Part I

What Are International Networks?

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Social Network Analysis and the Study of World Politics

1. Introduction

On October 29, 1929, "Black Tuesday," stock markets in the United States collapsed. This event generated global ripple effects. Within weeks, worldwide production levels dropped sharply. Exports in most industrialized states plummeted by as much as 50 percent. Construction ground to a halt. Unemployment rates rose to 25 percent in the United States and to as much as 40 percent in several European states. The Western and Central European states were hit the hardest, as their economies were highly dependent on trade with the United States and with each other. England was America's largest trading partner. It was also the largest trading partner of France, Netherlands, and Sweden. Netherlands also had substantial trade with Germany, which also happened to be the largest trading partner of Turkey, Czechoslovakia, and Poland. Economists continue to hotly debate the reasons for the Great Depression (Hall and Ferguson, 1998). However, it is clear that this event had such profound ripple effects because of a growing level of global economic interdependence, the monetary and fiscal policies of the key states in the system, and the global expansion of money supply and credit. The Great Depression also brought about political changes in several states. The rise to power of Hitler and the Nazi Party in Germany, the 1931 Japanese invasion of Manchuria, and Japan's 1936 invasion of China can be directly or indirectly linked to the Great Depression.

On August 1, 1990, Iraqi troops invaded Kuwait. Within a few weeks, a coalition of thirty-four nations – some committing troops, others contributing funds and logistics – organized to push Iraq out of Kuwait. This coalition was led by the United States, but it also included Iraq's Arab allies: Egypt, Syria, Saudi Arabia, and the Persian Gulf States. The United Nations Security Council authorized economic sanctions against Iraq on August 6 and later (November 29, 1990) voted to authorize

the use of force if Iraq did not withdraw from Kuwait. On the night of January 15, 1991, the coalition attacked Iraq, starting the first Gulf War.

In a 1993 article, Harvard political scientist Samuel Huntington asserted that the post–Cold War order would be restructured along civilizational divides. In the early part of the twenty-first century, these divides – which he dubbed the "clash of civilizations" – are about to form the major source of conflict. This conflict would pit the Judeo-Christian civilizations against the rest of the world's civilizations, primarily the Islamic and Oriental ones (Huntington, 1993, 1996). Huntington's thesis sparked a major debate among scholars. It was, however, of little interest to politicians in the United States and the West. The 1990s appeared to be an era of peace, prosperity, and stability under Pax Americana. The world seemed a far less threatening place than it had during the Cold War. The terrorist attacks on the United States of September 11, 2001, brought the clash of civilizations thesis to the fore. It became a hidden element of the Bush administration's war on terror and an open thesis among neoconservatives in the United States and other Western states. Soon enough, the United States invaded two Islamic countries – Afghanistan and Iraq – and in the process issued threats against other Islamic countries such as Syria and Iran. Islamic terrorists became the focus of the U.S. war on terror, and they responded with attacks on Spain, the United Kingdom, Israel, and India, as well as on other Muslim states (e.g., Indonesia, Malaysia, Pakistan, Saudi Arabia, and Jordan). The concept of "terror networks" has become a central topic of discourse among security experts.[1]

In his 1962 book *The Guthenberg Galaxy*, Canadian scholar Marshall McLuhan coined the term "the global village," to describe the effect of electronic communications on culture. He argued that these new media technologies create a homogeneous space and eliminate information time – the time between the source of a media message and its target. This has a profound effect on various aspects of our lives. Although his focus was on communications, other scholars and experts began using the term in a variety of economic, social, and political contexts to describe various forms of interdependence and globalization. Not surprisingly, one of the classic works in international relations – Robert Keohane and Joseph Nye's *Power and Interdependence* – focused on networks of relations among states and how these have reshaped the key features of international relations in the modern era (Keohane and Nye, 1987).

How are these seemingly unrelated events and writings connected? The short answer is that they, along with many other examples that I discuss throughout this book, suggest a common theme: international relations

[1] Quite likely, Claire Sterling's book *The Terror Network*, which covered the interrelations among terrorist organizations in Europe and the Middle East in the 1970s (Sterling, 1981), is the source of this phrase.

are about networks. Most interactions among states or between states and nonstate actors take place within different networks. People may mean different things when they talk about networks. Yet, we typically think of a network as a collection of units – in our case, states and nonstate actors – that have ties with one another. These ties determine how information and influence flow in the global village. They help explain the global ripple effects of the 1929 stock market crash. Such networks are instrumental in explaining how the thirty-four-nation coalition formed to fight against the Iraqi occupation of Kuwait. If we are to understand international relations, we must study international networks.

