SOCIAL CONFLICTS AND MOVEMENTS: A NETWORK APPROACH

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Dedication

To my family...

Declaration

I hereby declare that except where specific reference is made to the work of others, the contents of this dissertation are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other university. This dissertation is my own work and contains nothing which is the outcome of work done in collaboration with others, except as specified in the text and Acknowledgments.

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Abstract

Today, the world experiences a permanent increase in wealth inequality. While the bottom half of the population is coerced to share less than 1 percent of world wealth, the top ten percent own 89 percent of all assets (Suisse, 2016). Money is not everything but in such a concentrated capitalist world, it is almost so. Widespread poverty and starvation is just two consequences, among innumerable others. As production centralized in a world-scale, competition escalates. Producers reduce the cost in return of unemployment and poor working conditions that steal the life of more workers each day. While unemployment rises among the young population, depression within juniors becomes a major threat.

In a world scale, nations are at war not only in the social or economic sphere. Armed conflicts spread to all over the world. Millions of people leave their homes and squeezed between borders. Unfortunately, "developed" countries handle this situation just as a "migration problem". These are only several problems of the current world, among countless others. Day by day, the system generates deeper social, political and economic destruction.

On the other hand, since Hegel, we are explicitly aware that each fact or situation reveals its own contradiction. Social processes are not an exception. Destruction comes with opportunities for recreation. Almost in all regions, local or extensive objections emerge in one or another sphere. Some take the form of political reaction, others as movement organizations or spontaneous street movements.

In the literature, the discussions on these movements build on the aspects of why and how they emerge and survive or fade. In such an unequal world; the one becoming more destructive for crowds and only relatively few groups benefits; another relevant aspect of the similar discussion should be considered: *why not*? Why are the crowds also poor in becoming organized to stop this destructive process? In this sense, analyzing only the generated movements has two main fallacies. First, in general, the discussions are condemned to stay in local spheres. Second, 'B explains A' doesn't imply

'absentee of B not explains $not - A$'. From this point, we can suggest the complementarity of these two aspects. In this thesis, I suggest communication processes as a bridging perspective. Accordingly, social movements are considered as products of communication processes.

The network mechanism has been criticized by construction being local. However, previous studies show the capacity of this mechanism in explaining many global phenomena. Several examples are discussed in the first chapter. The basic definitions and representations which will be used in the rest of the study are introduced in this chapter also.

The second chapter switches to social movements. The traditional theories of the social movements are reviewed from a critical perspective and the current developments on the subject are discussed. The necessity of a new perspective has been discussed in the plenty of current studies. In this chapter, I try to convince *audience* that it is promising to use network theory for social movements. At the end of the chapter, a general perspective is introduced.

I construct two different models in the following chapters so as to study different aspects.

The first one examines the possible network structures when there is interaction between conflicting identities. A standard communication network is modified by including heterogeneity in benefits received from connections. Moreover, benefits of indirect connections also modified based on through whom one connects. Like in the standard connection model, the network externalities generate discrepancy between stability and efficiency.

The fourth chapter is an application of the mechanism described in the second chapter. I discuss the structures under which agents willing to use interaction as a resource for action against opposition. Information dominance and size dominance are introduced as two sides of a coin in decision-making process. In the existence of various and complex identity structures, multilayer analysis is necessary. Moreover, defining mobilization as value transfers between opposites, the structures which generate possible mobilization acts are examined.

The thesis is concluded with a brief summary of main findings and discussion on further insight.

This thesis is an attempt to contribute literature on social conflicts and movements, especially which uses a network perspective. As far as we know, it is one of the few studies working network theory with a dialectic methodology.

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Chapter 1

Definitions and a Review of Network Theory

1.1 Introduction: Why Networks Matters

Humans are social beings. The relations one involved in shapes her identity and whole life. Social networks describe and define these relations. While generating significant social and economic outcomes, the boundaries of the opportunities formed by these relations reproduce many of them. Accordingly, although random ties are relevant in many contexts, strategic network formation is a significant complementary in the decision-making process.

Earlier empirical studies point out the significance of social contacts in socio-economic spheres (Granovetter, 1995; Milgram, 1967; Rees, 1966; Lazarsfeld *et al.*, 1948). Moreover, it is found that differentiation on network structures generates different outcomes for different groups (Moore, 1990). Several network models have been developed to explain these significant facts (Jackson & Wolinsky, 1996). Examples consist of the role of networks in labor market (Calvo-Armengol & Jackson, 2004), information gathering (Galeotti & Goyal, 2010) and knowledge diffusion (Cowan & Jonard, 2004), public goods provision (Bramoullé & Kranton, 2007), crime decisions (Calvó-Armengol & Zenou, 2004), construction of friendship (Currarini *et al.*, 2009) etc. How network structures influence on our lives make it relevant to understand the way networks affect behaviors and the structures more likely to emerge in societies (Jackson & Rogers, 2005). Although network analysis is criticized by being local in construction, networks provide ”the most fruitful micro-macro bridge (Granovetter, 1973, pp1360)”. Several studies explain global regularities through local phenomena by using network theory. Inequality

(Calvo-Armengol & Jackson, 2004; Kets *et al.*, 2011), Small Worlds (Jackson & Rogers, 2005), Core-Periphery Structures (Galeotti & Goyal, 2010), Homophily and Segregation (Currarini *et al.*, 2009) are some of the relevant examples and will be reviewed in the second part. Before passing to discussions on conflicting situations, social movements, and networks, this chapter clarifies main definitions and notations used in network theories.

1.2 Review: How Network Theory Matters?

In this section, I will review some of the studies mentioned above to show that social networks do no only matter for short run, daily or local situations, but have significant long-run effects and capable of explaining global regularities.

The empirical studies in labor market demonstrate that significant percent of the employees find their job through social contacts and it is robust across race and gender (**?**Granovetter, 1995). Moreover, employers also rely on the social contacts in hiring process (Rees, 1966). Accordingly, more focus has been paid to the role of social contacts and network structures on the labor market outcomes. Several network models have been constructed upon these facts. Calvo-Armengol & Jackson (2004) build a model in which agents gather information about job opportunities through their social contacts. Given network structure, pre-existing differences in the network structure is able to explain the significant part of the inequalities in wage levels and employment status. Calvó-Armengol (2004) develops a strategic network formation model and indicates the clash between stability and efficiency. The model shows that pairwise equilibrium networks always exist and they are generally inefficient in terms of wealth produced. In a similar vein, endogeneous job contact model is developed by Galeotti & Merlino (2014) to examine the impact of labor market conditions on decisions of network formation. As the possibility of unemployment rises, the investment in connections increases in order to access information about available jobs. The prediction of the model has been supported by UK labor market data. Montgomery (1992) examines the strength of the weak ties in job finding process and demonstrates a correlation between network composition of an agent and the minimum acceptable wage she sets. Networks are not only used to explain inequality in earnings and employment status. In a general sense, Kets *et al.* (2011) construct a model showing that how network structure constraints the level of inequality that can be sustained among its members. In a broader sense, this may shed light for further studies to explain increasing inequality and evolution of network structure.

Travers & Milgram (1969)'s experiment is a well-known example to examine small world problem. This experiment finds that one can reach others within only small steps even the distance between two is high. In fact, this is a significant property experienced in real life structures. Jackson & Rogers (2005) construct a connection model where individuals benefit not only from direct contact but also from indirect links. The findings support the emergence of small-world features for a wide variety of parameters. Another significant but less cited finding of Milgram (1967) is the composition of the relations. While small worlds are experienced, it is also found that people prefer to communicate through same sex individuals. In other words, there is a high rate of homophily in terms of network formation. A supporting finding on the differentiation of women's and men's personal networks is pointed in Moore (1990). Moreover, any social network structure is found to has perpetuating effect through constraints it generates in different spheres. In the same line with these facts, Currarini *et al.* (2009) develop a friendship model that sheds light on the segregation patterns observed in social and economic networks. When there are different groups within a society, the relations of all groups are found to be biased towards same-type. Furthermore, larger groups tend to form more same-type ties which have significant implications on segregation of minorities. Since larger groups tend to form more ties per capita, this structure may generate inequalities in a variety of situations.

The emergence of Core-Periphery structures is well discussed in the literature. Information gathering is a relevant example to examine the emergence of such structures due to the fact that a significant portion of the information has been flowing through a small subset of the people. Hojman & Szeidl (2008) develop an information exchange model showing that under directed relations when the cost of information acquisition is personal, a core-periphery structure will emerge as an equilibrium. When link formation necessitates obeying of both sides which bear cost for both, if the surplus from connecting an agent monotonically increases in the number of her neighbors, then star structure will still be equilibrium. A similar result about directed networks holds in Galeotti & Goyal (2010). However, when a mutual contest is necessary for link formation, it is shown that the equilibrium will be where everyone should acquire the same amount of personal information. From a complementary approach, Bramoullé & Kranton (2007) examine the amount of contribution of agents to a public good given a fixed network structure. The model suggests that individuals who have active social neighbors spend less cost in return of high benefit due to network effects. In other words, the individuals who have relatively favorable positions bear less cost and rely on others' contribution causes Free Riding Problem.

1.3 Definitions

Let $N = \{1, 2..., n\}$ defines a finite population including n agents[1]. The network relations of these agents are defined by a graph. Each node represents an agent and each link in the form of a tie or an arc represents a relation between two agents. There are mainly two types of graphs. The undirected form discusses the situations where any link necessitates a joint agreement. One can not be related to other without the other being connected to her. Partnership, friendship, alliances, trade relations are examples of this form of relations. The directed form discusses the situations where one is able to connect without other's permission. Citing or twitter follow-up relations are examples of this form. Moreover, the relations may be weighted which depends on some characteristics of the two ends, or unweighted which is anonymous.

A graph (N, g) consists of a set of nodes and a real-valued $n \times n$ matrix g. Each entry of the matrix, g_{ij} represents the relation between i and j. An undirected graph is symmetric in the sense that $g_{ij} = g_{ji}\ \forall\ ij \in N$. All entries take one of two values for unweighted forms where $g_{ij} = 0$ represents the absence of the relation and $g_{ij} = 1$ represents presence of a relation between i and j. The intensity of relations can be shown in weighted forms in which entries can take more than two values. g_{ii} represents a self-link and generally takes 0 or 1 for all $i \in N$. An alternative way of representing an undirected graph is a set notation. Links are listed as a subset of population of size 2 such as $g = \{ij\}$. Accordingly, $g_{ij} = 1$ or $ij \in g$ are two equivalent ways of saying i and j are linked under the network g. $g + ij$ denotes the network obtained by adding a link between i and j to an existing network g and $g - ij$ generated by deleting the link ij from the network g.

$N(g) = \{i | \exists j \text{ s.t } ij \in g\}$ denotes the set of nodes that have at least one link in g. $G(N)$ is the set of all undirected and unweighted networks on N. Given a subset of nodes $S \subset N$, $g|_S$ denotes the network which restricted to

[1] This part mainly based on Jackson *et al.* (2008). A detailed discussion on each concept can be found in there.

the nodes of S such that

$$[g|_S]_{ij} = \begin{cases} = 1 \text{ if } i \in S; j \in S \text{ and } g_{ij} = 1 \\ = 0 \text{ otherwise} \end{cases}$$

Direct contacts are relevant in many contexts. For an undirected graph, a *walk* between i and j is a sequence of links $i_1 i_2 ... i_{K-1}, i_K$ where $i_k i_{k+1} \in g$ for each $k \in \{1, 2, ..., K-1\}$ and $i_1 = i$, $i_K = j$. A *path* is a walk where each of the node in the sequence of $i_1, ..., i_K$ are distinct. A *cycle* is also a walk where $i_1 = i_K = i$ and all other nodes are distinct. The *geodesic* between i and j defines a path involves minimum number of links between these two nodes, *the shortest path*. The *distance*, l_{ij}, between two agents is the length of the shortest path. If there is no path between two nodes, the distance is infinite. The *diameter* of a network is the largest distance between any two nodes.

Another relevant point is the nodes one can reach through the paths she involved in. Any node can be reachable by all others in *a path connected network*. An undirected network g is connected if for each $i \in N$, $j \in N$ there exists a path between these two agents in g. Any networks may contains different components. The components of a network are the distinct maximally connected subgraphs of that network. A component can be denoted as $g' \subset g$, such that
1. $\forall\ i \in N(g')\ j \in N(g')$ and $i \neq j$ there exists a path between i and j;
2. for any $i \in N(g')$, $j \in N(g)$ $ij \in g \implies ij \in g'$.
A *clique* is a maximal completely connected component of a given network.

The neighborhood of any node in g can be defined as $B_i(g) = \{j : ij \in g\}$. We can also define the extended neighborhoods of a node, the nodes can be reached by neighbors. For instance, two-neighborhood of a node defines the set of neighbors and neighbors of neighbors and denoted by

$$B_i^2(g) = B_i(g) \cup \left(\bigcup_{j \in B_i(g)} B_j(g) \right)$$

The *degree* of a node in an undirected graph is the number of the links she involved in. It is equivalent to say the degree of agent i is the number of neighbors she has such that
$d_i(g) = \#\{j :\ ij \in g\} = \#B_i(g)$.
The maximum possible number of the degree on any node is $n-1$. The *density* of a network is the relative fraction of links in a given structure.

The literature mainly deals with two different network formation process. One is random graphs in which links are drawn based on some probabilistic rule. The other one concerns the strategic decision-making process based on the costs and benefits of the links. This study concerns the cases under the latter process.

The utility function of a node i, $u_i(g)$, shows the benefits net of costs she experiences as a function of the network g. The specification of the utility function highly depends on the context of the application. Any utility maximizer agent is assumed to know the change of her utility when she constructs a new link or destruct an existing one.

A value function,$v : \{g|g \in g^N\}$, represents the value generated by a graph g where g^N denotes the complete graph. The set of all these function is denoted by V. In many applications, the total value of a network is regarded as the summation of individual utilities $v(g) = \sum_i u_i(g)$.

A network g is *strongly efficient* if $v(g) \geq v(g') \ \forall \ g' \subset g^N$. If there are finitely many networks, there exists at least one efficient network structure. An *allocation rule*, Y, specifies the way of value distribution among agents. $Y_i(g, v)$ denotes the payoff to each node from network g under value function v.

To discuss which networks emerge and persist under different conditions, we should specify a stability condition. Standard Nash equilibrium may not make much sense for undirected network formation process. One of the cases emerged as a Nash equilibria is by construction excluded in link formation process (Jackson & Rogers, 2005, pp.204). Accordingly, while Nash equilibrium is relevant for directed graphs, there is a contradiction with assumptions of undirected network analysis. Instead Jackson & Wolinsky (1996) introduce *pairwise stability* concept for standard network games.
A network g is pairwise stable respect to v and Y if not any agents benefit from severing an existing link, and any new link doesn't generate a higher value for both of the agents. These conditions can be formalized as:
i. $\forall \ ij \in g$, $Y_i(g, v) \geq Y_i(g - ij, v)$ and $Y_j(g, v) \geq Y_j(g - ij, v)$
ii. $\forall \ ij \notin g$, if $Y_i(g, v) < Y_i(g + ij, v)$ then $Y_i(g, v) > Y_j(g + ij, v)$.
Note that, in the absence of side payments we can take $Y_i(g) = u_i(g)$.
Pairwise stability is a relatively weak notion since it only considers deviations on a single link or at most a pair of players at a time (Jackson & Rogers, 2005, pp.205). In general, these should be considered as simplified

assumptions and should be extended in case of other necessities.

1.4 Concluding Remarks

This brief introductory part aims to show how networks and related models are significant in explaining several social phenomena. The emergence of several social structures and their outcomes have already discussed with a network approach. Rest of the study built on the existence of conflicting situations between individuals and emergent structures with remolding social movement approach with network perspective. Before, this chapter clarifies the definitions and notations that will be used and discussed in the following chapters.

As stated above, network theory gives significant insight for a variety of social phenomena. In the following chapters, I will discuss the use of network theory for social conflicts and resultant movements from several aspects.

Chapter 2

Social Movements: A Critical Review and a Network Approach

2.1 Introduction

In the first chapter, I discuss the explanatory power of the network theory for several social phenomena. The main aim of this chapter is to show that network theory presents an encouraging perspective for social conflicts and resultant movements. First of all, I discuss the necessity of a new approach for analyzing social movements. Then I present why network theory is relevant and how can we use it?

In contemporary societies, social movements are central actors pointing to major problems in the economic, social and political environment. They have also significant capabilities or impact on reshaping these environments.

In the literature, capitalist societies are regarded as places where social movements are born. It is argued that capitalist developments such as state building, urbanization, proletarianization and war constitute the necessary conditions. Still, this definition does not cover some early movements. For instance, Manuel Castells defines Castalian city revolts in 1520-22 as the most important urban social movement (Castells, 1983, 4).

Such a conceptual limitation can be comprehensible for practical reasons. In addition, it wouldn't be wrong to say social movements experienced in capitalist societies have specific features. Nevertheless, this causes significant fallacies. In a very narrow sense, it is limitation of the societies with capitalist ones and acceptance as if there is no conflicts in other societies. On the other hand, in a very broad sense, it is equivalent to claim that no other form of societies exists before and even if existed capitalism is the end of the history. For instance, 'shift in main conflict' argument of European tradition rooted in equating classes and class struggle with capitalist societies. The change in the nature of the workers' movements is recorded as a shift in the conflict that shelves class-based conflicts. However, classes and related conflict are direct consequences of the private property (of means of production) dominated in slavery societies and continue with deepen to this day. The details will not be discussed here, as this discussion is beyond the scope. However, the contradiction can be overcome with noting that traditional literature on social movements analyzes them as special forms of collectivity which materialize in capitalist societies.

We can develop the existing analysis through overstep the limits of this conceptualization. Current literature already emphasis on the necessity of conflicts and the role of relations for social movements analysis. Since Hegel, we are explicitly aware that each fact or situation reveals its own contradiction. In addition, interactions can not be explanatory alone in case we accept humans are social beings. It will be explanatory if we analyze when, where and under what conditions opposites interact. Accordingly, this paper analyzes social movements as an outcome of interaction process of *"opposites".* This chapter presents a broader perspective for the use of networks on social movements analysis.

In fact, two different approaches to literature are dominant: American tradition and European tradition. The second section reviews the leading arguments of these two traditions. Since the 1970s these theories have been updated due to the changes in the nature of social environment (Crossley, 2002) and the angle between them has increased. Currently, a lot of effort is being made to converge them. The third part discusses the role of network theory for social movement analysis mainly through three channels: (1) as a Resource (2) as a Context Provider and (3) as a Policy Tool. Furthermore, I will show that these are already supported by developing literature on the issue. This chapter will be concluded with a brief discussion on boundaries of this perspective.

