

## **ABSTRACT**

BODEN, MADISON LYN. The World Wildlife Web: The Network Structure of the International Trade of Protected Animal Species. (Under the direction of Dr. Steven McDonald).

Existing world-systems studies have rarely examined how the distinctiveness of a commodity dictates the patterns of trade. The present study asks if the patterns of the global trade of protected animals, a very distinct form of commodities, take the same form as those of more general commodities. The patterns of the global protected animal trade differ from that of past studies because the trade of animal and animal byproducts is defined by a series of factors unique to the trade of animals, which ultimately shapes the resultant global trade network. These factors include the tropical biome's monopoly over animal products, a demand for animal products, concern for animal well-being and the adapted shipping techniques, and trade agreements that either restrict or permit the trade of these protected animals or animal products. Using a blockmodel analysis of the nations included in the CITES Trade Database, the study finds that the global trade of protected animals is made up patterns of international connections that deviate from past studies of more general trade with regard to the contents of the blocks and the patterns in which the blocks trade with one another.

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The World Wildlife Web: The Network Structure of the International Trade of Protected  
Animal Species

by  
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**DEDICATION**

I dedicate this thesis to Gabbi Lyn Boden.

## **BIOGRAPHY**

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## INTRODUCTION

Past world-systems studies of trade networks do not place the unique characteristics of commodity, and their potential impact on the trade network, at the forefront. These researchers either group all commodities from a database into one large group (Kick et al. 2011; Lloyd, Mahutga, & De Leeuw 2009; Snyder & Kick 1979; Van Rossem 1996) or they divide the commodity data into various raw and processed commodity groups (Nemeth & Smith 1985; Smith & White 1992; Steiber 1979; Tong & Lifset 2007), which ultimately ignores commodity heterogeneity in the structure of the world system. However, commodities have dimensions that extend far beyond their state in the process of completion. These dimensions, which include the commodity's origin and that region's features, cultural significance and demand, and conditions for trade, have the potential to dictate who is dominating the trade of said commodities and how these commodities are being traded between actors. In other words, specific characteristics of a commodity can add nuance to the world-systems template of the structure of the global trade network.

This paper explores this notion of a nuanced world-systems template by comparing the trade patterns of specific commodities to the trade patterns of general commodities. Specific commodities are a group of commodities that share same source or exist at some point as the same raw form. Based on this shared origin and its unique characteristics, this group of commodities may also distinguishable based on cultural significance, rates and sources of demand, and specialized trade conditions. General commodities, however, are more extensive groupings of commodities that are clustered together regardless of their characteristics. Occasionally, they are grouped based on their stage in the production process and may be broken up into categories such as crude materials, mineral fuels, chemicals,

machinery, manufactured goods, and waste/scrap. Despite this occasional arrangement based upon production-based characteristics, these commodities are grouped together with disregard for heterogeneity, or the various raw forms and origins that exist within the overall group. Essentially, these commodities are considered "general" since their grouping cannot reveal any specific characteristics outside of stage in the production process.

Do the patterns of the trade of specific commodities take the same form as those of general commodities? More specifically, does a world-systems-based core-periphery structure exist for these specific commodities? Are the core actors in the general commodity trade similar to those in the trade of specific commodities? There is little specific world-systems research that addresses these questions. It is plausible that the network of a specific type of commodity will look and act the same as the network of general commodity trade, for past research suggests that trade networks take on a core-periphery structure where a consistent set of core countries dictate patterns of trade. It is also plausible, however, that the patterns of specific commodity trade differ from the general commodity trade with regards to who is trading with whom and to what extent.

The trade of protected animal species, the sale or exchange of endangered live animals and their byproducts by people, is an ideal case for demonstrating a nuanced world-systems trade pattern because protected animals as commodities differ from the general commodities analyzed in the aforementioned studies. These animal-based commodities include live endangered, and ultimately protected, animals and animal byproducts that are used for traditional medicine, leather goods, hunting trophies, and live animals for pets or public display<sup>1</sup> and all come from the same source and take the same raw form: endangered

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<sup>1</sup> The CITES Trade Database (2013) provides basic information regarding the purposes of trade transactions for protected animals or their byproducts. Such purposes include (and are limited to) breeding in captivity or

animal species. Not to mention, these commodities are embedded in a highly politicized context due to their protected status. The trade of these animal and animal byproducts is defined by a series of unique factors based on this protected animal source, which ultimately shapes the resultant global trade network. These unique dimensions of the trade of protected animals include, (1) the tropical biome's monopoly over diverse animal products; (2) a demand for animal products in some nations, but not others; (3) concern for animal well-being and the adapted shipping techniques; and (4) trade agreements that may either restrict or permit the trade of these animals or animal products. These factors may ultimately shape the resultant global trade network and lead it to differ from what previous world-systems studies of heterogeneous groupings of general commodities find with regards to core-periphery structure and content.

By using social network analysis and blockmodeling data analysis techniques on data collected by the Convention on International Trade in Endangered Species (CITES) from 2003 to 2013, I examine how the characteristics of the trade network for this type commodity deviate from the world-systems template of the structure of the global trade network. The CITES data used in this study provides information regarding the trade of *protected* animals. The level of protection provided to the animals by CITES depends upon their risk of extinction, which is reflected by their classification in the CITES Appendices<sup>2</sup>.

The implications of this study are two-fold. First, this study shows a more nuanced conception of what past world-systems literature establishes as patterns of global trade and

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artificial propagation, educational, hunting trophy, law enforcement/judicial/forensic, medical (including biomedical research), reintroduction or introduction into the wild, personal, circus or travelling exhibition, scientific, commercial, and zoo.

<sup>2</sup> Appendix I species are those that are the most endangered of all the animals listed in CITES, and are therefore prohibited from trade except in exceptional circumstances. Appendix II species are not necessarily now threatened with extinction, but are at risk for extinction unless trade is controlled. Appendix III species are afforded protection at the request of a CITES Party that already regulates the trade of said species, and therefore requires the assistance of other nations to prevent "unsustainable or illegal exploitation" (CITES 2015).

power dynamics. Second, the present study has global environmental policy implications. For some human actors involved, the international trade in wildlife is financially lucrative, yet this trade has negative consequences for a variety of rare animal species and therefore threatens global biodiversity (CITES 2014; Fernandes-Ferreira et al. 2012; Henry 2004; Sodhi et al. 2004; TAFFIC 2008; Wright et al. 2007). This specific type of trade also has negative impacts on the welfare of the animals being transported for trade (Baker et al. 2013; Bush et al. 2014; Cantú Guzmán 2007; Kawata 2014). In order to reduce some of the environmental consequences of wildlife trade, bans and regulations are put into place by local and national governments, and through international agreements between governments. In some instances, these bans and regulations are effective, however, in others, trade continues to exist and illicit wildlife markets continue to thrive (Cantú Guzmán 2007; Henry 2004; Lemieux and Clarke 2009; Zhang, Hua, and Sun 2008). To comprehend this unrelenting market, it is vital to understand the global trade networks involved. This way, one can recognize key players in the environmentally devastating wildlife trade network, and governmental entities can then create policy that enhances the wellbeing of various species and the environment as a whole.

