This is to certify that the

dissertation entitled

The Politics and Process of International Trade: Domestic and International Factors Affecting Trade Policy Matters

presented by

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has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Political Science

Major professor

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Date November 17, 1995

ABSTRACT

THE POLITICS AND PROCESS OF INTERNATIONAL TRADE:
DOMESTIC AND INTERNATIONAL FACTORS
AFFECTING TRADE POLICY MATTERS

By

Sherry Bennett Quiñones

This research consists of three separate studies, which share a common substantive topic on international trade. Thus, although each of the models presented share a substantive focus, they vary considerably in theoretical orientation, scope, and method. As such, they comprise distinct chapters. The first chapter, *Congressional Responsiveness to Constituency Demands: The Political Economy of the North American Free Trade Agreement*, is a study that examines domestic political processes influencing trade policy in the United States. Specifically a theoretical argument is developed that contends protectionist (import-competing) and anti-protectionist (export-competing) interests will demand responsiveness from their representatives on trade policy matters. To test the theoretical model, the vote outcome associated with NAFTA is analyzed. Using political and economic data collected from 104th congressional districts, a set of propositions are tested with ordinary least squares and probit estimations. The overall results obtained from the

analysis of the model, suggest that the economic effects of the vote tend to dominate over traditional political issues.

The second chapter, *Modeling the Dynamics of Power, Trade and Conflict: Fluctuations in the Economy, Alternating Distributions of Power and the Prospects for Peace*, proposes a novel theoretical and empirical framework for analyzing long cycles. The theoretcial model integrates the analysis of economic and political cycles into a unified causal framework capable of explaining the onset of systemic conflict in the international system. Using political and economic data from 1850-1976, the empirical analysis draws upon new theory on contegration in econometrics to test the interrleationship between systemic conflict, the distribution of power, and trade. Integration tests find that each of the phenomena are independently characterized by stochastic trends, while cointegration tests indicate that these series share a common trend over time. This subsequently results in another of tests, which demonstrate that conflict in the system responds alone to changes in the distribution of power, trade and economic waves.

The third chapter, *Regime Structure, Leadership Uncertainty and the Maintenance of Cooperation: The Gains in Modeling International Economic Regimes as Organizational Teams*, seeks to formalize a model of an international trade regime by conceiving the structure as an organizational team. The formal model takes into account an N-person environment, which incorporates Bayesian updating among the actors, to test for the prospects of cooperation within a regime under

conditions of leadership uncertainty. A simulation is conducted to test several propositions. The results of the analysis suggest that as the probability of confronting a strong leader rises, the payoffs from defection decrease among states comprising the regime. However, as the probability of confronting a weak leader capable of punishing rises, the payoffs from defection increase among the states comprising the regime. The implications from these results are drawn out, while suggestions for future research are delineated.

ACKNOWLEDGMENTS

It is a happy day that I sit here in front of my computer typing up my final remarks and thanks to my numerous friends, colleagues and family, whose support have made this accomplishment mean something. First and foremost, I would like to extend my heart felt thanks to my committee members, Gretchen Hower, David Rohde, Scott Gates and Jim Granato. Each of them have contributed immensely, and in very different ways, to my training and development as a student. They have made this last hurdle a seemingly, painless process...well, maybe just a little painful. In addition, Renée Smith has been an important influence in my life over the last six years. She is originally responsible for steering me down this path as an undergraduate in the winter quarter of 1989. Her honesty, generosity, and integrity make her unusual and a great friend. Her determinism, ambition, intensity, and high standards are contagious. Also, a big thanks to Cliff Morgan, Ric Stoll and Rick Wilson for their encouragement and support during the past year. Also Chris Anderson, Jeff Bowers, Kathleen O'Connor, and Dan Ward were immensely supportive.

I am also grateful to my numerous friends that made my years in East Lansing some of the most memorable experiences of my life. Kevin, Mel, Kate (and now Ty)

are great friends and were the best neighbors. I already miss the warm fires and engaging conversation. Big thanks to Kim Eby & Jose Cortina, two truly interesting people, who I treasure knowing always. Also, Jean Phillips & Stan Gulley for being kind and generous friends and aiding in my endeavors to consume great food and wine. In addition, I would like to thank my friends and colleagues in the political science department at Michigan State, particularly Shelly Arsneault (and Tony), Bob Orme, Phil Alderfer, Misha Barnes, Jeff Coupe, Kathleen Dowley, John Davis, Eric Duchesne, Brian Janiskee, and Sara McLaughlin. Each of them made my days in Kedzie hall fun. Also, a big thanks to Gretchen and Paul for softball and poker. Also, a big thanks to Keith Hattrup, Sandy & Ron Landis, Jeff Schneider, Joanne Spear Sorra, and Steve Kowslowski for great memories, too numerous to mention. I'll treasure my friendships with all of them forever.

Lastly, Terry, Brett and Reba made this accomplishment mean something special. Their wisdom, trust, respect, and unconditional love give me encouragement everyday. I thank Eupi and Rosin for their love and respect, and most of all for Mickey. Mickey is my best friend. My accomplishments are in part a reflection of his unyielding love, support, respect, and admiration. Our life together has been a fun experience and I look forward to what the future holds!

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CHAPTER 1

CONGRESSIONAL RESPONSIVENESS TO CONSTITUENCY DEMANDS: THE POLITICAL ECONOMY OF THE NORTH AMERICAN FREE TRADE AGREEMENT

Introduction

The large international trade deficits the United States accrued during the 1980's have heightened concerns about the future of domestic industries and job security. The loss of manufacturing jobs, heightened competition from import producers, and lack of access to foreign markets have left numerous economists and policy makers debating the merits of free trade.[1] Subsequently, adversaries and proponents of free trade alike have purposefully sought to influence the composition of trade policy. These pressures have subsequently been associated with an increase in the number of trade bills introduced in the House within the last couple of decades. Some opponents of free trade have sought specific protection for particular domestic industrial sectors.[2] However, other forms of

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[1]See Lawrence & Schultze (1990) and Destler (1992).

[2]The *Textile Bill* of 1985 and the *Fair Practices in Automotive Products Act* passed in 1982 are two examples of domestic content legislation seeking specific protection for domestic industries enduring some form of economic stress under free trade.

legislation have recently sought to expand the breadth of trade in the form of bilateral and multi-lateral free trading agreements.

Presidential power to initiate free trade agreements (FTA) was initially granted by Congress in the Tariff and Trade Act of 1984. Subsequently a bilateral free trade agreement was initiated with Israel in 1985.[3] This pact was to set the stage for future free trade accords and was passed with no opposition in the House.[4] In 1988 another bilateral FTA was signed between the United States and Canada. The passage of this agreement proved more controversial than its predecessor. Because Canada is the United State's largest trading partner, this agreement was more likely to affect more import and exporting industries than the agreement with Israel. As such, more special interest groups campaigned against it.[5]

However, the vote on the North American Free Trade Agreement (NAFTA) last year afforded a true test of congressional support for free trade, in part,

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[3]The House approved the agreement by a 422-0 vote May 7, 1985. Under the agreement Israel was to drop over one half of existing restraints on U.S. imports, with the rest to be phased out by 1995. In addition, the United States would immediately lift 80% of its barriers on Israeli goods (*Congressional Quarterly Almanac*, 1985, p.260).

[4]Initially the president's power to negotiate a free trade agreement was granted by Congress only in the case of Israel. Congressional concerns over granting the president free reign in drafting similar trade agreements with other nations, were manifested in a senate report. This report made clear that the free trade agreement with Israel was a special case and that future agreements would have to be negotiated on a nation-by-nation basis (see *Congressional Quarterly Almanac*, 1984, p.171).

[5]Nevertheless, the House approved the free trade agreement by a 366-40 vote August 9, 1988 (*Congressional Quarterly Almanac*, 1988, p.86-H). The pact was designed to phase out tariffs between the United States and Canada over a ten-year period (the United States tariffs on Canadian goods averaged 4%, while Canadian duties on U.S. goods averaged 10%). In addition it contained some restrictions on cross-border investments and trade services. Moreover, it guaranteed U.S. access to Canadian oil, gas, and uranium (see *Congressional Quarterly Almanac*, 1988, pp.222-23).

because it was drafted at a time in which strong protectionistic forces were sweeping the nation at levels not known since the passage of the Smoot-Hawley tariff in 1930.[6] NAFTA is by far the most comprehensive free trade agreement passed by Congress to date. Similar to the other bilateral trade agreements, it sought to eliminate all tariffs on goods produced and sold in North America. In addition, it included numerous provisions concerning the maintenance of free and fair trade on such things as investments, intellectual property rights, and services. However, the passage of NAFTA made numerous labor and manufacturing groups vulnerable. More often than not, the agreement was publicly equated with the loss of labor and manufacturing jobs.[7] Although, economists and trade experts alike forecast long-run benefits associated with the free trade agreement (i.e. stimulated growth resulting in a net plus of jobs), concerns over potential joblessness resonated in the media.[8] The crux of the issue really concerned who would lose in the short-run. Few economists denied the inevitable period of short-term adjustment that would take place. Specifically, short-term adjustments would

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[6]The House passed NAFTA with a 234-200 vote. A strong majority (75%) of the Republicans voted in support of the agreement (132-43), while a majority of the Democrats (60%) voted *against* the agreement (102-156) (*Congressional Quarterly Weekly Reports*, November 20, 1993, p. 3224).

[7]An extensive debate in economics exists over the effects of trade on employment. The purpose of this paper is not to address this debate per se, but rather, in some sense, to examine the politics evolving from it. See Hufbauer et al. (1993) for a discussion of the impact of NAFTA on employment. Generally, the empirical effects of trade on employment remain inconclusive. See Tyson et al. (1988) and Deardoff & Stern (1979) for a general discussion of labor's stake in international trade matters.

[8]U.S. Trade representative Mickey Kantor, along with numerous economists, defended the employment benefits associated with the agreement. Specifically, he claimed that it was a better deal for U.S. workers than existing status quo policies. The creation of over 200,000 jobs was projected within the first two years after NAFTA's passage. Potential gains for U.S. industry would come in various forms over a wide spectrum of sectors: new car sales, beef exports, financial services (*Congressional Quarterly Weekly Reports*, September 18, 1993).

result in a loss of jobs in some industries, even though in the long run more jobs would be created.[9] If NAFTA, in the long run, would accrue benefits to American industries, why was there such resistance to its passage?

To answer this question appropriately, a theoretical framework is developed and subsequently tested. An argument is developed that suggests constituents vulnerable to short-term adjustment costs demand regulation of protection. By testing a majoritarian politics hypothesis, I will show how the outcome of the vote on NAFTA was a function of political constraints imposed by constituents confronting potential economic risk in their districts. Generally speaking, this research finds support for the notion that representatives will supply protection to vulnerable interests if it is in their best "re-election" interest to do so.

Specifically, the analysis confirms several interesting results. Initially, protectionist interests affiliated with manufacturing labor (import oriented) and union groups do encounter greater unemployment risk, while their anti-protectionist counterparts (export oriented) do not. Moreover, the risk of unemployment subsequently results in protectionist interests significantly affecting the likelihood of a representative voting against the free trade agreement, while anti-protectionists groups tend to decrease the probability of a representative voting against free trade. Surprisingly, the overall results obtained from the analysis of the model, suggest that the economic affects of the vote tend to

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[9]See Hufbauer et al. (1993) for a thorough discussion about the net gains associated with the passage of NAFTA.

dominate over traditional political issues such as partisan affiliation, presidential support, and a representative's previous election support. These results suggest support for Wallerstein's (1987) argument that unemployment tends to dominate the politics associated with the demand for protection. However, initially it is necessary to precede with a discussion about the nature of the politics surrounding the debate over NAFTA's, to demonstrate its appropriateness as a test of the theoretical model.

The Politics Surrounding NAFTA

The debate over NAFTA dominated the media weeks before it was to be proposed to the House for a vote. Concerns over short-term adjustment costs were reflected in polls taken before the NAFTA vote. Molyneux (1994) found that clear majorities believed NAFTA would cause U.S. companies to relocate to Mexico (73%) and result in lower wages for American labor. Moreover, a commanding three-to-one majority felt the agreement would result in fewer jobs in the United States. This fact is reinforced by an *NBC News/Wall Street Journal* survey, which found by a five-to-three margin that Americans felt the treaty would lose more jobs for the United States than it would gain. Even though conventional wisdom suggested that NAFTA would actually result in a net gain of employment over the long run, the alleged threat of a giant *"sucking sound"* of jobs going south

permeated the public debate.[10] Opinions of Populist politicians, such as Perot, permeated the media with anti-NAFTA rhetoric. Perot's attempts to influence the NAFTA debate culminated into a book and subsequently a debate with Vice President Al Gore.[11]

Representatives and governmental officials sensed extreme opposition to NAFTA's passage. Most of this opposition was largely attributed to fears over losing jobs. Labor Secretary Robert B. Reich commented,

> "This opposition has little to do with the agreement and much to do with the pervasive anxieties arising from economic changes that are already affecting Americans" (*Congressional Quarterly Weekly Report*, September 4, 1993, p.2335).

