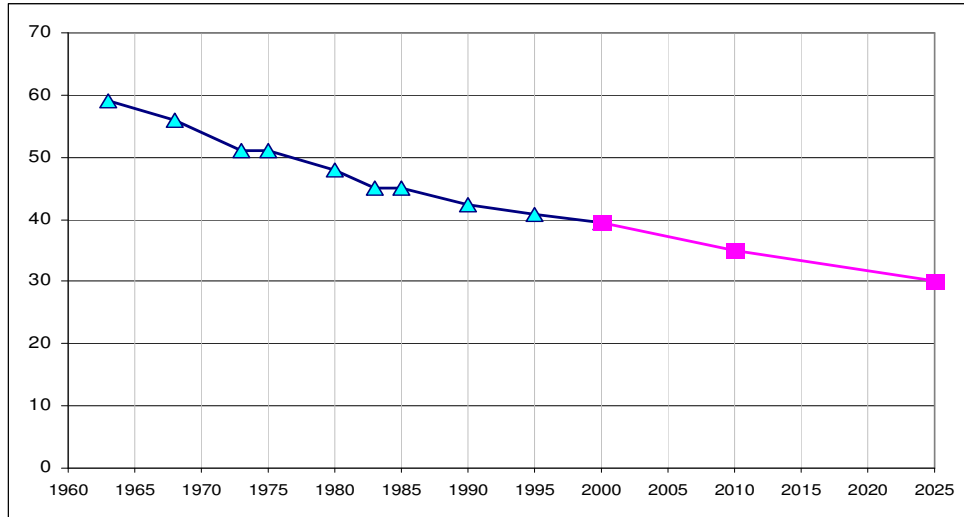


5.4. Gini Coefficient

Gini time series data for 1963-2000 have been collected from various sources including United Nations publications. We assumed that after Turkey's EU

membership by 2010 the improvement in the income distribution in Turkey will accelerate as shown in right part of the graph (Figure 9).

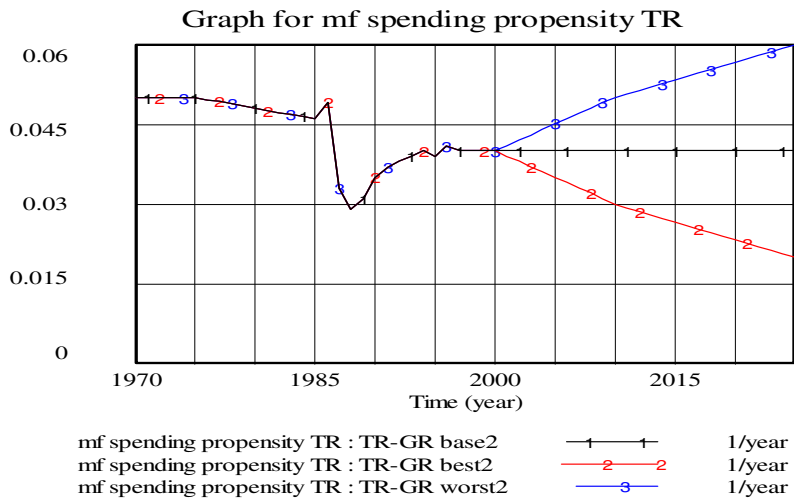
Figure 9. Gini coefficient for Turkey; (triangles from literature, squares assumed).



5.5. Military Power

Military spending as a percentage of GDP has been plotted in Figure 8. In the model this percentage has been assumed to decrease from 2010 (possible/probable EU membership) to 2025 linearly reaching a final value of 0.02.

Figure 10. Military Spending as percentage of Turkish GDP.



6. Simulation Results

The model was run between Turkey and Greece. The time horizon of the Turkey - Greece simulation is 55 years. The period 1970 - 2000 is used for comparing the model output with historical conflict data and adjusting the parameter values accordingly for the base run and the period 2000 - 2025 is for future simulation.

In this study international and domestic conflict levels are defined to take values between 0 and 1. To make easier the interpretation of model output the pressure is defined by differentiating between 0 and 1 by 0.2 steps. Table 2a and Table 2b show the levels of international and domestic conflict.