## **WORLD-SYSTEMS ANALYSES OF GENERAL TRADE NETWORKS**

According to Wallerstein (1974) the capitalist world system is based on a global division of labor, in which labor conditions vary and relationships between regions are shaped. All regions of the world can be placed within four categories: the core, the semi-periphery, the periphery, and external. Powerful core regions benefit the most from the capitalist world economy, and are advantaged at the expense of the less powerful peripheral

regions. The structure of the world system emerges from this series of unequal exchanges between the core and periphery. This is demonstrated empirically in several studies, where the core of a network is the most extensively connected and most centrally located within the resultant network structure, and the peripheries are less extensively connected than the core and are therefore less central actors in the network (Kick et al. 2011; Lloyd, Mahutga, & De Leeuw 2009; Nemeth & Smith 1985; Smith & White 1992; Snyder & Kick 1979; Steiber 1979; Tong & Lifset 2007; Van Rossem 1996).

Two main approaches have been used to empirically test Wallerstein's (1974) world-systems perspective. The first approach combines economic and non-economic factors in the identification of a world-systems structure (Kick et al. 2011; Snyder & Kick 1979).

Researchers who use this approach operationalize the structure of the world system according to networks of trade flows (economic factors) in which commodities from the database of choice are analyzed as one heterogeneous group (Kick et al. 2011; Snyder & Kick 1979; Van Rossem 1996). These researchers also operationalize the structure of the world system according to non-economic factors such as military interventions, diplomatic exchanges, and conjoint treaty memberships (Snyder & Kick 1979), armament transfers, IGOs, and embassies (Kick et al. 2011), and arms trade, diplomatic exchange, and presence of foreign troops (Van Rossem 1996). Non-economic factors are included in these world-systems analyses because previous studies indicate cultural and political networks, in addition to economic linkages, play fundamental roles in the world system (Snyder & Kick 1979; Meyer et al. 1997).

The second approach only considers economic factors in the form of trade relations (Lloyd, Mahutga, & DeLeeuw 2009; Nemeth & Smith 1985; Smith & White 1992; Steiber

1979). Studies that take this approach use the United Nation's Commodity Trade Statistics Database (Nemeth & Smith 1985; Smith & White 1992; Steiber 1979; Tong & Lifset 2007) or the World Trade Analyzer (Lloyd, Mahutga, & De Leeuw 2009) as trade data for their analyses. These researchers either aggregate all commodities to generate a single network (Lloyd, Mahutga, & De Leeuw 2009) or they base their analysis on the trade of commodities that are classified by their level of completion in the industrial process (Nemeth & Smith 1985; Smith & White 1992; Steiber 1979; Tong & Lifset 2007). Studies that rely on the commodity's level of completion for their analysis separate commodities into categories such as crude materials, mineral fuels, chemicals, and machinery (Steiber 1979), heavy, intermediate, and light manufactures, raw materials, and food products (Nemeth & Smith 1985), raw materials and processed commodities (Smith & White 1992), or ores, manufactured goods, machinery/vehicles, and waste/scrap (Tong & Lifset 2007).

To find the roles and positions of nations involved in trade, these studies stack each category-based relationship on top of one another to create a "super matrix" before calculating structural equivalence (Lloyd, Mahutga, & De Leeuw 2009:61). This resulting matrix then represents the equivalence between each country after taking into account the level of completion of each commodity. This technique is often used to study dependency arguments that claim that core nations trade a great deal of both raw and processed materials with other core nations, and raw materials flow from the periphery to the core and finished products flow from the core to the periphery (Nemeth & Smith; Smith & White 1992; Steiber 1979).

Regardless of the approach used, similarities exist with regard to the resulting network structure and the contents of the core block(s). Across these studies, a core-

periphery structure with a consistent set of core countries is found. Even studies that divide their analyses by their level of completion in the industrial process find support for the notion that this set of core nations dominate trade at the expense of the less powerful peripheral regions due to the core nations' sophisticated manufacturing capabilities. Differences exist between the studies of these findings, which could be attributed to the data of choice and the time frame of interest.

### Network Structure

Studies that operationalize the structure as the world system as economic and non-economic in nature find support for world-system theories of structure, meaning that a core-semiperiphery-periphery structure exists in the world system (Kick et al. 2011; Snyder & Kick 1979; Van Rossem 1996). There is variation in findings, however. Snyder & Kick (1979) find three partitions in the world-system, where boundaries exist between a core, a semi-periphery, and a periphery. Kick et al. (2011), on the other hand, find five partitions which includes two cores: a center core and a core. In addition, Kick et al. (2011) finds an upper periphery, semi-periphery, and a periphery. Van Rossem (1996) finds a core and semiperiphery plus primary and secondary peripheries. Regardless of the number of partitions found, however, each study indicates the existence of the core-semiperiphery-periphery structure that is characterized by Wallerstein (1974).

Studies that only analyze trade flows also find evidence of the general world-systems structure developed by Wallerstein (1974) (Lloyd, Mahutga, and DeLeeuw 2009; Nemeth & Smith 1985; Smith & White 1992; Steiber 1979; Tong & Lifset 2007). Some variations exist across these studies, however. First, like studies that focus on both economic and non-economic factors, the number of partitions found in their respective networks varies for each

researcher. For example, Nemeth and Smith's (1985) findings indicate the presence of four strata in the world economy: core, periphery, and strong and weak semiperipheries. Smith and White's (1992) findings support the existence of core, semi-periphery, and periphery positions in the world-economy, but also find the existence of at least two subdivisions in the periphery and semi-periphery. Tong and Lifset (2007), who limit commodities to copper-based commodities, uncover a two-tiered global system that only includes a core and periphery.

#### Contents of the Blocks

Across studies, certain countries are consistently classified as core nations. These countries include: Australia, Belgium, Denmark, France, Germany, Italy, Japan, Luxembourg, Netherlands, Spain, Switzerland, the United Kingdom, and the United States (Kick et al. 2011; Lloyd, Mahutga, & De Leeuw 2009; Nemeth and Smith 1985; Smith and White 1992; Snyder and Kick 1979; Steiber 1979; Tong and Lifset 2007; Van Rossem 1996). The fact that a consistent set of core countries can be derived from different studies across time shows the salience of some nations in the general commodity trade compared to other, less dominant nations.

Still, some nations are classified as core in some studies, but not in others. In short, studies using more recent data, such as Kick et al. (2011); Lloyd, Mahutga, and De Leeuw (2009); Tong and Lifset (2007); and Van Rossem (1996), show nations in their cores not previously categorized as such. These countries include Brazil, China, Hong Kong, Indonesia, Malaysia, North and South Korea, Singapore, Thailand, and South Africa. This indicates that it may be plausible that certain nations are mobile within the world system; moving from the periphery into the core.

Variation also exists across the researcher's semiperipheral and peripheral classifications but to a much greater extent than the core classifications. This is because disagreements exist across studies regarding the total number of semiperipheries and peripheries and subgroups of these strata, and therefore disagreements over the categorizations of particular countries. For instance, Tong and Lifset (2007) find evidence of a core and periphery with no semiperiphery whereas other studies find evidence of one or more semiperiphery (Kick et al. 2011; Lloyd, Mahutga, & De Leeuw 2009; Nemeth and Smith 1985; Smith and White 1992; Snyder and Kick 1979; Steiber 1979; Van Rossem 1996). It is difficult to comprehensively compose a set of semiperipheral or peripheral nations when these categories exist in some studies, but not others, or have different partitions or subgroups of categories.

Each study also covers different ranges of data. According to Smith and White (1992), certain countries stay in one stratum over a period of time, yet others can shift over time. This may lead to one study using older data classifying a nation as peripheral whereas a study with more recent data may classify that same nation as semiperipheral. Plus, the number of countries analyzed in each study varies greatly. The studies explored here have from fifteen countries or aggregates (Steiber 1979) to 163 countries (Van Rossem 1996). This makes it difficult to compare the lower strata block contents across studies since there may be a number of countries in one study that are simply not accounted for in other studies. Overall, inconsistencies across studies regarding number of strata, strata portioning, time period of interest, and number of countries analyzed makes difficult to identify a consistent set of semiperipheral and peripheral nations across these studies.