International networks come in many shades and colors. Cooperative international networks include security alliances, general trade networks, and specific trade networks (such as arms trade), foreign direct investment, international organizations, diplomatic relations, and cultural networks, to name just a few. Conflicts are also conducted within networks – state A fighting state B may look at the prospects of having its allies help it or the risk of having B's allies join the fray (Bueno de Mesquita, 1981; Altfeld, 1984).

Like Keohane and Nye, many international relations scholars used the terminology of social networks to discuss international phenomena. Yet, for a very long time they have failed to realize that there exists a scientific approach to the study of networks. This approach is used in such diverse fields as epidemiology, evolutionary biology, physics, mathematics, and computer science (Watts, 2003; Barabási, 2003). These fields are seemingly unrelated to the study of international relations, so there was no apparent reason to see the relevance of network analysis to international politics. However, since the early 1950s, Social Network Analysis (SNA) has become increasingly influential in the study of interpersonal relations in psychology, in theories of organizations in sociology and organizational studies, and in the study of macro-social processes in structural sociology (Wasserman and Faust, 1997: 3–17), and it has become increasingly popular in economics (Jackson, 2008). SNA approaches have even been used in political science (Knoke, 1990). Yet, despite the popularity of this approach in so many disciplines, its use in international relations was minimal until quite recently. Ironically, until the early 2000s, most studies of the international system utilizing SNA approaches were conducted by sociologists, rather than by political scientists.

Recently, however, a growing number of political scientists started to apply SNA approaches to the study of international processes and phenomena. Yet, as is the case with a novel undertaking in any field, the study of international networks is treated with a great deal of suspicion and skepticism. People may use the lingo, but they are generally unfamiliar with the approach. All too often, students of international politics do not understand the relevance of SNA to the systematic study of

international structures and processes. Therefore, they find it difficult to grasp how this approach can contribute to our understanding of the substantive issues and problems of the field. Others who may understand some aspects of SNA view it in rather narrow terms, as a methodology or a set of measures of relationships.

SNA is much more than a methodology. It is a whole perspective of social processes – one that views such processes as emergent structures of a system of relationships among people, groups, institutions, and nations. It approaches social processes and structures from a vantage point in which voluntary associations (due to the choices made by units) or involuntary associations (such as geographical proximity between units or shared cultural attributes) result in structures of relationships. Many of these emergent structures are unintended. Many others are not readily visible. SNA offers a wide array of concepts, measures, and statistical and mathematical tools to systematically study these structures. In short, SNA is a science of interactions. And because international relations is all about interactions among states and between states and nonstate units, SNA is a perfect fit for the study of international relations.

One of the goals of this book is to remedy this situation. I aim to demonstrate the relevance of SNA and the substantive contributions it offers to our scientific understanding of world politics. However, the primary aim of the book is not methodological but substantive. This is the first book-length study of international relations using SNA. It develops and tests a general theory of networked international politics (NIP) that focuses on the evolution of international relations as a set of interrelated and interacting networks. This study addresses the following questions:

1. How, why, and when do different international networks form?
2. How do they change over time? What factors determine the nature, magnitude, and types of change in a given network?
3. How do different networks affect each other? Do changes in one network affect changes in the structure or characteristics of other networks? If so, how do cross-network relations work and what are their consequences?
4. How do the structure and characteristics of international networks affect various historical processes such as changing levels of international stability, the degree of economic inequality, and transformations in the structure of the system?
5. What is the relationship between *nondiscretionary* networks (e.g., geographic or cultural networks) and *discretionary* ones (e.g., alliances, trade, international organizations)?

The central argument of NIP theory is simple: International relations have evolved as a set of interrelated cooperative and conflictual networks. These networks coevolve in constant interaction with each other, and this

interaction has important implications for the behavior of nations and for the structure of the international system. To understand where we were nearly two hundred years ago, how we got from the end of the Napoleonic Wars to the hierarchical system of the present, and where we might go in the future, we must understand how these networks were formed, how they change, how they affect each other, and how they condition the behavior of state and nonstate units.