The time series evaluation of the variables population and technology, which are the inflow to the stocks in the model, namely military force, lateral pressure and internal pressure are presented in Figure 11.

6.1. Scenarios and Sensitivity Analysis

Sensitivity analysis of simulation means performing repeated simulations in which model parameters are changed for each run. This can be very helpful in understanding the behavioral boundaries of a model and testing the strength of model-based policies.

The model is based on quite a few assumptions and these assumptions are known to be uncertain. It is possible to change the assumptions one at a time and simulate the model to understand the implications. There is an alternative way to do this, known as “Multivariate Sensitivity Simulation” (MVSS). To do this, it is essential to set ranges on the uncertain assumptions, and then the model will be run multiple times with randomly selecting values for the uncertain assumptions.

For example, actual population growth rate of Turkey is 0.0153 in 2000. Then this rate will decrease with a slope of 0.000213, which means the population growth rate will be 0.01 in 2025. This slope was used in the baseline simulation. For sensitivity analysis the range of this parameter should be set to a minimum value, which represents the minimum value that the slope can take on, and to a maximum value, which implies the maximum value that the slope can take on. These values are set to -0.0004 and 0.00. In 25 years there may be +/- 54% change in technology growth rate: technology growth rate = $0.056 \pm 25 * 0.0012$.

In the baseline simulation the output shows the population of Turkey will be between ca. 84 and 92 million with a reliability of 95% in 2025. Table 4 summarizes the assumed value of various variables used in three different scenario settings. Table 5 lists the ranges of major variables used in the multivariate sensitivity simulation.

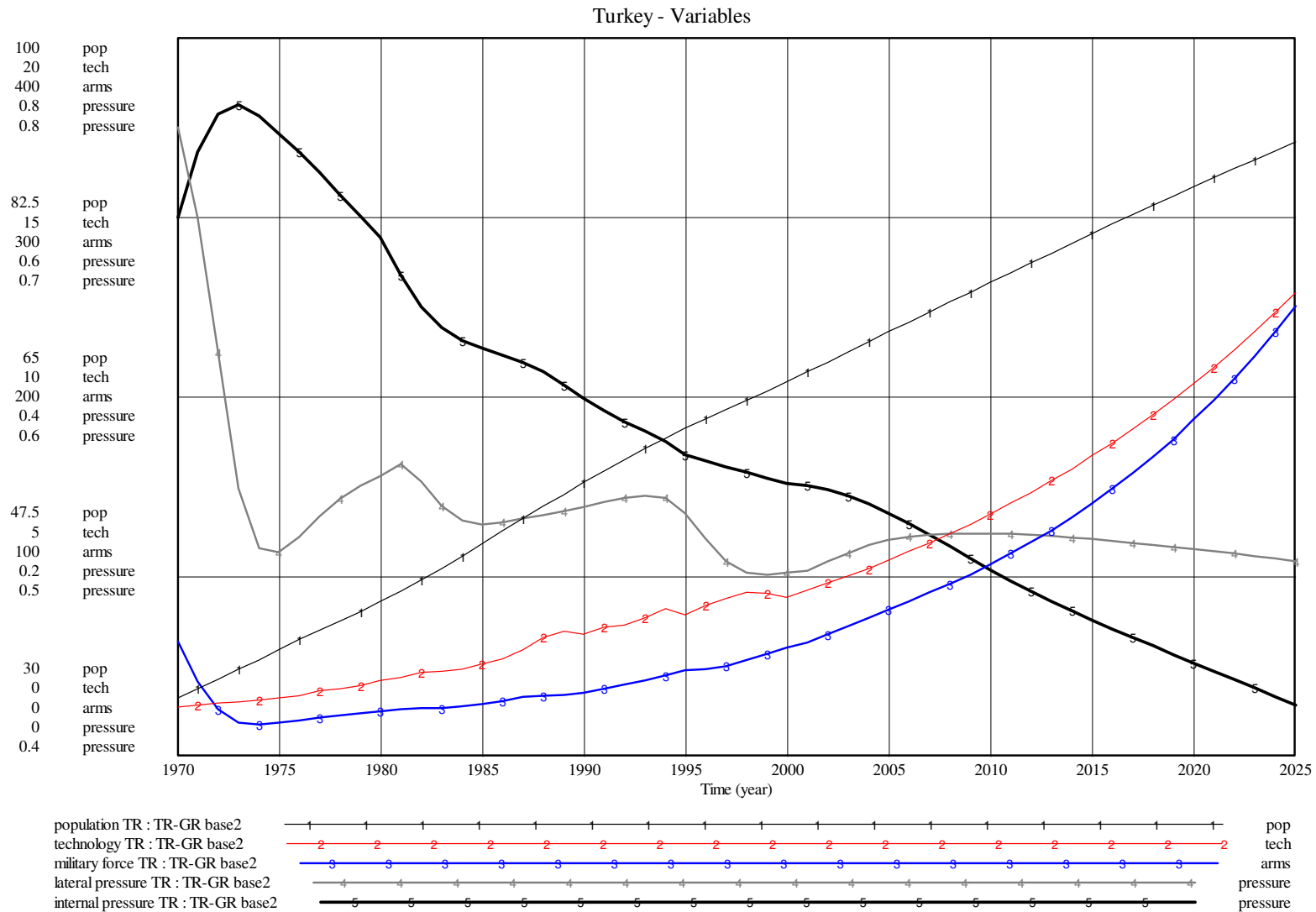
Table 4. Values of Several Variables for 3 Scenarios