### Patterns of Trade Flows Between and Within the Core and Periphery

Researchers also analyze trade among and within strata. Strata refer to the various categories, or levels, of the world system such as core and periphery. Studies consistently show that, within a world-systems structure, core countries dominate in intra- and inter-strata trade, whereas countries in the periphery are connected more to the core than they are to other nations in the periphery.

In his analysis of the trade of four major commodity types, Steiber (1979) finds that core countries trade the most with each other, while also trading heavily with other blocks in the system. Peripheral countries' levels of exchange were small, but heavily centered in the core. Kick et al. (2011) also contribute to the understanding of trade among and within classifications. In their analysis of commodity trade, Kick et al. (2011) finds all blocks remain very closely tied in exports and imports to the most central core block. In their study focusing on the trade of 15 types of trade commodities, Smith and White (1992) find that although processed commodities circulate within the core, exchanges still tend to move from higher strata to lower strata. However, for raw products (with the exception of highly industrialized agriculture), intra-core exchange is common, yet inter-strata exchange is more likely to move from the peripheries to the core.

In sum, the network structure of trade for general commodities remains mostly consistent across various studies with only a few differences that are attributable to the data of choice and the time frame of interest. General commodity trade takes a core-periphery structure with a small grouping of countries dominating trade. Do the global patterns of animal trade take the same form as that of more general commodities, where there is a core-periphery structure and the usual grouping of key actors?

## **THE UNIQUE NATURE OF ANIMAL TRADE**

The current study only looks at the trade of specific commodities, protected animals and animal products, in order to see whether or not the trade of these specific commodities has the same global trade patterns as the trade of general commodities. Existing literature provides insights into the factors surrounding this animal trade that would lead one to believe that the global network of the protected animal trade differs from the global network of general commodity trade. Primarily, protected animals as commodities differ from the general commodities analyzed in the aforementioned studies. The trade of these specific commodities is defined by a series of factors unique to the trade of protected animals, which may ultimately shape the resultant global trade network and lead it to differ from what previous world-systems studies of more general commodities find. A non-exhaustive list of factors driving this variation includes, (1) the tropical biome's monopoly over diverse animal products; (2) a demand for animal products in some nations, but not others; (3) concern for animal well-being and the adapted shipping techniques; and (4) trade agreements that may either restrict or permit the trade of certain animals or animal products.

### Monopoly in the Tropics

Studies of the theory of ecological unequal exchange are the frontrunners in the race to achieve understanding of how environmental dynamics shape global trade patterns. Ecological unequal exchange theory posits that countries advantageously situated within the network of global exchange are more likely to secure favorable terms of trade at the expense of countries with natural resources (Bunker 1984; Lawrence 2009; Rice 2007; Shandra, Leckband, & London 2009). This theoretical framework supports the notion that factors associated with natural phenomenon may influence the structure of the world system, and a

consideration of natural variables is essential to understanding this system. These works provide support for the notion that environmental factors, such as climate, topography, and weather can influence patterns of trade. According to this theoretical framework, certain nations are able to produce or access resources that other nations cannot produce or access within their own borders, and as a result, these natural resource-advantaged nations are targeted and drawn into the economic market primarily for the benefit of nations who, although already dominant in the world system, are disadvantaged regarding natural resource access in their own nation (Bunker 1984; Lawrence 2009; Shandra, Leckband, & London 2009).

Even when researchers do not frame their analyses through ecological unequal exchange theory, they provide evidence that environmental factors, particularly climate, are able to shape global trade patterns. A review of nongovernmental organization reports and peer-reviewed articles from 2006 to 2011 finds that the most reported players in the international animal trade include countries in Asia, Africa, and Central and South America (Baker et al. 2013). Nations in these regions of the world, rather than nations in North America and Europe, may be the main players in the animal trade due to the characteristics of the specific type of commodity being traded. In-demand animals and animal products could simply originate from regions where there are high concentrations of commonly-classified peripheral nations, such as Asia, Africa, and Central and South America. Consequently, there may be few in-demand animals and animal products that originate from areas of the world where commonly-classified core nations are located: North America and Europe. Overall, this dynamic of the animal trade may lead to increased trade activity among nations that are commonly classified as peripheral rather than core.

Additionally, a number of coveted species for the animal trade are located in the tropical regions of the world. Interestingly, the tropical biome makes up significant portions of Asia, Africa, and Central and South America: the dominant players in the animal trade. According to Nijman and Shepherd (2007), a significant part of the wildlife trade deals with tropical species; therefore, it is plausible that countries in the tropical biomes have a monopoly on species to be exported. Any differences between the trade patterns of general commodities and the trade patterns of animal-based commodities with regard to who is trading with whom could be explained by considering the climatic region in which each country of interest is located.

Furthermore, past research provides evidence that trading patterns are dependent on high concentrations of resources that are only found in certain regions, such as wildlife in the tropical regions of the world (Carpenter, Rowcliffe, and Watkinson 2004; Ji, Zhang, and Fan 2014; Peck 2002; Tong and Lifset 2007). In a study of the international trade in chameleons, Carpenter, Rowcliffe, and Watkinson (2004) note that most countries involved in the export of chameleons are from within the geographical range from which the species of chameleons originate. Other studies that focus on the trade of geographically dependent resources and items, rather than just animals, assert that resource locations determine trade patterns (Carpenter, Rowcliffe, and Watkinson 2004; Ji, Zhang, and Fan 2014; Peck 2002; Tong and Lifset 2007). Again, the differences in trade patterns between general and animal-based commodities, such as previously-classified peripheral nations acting as core nations in the trade network, could be explained by considering the climatic region in which the commodity of interest and the key players in the trade of said commodity are located.

### Product Demand

Differences between the trade patterns of general commodities and animal-based commodities could also be attributed to the dynamics of product demand. Some nations may demand region-specific products, but not others. For instance, several cultures throughout the world depend on traditional medicines, which often contain animal parts, such as horns, bones, grains, and gall, as the main ingredients (Alves and Rosa 2012; Henry 2004). These traditional medicines are not universally used, as demand for traditional medicines is concentrated in Asian and African countries (Alves and Rosa 2012). Because of these specific commodity-based markets that are located in certain areas, but not others, the structure of the trade network may differ from structures that were found after analyzing more general commodities. In other words, a nation that is not a central actor in the general commodity trade may be a central actor in the international animal trade due to its active participation in the trade of specific animal-based products.

### Shipping and Animal Wellbeing

Shipping issues may also factor in to differences between the network structures. In other words, trade of wildlife could be focused more on the “where” in addition to the “who.” Countries could choose to trade with certain nations rather than others based on location due to concerns over the welfare of live animals during transport. The trade of animals negatively impacts the welfare of many live animals being transported for trade (Baker et al. 2013; Bush et al. 2014; Cantú Guzmán 2007; Kawata 2014). For instance, as soon as a wild animal is captured and removed from its habitat, the animal can suffer through restraints, proximity to humans, and other predatory animals (Baker et al. 2013). Further, animals captured for trade risk death in transit to its destination via crushing, asphyxiation, starvation,

dehydration, temperature inconsistency, disease, stress, or injury (Baker et al. 2013; Cantú Guzmán 2007).