Similar sentiments were echoed by representatives. Rep. Anna G. Eshoo, a first-term Democrat from California, was inclined to support NAFTA but admitted that she was susceptible to pressures from labor groups to vote against it. Dennis Hitchcock, a member of the *Air Transport Employees Union* from Eshoo's district, was against NAFTA and warned Eshoo about losing support from labor if she

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[10]The reference of a "giant sucking sound" in the U.S. job market was made by Ross Perot in his book, Save Your Job, Save Our Country. Senate Assistant Minority Leader Alan K. Simpson (Republican Wyoming) offered an alternative hypothesis that suggested, "the (*giant*) sucking sound in Ross Perot's corner....is from some extraterrestrial vehicle pulling his brains from his body" (*Congressional Quarterly Weekly Report*, September 13, 1993, p.2439).

[11]However, ironically, evidence suggests that Perot may have actually hurt the anti-NAFTA cause and that his performance in the debate, if anything, actually served to decrease the public's opposition. Perot's negligible effect on the NAFTA debate was reinforced by an ABC poll that found a 5 percentage point opposition margin the night of the debate that grew merely to an eight percentage point gap two nights later (Molyneux, 1994). Even in the state of Michigan, a highly touted anti-NAFTA state, Perot's effect was negligible on opposition forces. A state poll found a 15 percentage point opposition margin the night of the debate, which decreased to an nine percentage point gap after the debate (EPIC/MRA Report, Vol.1, No.20, December 15, 1993).

voted for the agreement.[12] Moreover, Representative Mike Kopetski, Democrat-Oregon, had similar threats levied against him. In fact, he reported that his support for the trade pact ended his relationship with the *International Association of Machinists and Aerospace Workers*, which reportedly will no longer give him PAC funds.[13] However, despite labor's pressure to constrain Eshoo's and Kopetski's support for NAFTA, both voted for the agreement.

However, this is not the case for a Republican representative in South Carolina. Republican Bob Inglis from South Carolina's 4th district, a place where economic prosperity and international trade are supposed to be closely associated, leaned against voting for NAFTA. Inglis was quoted as saying that he would, "...vote against NAFTA because I fear the loss of the manufacturing base of the country." Inglis received pressure from prominent local business people in his district. For example, Milliken, a big textile industrialist and influential figure in Republican politics in Inglis's district (not to mention throughout the state) was vehemently against NAFTA's passage. It was Milliken's support that helped Inglis secure his seat. Thus, it was no surprise to learn that Inglis later voted against the agreement.[14] What seems clear, is that labor unions and manufacturing interests can use carrots to gain influence, in addition to sticks to shape legislative

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[12]In fact, labor unions in her district went so far as to pass resolutions calling for member unions not to endorse or provide campaign cash to any members of Congress who supported the agreement (*Congressional Quarterly Weekly Reports*, November 6, 1993, p. 3016).

[13]See (*CQ Weekly Reports*, September 18, 1993, p.2437).

[14]See (*Congressional Quarterly Weekly Reports*, November 6, 1993, p.3018-19).

preferences. However, what determines when a legislator will choose to succumb to the pressures from dominant local interests? Moreover, if a legislator is susceptible to constituency pressure on trade matters, which interests is she most likely to be sensitive too?

Both political scientists and economists alike have tried to explain why it is rational for legislators to vote in favor or against their constituents.[15] In terms of trade policy matters, three principle literatures exist that seek to explain policy outcomes. The first is generally referred to as the *pressure group hypothesis* (or more generally, capture theories).[16] Explanations of this sort propose that trade policy outcomes result from special interest groups competing among themselves for political influence and wealth by lobbying politicians. The second variant, the *congressional dominance* theory, suggests the bureaucracy in charge of regulation is not susceptible to capture, or influence by interest groups.[17] Rather, Congress as an institution, controls the bureaucracy through oversight and is largely responsible for the distribution of benefits. Lastly, the *majoritarian politics hypothesis* (or more generally the voting model approach) proposes that trade policy outcomes are a function of political pressures imposed by constituency interests within a district.[18]

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[15]For example see Downs (1957), Stigler (1971) and Fiorina (1974).

[16]For example see Schattschneider (1935), Stigler (1971), Peltzman (1976), Becker (1983), Findlay & Wellisz (1986) and Magee et al. (1989).

[17]For example see Shepsle (1979), Shepsle & Weingast (1984) and Weingast (1981; 1984).

[18]For example see Laverge (1983), Mayer (1984), McArthur & Marks (1988).

Because the following research is concerned with examining local pressures on congressional decision-making, a majoritarian politics approach to the study of trade policy outcomes is most appropriate. As such, the theoretical argument draws upon the latter research, by examining how constituency preference demands for trade regulation become supplied by their representative. The investigation of the demand for, and supply of protection, is by no means a novel undertaking.[19] However, previous studies seeking to predict policy outcomes have not fully accounted for the sources of economic risk responsible for constituency demands for trade regulation. Moreover most models fail to capture demands on both sides of a free trade issue. Typically existing models focus exclusively on special interests *against* free trade legislation, while not considering the role of interests seeking to lobby on behalf of less restrictive agreements.[20] The following research controls for both protectionist and anti-protectionist interest groups. Moreover, on the supply side, numerous studies have not fully considered the political risk faced by representatives and their vote on trade policy matters. Specifically, most existing research does not clearly delineate the link between

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[19]For example see Ray (1981), Frey (1984), Coughlin (1985), Nelson (1987), Conybeare (1991), and Hansen (1991). Wallerstein (1987) also discusses the importance of the demand for, and supply of, protection. However, his model is incomplete as his aim is simply to capture the effects of unemployment on the demand for protection. The model developed in this paper considers protection for interests not only against free trade, but also, interests that advocate free trade. The former is considered in virtually all models seeking to explain trade policy outcomes, while the latter is typically ignored.

[20]Destler et al. (1987) are one of the most notable exceptions. They find that opposition interests are better at getting *specific* protection, but not at *general* procedural changes. McArthur & Marks (1988) are another exception. They control for farm employment and export employment and suggest that they will have a negative effect on a legislator's vote for a protectionistic bill.

constituent pressures and congressional decision making on trade policy matters. As such, I will draw upon existing congressional literature to model congressional decision-making on NAFTA appropriately.

A Generalizable Theory of Congressional Responsiveness

A representative democracy is premised on the notion that there is a link between constituency preferences and their representative's preferences on policy. Foremost, representation manifests itself in the electoral connection (Mayhew 1974). To the extent that members of Congress depend upon the support of their constituency to maintain tenure in office, there exists a strong incentive for representatives to reflect the policy preferences of the people comprising their district. One of the central tasks in developing this theoretical argument is to explain the nature of preference formation. A supply and demand framework is an intuitive way to model the preferences of constituents and congressional responsiveness:

$$\textit{Demand} = f\ (\textit{constituency preferences})$$
$$\textit{Supply} = f\ (\textit{congressional responsiveness})$$

In this framework, the question becomes whether constituency preferences, in the form of a *demand* for a particular policy outcome, are *supplied* by their respective member of Congress, hence determining the extent of congressional

responsiveness to constituency interests. Accordingly, it is important to consider the factors which explain the development of constituency preferences for trade legislation as well as the determinants which explain why representatives may or may not consider such factors in their decision-making process.

Constituency Preference Demands

Individuals purposefully vote for a particular representative because they embody similar beliefs and attitudes that correspond, at some level, to their own. Fundamental to the notion of a congressmen's *representation* then, is identifying who or what groups have particular preferences on any given piece of legislation. Ironically, on the issue of NAFTA, indications from opinion polls suggest that a majority of respondents polled were generally unaware or unconcerned with the agreement.[21] Undoubtedly however, there did exist a particular segment of society for whom NAFTA became a particularly important issue. What distinguishes these individuals for whom the agreement was important from others who had no interest in NAFTA? Specifically, what characteristics differentiate constituents who were concerned with NAFTA's outcome from those who were not? Moreover, what type of preferences did these constituents have and what was their

[21]Newhouse and Matthews (1994) present polling data that demonstrate that a majority of the American population never became polarized on the NAFTA issue. In fact, the vast majority of Americans never became informed or thought the agreement would directly have an effect upon them. Specifically, they found that 6 out of 10 Americans were not following the debate on NAFTA. Moreover, they found that a surprising 4 out of 5 Americans did not even know whether their representative was for or against NAFTA. In fact, Molyneux (1994) only found a narrow margin of voters identifying themselves supporting or opposing the agreement.

effect on the voting behavior of legislators? Answers to these questions are crucial in delineating the factors important in explaining constituency preference demands and congressional responsiveness.

At some general level, there were individuals who had a preference on the outcome of NAFTA and individuals who had no preference on the issue at all. To explain the outcome of the NAFTA vote, it is first necessary to distinguish at the district level, which constituents had preferences (and later what those preferences were) from those who had no preference. Arnold (1990) has developed a simple framework which distinguishes between two different types of publics that comprise a member's congressional district. They are the attentive and inattentive publics. My model generalizes this idea about publics to the analysis of trade policy. With respect to any given issue on the congressional agenda, *attentive publics* are citizens who are aware of a specific issue and have a firm preference concerning how their representative should vote. In contrast, *inattentive publics* are constituents who do not have firm policy preferences on a particular issue.[22]

Attentive publics correspondingly have, by definition, a high *salience* factor associated with a particular issue. The term "salience," represents the sensitivity and prominence felt about a particular issue for a particular constituent or interest group. Coinciding with the notion of saliency is what Kingdon (1989) refers to as the *intensity* associated with a particular issue. Individuals who find a particular

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[22]See Arnold (1990) p.64-65.

issue salient, do so in part, because it has an effect upon their lives. The more directly the issue affects an individual's life, the more intense a preference becomes. As constituents become more intense in their preferences, legislators will generally weigh their opinions more heavily.[23] Furthermore, Arnold (1990) notes that legislators are forced to serve the interests of their attentive publics. With respect to NAFTA, attentive publics refer to both opponents and proponents of free trade which have strong preferences vehemently against the agreement, or conversely, strong preferences for the agreement.

Generally, constituents who found NAFTA to be a salient issue, did so because they felt that it would affect their employment status.[24] Again, the politics surrounding the debate on NAFTA derived in large part from the anxieties arising from economic changes that were perceived to affect the domestic economy. Of primary interest to numerous constituents was the risk of unemployment. Thus, in some measure, constituency preferences for trade policy depend on the costs and benefits associated with the outcome, or in the case of NAFTA, the perceived outcome and its affect on employment. The economic self-interest of groups

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[23]Kingdon notes that intensity among constituents is not constant. Likewise, not all issues will have the same degree of intensity. However, in this model, NAFTA is perceived as a salient issue because of its alleged effect on employment. Thus, constituents confronted with alleged job losses from NAFTA will have a strong intensity associated with protecting the economic survival of their particular industry. Moreover, this would include individuals or interests groups that would also suffer from other's job loss. That is, loss of employment has spill over effects that affect the economic interests of groups dependent on the economic survival of other individuals.

[24]This does not deny the fact that constituency preferences could have an ideological component associated with them. However, it is argued that a majority of the constituents who found NAFTA salient, had higher levels of intensity associated with a job dimension than with an ideological dimension.

seeking to protect themselves has been studied in numerous settings.[25] Laverge (1983) was one of the first economists to incorporate the political process in an empirical study of policy outcomes related to tariff policies. Extending this work into trade policy is still a relatively new endeavor for economists.[26]

Unemployment is perhaps the greatest cost and most salient issue for constituents to take into account when determining preferences for a trade policy.[27] In fact, unemployment has been found to be one of the primary determinants driving the demand for protectionist policies.[28] Ironically, Wallerstein (1987) has cited the general neglect of political scientists in modeling the threats of unemployment in the analysis of the demand for protection. However, recently economists seeking to explain trade policy outcomes have begun to incorporate

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[25]For example see Stigler (1971) and Peltzman (1976).

[26]For example see Peltzman (1984), Coughlin (1985), Tosini & Tower (1987) and McArthur & Marks (1988). Unfortunately most of these models resemble what Krehbiel (1993) refers to as "kitchen sink" models. Namely, political variables are tossed in solely to see what explanatory power they have with little regard to what theoretical contributions they might offer.

