

Simulating Ethnic Conflict and Secessionism for Joint Experimentation

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ABSTRACT

The post Cold War period has been characterized by a dramatic increase in intra-state conflicts, the later significantly outpacing inter-state wars both in their duration and intensity. In an increasingly globalizing and interdependent world intra-nation conflict in the guise of ethnic conflict has serious implications for regional and international stability.

There is a burgeoning literature on the relative salience of political, economic, and social conditions in the emergence, escalation, and diffusion of ethnic unrest. Contributing theories analyze the significance and/or interaction of conditions such as deprivation, inter-group antipathy, institutional constraints, demographic change, predatory groups, and external intervention on ethnic awareness, mobilization, unrest, and subsequent irredentist goals. There is also a plethora of research on strategies for managing intra-state conflict. While conspicuous attempts are being made to synthesize explanations and prevention of ethnic unrest and secessionism, few methodological tools are available that can fully integrate the theories and strategies at various levels of a socio-political system—individual, group, national, and international.

This paper presents a multi-agent simulation as a technique to explore, test, and validate theories of ethnic conflict at multiple levels of analysis. Specifically, it presents the development and implementation of a ‘Virtual State (VS)’ and the subsequent ‘Virtual International System (VIS)’ to explore:

- conditions for the emergence of ethnic unrest,
- conditions for the diffusion and escalation of ethnic conflict,
- conditions for the emergence and success of secessionist movement, and
- conditions for the success of multilateral interventions and the effects of DIME (Diplomatic, Information, Military, Economic) actions on prevention of secessionist movement.

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INTRODUCTION

Intra-state conflict in the guise of ethnic, religious, regional, or linguistic differences is one of the most significant threats to the territorial integrity and stability of various countries in the present international system. Apart from its various attributes such as endemic violence, mass-killings, genocide, and fragmentation of the polity, ethnic conflict is one of the very few potent factors that can trigger intense mass conflict engulfing significant parts of the world. Porous state boundaries and cross border ethnic linkages make diffusion and escalation of conflicts a distinct possibility for neighboring states. The Arab-Israeli conflict and the conflicts in Sri Lanka, Rwanda and Burundi, Somalia, former Yugoslavia, Sudan, and Liberia are prominent cases in point.

While ethnic conflict has been one of the endemic features of the state system, the post Cold War world has seen a marked rise in ethno-nationalist movement. With its irredentist goals, ethno-nationalism is fast becoming a matter of grave concern for scholars and politicians alike. According to Bertrand (2004) ethno-nationalist conflict is a specific type of ethnic warfare that has the objective of establishing a new nation-state through secession, the latter requiring systematic organization, resource accumulation, and a greater role of ethnic elites in directing violent acts.

Theories explicating ethnic conflict are a combination of economic, political, symbolic, and psychological factors essential to the development of animosity between groups. Explanations include: group worth, group stereotyping, and group anxiety (Horowitz 1985); relative deprivation and economic advantages/disadvantages (Gurr 1970; Collier 2000; Giordano 2005; Besancon 2005); organizational resource accumulation and mobilization (Brubaker 2004); ethnic elites and mobilization (Brass 1997); globalization (Appadurai 1976); political institutions and access to and allocation of resources (Bertrand

2004); unequal control over state power and resources (Hechter 1995); identity and ethnic boundaries (Turner and Reynolds 2001; Kaufmann 2001; Zartman 1997); and competitive electoral politics and ethnic outbidding (Horowitz 1991). A related stream of literature analyzes the linkage between ethnic conflict and *forms* of conflict. Specifically, this genre of literature analyzes the relationship between ethnicity and collective violence and the various ways in which violence can take ethnic hues (Brubaker 2004, 1998; Bertrand 2004).

Complicating irredentism is its externalization or diffusion due to third party interventionism. In a seminal article, Brown provides a summary of external dimensions of internal conflicts ranging from humanitarian intervention due to refugee crisis or genocide (NATO intervention in former Yugoslavia) to opportunistic interventions and invasions (South African support for insurgents in Mozambique and Angola, Syrian invasion of Jordan during the latter's civil war, Angolan invasion in Zaire, and Pakistan's assistance to insurgents in India's Punjab). According to Brown in all of the above examples the intervening states exhibited a combination of political, economic, and/or military interests (Brown 1996). Foreign interventions are also likely from culturally/religiously related powers (Lobell and Mauzeri 2004).