Scenoria	MF spending propensity		Gini		Democracy		t slope		p slope		
	TR	GR	TR	GR	TR	GR	TR	GR	TR	GR	
Base	2000	0.04	0.046	39.54	35	0.35	0.286	0	0	-	-
	2010	0.04	0.04	35	31	0.30				0.000213	0.000246
	2025	0.04	0.04	30	25	0.25	0.18				
Worst	2000	0.04	0.046	39.5	35	0.35	0.286	0.0012	0.0012	0.00	0.00
	2010	0.05	0.05	42	37	0.40					
	2025	0.06	0.06	50	40	0.45	0.30				
Best	2000	0.04	0.046	39.54	35	0.35	0.286	0.0012	0.0012	-	-
	2010	0.03	0.03	30	28	0.20				0.000413	0.000346
	2025	0.02	0.02	25	20	0.14	0.14				

Table 5. Ranges of Several Variables for base model for sensitivity analysis.

	modelValue	Min	Max	modelValue	Min	Max
Base Model	TR	TR	TR	GR	GR	GR
ip adaptation time	3.5	2.8	4.2	3.5	2.8	4.2
domestic conflict break point	1.9	1.52	2.28	8	6.4	9.6
initial internal pressure	0.7	0.56	0.84	7.4	5.92	8.88
lp adaptation time	18	14.4	21.6	18	14.4	21.6
lateral conflict break point	5	4	6	5	4	6
initial lateral pressure	0.7	0.56	0.84	0.7	0.56	0.84
t slope	0.00	-0.0012	0.0012	0	-	0.0012
p slope	0.000213	-	0	0.000246	-	0.00