Because of this, nations may want to trade live animals with nations in close range, or with simpler trade routes, in order to ensure the well-being of the animal being transported. Furthermore, shorter and simpler trade routes may be favorable for the transport of whole animal specimens, both alive and dead, that are larger, more cumbersome, or more fragile than other manufactured goods. Plus, the shipment of animals, specifically live animals, can be costly (Kawata 2014).

### Trade Agreements and Laws

The trade network of animal-based commodities could differ the trade network of general commodities due to trade agreements between nations that either restrict or permit the trade of certain animals or animal products. For example, the United States was the first nation to become party of CITES at the Convention's conception in 1975 (CITES Trade Database Team 2013); therefore, its long tenure as a member of CITES could lead to its lack of trade ties to other nations within the global animal trade network. Not to mention, the Endangered Species Act in the United States makes CITES law, and strictly prohibits United States citizens from trading threatened or endangered species within and between the nation's states and also abroad (Endangered Species Act 1973). Additionally, the 1993 Wild Bird Conservation Act stopped the mass import of parrots into the United States (Wild Bird Conservation Act 1993), which means that the United States may lose trade ties to those nations from which they imported parrots. Overall, nations with abundant trade restrictions on animals and animal products may see a difference between their trade patterns of animal products and their trade patterns of general commodities. For instance, a nation commonly

classified as core in the trade network of general commodities could be a peripheral nation in the trade network of animals and animal products if that nation has written restrictions on the trade of animals and animal products. Although a nation may be core-like in its extensive trade network of general commodities, its trade network may not be as extensive, and more peripheral-like, when looking exclusively at a commodity that is restricted.

## **DATA**

The data set used in this study is the CITES Trade Database (UNEP-WCMC 2013). CITES is an international agreement between governments of various countries, and its goal is to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES 2014). CITES provides a legal framework for regulating international trade in species threatened or potentially threatened by that trade (CITES 2014).

The CITES Trade Database (2013), currently holds over 13 million records of trade of live specimens and byproducts of wildlife, and over 34,000 scientific names of taxa, including both plant and animal species. My study only includes animal species. Members of CITES collectively report around a million records of trade in CITES-listed species of wildlife. The variables recorded in this dataset include the year of the recorded trade transaction (1975-2013), the exporting and importing countries, the origin country of the species or specimens, the purpose of the transaction, the source of the specimen (i.e. wild, bred in captivity, etc.), the trade term (i.e. what is being traded, such as live specimens, skins, etc.), and the taxon of interest. The study only covers 2003-2013, due to limitations in computing power. I dropped cases with missing information on either the importer or exporter country. The resulting subset of the data contains 2052 export-import relationships for 241 countries.

## **METHODS**

The present study uses social network analysis, specifically blockmodel analysis, to analyze the structure of the wildlife trade network. A blockmodel analysis of trade networks allows the researcher to identify clusters of countries based on their filling of similar roles in the trade network. Through this, one can examine the trade relations among and between those clusters. Current world-systems studies of trade networks use social network analysis techniques as their main analytic tool (Lloyd, Mahutga, and DeLeeuw 2009; Nemeth & Smith 1985; Smith & White 1992; Steiber 1979; Tong Lifset 2007; Kick et al. 2011; Snyder & Kick 1979). Network analysis is ideal for trade studies because international trade networks are not random networks, but present well-defined characteristics (De Benedictis and Tajoli 2011). Furthermore, network analysis, particularly blockmodel analysis, is able to provide “concrete statements concerning structure, position, role, and relations among these constructs”, which is essential to comprehending network structure (Snyder & Kick 1979:1103).

This study uses UCINET, a network analysis software, to analyze the data. The data are entered into UCINET as an edgelist, which in this case is a two by 2052 matrix. There are 2052 rows for each trade relation in the data, and there are two columns: the first lists the exporter nations and the second lists the importer nations. The data in the edgelist are directional, which means that when calculating structural equivalence in the next step of the analysis, the exporter to importer relationship is incorporated.

I use the CONCOR program in UCINET to perform blockmodel analysis on the data (Borgatti et al. 2002). CONCOR blocks or clusters actors based on structural equivalence. Two or more actors are structurally equivalent when they display identical relations with

each other. CONCOR creates the blocks, and UCINET's output of block densities in the reduced blockmatrix aids in the description of the ties between the blocks. The blockmatrix's dimensions are determined by the number of blocks produced by CONCOR. For instance, if CONCOR creates 8 blocks, the resulting matrix will be 8 by 8. Each cell of this matrix shows the density of the ties between the blocks that make up the rows and columns of the matrix. A tie exists between two blocks if the density of the tie exceeds the mean block density score of the entire matrix. The densities in the blockmatrix reveal how the blocks of structurally equivalent actors connect to one another. In other words, one can interpret each block's place and role in the overall structure.

More specifically, an analysis of these connections between blocks shows to what extent each block of countries is trading with the other blocks of countries. In addition, it shows which blocks primarily import and/or export animal products with respect to other blocks. Through this, one can see whether or not a world-systems-based core and periphery structure occurs in the animal trade network. If a core-periphery structure appears, one or two blocks will be more highly connected than the other blocks in the network. These highly connected blocks are the core(s) of the network, while the lower connected blocks are the periphery. Periphery blocks should be connected to the core, but not to other periphery blocks. Density scores are also provided within block in order to determine the extent to which the countries within the block are trading animals and animal products among themselves. The higher the density score, the more trade is going on between the countries within a particular block.

## FINDINGS

A blockmodel analysis using CONCOR in UCINET finds eight blocks made up of countries that are more structurally equivalent to one another than to other blocks. In other words, these countries are grouped together into individual blocks based upon the extent to which the countries display identical trade relationships with other countries. Table 1 shows this listing of the eight blocks.

Table 2 shows the densities of ties within and between each of the eight blocks depicted in Table 1. When interpreting the densities of ties between two blocks in the context of trade, the closer the density is to 1.000, the higher the density of trade is between the two blocks. When interpreting the density within a single block, the closer the density is to 1.000, the more the nations within that particular block are trading with each other.

Figure 1 is a graphical representation of the network linkages within the global wildlife trade network. In the graph, two points, which represent blocks, are connected by a line if their density scores exceed the mean block density score (0.038), which is seen in the reduced blockmatrix (Table 2). A two-headed arrow shows that there are strong ties for both directions of the relationship. For instance, the directional tie connecting Block 5 to Block 8 and the directional tie connecting Block 8 to Block 5 both exceed the mean block density score. A one-headed arrow shows that only one direction has a tie density that exceeds the mean block density score. As seen in the graph, the directional tie from Block 5 to Block 6 exceeds the mean block density score, whereas the directional tie from Block 6 to Block 5 does not. The graphical representation of this network should be viewed and interpreted with caution. Figure 1 does not show the densities in Table 2 and other specific information and interpretations presented in this paper.

Figure 1 and the densities presented in Table 2 suggest that, for the animal and animal product-based trade relations, a center core-core-semiperiphery-periphery structure exists.

#### The Center Core and Core

In Figure A, one can identify a center core, Block 5, and a core, Block 6. These core blocks are the most connected actors in the system. The center core Block 5 is connected to every other block in the network, which indicates that that this block contains nations that are similar in their high activity in the animal trade network. The densities of ties in Table 2 provide further insight into Block 5's connections to other blocks in the network. The densities of ties that connect Block 5 to the other blocks are high compared to other between-block tie densities seen in Table 2, which shows that that not only are the nations in Block 5 simply trading with each of the other blocks, but also Block 5 has a high density of trade with blocks in lower strata. Essentially, Block 5's connections to all blocks in the network and its dense ties with these blocks indicate that it is the center core of the animal trade network. The core Block 6, on the other hand, is the second most extensively connected block. It is connected to six of the seven other blocks. Because Block 6 is not as extensively connected as Block 5 is, Block 6 cannot be considered a "center core" and is instead considered a "core". Overall, Block 5 and Block 6 are the center core and core respectively, for they are more extensively linked with all the rest of the system than are any of the other blocks in the network.