[27]Ironically, the resulting costs associated with protection are typically imposed on the general public (Ray 1981). Even though overall estimates of the costs associated with protection are low (see Feenstra (1992)), the effect they have on driving up consumer products is indisputable. However, because consumer groups tend to represent a large diffuse group, typically they do not mobilize. One of the most notable examples is the sugar lobby's success in getting protection. Moreover, empirical evidence suggests that industry interests are typically weighted more heavily than consumer interests (see for example Ray (1974), Baldwin (1976) and Caves (1976)). In addition, consumers will more likely determine their preferences on trade policy as an employee rather than a consumer. For example, Conybeare (1991) finds voters employed in an industry within a district find their interests as employees outweighing their interests as consumers.

[28]See for example, Nowzad (1978), Anjaria et al. (1982), Wallerstein (1987), and Tyson et al. (1988). Unemployment at the national level is believed to effect the supply of protection. There is a literature which seeks to explain the relationship between business cycles and the tariffs (see Takacs 1981, Gallarotti 1985; Cassing et al. 1986). Although the purpose of this paper is not to examine tariff trends over time, national economic factors have a role in determining the supply of protection.

unemployment effects into their analysis.[29] Likewise, the model developed in this research considers the effects of unemployment on constituency preferences for trade legislation. Because NAFTA would result in adjustments costs in the form of joblessness, certain interests groups had negative expectations about NAFTA's effect on their employment if the agreement were passed into law. However, there were also interest groups that had negative expectations about the level of employment that would exist if NAFTA were not to pass. Specifically some jobs remain vulnerable to free trade (such as employment associated with import-competing industries), however, some types of employment rely on the existence of free trade (i.e. exporting industries in general). As such, it is necessary to control for both, *protectionist forces* and *anti-protectionist forces*.

As demonstrated above, it is important to take into consideration that the debate over free trade and its affect on job security cut two ways. If constituents felt that their employment status was threatened by NAFTA's passage, then these individuals were more likely to be intensely opposed to the agreement. These constituents can generally be associated with manufacturing employment and employment in import-competing industries threatened by foreign competition. On the other hand if constituents thought that their employment depended on the prevalence of free trade, then they were more likely to find themselves supporting the agreement. These constituents can generally be associated with employment

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[29]For example see Takacs (1981), Coughlin (1985), Wallerstein (1987), Magee & Young (1987), McArthur & Marks (1988), Marks (1993).

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that is dependent upon access to foreign markets and purchasing of wholesale goods.[30] Surprisingly, few existing studies capture anti-protectionist forces and their influence upon the political process. The theoretical framework developed in this research, takes into account the variance in constituency preferences for free trade policy. The theoretical arguments developed above will be tested with the following propositions:

Proposition (1): Districts composed of manufacturing interests, are more likely to confront the risk of unemployment, and therefore will have a lower propensity to support NAFTA.

Proposition (2): Districts composed of manufacturing interests related directly to export markets, are less likely to confront the risk of unemployment and therefore will have a higher propensity to support NAFTA.

Proposition (3): Districts with a large percent of union members associated with labor, are more likely to confront the risk of unemployment, and therefore will have a lower propensity to support NAFTA.

However, the negative expectations concerning NAFTA's affect on employment may have subsided if safety nets, or resources more generally, were available from the federal government to offset the economic adjustments resulting from the implementation of the free trade agreement. Specifically, the existence of

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[30]See Destler & Odell (1987) for further evidence on the sources of *anti-protectionist forces*. Aside from the lack of access to foreign markets and goods, another potential threat associated with restricting free trade is the likelihood of setting off trade wars. Restricting access to domestic markets from foreign competition has the potential to produce retaliatory trade policies from other nation-states.

federal resources to small businesses, groups in need of job training, and individuals in need of low income housing, etc. may have served to offset the detrimental impact associated with the passage of the free trade agreement, and hence the pressure from members to vote against NAFTA. This suggests the following proposition:

Proposition (4): Districts with a large number of safety net resources will have a higher propensity to support NAFTA.

Now that the fundamental theoretical components associated with constituency preference demands have been delineated, it is necessary to turn towards a discussion of congressional responsiveness. To elicit a complete theoretical framework that can explain trade policy outcomes, it is vital to incorporate how constituency preference demands are rendered in the political process.

Congressional Responsiveness and the Determinants of Preference Supply

Although it is possible to identify the existence of constituents with strong preferences for and against NAFTA, how do these preferences subsequently get representation? Moreover, which constituency preferences get represented? When considering the answers to these questions, it is necessary to analyze the motivation behind congressional actions and decision-making. It is generally

assumed that the primary goal of all members of Congress is to be re-elected. Thus most, if not all of their activities take into account what effect a vote will have on their bids for re-election.[31] In doing so, they will identify with the dominant industrial interests within their district. Kingdon (1989) concludes that nearly all members of Congress defend important industries within their own districts. As an industry becomes economically important in a district, so does the maintenance of its economic survival. When an important industry within a district is threatened so is the economic well-being of the district. This is the crucial link between constituency preference demands for the regulation of trade and congressional response. If a congressman does not heed the call for protection by important industrial interests within a district, then the representative faces possible retribution at the polls.[32]

Without question, representation tends to be rewarded in Congress. Good service translates into a long tenure in office.[33] Kingdon (1989) and Fiorina (1974) associate a representative's seat safety and long tenure in office with following

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[31]Although re-election is a legislator's primary goal, this by no means suggests that good policy-making is not a concern. Members of Congress have their individual policy preferences independent of their constituents. However, in some instances, a representative's preferences will take second priority if she finds that her constituency's preferences are in conflict (especially if the constituency's preferences are associated with high intensity (Kingdon 1989)).

[32]The notion that concentrated interests prevail in getting their preferences represented by a representative at the expense of diffuse unorganized interests has been formally deduced in numerous settings (see for example Downs 1957, Olson 1968, and Stigler 1971). Fiorina (1974) has posited that a member of Congress will appeal to its largest sectional interests. In a similar vein, Fenno (1978) points out that representatives appeal primarily to their re-election constituency.

[33]For example see Wilson (1986), Kernell (1977), Polsby (1968), and Thompson & Moncrief (1988).

their constituency's preferences on *high salience* votes. As such, at some basic level, representatives have an incentive to reflect (or supply) the preferences of their respective re-election constituency. If they repeatedly fail to supply constituency preferences, they are most likely to face political risk. Political risk is defined as a legislator's chance of damaging or losing support networks associated with her re-election efforts. Specifically, political risk is associated with the loss of economic resources and votes. When representatives choose not to vote according to their constituents preferences then they risk the loss of support. Again, support represents not only votes, but economic resources. One of the biggest economic losses is campaign funds. Representatives depend on campaign resources in their re-election efforts. Numerous individuals and groups donate economic resources to a candidate because of the particular type of representation she will bring to the district. Thus, contributions are to some degree, analogous to political investments made by groups and individuals.[34] This suggests the following proposition:

Proposition (5): Representatives, which have a higher percentage of their total campaign resources from labor political action committees, will have a lower propensity to support NAFTA.

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[34]For example, see Snyder (1990). He models campaign contributions as a form of investment by interest groups in the House from 1980-1986.

Related to loss of support, is the level of vulnerability that characterizes a legislator in his district. Vulnerability within a congressional district is associated with the strength of support received from a representative's district. It is postulated that the more vulnerable legislators become, the less likely they are to risk upsetting their district's interests. Freshmen are most likely to feel vulnerable as they have little experience in their positions and have little power to influence outcomes in Congress. Legislators elected to office by narrow margins of support, have a higher risk of retribution from constituents by failing to vote according to their preferences.[35] Surprisingly, the link between electoral margins and trade policy outcomes is not clear and has not been systematically explored.[36] Nevertheless, the link between vulnerability and risk is made more clear when considering an attentive constituency's preference on a salient issue such as NAFTA. Concern over the NAFTA vote was voiced by several Republican legislators from marginal districts. In fact, it was the plight of several vulnerable congressmen that inspired GOP leaders to demand that the White House and its allies in Congress work harder to win over more support from Democrats from competitive districts where NAFTA was unpopular.[37] This suggests the following proposition:

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[35]The argument suggests that legislators elected by a narrow margin, begin their service in a district that is not completely supportive. Thus, a legislator is most likely to face a tough competitive bid for re-election that could be exacerbated by an electorate not happy with its representation.

[36]See Arnold (1990, p.45) for a discussion of this issue.

[37]See *Congressional Quarterly Weekly Reports*, September 18, 1993, p.2439.

Proposition (6): The percentage of vote support a representative received in the last election, should be positively related to the propensity of the member to support NAFTA. Specifically, representatives from districts in which they received a large percentage of the vote, will have a higher propensity to support NAFTA, while representatives from districts in which they received a small percentage of the vote, will have a lower propensity to support NAFTA.

Also it is important to take into consideration the effect that tenure in office has on a representative's likelihood of voting in support of NAFTA. That is, members that are new to Congress and have comparatively little experience in contrast to incumbents, will be most susceptible to feel pressure to vote against NAFTA. As such, the following proposition will be tested:

Proposition (7): Freshmen representatives will have a lower propensity to support NAFTA.

In addition to district pressures imposed on a representative's preferences, party organizational and executive constraints persist as well. With respect to the former, opposition to NAFTA was strongest among the Democratic membership. In fact, if it were not for the Republican support of NAFTA, the agreement certainly would not have passed. Numerous studies seeking to explain trade policy outcomes have controlled for a representative's party affiliation. However, empirical results are mixed. Typically, such models justify the inclusion of party as a control variable with merely ad hoc generalizations about Democrats having a

natural disposition against free-trade. However, this generalization is not appropriate given Clinton's overwhelming support for the agreement.[38] On the contrary, given the historical institutional bias of the executive office, in support of free trade principals, Clinton's support for NAFTA may not be so surprising. To the degree that Clinton is a Democrat, his support for NAFTA may seem unusual, however, it is not unusual because he is the executive. The executive branch has historically supported free trade, more so than the legislative branch, which traditionally has been considered more protectionistic (Baldwin, 1984, Cline 1989). This makes sense to the degree that the President has more diffuse interests to take into account when determining trade policy, more so than representatives.

Representatives generally tend to find themselves more subservient to local pressures than the executive because of strong, concentrated interests within their districts. In fact, contrary to the preferences of their executive, some Democratic leaders, such as the Democratic Whip, David Bonior, were ardently campaigning against the agreement. On the surface it would seem that the executive would have some influence on a legislator's vote, especially from members in districts that supported the president in the last election. However, this may not be the case given the institutional bias of the executive to support free trade and the contrasting protectionist bias in Congress. In trade policy matters, a president's

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[38]This makes sense to the degree that the President has more diffuse interests (i.e. a more dispersed constituency) to take into account when determining trade policy, more so than representatives (Baldwin, 1984, Cline 1989).

influence within a district may have no effect in stimulating free trade preferences. Moreover, due to the fact that Clinton is a Democrat, and Democrats since the 40's have been the party associated with supporting protectionism, his influence within a district may serve to decrease the propensity for a representative to support free trade. Thus, the following propositions will be tested:

Proposition (8): Representatives from districts which supported Clinton, will have a lower propensity to support NAFTA.

Proposition (9): Democratic representatives will have a lower propensity to support NAFTA.

Members of Congress are also undeniably bounded by their own ideological predispositions. Numerous empirical models seeking to predict trade policy suggest that the ideological predisposition of a representative can help explain a vote outcome.[39] The argument suggests that liberal members of Congress have a higher propensity to support restrictions on free trade, and conversely, conservative representatives will be more likely to vote against restrictive trade policies. The empirical findings from these studies however are inconclusive due to poor measures of ideology.[40] However, typically it is plausible to assume some consistency in the ideological predispositions of representatives, such that,

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[39]See Peltzman (1984), Kalt & Zupan (1990).

[40]Generally, most of the studies use ADA ratings. The problem associated with these measures have been noted (see Jackson & Kingdon 1990, 1993; Krehbiel 1993).

members who typically vote liberally, or conservatively, on economic issues, will tend to exhibit similar ideological dispositions on trade policy matters. As such, the following proposition will be tested:

Proposition (10): Representatives with liberal rating scores on economic issues will have a propensity to support NAFTA.

A Model of Congressional Responsiveness

Data

To test the theory about constituency preference demands and congressional responsiveness, data were collected for all 435 Congressional districts of the 103rd Congress. Table 1.1 below lists the variables used in the analysis, describes how they were measured and their respective sources.