Figure 11. Variables of Turkey



6.2. Domestic Conflict

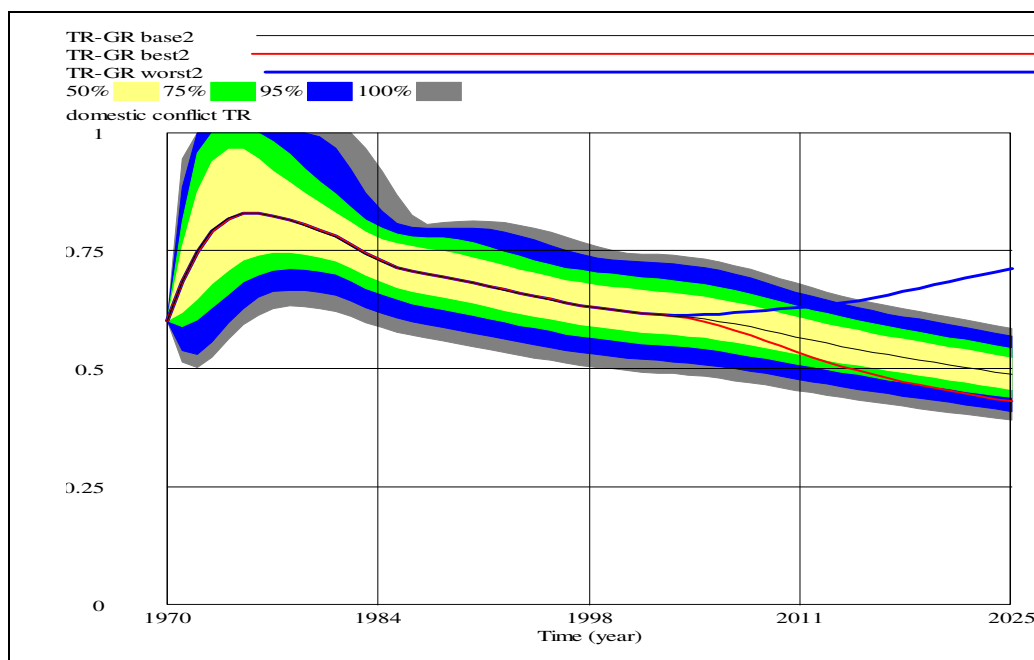
As seen in the Figure 10 the high pressure in the pre-1980 period in Turkey implies terror actions in the whole country. In this period Turkey was in a big trouble with terrorism and has experienced the highest level of domestic conflict.

After this period tension began to fall and reached to 0.6-0.8 level in 1984. From 1984 on the tension implies the regional terrorism activity as it actually happened. By a slight decrease this tension continues until 2010 (Figure 13).

The tension is at 0.65-0.5 level between 2010 and 2020, which implies the clash involving demonstrations. The reason for this pressure might be several but for the near future human rights demonstrations, income inequality, high rate of inflation, economic difficulties, etc., could be counted.

The Turkish government and people need to recognize that the “worst case” parameter values (high population increase, high military expenditure, etc.) result in an increase in domestic conflict after 2005.

Figure 12. Domestic Conflict Turkey



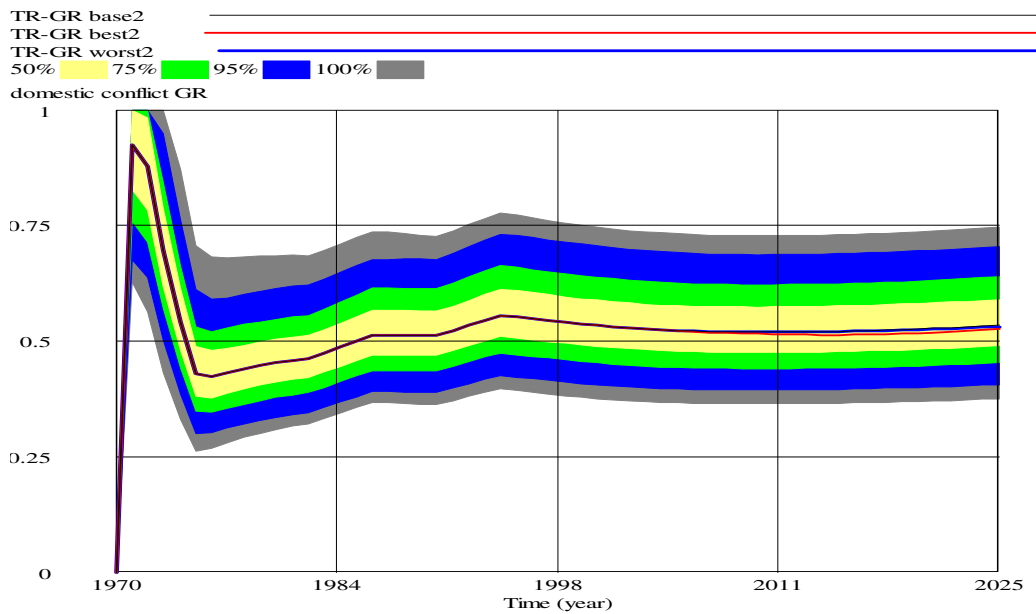
After 2020 the pressure will decrease to 0.2-0.4 level, which implies demonstrations level. During this period it might be expected that Turkey will not face an important level of pressure.