A third genre of discourse focuses on possible frameworks for the mitigation of ethno-nationalist mobilization and/or effective resolution of ethnic conflict. Varying in scope and funneled by ideological convergence of scholars, policy makers, and local implementers, conflict mitigation and resolution aims at identifying and supporting structures that help strengthen and solidify peace in a war torn region. This post-conflict operation requires a combination of military and non-military actions to stabilize and reconstruct a weak/failing state. Over the years, numerous policy options have been advanced to manage secessionist and violent ethnic mobilization such as power sharing (Lijphart 1985; Schnekener 2002);

repression (Adam 1971); economic aid and incentives (Carley 1997); economic sanctions (Rogers 1996); democratization (Snyder 2000); federalism and power devolution (Bertrand 2004); autonomy (Lapidoth 1996); forcible partition (Sambanis 2000; Kaufman 1988). Complementary strategy is the much propounded effects based operation (EBO) as delineated by the US Department of Defense (Smith 2002). EBO is a comprehensive strategy that aims at determining various courses of action—Diplomatic, Information, Military, Economic (DIME) across all elements of a state's power—Political, Military, Economic, Social, Information, and Infrastructure—(PMESII) in order to understand which courses of action can achieve the desired outcome.

Although numerous studies abound explicating the causes of ethnic conflict, very little is known about the conditions under which ethnic tensions emerge and regress towards secessionism, why one form of conflict occurs over others, and the clear factors that trigger violent conflicts. Similarly, little is known about why some states are more likely to intervene than others in conflicts outside their borders. Further, there is a paucity of literature on *conditions* under which successful intervention is most likely as well as the *types* of intervention that are most likely to succeed.

One of the difficulties in 'real world' analysis pertains to the scarcity of cases of secessionism which in turn are context and time dependent. Second, the enormity of variables and interaction effects and the immense difficulty in gathering relevant data pose daunting challenges to scholars and policy makers and can at best lead to partial understanding of ethnic conflict and of its mitigation. Finally, real life cases are serious risks to the local implementers who often lack the necessary information, or the optimal solutions for conflict resolution.

Computational experimentation methodology presents a new way of analyzing ethnic conflicts and secessionisms. In this approach one recreates the environment based on theoretical models of behaviors and calibrates them to fit the situation at hand. If the theoretical models are robust enough, then the situation re-created can give revealing insights into the situations under investigation. Obviously, there will always be a lack of data and deep understanding of the flow of information, the interaction between the key

actors, and the cascading effects of events leading up to the conflict. Agent based synthetic environment allows us to fill in the gaps through experimentation with the solitary and collective behaviors of individuals, groups, organizations, and institutions.

Agent based simulation methodology allows us to integrate and evaluate various existing theories, paradigms, and courses of actions in a single holistic framework. This 'third way of doing science' as eloquently stated by Axelrod (2003), is a 'virtual' interactive system that creates artificial autonomous agents that mimic the behavior patterns of their counter-part in the real world. These autonomous agents 'have control over their own behavior and can act without the intervention of humans or other systems' (Sawyer 2003). They can interact with other agents within the virtual environment and are able to communicate, negotiate, and cooperate with each other. Agent based simulations allow:

- researchers to run virtual experiments in an environment in which consequences of decisions can be measured and analyzed;
- integration of multiple theories from various specialized disciplines for a comprehensive understanding of underlying phenomenon;
- creation of representation of agents with multiple decision strategies both rational and non-rational;
- modeling of heterogeneous actors who can modify their behavior during the course of the simulation; and
- facilitation of a seamless and interchangeable integration of human and software agents (Buodriga and Obaidat 2004; Chaturvedi et al. 2005; Sawyer 2003).

Specifically, agent based modeling has immense usage in social science that is still concerned with how macro level phenomenon emerges from micro level actions. According to Sawyer, 'emergence of macro from micro is perhaps the most interesting feature of artificial societies. In the artificial societies...macro-structural phenomena emerge, attain equilibrium, and remain stable over time. Thus, artificial societies provide sociologists with a tool to explore the micro-to-macro transition' (Sawyer p. 333).