Constituency Demand Variables. Numerous reports and opinion polls about NAFTA indicated that many concerns arising from the agreement's passage were related to its effect on labor and more specifically manufacturing employment. Because these employment sectors have witnessed a decrease in the growth of jobs available, districts which have a large percentage of these groups, will tend to have a constituency that has negative impressions about NAFTA's affect on future employment.

Table 1.1

Variable Descriptions

Variable	Measure	Hypothesized Effect	Source
(VOTE): Roll call for NAFTA	Coded (0=no; 1=yes).		*Congressional Quarterly Weekly Reports*, November 20, 1993, p.3224.
(MANUFEXP): Manufacturing Export Employment	The percent of individuals in each state employed in manufacturing.	(+)	*1993 Statistical Abstracts of the United States*. Table 1268, p.756. Figures are by state and reflect 1989 figures.
(MANUF): Manufacturing Employment (not associated with Exports)	The percent of employees in the civilian labor force, 16 years and older.	(-)	*1993 Statistical Abstracts of the United States*. Table 626, p.396. Figures are by state and reflect 1992 figures.
(UNIONTOTPCT): District level union membership	Percentage of all workers who are members of a union in the representative's district.	(-)	*Current Population Surveys*, 1991-92. (Box-Steffensmeier et al., 1995).
(IDEO): Liberal Ideological Ratings on Economic Bills	Rating scale of liberal voting on economic policies (0-100).	(-)	*Almanac of American Politics*. 1992. National journal ratings for each congressmen.
(PARTY) Partisan affiliation	Coded (0=Republican; 1=Democrat)	(-)	*Politics in America*. 1992. Recorded for each legislator.
(PRESUPPORT): Presidential Influence	The difference between the total votes the president received in 1992 election and the total votes a legislator received from a district.	(+)	*Politics in America*. 1992. Recorded for each legislator.
(LABTPCT): Campaign contributions from labor PACS	Percentage of total contributions to a member's campaign committee from labor-related PAC's	(-)	*Federal Election Campaign Commission*, 1992. (Box-Steffensmeier, 1993)
(SAFETY) Safety nets	Total resources given by the federal government to each state to offset adjustment costs to constituents.	(+)	*1993 Congressional Abstracts of the United States*.
(UNEMPTPCT) Percent of unemployment in the district	Percent of unemployed individuals within each district. Includes all males and females 16 years and older in the labor force.	(-)	*1990 U.S. Census Data, 104th Congress*. Obtained from the 1990 Census Lookup site, http://www.census.gov/cdrom/lookup. Database C90STF3D, question P70.
(VOTEPCT) Percent of vote in last election	Percentage of vote in the 1992 House of Representatives election won by the member of congress.	(+)	*Politics in America*. 1992. Recorded for each legislator.
(FRESHMEN) New member congress	Coded (0=Tenure, 1=New)	(-)	*Politics in America*. 1992. Recorded for each legislator.

Thus, the endogenous variable in the demand equation is *percent of unemployed workers* (UNEMPTPCT) within each congressional district. Moreover, because labor unions and manufacturing groups were strongly protesting the passage of NAFTA, *union membership* (UNIONTPCT) and *manufacturing employment* (MANUF) are controlled for in the model. Both of these variables should have a negative effect on the likelihood of a congressmen voting in favor of the free trade agreement.

However, it is also important to consider the role that proponents of NAFTA had in influencing legislators' policy preferences. Typically most studies merely control for interests on one side of the issue. Thus, I depart from other studies by explicitly controlling for the existence of interests for the free trade agreement. I do so by controlling for *export manufacturing employment* (MANUFEXP), which represent interests in favor of NAFTA. The existence of manufacturing jobs related to exports is hypothesized to have a positive effect on a representative's likelihood of voting for NAFTA. Lastly, the level of resources that exist to compensate workers who find themselves enduring adjustment costs is controlled for in the empirical model. Such resources have been referred to as *safety nets*. They are general resources used to offset financial injury associated with unemployment (Bates et al., 1991).

Congressional Supply Variables. Recall that representatives are postulated to be risk averse in terms of pursuing activities associated with losing economic

resources for their re-election efforts. As such, their preferences on trade policy will, in part, be influenced by groups contributing to their election war chests. Thus, if labor groups represent a significant proportion of a representatives campaign funds, the likelihood of the representative voting for NAFTA will decrease. As such, the influence of *contributions by labor political action committees* (LABTPCT) are controlled for in the model. It is postulated that representatives who receive funds from PAC's will be less likely to vote for the free trade agreement. To test for the effect that party affiliation has on a congressman's decision to vote for the agreement, a dummy variable representing *party affiliation* (PARTY) is used in the model.

NAFTA's passage was one of the most important issues on the president's agenda. Clinton was widely known by most Americans to support NAFTA's passage. However, what effect did the president's position on NAFTA have on congressional decision making? Surprisingly, presidential influence has been ignored by most explanations of trade policy outcomes. If a president has a lot of support within a particular congressional district, it is unlikely that a representative would publicly criticize the president's policy decisions. However, just because a particular district supports the president, a member of Congress may not be more likely to adopt the policy position of the executive on trade policy matters. Again, the executive has an institutional free trade policy bias, whereas, the legislative branch does not. Thus, *presidential support* (PRESUPPORT) within a

representative's district may not have influence on a representative's position on NAFTA.[41]

In addition, the vulnerability of a congressmen's seat is analyzed. It is hypothesized that the more vulnerable representatives are, the less likely they are to risk upsetting their constituency interests. Vulnerability is assessed by two factors. First, the model controls for the *total proportion of votes received* by the representative in the last election (VOTEPCT). Secondly, the model controls for *experience in Congress* by examining whether a member is new to the house (FRESHMEN).

Some representative's voting preferences on NAFTA were undeniably bounded by their own ideological predispositions. As such, controlling for the ideological predispositions of representatives may help explain NAFTA's vote outcome. Traditionally Democrats have been associated with protectionist trade policies, while Republicans have been viewed as advocates for free trade. Thus, liberal representatives will be more likely to support restrictions on free trade. Conversely, more conservative legislators will be more likely to vote against restrictive trade policies. Thus a measure of a representative's *ideology on economic issues* (IDEO) will be used in the model. This variable registers the liberal voting orientations of legislators on economic policies. The more liberal a representative, the less likely the member is to vote for the free trade agreement.

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[41]This is contrary to Bartels (1991) argument in his analysis of votes on defense appropriations.

Method

To capture the preferences of congressmen for NAFTA, roll call votes for each representative on the agreement are used.[42] Unfortunately, a more complete measure of congressional preferences cannot be obtained due to the manner in which the agreement was considered on the House floor.[43] Congress considered NAFTA under the *fast track* procedures. This procedure effectively prevents any amendments from being considered or added onto the agreement. Moreover it requires that a vote be taken within 90 days after the agreement is formally submitted to the House by the president.[44] Due to the dichotomous categorical nature of the dependent variable, an alternative estimate technique from ordinary least squares is required (Greene 1991; Maddala 1983, 1993). As such, the empirical model will take the form of a probit below:

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[42]*Congressional Quarterly Weekly Reports*, November 20, 1993, pp.3224-3225.

[43]Due to the lack of amendments, and hence roll calls for such amendments, superior measures of representative preferences developed by Krehbiel & Rivers (1988) cannot be obtained. See Bartels (1991) for an example of Krehbiel & Rivers technique. Bartels uses their technique to analyze congressional decisions on defense expenditures.

[44]See *Congressional Quarterly Weekly Reports*, September 4, 1993, p.2335; October 2, 1993, p.2621. Arnold (1990) and Bach & Smith (1988) note that restrictive rules are used as tactical devices in the House to protect the content of bills. Generally, restrictive rules have not been found to favor either attentive or inattentive groups. However it is a strategy that can be used to benefit either concentrated interests or diffuse interests (Arnold 1990, p.131). Fast track procedures have been used to draft and secure approval for the 1979 Trade Act and the 1988 Canadian Free Trade Agreement. Interestingly, the Israeli free trade pact was not considered under fast track. However, this is attributed to the fact that no opposition was anticipated in the House nor the Senate (*Congressional Quarterly Almanac*, 1985, p.260).

$$
\begin{aligned}
Y_1(VOTE) = {} & \alpha_1 + X_1(MANUF) \\
& + X_2(MANUFEXP) \\
& + X_3(UNIONTOTPCT) \\
& + X_4(UNEMPTPCT) \\
& + X_5(IDEO) \\
& + X_6(PARTY) \\
& + X_7(PRESUPPORT) \\
& + X_8(LABTPCT) \\
& + X_9(SAFETY) \\
& + X_{10}(VOTEPCT) \\
& + X_{11}(FRESHMAN) + \epsilon_t
\end{aligned}
$$

Empirical Results

Descriptive statistics are provided in Table 1.2 for all of the variables used in the empirical model. In addition, Tables 1.3 and 1.4 provide a listing of the results obtained from the OLS and probit estimations.

Propositions (1)-(3) need to be assessed by two sets of analysis. The first part in testing their veracity, involves establishing the nature of unemployment risk within congressional districts. Throughout the previous discussion of the theoretical model, an argument was developed identifying those groups which perceived themselves to be most vulnerable to a loss of unemployment. It is important to stress that the anxieties associated with joblessness stemmed not only from groups worried about NAFTA's passage, e.g. *protectionist groups*, but also groups concerned about the possibility that NAFTA would not pass, e.g. *anti-protectionist groups*.

Table 1.2

Descriptive Statistics

Variable	Min	Max	Mean	Std. Dev.
VOTE	0	1	0.5379	0.4991
MANUFEXP	0.9	380.0	129.45	108.13
MANUF	5.40	1746.0	670.90	491.13
UNIONTOTPCT	0.0256	0.3733	0.1638	0.0736
IDEO	0.00	91.00	47.442	29.076
PARTY	0.00	0.00	0.402	0.490
PRESUPPORT	-143200	86310	-35086	33214
LABTPCT	0.00	0.48	0.1018	0.1094
SAFETY	32.00	3166.0	978.78	841.97
UNEMPTPCT	0.019	0.412	0.172	0.066
VOTEPCT	0.50	1.00	0.65	0.11
FRESHMAN	0.00	1.00	0.262	0.440

Table 1.3

Ordinary Least Squares Model

Independent Variable[a]	Coefficient	Std. Error
MANUF	0.0004***	0.0001
MANUFEXP	-0.0017***	0.0002
UNIONTOTPCT	0.7142***	0.0462
NOB=435	Onetail: (p<.10)* (P<.05)**(P<.01)***	R^2=.127

[a] Dependent Variable: Total Percentage of District Unemployment

Table 1.4

Probit Model

Independent Variable[a]	Coefficient	Std. Error
MANUF	-0.0029***	0.0009
MANUFEXP	0.0150***	0.0041
UNIONTOTPCT	-5.2682***	1.2400
SAFETY	0.0001	0.0001
LABTPCT	-3.7358***	0.9009
FRESHMAN	-0.7703	0.7399
VOTEPCT	0.4637	0.6247
PRESUPPORT	- 0.00001	0.00002
PARTY	0.4761***	0.1942
IDEO	-0.0004	0.0007
CONSTANT	0. 3243	0.5291
NOB=435 74% cases correctly[b] $-2Ln\lambda \sim X^2 = 135.68$***	Onetail: (p<.10)* (P<.05)**(P<.01)***	

[a] Dependent Variable: NAFTA Vote

[b] This is compared to the restricted model with only a constant term in which 54% of the votes were correctly predicted.

With respect to the former category, these groups consisted mainly of manufacturing industries competing with imports and unions identifying with labor groups, while the latter consisted mainly of manufacturing groups dependent upon export markets.

To test the assertions identifying the groups associated with unemployment, an OLS was estimated, which examined the percent of unemployment within each district UNEMPTPCT, as a function of the percent of manufacturing employment MANUF, percent of union members UNIONTOTPCT, and manufacturing employment associated with export industries MANUFEXP. The results reported in Table 3 suggest support for the arguments developed above. First, manufacturing employment and union membership within a congressional district have a positive relationship with district unemployment. Moreover, they are both statistically significant predictors. Secondly, manufacturing employment associated with exports is negatively associated with district unemployment. Likewise, this variable is also statistically significant. Thus, it is possible to conclude support for the argument suggesting that specific groups are more vulnerable to unemployment risk than others.