The NIP theory builds on the central paradigms of international relations: realist, liberal, and constructivist/cultural. In subsequent chapters, I introduce the theory, derive testable propositions from it on a wide array of issues, and test these propositions empirically. In this chapter, I provide a brief introduction of the key ideas of SNA. I also review the history of the approach as well as some of its key contributions to the study of international relations. Finally, I provide a brief overview of the book.

2. What is Social Network Analysis?[2]

2.1. Defining and Presenting Networks

A network is a set of units (nerves, species, individuals, institutions, states), and a rule that defines whether, how, and to what extent any two units are tied to each other (Wasserman and Faust, 1997: 20; Watts, 2003: 27). Such a rule can be a statement such as "live next to each other," which defines a neighborhood network. The statement "is a friend of" defines a friendship network. In our case, a statement like "has a formal alliance with" defines an alliance network, while a statement like "trades with" defines a trade network.

Social network analysts typically distinguish between two types of networks: relational and affiliational. *Relational networks* (also called *one-mode networks*) are characterized by rules that that define the presence, direction, and magnitude of a relationship between any two units. For example, neighborhood, friendship, alliance, or trade networks are relational networks. *Affiliation networks* (also called *two-mode networks*) are those in which the rule defines an affiliation of a unit with an event, organization, or group. Membership in professional associations, in social clubs, national membership in international organizations, or the distribution of states' population across religions, all reflect affiliational networks.

A relational network can be symmetric or asymmetric. An alliance network of states is by definition symmetric. The rule "is an ally of" stipulates that if state i has a defense pact with state j, then j has a defense pact with i. This applies to all states and all alliance types. On the other hand, a

[2] This is a very brief and superficial introduction to SNA. More elaborate textbooks include Wasserman and Faust (1997), Scott (2000) and Jackson (2008).

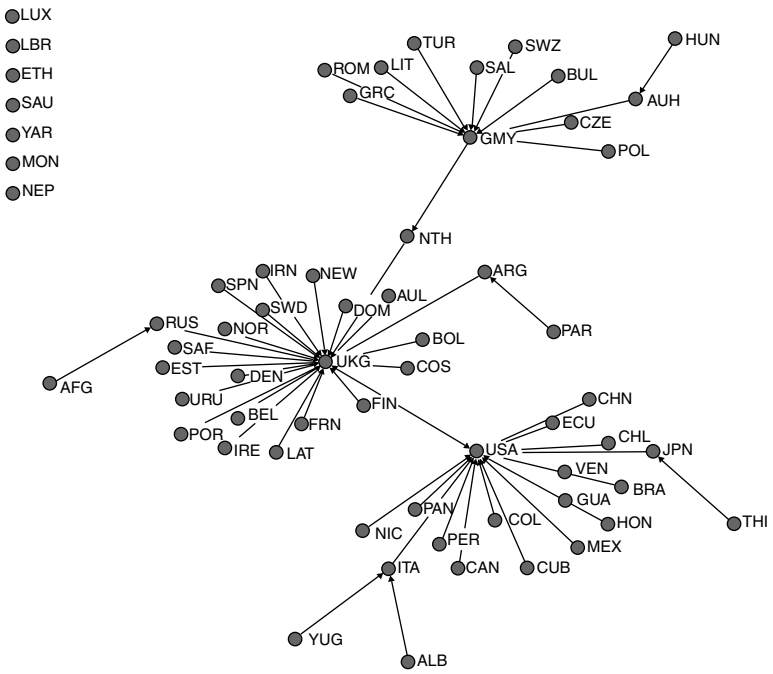

Figure 1.1. Trade network of major trading partners, 1929.

trade network defined by the rule "*i* exports goods worth *x* dollars to *j*" is an asymmetric network. The fact that *i* exports a certain amount to *j* does not imply that *j* has any exports going to *i*. Or, if state *j* does export goods to *i*, there is no guarantee that *j*'s exports to *i* are at the same level *x*.

Networks can be represented by graphs or by matrices. A graph is a description of a network in terms of units (nodes) and arrows (edges) connecting some of the nodes to each other. Consider, for example, Figure 1.1, which describes the flow of trade in the international system in 1929. This figure is a network that is made up of states, and relations are defined by the rule "state *j* is state *i*'s largest export partner."[3] This figure displays the largest export partner of each country.