2.2 Literature Review

The literature on social movements has developed through mainly two traditions. One is American tradition that focuses on the collective behavior. The other is European tradition focusing on the core conflicts within societies. One should note that this differentiation is shaped by the historical patterns experienced by two regions and theoretical bases scholars influenced.

The eighteenth century was the time when Americas and European region had physically restructured. Presumably, this reconstruction process has more than 'handover'. Since invasion of Americas by the European powers in fifteenth century, the region has experienced 'handover wars' between the Empires. Still, that is not the whole story. The ongoing anti-slavery and anti-colonial struggle had strong influences on the process of reconstructing the region [1]. These movements were essentially influential in shaping the partnership and opposition between the leading powers. At the same period Europe, in general, influenced by two main factors. One was the French Revolution of 1789 and sequent Napoleonic Wars. The result was the defeat of the monarchy and the rebuilding of the region through the struggles for independence. In fact, resultant nation states have shaped by these struggles. The other is the Industrial Revolution, which caused a major change in the production process. The forms of movements had affected by centralization of production in workplaces and factories. While America is united around a constructed nation, Europe is divided into many nation states based on pre-existing or constructed identities. Despite the fact that distribution was the key issue for both, the United States experienced it indirectly due to the dominance of nation-based struggles. On the contrary, by the middle of the nineteenth century, class-based features of movements were more noticeable in Europe. [2]

As expected, differentiation of patterns which is actually simplified in the above lead to differentiation of the theories. This is observed from the point of departure: scope of the social movements. In general, American tradition includes any protest event even including negotiable issues whereas European tradition contains only actions that challenge the systemic mechanisms (Diani, 1992, pp.10). Thus, while the former focuses on "what brings people together," the latter interested in "what constitutes the main conflict in so-

[1] American Independence War and Haitian Revolution are among the most known movements. See Martin (2008) for the impact of Haitian Revolution.

[2] In fact, these processes are highly interactive and complex. The main purpose of this simplification is to show how important historical models are for theoretical developments.

ciety". On the other hand, the similarity is a consensus about changes in the social, economic and political environments in the mid-twentieth century, as well as inadequacies of the earlier explanations of the social movements by the 1970s (Buechler, 2011, pp.111). The two continents experienced the process of change differently. Organizations and antagonistic movements in the United States differentiate sharply. Organizations born during the protests quickly structured as interest groups, while the antagonistic movements were marginalized. In Europe, the inheritance of workers' movements has been influential in the developing movements (Della Porta & Diani, 1999, pp.2-3). This divergence over different theoretical heritages has increased the gap between the two traditions over the next decades. To explain transformation, American tradition focuses on the increase in resources and political opportunities, while European tradition emphasizes a great change in social formation and core conflict.

2.2.1 American Tradition: From Collective Behavior to Mobilization Theories

American literature has constructed upon the classical structural-functional theory.

The early studies state social psychological factors as the main causes motivating people to act. Relativity is the dominant perspective of the time. James C. Davies and James A. Geschwender are two significant theorists on this approach. Davies (1962) indicates that the revolutions and protests come after a sharp decline following a long-term economic and social improvement. Anxiety and fear of losing what they own motivate people to react. On the other hand, Geschwender (1968) finds the statement of Davis as incomplete and introduces several hypotheses capturing various cases. First, when circumstances continuously improve the expectation of individuals increase. The motivation of people rises as the gap between real and expected rate increase. Second, people derive their standard of satisfaction relative to others. As the gap between own experiences and observed circumstances rises, motivation increases. Third, people upset with decreasing of a gap between them and previously inferior ones. Even if there is an improvement, relativity may make them mobilize. In short, the relative deprivation of individuals makes them react in the form of protest or revolutionary act.

Another perspective focusing "behavior" and "change" rather than "psychology" and "reaction" begins to dominate the literature by mid-twentieth century (Della Porta & Diani, 1999). The main focus shifts to collective behavior. Ralph Turner and Lewis Killian are two leading scholars who conceptualize social movements as a form of *collective behavior*. Norms are introduced as the main guides of behavior. When existing norms do not provide a satisfactory structure for behavior, new norms emerge. The former is propagated as irrational and the current structure is accused of being unjust. Thereby, a kind of action is legitimized to transform of existing norms (Turner & Killian, 1987). Meanwhile, extraordinary events and pre-existing ties are presented as two factors promoting collective behavior. Some classical studies also emphasize the role of group identity and solidarity. Several studies discuss social classes and organizations as the main carriers of the movements. Conversely, Seymour Martin Lipset emphasis on the destructive role of organizations. According to Lipset, institutions including unions and other voluntary organizations have high tendencies of becoming oligarchic (Lipset *et al.*, 1956). To achieve its goals, subgroups should interact within broader organizations.

At the end of the 1960s, the emergence and rise of the movements in a relatively prosperous period forced a theoretical change. Scholars of the period are inspired by new developments in economics and political science. Constructive criticism of early studies leads to the development of mobilization theories after the 1970s. Research Mobilization Theory and Political Process Theory are the two main streams stemming from similar objections. At this point, an economist makes a significant contribution to movement analysis. Mancur Olsun's work on rational choice theories shifts attention from behavior to action. Analysis on masses' reaction is replaced by participation decisions and mobilization of collective decision.

Resource mobilization theories (RMT) define the collective movement as purposeful and organized action. Rational actors decide according to costs and benefits of the action. There is always enough discontent and grievances in a society for encouraging a movement (McCarthy & Zald, 1987). The studies examine the conditions and processes under which resources transform dissatisfaction to a collective action. The capacity of a movement depends on the material resources (work, money, concrete benefits etc.) and non-material resources (authority, friendship etc.) available to the group (Della Porta & Diani, 1999, pp.8). Oberschall (1973) introduces significance of social structure on the possibility of mobilization. Vertical segregation and horizontal integration are significant resources increasing the likelihood of mobilization.

As stated above, protests often result in the emergence of well-structured organizations in the United States. Therefore organizational forms have weight on American scholars. John McCarthy and Mayer Zald are two leading scholars emphasis on organizational forms. They define social movements as "opinions and beliefs that represent preference structure for change" (McCarthy & Zald, 1987). Different movements have different preference structures. Highly inspired by mainstream firm theory, movements are described as a sector in which different industries representing different preferences. Social movement organizations, like firms, compete to define the terms of social movement actions. By the mid-twentieth century, the increase in resources enhances the competition between these organizations. This rise enhances mobility. Different interaction within social movement sectors causes different forms of movements. McCarthy & Zald (1987) conceptualizes current movements as "professional movements" so as to highlight preference structure and participants. These movements differentiate with higher durability (diversification in issues) and higher vulnerability (existence of external resources). While entrepreneurial leaders and resource availability are outcomes in classical approach, they are independent variables for professional movements.

Political process theories focus on the differentiation of groups in terms of political power. In a population, not all groups have equal access to the political sphere. Some groups are constrained. Implementation of any political strategies is ineffective for those groups. The studies focus on "political opportunities". Empirical studies use several variables as a proxy of political opportunities; like the degree of openness of the local political system by Peter Eisinger, electoral instability by Piven and Cloward, the availability of influential allies by Gamson, tolerance for protest among the elite by Jenkins and Perrow (Della Porta & Diani, 1999, pp.9-10). Tarrow (1983, 1989) defines "protest cycles" with analyzing the effect of openness and closeness of formal political access, the degree of stability and instability of political alignments, the availability and strategic posture of political alliances and political conflicts between and within elites in Italy. The most effective organizations are described as autonomous and interdependent social networks linked by loosely coordinated mobilizing structures. Polity theory of Charles Tilly is another significant contribution (Tilly, 1978). There is a polity sphere within the population. Polity members and the government can access this sphere, but others can not. These outsiders are not able to influence policies with any political strategies. As a result, they tend to engage in collective action. Political opportunities, the emergence of external threats and pre-existing organizations are presented as the main forces of mobilization. It is observed that, even in the presence of major threats and new opportunities, poorly connected groups rarely act collectively. In the light of this, McAdam focuses on the "right circumstances" for movements. Three main factors for achieving *right circumstances* are counted as political opportunity, local organizational structure and cognitive liberation(McAdam, 1982). The last one is the main contribution of his work for explaining insurgency. Presumably, isolated people can not communicate with others to prove change. Social ties support the process of cognitive liberation through the generation of network and social supports. This process increases the likelihood of movement.

2.2.2 European Tradition: From Marxist View to New Social Movements

As stated above, European tradition is built on the Marxist theory. Social movements are regarded as being shaped by the social structure. As the social structure changes, the form of movements is expected to change.

Marxist literature classifies societies based on the productive forces, production relations and their interaction. Productive forces have a strong tendency for development, whereas production relations constraints the development and resist to change. This progress generates the conflict which society shaped around. The central conflict for industrial movements is the conflict between working class and bourgeoisie. Throughout the nineteenth century, movements have been equalized with revolutionary challenges of the working class.

By the mid-twentieth century, a series of social movements emerged in different forms. Especially student movements in France, Berlin, Italy and even in the US and their demands concerning the quality of life constitute a new challenge for the European scholars. The inadequacy of the old theories forced them to restructure the theory in order to explain emergent forms. The literature is expanded with critiques of Marxist arguments about social conflict. Bush & Morris (2008) claims that capability to access polity sphere through labor organizations and political parties removed the primary *raison d'etre* of these movements. Touraine (1971, pp.17) suggests that the conflicts between these two groups shifted to decision-making rather than power relations. As a result, the exercise of the power within working places is not central anymore. Although there are major variations within the new social movements approaches, in general, these theories are based on a grand change in social structure and conflict. Often, theorists link the change in the form of social movement to the rise of post-modernity.

Allain Touraine is one of the most influential scholars who proposes the shift from a materialistic world to a post-materialist one (Touraine, 1971). According to Touraine, the economic decisions and struggles are not as central as in the earlier societies. Even though economic growth is more important than ever, it is misleading to put only economic mechanisms at the center of social organizations. All spheres of social life are integrated into "production process". As a result, social relations constitute the main explanatory factor of social structure. Unlike Marxian approach, it is claimed that the main driving force of the reactions in society is not exploitation but alienation. Society is segmented into two: ruling classes and people working for their interests. Social life forces the latter to alienate from their own. Accordingly, the conflict is no longer between capital and labor but among these segments of society (Touraine, 1971, pp.4-10). Jürgen Habermas constitutes a theory of social evolution which distinguishes rationalization of lifeworld from increasing complexity of social systems (Habermas, 1987, pp.118). The differentiation of these two increases as the rationality and complexity increases. Habermas defines structural components as culture, society, and people which are reproduced by cultural reproduction, social integration, and socialization [pp.138]. When these processes are controlled by officially organized action spheres such as the economy and the state, the world of life is colonized [p. 305]. As a result, new conflicts shifts to these spheres [pp.392]. Then mobilization is defending or bringing back life-forms rather than a distribution act.

Alberto Melucci extends the boundaries of the production concept and leaves it at the center of his study [3]. In a broader sense, classes are groups struggling to orient social production. Based on this conceptual modification Melucci (1980, pp.212) sets the antagonism of classes as the main determinant of the social structure and the source of collective actions. The emergence of the new movements is due to the changing nature of the production structure. Production goes beyond the conversion of nature into a commodity. It also includes the production of social relations, social systems even the biological and interpersonal identity of the individual (Melucci, 1980, pp.218). Extension of the boundaries that class conflict could emerge also extends the boundaries of intervention. In that vein, the base of social resources is extended to social and personal identity. The target of collective action be-

[3]Production is defined as "the formation or transformation of objects, within the framework of certain social relations, by the application of certain means to a primary material (Melucci, 1980, pp.210)." Accordingly, social production is used to emphasize its social character.

comes the right of people to claim their own identity. New conflicts around the identities mobilize the groups which are most directly affected by the manipulation of the socio-economic environment. Despite the various forms of movements, Melucci indicates that the lack of a particular leader group did not lead to the disappearance of class-based features. The common characteristics of new movements are counted as (i) end of separation between public and private sphere, (ii) emergence of marginality and deviance as a result of domination of daily life, (iii) directed at autonomy or independence rather than access to political power, (iv) placing solidarity as an objective and (v) direct participation and rejection of representation (Melucci, 1980, pp.219-221).

There are many other studies emphasizing the change in the social structure as the main force of emergence of new forms of movements. Lash & Urry (1987) defines a shift from national, regulated markets to increased internalization of production, capital, and markets. The change in occupational structure as a precondition in this process causes it to grow in the service class, which is partly responsible for producing new movements [pp.195]. Similarly Offe (1985) refers to structural changes and changes in class structure as the main source. Unlike Lash and Urry, Offe insists on the inadequacy of class-based system. The extension of social base - new middle class and de-commodified social groups- is evidence of the emergence of new political organizations which are not class-oriented. As others, Offe characterizes these new forms of personal autonomy and identity; opposition to centralized control mechanisms; informal and non-hierarchical forms of internal organization and "protest politics" (Bagguley, 1992, pp.31-32).

2.3 Replacing Networks to Right Place

Up to now, I review the literature on the leading arguments and scholars of each tradition. As discussed by Cohen (1985, pp.664), each tradition derived theoretical framework that excludes the main focus of the other. In fact, these two streams differ in their focus (Melucci, 1980, 1996). American tradition contributes to the manifestation of the movements while European tradition contributes formation of processes by which movements are produced. Currently, rather than accepting them as rivals more attention is paid to complementary features of these two approaches. For instance, a conceptual synthesis is provided by Diani (1992). Crossley (2002) criticizes 'new' American tradition in terms of its weakness on agency and structure and discuss the possibility of a new kind of synthesis. Opp (2009) makes a theoretical contribution to this area.

One way or another, current studies point the possibility and necessity of synthesizing these two. I will focus on their common explanatory base rather than discussing the weaknesses and strength of each theory. One way or another interaction is included in almost all studies. I will attempt to derive a more general perspective with a conceptual extension on social movements and focusing on the communication networks in terms of three main dimensions (1) as a Resource (2) as a Context Provider and (3) as a Policy Tool.

2.3.1 Scope of the Social Movements

The scope of the social movements is drawn from the two main perspectives described in the existing literature.

First of all the conceptual boundaries is extended. As stated above, the traditional literature constrained the collective actions in capitalist societies. This perspective squeezes the upcoming studies to comparison between industrial and post-modern societies. Dialectic methodology is relevant to overcome this problem. Vander Zanden (1959)'s critiques on contemporary studies shed lights for a more a broader perspective.

> "Movement frequently begets countermovement. Between the two a dynamic interrelation occurs (Vander Zanden, 1959, pp.313)."

The second one is currently developing network approach. Diani (1992)'s three-fold conceptualization presents networks of relations between a plurality of actors, collective identity, and conflictual issues as the main components of the collective movements.

On these basis, social movements are described as the outcomes of interaction process between opposites.

2.3.2 Social Links as Resources of Mobilization

The literature frequently discusses existence or absence of ties as a resource of mobilization. While classical American tradition defines isolation as the main motivation behind the collective behavior, empirical studies falsify this hypothesis (McPhail, 1971). Instead, it appears that socially connected people are more likely to mobilize (Oberschall, 1973; Snow *et al.*, 1980).

Actually, links can appear within an organization, between organizations or non-organizational/ personal. It is claimed that when links combine with coalitions, the likelihood of mobilization increases. Oberschall (1973) interprets the latter as vertical segregation and the former as horizontal integration. Similarly, Tilly (1978) defines an organization (CATNET) as a product of two component (Catness x Netness). Netness describes the intensity of networks among group members while Catness refers to the strength of shared identities in a group. Groups with densely linked and shaped around a collective identity (sexuality, ethnicity etc.) are more prone to mobilization compared to other forms of interacted relations. Empirical studies support such a distinction about the roles of different interaction processes. For instance, physical opportunities of campuses generate horizontal integration with facilitating communication and creating vertical segregation by separating students from other personal and professional ties (McAdam, 1988). Not only mobilization theories but also new social movement theorists frequently refers to face-to-face interaction on the formation of collective interest and identities (Hannigan, 1985, pp.449).

It is obvious that personal and organizational contacts play a significant role in emergence of and one's participation in movements. Inherently individuals take part in many and various types of interactions. Accepting the role of pre-existing ties is not enough to understand the role of the networks in social movements(Della Porta & Diani, 1999, pp.115).

Accordingly, we should focus on the conditions under which individuals willing to and capable of using their personal network as a resource of mobilization. Up to a certain point, I stand with relativeness approach. However dialectic says, in the case of any action there is a possibility of a counteraction. Interacting with an opposition make people realize this option. Therefore they should consider the possibility of any more successful countermovement through her local knowledge. In other words, individuals should believe together they can. Otherwise, probably they are not willing to move even if things are getting worst and worst for them.

2.3.3 Spatial Dimension of the Networks as Context Provider

The flow of information is the basis of any type of interaction. In reality, different types of relations materialize within different spheres. The context of the information flowing through the relations influenced by the sphere they materialized. In other words, it is claimed that family, neighborhood, working place or school defines the boundaries of the information people sharing. Therefore, spatial dimension of the relations can give significant insight on differentiation of the forms of movements.

Snow *et al.* (1980) is one of the leading studies emphasizing on socio-spatial settings of movement participation. It use a broad dataset on participants of different forms of movements. In terms of student movements, 70% of the students participate through their preexist personal relations whereas public channels motivate 30% of them. Oliver & Myers (2003, pp.177) defines three dimensions of networks relevant to study social movements:
(1)Spatial: The movements are space-bounded which are already socially organized areas;
(2) Organizational: There are different links between and within spaces that coordinate the actions of individuals and organizations;
(3) Other social: Friendship, employment, kinship-like personal ties may create external links to the movement organization. In addition, Oliver & Myers (2003, pp.183) diversifies two types of networks to identify information flow: node-to-node and broadcast.

One of the most challenging analyses is done by Gould (1993). Gould criticizes the studies that assess the Paris Commune in terms of its participants. While the traditional approach focuses on the role of close-knit professional groups, the data indicate that the participation rates of these groups are low. Instead the mobilization emerged through neighborhood networks. Gould explains this as a transition from trade to neighborhood networks in the organizational framework of mobilization.

On the basis of these discussions, I suggest that participants are significant for movements, but it is the *place* that characterize the movement. This is compatible with McAdam & Paulsen (1993, pp.659) who claim that ties are significant as much as they developed in organized circles. Otherwise, neither organizational embeddedness nor strong ties to another volunteer are strong predictive for high likelihood of mobilization. Consider the Glasgow Rent Strike. Although the participants are workers of the region, the interaction was not through worker identity. Instead, links are developed in the neighborhood and the movement mobilized through housing crises [pp.27-37] (Castells, 1983).