As such, it is possible to explicitly test propositions (1)-(3). Table 1.4 reports the results from the probit model. Recall that proposition (1) anticipates that representatives with a large manufacturing interest group base will have a negative propensity to vote for NAFTA. Indeed support is confirmed for this

MANUF is found to be both negative and statistically significant. Proposition (2) anticipates the opposite effect for manufacturing groups associated with export industries. Specifically, representatives from districts comprised of manufacturing groups dependent upon exports markets are less likely to vote for NAFTA. The results obtained from the probit estimation render support for this proposition as the coefficient estimate for MANUFEXP is positive and statistically significant. Proposition (3) suggests that representatives from districts with a large percentage of labor union membership, will have a negative propensity to support NAFTA. Indeed, the results from the analysis support this proposition as the coefficient estimate for UNIONTOTPCT is negative and statistically significant. Proposition (4) is the last hypothesis specifying the demand side of the theoretical model examining factors responsible for constituency trade policy preferences. It suggests that safety nets help groups or individuals in transition from one job to another. Thus, the argument contends that members of Congress will have a higher propensity to vote for NAFTA, if they have resources at their disposal to give to groups or individuals vulnerable to adjustments (e.g. temporary unemployment) resulting from the NAFTA. The estimates obtained from the analysis give some confirmation to this proposition. The estimated coefficient for SAFETY is positive, however, it is not statistically significant.

The remaining propositions (5)-(10) specify the supply side of the theoretical model examining factors responsible for congressional responsiveness

to constituency preferences. Specifically, proposition (5) states that members who receive a large percentage of their total campaign contributions from labor political action committees will have a negative propensity to vote for NAFTA. Indeed, support is rendered for this proposition as the coefficient estimate for LABTPCT is negative and statistically significant. Propositions (6) and (7) attempt to ascertain the effect that electoral vulnerability and experience within the House have on a representative's propensity to vote for the NAFTA. With respect to the latter proposition, the argument developed in this research contends that the percent of votes members received from their districts in the last election should be positively related to their propensity to vote for NAFTA. As such, the model anticipates that representatives who received lower percentages of support, will have a lower propensity to vote for NAFTA, while members who received a higher percent of support, will have a higher propensity to vote for NAFTA. Minor support is rendered for this proposition as the coefficient estimate for VOTEPCT is positive, but it is not statistically significant. Proposition (7) suggests that new members of Congress will have a lower propensity to vote for NAFTA because of their vulnerability stemming from lack of tenure in office. However, the coefficient estimate for FRESHMEN, albeit negative, is not statistically significant. Thus, only meager support is found for this proposition.

Proposition (8) examines the influence of presidential support in a member's district and what effect this subsequently has on the representative's

propensity to support NAFTA. Again, because of the institutional bias towards free trade that permeates the executive office contrasts greatly with Congress's protectionist bias, more often than not, preferences for trade policy will be divergent between the two institutions. Thus, it is unlikely that presidential support in a district will increase the propensity for a representative to vote for NAFTA. Some minor support is rendered for this hypothesis as the estimated coefficient estimate for PRESUPPORT is negative. However, it is not statistically significant.

Proposition (9) examines the effect of partisan affiliation of a member and its influence on the NAFTA vote. The proposition contends that Democrats are more likely to vote against the NAFTA. Interestingly however, the estimated coefficient on PARTY suggests the opposite effect and was statistically significant. This results suggests that Democrats were more likely to vote for NAFTA. What possibly accounts for this counterintuitive result, especially since a majority of Democrats actually voted against NAFTA?[45] One answer lies in the heterogeneous nature of congressional districts that Democratic members represent. Research suggests that Republicans tend to represent more homogenous districts, while Democrats represent more heterogenous districts (Rohde, 1994). As a result, Democrats have more divergent interests to represent within their respective districts, more so than their Republican counterparts. As such, using a

[45]Recall that the vote of NAFTA was split 234 for and 200 against. 40% of the vote in support of NAFTA cam from the Democrats, while over 75% came from Republicans.

party control variable to predict propensity to support free trade may not be the best means of testing what influence partisanship has on trade policy vote outcomes. The model may need to be complicated in order to take into account the heterogenous character of congressional districts and what effect this has not only on congressional preferences, but on constituency preferences as well.

Lastly, proposition (10) seeks to determine what the ideological predispositions of representatives on economic policy have on trade policy. The proposition suggests that members with liberal ideological ratings will be more likely to vote against NAFTA. Minor support was rendered to this proposition. Specifically, IDEO is found to be negative, however it is statistically insignificant.

Conclusion

The general theoretical framework examining congressional responsiveness to constituency demands received some support from the model analyzing the vote on NAFTA presented in this research. Particularly, this research contributes novel findings to three literatures: congressional decision making, majoritarian politics, and the political economy of trade policy matters.

First, the analysis reveals that congressional responsiveness on trade policy, seems to be less a function of political matters related to party, tenure in office, etc., and more a function of the economic risk that dominant constituent groups

confront within a representative's district. This suggests that economic factors responsible for constituency demands, both protectionist and anti-protectionist, have a significant effect on congressional decision making more than convential political factors. This finding supports Kingdon's (1989) and Arnold's (1990) insights about the influence of major industrial groups and attentive publics on congressional responsiveness. Specifically, as the argument concerning constituency demands suggests, industry associated with manufacturing (related to both imports and exports), labor and unions groups, are attentive to trade policy debates. As such, these groups subsequently find representation of their demands, as members respond to their economic risk conditions.

Secondly, to the degree that particular attentive groups tend to dominate the process, the majoritarian politics premise gains support in the realm of trade policy matters. However, this does not suggests that Congress is dominated by an overwhelming protectionist bias. Again, attentive groups refer to both opponents and proponents of free trade. The inclusion of controls for both protectionist and anti-protectionist groups suggest that they each have a significant influence on congressional decision making.

Third, the theoretical framework and empirical results support the conclusion that the political economy of trade policy, to a large degree, evolves around the potential economic risk to constituents vulnerable to unemployment. Because groups associated with unions, labor, and manufacturing are vulnerable to

unemployment, they will seek protection. This supports Wallerstein's (1987) contention that unemployment has a direct effect on the demand for protection.

Concluding, the examination of the NAFTA vote yields some interesting results that make future research in this area an important consideration. Three particular topics merit attention, which have the potential to yield important insights into the literature investigating the politics and process of trade policy matters. First, because trade policy is an issue important to constituents' interests, as exhibited by the politics stemming from the NAFTA vote, it is important to recognize it as a policy arena full of divergent interests which are likely to get more polarized in the future. Because it is a salient issue riddled with competing interests, the politics of trade policy formation are likely get more competitive. If the United State's dependence on export markets continues to grow, anti-protectionist forces will continue to secure their policy preferences. However, if current pleas by politicians in favor of isolationist policies gains increasing support, advocates of protectionism may find their preferences represented in a new era of U.S. trade policy strategy.

This leads to the second point of interest which is that the institutional variance among the executive and Congress warrants further investigation. If interest group preferences become more politicized, will institutions currently charged with authority and decision-making on trade policy matters change in order to accommodate efficient responsiveness to policy demands? What will

happen to the United States general trade policy orientation if partisan politics over trade policy matters heightens in the future? As parties become more homogenous, as reflected in intraparty voting patterns in Congress (Rohde, 1991), party organizations will serve as stronger cues for constituents to obtain representation for their preferences on trade policy matters. Will a new era of protection by demand ensue? An examination of these issues should provide some answers to these important questions.

CHAPTER 2

MODELING THE DYNAMICS OF POWER, TRADE AND CONFLICT: FLUCTUATIONS IN THE ECONOMY, ALTERNATING DISTRIBUTIONS OF POWER AND THE PROSPECTS FOR PEACE

Introduction

Over the last several decades, political scientists have been intent on examining whether recurring patterns exist among macro level economic (e.g. prices, production, etc.) and social phenomena (e.g. international conflict). The contention that long cycles of political and social phenomena exist over time in the international system continues to evoke controversy and hence, remains an enduring puzzle for international relations scholars.[1]

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[1]It has been six decades since Nikolai Kondratieff (1935) first published his thoughts on the existence of long waves in the international economy over time. Long waves (or more generally, Kondratieff cycles) are defined by alternating economic phases. Generally speaking, they are comprised of an *expansion phase* and a *stagnation phase*. Some of the literature refer to the former as an *upswing* and the latter as a *downswing* (Goldstein 1985). The transition point from an expansion phase to a stagnation phase is called a *peak*, while the point from a stagnation phase to an expansion is called a *trough*. The dates of the transition points are used to define the historical dating of the long wave phases, that Kondratieff posited to repeat roughly every fifty years. As Goldstein (1988) notes, the longwave phases occur across national boundaries. That is, they are macroeconomic phenomena. Therefore they are systemic-level phenomena and should be modeled accordingly.

Of particular interest to scholars in this research tradition has been the examination of cycles related to both economic activity (Goldstein 1988) and political order within the international system (Gilpin 1981, Wallerstein 1983, and Modelski 1987a), and their association with the onset of major power war. During the last decade, this literature has been engaged in debates over three central issues: (1) empirically substantiating whether long cycles exist in the international system; (2) determining the most appropriate cycle phase dating scheme; and (3) establishing the precedence of economic long waves or political cycles as generating mechanisms responsible for the onset of conflict in the international system.[2]

The present research seeks to advance a single deductive framework that is capable of addressing these controversies in this literature, while at the same time broadening and synthesizing the theoretical and empirical contributions of scholars in this research tradition. This is accomplished first, by integrating political cycle and economic long wave theories into one theoretical framework, which explains change in conflict within the international system.[3] Similar to Pollins (1995), I believe that these processes are best understood in an integrated framework. However, to facilitate a broader understanding of the dynamics inherent within the

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[2]Economic long waves consists of series relating to prices and inflation, production, etc., while political cycles relate to series representing leadership, hegemony, the distribution of power, etc.

[3]Pollins (1995) makes a similar argument to develop his co-evolving systems model. The present work seeks to build upon Pollin's theoretical integration, but is distinct in that the framework advanced here is a more general model seeking to explain changes in the trend associated with armed conflicts over time within the international system. This argument will be fully developed in a subsequent section.

international system, I contend that the distribution of power is an integral part of a general theory capable of delineating the mechanisms responsible for generating change in systemic conflict.[4]

Secondly, by using new theory in econometrics on cointegration, the model developed in the present research seeks to redirect the current preoccupation with determining the existence of cycles, duration, and the timing of their phases, into a broader conceptualization. Specifically, the conceptualization considers whether these phenomena are characterized by stochastic trends, and if the trends associated with each of these factors may be in common over time. As I will demonstrate, the proposed shift in focus affords a more accurate conceptualization about the interrelationship between the processes over time. Moreover, it yields a new unifying insight into the controversies concerning the precise dating of cycle phases and whether the existence of cycles can be empirically substantiated. The model itself has broader applicability: it has the potential to incorporate other systemic factors, both economic and political, in the analysis of international conflict or in studies seeking to explain system transformation.

To facilitate an examination of the proposed framework, it is necessary to briefly return to an discussion of the enduring controversies within this literature. The discussion highlights the main issues in dispute within the literature and

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[4]In this research, the analysis of conflict extends beyond major power war. This is done for reasons that will be elaborated upon in the development of the theoretical model. In short, to depict the overall level of hostility in the international system, conflictual events short of war need to be taken into account. This will aid in the development of a general indicator reflecting overall *systemic conflict*. Pollins (1995) makes a similar argument in his co-evolving systems model.

emphasizes how the framework advanced in this research can address these issues. Specifically, I contend that the theoretical and empirical framework advanced in this research resolves these disputes. In addition, the framework integrates and extends the numerous contributions of scholars in this research tradition. The discussion briefly highlights both theoretical and empirical recommendations that are advanced in this study, while development of the full arguments for each critique are developed in the appropriate sections.

Theoretically, this literature has traditionally not integrated the analysis of economic and political cycles into a unified causal theory capable of explaining the onset of systemic conflict in the international system. This has negated the ability to specify and examine explicitly the causal mechanisms responsible for generating change in system conflict. Recent work by Pollins (1995) has sought to address this issue. Examining global leadership cycles and economic long waves, Pollins contends that there exists a tendency in traditional research to isolate the effects of these phenomena when examining how they are correlated with the occurrence of conflict.