We can use this picture to illustrate some concepts in SNA. First, there are a number of states, including Luxemburg (LUX), Liberia (LBR), and Ethiopia (ETH), for which we do not have trade data. In this case, I

[3] States are marked by circles and labeled by three-letter identifiers. See the code list of state labels in the book's Web site. An arrow going from state *i* to state *j* means that the cost of imports from *i* to *j* is higher than the cost of *j's* imports from any other state. So there is only one arrow going out from one state to another state. The actual trade network for this year is much more complex, as we will see in the next chapters. Sources for these data are given in Chapter 2.

assumed that they have no meaningful trade ties with anybody. Units that do not have ties to any other units are called *isolates*. Second, as noted above, this is an asymmetric network. In most cases, the arrows go only one way. For example, consider the lower part of the figure. The arrows going from Yugoslavia (YUG) and from Albania (ALB) to Italy (ITA) mean that Italy was the largest trading partner of YUG and ALB. However, Italy's largest trading partner in 1929 was the United States (USA). Yet, symmetries may exist even in asymmetrical networks. For example, the arrow going from England (UKG) to the USA is bidirectional, meaning that England and the USA were each other's largest trading partners.

Third, we can see in this figure three *hubs*. A hub is a cluster of units, all connected to a relatively central one. The upper hub is clustered around Germany (GER). It includes states such as Turkey (TUR), Switzerland (SWZ), and Czechoslovakia (CZE), to name a few. The central hub clusters around UKG, and it includes states such as the Netherlands (NTH), France (FRN), Sweden (SWE), and Spain (SPN). Finally, the third, lower hub is clustered around the USA, and it includes Canada (CAN) and most of the central and southern American states. The USA and UKG are not only fairly central states but also *bridges*: They connect different clusters of states to each other. This helps to make an interesting historical point: Had it not been for the strong trade ties between the United States and England, the effects of the Wall Street collapse on the global economy may not have been as profound. Netherland is also a bridge state because it connects between the UKG hub and the GER one.

Consider the way in which an affiliation network is presented. Figure 1.2 shows the international governmental organizations (IGO) network in 1910. The rule that defines this network is "state i is a full member of IGO k."

Clearly, this is a far more complex network than was the major trading partners' network of 1929, but even this network is considered a relatively simple one. The circles in this network are still nodes, or states. The squares are events – in our case, international organizations. An arrow going from a state to an IGO means that the state is a member of a certain IGO. For example, if we look at the southmost IGO in the figure – the Organization of American States (OAS) – we can see that a cluster of states are members (e.g., Venezuela [VEN]; Salvador [SAL]; Dominican Republic [DOM]; Nicaragua [NIC]).

The complexity of the graphic form of presentation increases exponentially as networks grow in size and in the number of ties between them. Therefore, many analysts prefer using matrices to represent networks. A relational network can be represented by an $n \times n$ sociomatrix (often labeled **S**), where rows and columns represent nodes, and entries s_{ij} represent the presence/absence or magnitude of a tie between row node i and