Therefore, we should focus on the spheres where interaction between opposites taking place. The multiplicity of relations (McAdam & Paulsen, 1993) and multilayer network structure presents a promising perspective so as to represent spatial dimension.

2.3.4 Existence and Absence of Links as a Policy Tool

Crossley (2002, pp.95) states that "Networks are as much products as producers of social movements." On the one hand, social movements restructure social relations, on the other hand, social relations motivate movements.

As discussed in the first chapter, in many social context link formation is a strategic network formation process. Individuals can interact and decide to form a link that beneficial for both, or one of them decide to break an existing link if it is costly enough. However, there is another face of the coin. If this is so, than the boundaries of the communication bases are open to intervention. This claim is consistent with the discussion of Melucci who states that:

> "The necessity of controlling conflict obliges the system of domination to intervene constantly at the different levels of the social structure in order to hold conflict on them within limits compatible with the fundamental class relations Melucci (1980, pp.214-215)."

In "modern democracies" direct intervention is the last resort for the dominant class. Instead they have several mechanisms to produce "compulsory volunteering". At this point, the two dimensions discussed above are significant policy spaces.

Around the 1900s plantation owners in Hawaii keep labor movements under control by employing workers who speak different native languages (Takai, 1984). By doing so, owners deter workers from using interaction as a resource of mobilization. Mass media is a significant mechanism to design context of the information flow. For instance, the news media are intentional actors who choose "stories" to be propagated (Oliver & Myers, 2003, pp.184). Similarly, the social media creates the "trend topics" of the day and mobilize collective action in form of twit-storm. The closure of television channels, the prohibition of newspapers, the blocking of social media tools and even the interruption of the Internet are indicators of the use of link-removal as a preventive policy tool. Another mechanism can be formation of countervailing networks by oppositions. Snow *et al.* (1980) discusses that existence of countervailing networks decreases the likelihood of mobilization. In a similar vein, Zald & Useem (2009, pp.266) describes six different cases for the role of authority in movement vs. counter-movement interaction.

Moreover "modern democracies" accepts the authority as an intermediary. Both movement and counter-movement are in struggle to convince and convert authorities. However, the movements generally against policies of authority which forces authority for taking action. In this case, authority is either direct counter-movement or sponsors a counter-movement against the movement. For instance, flexible labor market policies can be classified in the latter case, while war policies may be included in the former one.

Therefore we should not omit the fact that communication links may serve as a control mechanism for policy makers. In some cases, links may be used to discourage any possible movements. When necessary they may be used to motivate people to choose one form of the movement to another. On the basis of these discussions, we should focus on the social conditions under which interaction taking place. Positional heterogeneity among agents can reflect a significant aspect of this dispute.

2.4 Concluding Remarks

In this chapter, I review the two dominant stream of the literature on social movements. The main aim is to convince the audience to necessity and possibility of a new approach that merge strong sides of each theory and replace weak ones. Network theory is a good candidate to bridge these two approaches as well as to improve previous arguments.

First, any theory should get rid of the fallacy constraints social conflicts and collective behavior with capitalist societies. Instead conflicts emerge and spreads as an outcome of interaction process. Moreover movements and counter-movements come along together. Such a **dialectic methodology** will overcome several shortcomings of previous arguments. The scope of the social movements can be described as follows.

Definition 2.4.1. Social movements are outcomes of interaction process between opposites.

To present opposition, I introduce **heterogeneity in identities** of individuals.

The approach presented here is closer to American literature in terms of proposing interaction as a resource of mobilization. However, my point differentiates in terms of the conditions that makes individuals to use interaction as a resource. Awareness of a conflicting situation and belief on a collective success are two factors motivating individuals. Under incomplete information, the structure determines the individuals one is able to reach. Accordingly, not only pre-existing ties but also network structure that pre-existing ties lied is relevant. Furthermore, the sphere interaction taking place characterize the movement. Therefore, the network structures of different spheres have a significant influence on the emergence of one form but not another. As a result, a broad and consistent should introduce **multiple layers** so as to represent different spheres. Lastly, if links and network structure can be used as a policy tool, then incentives can discourage or encourage a possible movement. In this point, determining the individuals or groups who have the capability to intervene becomes a relevant issue. As a result, a broad and consistent should introduce **social conditions** and **positional heterogeneity**. The main proposes of this chapter can be summarized as follows.

Definition 2.4.2. A broader and consistent theory on social movements should answer three main questions: 1. *Who* are willing to use interaction as a resource of mobilization?
2. *Where* do these taking place and under which *structure*?
3. Under which *rules* and *conditions* the interaction takes place?

Obviously, these constitute a broad perspective however the implication is complex. Probably, more detailed and purposeful data should be constructed. On the other hand, the simple perspective still able to explain several points. These will be discussed through two simple examples in the following chapters.

Chapter 3

Connection Model for Conflicting Agents

3.1 Introduction

In the second chapter social movements are described as the outcome of an interaction process between opposites. Awareness of a conflicting situation is a necessary condition to motivate any individual. In case f local processes, the awareness emerges through face-to-face communication links. On the other hand, once individuals face a conflicting situation, using interaction as a resource of mobilization is a strategic decision.

In this chapter, I set up a modification of the connections model of Jackson & Wolinsky (1996) to examine existence of conflicting nodes for a specific issue.

In a society there are supporters, opposition and neutral individuals in terms of their attitudes towards a specific concern. Individuals communicate their attitudes through their personal networks. Standard models proposed that people benefit from communication with others. First, it is an opportunity to extend their own base. Second, it is a way to decrease uncertainty. The benefits decay with distance. In addition to the standard approach, this model considers the interaction between opposites. Accordingly, the benefit from any link is modified based on the participants' characteristics. For instance, if the relations of an individual dominated by opposition, she will probably depressed. In this sense, this model is a modified version of the standard connections model where the characteristics of the individuals matters in utility calculations. In fact, this is a highly stylized model in which an agent will get extra benefit from similar contacts and extra loss from opposition once she learns the identity of her partner.

The connections models use distance- based utility functions in calculation of costs and benefits. The utility of each individual form a given network structure is determined by the number of direct and indirect contacts. The total value generated by the network is summation of the payoffs of all individuals.

There are several studies using connections model for endogenous network formation analysis. We can classify them into two. Jackson & Wolinsky (1996) represents the first group while Bala & Goyal (2000) is an example for the second group. The main difference appears in the formulation of link formation. The first group assumes two-sided link formation in which a link between two people requires investments of both. On the other hand, the second group includes one-sided and non-cooperative link formation where an individual is able to form link with another by incurring some costs. Of course, it is not only the matter of formulation but depending on the point which they want to emphasize. The former focuses on the tension between stability and efficiency. There are stable networks which are inefficient. Inefficiency can be eliminated through allocation of resources to some individuals who are not take part in the value generation process. On the other hand, the latter interested in the relation between equilibrium and efficiency. In a range of values, the star structure is found to be unique efficient and strict Nash network.

This paper interested in pre-existing ties which need not be constructed for the purpose of mobilization but can be used for that purpose under some conditions. In other words, links are not always used as a mobilizing resource. As a result, link formation is considered as a two-sided information flow instead of a non-cooperative case. The main aim is the identification of stable and efficient networks.

Jackson & Wolinsky (1996) introduces a model in which individuals get utility from both costly direct links and indirect contacts. The benefits deteriorates as the distance between individuals rises. Accordingly, the actions of others affect the benefits of an individual which creates positive externalities. The symmetric version of the model shows the resultant contradiction between efficiency and stability due to the externalities. However, the standard model has two main critical aspects (Jackson *et al.*, 2008, pp.209). First is homogeneity. The standard model assumes that actors are homogeneous and have same utility functions. Second, the benefits from indirect connections only depend on the minimum path.

There are various studies extending the standard model so as to discuss the first criticism. Heterogeneity in the utility can be sustained through differentiation of the benefits from the connection as well as costs of linking.

The extension of the standard model on the cost side exhibits significant results. Johnson & Gilles (2000) introduce a spatial cost topology with placing agents in a line. Links costs are assumed to be proportional to distance. Each individual gains benefit from contacts that decay with distance. Under high costs empty networks emerges. Under relatively low costs chain structure emerges but it is not stable. The star structure appears whenever the decay is high enough but it is pairwise stable only when it is not too high. Jackson & Rogers (2005) models variation of cost with replacing agents in different "islands". In this model, the benefits are truncated such that individuals benefit from indirect contacts which are not placed more than distance D. The linking cost is lower between agents of the same group than the connection with an agent of a different group. The island-connections model generates small diameter and high clustering, resulting in small-world networks. Studying a connection model with variation in cost structure, Galeotti & Goyal (2010) generates constructing results. In contrast to former models, it is assumed that the decay of benefits is negligible. The model generates networks with a high degree of centrality and short average distances like star-sponsored structures. Accordingly, it is claimed that any equilibrium network is minimally connected and these networks do not exhibit clustering. Using non-cooperative link formation perspective, Galeotti *et al.* (2006) models value heterogeneity as well as variation in the cost structure of relations. The model found that value heterogeneity is relevant for the connectedness of the network while cost variation is significant for both connectedness and structure of the relations.

Any other specification on indirect benefits aside from minimum path is not discussed in the literature at all. In other words, the second criticism needs more discussion. I attempt to extend this point by differentiating the utility one gets from indirect connection through different agents.

Another significant assumption of these models is the complete information. Individuals are assumed to know network structure and the utility functions of others. One exception is McBride (2006) who construct the model under the imperfect monitoring of others' network structures. The model accounts for players' observational limitations. The equilibrium is efficient under perfect monitoring or when people can observe at least half of the population. As the boundary decreases over-connection occurs which replaced with under-connection as a further decrease. It is shown that imperfect monitoring resultant in many inefficient equilibria. The assumption of capability to calculate marginal benefits of each link independent of the network structure eliminates the inefficiencies resultant from over-connection. Common knowledge on rationality eliminates the inefficiencies resultant from under-connection.

In this chapter, I consider the information problem when the benefits from contacts vary based on others' characteristics. Moreover, the benefits from indirect connections also depend on who connects the two.

In the second section, first I discuss the standard connections models and its extensions. Then I introduce a modified version of the model capturing the interaction between opposites. I construct several examples to make the main points of the modified model in the third section. The chapter is concluded with a brief summary and further discussions.

3.2 Model

3.2.1 Connections Models

The connections models developed for social connections (Jackson & Wolinsky, 1996). Standard version uses unweighted undirected relations. The links represent social relations between agents. The direct relations offer some benefit in return for some amount of costs. Moreover, through these links, they also benefit from indirect relations. The value obtained from others decay by the distance. The utility of each player i from the network structure g is formalized by

$$u_i(g) = w_{ii} + \sum_{j \neq i} \delta^{d_{ij}} w_{ij} - \sum_{j:ij \in g} c_{ij} \tag{3.1}$$

where $w_{ij} \geq 0$ denotes the inherent value of individual j to i; c_{ij} denotes the cost to i of maintaining the link ij; d_{ij} is the number of links in the shortest path between i and j; $0 < \delta < 1$ describes the idea that the value that i derives from being connected to j is depends on the distance between i and j. Less distant connections are more valuable than more distant ones, but direct connections are costly. The total value of network g is the summation of utilities of all individuals:

$$v(g) = \sum_{i \in N} u_i(g) \tag{3.2}$$

The symmetric case assumes no intrinsic value from one-self $w_{ii} = 0$ and the homogeneity between the benefits of all links and costs $w_{ij} = 1; c_{ij} = c$

$$u_i(g) = \sum_{j \neq i} \delta^{d_{ij}} - \sum_{j:ij \in g} c \tag{3.3}$$

Under this basic model, pairwise stability is applied to predict which forms may emerge and to examine the efficiency of these structures. The model shows that there exist cost ranges where the complete graph, star containing everyone and the empty network emerges as uniquely efficient structures. Moreover, it is shown that pairwise stability requires at most one non-empty component. Whenever $c < \delta - \delta^2$ the complete network is found to be uniquely efficient and pairwise stable structure. For $\delta - \delta^2 < c < \delta$ star encompassing all agents is the uniquely efficient but not uniquely pairwise stable structure. Lastly, for $\delta < c$, empty network is the uniquely efficient but we can find non-empty pairwise stable structures which are inefficient. Jackson & Wolinsky (1996) shows that even in an extension of the model capturing side payments there is a discrepancy between efficient and stable structures.

The well-discussed extension of the standard connection model counts in cost heterogeneity. In the islands-connections model, the cost structure within and across islands differentiates (Jackson & Rogers, 2005). For simplicity, they constraints the benefits of the indirect links. Whenever the length of the minimum path between two individuals is higher than some D, they don't receive any value from each other. The utility of individuals defined by

$$u_i(g) = \sum_{j \neq i: d_{ij} \leq D} \delta^{d_{ij}} - \sum_{j:ij \in g} c_{ij} \tag{3.4}$$

where $c_{ij} = c$ if i and j are in the same island and $c = C$ otherwise. Moreover, it is assumed that the cost of connection with closer agents is lower compared to connection with more distant ones such that $< c < C$. The model shows that for a variety of parameters, networks are characterized as small diameter and small average path lengths which are main characteristics of "the small worlds".

Similarly, Johnson & Gilles (2000) modify connection model so as to present *a spatial cost topology*. The cost heterogeneity may be caused by geographic, social or individual differences. Cost topology is assumed to be linear such that agents are placed in a real line $\mathbb{R}$. The number of all players spatially in between i and j including i and j defined as n_{ij} and the length of this set is defined by l_{ij}. The utility function is defined by

$$u_i(g) = \sum_{j \neq i} \delta^{d_{ij}} - c \sum_{j:ij \in g} l_{ij} \tag{3.5}$$

The empty network is both efficient and pairwise stable for high costs. For low costs, the chain is efficient but not pairwise stable. The efficiency and stability of the star structure do not only depend on the cost but also depends on the rate of decay. For stability, decay should be higher than $\delta = \frac{\binom{n}{2}}{n-1}$. However for large values of the decay rate, it is not efficient.

To sum up, the standard model with its extensions discuss the discrepancy between efficient and stable structures.

3.2.2 Connections Model with Conflicting Agents

As stated in previous chapter, the main concern of the study is the interaction between opposites. Concordantly, I modify the connection model counting in conflicting agents.

I will consider the case when each agent has either positive or negative view on a specific issue. For instance, if the specific issue is war there are people who support the war for some reason and there are opposition who wants peace. The value one receives from being connected to other depends on the type of each agent. The total value of the communication structure can be considered as the value of the interaction abut that specific issue. For simplicity I will call the people with same views as "allies" and people with opposite views as "enemies".

The studies of Jackson & Rogers (2005)'s islands connection model and Johnson & Gilles (2000)'s spatial connection model present a similar way of extension while they introduce the heterogeneity through cost structure. Instead, I will introduce heterogeneity in intrinsic function. In this model, the efficiency of the network structure will depend on how people value the allies and enemies.

Individuals are not able to know the views of each agent in the society. It is more realistic to consider that each individual only knows the types of agents with a given distant. For simplicity, I will assume this distance as 1. In other words, each agent knows only the types of direct contacts. The value one receives from indirect connections not only depends on the minimum path but also the type of the bridging neighbor. The path through an ally will give higher benefit than the path through an enemy.

The benefits one receives from any connection can be separated to two parts. First part stands for the standard benefit from a connection which unlocks connection to others and also reduces the uncertainty. Second part stands for the extra gain or loose due to the type of the connected agent. As in the standard model, the benefits decay with the distance while only direct links are costly. The utility of person i from network g can be written as

$$u_i(g) = \sum_{j \neq i} (w + w_{ij})\delta^{d_{ij}} - \sum_{j:ij \in g} c \tag{3.6}$$

where w_{ij} shows the extra gain or loose of i depending on the type of the neighbor j; d_{ij} is the shortest path. w and c are taken as free from relations. As in standard models, $0 < \delta < 1$ and show the proportion of decay of benefit by distance.

The specification of the benefits represent a significant contribution of the model. Although as in standard model the indirect benefits received only through minimum path, unlike the standard one it differentiate by the type of the bridging neighbor. If one can reach other through two different paths with the same distant, she should decide which one she is willing to use.

Assumption 3.2.1. [Rationality Condition]: Consider a network g in where $k, z \in B_i(g)$ but $j \notin B_i(g)$. Moreover if $i_1 = 1$ and $i_K = j$, suppose $k, z \in \{1, 2, .., K-1\}$. Suppose $v_{ij}(g)$ denotes the utility i receives from j and l_{ij}^k denotes the distance between i and j through k. If $l_{ij}^k = l_{ij}^z = d_{ij}$ then $v_{ij}(g)$ can take two values: $v_{ij}(g)^1 = (w + w_{ik})\delta^{d_{ij}}$ or $v_{ij}(g)^2 = (w + w_{iz})\delta^{d_{ij}}$. i chooses the path with k if $v_{ij}(g)^1 > v_{ij}(g)^2$ and the path with z if $u_{ij}(g)^2 > v_{ij}(g)^1$. If $v_{ij}(g)^1 = v_{ij}(g)^2$, she is indifferent.

Assumption 3.2.1 represents the role of the bridging agent in one!s relations. It is not unrealistic if we consider real life experiences. I will probably more benefit from the connections of my friend but less from my enemies.

Let $N = \{1, 2, .., n\}$ be the set of individuals. Suppose Group 1 (S_1) includes positive views and Group 2 (S_2) includes negative views in the population. The extra value will be defined as:

$$w_{ij} = \begin{cases} = w_1 \text{ if } i, j \in S_1; \text{ OR } i, j \in S_2 \\ = w_2 \text{ if } i \in S_1 \text{ and } j \in S_2; \text{ OR } i \in S_2 \text{ and } j \in S_1 \end{cases}$$

Once they interact, they communicate on types of each other. Accordingly they get/loose extra value. Note that, if $w = 1$ and $w_{ij} = 0 \; \forall \; i, j \in N$ the model is standard symmetric connection model.

Another significant assumption is about the benefits one gets from allies and enemies.

Assumption 3.2.2. $w_1 > 0$ and $w_2 < 0$.

Assumption 3.2.2 represents the idea that agents will get extra value from interaction with allies, but loose some value from the enemies. In fact the specifications of w_1 and w_2 indicates how a society values consensus and conflicts

Assumption 3.2.1 represents that, this effect passes through indirect connections. Under these assumptions, we can conclude that in the case of possibility an agent would prefer to contact others through allies. Example 3.2.1 examines a basic case to present these assumptions.