Specifically, Pollins argues that more often than not, establishing the precedence of economic long waves, or leadership cycles, as generating mechanisms responsible for the onset of conflict in the international system, has taken priority over developing an integrative approach to the study of these

phenomena and their interrelationship with armed conflict.[5] To address this void, Pollins (1995) develops a system-level model, which views the incidence of armed conflict as influenced by the interaction, or co-evolution, of economic long waves and leadership cycles. However, he, along with traditional research in this area, does not examine how these processes are interrelated, nor their temporal relationship with systemic conflict.[6] The research in this paper demonstrates that a true "co-evolving" argument necessitates the development of theory capable of delineating how the processes under consideration are connected. Thus, a co-evolutionary theory involves (1) determining the independent effects of cyclical phenomena upon one another, and the possibility of reciprocal relationships (i.e. feedback) upon one another over time; (2) contemplating what structural changes are fundamental to generating change in the international system; and (3) rigorously delineating the temporal ordering of the processes characterizing the

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[5]For example, Modelski's (1987a) work on leadership suggests that both political and economic structures comprise distinct realms, and as such should be analyzed separately. Moreover, recent work by Modelski & Thompson (1995) examines leading sectors and global power as separate, independent, co-evolving systems. Pollins (1995) discusses this latter point to demonstrate a conceptual shift in his model from traditional long cycles research. He is one of the first scholars to promote an integrative approach.

[6]Again, this is a general criticism warranted to the cycles literature. Developing a theory capable of explaining the interrelationship between economic waves and leadership is not the purpose of Pollins research. Specifically, he states:

> "While these processes themselves may well be inter-related in ways yet to be specified, I contend that each makes its own contribution to the generation or suppression of armed conflict, in keeping with the particular phase each cycle is in at a particular time." (Pollins, 1995, p.9)

As such, the co-evolving systems model that Pollins promotes does not explain how these processes influence one another (i.e. how they are integrated) over time. Pollins notion of integration is a mechanism in which to match cycle phases associated with leadership cycles and economic long waves. This is done to see how the joint ranking of these cycles are ordered to determine the cumulative effect that they have on the likelihood of armed conflict.

system and their relationship with systemic conflict. This necessitates an examination of exogenous assumptions made within a co-evolving theoretical model.

In this research, a theory is developed that addresses each of these issues. The theory contends that economic activity and commerce over time, tend to impact the concentration of power among states in the international system. When this occurs, the configuration of states in the system is altered. This subsequently changes the international structure. To the extent that this change produces uncertainty about the security of states in the new system structure, then the onset of systemic conflict will also be affected.[7]

This theoretical framework affords several innovative extensions into this literature. First, the model integrates the influence of the distribution of power and international commerce into this literature. All too often the influence of trade is overlooked as a determinant in the nature and magnitude of systemic conflict.[8] Currently studies that examine the influence of interstate commercial activity on conflict yield mixed conclusions. In addition, this framework specifically delineates the exogeneity of armed conflict, to the endogenous processes

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[7]Again, note the theoretical argument developed in this research uses a more general measure of conflict similar to Pollins (1995). Because the analysis of major-power war is too restrictive for the purposes of the following research, conflicts short of war are also analyzed. This will be further elaborated upon in the development of the model. Note, because this research uses a more general measure of conflict, it is inappropriate to directly compare the analysis in this study with most of the traditional cycles research that analyses major power war.

[8]This is especially true in studies investigating systemic level behavior. Notable exceptions are the work of Gowa (1989, 1994), Gowa & Mansfield (1993), and Mansfield (1994).

responsible for generating changes. These endogenous processes are the distribution of power, commerce and economic activity. These exogeneity assumptions posited can subsequently be tested in the empirical model developed in this research.

Empirically, the methodological approach advanced in this research, not only has the potential to resolve existing debates over empirically substantiating the existence of cycles, their duration, and the determination of their dating schemes, but can advance a common framework that is capable of (1) empirically demonstrating how cyclical phenomena co-evolve, by using new theory in econometrics on cointegration, to see if these phenomena share a common trend over time; and (2) assess what phenomena are formally generating dynamics in the international system by conducting exogeneity tests within a cointegrating framework. Briefly each of these points will be discussed to delineate the particular controversy in the literature and how the proposed research seeks to address the issue.

As previously mentioned, one of the central interest to scholars in this literature is empirically substantiating whether long cycles exist in the international system.[9] That is, proponents maintaining the existence of cycles, find that over time, systemic phenomena (e.g. leadership, economic waves, etc.) tend to rise and decline over time in repeated patterns, and that particular sub-periods tend to be

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[9]For a discussion of recent literature on this issue see Beck (1991b), Goldstein (1991), Williams (1992) and Williams et al. (1994).

correlated with the onset of major power war. However, establishing whether cycles exist has been bedeviled by variances in the series under investigation, the time frames under analysis, and the techniques used to verify their (non)existence. Moreover, a related issue in dispute pertains to the dating schemes that depict the timing and duration of various cyclical phenomena.[10] Most studies examining long cycles have tried to fit a common cyclical pattern among the series of interest, in an attempt to establish whether cycles exist and to establish their duration.[11] However, cycle dating schemes typically encounter criticism because they are considered subjective. Moreover, any nonmonotonic series (e.g. a series which drifts in one direction then changes and drifts in the opposite direction) has cyclical properties that are randomly distributed throughout time, rendering substantive significance to cyclical periods tenuous at best.[12]

The framework utilized in this research goes beyond substantiating the (non)existence of cycles, by examining the relationship among the trends associated with cyclical phenomena (e.g. economic waves, power concentrations, systemic conflict, etc.). If these trends are co-evolving, then their empirical determinants will suggest that they share a common trend over time. The focus on common trends negates the issue of empirically substantiating cycles, in favor of

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[10]Goldstein (1988), Modelski & Thompson (1988), Pollins (1995), Thompson (1992), Wallerstein (1983) all specify dating schemes for various cyclical phenomena.

[11]Imposing a cyclical structure on the series of interest, is considered a restrictive assumption about the functional form of the data.

[12]Pudaite (1991) and Beck (1991b) make similar arguments in their analysis of the long cycles literature.

deriving some theoretical expectations for why and how these series are related to one another over time. This conceptualization extends a beneficial insight as it affords an unrestrictive specification about the relationship between these constructs over time. Previous attempts to specify periodicities have produced conflicting conclusions in the literature, resulting in endless debates over the empirical existence of cycles.

Another empirical criticism in this literature is the lack of attention to the assessment of exogeneity assumptions in most of the long cycles literature. Exogeneity is fundamental in the determination of causality between two or more variables. Typically most of the literature ignores this issue, both theoretically and empirically.[13] The purported research elucidates a theoretical model and empirical test capable of assessing causal mechanisms between conflict and economic phenomena in the international system. Error correction models in general, and cointegration in particular, imply causality. Generally speaking, for a pair of series to have a long-run equilibrium relationship, by definition there must be some form of causation between them. In other words, the series need to have the necessary dynamics to form a long-run relationship to begin with (Granger, 1988a). This

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[13]Goldstein (1988) is one of the few scholars that has addressed the issue of causation. Included in his empirical analysis is a series of Granger causality tests. However, as will be discussed in a subsequent section, Granger causality tests are not adequate tests for causation, especially in the context of a hypothesized cointegrating relationship (Granato & Smith 1994a, 1994b).

research begins to explore the necessary dynamics and restrictions necessary for cointegration in a partial system (Johansen 1992a, 1992b).[14]

By taking the proposed theoretical and empirical approach, this research yields insights into several enduring puzzles in the long cycles literature and illuminates a more general picture of the relationship between power, trade, economic activity, and systemic conflict. Drawing upon several related, albeit distinct literatures, this paper advances a more general theory and test in support of the significance of economic waves and political cycles in explaining conflict in the international system. This, in turn, results in the development of an empirical model, which is tested, and subsequently finds support for a set of theoretical propositions. Specifically, the empirical analysis finds that the distribution of power, conflict, trade and economic waves in the system, are independently characterized by stochastic trends. Moreover, when these trends are analyzed together, empirical evidence suggests that they share a common path over time. This leads to the development of another set of tests, which demonstrate that conflict in the system alone responds to changes in the distribution of power, trade and economic waves.

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[14]Discussions of the issues involved in assessing causality and diagnostics tests appropriate to determine causality within a cointegration framework have only surfaced in the last several years. See Granger (1988a, 1988b), Johansen (1988, 1992a, 1992b), Granger & Lee (1989), Johansen & Juselius (1990), and Ericsson (1992) for a discussion in economics and Ostrom & Smith (1992) and Durr (1992) in the political science literature. Generally speaking, cointegration implies symmetry between any series forming a long-run relationship, complicating for exogeneity conditions within a statistical model. It will be demonstrated in the development of the statistical model proposed that under certain restrictions, it is possible to assert that particular series may have asymmetric effects on an equilibrium relationship (i.e. cointegrating vector), and hence, may be deemed weakly exogenous to the dependent process under analysis.

The general framework developed in this analysis, should prove sufficient to explore other types of social phenomena related to power, trade, and war in the international system. However, before discussing the theoretical framework advanced in this research, a brief discussion about the current literature will precede in order to demonstrate where existing research stands and where the present research departs and seeks to make a contribution.

Long Cycles in Review

Long Cycles are conceived by its proponents as a systemic theoretical explanation for the recurrence of war over the last several centuries. It is not a theory about the causes of major war per se. Instead, it is based on the notion that behavior in the global political system has a time pattern or rhythmic characterization.[15] Within political science, this literature is most notably associated with the work of Modelski (1978, 1981, 1987a, 1987b), Thompson (1983, 1988) and Goldstein (1985,1987, 1988).[16] Most of this research extends the initial insights of Kondratieff (1935) in an attempt to uncover the interaction

[15]Perhaps it is the focus on the empirical attributes of these series that render long cycle critics some validity in their assessment of this literature as atheoretical.

[16]This list of research is by no means exhaustive. For extensive annotated bibliographies see Barr (1979), Goldstein (1988), Modelski (1983, 1987a), Rosecrance (1987) and Thompson (1988).

between periodic major wars in the global system and changes in the behavior of prices and production indexes in the world economy.[17]

The origin of the Long Cycles literature has been largely attributed to the original investigations of Kondratieff (1935). His research consisted of examining numerous price, production and consumption series for several advanced industrial nations, in an effort to determine whether long waves of economic phenomena exist and what time periods they might possibly comprise. In his analysis, he finds some support for the existence of longwaves and concludes that approximately three waves exist which can be traced back to the late 1780's.[18] Interestingly, Kondratieff surmised that long waves were behavioral regularities in the international system that could be generalized to other economic and social phenomena, such as conflict. Specifically, he contended that rising phases of long waves were correlated with high tension, which subsequently increased the probability of conflict. However, he didn't offer any theoretical arguments for his assertions, other than suggesting that rising phases of the long wave tended to be characterized by high levels of interstate tension over markets and raw materials.

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[17]The analysis of long cycles and political phenomena has been organized into several theoretical frameworks. The leadership cycle (Modelski 1978) and the power transition school (Organski 1958, Organski & Kugler 1980) and the world-system school (Wallerstein, 1974). All of these studies examine war in a slightly different manner. Specifically, leadership studies focus on the effect of war in establishing new world orders, while the power transition studies focus on changes in power and it's effect on patterns of war over time. The world systems perspective examines the problem of war and hegemony through a Marxists perspective.

[18]A wave (or cycle more generally) is comprised of an upswing and a downswing. Kondratieff's cycles date roughly: (1) 1830-1860 (up), 1860-1890 (down); (2)1890-1914 (up), 1914-1940 (down); (3)1940-1968 (up), 1968-to be determined (down). Kondratieff used moving averages and trend deviations to analyze on wholesale prices, interest rates, wages, foreign trade and production data series from Britain, France, Germany and the United States.

Thus his work is perhaps the first theoretical link in this literature that examines cycles of macroeconomic conditions and conflict behavior in the international system.[19] However, Kondratieff did not make any explicit attempt to deal with exogeneity issues other than to suggest that recurring events were the *effects* of long waves and not responsible for causing them.[20]

In the late 70's and early 80's Modelski began publishing some of his research on long cycles. This work is largely attributed to begin the new upswing on long cycles research in political science. In his work, Modelski is the first scholar to extend Kondratieff's notion that behaviors occur in repeating patterns in order to uncover recurring phenomena related to global leadership. He hypothesized that long-term fluctuations in political and economic systems within the international system are characterized by similar processes that are correlated in some manner. As such, an increase in the demand for resources and capital in one system, would subsequently decrease the supply available to the other system.[21] Moreover, this process is cyclical and can be characterized by four

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[19]Although Kondratieff is largely characterized as the original scholar to link economic and war cycles, Goldstein (1988) cites Johan Åkerman (1932), a Swedish economist, as the first researcher to associate war as the central cause of long waves.

[20]Here Kondratieff seems to make an explicit exogeneity assumption. That is, he draws a causal distinction between long waves and other phenomena. Specifically, he suggests that long waves contribute explanatory or predictive power for studying recurring phenomena (e.g. war) in the international system. However he never explicitly addresses the issue.