This paper is organized in two parts. In the first part we describe the development of large scale Virtual International System. We then configure a small-scale artificial society within the VIS concepts to study ethnic relationships in part two.

MODELING A VIRTUAL INTERNATIONAL SYSTEM

We use Synthetic Environment for Analysis and Simulation (SEAS) to construct a virtual international system (VIS) consisting of many multi-ethnic states each mirroring its respective counterpart in the real world. A Virtual State is represented by four primitive constructs: Individuals, Organizations, Institutions, and Infrastructures (IOII). These four primitives are used to model higher order constructs such as geographical entities (nations, provinces, cities), political systems (type of government, political parties/factions), military (soldiers, institutions),

theoretical paradigms as published in peer reviewed scholarly literature. Several theoretical paradigms from various disciplines were integrated to model the behavior of agents and the interaction pattern between them. Similarly, other states in the environment are also constructed to represent VIS. In addition to the intra-state interaction between agents, we construct rules for inter-state interactions.

Political and social systems of a state are modeled as a multi-agent system representing the human elements. Individual citizen agents are constructed as a proportional representation of the societal makeup of a real nation. Each individual agent consists of a set of fundamental constructs – traits, well-being, sensors, goals, and actions. For example, a citizen agent is encoded with static traits such as race, ethnicity, income, education, religion, gender, and nationalism; and dynamic traits such as religious, political, societal, and violence orientations. We

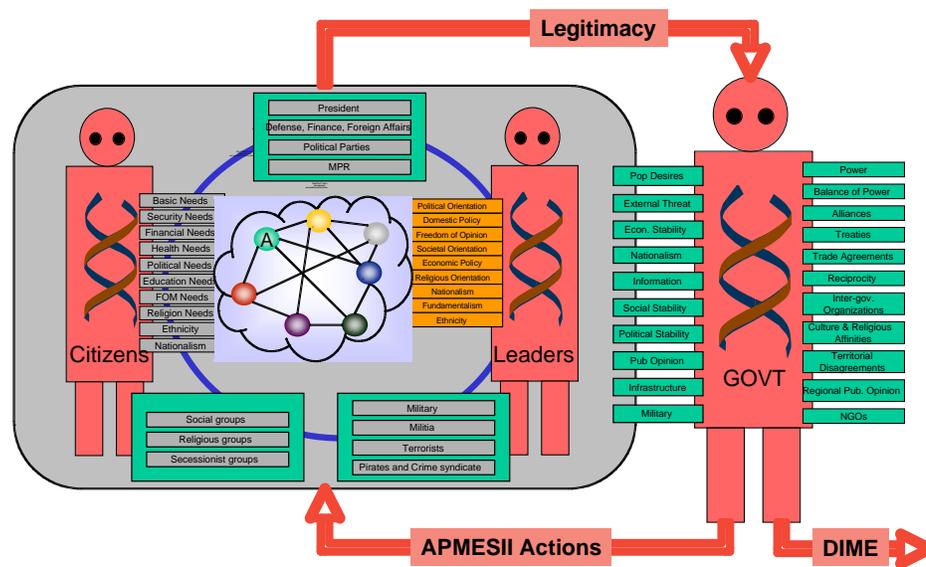


Figure 1. Agent Classes and Their Interactions in Virtual International System

economic system (formal and informal structures), social system (institutions, groups), Information systems (print, broadcast, internet), and critical Infrastructures (banking, oil and gas, electricity, telecommunications, transportation) as shown in Figure 1. The virtual environment also provides the rules that govern and guide the actions of agents and interactions between agents. These rules are based on various

use Kahneman’s (1999) concepts of **subjective well-being**, which refers to a person’s assessment of their perceived state of happiness or well-being. The agent’s well-being consists of eight needs: basic, political, financial, security, religious, educational, health, and freedom of movement. Traits and well-being together determine the set of basic goals for a class of agents. An agent uses its “**sensors**” to sense the

environment, listen to messages from his/her leader(s), the media, organizations, and other members of the society. Based on the sensed information, each agent can autonomously choose from its repertoire of configurable action set or adjust its goals. Traits, well-being, and goal determine the available actions each agent can take. For example, an agent can **migrate** to a different location (geography) to **seek** a better job to satisfy its **financial well-being**. Traits, well-being, sensors, and actions together determine the **behavior** of the agent.

climate of the synthetic environment and impose their stances upon citizens and organizations to promote their respective goals. The goal of leader agents is to set the agenda of the organization or institution in which they reside and persuade the citizen/member agents to make decisions that favors those positions.