Example 3.2.1. Suppose $N = 3$ such that $\{1\} \in S_1$ and $\{2, 3\} \in S_2$. Consider two different network structure: $g = \{12, 13\}$ and $g^{'} = \{13, 23\}$ which are represented in Figure 3.1. Under standard model the $u_2(g) = u_2(g^{'})$ and the total value of the network is same.
Under the modified version $u_2(g) = (w - w_2)(\delta + \delta^2) - c$ and $u_2(g^{'}) = (w + w_1)(\delta + \delta^2) - c$. Under Assumption 2.1, $u_2(g^{'}) > u_2(g)$. Moreover the total value of the networks will be $v(g) = 4\delta(w - w_2) + 2\delta^2(w - w_2) - 4c$ and $v(g^{'}) = 2\delta(w - w_2) + 2\delta(w + w_1) + 2\delta^2(w - w_2) - 4c$. $v(g) - v(g^{'}) = -2\delta(w_1 + w_2)$. As a result, in the modified model the value of second structure is greater than the first structure.

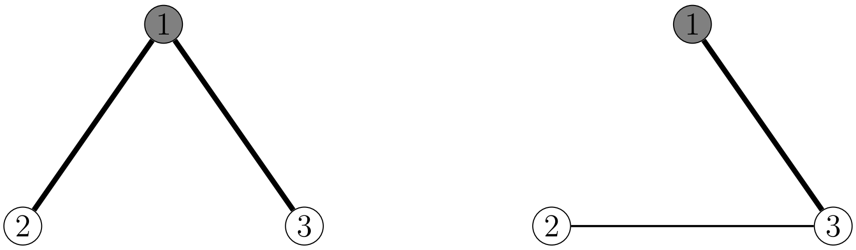

Figure 3.1: The Significance of The Bridge's Identity

Example 2.1 propose that the total value generated by a network influenced by the density of same type and opposite type connections.

Example 3.2.2 presents the idea behind Rationality Assumption.

Example 3.2.2. Suppose there are 4 nodes where each group has two members. $S_1 = \{1,2\}$ and $S_2 = \{3,4\}$. Consider the network structures $g = \{12, 23, 34\}$ and $g'\{12, 13, 34, 24\}$ which are shown in 3.2. Denote the value

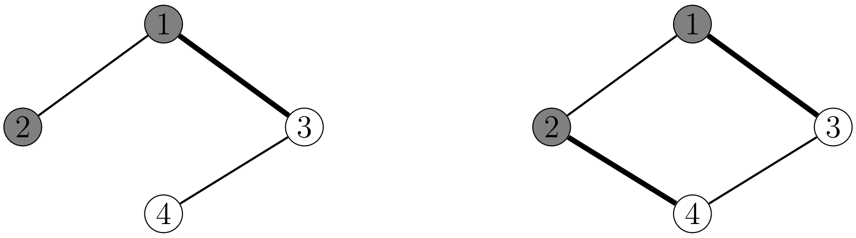

Figure 3.2: Rationality Assumption

of a link in $ij \in g$ for i $v_{ij}(g)$ and for j $v_{ji}(g)$. $v_{31}(g) = (w-w_2)(\delta+\delta^2)-c$ and $v_{31}(g') = (w-w_2)\delta - c$. While node 3 should interact with node 2 through enemy in the first structure, connection between 2 and 4 make her to reach 2 through an ally. This will increase the utility node gets from the structure.

Before moving to analysis, I examine the values of several structures to deepen the understanding of the model.

Values for Different Network Structures

Suppose there are $|S_1| = n_1$ and $|S_2| = n_2$; $i \in S_1$ and $j \in S_2$. The values of basic structures can be calculated as follows.

Complete Network

The complete network is the one in which each node connected to all others such that $g_{ij} = 1$ $\forall i, j \in N$ and $i \neq j$. Each agent has $n-1$ links and in total there are $\frac{n(n-1)}{2}$ links.

The utility of agent i is:
$u_i(g^N) = [(n_1 - 1)(w + w_1)\delta + n_2(w - w_2)\delta] - (n-1)c$
$u_j(g^N) = [(n_2 - 1)(w + w_1)\delta + n_1(w - w_2)\delta] - (n-1)c$
The total value of the graph will be

$$v(g^N) = n_1(n_1-1)(w+w_1)\delta+n_2(n_2-1)(w+w_1)\delta+2n_1n_2(w-w_2)\delta-n(n-1)c$$

Circle
The circle is the one where each agent has two neighbors and in total there are n links.

In a circle structure, for each agent the network can be partition into two. Suppose j is the neighbor in left hand side and k is the neighbor in the right hand side.
If <u>n is odd</u>, agent reaches $\frac{n-1}{2} = D$ members from each side. Then for each agent $u_i(g) = (w + w_{ij})[\delta + \delta^2 + ... + \delta^D] + (w + w_{ik})[\delta + \delta^2 + ... + \delta^D] - 2c$
If <u>n is even</u>, for each agent through right or left has the same distance from the last member of the population. One trick is associated to the assumption of Rationality. Agent would prefer to connect through an ally whenever she is indifferent in terms of the shortest path. Then the utility of an agent i is
$u_i(g) = (w+w_{ij})[\delta+\delta^2+...+\delta^{D-1}]+(w+w_{ik})[\delta+\delta^2+...+\delta^{D-1}]+(w+w_{it})\delta^D-2c$
$w_{it} = w_1$ if $w_{ij} = w_1$ or $w_{ik} = w_1$ and $w_{it} = w_2$ if $w_{ij} = w_{ik} = w_2$.

The total value of the network structure does not change with based on the n such that in any case it is
$v_g = \sum_{i=1}^{n} u_i(g)$

Chain
The chain structure is the one in which everyone has at most two neighbors. In fact, chain is obtainable from a circle by severing a link between two agent. The total number of the links is $n - 1$.

In a chain, the values is similar to the circle except the first and the last members have only one neighbor. Suppose i is the i^{th} member. Again, j is the neighbor on the left and k is the neighbor on the right. The utility of agent i is
$u_i(g) = \Big(((w+w_{ij}))(\delta+\delta^2+...+\delta^{i-1}\Big) + \Big(((w+w_{ik}))(\delta+\delta^2+...+\delta^{n-i}\Big) - 2c$
where $i \neq 1, i \neq n$.
For $i = 1$, the first part of the utility function will be zero and for $i = n$, the last part of the utility function will be zero.

The total value of network is
$v(g) = \Big((w + w_{ik})(\delta + \delta^2 + ... + \delta^{n-1})\Big) + \Big((w + w_{ij})(\delta + \delta^2 + ... + \delta^{n-1}\Big) + \Big[\sum_{i=2}^{n-1} \Big(((w + w_{ij}))(\delta + \delta^2 + ... + \delta^{i-1}\Big) + \Big(((w + w_{ik}))(\delta + \delta^2 + ... + \delta^{n-i}\Big)\Big] - 2(n-1)c$

Example 3.2.3 represents a possible extension of this representation to any chain-like structures.

Example 3.2.3. Consider the network structure in Figure 3.3 such that $N = 7$, $S_1\{1, 3, 4, 6, 7\}$ and $S_2 = \{2, 5\}$. The network structure denoted as $g = \{12, 23, 34, 35, 56, 67\}$.

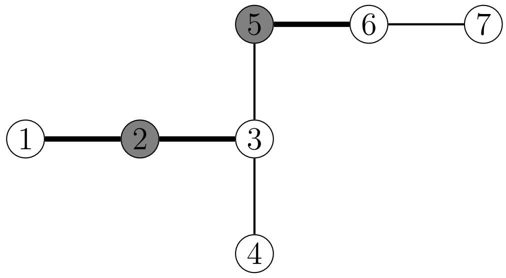

Figure 3.3: Conflict in a Chain-Like Structures

Unlike standard chain, the network ramifies into two after node 3. The nodes in each distance can be different than one. For instance, Node 1 has two other nodes with distance three. Node 3 has three direct neighbors, so have three branches instead of two.
$u_1 = (w - w_2)(\delta + \delta^2 + \mathbf{2}\delta^3 + \delta^4 + \delta 5) - 2c$
$u_3 = (w - w_2)(\delta + \delta^2) + (w - w_2)(\delta + \delta^2 + \delta^3) + (w + w_1)(\delta) - \mathbf{3}c$
This representation is helpful to calculate the value of any agent in any kind of partially connected network structures.

<u>Star</u>
Star network is the one in which there is a central agent i connected to all others whereas i is the only neighbor of others such that $g_{ij} = 1$ for $\forall j \neq i$ and $g_{ik}) = 0$ for $k \neq i$.

The star structure that encompassing all members of the society can be drawn as a chain. This case, each agent classifies the members into three, one has $n - 2$ stands last members, one stands for the central member and the other stands for the initial node. In Figure 3.4 1 is the initial node, 2 is the central node and the other 5 nodes are the last members. Consider a structure where agent z is central such that $\underline{z \in S_1}$.

$u_z(g) = (n_1 - 1)(w + w_1)\delta + n_2(w - w_2)\delta - (n - 1)c$
$u_i(g) = (w + w_1)\delta + (n - 2)(w + w_1)\delta^2 - c$

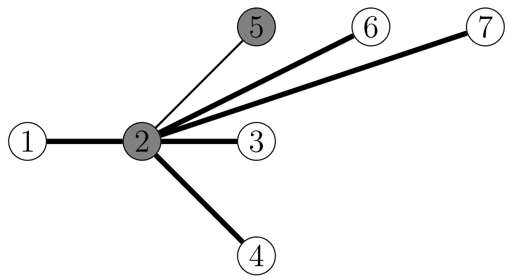

Figure 3.4: Conflict in a Star Network

$u_j(g) = (w - w_2)\delta + (n-2)(w - w_2)\delta^2 - c$
$v(g) = u_z(g) + (n_1 - 1)u_i(g) + n_2 u_j(g)$

$v(g) = 2(n_1 - 1)(w + w_1)\delta + 2n_2(w - w_2)\delta + (n_1 - 1)(n - 2)(w + w_1)\delta^2 + n_2(n-2)(w - w_2)\delta^2 - 2(n-1)c$

Note that if agent y is central such that $y \in S_2$.
$v(g') = 2(n_2 - 1)(w + w_1)\delta + 2n_1(w - w_2)\delta + (n_2 - 1)(n - 2)(w + w_1)\delta^2 + n_1(n-2)(w - w_2)\delta^2 - 2(n-1)c$

Efficiency and Stability

In this part I discuss the efficiency and stability conditions of different network structures.

The arguments are derived for a population where the sizes of groups are different. Suppose $|S_1| = n_1$ and $|S_2| = n_2$ where $n_1 > n_2$.

CASE 1: Complete Structure

Proposition 1. If $c < (w - w_2)\delta - (w + w_1)\delta^2$ the complete graph g^N is the unique strongly efficient network. At this cost range, g^N is the unique pairwise stable network.

Proof. Any agent receives from indirect link at most $(w + w_1)\delta^2$. A direct contact brings any agent at least $(w - w_2)\delta - c$ and at most $(w + w_1)\delta - c$. If the highest gain from indirect link is lower than the least gain from a direct link then any agent will gain with forming a link. If $(w + w_1)\delta^2 < (w - w_2)\delta - c$, forming a link between two agents who are not directly connected will improve their utilities and accordingly increase the total value.
From complete network, if a link between allies is destroyed the value changes

by $2[-(w+w_1)\delta+(w+w_1)\delta^2+c]$ and destruction of a link between enemies changes the value by $2[-(w-w_2)\delta+(w+w_1)\delta^2+c]$. If $c<(w-w_2)\delta-(w+w_1)\delta^2$ this also implies $c<(w+w_1)\delta-(w+w_1)\delta^2$. Under this cost condition, deviation from a complete network by severing a link between any two agent decreases the utilities of both agent. As a result, complete graph is also the unique pairwise stable network.

□

CASE 2: Connected Allies

Lemma 3.2.1. Two allies benefit from a direct link if $(w+w_1)(\delta-\delta^2)>c$

Proof. The highest indirect benefit between two allies is connection through only one ally: $(w+w_1)\delta^2$. If the value of a direct link, $(w+w_1)\delta-c$, is higher than the highest indirect benefit, any two allies gain by forming a link.

□

Under this cost structure any efficient network contains connected allies. Which structures occur under efficiency and pairwise stability conditions depends on the relations between the interactions.

Lemma 3.2.2. If $(w+w_1)\delta^3<(w-w_2)\delta-c$ any efficient network contains at least n_2 one-to-one inter-relations.

Proof. Let L denote the number of links between enemies. If $L<n_2$, then there is at least two individuals in both groups, who don't have direct connection with a member of other group. Connection increases each of them by at least $(w-w_2)\delta-c-(w+w_1)\delta^3$ which put higher than zero .

Table 3.1 shows the highest changes by formation of a second link. Note that the highest value is generated by connection of unconnected two agents. DC denotes the changes for the connected partners and IC shows the changes for others. # shows how many people affected by this change.

Under given cost structure, the summation of third column is higher than the summation of the second column. Moreover, the value of L^{th} link between unconnected two enemies is $(w-w_2)\Big[2\delta-(n-4L+2)\delta^2\Big]+(w+w_1)\Big[(n-2)\delta^2-(2n-4L+2)\delta^3\Big]-2c$. The difference between L^{th} and $(L+1)^{th}$ link is $4(w+w_1)(\delta^2-\delta^3)$ which is higher than zero. As a result, under this cost range the efficiency necessitates at least n_2 one-to-one inter-group links.

□

Lemma 3.2.3. Any efficient network have more than n_2 links is not pairwise stable.

	What	Replaced by	Nodes #	Effect
DC	$(w + w_1)\delta^3$	$(w - w_2)\delta - c$	2	+
DC	$(n_2 - 2)(w + w_1)\delta^3$	$(n_2 - 2)(w - w_2)\delta^2$	1	+
DC	$(n_1 - 2)(w + w_1)\delta^3$	$(n_1 - 2)(w - w_2)\delta^2$	1	+
IC	$(w - w_2)\delta^2$	$(w + w_1)\delta^2$	2	+
IC	$(w + w_1)\delta^3$	$(w + w_1)\delta^2$	$n_2 - 2$	+
IC	$(w + w_1)\delta^3$	$(w + w_1)\delta^2$	$n_1 - 2$	+

Table 3.1: The Effect of the Second Link in Between Two Completely Connected Groups

Proof. If $L > n_2$, some of the members in second group have more than one links. The value will change by
$\Big(2(w - w_2)\delta - 2c - 2(w + w_1)\delta^2\Big) + \Big(n_2(w + w_1)\delta^2 - n_2(w - w_2)\delta^2\Big)$.
Under this cost structure, the left hand side will be negative while the right hand side is positive. If the positive side dominates, the value increases with extra links. On the other hand, the change of an extra link for an unconnected agent will be $(w + w_1)\delta^2 - (w - w_2) - c$ which is lower than zero. An unconnected agent would be worst of with extra links since she can already reach to enemies through allies with distance 2.

□

Lemma 3.2.2 and Lemma 3.3.3 can be summarized as
1. In case the negative effect of the extra links dominates, n_2 one to one link is efficient and pairwise stable.
2. On the other case, n_2 one to one link is pairwise stable but inefficient.

On the other hand, if the highest value of the second link is lower than zero, any efficient network will contain at most one bridging links.

Lemma 3.2.4. If $(w - w_2)\delta - c < (w + w_1)\delta^3$ any efficient network that have more than one inter-connection is not be pairwise stable.

Proof. Table 3.1 shows that if $(w - w_2)\delta - c < (w + w_1)\delta^3$, the direct change is negative which makes connected agents worst off. However, if the benefit of indirect connections is higher than the loose of the connected agents, increase in total value is possible. For instance, if the population is too high, network externalities may increase the value of the network while any improving change in terms of efficiency is not pairwise stable.

□

Lemma 3.2.5. If $c > (w - w_2)\delta + (n_2 - 1)(w - w_2)\delta^2$, totally segregated ally groups is the unique pairwise stable network.

Proof. Table 3.2 shows the highest changes with formation of the first links between two groups.
Suppose $i \in S_1$ and $j \in S_2$ such that $g_{ij} = 1$.

	What	Replaced by	Nodes #
DC	0	$(w - w_2)\delta - c$	2
DC	0	$(n_2 - 1)(w - w_2)\delta^2$	1
DC	0	$(n_1 - 1)(w - w_2)\delta^2$	1
IC	0	$(w + w_1)\delta^2 + (n_2 - 1)(w + w_1)\delta^3$	$n_1 - 1$
IC	0	$(w + w_1)\delta^2 + (n_1 - 1)(w + w_1)\delta^3$	$n_2 - 1$

Table 3.2: The Effect of the First Links Between Two Completely Connected Groups

$\Delta u_i(g) = (w - w_2)\delta - c - (n_2 - 1)(w - w_2)\delta^2$ and
$\Delta u_j(g) = (w - w_2)\delta - c - (n_1 - 1)(w - w_2)\delta^2$.
If the lowest one has a negative value, the unconnected ally groups is pairwise stable even if it is inefficient. Under the assumption $n_2 < n_1$, if $\Delta u_i(g) < 0$ any inter-connected structure is instable. That is to say if $c > (w - w_2)\delta + (n_2 - 1)(w - w_2)\delta^2$, the pairwise stable network contains segregated ally groups. On the other hand, since connection necessitates mutual desire, the variables should satisfy at least $\Delta u_j(g) > 0$.

□

Lemma 3.2.5 tells that, to have a pairwise stable completely segregated ally groups, the conflict should be too high such that $\frac{c}{1-(n_2-1)\delta} > (w - w_2)\delta$ should be hold. On the other hand, if population is large enough even under high conflict, connection may generate stable outcomes. However, in terms of efficiency the table shows that completely segregated ally groups can be efficient only for small groups. For large groups the efficient structure will be connection between two groups even it can be instable.

The findings of this part supports the tension between efficient and pairwise stable structures.

Proposition 2. For $(w - w_2) - c < (w + w_1)\delta^2 < (w + w_1)\delta - c$

1. If $(w - w_2)\delta + (n_2 - 2)(w - w_2)\delta^2 < c$ the pairwise stable structure is complete segregation. In terms of efficiency, if $c < (w - w_2)\delta + \frac{n-2}{2}(2w +$

$w_1 - w_2)\delta^2 + (n_1 - 1)(n_2 - 1)(w + w_1)\delta^3$ forming link increase the value so efficient structure should have at least a bridge. However if c is between these two values, then it is not pairwise stable. Pairwise stable structure will be inefficient.

2. If $(w - w_2)\delta - c < (w + w_1)\delta^3$, any efficient network which have more than one link is not pairwise stable.

3. If $(w + w_1)\delta^3 < (w - w_2)\delta - c$, the pairwise stable network contains n_2 one-to one inter-relation between groups and this can be inefficient.

CASE 3: Broken Links with Allies:

Lemma 3.2.6. If $(w + w_1)(\delta - \delta^2) < c$ any efficient network contains a star within ally groups.