In Table 2, intra-strata trade, or trade within blocks, can also be seen. The center core block, Block 5, has a relatively low intra-strata trade density (0.014), which falls below the average density of 0.038. In fact, Block 5, the center core, is close in intra-strata trade density to the peripheral blocks. On the other hand, the core Block 6 has the third highest

intra-strata trade density (0.045), which is greater than the average density. These findings diverge from past findings in part, for past studies find that core blocks have the highest levels of intra-strata trade (Kick et al. 2011; Smith and White 1992; Steiber 1979). Rather than both cores from this study having high levels of intra-strata trade, only one of the cores does.

*Contents of the Cores: An Absent United States*

A small set of core countries stay consistent across existing studies. Past studies classify these countries as core countries or center core countries depending on the study. These countries include: Australia, Belgium, Denmark, France, Germany, Italy, Japan, Luxembourg, Netherlands, Spain, Switzerland, the United Kingdom, and the United States. The current study finds that most of these countries are within the center core or core blocks with one major exception: the United States is in a peripheral block rather than a core block<sup>3</sup>. More specifically, the United States' role in the animal trade network is similar to that of small islands in the Caribbean and South Pacific and also countries in Africa, Central Europe, and South Asia. Each of these countries that the United States is structurally equivalent to in animal trade are, in studies of general commodity trade, either considered part of the lower strata or are not even included in past studies due to their small population size. The United States appears in the same structurally equivalent block as the other more peripheral countries because each of these countries engages in animal trade with the United States but not each other.

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<sup>3</sup> In order to further examine this finding, I conducted an additional analysis in which I moved the United States into its own block. This analysis produced only minor changes in trade patterns, mostly regarding the periphery's connections to higher strata, but it did not significantly alter the overall core-periphery structure of the network.

This is a significant divergence from past findings, for past studies finds the United States located within a core block and therefore having similar roles as that of Australia, Belgium, Denmark, France, Germany, Italy, Japan, Luxembourg, Netherlands, Spain, Switzerland, and the United Kingdom (Kick et al. 2011; Lloyd, Mahutga, & De Leeuw 2009; Nemeth and Smith 1985; Smith and White 1992; Snyder and Kick 1979; Steiber 1979; Van Rossem 1996). In these studies, the United States is in a centrally located block that trades extensively with other nations in the core in addition to nations in lower strata. This major divergence from previous findings indicates that the world system structure of animal-based commodities is unique from that of general commodities studied in past research, may lead to a more nuanced understanding of the world-systems perspective.

The fact that the United States is not in the core of the global animal trade could be due trade agreements between nations that either restrict or permit the trade of certain animals or animal products. All CITES signatories must implement the treaty, but it does not take the place of national laws (CITES 2014), which means that although each nation agrees to the treaty, not all will pass effectual national laws. As stated previously, The Endangered Species Act, the 1993 Wild Bird Conservation Act, The Coral Reef Executive Order, The Migratory Bird Treaty Act, and The Lacey Act of 1900, among others (Wildlife Conservation Society 2015), may be what leads the United States to be outside of the core of the animal trade network. Plus, the United States was the first nation to become party of CITES at the Convention's conception in 1975 (CITES Trade Database Team 2013); therefore, its long tenure as a member of CITES could lead to its lack of trade ties to other nations within the global animal trade network.

Furthermore, each Party's governmental entities are responsible for the enforcement of the law used to implement CITES and also any additional or local laws regarding the trade of animals. Because of this, the level of enforcement employed to uphold these laws could differ widely from nation to nation regardless of their loyalty to CITES. As a result, the ability for the governments in a nation to uphold the laws could be more pertinent than the number of laws overall. Although trade restrictions, and possibly highly effective enforcement of them, in the United States may explain why the United States is not structurally equivalent to nations located in the center core and core of this study, studies that explore the specific animal trade relationships between the United States and the other nations within Block 2 are needed to further understand this unexpected finding.

*Contents of the Cores: Notable Outliers*

The center core and core of the current study contain countries that were occasionally classified as core in past studies. These countries were classified as center core or core in the more recent studies explored in the literature review, namely Kick et al. (2011); Lloyd, Mahutga, and De Leeuw (2009); Tong and Lifset (2007); and Van Rossem (1996), and include Brazil, China, Hong Kong, Indonesia, Malaysia, North and South Korea, Singapore, Thailand, and South Africa.

Looking at the classifications of countries in past studies, it is clear that certain countries maintain their spot in the core, yet more countries are added over time. Previous research indicates that shifts in positioning in the global network are plausible (Smith and White 1992). As the data used in studies of the world system become more recent, the content of the core fluctuates somewhat. Countries classified as peripheral or semiperipheral in studies using data from the years 1960 to 1980, such as Brazil, Hong Kong, Indonesia,

Malaysia, Singapore, and Thailand (Lloyd, Mahutga, and De Leeuw 2009; Nemeth and Smith 1985; Smith and White 1992; Snyder and Kick 1979; Steiber 1979) are classified as core in some studies using post-1980 data (Kick et al. 2011; Tong and Lifset 2007; Van Rossem 1996). Because of this, it is not surprising that the current study, which uses the most recent data (2003-2013), would include a few nations that have recently found their way from the semiperiphery/periphery into the core of the network.

Other nations classified as center core or core nations in the current study are never classified as such in other studies. These outlier countries in the center core include: Argentina, Azerbaijan, Czech Republic, Mexico, Niue, Togo, and the United Arab Emirates. Outlier countries in the core include: Anguilla, Cameroon, Colombia, Congo, Faroe Islands, Ghana, Guadeloupe, Hungary, Malawi, Namibia, Russian Federation, Vietnam, Zambia, and Zimbabwe.

As suggested by previous studies, the most reported players in the international animal trade include countries in Asia, Africa, and Central and South America (Baker et al. 2013), which means that it is not unreasonable that nations from these regions of the world would be key players in the global animal trade. Why these nations are involved in the animal trade in the first place can be explained by these nations' geographic location and climatic advantage. Of the outlier nations classified as center core and core, 16 of the 21 are located within the tropical region of the world, where a number of coveted species for the animal trade are located. According to Nijman and Shepherd (2007), a significant part of the wildlife trade deals with tropical species; therefore, it is plausible that countries in the tropical biomes have a monopoly on species to be exported. In essence, the unique structure

found in this study could be explained by considering the climatic region in which each country is located.

Furthermore, past research provides evidence that trading patterns are dependent on high concentrations of resources that are only found in certain regions, such as wildlife in the tropical regions of the world (Carpenter, Rowcliffe, and Watkinson 2004; Ji, Zhang, and Fan 2014; Peck 2002; Tong and Lifset 2007). In short, if the animal commodities of interest begin their trade route from areas in which these animals are highly concentrated, which, as past evidence shows is predominantly tropical, then there is reason to believe that tropical nations, such as the ones seen in the cores of the present study, would be key actors in the global animal trade.

These commonly-classified peripheral nations found in the core of this study could also be filling their niche in a global system that disadvantaged them in the past. As emphasized previously, certain nations, namely the tropical nations found in the periphery of past studies, are able to access and provide resources, particularly desired tropical animal species that other nations cannot access within their own borders. As a result, these tropical animal-advantaged nations are drawn to the economic market in order to assert their dominance by fulfilling the demand for animal resources when the more powerful core (and often non-tropical) nations cannot. Essentially, in an effort to overcome power imbalances in the world system, the commonly-classified peripheral nations found in the core of this study could simply be taking advantage of the gap in the market that other commonly-classified core nations cannot fill.