Turkey must be careful about the level of military expenditure. If the level of military expenditure is increased (scenarios 2 and 3) domestic conflict increases above its 1990's level after 2020. When/if Turkey becomes a member of EU by 2010 the situation may change.

According to the model structure, the limited geographic size of Greece increases the chances of domestic conflict after 2010 (Figure 11). However, incorporation of the

effect of the EU membership into the model structure may certainly change this model behavior.

Figure 13. Sensitivity Analysis of Domestic Conflict Greece.



6.3. Scenarios

Figures 14a, 14b and 14c show results of three scenarios.

Figure 15 shows that an international conflict between Turkey and Greece is highly unlikely. Political leaders of both countries should stop using expressions in their speeches which would imply a conflict between the two countries. It is rather interesting that the model does indicate the existence of conflicts in 1984 and 1996 (cf. Conflict #s 16, 18 in Appendix A).

Figure 14a: Sce-base - Domestic and International Conflict TR-GR

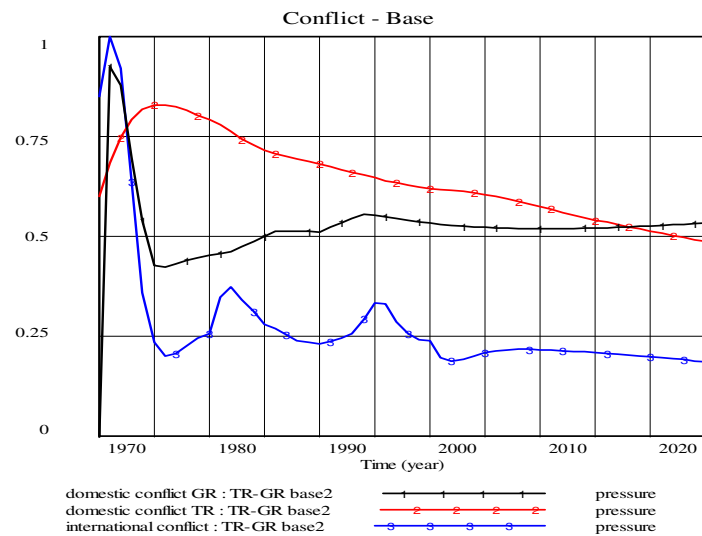
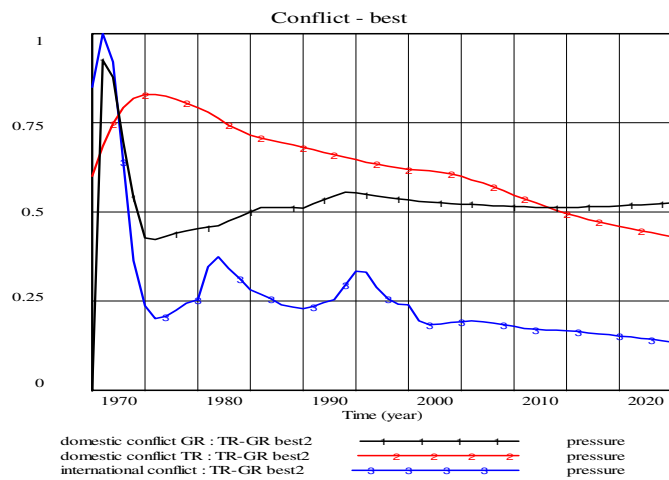
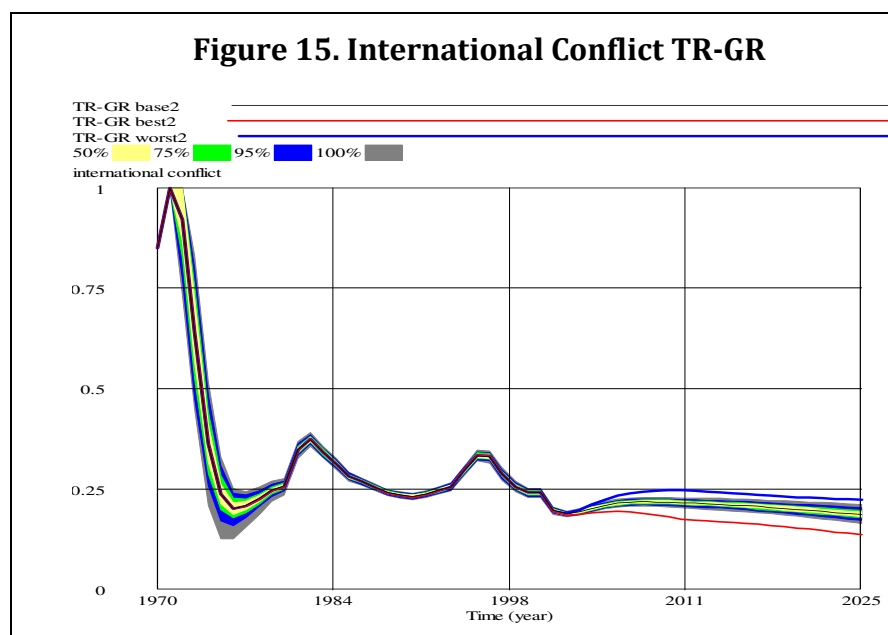
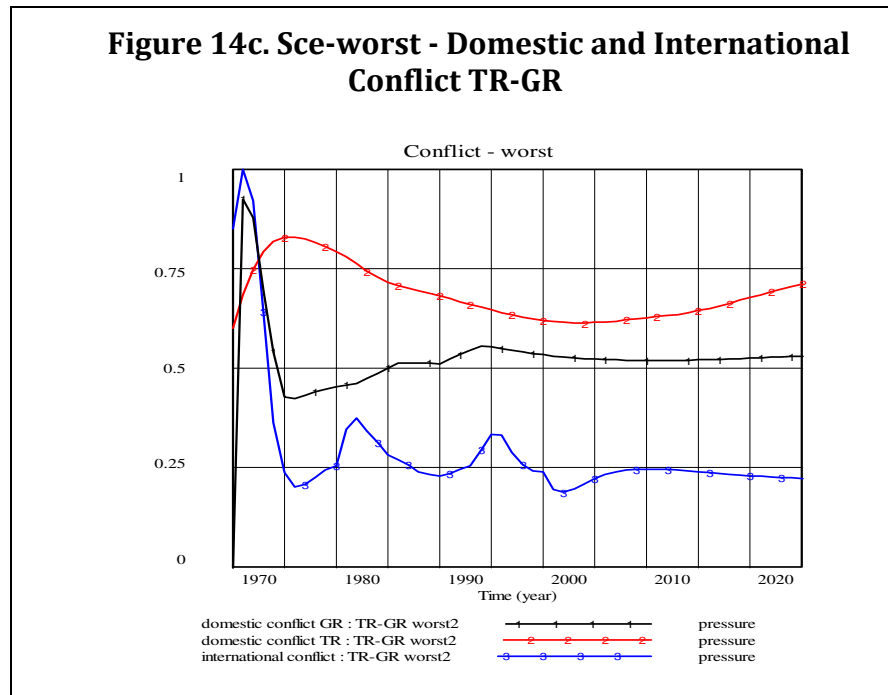


Figure 14b. Sce-best - Domestic and International Conflict TR-GR





7. Conclusion

We have used system dynamics modeling to examine the major processes that generate conflict and warfare within and between nations in the case of Turkey and Greece.

The dynamic structure of international and domestic conflict was explored by defining population, technology, resource, military expenditure, trade and bargain leverage, democracy level and income equality level, which are the inflow to lateral and internal pressure, of Turkey and Greece. *The simulation results indicate that an international military conflict between Turkey and Greece is highly unlikely in the*

future, unless both countries increase their military budgets much above their levels in early 21st century.