[21]Modelski conceives the international system to be comprised by distinct realms, i.e. a political system and an economic system. However, he seems to suggest that acquiring resources in these distinct realms is a zero sum process. This may not adequately capture the dynamics of the interrelationship between the political and economic systems. Especially if one takes the view that they maintain some long-run equilibrium relationship as the current research contends.

distinct phases (1) global war; (2) the emergence of the world power; (3) delegitimation of power; and (4) deconcenetration of power. The occurrence of another global war starts a new cycle. Modelski (1981) also models the association between world power phases and Kondratieff's economic waves. However, he does not explain the explicit link between economic and power cycles. Specifically, he does not address issues associated with causality. In fact, most of this research virtually ignores exogeneity assumptions about what is driving these cyclical processes over time. In some sense, Thompson & Zuk's (1982) research is one of the first attempts to causally link cycles of conflict and economic phenomena together by examining the timing of wars and the timing of upswings and downswings of Kondratieff waves.

By examining the timing of Kondratieff price waves, Thompson & Zuk (1982) seek to determine whether war inaugurates or reinforces upswings in Kondratieff waves and whether war inaugurates the down swing of the long wave. Using various descriptive statistics, they find little support for the notion that war inaugurates upswings, but they do find evidence that Kondratieff's upper turning points coincide with the termination of war.[22] They conclude that there "can be little doubt that wars and their associated economic disruptions lead to price level increases " (1982, p.635). In order to test the extent to which wars are responsible

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[22]Specifically they examine wholesale prices at war peaks and calculate a five year mean preceding the war peak, and its corresponding percentage increase. Moreover, they examine price levels at different turning points of the Kondratieff, by analyzing data on upswing annual percentage changes and the prewar annual percentage changes.

for inflation, they use an ARIMA impact assessment model (Box & Tiao, 1975). From their analysis they find significant increases in inflation during war, followed by a period of readjustment that lasts about twenty years. They conclude by stressing the need to study the long term impacts of wars because of its fundamental impact on political and economic systemic processes. This research is valuable in its assessment of war having an long term effect on aggregate economic conditions. However this research stops short in making any explicit exogeneity assumptions. Instead, Thompson & Zuk (1982) suggest that their approach is similar to Modelski's long cycle of world leadership. Specifically, they contend "that Modelski's argument that global wars and Kondratieff long waves reflect a *common underlying process-alternating changes* in global order priorities-offers an attractive way out of the causality corner" (p.640, 1982).[23] However, I contend that the notion of "process-alternating" implies a distinct causal, albeit nonconstant, relationship between economic and conflict phenomena over time. The model purported in this research is able to capture the long term relationship of war and economic phenomena as a nonconstant relationship and to address the causal assumptions implied by such a specification.

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[23]Emphasis added. However, I contend that they offer more causal anecdotes than they give themselves credit for or at least more than they are ready to acknowledge. This fact is illustrated in some of their writing. For example, when they comment, "...we should not forget that major wars have reinforced rather than initiated the price upswing. It is quite conceivable, then, that changes in global-order priorities *precede* the advent of global wars and are therefore *responsible* for the upswings" (emphases added) (Thompson & Zuk, 1982).

Goldstein's (1988) *Long Cycles*, is the most extensive, thorough, historical accounting of the long cycles literature in both economics and political science. He argues "cyclic time" varies from one period to another (i.e. from one cycle to another) and that strict periodicity is less important than the realization of a repetition of behavior over time. As such, Goldstein does not think it necessary to constrain his analysis of cycles to a "fix" period. He suggests that fixed period cycles are not realistic and therefore develops a "base dating scheme" to allow more flexibility in his analysis for cycles.[24] In order to address the issue of exogeniety, Goldstein conducts a series of granger causality tests to assess which series may be causing the other.[25] In his analysis he finds support for the notion that war leads to inflation. Although Goldstein does make one of the first explicit attempts to empirically verify exogeneity assumptions, there are several issues complicating his analysis. Foremost is that granger causality tests are not useful in determining "causation" per se. They are useful only in determining what variables perform best in their predictive capabilities (Granato & Smith, 1994a, 1994b).[26] Moreover, although Goldstein renders valuable insights into the correlates of various economic and conflict series over time, this does not explicitly develop a general model per se.

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[24] His base dating scheme is essentially a series of cyclic up and downs (of varying periods) that have been spliced together from the works of different scholars examining long cycles.

[25]See Freeman (1983) for an excellent review of granger causality tests applied to political statistical models.

[26]These issues will be elaborated upon in a subsequent section dealing with cointegration and causality.

After the original work of Modelski, Thompson and Goldstein, subsequent research has become engulfed in analyzing the periodicity of cycles. However, most proponents of longwaves do not theoretically purport the notion of "strict" periodicity. This misnomer, i.e. the notion that there can be variance in the duration of cycles, has compelled critics, such as Beck (1991b) to suggest that "[t]here is a working oxymoron in the notion of a 'fluctuating' cycle," and to empirically substantiate the existence of cycles. Beck does so by utilizing spectral analysis.[27] As Beck's interest is primarily methodological, he examines whether there are long cycles in war severity, and whether those cycles are related to inflation. His main contention is that fixed periodicity methods, particularly spectral analysis, are the appropriate tools in which to empirically verify the existence of long wave relationships. As such, he takes issue with Goldstein's "base dating scheme" methodological approach, which is primarily descriptive. His arguments and evidence are compelling. He finds no evidence of cyclic behavior in any of the series. Interesting however, is the fact that he does find some support for the notion that there exists an interrelationship between the variables. However, he stresses that this interrelationship has nothing to do with cyclicity per se.

Nevertheless, a few scholars have posited that some series associated with systemic behavior are characterized by irregular periodicities and therefore reflect

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[27]To some extent this is not a novel enterprise. Adelman (1965) is one of the first to conceive a test of long cycles using spectral analysis.

nonlinear dynamics, which when modeled appropriately have cyclical properties. These models find support for the existence of cycles, even though the periodicities and the duration of cycles may vary throughout time. Acknowledging that there is disagreement in the literature on the precise nature of the periodicity of cycles, Sayrs (1993) specifies a nonlinear model of the war cycle where upswings and downswings do not occur at regular intervals. Utilizing a markov specification she finds evidence of cycles.[28]

Most recently, several multivariate models have been specified to analyze the confluence of various political and economic series over time. However, these studies do not make explicit exogeneity assumptions and theoretical assumptions about the relationships between the variables under analysis. Specifically, Goldstein (1991) utilizing vector autoregression analysis (VAR) finds that periods of severe war follow phases of robust economic growth, which subsequently lead to phases of stagnant growth.[29] Moreover, he finds that wars cause long waves in prices and inflation, which tend to subside in the downturn phase of the war cycle.[30] However, Williams (1992) utilizing Bayesian vector autoregression (BVAR), an approach he believes is superior, seeks to test a model similar to

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[28]Richards (1993) similarly uses a nonlinear estimation technique to determine the existence of cycles in systemic power concentrations over time. She finds evidence for irregular chaotic cyclical dynamics in concentration patterns in the international system. The issue of power concentrations will be discussed in future research.

[29]VAR is a multiple time series generalization of an autoregressive model (Maddala 1992). See Sims (1980) and Freeman et al. (1989) for an in-depth discussion of this type of time series modeling approach.

[30] In addition, Goldstein (1988) concludes from his analysis that production waves lead war and price waves.

Goldstein's. Specifically, Williams contends that there is not sufficient theoretical justification to impose restrictions on empirical models of long cycles.[31] Although he acknowledges that VAR is an approach that is capable to overcome specification problems in time series models, it has methodological problems. Particularly he notes that VAR's are unparsimonious and potentially unstable through time.[32] In his analysis, Williams, using BVAR, finds little support for the Goldstein's model, and hence, long cycle theory.

An examination of the long cycles literature suggests that several deficits exist, which need to be addressed, in the development of a general theory of that is capable of examining the dynamic interrelationship between the economy and war. First, it is crucial to develop a theoretical foundation. Distinct correlations have been uncovered which describe the general patterns of conflict and economic series over time. However, discerning how these various stories fit together to comprise a theory about the pattern of political and economic phenomena over time remains unclear. Most of long cycles research does find some correlation between various economic and political series. The question then becomes, what drives the patterns observed in the international system? How are they related to changes in the distribution of power in the international system? How does

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[31]BVAR analysis essentially requires that prior distributional assumptions be adopted prior to estimation. Technically this involves specifying a prior distribution for the coefficients in a VAR. Generally, in each equation comprising the (VAR) system of equations, the coefficient of its own lagged variable has a prior mean of one, while all other variables have prior means of zero. Moreover, the variance of the prior is specified to decrease as the lag length increases. For a thorough description of this approach in political science see Williams (1992), and in economics see Doan et al. (1984) and Litterman (1986).

[32]See Pagan (1987) for a comparison of a VAR model to other types of time series models.

international trade fit into this picture? Answer to these questions will help provide direction towards a general explanation for systemic conflict, power, the economy and trade that is capable of examining, not only what factors are responsible for changing the structure of the international system, but is also able to specify exactly how change occurs and the repercussions this has for the timing of conflict.

Second, and integral to accomplishing the first task, is addressing the issue of exogeneity. Exogeneity assumptions need to be examined for both theoretical and empirical reasons. Theoretically, exogenous conditions are explicit to any theoretical model seeking to explain what drives change in the system, in addition to the timing of these changes. Empirically, exogeneity assumptions are necessary when specifying a causal multivariate model. The model purported in this research suggests that the distribution of power and systemic conflict share an equilibrium relationship. Specifically, changes in systemic conflict can be understood as both (1) shifting international trade and economic conditions in the system and (2) reactions to changes in the distribution of power. Empirically this involves testing for cointegration among the series of interest and subsequently specifying an appropriate error correction model. Within this type of framework, causality is assumed and will be examined to determine if proposed exogeneity assumptions are valid conceptually and empirically. Using theory, a valid empirical specification can be derived that will render an appropriate test of the

interrelationship among economic and conflict phenomena in the international system. However, before the model is delineated, it is first necessary to disseminate the dynamics of systemic conflict that are captured in the proposed theoretical model.

Explaining the Dynamics of Systemic Conflict

This research purports a theoretical explanation that attempts to develop a more general understanding of the interrelationship between systemic conflict, power, the economy and trade over time. In order to do so, it is essential to move beyond the question of whether cycles exist. At some level, the more appropriate question to investigate is *why* they may or may not exist. It seems clear from the previous discussion of the long cycles literature, both economic phenomena and systemic conflict do not have fixed, conjoint, cyclical periodicities. In the strictest technical sense then, long cycles do not exist. However, the more interesting conclusion is somehow these phenomena have demonstrated some interrelationship. To disseminate the dynamics of systemic conflict, the individual effects of the economy, trade, and the distribution of power will first be explored.

The International Economy

Generally speaking, aggregate prices in the international system have tended to follow similar patterns of systemic conflict over time. That is, the rise and fall of prices correspond with the rise and decline of conflict in the international system. However, what theoretical reasons explain their alleged correlation over time? Initially, the effects of war on prices is fairly indisputable. The outbreak of war is associated with aggregate shocks in the supply and demand for goods. As a result, prices tend to rise when a shortage of goods and services cannot meet demands in the market place (Goldstein 1988, Beck 1991b). However, the notion that prices lead to war, in a causal sense, is not so clear. Although prices change when supply and demand shocks occur during a conflict, it is quite another issue to suggest that price changes are responsible for causing conflicts.[33]

However, once conflict has occurred, price changes tend to reinforce conflict in the system. That is, sudden changes in the supply and demand for goods can promote tensions among states. Moreover, the escalation of prices tend to reinforce tensions as inflation makes it more difficult for nation-states to secure

[33]The explanation developed in this research does not purport an explanation that suggests the relationship between prices and conflict is symmetrical, because the argument for prices causing war is tenuous at best (Goldstein 1988, and Beck 1991b). Thus to some degree, the relationship between prices and systemic conflict may be asymmetrical. This technical issue will be used in the development of an argument that suggests prices should be treated weakly exogenous to systemic conflict. If this assertion proves true, then the most appropriate specification of the long-run relationship hypothesized may be cointegration in a partial system.

the goods and services they need.[34] Thus changes in the supply of goods and the rise in inflation that can ensue may produce tensions, which may serve to reinforce systemic conflict. Thompson & Zuk (1982) find support for the notion that prices tend to reinforce the upswing in conflict (war). However, they also argue that prices are not solely responsible for causing systemic conflict. Moreover, another reason for this correlation, although not widely discussed is that governments tend to finance wars, not only through loans, but also through fiat money (Sargent 1986). Fiat money is essentially money borrowed from domestic monetary authorities. Thus, when the money supply increases, a subsequent rise may occur in inflation. Thus, to the extent that the onset of conflict is responsible for shocking normal market conditions, then the anticipated relationship between systemic conflict and inflation is positive. Thus, it is plausible to anticipate that inflation and systemic conflict will generally follow similar patterns over time. Figure 2.1 plots systemic conflict and inflation in the world market over time. Table 2.1 list the variables used in the analysis and their respective sources.