Proof. Within ally groups any member of a triangle has $u_i = 2(w + w_1)\delta - 2c$. If a link between two allies destroyed the value of two ends changes by $(w + w_1)\delta^2 - (w + w_1)\delta - c$ which put higher than zero at this cost range. The value of the center will not change. Moreover, as the diameter decreases, the value increases. As a result, any efficient structure should include stars within each group.

□

The bridge which brings highest value to network is connection between two centers and the benefit of the first link between two centers is the summation of third column in Table 3.2.

Lemma 3.2.7. If $(w - w_2)\delta - c < (w + w_1)\delta^3$ any efficient network that have more than one inter-connection is not be pairwise stable.

Proof. The difference between Case 2 and Case 3 in terms of formation of a second link is based on the externalities. Unlike Case 2, since the peripheral agents already use the center for indirect connection to other group and the diameter would not change with any other connection, the value they received will not change. The only indirect change will appear on central agent due to Rationality assumption. Table 3.3 shows the changes of the value for each agent. Under specification of δ, any connection between two peripheral nodes makes them worst off. This time indirect benefit is much more lower. If direct losses dominates the gains of two central agents, then second link will be inefficient. Moreover if $c < (w - w_2)\delta - (n_1 - 1)(w - w_2)\delta^2$ the only one bridge is both efficient and pairwise stable.

□

	What	Replaced by	Nodes #	Effect
DC	$(w+w_1)\delta^3$	$(w-w_2)\delta-c$	2	-
DC	$(n_2-2)(w+w_1)\delta^3$	$(n_2-2)(w-w_2)\delta^2$	1	-
DC	$(n_1-2)(w+w_1)\delta^3$	$(n_1-2)(w-w_2)\delta^2$	1	-
IC	$(w-w_2)\delta^2$	$(w+w_1)\delta^2$	2	+

Table 3.3: The Effect of the First Link Between Two Stars

Lemma 3.2.8. The segregated stars is the efficient structure if

$$(w-w_2)\delta + \frac{n-2}{2}(w-w_2)\delta^2 + \frac{n-2}{2}(w+w_1)\delta^2 + (n_1-1)(n_2-1)$$
$$(w+w_1)\delta^3 < c < (w+w_1)\delta + \frac{n_2-1}{2}(w+w_1)\delta^2$$

Proof. The left hand side shows the highest possible value of the first link which is the summation of the third column in Table 2. If this is lower than zero, any bridge lowers the value of the structure. The right hand side shows the value of the star when $i \in S_1$ is the central agent. Under this cost structure the segregated stars is the uniquely strong efficient structure.

□

Combining with the argument in Case 2, we can conclude that under any cost structure, a pairwise stable segregated structure is probably inefficient. The only coincidence can be obtained for small groups.

Lemma 3.2.9. If $(w+w_1)\delta^3 < (w-w_2)\delta - c$, the network structure where all peripheral agents connected with hub of the enemy is a pairwise stable and there are $2n-2$ links.

Proof. A link between two hubs change the value for each by $(w-w_2)\delta - c - (w+w_1)\delta^2$ which is lower than zero. Under Rationality assumption [1] the same is true for peripheral agents. If two opposition break the link they will lose by $(w+w_1)\delta^3 - (w-w_2)\delta - c$ which is also lower than zero. As a result, no one wants to change the structure and it is pairwise stable.

□

However this is not the unique pairwise stable structure.

[1] Note that even if one don't use the rationality assumption, if $(w-w_2)\delta < (w-w_2)\delta^2$,, a link between two peripheral enemies decrease their utility

Lemma 3.2.10. If $(w+w_1)\delta^3 < (w-w_2)\delta - c$, the network structure where all peripheral agents connected with all peripheral enemies but not hub, and hubs connected to each other but not peripheral enemies is also pairwise stable and there are $n_1 n_2$ links.

Proof. If two peripheral enemies break the link the value will change by $(w-w_2)\delta - c - (w+w_1)\delta^3$, and for two hubs breaking will cause a change $(w-w_2)\delta - c - (w+w_1)\delta^3$. Both are lower than zero, so no one wants to severe the existing links. If a periphery and a hub from different groups construct a link the utility of each will change by $(w-w_2)\delta - c - (w+w_1)\delta^2$ which is again lower than zero. Similarly, no one wants to construct a new link. As a result, this structure is also pairwise stable.

□

The arguments under this cost structure can be summarized as follows.

Proposition 3. For $(w+w_1)\delta - c < (w+w_1)\delta^2$,

1. If $(w-w_2)\delta + (n_2-2)(w-w_2)\delta^2 < c$ the pairwise stable structure is completely segregated stars.
If $c < (w-w_2)\delta + \frac{n-2}{2}(2w+w_1-w_2)\delta^2 + (n_1-1)(n_2-1)(w+w_1)\delta^3$ forming a link will increase the total value. In this case the efficient structure should have at least a bridge. However if c is between these two values, then pairwise stable structure will be inefficient.

2. If $(w-w_2)\delta - c < (w+w_1)\delta^3$ any efficient network that have more than one inter-connection is pairwise stable.

3. If $(w+w_1)\delta^3 < (w-w_2)\delta - c$, there are several pairwise stable network structures.

CASE 4: Isolation

Proposition 4. If $c > (w+w_1)\delta + \frac{n_1-2}{2}(w+w_1)\delta^2$, the strongly efficient network will be empty and this is pairwise stable.

Proof. The proof is straight forward. Under this cost structure, the ally-stars have negative values which can be increased to zero if all links destroyed. Since this condition implies higher cost than the value of a direct contact among any two types, it is also pairwise stable.

□

3.3 Examples

As discussed above, specifications on w_1, w_2 indicate how society values consensus and conflicts on a specific issue. Different valuation of opposition generates different stable and efficient structures.

In this part, I construct several examples for different specifications.

Example 3.3.1. ***[Change in Conflict]***
Consider a specific issue which society experiences conflict between several agents. Suppose each individual receives a value of 4 from each connections. If they have same view on that issue, the value will rise to 6. Moreover suppose the cost of each link is 0.3 and the decay by %30.

Case 1: *[Low Conflict- Complete Structure:]*
Suppose the conflict is not much relevant such that interaction with the opposition diminishes the value only by 1. In this case, the complete structure will be both uniquely strong and pairwise stable structure. Value from a direct connection is lower than the highest values of an indirect connection. As a result, the maximum value of the structure results in a complete structure. Moreover, if two allies destroy the link, each will loose $(1.5 - 0.54)$ and if two enemies destroy the link they will loose $(0.6 - 0.54)$ and the losses will be higher than zero. As a result complete network will be the unique pairwise and stable network.
If the conflict in that issue is not significant at all or people care opposition relatively lower than complete network will be stable as well as efficient structure.

Case 2: *[Mediated Conflict: One-to-One Connection]*
Suppose valuation of conflict rises to 1.5. Under rationality assumption, severing the link between two enemies will increase the value of the network since $0.54 - 0.45 > 0$. However, completely segregated ally groups value less than the complete structure. After some calculations, one can find that bridging two groups by one link will increase the total value by $0.441n + 0.324n_1n_2 - 0.331$. For $n_1, n_2 > 0$ this is higher than zero. Moreover the $L^{th} \geq 2$ one-to-one link between two groups will value $0.441n - 0.282L - 0.27$. Any L^th link necessitates at least $2L$ size of the population which makes the value at least $0.6L - 0.27$ which is higher than zero for any L. After n_2 one-to-one links established, the value of an extra link between unconnected agent from first group and the second link of any player from second group has a value of $0.045 + 0.315n_2 > 0$. The positive value caused by a change in the path

of the relations by people in the second group. While they have to connect through an enemy to any unconnected individual, one link give way for all to change the path and connect through an ally. As a result, the most efficient structure will include n_1 links. However, the individual from the first group will change by $(0.54 - 0.75 + 0.3)$ which is lower than zero. Any extra link will not be beneficial. Lastly, severing a link when there is one-to-one n_2 links will diminish the value of each at least $(0.45 - 0.162)$ which is higher than zero. Accordingly, the pairwise stable network contains n_2 one-to-one link which is inefficient.

Case 3: *[Higher Conflict: One Bridging Link]*
Suppose the valuation of the conflict rises to 4.5. The value of the first link between two groups is $0.216n + 0.324n_1n_2 - 1.146$ which is higher than zero for $n_1, n_2 \geq 2$. The value of the L^{th} link is $0.216n - 0.161L - 6.87$. A second link increases the value of the network structure if $n > 27$. For the second link, the bridging node will get $-0.15 - 0.612 + n_2 - 2(0.045 - 0.162)$ which is lower than zero. As a result, construction of a second link is not pairwise stable, although it increases efficiency.
The fist link increases the value of two connected agents by $-0.15 + (n_1 - 1)0.045$, $-0.15 + (n_2 - 1)0.045$ which are higher than zero for $n_1, n_2 \geq 4$. Whenever $n < 28$ and n_2 is at least 4, bridging two ally groups by only one link will be efficient and pairwise stable structure.

Case 4: *[High Conflict: Segregated Ally Groups]*
Consider the case in which involving in conflict quite diminish the value such that $w_2 = 6$. The value of a bridge between two groups is $(0.036n + 0.324n_1n_2 - 2.196)$. It is higher than zero for $n_1 \geq 3$ and $n_2 \geq 2$. However, for connected agents the value of the link will be $(-0.6 - (n_2 - 1)0.18)$ and $(-0.6 - (n_1 - 1)0.18)$ which are lower than zero for any n_1 and n_2. As a result, segregated ally groups will be pairwise stable network structure but it is inefficient if $n_1 \geq 3$ and $n_2 \geq 2$.

Example 3.3.2. ***[Structure of the Stars]***
Star structure is generated if an agent receive relatively lower benefits from connection between with an ally.

Case 1: *[Connected Peripheral Agents]*
If the difference between the valuation of ally and enemy is low and the decay is high enough, the efficiency requires connection of the distant agents.
Consider the case where the value of a link is 1 while extra gain and loss are both 0.1, cost of a direct link is 0.24 and the decay is high such that $\delta = 0.7$.

In this case $(w+w_1)\delta^2 > (w+w_1)\delta - c$. Since the total value decreases with distance, the efficient structure should include a star within each group. Any link with hub, say a peripheral agent of group 2 connect to center of group 1, changes value by $(0.0637n_1 - 0.2637)$ and it is higher than zero. However the hub will loose value of 0.051 which is not pairwise stable.
The value of the first link between two peripheral agent is
$(0.2254n + 0.7546n_1n_2 - 0.4254)$ and it is greater than zero for $n_1, n_2 \geq 1$. For each additional link $L \geq n_2$ the link will shorten the path for only connected agents and the hub through changing the path she uses. Accordingly each additional one-to-one link will generate value of 0.3234. At $L = n_2$ the center of first group has already maximize extra benefit through changing the path. Then the value of each link up to $L = n_1$ is (0.1744) and $L > n_1$ the value will be (0.025). After that a hub will loose of (0.149) with linking any peripheral agent. Accordingly connected peripheral agents generate a pairwise stable network.
Another pairwise stable structure will be the star where all peripheral enemies connected to both central nodes. After some calculations it is clear that the total value generated by peripheral connections network is higher by amount of $0.596 + 0.298n$ compared to hubs-based star structure.

Case 2: *Bridging Hubs*
Consider the case where the any link has a value of 4 and cost of a direct connection is 1.5. Connection of ally increase the value of a link by a value of 2 and enemy decreases it by a value of 1. The value of the link decreases by %60 by distance. Between two ally stars, the highest value of the first link is $(-3.288 + 0.48n + 2.592n_1n_2)$. This is greater than zero for $n_1, n_2 > 1$. However the highest value of the second link is $(-3.168 - 0.216n)$. Accordingly efficient network has only one bridging link.
Moreover the first link increases the value of both hubs by $(0.3+1.08(n_2-1))$ and $(0.3 + 1.08(n_1 - 1))$. A link between hub and an opposite periphery will decrease (-1.05). As a result the structure where there the hubs are bridging agents is pairwise stable and also efficient structure.

Case 3: *Isolated Stars*
Consider the case in Example 1 and suppose the cost af any link rises a value of 1.3. Now a bridge between two hubs will generate additional value of $(-0.184n + 0.324n_1n_2 - 0.756)$. This value is greater than zero for $n_1, n_2 \geq 4$. However the positivity of the total value is generated through externalities. The link brings negative values for two connected agents since $(w - w_2)\delta - c < 0$. As a result, segregated stars will be pairwise stable and it is inefficient.

Example 3.3.3. [Isolated Nodes]

Case 1: *Inefficient Isolation*
Now consider the case just above with $n_1 = 10$ and $n_2 = 8$ and cost of any link rises to 2.5. The value of the stars will be 26.28 and 12.88. All these positive effect is generated by externalities. Hub will increase utility if she breaks any link. In this case, empty network is pairwise stable but inefficient. Another pairwise stable network will be a circle containing at least seven allies. The total value of the network will be 0.028 where everyone gains small amount but greater than zero. Severing a link will make individuals worst off approximately (-1.4). Additional link will also decrease the value of any agent. As a result a circle can generate inefficient pairwise stable structure.

Case 2: *Efficient Isolation*
Consider the case when the cost of each link rises to 4. This cost structure will make the value of the star negative. Moreover, the cost of connection rises higher than any kind of compensation through externalities. As a result, the empty structure is uniquely efficient and pairwise stable structure.

3.4 Conclusion

The main aim of this chapter is drawing the possible network structures under the existence of conflicts between agents. For this purpose, I extend the standard connections model including heterogeinity in value received from different agents. The valuation differentiates based on the consensus and conflicts on a given issue. Individuals communicate their perspective through communication. For simplicity, I assumed that each agent only knows the perception of neighbors. Communication is costly. However, indirect contacts also bring value. Since one doesn't know the perception of indirect contacts, the value received from them adjusted by the perception of the bridging agent. The possible network structures discussed under different sizes of groups.

The main findings are compatible with standard connection models. In most cases, there is a discrepancy between efficiency and stability. Although it is a highly stylized model, the findings are explanatory for several social phenomena. For instance, segregation is found to be efficient and sustainable for individuals for only small groups. For larger populations full segregation is inefficient. In this point, sufficient transfer payments may be analyzed to get further results. Even if the conflict has a depressing effect in which case the utility decreases with a direct contact, a society may encourage some people for becoming a bridge in return to some transfers.

A more dynamic environment would generate more interesting results. For instance what if a change in perceptions is possible? Or the awareness of a conflict necessitates a direct contact such that the people who contact with allies would not get an extra value as long as they meet with an enemy and only after that they value allies higher.

Although the model is quite simple, it is flexible to consider many other aspects of the problem. Moreover, it is obvious that network theory has more to say about interactions under the existence of social conflicts. There are much more to say when we consider the possibility of collective action and mobilization which can be subjects of the further studies.

Chapter 4

The Role of Pre-Existing Ties in A Given Network

4.1 Introduction

This chapter aims to present a simple model including the arguments presented in the last section of Second Chapter.

In the second chapter, I have introduced the importance of network analysis for several aspects of social movements. In several places, I have stated that the role of pre-existing ties has frequently pointed in previous studies. However, the necessity of a broader perspective is obvious.

In the literature, social movements have defined in various ways. Accordingly, the focus of the studies varies. As stated in the second chapter, in general, American tradition concerns "how movements are mobilized" whereas European studies are dominated by the interests on "why movements occur". The studies within each stream also differentiate in their focus and the methodology they use (see Della Porta & Diani (1999) for a detailed discussion on the concept). In contrast with all differences, the significance of network mechanism or components has been emphasized in almost all studies.

On the other hand, Western dominance in the literature has been challenged by several studies. Discussing the ecological movements in Japan, Broadbent (2003) criticizes Western theories as being inadequate for different types of societies. Material and cultural bases of the individual rationality are claimed to be inadequate for Japan's vertical society. Social context in the form of networks and roles are presented as a bridging factor. Western countries are assumed to be relatively individualistic and diverse. In such a thin social context, recruitment is motivated by individual ideological or moral convictions. Dense and centralized networks are frequently described as the source of movements. Although this is not neglected, in a thick social context like in Japan, the social network structure is significant than individual relations. Social control sustained through local vertical networks and how people related to the leader is deterministic. Accordingly, the role of networks as well as the actors differentiate in both societies.

Diani (2003) defines social movements as complex and quite heterogeneous network structures. Although there are studies implicitly analyzing social movements as networks, Diani's explicit definition is stimulating. In preceding studies, pre-existing ties (personal or organizational) were considered just as an important factor in participation decision of individuals. However, subsequent studies find this explanation incomplete. The existence of pre-existing links is not a distinctive factor. Probably there are many people who linked with members but not take part any action. Since these studies generally focusing on the people already participated, they undermined this fact.

Snow *et al.* (1980) is considered as the leading study pointing the necessity of specification in relations for movement recruitment process. Based on the empirical data, the article shows that network linkages are important in counting the differences in movements' recruitment. McAdam & Paulsen (1993) introduces "countervailing effects". Analysis on the Free Summer School by McAdam & Paulsen (1993) shows that the multiplicity of the ties has different impacts on the participation. Some ties support participation whereas others may influence on other direction. This study states that pre-existing ties significant only if there is strong identity linked with the movement in question. However strong identity alone may not effective to generate movements. The construction workers have a strong identity but the absence of ties between them discourage them to mobilize even there was huge mobilization within working class in 1860s France (Gould, 1991). On the other hand, pre-existing ties found irrelevant for some movements like Hare Krishna (Snow *et al.*, 1980). These all demonstrate that in some cases people are convinced to use interaction as a resource for mobilization, in some cases they don't. Furthermore, the effect of links is contextual. With similar considerations, Passy & Monsch (2014) classify movements based on their costs and showed the different effects of ties on participation to different forms of the protests.

This chapter is motivated by the emphasis on the necessity and possibility of a new methodology using the tools of network theory (McAdam, 2003; Krinsky & Crossley, 2014). Networks are both producing the movements and also they are products (Crossley, 2002).

Movements are not "sudden and instantaneous acts". Throughout this study, I describe social movements as outcomes of an interaction process of opposites. In daily life, people already interact with each other. In some cases, they are influential in the production of a movement while in some cases they are irrelevant. Then, can we construct a general mechanism to understand the differential effect of interaction on movements? This chapter attempts to construct a general mechanism focusing on the questions raised in the second chapter. The basic model answers the question of when individuals use interaction as a resource for mobilization. This basic model is extended to cover where and under what conditions these interaction taking place with the introduction of multiplexity and positional heterogeneity, respectively.