Additionally, the presence of these typically peripheral nations within the core of the animal trade could be due to the fact that some nations may demand region-specific products,

but not others. For instance, several cultures throughout the world depend on traditional medicines, which often contain animal parts, such as horns, bones, grains, and gall, as the main ingredients (Alves and Rosa 2012; Henry 2004). These traditional medicines are not universally used, for demand for traditional medicines is concentrated in Asian and African countries (Alves and Rosa 2012). Because of these specific commodity-based markets that are located in certain areas, but not others, the patterns of trade may differ from patterns that were found after analyzing more general commodities.

Geographic distance between the source and destination of the animal products being traded may be the reason why certain nations more active in the animal trade than they are in the trade of general commodities. With increased shipping or travel distances, there may be greater concern for animal well-being. As a result, shipping or travel techniques may need to adapt. Because of this, trade of wildlife could be focused more on the “where” in addition to the “who.” Countries could choose to trade with certain nations rather than others based on location due to concerns over the welfare of live animals during transport. The trade of animals negatively impacts the welfare of many live animals being transported for trade (Baker et al. 2013; Bush et al. 2014; Cantú Guzmán 2007; Kawata 2014). For instance, as soon as a wild animal is captured and removed from its habitat, the animal can suffer through restraints, proximity to humans, and other predatory animals (Baker et al. 2013). Further, animals captured for trade risk death in transit to its destination via crushing, asphyxiation, starvation, dehydration, temperature inconsistency, disease, stress, or injury (Baker et al. 2013; Cantú Guzmán 2007).

Because of this, nations may want to trade live animals with nations in close range, or with simpler trade routes, in order to ensure the well-being of the animal being transported.

Furthermore, shorter and simpler trade routes may be favorable for the transport of whole animal specimens, both alive and dead, that are larger, more cumbersome, or more fragile than other manufactured goods. Plus, the shipment of animals, specifically live animals, can be costly (Kawata 2014). Further research on the specific trade routes and actors involved in live animals will be needed in order to explore this notion. Spatial analysis, which examines the physical distance between the countries within and among the blocks, or a case study focused on a particular animal or animal product could contribute to understanding of the unique structure found in this study.

### The Semiperiphery

One can also see the semi-peripheral Block 7 and Block 8 through the graphical representation of Figure A and the block densities in Table 2. Figure A shows that Block 7 and Block 8 are next most extensively connected blocks since each of these blocks connects to four of the other blocks: the center core, the core, one periphery, and also each other. Because Block 7 and Block 8 are neither the most nor least extensively connected blocks, yet also share a connection, these blocks are considered semiperipheral. Further, Table 2 shows the density of the connections between Block 7 and Block 8 and among the other blocks in the network. Block 8 and Block 7 are strongly connected to the core blocks, Block 5 and Block 6. Also, Block 8 and Block 7 share strong connections to each other, which is indicative of a semi-peripheral relationship rather than a peripheral relationship.

The connections between Block 7 and Block 8 and their individual connections to the center core and core are some of the strongest connections in the network, but their connections to the peripheral blocks (Block 7 to Block 3; Block 8 to Block 4) are much weaker. In other words, Block 7 and Block 8's lack of ties to other blocks in the system

compared to the extent that Blocks 5 and 6 do, position these blocks in the semi-periphery. The more peripheral a block is, the more it is connected with the core blocks, and less so with other similarly positioned blocks (Kick et al. 2011). In other words, because of the strong connections between the Blocks 7 and 8, these blocks are considered semi-peripheral rather than peripheral.

Of all of the blocks, the most dense trade networks exist within the semi-peripheral Blocks 7 and 8. In other words, Block 7 and Block 8 are trading a great deal within their own blocks. This is counter to what previous studies find, for past studies find higher levels of intra-core trade within the core blocks and less intra-core trade within the semiperiphery blocks (Kick et al. 2011; Smith and White 1992; Steiber 1979).

### The Periphery

Blocks 1, 2, 3, and 4 can be classified as the periphery. Figure A shows that each of these blocks is only connected to the network through the central core (Block 5) and/or core (Block 6) blocks plus either a semiperipheral or another peripheral block. Table 2 shows that the density of ties between these peripheral blocks and the core and center core are stronger than those of the ties between the peripheral blocks and semiperipheral or other peripheral blocks. Block 1 is connected to the center core and core plus it has a weaker connection to the peripheral Block 2. In addition to its connection to the peripheral Block 1, Block 2 is also more strongly connected to core and the center core. Block 3, like Blocks 1 and 2, is connected to the center core and core, but it also has a weaker connection to the semiperipheral Block 7. Block 4 is only connected to the central core, Block 5, but is also connected to the semiperipheral Block 8 through a weaker tie. This strong connection with

core actors, rather than with other similarly positioned actors, is indicative of a peripheral classification (Kick et al. 2011).

The peripheral blocks, Blocks 1, 2, 3, and 4 have low intra-strata trade densities compared to other blocks. This does not run contrary to what past studies find, for past analyses consistently find low intra-strata trade densities, relative to other blocks in the network, for peripheral blocks (Kick et al. 2011; Smith and White 1992; Steiber 1979).

#### Contents of the Lower Strata: Semiperiphery and Periphery

It is unclear why the nations in the semiperipheral and peripheral blocks are clustered together. The semiperiphery blocks, Block 7 and 8, each contain nations that, when put together, show no obvious associations. For instance, Block 7 contains Caribbean and Pacific islands, and countries in Asia, South America, Europe, and Africa. The peripheral blocks follow suit, for the nations within each of the peripheral blocks span the entire globe and encompass nations of all sizes. Further investigation is needed to better explain why these nations are structurally equivalent.

It is difficult to compare the semiperipheral and peripheral block contents of past studies with the present study primarily because the present study contains a larger sample of countries than do past studies. For example, Van Rossem (1996), which analyzes the most countries compared to other studies explored in this paper, analyzes 163 countries whereas the present study analyzes 241. Because of this, it is difficult to compare the lower strata block contents across studies since there are a number of countries in the present study that are simply not accounted for in past studies.

Additionally, since there is no consensus on strata categories in the networks across this study and past studies, it is difficult to compare the contents of the present study's

semiperiphery and periphery with those of past studies if said past studies find different partitions or subgroups of categories. For example, Kick et al. (2011) finds an “upper peripheral” stratum in addition to a center core, core, and semiperipheries. This causes issues for adequate comparison because it is unclear whether the countries in this “upper peripheral” strata should be compared against the core or semiperiphery strata in the present study when no equivalent group exists. This study also uses much more recent data than past studies. As discussed previously, it is clear that shifts in positioning in the global network are plausible (Smith and White 1992). In short, there is a great deal of inconsistency across past studies regarding the lower strata blocks and their contents; therefore, it is difficult to discern whether or not the contents of the lower strata in the present study match those of past studies.