Clusters of agents form groups, organizations, or institutions. They differ from individuals with regard to the rules that govern their behavior and intent. Groups are either informal or formal.

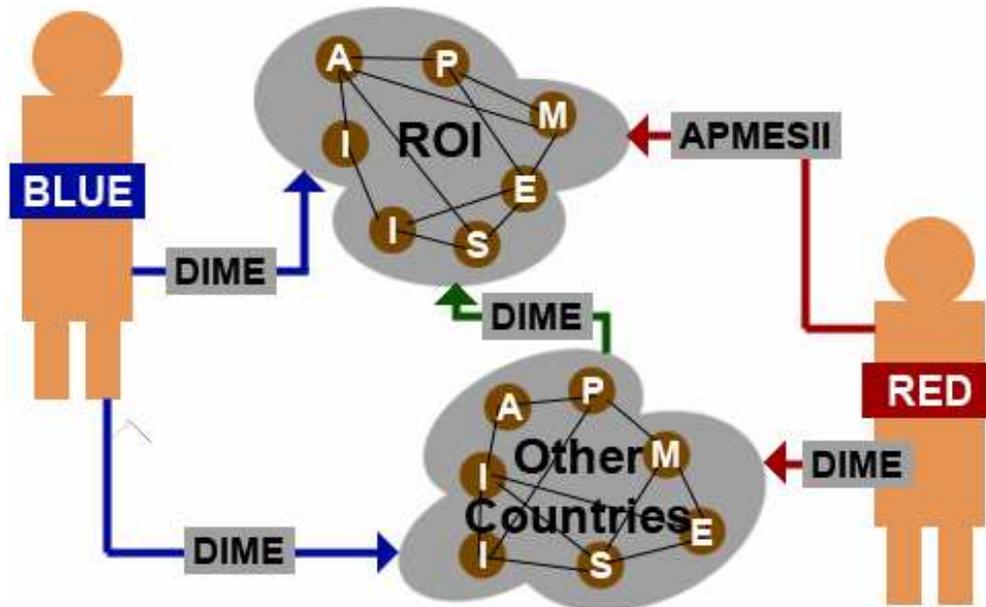


Figure 2. Interaction between Different Players in VIS. ROI: Region of Interest; DIME: Diplomatic, Information, Military, Economic Actions; APMESII: Agent, Political, Military, Economic, Social, Information, and Infrastructure Nodes.

An agent can be an ordinary citizen or a leader. The leader agent is encoded with influence levels that reflect his/her power within the group, organization, or institution. A leader agent is categorized as social, religious, and/or political and has a repertoire that is larger than that of citizen agents and includes additional traits such as power base, ideology, and his/her stance on economic, political, and social policies. These agents are able to affect the political and social

Formal groups' rules of engagement are published and are relatively static, while those of informal group are only known to its members and continuously evolve based on interactions among the environment, leader, and members. Institutions are like formal organizations with an additional power to influence the behaviors of members and non-members. An example of traits, well-being, sensors, and actions of different classes of agents are given in Table 1.