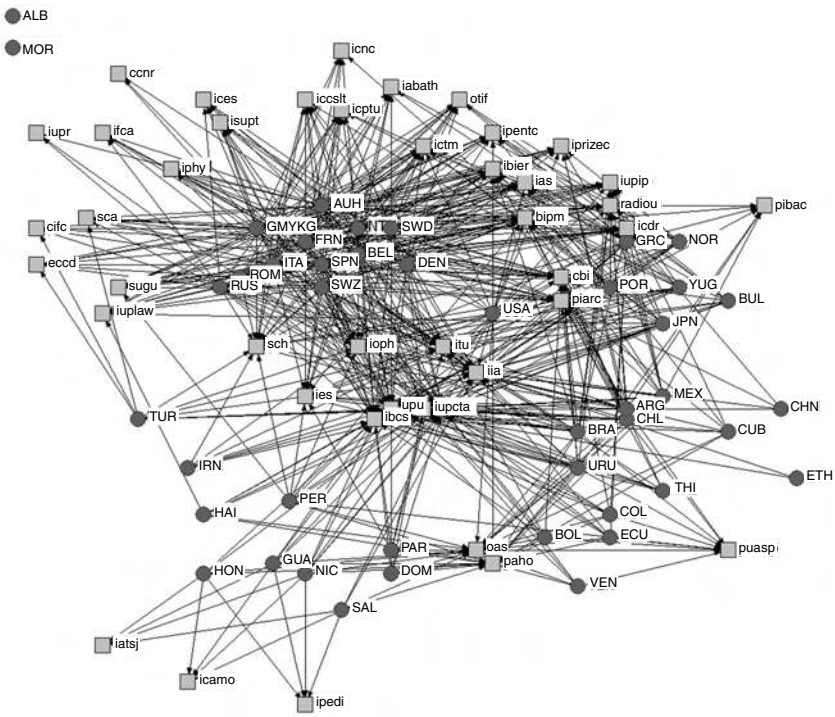

Figure 1.2. IGO network, 1910.

column node j. Likewise, an affiliational network is represented by an $n \times k$ matrix (often labeled **A**) in which rows represent nodes and columns represent events, organizations, or other types of groups. Each entry a_{ik} reflects the presence/absence or magnitude of the affiliation of node i with group k. Matrix representations of networks allow us to perform various sorts of transformations and analyses more conveniently.

Chapter 2 provides a more detailed exposition of concepts, functions, and methods of SNA. Therefore, I restrict the discussion in this chapter to a few cardinal points. First, SNA can deal with relatively simple systems (e.g., a group of children who report friendship patterns or patterns of communication in a relatively compact organization) or with huge systems (e.g., user groups on the Internet, air traffic systems in the United States, scholarly communities in various fields of science). The more complex the system, the more useful SNA concepts and methods for tracing the structures, patterns, and processes that operate within them. If the image of the IGO network in 1910 seems complex, imagine the complexity of some of the Internet networks.

One of the better known aspects of how this tremendous complexity is reduced through a web of ties is the *small world phenomenon* (Milgram,

1967; Watts, 2003: 37–42). This set of studies that started with a simple experiment. Researchers asked people in Kansas and Nebraska to send a booklet to someone in Massachusetts whom they did not know. They had to send the booklet to someone whom they knew and ask that person to send the booklet to someone he or she knew, and so forth. Milgram showed that, for the American population, the median length (degrees of separation) between any two individuals is between two and ten, with the median being six degrees. No matter how many people are in a network, to some degree (albeit through a number of intermediaries), all are connected. This could not have happened if people had ties that were structured along geographic contiguity. The small world phenomenon is simply that even a small number of ties that are not contiguous in a specific way can generate very fast, highly connected networks.[4]

The second point immediately follows. The exponential increase in the complexity of social systems is not due only to the size of the system (the number of units in it) or the complexity of ties between units. Rather, complexity grows with the types of ties between units. Even relatively small units that have multiple types of ties can become highly complex. Think of the interstate system in 1816. It had "only" twenty-three states. Much of the interaction between these states was either political or economic (with ties being conflict, alliances, diplomatic relations, and some trade). But in 1816, there was only one international organization: The Central Commission for the Navigation of the Rhine. This organization had only six members: France, Belgium, Baden, Bavaria, Prussia, and Hesse Grand Ducal. In 1910, the number of states was forty-six, exactly double the number of states in 1816. Yet, there were also forty-six IGOs, and nearly all states participated in at least one of them. (Only Albania and Morocco are not listed as having at least one IGO membership.) If we want to understand international politics as a set of interconnected networks, we have to deal with complexity that arises from *multiplexity*: possible ties between states across a number of different networks. I illustrate some of this in Chapter 3 and analyze aspects of this multiplexity in Chapter 11. Social network analysis has developed a number of models that estimate and analyze interdependencies between different networks.

The third point is that, even in simple networks, ties reflect both visible and hidden structures. Visible structures are readily interpretable in

[4] Of course, there are some flaws in this model, because the people that the second person in the chain knows probably know quite a few of the people that the first person knows, and so forth. So there is a fair degree of overlap in terms of who knows whom. Nevertheless, many subsequent experiments (including reverse small world experiments; Wasserman and Faust, 1997: 53–54) confirmed Milgram's seemingly astounding results. Watts and Strogatz (1998) published a classic article that models this process in random networks.