The basic mechanism has inspired by the definition of Diani (1992, pp.17). Three basic components of social movements are described as networks of relations between the plurality of actors, collective identity, and conflictual issues. Plurality of identities resultant in different attitudes to various issues. When opposite identities interact, conflict emerges. The third chapter discusses stability and efficiency of various network structures when the benefit of the links diminish with the interaction of opposites and rise with the interaction of similar identities. This part goes beyond. The discussion in here will be limited to local interaction processes where face-to-face interaction is the main base. Otherwise, a conflict may emerge based on the exogenous attack to a specific identity. I will call the former as *endogenous clash*.

Individuals will communicate their identities through personal communication channels. The ones who experience conflicts through interaction with opposites make a strategic decision on using interaction as a resource of mobilization. *Conflicting agents* compare extension capability of a movement and any possible counter-movement before deciding to act in favor of own-identity. Whenever former greater than the latter, interaction becomes a resource of mobilization. Explicitly this means the willingness of individuals to spend special effort for struggle and for mobilizing others for that struggle. In other words, they are willing to invest on relations for mobilization purposes. However, one should note that the analysis on investment decision is out of the scope of this paper and it is limited whether the network structure encourages or discourage them from investing.

The basic mechanism is extended to contribute discussions on the "new" types of the movements. The interaction between opposites is taking place in various spheres and the context of the interaction differentiate accordingly. This is what I discussed as the spatial characteristic of the communication. A simulation model of Apolloni *et al.* (2009) contain a consistent argument. It is found that shopping and recreational activities are relevant in the diffusion of informal topics; while home, work or school are found to be significant in the diffusion of other issues. Gould (1991, 1993) discussed the differentiation of movements in Paris in the 1860s and 1871. In 1860s France experienced huge working class movements. However, construction workers while high in quantity could not organize for the labor movement. On the other hand, they were main actors in 1871 Paris Commune which described as neighborhood movement. The data shows opposite for foundry workers. Technical development in industry lead some branches to loose their control over skills while for some branches it was still unavailable. Construction was in the first category. Construction industry spread to whole city and clusters demolished. Accordingly, interaction among construction workers has broken in workplaces. On the other hand, they establish links through the neighborhood. Meanwhile, foundry workers were still enjoy clustering and interact through their worker identities. The reason behind has claimed to be a shift form organizational framework for the mobilization shifted from trade to neighborhood (Gould, 1993). In other words, interaction becomes resource for neighborhood mobilization. As a result, construction workers were participants of the movement as residents not as workers and foundries were unattached to movement due to lack of residential interaction. The studies of Castells (1983) points out the significance of residential interaction in the context of social movements.

On the basis of these discussions I extend the basic model introducing a multi-layer network structure. Individuals communicate different identities through links established in different spheres. For instance, generally, material identities communicated in economic spheres like markets. On the other hand, cultural identities communicated in social spheres like the neighborhood. Nowadays, social media platforms play significant role in the communication of political identities. It is suggested that, although the participants are important it is the sphere that characterizes the forms of the movements.

If links are resources and networks structure defines the boundaries of the usage of these resources, then these two can be used as a policy tool for encouraging or discouraging possible (counter-)movement. This point is discussed with the introduction of inequality in opportunities and positional heterogeneity.

This chapter is constructed as follows. The next section discusses the methodology and introduces the general mechanism. The model is extended in the third and fourth sections. The chapter is concluded with a brief summary and further insights.

4.2 Definitions and Methodology

Diani (1992, pp.17) defines three basic components of social movements as networks of relations between plurality of actors, collective identity, and conflictual issues.

4.2.1 Nodes

The actors are individuals within a society with a finite population $N = \{1, 2, ..., n\}$. Individuals will be characterized by their identities. Most of the identities are hidden information that can be communicated only through interaction.

In each category, there are various types that one describes herself. For instance, gender is a category. Man, woman and LGBTI are three types within that category. Religion is another category which consists different types like Muslim, Jew, Christian, Atheist etc. Addition to these, as mentioned above, each may make out its own opposition. For instance, a conservative may define herself also as anti-Communist.

Putting together, we can describe a society with a matrix of identities. Suppose there are $K = \{1, 2, ..., k\}$ categories and within each category there are t types. Matrix of identities is $\mathbb{I} = (\Gamma_{is_r}) \in \mathbb{R}^{n \times kt}$.

$$\mathbb{I}_{nk_t} = \begin{bmatrix} \Gamma_{11_1} & \Gamma_{11_2} & \dots & \Gamma_{11_t} & \Gamma_{12} & \dots & \Gamma_{1k_t} \\ \Gamma_{21_1} & \Gamma_{21_2} & \dots & \Gamma_{21_t} & \Gamma_{22} & \dots & \Gamma_{2k_t} \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ \Gamma_{n1_1} & \Gamma_{n1_2} & \dots & \Gamma_{n1_t} & \Gamma_{n2} & \dots & \Gamma_{nk_t} \end{bmatrix}$$

In $\mathbb{I}$, each row characterizes agent i. Each column belongs to a type in a specific category. Γ_{is_r} shows the identity code of person i on type r within category s. Each entry of the matrix can take three possible values.

$$\Gamma_{is_r} = \begin{cases} = 0 \text{ if } i \text{ doesn't have any tendency on the type} \\ = 1 \text{ if } i \text{ defines herself as } s_r \\ = -1 \text{ if } i \text{ defines herself as } anti - s_r \end{cases}$$

Example 4.2.1. Consider a society which shaped by three main identity categories which are gender, religion and political view. Suppose three different types are defined within each category such that $K_1 = \{woman, man, LGBTI\}$, $K_2 = \{Christian, Muslim, Jew\}$ and $K_3 = \{Nationaist, Liberal, Socialist\}$. A person can be a Muslim and Nationalist Man who oppose LGBTI, non-Muslims and Socialist or a LGBTI who have no tendency on religion but oppose Nationalists.

Matrix Notation

Identities of each individual can be listed as
$\mathbb{I}_i = \{(k_{11}, k_{12}, k_{13}), (k_{21}, k_{22}, k_{23}), (k_{31}, k_{32}, k_{33})\}$ such that

$$K_1 = \begin{cases} k_{11}, & \text{for } woman \\ k_{12}, & \text{for } man \\ k_{13}, & \text{for } LGBTI \end{cases} \quad K_2 = \begin{cases} k_{21}, & \text{for } Christian \\ k_{22}, & \text{for } Muslim \\ k_{23}, & \text{for } Jew \end{cases} \quad K_3 = \begin{cases} k_{31}, & \text{for } Nationalist \\ k_{32}, & \text{for } Liberal \\ k_{33}, & \text{for } Socialist \end{cases}$$

Or as described above we can recode the identities such as
$\mathbb{I}_1 = \{(0, 1, -1), (-1, 1, -1), (1, 0, -1)\}$ and $\mathbb{I}_2 = \{(0, 0, 1), (0, 0, 0), (-1, 0, 0)\}$.
The matrix for identities is 2×9 matrix such that

$$\mathbb{I}_{23_3} = \begin{bmatrix} 1 & 0 & -1 & -1 & 1 & -1 & 1 & 0 & -1 \\ 0 & 0 & 1 & 0 & 0 & 0 & -1 & 0 & 0 \end{bmatrix}$$

Each category can be defined with sub-matrix such that

$$\mathbb{K}^1 = \begin{bmatrix} 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix} \quad \mathbb{K}^2 = \begin{bmatrix} -1 & 1 & -1 \\ 0 & 0 & 0 \end{bmatrix} \quad \mathbb{K}^3 = \begin{bmatrix} 1 & 0 & -1 \\ -1 & 0 & 0 \end{bmatrix}$$

States of the World

Whenever the identities of the individuals affect the decisions and resultant pay-off, there is incomplete information problem.

Lemma 4.2.1. For each category with t types, there are $2^t \binom{t+2}{2}$ possible states a person can define herself.

Proof. Take the example of category Religion. First of all, for a person Muslim and Christian can not exist together while anti-Muslim and anti-Christian can. Moreover, one can not define herself both Muslim and anti Muslim.

Formally:
1. A type is exclusive such that a person has at most one 1 within a category.
2. Opposite and absentee is inclusive such that there may be many -1s or 0s within a category.
3. Inclusion of an identity and opposition is incoherent, and don't counted.
If there exist a type r such that $i_{1_r} = 1$, there are $t2^{t-1}$ possibilities. Furthermore, there are 2^t more possibilities in case of no $i_{1_r} = 1$. As a result, there are $(t2^{t-1}) + 2^t$ possible state for an individual define herself within a category.

□

Lemma 4.2.2. If t_k shows the number of the types within a category k of total K category, then there are $\left[\prod_{k=1}^{K} 2^{t_k}\left(\frac{t_k+2}{2}\right)\right]^n$ possible states in a society with a finite population n.

In many cases, people get signals about identities of others. They may be strong or weak, true or false. Moreover, the observability of a specific characteristic is obviously contextual. For instance, individuals may not able to observe the employment status of people in the neighborhood, but it is probably common knowledge within a working place.

On the other hand, several issues necessitate interaction. Social movements are frequently constructed around these kinds of issues consisting political view, religion, a specific idea on a policy etc. This leads to a simplifying assumption.

Assumption 4.2.1. Individuals communicate their identities through interaction.

Accordingly, network structure defines the information one can gather about other's identities.

4.2.2 Network Structure

As people learn other's identities through communication, links become a relevant source for gathering information. Parallel to this, in reality, most of the case the network structure limits the information base of each person.

The personal network of an individuals is represented by a graph $G(N, g)$ where $N = \{1, 2, ..., n\}$. $g = [g_{ij}]_{i,j \in N}$ is a square matrix where $g_{ij} \in 0, 1$ represents the availability of an edge from person i to person j. Directed form can be significant on analysis of mediated interaction. For a local interaction necessitates face-to-face communication structure, undirected networks are sufficient. On the other hand, weighted form may be essential if for instance at least some amount of time is necessary for individuals to communicate their identities. Obviously, the time spends together will deepen the interaction among people and may increase the information about each other. In the case, where we split the characteristics of individuals into several pieces, the existence of a link indicates communication on a specific category. As a result, the unweighted form is also sufficient.

That is to say, identities of individuals in specific categories are communicated through unweighted undirected links. The relations within a society can be shown in a matrix form such that

$$G_{ij} = \begin{bmatrix} g_{11} & g_{12} & g_{13} & \cdots & g_{1n} \\ g_{21} & g_{22} & g_{23} & \cdots & g_{2n} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ g_{n1} & g_{n2} & g_{n3} & \cdots & g_{nn} \end{bmatrix}$$

Assumption 4.2.2. Through personal network individuals are able to learn:
1. k_j for all $j \in B_i(g)$
2. g_{jk} for all $j, k \in B_i(g)$

The first part of the assumption 4.2.2 indicates that each agent learn the identity of direct contacts through personal network. Following Chwe (1999, 2000), the second one indicates that each agent also knows the relations among two neighbors.

Indifferent States
Denote the possible states for an individual by $\mathbb{K}$. When the actual state of the status is $\theta \in \Theta$, i knows only that the state of the world is in the set $\mathbb{P}_i(\theta) = \{(\theta_{B(i)}, \phi_{N-B(i)}) : \phi_{N-B(i)} \in \{\mathbb{K}\}^{n-\#B(i)}\}$. Taken together, the sets $\{\mathbb{P}_i(\theta)\}_{\theta\in\Theta}$ forms a partition of Θ, which we call $\mathscr{P}_i$. If two states are in same element of the partition $\mathscr{P}_i$, then person i cannot distinguish between them, and hence will have same belief in either states (Chwe, 2000).

Example 4.2.2. [Incomplete Information]
Suppose $N = 3$, $K = 1$ which denoted by a and have three types such that $k_a = \{a_1, a_2, a_3\}$. Consider the actual state of identities are given by $\theta = \mathbb{K} = \{(1, 0, -1), (-1, 1, 0), (-1, 0, 1)\}$ and the network $g = \{12, 13\}$ and identities. The network structure shown in Figure 4.1, where $\mathbb{I}_i$ show the personal identity of i.
Any Γ_{i1} have 20 possible codes so $|\Theta| = [20]^3$. Given the network structure,

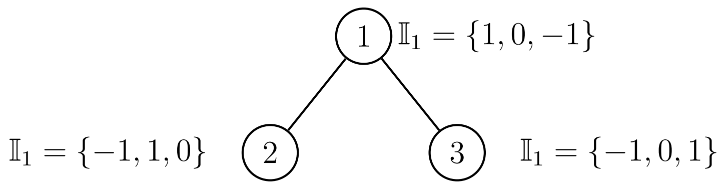

Figure 4.1: Network Structure with Different Identities

person 1 knows the actual state:
$\mathscr{P}_1 = \{(1, 0, -1), (-1, 1, 0), (-1, 0, 1)\}$. However $|\mathscr{P}_2| = |\mathscr{P}_3| = 20^2$. They can not distinguish between these states.

In information sharing literature, frequently it is assumed that people benefit from the connection of different identities. They use the advantage of flowing of information on different issues. However, the existence of conflicting situation alters the situation. Probably conflict will prevent the flow of any information and even lead to clashes.

4.2.3 Conflicting Situation

As discussed above, opposites may accompany each other. Since identities are contextual, opposites may not always meet in the same sphere. In this point, several concepts should be clarified.

Within a society:
1. *conflicting possibility* occurs if there are individuals with opposite identity codes within the same category.
2. *conflicting issue* emerges if at least one side is aware of this possibility.
3. *conflicting situation/ clash* necessitates awareness of both sides.
Note that, in this chapter, conflicting issue and a clash have the same meaning due to the usage of undirected relations.

Formally, conflicting possibility occurs if there $\exists\ i, j \in N$ such that $(\Gamma_{it})_k = -(\Gamma_{jt})_k$ where $k \in K$ and t denotes the type. Conflicting issue appears if $g_{ij} = 1$ or/and $g_{ji} = 1$ and a clash occurs if $g_{ij} = g_{ji} = 1$.

This chapter interested in the clashes emerges in a local environment. However, one should note that this is not the only way a clash may emerge. For instance, an attack to a specific identity or emergence of a new type opposing existing norm (Turner & Killian, 1987) can be a source for some kind of anti-systemic movements.

Alternatively, we can say that whenever $\Gamma_{it} \times \Gamma_{jt} = -1$ there is a conflicting possibility. Conflicting issue occurs if $g_{ij} = 1$ or $g_{ji} = 1$ and these two sides clashes if $g_{ij} = g_{ji} = 1$.

Outer product is be used to characterize the conflicts. If $\mathbb{I}_s$ denotes the column vector of identity $s \in k$ the conflicting possibility can be derived from $C^s_{ij} = [\mathbb{I}_s] \otimes [\mathbb{I}_s]^T$. This equation shows conflicting possibility of any pairs i and j on category s. Note that conflicting matrix is a symmetric square matrix. If c_{ij} denotes the conflicting possibility of i with j; $c_{ij} = c_{ji}$. Conflicting issue appears for j if $c_{ij}g_{ij} = -1$ and clash between two individuals will emerge if $c_{ij}g_{ij} = c_{ji}g_{ji} = -1$.

A clash is a necessary but not a sufficient condition for emergence of a social movement or participation of agent to a movement. Mobilization is a strategic decision defined by the boundaries of collective identity.

4.2.4 Collective Identity

Diani (1992, pp.9) defines *"the boundaries of social movement networks as the shared identities of actors involved in the interaction"*. This definition signs the importance of similar identities of individuals on the expansion of a clash to a movement. There are studies criticizing this perspective. Broadbent (2003) refers to the importance of the positions of individuals especially in vertical societies like Japan. As a result, collective identity may not be the summation of individual identities but something culturally shaped. In horizontal societies like Western countries, individual preferences and similarities may be deceiving. In vertical societies, on the other hand, relational explanations are more powerful.

If it is the proportion of population sharing the same identity that defines the boundaries of collective identity, then the number of links are more relevant than positions. Otherwise, the positional hierarchy will be decisive. A broader theory should be explanatory for both cases.

In both cases, we should define a mechanism under which individuals decide to use interaction as a resource for mobilization. The existence of incomplete information force people to predict boundaries of the size of shared identities. In a dialectic environment, people should consider also the boundaries of possible counter-movement. If network conditions assure an agent that a counter-movement is more probable, she is discouraged to use interactions as a resource. In horizontal-like structures, the number of neighbors becomes significant in collective identity construction. In vertical-like societies, the identities of hierarchical advantageous groups become more significant.

The basic model will be constructed for anonymous nodes. The hierarchy among individuals will be introduced in the extended version.

4.3 Analysis Under Incomplete Information

When two opposite agents linked, before considerations on mobilization each will measure the power of other side. If one believes the opposite have relational dominance then she would prefer not to make any opposing behavior. At the same time if the partner believes the opposition is dominated, then she would like to act oppose to others.

However, agents don't have full information on others. As a result, each will construct beliefs on others based on their local knowledge.

Assumption 4.3.1. Individuals are identical except their identity codes..

Individuals know that, they are identical except their identities on specific issues. This assumption will be relaxed when we introduce positional heterogeneity.

4.3.1 Construction of Beliefs

Before any mobilization decision, agents should construct their beliefs on the dominance of other side. Denote P_{ii} as i's own-belief and P_{ij} as i's belief on j. These measures should represent the possible size of the bases of each side. Whenever $P_{ii} < P_{ij}$, agent i thinks the base for opposition is larger. Accordingly, she is not willing to use her interaction as a resource of any mobilization purposes. Otherwise, she believes her identity has a larger base and willing to use her interaction for mobilization purposes.

I will specify this function as a product of two variables. One measures the proportion of information one is able to reach and the other stands for the numbers of possible allies and enemies, and the other measures.

Informational Dominance

Each agent aware of the fact that they have local knowledge and any decision she makes will not take under the exact conditions.Informational dominance will be measured by the proportion of information one is able to reach given the structure. I will introduce the link degree centrality which is a modification of degree centrality. The latter is insufficient since at this point not only the identity of others but also the relations are significant.

Definition 4.3.1. The link degree centrality can be formalized as $\zeta_i = \frac{\binom{\#B_i(g)+1}{2} + (N - \#B_i(g) - 1)}{\binom{N}{2}}$ where $\#B_i(g)$ is the number of neighbors of agent i under network g.

Link degree centrality 1 implies that the agent is completely connected and know the identity codes of all. As a result, any f function shows the state of the world and possible bases for movement and a counter-movement.

On the other hand, an individual may not know the real link degree of the others. Accordingly, if there exists $z \in N : g_{jz} = 0$, there are two options. Either $g_{iz} = 1$ or $g_{iz} = 0$. It is possible to calculate various ζ'_{ij} as uncertainty rises.

Dominance on Size

The second component is a function of the size of allies and enemies within a society.