Table 1: Agent Repertoire

IOI Categorization	Entity Type	Traits	Goals	Sensors	Actions
Individual	<ul style="list-style-type: none"> • Citizens 	<ul style="list-style-type: none"> • Age • Income • Education • Ethnicity • Religion • Ideology 	<ul style="list-style-type: none"> • Maintain and enhance personal well being 	<ul style="list-style-type: none"> • Leaders • Organizations/ media • Institutions 	<ul style="list-style-type: none"> • Demonstrate • Riot
	<ul style="list-style-type: none"> • Leaders 	<ul style="list-style-type: none"> • Type Power oriented, Affiliation oriented, Responsive, Ideologue • Ethnicity • Race • Income • Education • Attitude towards group, state 	<ul style="list-style-type: none"> • Maintain and enhance personal influence • Maintain and enhance the influence of their organization • Maintain and enhance well being of their members 	<ul style="list-style-type: none"> • Followers' well being • Organizational power base • Control over resources 	<ul style="list-style-type: none"> • External Consensus Collaborate • Internal Set agenda Unify Coerce
Organization	<ul style="list-style-type: none"> • Informal groups • Formal organizations • Networks 	<ul style="list-style-type: none"> • Type • political, religious, social, economic, media • Size • Control over resources • Ideology • Ethnicity • Nationalism • Religion 	<ul style="list-style-type: none"> • Survive • Maintain • Increase membership • Seek influence 	<ul style="list-style-type: none"> • Member well being • Other organizations 	<ul style="list-style-type: none"> • External Demonstrations • Riots • Attacks • Internal • Set agenda • Collaborate • Unify • Seek consensus • Coerce
Institutions	<ul style="list-style-type: none"> • Government 	<ul style="list-style-type: none"> • Type • Political • Military • Economic • Spatial • Central • Provincial • Local • Power • Resource • Competence • Nationalism 	<ul style="list-style-type: none"> • Policy implementation • Policy adjudication • Policy enforcement • Policy formulation • Influence policies 	<ul style="list-style-type: none"> • Population's well-being component • Public's Confidence/legitimacy • Public's Trust • Resource availability • Other institution's actions • Incoming actions • DIME Actions 	<ul style="list-style-type: none"> • Internal Collaborate • unify • Coerce • Enforce • Respond • Prepare • Recover • Reconstruct • External Attack • Ally • Defend • Aid • Coerce • Trade

COMPUTATIONAL EXPERIMENTATION IN AN ARTIFICIAL SOCIETY

The main research question for this experiment is to examine under what conditions groups move between states of co-existence, e.g., from a peaceful state to secessionism and under what condition external intervention prevents or conflates the ethnic animosity.

We use VIS to create a small-scale artificial society to analyze the emergence of behavior between agents. While each autonomous agent makes their own decision based on the information they sense and the behavioral rules that they possess, the interplay among agents and between agents and the environment is modeled using socio-physics concepts (Arnopoulos, 1993). Socio-physics entails using laws of

physics to describe social behaviors. We use a special class of socio-physics, called attribute based gravitational method (ABG) to model interactions between individual agents. The individual level interactions give rise to emergent behaviors. ABG differ from the regular gravitation model in the following manner:

- a. The magnitudes of repulsion and attraction forces are based on the attribute rules.
- b. Only particles that match attribute rules will be selected for force calculations.
- c. Forces will be calculated for each “force attribute type” in an agent.

For the sake of simplicity, each agent in the society has three attributes: Race (alpha, beta), Income level (high, medium, low), and Religion (delta, omega). Each agent is either attracted to or repulsed by the other agent. The attraction and repulsion forces follow the standard force law:

$$F = G(m_1m_2)/r^2 \quad (1)$$

Where, F is the force the two agents exert on each other. G is the gravitational constant for the system, m is the mass (the number of citizens of that type), and r is the distance between them (race, income, or religion)

Race

The model assumes that people of the same race will be attracted to each other and people of different races will be repulsive. The force will also take into consideration historical hatred (hh), economic inequality (ei), political inequality (pi) and institutional repression (rp).

For the same race, the force of attraction is given by:

$$F = G(m_1m_2)/r^2 \quad (2)$$

If the race is different, then the force of repulsion is given by:

$$F = -(G(m_1m_2)/r^2 + A(ei) + B(po) + C(rp)) \quad (3)$$

Where, A , B and C are the weights of the respective variables in the model.

Income Level

The model assumes that agents in the higher socio-economic group will be attracted to agents with similar background and repulsed by those in the others. If income level is the same, the force of attraction is given by:

$$F = G(m_1m_2)/r^2 \quad (4)$$

If the income inequality is high, then the force of repulsion is given by:

$$F = -G(m_1m_2)/r^2 \quad (5)$$

Religion

The model assumes people of the same religion will exert force of attraction on each other and people of different religion will exert repulsive forces. The force will also take into religion inequality (ri).