## **CONCLUSION**

Past world-systems studies of trade networks do not place the unique characteristics of commodity, and their potential impact on the trade network, at the forefront. By grouping all commodities from a database into one large heterogeneous group (Kick et al. 2011; Lloyd, Mahutga, & De Leeuw 2009; Snyder & Kick 1979; Van Rossem 1996) or dividing the commodity data into various raw and processed commodity groups (Nemeth & Smith 1985; Smith & White 1992; Steiber 1979; Tong & Lifset 2007), researchers are unable to uncover how the distinctiveness of a commodity being traded influences the patterns of trade. Commodities have dimensions that extend far beyond their state in the process of completion, which can include the commodity’s origin and that region’s features, cultural significance, and conditions for trade. These can have the potential to affect who is trading said commodities and how these commodities are being traded. In other words, specific

characteristics of a commodity can add nuance to the world-systems template of the structure of the global trade network.

Global animal trade is made up patterns of international connections that deviate from past studies of more general trade. Although the general core-periphery structure found in this study parallels the structure found in past studies of more general commodities, there are some significant differences that show that the global animal trade network is its own unique entity. The first difference is unexpected high levels of trade within the semiperiphery blocks, yet low levels of trade within the center core and core blocks. The other differences include additions and absent nations within the center core and core blocks. For instance, the dominant actors in general commodity trade still exert their dominance in the animal trade, yet other nations, not often characterized as dominant nations, have become central actors. The United States, however, though a key player in the general commodity trade, acts as a peripheral nation in the animal trade.

This study has implications for both sociological perspectives and environmental policy. First, this study contributes to our understanding of existing sociological perspectives and how we study them. It shows a more nuanced conception of what past world-systems literature establishes as patterns of global trade and power dynamics. In other words, this study reveals the important role of commodity characteristics in the network structure of global trade. Furthermore, this study empirically extends past world-systems analyses. Data used in this study are relatively recent compared to past studies, specifically including information on all reported animal trade from 2003 to 2013. Additionally, the current study uses a greater number of countries than previous studies of the world-system. Other researchers limit their country samples significantly, which may lead to previous studies not

grasping the various countries involved in the world-system. Past research analyzes a minimum of fifteen countries or aggregates (Steiber 1979) to a maximum of 163 countries (Van Rossem 1996). The current study includes 241 different countries. It should be noted that the choice to include all nations in the study is due to the nature of animal trade. According to Nijman and Shepherd (2007), a significant part of the wildlife trade deals with tropical species; therefore, it is important to include even the smallest tropical island nations into the sample. Areas in the tropical regions of the world have high levels of biodiversity (James Cook University 2014), which makes them ideal regions for providing rare and unique wildlife for global markets such as the pet trade.

Second, this study can help inform policy aimed at curbing the detrimental effects of the global animal trade. By recognizing key players in the environmentally devastating wildlife trade network, governmental entities can target these areas and encourage sustainable alternatives to animal trade through education and campaigns. Hopefully, these policy efforts will enhance the wellbeing of various species and the environment as a whole.

Shortcomings of the study come primarily from the data used. The CITES Database is not an exhaustive measure of all animal trade exports and imports, for it is user generated (CITES Trade Database Team 2013) and some cases go completely undetected. For example, Nijman and Shepherd (2007) find that more turtles are traded undetected than detected by CITES data. Only studies that compare actual investigated trade numbers with the recorded CITES trade counts can detect this occurrence.

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**APPENDICES**

## APPENDICES

Table 1: 8-Block Model Block Contents

| BLOCK               | COUNTRIES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Block 1 (Periphery) | AD (Andorra) AO (Angola) AS (American Samoa) BF (Burkina Faso) BJ (Benin) BT (Bhutan) CD (Dem. Repub. of the Congo) CF (Central African Republic) CK (Cook Islands) ER (Eritrea) GN (Guinea) GU (Guam) GW (Guinea-Bissau) IO (British Indian Ocean Territory) KG (Kyrgyzstan) KM (Comoros) LA (Lao People's Democratic Republic) LR (Liberia) MD (Republic of Moldova) MQ (Martinique) MS (Montserrat) NE (Niger) PG (Papua New Guinea) PR (Puerto Rico) SC (Seychelles) SR (Suriname) TK (Tokelau) UM (U.S. Minor Outlying Islands) VI (Virgin Islands – U.S.) YE (Yemen)                                                       |
| Block 2 (Periphery) | AG (Antigua and Barbuda) BD (Bangladesh) CC (Cocos Keeling Islands) CV (Cape Verde) DJ (Djibouti) DM (Dominica) EH (Western Sahara) FJ (Fiji) GA (Gabon) GG (Guernsey) GI (Gibraltar) GQ (Equatorial Guinea) GS (South Georgia and South Sandwich Islands) HT (Haiti) LC (Saint Lucia) MP (Northern Mariana Islands) MR (Mauritania) NF (Norfolk Islands) NR (Nauru) PF (French Polynesia) PW (Palau) RW (Rwanda) SK (Slovakia) SO (Somalia) ST (Sao Tome and Principe) TC (Turks and Caicos Islands) US (United States) VC (St. Vincent and the Grenadines) VU (Vanuatu)                                                        |
| Block 3 (Periphery) | AF (Afghanistan) AL (Albania) AN (Netherlands Antilles) BA (Bosnia and Herzegovina) BB (Barbados) BY (Belarus) BZ (Belize) CU (Cuba) DO (Dominican Republic) DZ (Algeria) FK (Falkland Islands) GE (Georgia) GT (Guatemala) HN (Honduras) KN (Saint Kitts and Nevis) LS (Lesotho) LY (Libya) ME (Montenegro) MK (Macedonia) ML (Mali) NC (New Caledonia) NI (Nicaragua) PA (Panama) PE (Peru) PM (Saint Pierre and Miquelon) PY (Paraguay) RE (Reunion) SB (Solomon Islands) SN (Senegal) TD (Chad) TJ (Tajikistan) TZ (United Republic of Tanzania) UG (Uganda) VG (Virgin Islands – British) WS (Samoa) YU (Former Yugoslavia) |
| Block 4 (Periphery) | AQ (Antarctica) AW (Aruba) BI (Burundi) BM (Bermuda) BW (Botswana) CX (Christmas Island) GD (Grenada) GF (French Guiana) GL (Greenland) GM (Gambia) GY (Guyana) KH (Cambodia) KI (Kiribati) KY (Cayman Islands) LI (Liechtenstein) NP (Nepal) PC (Former Pacific Trust Territory) SD (Sudan) SH (St. Helena and Dependencies) SL (Sierra Leone) TL (Timor-Leste) TO (Tonga) TT (Trinidad and Tobago) TV (Tuvalu) UY (Uruguay) YT (Mayotte)                                                                                                                                                                                       |