The attribute of military force was modified by military force assertiveness which has an impact on the probability of international conflict. Consequences of conflict variable was argued and redefined. It is obvious that each level of conflict has different impact on master variables. This consideration is another important contribution of this study. The level of international and domestic conflict is defined by differentiating between 0 and 1 by 0.2 steps. This made the analysts able to analyze the different levels of pressure.

By conducting simulation experiments with this model, we explored the dynamic behavior and scenarios resulting from any change in any of these elements. The time period for the simulation was selected 55 years. The period of 1970-2000 was used to calibrate the simulation results with actual historical results. The period of 2000-2025 is used to explore the dynamic behavior of the model.

In this model structure, variables such as population, technology, resources, military expenditure, democracy level and income equality level etc., are identified. But in real international relation system there are several other factors that have impact on international and domestic conflict. For example tourism movements, student exchange programs, foreign direct investments between neighbors have impact on the possible conflict between these countries. Addition of these and other variables to the model will be subject of further studies.

Future studies may incorporate interactions among the neighbors of Turkey (e.g. Greece-Bulgaria, Greece-Iran, Iran-Iraq, Iraq-Syria) and the 2003 developments in Iraq.

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Appendix A. List of Conflicts Involving Turkey

o	NAME of CRISIS	DATE	INTERNATIONAL CRISIS ACTOR	VIOLENCE	TRIGGERING ENTITY	CRISIS TRIGGER	OUTCOME SUBSTANCE	OUTCOME FORM
	Cilician War	1919-1921	Turkey-France	War	France	Non-Violent	Definitive	Formal Agreement
	Greece-Turkey War I	1920	Turkey-Greece	Minor Clashes	Greece	Violent	Definitive	Unilateral
	Greece-Turkey War II	1921	Turkey-Greece	War	Greece	Violent	Definitive	Unilateral
	Greece-Turkey War III	1922	Turkey-Greece	War	Turkey	Violent	Definitive	Unilateral
	Mosul Land Dispute	1924	Turkey-UK	Minor Clashes	UK	Political	Ambiguous	Semi-Formal Agreement
	Bulgaria-Turkey	1935	Turkey-Bulgaria	No Violence	Turkey	Non-Violent	Ambiguous	Semi-Formal Agreement
	Balkan Invasions	1940-1941	Turkey-Balkan Countries-Italy-Germany	War	Italy-Germany	Violent	Ambiguous	Unilateral
	Kars-Ardahan	1945-1946	Turkey-USSR	No Violence	USSR	Political	Ambiguous	Unilateral
	Turkish Straits	1946	Turkey-USSR	No Violence	USSR	Political	Definitive	Unilateral
0	Truman Doctrine	1947	Turkey-Greece-USA	No Violence	UK	Economic	Definitive	Unilateral
	Syria-Turkey	1957	Turkey-Syria USA	Discussion	Syria	Political	Definitive	Unilateral

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1	Confrnt.							
2	Cyprus I	1963-1964	Turkey-Greece-Cyprus	Serious Clashes	Cyprus	Political	s Ambiguou	Formal Agreement
3	Cyprus II	1967	Turkey-Greece-Cyprus	Minor Clashes	Cyprus	Indirect Violence	Definitive	Formal Agreement
4	Cyprus III	1974	Turkey-Greece-Cyprus	War	Non-State Actor	Internal Challenge	Definitive	Unilateral
5	Aegean Sea I	1976	Turkey-Greece	No Violence	Turkey	Non-Viol. Mil.	Definitive	Unilateral
6	Aegean Sea II	1984	Turkey-Greece	Minor Clashes	Turkey	Violent	s Ambiguou	Semi-Formal Agreement
7	Aegean Sea III	1987	Turkey-Greece	No Violence	Turkey	Political	s Ambiguou	Semi-Formal Agreement
8	Kardak Island	1996	Turkey-Greece	No Violence	Greece	Political	s Ambiguou	Semi-Formal Agreement

Source: Werner (1999)