For the case of same religion, the force of attraction will be:

$$F = G(m_1m_2)/r^2 \quad (6)$$

If the races are different, then the force of repulsion will be:

$$F = -(G(m_1m_2)/r^2 + A(ei) + B(po) + C(rp)) \quad (7)$$

A , B and C represent the weight of the respective variable in the model.

In addition to race, income, and religion, the following parameters have been identified based on the analysis of the literature previously discussed in the paper:

1. Historical animosity towards the other's race (each race=0 to 4, 0 being weakest)
2. Historical hatred towards the other religion (each religion=0 to 4, 0 being weakest)
3. Inequalities
 - a. Economy (each race) (low, medium, high)
 - b. Religion (each religion) (low, medium, high)
 - c. Political Power (each race) (low, medium, high)
4. Tolerance for inequalities
 - a. Economy (each race) (low, medium, high)

- b. Religion (each religion) (low, medium, high)
 - c. Power (each race) (low, medium, high)
5. Institutional repression upon a race (0-9) (zero being weakest)
 6. Institutional power (0-9) (zero being weakest)
 7. The initial rift between the races

Reduced Form Model of a Society

We build a small artificial society to study the situation described in the above vignette as shown in Figure 3. We construct an artificial

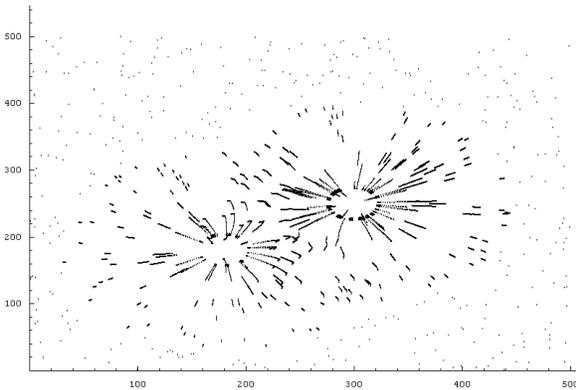


Figure 3. Emergence of two rival ethnic groups in an artificial society

society with two ethnic groups of citizens – a dominant group and a minority group. Each group of agents has certain traits and behaviors. The traits include race/ethnicity, control over resources (income), and religion (violence ideology). Each of these groups competes for resources and has certain dispositions about themselves and the other group as well as attitude toward the central authority. The groups consist of ethnic leaders with set agenda as specified in the table above. There is an external entity, which can be a regional country or UN or IMF. The external agent can either provide aid or impose sanctions on either group. The action ‘give aid’ is intended to increase the tangible resources of the group. The overall effect is to increase the control over resources. The second action ‘threaten or impose sanctions’ is a hostile action intended on intimidating groups into altering their behaviors.

We run a set of experiments to analyze the emergent behaviors of the relationships between the groups as shown in Figure 4. In the

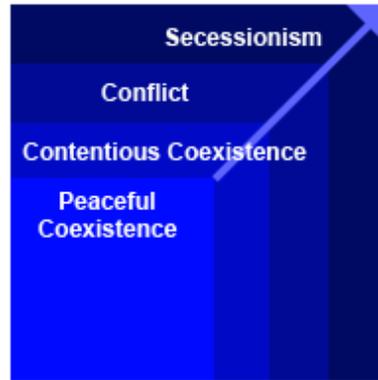


Figure 4. Emergent Ethnic Relationships in the Artificial Society

experiments we analyze the effects of economic and political inequalities while keeping the size and mix of the population constant. For each situation we calculate the level of rift between the groups as the economic and political inequalities shift. The level of ethnic rift is plotted over time as shown in Figure 5. The

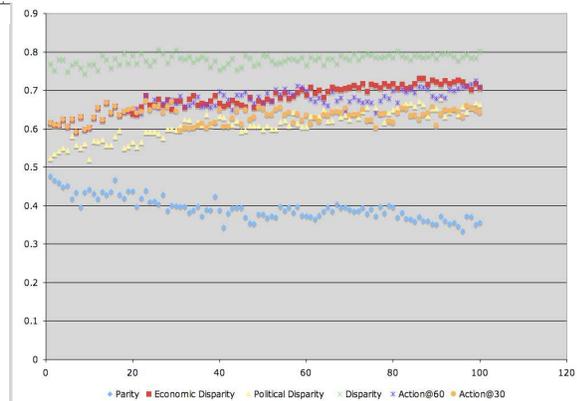


Figure 5. Emergence of different states of coexistence between the rival groups and the impact of external actions (economic aid)

citizens of the artificial society exhibit four broad states of ethnic relationship – peaceful coexistence, contentious coexistence, conflict, and secession.