Definition 4.3.2. [f function]
Suppose $A = |j : k_j = k_i|$ and $B = |j : k_j = -k_i|$ such that $A + B \leq N$, then the size dominance can be defined by $f(A, B)$. f is derived as an increasing function of supporters and decreasing function of the threats $f_A > 0$ and $f_B < 0$. In other words these inequalities holds:

1. $f(A', B) > f(A, B)$ if $A' > A$.
2. $f(A, B') < f(A, B)$ if $B' > B$.

Again agents will calculate f for both a movement and a possible counter-movement. f_{ii} represents the belief of i on own size dominance while f_{ij} shows the belief of i on j's size dominance.

Definition 4.3.3. [Beliefs on Dominance]
Whenever $ij \in g$ and $k_i = -k_i$.

$$P_{ii} = \zeta_{ii} f_{ii} \tag{4.1}$$

$$P_{ij} = \zeta'_{ij} f_{ij} \tag{4.2}$$

Risk Aversion

Consider a conflicting partner such that $k_i = 1$, $k_j = -1$ and $g_{ij} = 1$. Moreover suppose $\exists z : k_z = 1$ and $z \notin B_j(g)$. Figure 4.2 shows the agent j's belief on z and her beliefs on beliefs of i on z .

Agent j is unable to differentiate between these 12 cases. Then how will

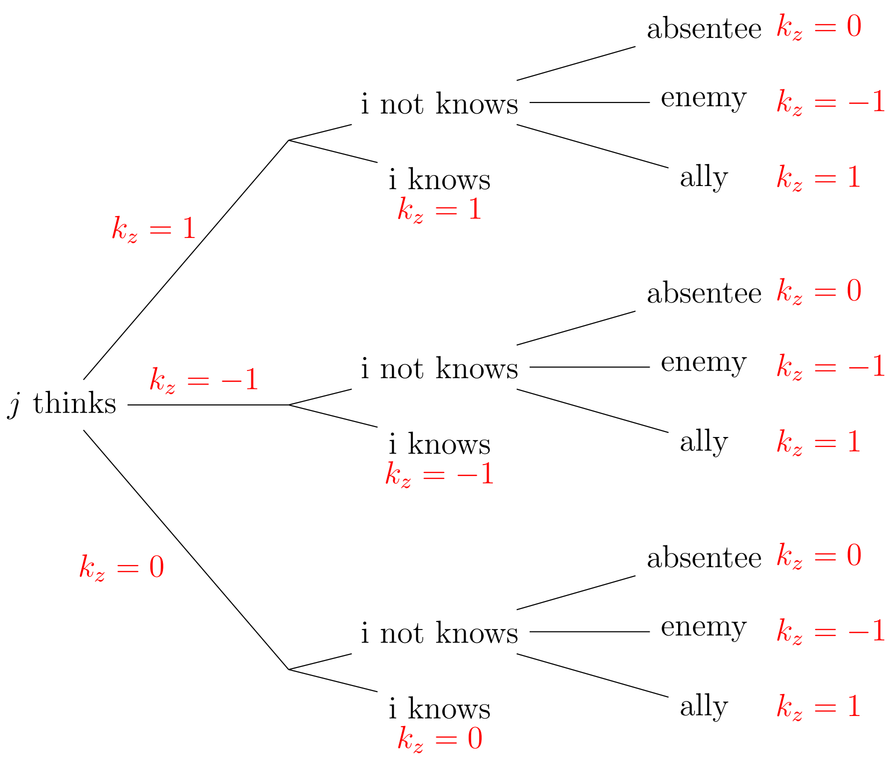

Figure 4.2: Construction of Beliefs, actual state $k_z = 1$

she decide?

Table 4.1 shows the beliefs of j case by case when both i and j are connected with others except z.

For each case, j compares the possible dominance of own and conflicting

Cases	P_{jj}	P_{ji}
CASE 1: $k_z = 1$	$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(b, a+1)$	$f(a+1, b)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a, b)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a, b+1)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a+1, b)$
CASE 2: $k_z = -1$	$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(b+1, a)$	$f(a, b+1)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a, b)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a, b+1)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a+1, b)$
CASE 3: $k_z = 0$	$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(b, a)$	$f(a, b)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a, b)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a, b+1)$
		$\frac{\binom{N-1}{2}+1}{\binom{N}{2}} f(a+1, b)$

Table 4.1: Comparison of Dominance by Agent j

partner within the case in question. When there are many agents that are not connected with any of the conflicting nodes, things will be more complex. Instead, a simplifying but realistic assumption will be helpful.

Assumption 4.3.2. Individuals are risk-averse such that when they could not distinguish the states, they will behave as if they are in the worst case.

Under this assumption, agent j will compare lowest P_{jj} with the highest P_{ji} among possible states. Accordingly, Case 1 generates the lowest value for P_{jj}. Under this case the highest $P_{ji} = f(a+1, b)$. This is another way to say that, if there exists $z \in N : g_{jz} = 0$ then j will assume that $k_z = -k_j$ and $g_{iz} = 1$.

Definition 4.3.4. An agent would not prefer to use pre-existing ties as a resource for mobilization if $minP_{ii} < max(P_{ij})$.

Dominance Under Risk-Aversion

Now, we can more concretely define the beliefs on dominance of each sides. Suppose there are N people in a society. Person i and person j have a conflict such that $k_i = -k_j =$ and $g_{ij} = 1$. Denote the relevant variables such that:
1. $b_i = \#\Big(B_i(g)\Big)$,
2. $b_{ij} = \#\Big(B_i(g) \cap B_j(g)\Big)$
3. $b_{ii} = \#\Big((B_i(g) \setminus B_j(g)\Big)$
4. Lastly, put * for ally and $^\circ$ for enemy such that b_i^* shows the number of the same identity neighbors of i and b_i° shows the number of the opposite identity neighbors of i.
Then:

$$P_{ii} = \Big(\frac{\binom{n_i+1}{2} + (N - n_{i)}}{\binom{N}{2}}\Big) f(n_i^* + 1, (N - n_i^*)) \tag{4.3}$$

$$P_{ij} = \Big(\frac{\binom{N-n_i+n_{ij}}{2} + (n_i - n_{ij})}{\binom{N}{2}}\Big) f(n_{ij}^\circ + N - n_i + 1, n_{ij}^* + (n_i - n_{ij})) \tag{4.4}$$

Under given specifications and assumptions, agent i compares these two measures before deciding to use interaction as a resource for mobilization. In the same line, the conflicting partner will also compute these two measures based on her personal network and resultant beliefs.

4.3.2 Analysis

First, I will examine the conditions under which the structure encourage or discourage usage of interaction as a resource for mobilization against opposition.

One Category One Type Case

This part analysis the case when individuals differentiate only in a specific category. If there are k types within a specific category, conflicting possibility over each type will be separately derived from

$$C_{ij}^t = \begin{bmatrix} \Gamma_{1t}\Gamma_{1t} & \Gamma_{1t}\Gamma_{2t} & \dots & \Gamma_{1t}\Gamma_{nt} \\ \Gamma_{2t}\Gamma_{1t} & \Gamma_{2t}\Gamma_{2t} & \dots & \Gamma_{2t}\Gamma_{nt} \\ \dots & \dots & \dots & \dots \\ \Gamma_{nt}\Gamma_{1t} & \Gamma_{nt}\Gamma_{2t} & \dots & \Gamma_{nt}\Gamma_{nt} \end{bmatrix}$$

Each entry shows the conflicting possibility between two agents over the specific type.

We can rewrite the conflicting possibility for each person $C_{tj} = (c_{tj})_{k\times n}$ such that

$$C^i_{tj} = \begin{bmatrix} \Gamma_{i1}\Gamma_{11} & \Gamma_{i1}\Gamma_{21} & \dots & \Gamma_{i1}\Gamma_{n1} \\ \Gamma_{i2}\Gamma_{12} & \Gamma_{i2}\Gamma_{22} & \dots & \Gamma_{i2}\Gamma_{n2} \\ \dots & \dots & \dots & \dots \\ \Gamma_{ik}\Gamma_{1k} & \Gamma_{ik}\Gamma_{2k} & \dots & \Gamma_{ik}\Gamma_{nk} \end{bmatrix}$$

Each entry shows the conflicting possibility of an individual i with each j over different types.

For simplicity, I start with a one type and two sides assumption.

Assumption 4.3.3. There is only one type and individuals identify themselves with same or opposite of that type.

In other words, this part examine the case where the type determinant such that each agent chooses one side.

Example 4.3.1. [$K = 1, t = 1$]:
Suppose $N = 10$, $K = 1$ and there is only one type, $t = 1$. Under assumption 4, individuals either support the type or oppose it. There are 2^{10} possible states of the world. Suppose the actual identity is

$$\mathbb{I}' = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ -1 \\ -1 \\ -1 \\ -1 \\ -1 \\ -1 \end{bmatrix}$$

The first four individuals have same type and the other six are opposites. The conflicting possibility will be defined with outer product of $\mathbb{I}'$ such that

$C = [\mathbb{I}'][\mathbb{I}']^T$. $C = (c_{ij})_{10\times 10}$.

$$C_{ij} = \begin{bmatrix} 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & -1 & -1 \\ -1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

Among these possibilities, existence of a conflict depends on the network structure. Suppose the network structure is $G'_{ij} = (g_{ij})_{10\times 10}$.

$$G'_{ij} = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The $n \times n$ clash matrix will be defined as $\mathbb{C} = [c_{ij} g_{ij}]$ such that

$$\mathbb{C} = \begin{bmatrix} 1 & 0 & 1 & 1 & \mathbf{-1} & \mathbf{-1} & \mathbf{-1} & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & \mathbf{-1} & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & \mathbf{-1} & 0 & 0 & 0 \\ \mathbf{-1} & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 1 \\ \mathbf{-1} & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ \mathbf{-1} & \mathbf{-1} & 0 & \mathbf{-1} & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The conflict appears between $\mathbb{C} = \{(1,5),(1,6),(1,7),(2,7),(4,7)\}$ as shown in Figure 4.3 with red lines. Nodes $3, 8, 9, 10$ have no conflicting link.

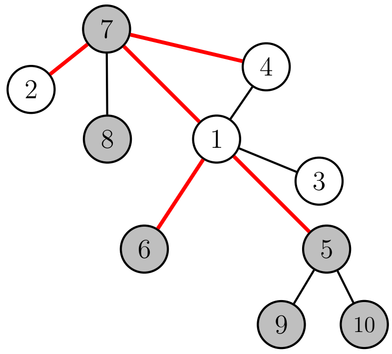

Figure 4.3: Representation of Conflicts

Based on the local information, we can define f_{ii} and f_{ij} for all conflicting situations:

For $i = 1$: $f_{11} = f(3,7); f_{15} = f(5,5); f_{16} = f(5,5); f_{17} = f(5,5)$.
For $i = 2$: $f_{22} = f(1,9); f_{27} = f(9,1)$.
For $i = 4$: $f_{44} = f(2,8); f_{47} = f(8,2)$.
For $i = 5$: $f_{55} = f(3,7); f_{51} = f(7,3)$.
For $i = 6$: $f_{66} = f(1,9); f_{61} = f(9,1)$.
For $i = 7$: $f_{77} = f(2,8); f_{71} = f(7,3); f_{72} = (6,4); f_{74} = (7,3)$.
In terms of beliefs on participants, interaction is not a resource for any of the agents since in all cases $f_{ij} \geq f_{ii}$

[Link Degree Centrality]
As discussed above, these functions will be modified with link degree centrality measure. When there are 10 individuals, we can define 45 possible pair-wise links. Agent knows own-links and whether a neighbor linked with other neighbour and given the size of population the absent links she has. Table 4.2 represents the links degree centrality of conflicting agents.

We can also calculate the group degree centrality of other agents. $\zeta_8 = \zeta_3 = \zeta_9 = \zeta_{10} = \frac{9}{45}$.

Now we can calculate the related dominance measures.
For $i = 1$: $P_{11} = 0.42f(3,7), P_{15} = 0.42f(5,5), P_{16} = 0.42f(5,5), P_{17} = 0.53f(5,5)$
For $i = 2$: $P_{22} = 0.2f(1,9); P_{27} = f(9,1)$.
For $i = 4$: $P_{44} = 0.22f(2,8); P_{47} = f(8,2)$.
For $i = 5$: $P_{55} = 0.27f(3,7); P_{51} = 0.66f(7,3)$.

ζ	1	2	4	5	6	7
1	0.42	NL	ally	0.42	0.42	0.53
2	NL	0.2	NL	NL	NL	1
4	ally	NL	0.22	NL	NL	1
5	0.66	NL	NL	0.27	NL	NL
6	1	NL	NL	NL	0.2	NL
7	0.66	0.51	0.66	NL	NL	0.33

Table 4.2: Link Degree Centrality of Conflicting Agents

For $i = 6$: $P_{66} = 0.2f(1,9); P_{61} = f(9,1)$.
For $i = 7$: $P_{77} = 0.33f(2,8); P_{71} = 0.66f(7,3); P_{72} = 0.51f(6,4); P_{73} = 0.66f(7,3)$.
For any specification of f, for all agents $P_{ii} < P_{ij}$. This mechanism suggest that under g and $\mathbb{I}$ no one willing to use interaction as a resource.

From Example 4.3.1 we can see that, any link with the opposition will increase the informational dominance. On the other hand, it may decrease agent's beliefs on the informational dominance of opposing agents with whom they are not linked. On the other hand, link with an ally will increase both informational and size dominance of any agent. At the same time, it may decrease the informational and size dominance of the opposing agents with whom she is not linked in reality.
Moreover, under given g we can calculate the minimum connection that one should have to use interaction as a resource. For instance agent 1 willing to use interaction under $g' = g + 12 + 19$. On the other hand, she will still unwilling to use interaction as a resource under $g'' = g + 12 + 18$. In the latter case, agent 7 discourages her to mobilize. Although they will have same informational dominance under both cases, the belief of 7's dominance on size will discourage 1 in the second case.

Let extend the case where there is still one category with more than one type.

Example 4.3.2. $[K = 1, t > 1]$
$N = 5$, $K = 1$ and $t = 3$ denoted by a_1, a_2, a_3. Suppose the extended form

of matrix of identities

$$\mathbb{I}_{53} = \begin{bmatrix} 1 & -1 & -1 \\ 0 & 1 & -1 \\ -1 & -1 & 1 \\ 0 & 0 & 1 \\ 1 & -1 & 0 \end{bmatrix}$$

The undirected network is $\{12, 14, 15, 23\}$. Each i calculates the dominance for each type separately. The network among individuals for each type has been drawn in Figure 4.4.

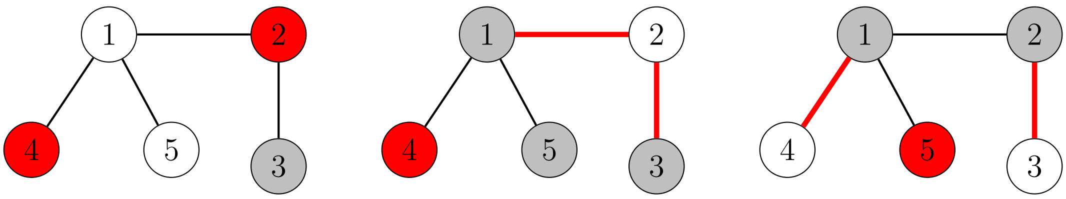

Figure 4.4: Conflicting Issues in 3-Type Category

For $t = 1$: $P_{11} = P_{1j} = 0$; $P_{22} = P_{2j} = 0$; $P_{33} = P_{3j} = 0$; $P_{44} = P_{4j} = 0$; $P_{55} = P_{5j} = 0$. Type 1 does not generate a conflict among society.

For $t = 2$: $P_{11} = 0.7f(2,2)$ $P_{12} = 0.5f(2,3)$; $P_{22} = 0.5f(1,4)$ $P_{21} = P_{23} = 0.7f(3,2)$; $P_{33} = 0.4f(1,4)$ $P_{32} = f(4,1)$; . Person 1 is willing to use interaction as a resource for an action against type 2.

For $t = 3$: $P_{11} = 0.7f(2,2)$ $P_{14} = 0.7f(2,3)$; $P_{22} = 0.5f(2,3)$ $P_{23} = 0.7f(3,2)$; $P_{33} = 0.4f(1,4)$ $P_{32} = f(1,4)$; Person 1 is also willing to use interaction as a resource for movement against type 3.

In the example, only Person 1 is willing to use interaction as a resource for an action against opposition to types 2 and 3. On the other hand, there is no conflicting issue on type 1.
The application of this example is as follows. Suppose the category reflects the identities on political views where agent 1 is a Nationalist, agent 2 is a Liberal and agent 3 is a Socialist. Under this structure no one will use interactions as a resource for an anti-Nationalist action; but Nationalist willing to use her base for anti-Liberal or anti-Socialist actions.

Introduction of Multiplexity

The extension of the model so as to examine multiple issues communicated in multiple spheres may shed light on significant questions. For instance, why people mobilize around some issues but not others although the latter may be more populated or more relevant. The significance of spatial dimension has already discussed in several studies that reviewed above.

Example 4.3.3. $[K = 3, t = 1]$
Consider a society consisting 14 agents. The communication structure of the society is shown in Figure 4.5. Consider the case the interaction takes place

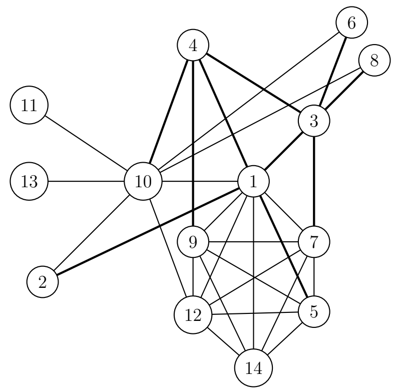

Figure 4.5: Network Structure of a Society- Unified Relations

in three different spheres where people differentiate in three categories. Suppose the structure of interaction in each sphere is as in Figure 4.6. Suppose

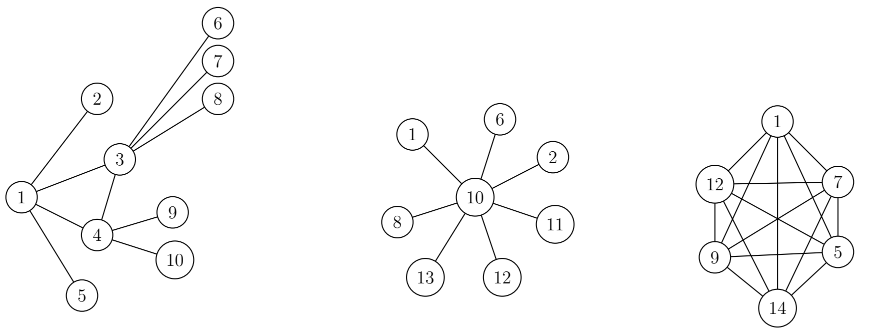

Figure 4.6: Network Structure of a Society- Relations in 3-Spheres

there is only one type in each category and the identities are as figure out in Figure 4.7. In the first case, although there is a size dominance of one type, information dominance of 3, 4 discourage them to act. Moreover, if for instance agent 3 linked with 9 and 10 under specific f function agent 3 may be willing to use informational dominance as a source for act against others. In the second case, again the informational dominance of 10 discourage populated group to act while encouraging her. Lastly, in the complete graph case, the size dominance encourage crowded group to act.