**Table 1 (continued)**

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Block 5 (Center Core)   | AE (United Arab Emirates) AR (Argentina) AT (Austria) AU (Australia) AZ (Azerbaijan) BE (Belgium) BR (Brazil) CH (Switzerland) CN (China) CZ (Czech Republic) DE (Germany) FR (France) HK (Hong Kong) ID (Indonesia) IT (Italy) JP (Japan) MX (Mexico) MY (Malaysia) NU (Niue) SG (Singapore) TG (Togo) TH (Thailand) ZA (South Africa)                                                                                                                                                                                                                                                                                                            |
| Block 6 (Core)          | AI (Anguilla) CA (Canada) CG (Congo) CM (Cameroon) CO (Colombia) DK (Denmark) ES (Spain) FO (Faroe Islands) GB (United Kingdom) GH (Ghana) GP (Guadeloupe) HU (Hungary) KR (Republic of Korea) MW (Malawi) NA (Namibia) NL (Netherlands) PT (Portugal) RU (Russian Federation) VN (Vietnam) ZM (Zambia) ZW (Zimbabwe)                                                                                                                                                                                                                                                                                                                              |
| Block 7 (Semiperiphery) | AM (Armenia) BN (Brunei Darussalam) BS (Bahamas) CI (Cote D'Ivoire) CL (Chile) EC (Ecuador) EE (Estonia) EG (Egypt) FM (Federated States of Micronesia) IE (Ireland) IL (Israel) IM (Isle of Man) IN (India) IR (Iran) IS (Iceland) KZ (Kazakhstan) LV (Latvia) MA (Morocco) MC (Monaco) MH (Marshall Islands) MN (Mongolia) MO (Macau) MU (Mauritius) NO (Norway) PH (Philippines) PK (Pakistan) PL (Poland) QA (Qatar) RS (Serbia) SE (Sweden) SM (San Marino) SU (Former Soviet Union) SV (El Salvador) SY (Syrian Arab Republic) TN (Tunisia)                                                                                                  |
| Block 8 (Semiperiphery) | BG (Bulgaria) BH (Bahrain) BO (Bolivia) CR (Costa Rica) CS (Former Serbia and Montenegro) CY (Cyprus) ET (Ethiopia) FI (Finland) GR (Greece) HR (Croatia) IQ (Iraq) JE (Jersey) JM (Jamaica) JO (Jordan) KE (Kenya) KP (Democratic People's Republic of Korea) KW (Kuwait) LB (Lebanon) LK (Sri Lanka) LT (Lithuania) LU (Luxembourg) MG (Madagascar) MM (Myanmar) MT (Malta) MV (Maldives) MZ (Mozambique) NG (Nigeria) NZ (New Zealand) OM (Oman) RO (Romania) SA (Saudi Arabia) SI (Slovenia) SZ (Swaziland) TM (Turkmenistan) TR (Turkey) TW (Taiwan) UA (Ukraine) UZ (Uzbekistan) VA (Holy See) VE (Venezuela) WF (Wallis and Futuna Islands) |

**Table 2: 8-Block Model Reduced BlockMatrix (Block Densities)**

|                | <b>Block 1</b>     | <b>Block 2</b>     | <b>Block 3</b>     | <b>Block 4</b>     | <b>Block 5</b>     | <b>Block 6</b>      | <b>Block 7</b>      | <b>Block 8</b>      |
|----------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|
| <b>Block 1</b> | 0.006 <sup>+</sup> | 0.009              | 0.014              | 0.003              | 0.054*             | 0.038*              | 0.021               | 0.021               |
| <b>Block 2</b> | 0.046*             | 0.012 <sup>+</sup> | 0.007              | 0.007              | 0.054*             | 0.059*              | 0.010               | 0.008               |
| <b>Block 3</b> | 0.006              | 0.010              | 0.020 <sup>+</sup> | 0.014              | 0.077*             | 0.042*              | 0.044*              | 0.037               |
| <b>Block 4</b> | 0.006              | 0.007              | 0.009              | 0.006 <sup>+</sup> | 0.054*             | 0.027               | 0.030               | 0.038*              |
| <b>Block 5</b> | 0.059*             | 0.054*             | 0.087*             | 0.074*             | 0.014 <sup>+</sup> | 0.077*              | 0.051*              | 0.065*              |
| <b>Block 6</b> | 0.038*             | 0.025              | 0.101*             | 0.027              | 0.027              | 0.045* <sup>+</sup> | 0.114*              | 0.072*              |
| <b>Block 7</b> | 0.006              | 0.009              | 0.012              | 0.007              | 0.113*             | 0.061*              | 0.051* <sup>+</sup> | 0.075*              |
| <b>Block 8</b> | 0.008              | 0.006              | 0.015              | 0.006              | 0.121*             | 0.049*              | 0.047*              | 0.055* <sup>+</sup> |

\*= tie; exceeds mean block density score (0.038)

<sup>+</sup> = intra-core trade density

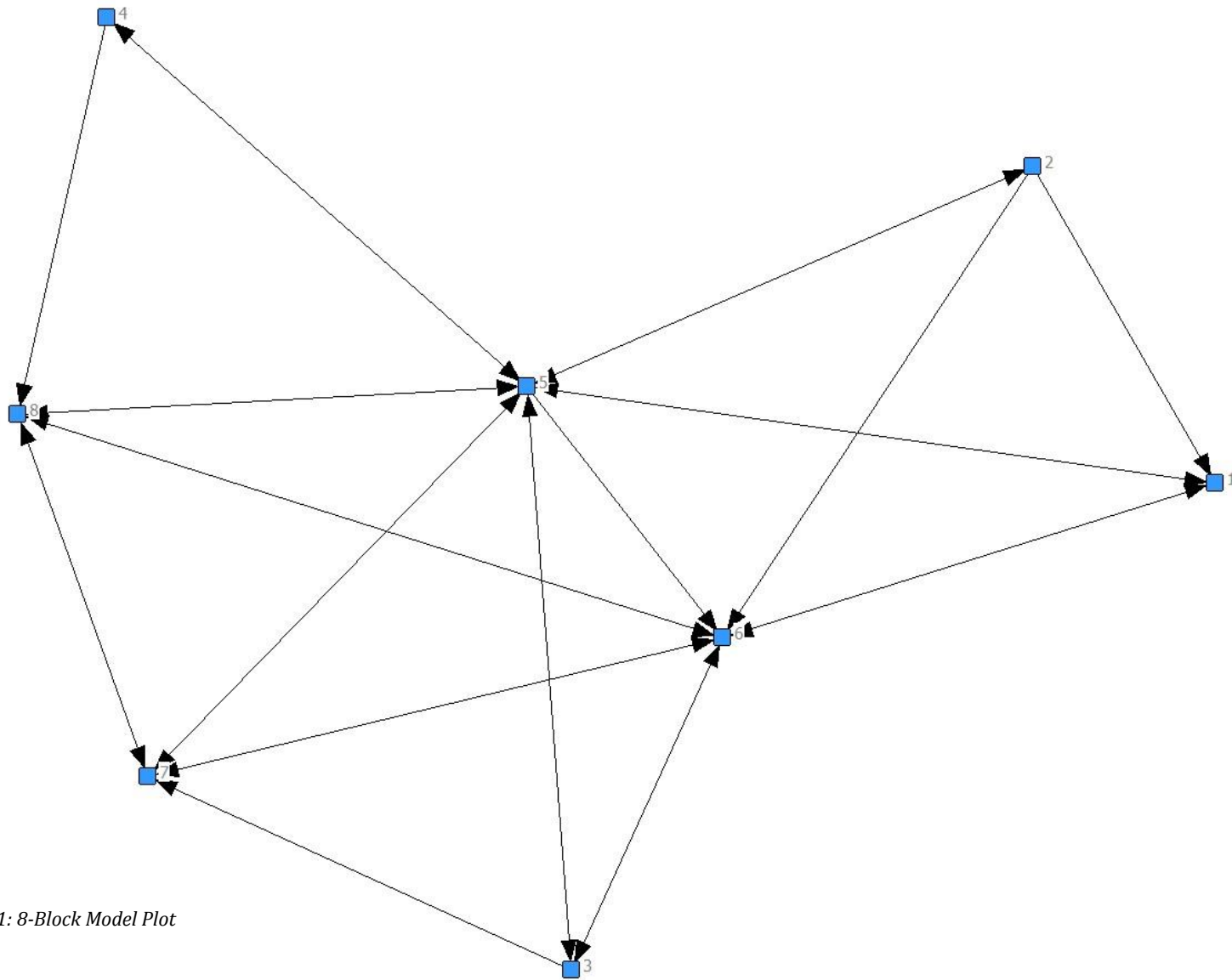


Figure 1: 8-Block Model Plot