It can be shown that even with diversity, groups can have peaceful coexistence if the economic and political inequalities are low. This state of coexistence is relatively stable and further

improves through prosperity and strengthens the institutions of the society.

Contentious coexistence occurs when there is high economic disparity but low political disparity. In such situations, groups will always compete for resources, thus pitting one against the other. If the institutions are strong then this state will persist, otherwise the economic disparity may lead to political disparity and repression. For societies in this state, the force of attraction between the groups is high enough to keep them together, and external influence has high thresholds to affect the state of the society.

Groups in a society can be in a state of conflict if there is political disparity even if the groups are equally well off. This type of disparity leads to repression of the weaker group and the erosion of social institutions. Societies in state of conflict are highly unstable and external influences can move it in either direction. If the societies are in the state of conflict for an extended period of time, there may be call for autonomy.

If there is both, economic and political disparity between the groups, and they have been in a state of conflict for an extended period of time and there are external influences, then ethnic conflict can move towards the demand for secession. There is a very high threshold for this state which generally is not reached without external influences.

CONCLUSION

In this paper we describe the creation of a Virtual International System using SEAS. We use VIS to create a small-scale artificial society to analyze the emergent ethnic relationship patterns. Our simple experiments reveal that ethnic relationships can broadly be categorized into four non-linear stages of group behavior—peaceful coexistence, contentious coexistence, conflicts, and secession. Each of these prototypical situations may resemble some country or another but does not include all the relevant variables that might go into ethno-political mobilization and secession.

Yugoslavia is an excellent case that supports the finding of our experiment, specifically movement from contentious coexistence to a complete break up of the state. A few significant interrelated factors contributed extensively to the

crisis. Internally, a weakening of the institutional structure of the state coupled with a gradual shift in ethnic balance of power led to a crisis of legitimacy for the government, which in turn was unable to respond to the demands and needs of various ethnic groups. Beginning in the late 1960's ethnic tensions increased due to wealthier republics resenting the economic burdens of sharing resources with the poorer ones. This state can be categorized as contentious coexistence. Government's response in the 1970's was to devolve power to the provinces giving them increased autonomy. This created a shift not only in power from federal to the various republics but also in ethnic balance from the Serb dominated federal government to various republics such as Croats dominated Croatia, and Slovenes dominated Slovenia. Externally, an IMF imposed macroeconomic stabilization program and the end of cold war severely affected Yugoslavia's economy and strategic positioning in the world. Resentment amongst ethnic groups grew with the heightened perception that the stabilization program adversely affected the republics that were the largest earners of foreign exchange. The IMF package was believed to have contributed to the bankruptcy of many firms and sharp increase in unemployment mainly in provinces such as Serbia, Macedonia, and Kosovo. Economic decline coupled with externally imposed reform program created a sense of deprivation and insecurity among the ethnic groups. This was aggravated by the role of leaders who began using nationalism as the dominant ideology to defend their republic's interests at the expense of the federal government. The federal institutional structures continued to weaken when republics such as Macedonia, Slovenia, and Croatia declared their republics to belong to Macedonians, Slovenes, and Croatians respectively. In each of the republics a predominant ethnic focus created perception of threat and security dilemma for other ethnic groups. For example, resentment amongst Serbs grew when they were asked to take loyalty oath in Croatia. Anti-Serb propaganda, ethno-nationalist rhetoric and widespread discriminations rekindled Serb fears and they started demanding territorial autonomy in Croatia. In mid-1991 in a referendum held in Croatia, an overwhelming majority voted for independence. Following that, in June of 1991 Slovenia and Croatia declared independence. Escalation of conflict occurred when individual states such as Austria and Germany gave

diplomatic recognition to Slovenia and Croatia, setting the stage for Yugoslavia's disintegration.

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