This mechanism can shed light on a controversial situation. Consider we

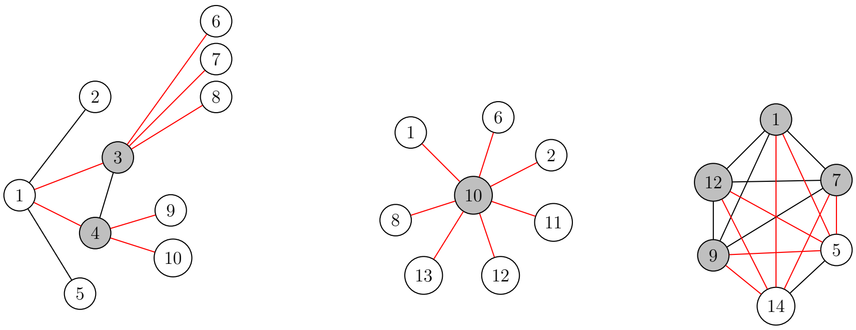

Figure 4.7: Representation of Clashes - Different Spheres

unify the relations and identities of whole society within one sphere as shown in Figure 4.8.

Take the conflicting relation between 10 and 1 generated in sphere 2. Under

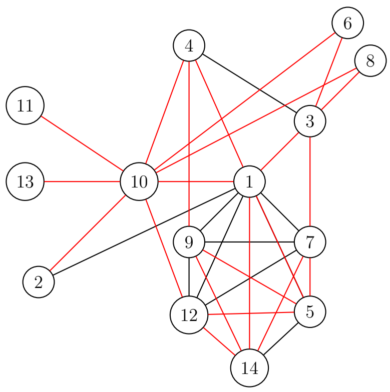

Figure 4.8: Representation of Clashes - Unified

unification, in addition to second sphere's relations 1 and 2 are seen to be ally due to relations in first sphere. Moreover, both 1 and 10 consider 4 as enemies again because based on the relations in the first sphere. Under these conditions $P_{10,10} = 0.42f(1,8)$ while $P_{10,1} = 0.42f(8,6)$. Accordingly, we can conclude that 10 is not willing to use interaction as a resource against opposition. However, probably she is using them in sphere 2. Similar analysis can be made for the agents in Sphere 3. This generates a controversial situation which can be overcome through spatial analysis.

We can conclude this part with summarizing the main findings of this very basic mechanism.

Proposition 5. Suppose there exist $i, j \in N$ such that $k_i = -k_j$ and $g_{ij} = 1$:
1. Complete network encourage the populated groups for action.
2. Independent of the size of allies or enemies, star structure encourages the central agent for action and discourages any other agents.
3. Within any partially complete structure, agents need some minimum amount of network to become willing for any action.

Proof. For the first case, it is obvious that everyone knows everyone has link centrality of 1. Accordingly, the size dominance will be decisive. Complete graph will encourage populated group to act.
Under star structure, the central agent i has link degree centrality of 1 and all others also believe this such that $\zeta'_{ji} = 1 \; \forall j$. Moreover $\zeta_{jj} = \frac{2}{N} = \zeta'_{ij}$. In terms of size dominance i believes that $f_{ij} = f(1, N-1) \; \forall j$. In the extreme case which produces lowest value for f_{ii}, it is equal to $f(1, N-1)$. As a result, in any case $P_{ii} > P_{ij}$. Furthermore star structure will also discourage opposition such that $f_{jj} = (1, N-1)$ and $f_{ji} = (N-1, 1)$ for any j.
The last case has already discussed in Example 4.3.1 and Example 4.3.3.

□

4.4 A Model for Mobilization

In this part, I will take the mobilization as a demand for a transfer of value generated through the links between two conflicting partners.

The value is generated through costly direct links and indirect benefits. In the absence of any conflict, each agent will get the value it generates. On the other hand, conflicts create opportunity for value transfers.

In fact, this is an extraction mechanism such that a conflicting partner who believes she is dominant enough will use the propagation mechanism for a value transfer. If the partner also believes the dominance of partner, she would not prefer others' to learn her identity. Otherwise they may also extract value from her. Roughly speaking, the dominant agent will say "I will not propagate other's against you, if you give me some part of the value". If the partner believes, she can, then she is willing to make the transfer. Even if partner doesn't demand, if one believes her dominance, she may willing for a transfer for not to face with an organized counter-movement.

I use the utility function of each agent by a kind of connection model discussed in Chapter 3.

$$u_i(g) = \sum_{j:j\in N} w\delta^{d_{ij}} - \sum_{j:ij\in g} c + \sum \tau_i \tag{4.5}$$

where $0 < \tau_i < 1$ shows the transfers defined below. Consider the case there exist $i, j \in N$ such that $k_i = -k_j$

$$\tau_i(g) = \begin{cases} = 0 \text{ if } P_{ii} < P_{ij} \text{ and } P_{jj} < P_{ji} \\ = \alpha w \text{ if } P_{ii} > P_{ij} \text{ and } P_{jj} < P_{ji} \\ = -\alpha w \text{ if } P_{ii} < P_{ij} \text{ and } P_{jj} > P_{ji} \end{cases}$$

Efficiency

Definition 4.4.1. g is uniquely strong efficient network if $\sum_i u_i(g) \geq \sum_i u_i(g')$ for all $g' \in g^N$.

Proposition 6. If $c < w\delta - \delta^2$, the uniquely efficient network is the completely connected structure, g^N.

Proof. By construction, any conflict is just generates opportunity for transfer of the value and doe not change the total value generated. Contribution of a link to total value is at least $2(w\delta - c - \delta^2)$. If this is higher than zero, the complete structure will be the uniquely most efficient structure.

□

Stability

Definition 4.4.2. The network g is societally stable if no one motivated to demand any transfers due to the conflicts such that $P_{ii}(g, \mathbb{I}) < P_{ij}(g, \mathbb{I})$ $\forall i, j \in N$ st. $k_i = -k_j$ and $g_{ij} = 1$.

These definitions results in instability of efficient structures whenever opposites are not equal in terms of size.

Proposition 7. Whenever $k_i = -k_j$ and $\#i \neq \#j$, the complete network is not societally stable.

Proof. Suppose $k_i = -k_j$. Consider the case $\#i = a; \#j = b$ and $a > b$. Under complete network, $\zeta_i(g^N) = 1$ and $\zeta'_{ij}(g^N) = 1$. Then for any i and j, $P_{ii} = f(a,b)$ and $P_{ij} = f(b,a)$ indicates that $P_{ii} > P_{ij}$ $\forall i,j$.

□

Proposition 8. Whenever there exists $i, j \in N$ such that $k_i = -k_j$, star network is never societally stable.

Proof. Star network always generates opportunity for the central agent to extract a value from opposition.
Consider the extreme case where the central agent is the only opposition. The beliefs of any periphery constructed such that whenever she is linked with any other periphery, she will also pay transfer. If the central agent determines α such that $w\alpha < w\delta - c - \delta^2$, any peripheral agent will not benefit from another link under her belief structure. As a result, central agent able to extract $(n-1)w\alpha$ amount of value.

□

Definition 4.4.3. g is pairwise stable if
i. for all $ij \in g$, $u_i(g) \geq u_i(g - ij)$ and $u_j(g) \geq u_j(g - ij)$ and
ii. for all $ij \notin g$ if $u_i(g + ij) > u_i(g)$ then $u_j(g + ij) < u_j(g)$.

The pairwise stability is becoming complex under this structure and the example will give some insight.

Example 4.4.1. Suppose $N = 4$ where $\mathbb{I}^{-1} = \{1, 1, 1, -1\}$. Consider the complete structure. As discussed above, it is the uniquely efficient structure when $c < w\delta - \delta^2$. For all $i, j \in N$, such that $k_i = 1$, $k_j = -1$; $P_{ii} > P_{jj}$. Agent j is willing to pay some transfers which may discourage any mobilization to push her out of the g which diminishes her utility to zero. However, if $\delta^2 > w\delta - c - w\alpha$, she will be better off with severing her two links with opposing partners. Under this conditions, complete structure is not pairwise stable. However, if $\delta^2 < w\delta - c - w\alpha$, complete structure will be both uniquely efficient and pairwise stable structure.

Figure 4.9 shows respectively, the efficient, pairwise stable and societally stable structures when $w(\delta - \alpha) - \delta^2 < c < w\delta - \delta^2$. The red lines show the conflicting situations, where the arrows shows the direction of the transfers.

4.4.1 Introduction of Social Environment

Following the discussion of Broadbent (2003) on horizontal and vertical societies, this part will focus on the impact of social organization on relational

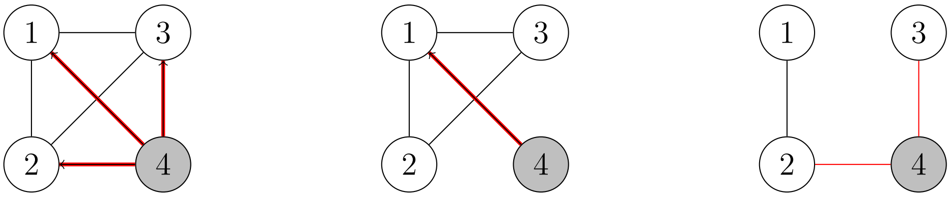

Figure 4.9: Efficiency, Pairwise Stability, Societally Stability

effect.

Definition 4.4.4. Horizontal groups are the ones where agents are anonymous in terms of relations whereas in vertical groups the hierarchical roles encourage or discourage use of relations.

Hierarchy Among Identity Groups

Consider the hierarchy among groups showed by the size of the agents who belong to that identity.

Assumption 4.4.1. The hierarchy is common knowledge.

Suppose r_i denotes the size of the agent i which is a proxy for positional hierarchal role of the agent within a society. Then we can modify the f function representing the roles of the agents within a vertical society such that $f^V(\sum_{i:k_i=1} r_i, \sum_{j:k_j=-1} r_j)$.

Example 4.4.2. Consider the third case in Figure 4.6 and suppose low populated agents have hierarchical advantage such that $r_1 = r_{12} = r_7 = r_9 < r_{14} = r_5$. Figure 4.10 shows this modification.
If $i = 1, 12, 7, 9$ and $j = 5, 14$, dominance for any agent can be calculated by $P_{ii} = f(4r_i, 2r_j) = P_{ji}$ and $P_{jj} = f(2r_j, 4r_i) = P_{ij}$. If $r_i = 2r_j$, hierarchy have stabilizing affect. As the hierarchical gap increases, this may turn to be a counter-movement effect.
Note that in a horizontal group, the roles will not make significant difference and there is the populated group willing to use interaction as resource. In a vertical society the roles may have stabilizing effect.

Proposition 9. Hierarchical heterogeneity among groups may have stabilizing or destabilizing affect.

Introduction of Social Control

Suppose there is a leader within a society. Example 4.4.3 is constructed to give an insight for the affect.

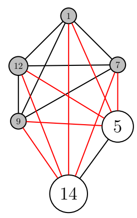

Figure 4.10: Representation of Clashes in the Existence of Hierarchy

Definition 4.4.5. The leader is the one who can control her allies among her neighbors.

Example 4.4.3. Consider the Case described in Figure 4.9 and suppose 4 is the leader. Leadership will not be effective for first two case when opposition knows 4 is alone. Consider the societally stable case. As long as $w\alpha < w\delta - c + \delta^2$, agent 2 willing to pay transfers to agent 4, believing that agent 4 has power to propagate agent 3 for discouraging her from connecting to agent 2 again. This condition also implies acceptance of transfers by agent 3. The structure will be pairwise stable as long as agent 4 determines the transfers such that $w\delta - c - \delta^2 < w\alpha < w\delta - c + \delta^2$.

We can extend the examples through defining various hierarchical roles within a society. However, these simplified cases give insight about a significant result .

Proposition 10. Whenever there is hierarchical heterogeneity among agents, as long as opposition doesn't connected, advantageous agents can define proper transfers which can be accepted by others.

Introduction of Organizational Behavior

Consider organized individuals are able to share their information about neighbors' identities.

Assumption 4.4.2. Linked agents can construct costly organizations and the transfers will be shared equally.

Whenever two allies could not able to use interaction as a resource, they can be better of through organizing. Note that if one is already willing to use and other not, equal share organizations will not be pairwise stable since the former will eventually transfer some value to latter.

Definition 4.4.6. Consider two agents i, z such that $k_i = k_z = -k_j$ and $P_{ii} < P_{ij}$, $P_{zz} < P_{zj}$. i and z will construct an *equal-share organization* if
1. If $P'_{ii} > P'_{ij}$ and $P'_{zz} > P'_{zj}$.
2. $c' < \tau$.

The conditions imply that two agents will construct an equal-share organizations if it makes them to use interaction as a resource; make them able to extract transfers and they can extract higher value than organizing cost.

Example 4.4.4. Consider the first Case discussed in Figure 4.6. Under assumption 4.4.2 there are three organization possibility: $12, 14, 34$. The first two will not make agents to get transfers by mobilizing since still $P_{ii} < P_{ij}$. Figure 4.11 shows the new network structure under organized 3 and 4. As long as there exists $w\alpha > \frac{c'}{3}$, 3 and 4 willing to construct an equal-sharing organization. Note that agents construct beliefs under risk-aversion, as a result they will prefer to connect with each other if $w\alpha < w\delta - c - \delta^2$. As a result as long as there exists transfers $w\alpha > max(\frac{c'}{3}, w\delta - c - \delta^2)$ equal-share organization will be pairwise stable.

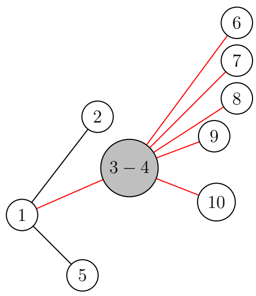

Figure 4.11: Representation of Clashes in the Existence of Organizing Possibility

This simple example shows that organization may have encouraging affect on mobilization.

Proposition 11. Organization of allies having information dominance may give them opportunity of transfers even if they are dominated in terms of size.

4.5 Conclusion

In this Chapter, I attempt to draw a broader perspective on conflicting situations using the network mechanism described in Chapter 2. The society constructed by individuals with different identities. As all facts and situations, each identity has its opposition. As long as these don't interact, there is no problem at all. However, whenever they interact there is a possibility of conflict. This possibility turns to be reality based on the informational and size dominance of opposing groups. In case of incomplete information, individuals predict these measures based on their beliefs. In this point, individuals are assumed to be risk-averse. Whenever one faces with several situations she can not distinguish, she would prefer to behave as if the worst case occurs. Obviously, this assumption doesn't hold for everyone, but simplification lead us to examine basic cases. For horizontal societies, size dominance is seen to be more significant compared to vertical societies. Lack of communication discourage a possible movement and encourage opportunity for disadvantageous groups in terms of size dominance. For partially connected structures, there is a minimum amount of links that encourages advantageous groups to act.

In reality, these have significant policy implications. Although this is a very simple and incomplete mechanism, for now, further research can shed light on the sustainability of persistent inequality. In this point, obviously, the introduction of multiplexity will generate significant results. For instance, consider the case where the value is generated and distributed in one sphere and redistribution is possible in others. Another significant issue should be considered in following studies is organizing possibility. External shocks can be the subject of further studies.

Chapter 5

Conclusion

From a dialectic perspective, consensus and conflicts are two sides of the same coin. Correspondingly, conflict is not an exception, but an ordinary state. What is more interesting is the *organized conflict* or the expansion of a specific conflict within the population. Moreover, social conflicts have the potential to turn into movements. Such social conflicts and movements are the main interests of this study.

For decades, there has been an increasing attempt to use network theory for explaining social phenomena. These attempts substantially motivated by global regularities like inequality, segregation, centralization etc. This is the main methodological motivation behind the use of network perspective.

First of all, the traditional literature on social movements is constructed upon a wrong paradigm. I couldn't find any consistent argument behind the limitation of movements to capitalist societies. Although it may generate simplicity for practical reasons and necessary for empirical studies, in most of the case leads to incoherent explanations. For instance, the explanations of changing nature of movements with post-modernism may shed light on the significance of identities, it undermines the class-based characteristics of these identities. These fallacies can be overcome by extending the conceptual boundaries.

I describe social movements as an outcome of the interaction process between opposites. Conflicts are ordinary states, but the transformation to movements necessitates interaction. However, interaction does not always resultant with a movement. People should decide to use interaction as a resource of mobilization beforehand. At this point, I am closer to RMT. However, locality of communication needs a deeper analyze on the decision making process. First, in the case of incomplete information, the communication structure determines the base of any possible movements. Second, communication has a spatial dimension which affects the possible forms of the movements. Third, communication has a political dimension which is able to encourage or discourage possible movements. At this point, I present a broader network perspective compared to RMT.

The first model I construct in the third chapter discuss the possible network structures in the existence of conflicting agents. I modify the standard connection model and replicate the main findings of this model. A remarkable finding of the model claims that for a variety of variables, segregation is not efficient but it is frequently pairwise stable. In practice, in terms of efficiency few the people should bear the cost of the conflict. A further study may interest in the transfer payments for the coincidence of stability and efficiency. This may shed light on inequality and the law of few. For instance, if coordination is limited then the bridge may extract higher values in return to tie the two groups compared to the amount when people are organized. Furthermore, a more dynamic environment can be constructed to examine the social relations in a more realistic way. For instance, the possibility of change on agent's ideas may lead people to invest in communication in a different way. In short, although this model is highly stylized in construction, extensions are possible and promising to examine different aspects of communication between opposites.

The second model I discuss in the fourth chapter is a simple attempt for application of the tools developed in the second chapter. Under local knowledge, the beliefs of individuals become relevant. The beliefs are assumed to be constructed based on two factors: quantitative dominance as well as informational dominance. The spatial dimension of the interaction is represented by multilayer network structure. The necessity of multiplexity is shown by a simple example. Lastly, the social environment has a significant impact on the possibility of mobilizing. The outcomes of a structure may differentiate with the introduction of positional heterogeneity or organizational opportunity. In reality, it is rare we face with full horizontal relations. This has significant policy implications. In the case of vertical relations, it is more feasible and relevant to use several mechanisms to discourage or encourage mobilization. A further research on policy implications will be relevant. Especially, an empirical study is necessary to test the arguments of this study and develop it further for a better understanding of social movements.

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