[34]Because inflation is the most common indicator used to study the economy, it will be used in the analysis that follows. It is simply the change in prices from one period to another, i.e. $(Prices_t) - (Prices_{t-1})$.

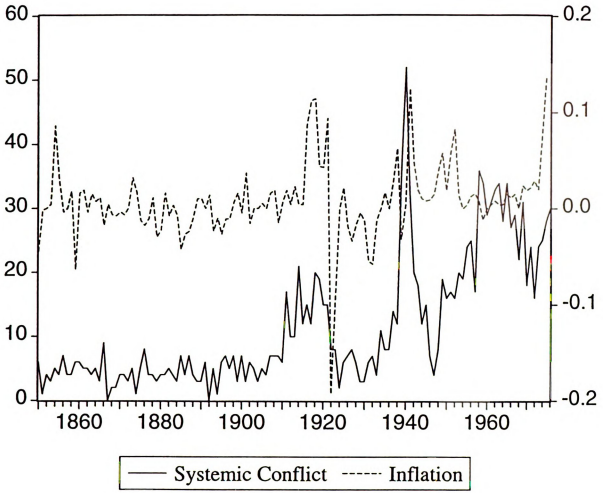

Figure 2.1 Relationship Between Systemic Conflict and Inflation

Table 2.1

Variable Descriptions

Variable Name	Source
Systemic Conflict	Gochman & Maoz (1984), *Militarized Interstate Dispute Data*. Revised under DDIR by Stewart Bremer, Binghamton University. Total number of MID's recorded for each annual observation. MID's encompasses all subcategories of disputes included in the data set. 1850-1976.
Distribution of Power	Modelski & Thompson (1988), *Sea Power in Global Politics*. Long cycle concentration index value for each annual observation. 1850-1976.
Trade	Kuczynski (1980). The ratio of exports to total world production (in constant 1913 dollars) for each annual observation. 1850-1976.
Inflation	Mitchell (1980). The first difference of the aggregate British wholesale price index for each annual observation. Common log value used for data analysis. 1850-1976.

Generally speaking, Figure 2.1 demonstrates the anticipated pattern. That is, when inflation rises, systemic conflict tends to increase in tandem. Conversely, when inflation decreases, systemic conflict declines.[35] As such, both processes will not drift far apart from one another for a long period of time, thus establishing the theoretical notion that these two processes maintain a positive long-run relationship. This will be formally tested with the following proposition:

Proposition (1): Inflation in the international economy is *positively* related to levels of systemic conflict in the international system.

This implies that as systemic conflict increases, aggregate economic conditions conducive to hostility will increase, over time, in proportion to the extent of the change. Similarly, as systemic conflict decreases, aggregate economic conditions conducive to peace will tend to increase. However, what influence does interstate commence have on conflict in the international system? It is to this topic that I now turn.

International Trade

The relationship between international commerce and conflict has been examined extensively. There are four basic theoretical orientations which examine

[35] The positive association between these two variables has been verified in several studies (Beck 1991b, Goldstein 1988, and Mansfield 1994).

the influence of trade on interstate relations.[36] The first is generally referred to as the *commercial liberal* perspective. Its roots extend into neo-classical assumptions about the benefits associated with free trade. With respect to interstate relationships, it suggests that trade promotes interactions and dependencies among states in the international system. To the extent that such interactions are mutually rewarding and not hostile, then trade will tend to promote peace and cooperation among nation states. This perspective stands in stark contrast to *classical realism.* Classical realists suggest that the frequency of conflict (war specifically), is not influenced by trade in any systematic way. Only the distribution of power influences peace and conflict in the system. Similarly, *structural realism* contends that wars occur when trade levels are relatively low as well as when they are relatively high. The effects of trade on war in this perspective, merely depend on the structure of the international system. Political-military relationships are more important than commercial relations. However, *mercantilists* (e.g. economic nationalists) argue that trade is an important determinant of conflict in the international system. However, contrary to commercial liberalists, interstate trade promotes hostility instead of peace because of the potential gains from trade that can accrue to a state's enemies.

All of these perspectives take a different stance on the benefits of international commerce and its ability to stimulate or hinder peace and conflict in

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[36]See Mansfield (1994) for an excellent, thorough discussion of these four different perspectives.

the international system. Empirical, studies examining which of these perspectives is correct are inconclusive. The theoretical model developed in this research contends that trade is an important factor to consider in the study of the causes of conflict. Because trade is partially responsible for the rise in wealth and growth of nations, its role in changing the distribution of power in the system can not be neglected. Thus, classical realism and structural realism are inadequate, as they fail to take into account the significance of trade. Moreover, trade seems to be negatively associated with systemic conflict.[37] The amount of trade continues to increase over time without a corresponding increase in conflict. Thus, the mercantilist perspective seems to be inadequate in its explanation of trade affect on interstate relations.

As such, to the extent that any conflict serves to deter the free flow of goods and services, the anticipated relationship between systemic conflict and trade is posited to be negative. Thus, contemplating the long term systemic effects of commerce on conflict lends support to the commercial liberal perspective and hence, the notion that these two variables have an inverse relationship. Figure 2.2 below demonstrates this relationship. This relationship will be formally tested with the following proposition:

Proposition (2): Aggregate levels of trade are *inversely* related to levels of systemic conflict in the international system.

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[37]This relationship has also been substantiated by other research. See Mansfield (1994).

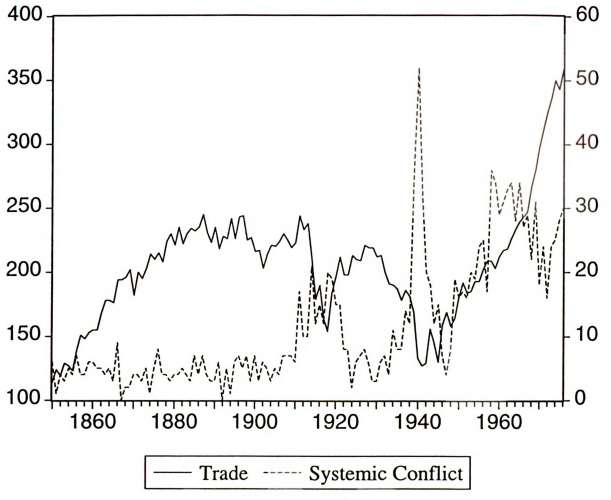

Figure 2.2 Relationship Between Trade and Systemic Conflict

The Distribution of Power

The relationship between the distribution of power and systemic conflict has been debated extensively by proponents of balance-of-power theory and power preponderance alike. Balance-of-power theorists traditionally believe that as the distribution of power becomes increasingly dispersed, the probability of war will subsequently increase. This stands in stark contrast to power preponderance theorists who posit the opposite relationship between the distribution of power and war. That is, as the distribution of power becomes progressively more homogeneous (e.g. power equality/symmetry among states), the probability of war will increase. However, the evidence in support of these theories is inconclusive at best.

Most recently Mansfield (1994) has posited, a compelling argument about the relationship between the distribution of power and war.[38] He suggests that the relationship between the distribution of power and the incidence of war is quadratic, thus suggesting that both, the highest and the lowest levels of concentration decrease the probability of conflict, while intermediate levels of concentration increase the probability of conflict.

However, most of these studies only consider the case of major power war. Again, because war is such a rare occurrence, when considering the relationship between the distribution of power and conflict in the system, the analysis of

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[38]Note however that Mansfield's (1994) research is specific to the analysis of major-power war. As such, his notion of conflict varies from the present study.

incidences of war among major powers poses a selection bias problem. Again, consideration of warfare among other states, other than major powers, needs to be considered, in addition to lower levels of conflict. Thus, when power becomes concentrated in the system, I anticipate that states are more likely to engage in conflictual behavior. Indeed this relationship is borne out in Figure 2.3 below. As power concentrations rise in the international system, a corresponding rise in the level of systemic conflict ensues. Likewise, when power concentrations decrease, so does the level of systemic conflict. This will be formally tested with the following proposition:

Proposition (3): The distribution of power concentration in the international system has a *positive* relationship with the level of systemic conflict.

However, how do systemic conflict, the distribution of power, trade and the economy fit into a general theory? This will be elaborated upon in the next section.

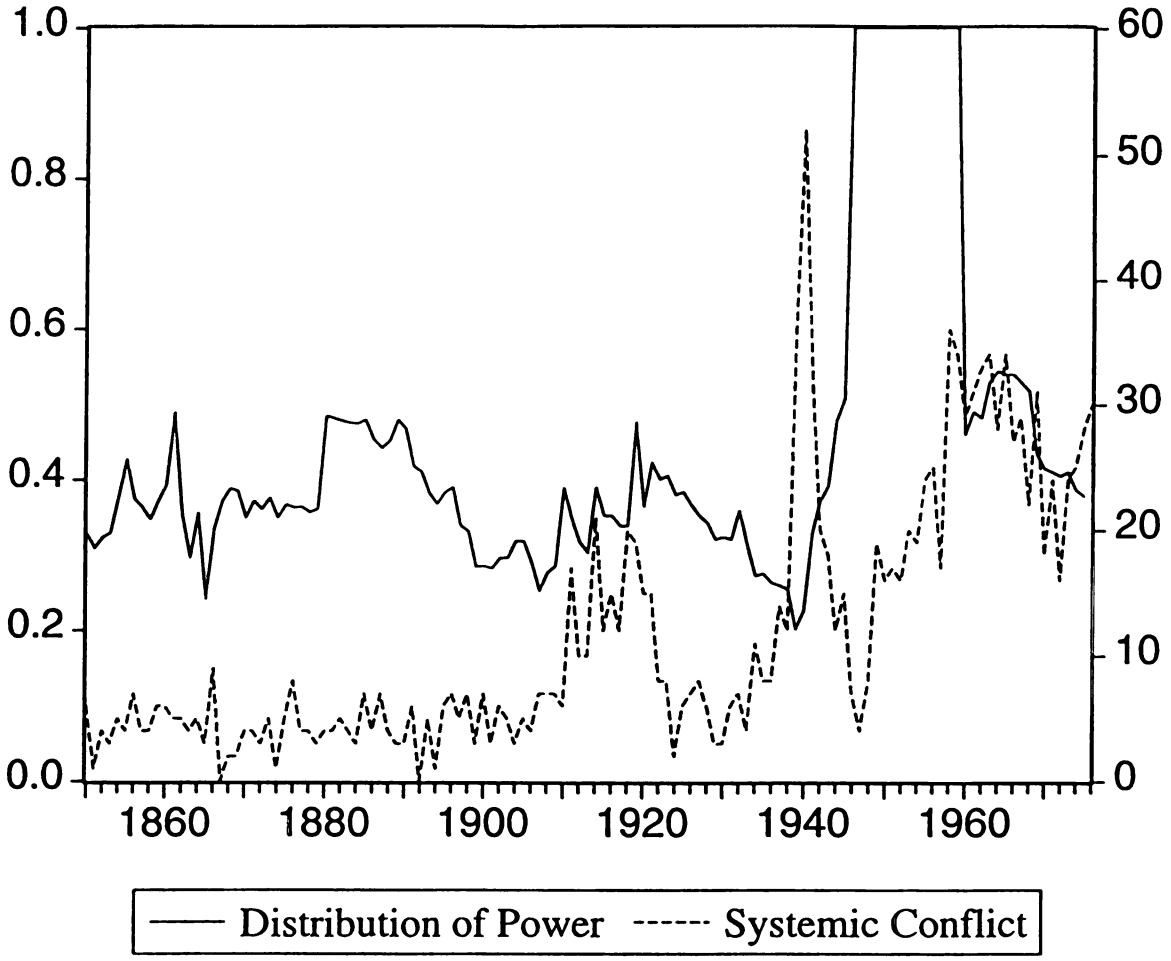

Figure 2.3 Relationship Between Distribution of Power and Systemic Conflict

Towards a General Co-Evolving Systemic Equilibrium Hypothesis

Initially, I surmise that observations in the international system are analogous to aggregate behavioral outcomes from the states comprising the system.[39] Moreover the system is characterized by aggregate economic conditions that are used to evaluate decisions to engage in international commercial activities, all of which have a substantial impact on the distribution of power among the states comprising the system. Specifically, the economy has an enduring effect upon interstate relations, both in terms of (1) determining the configuration of power (concentration and inequalities) among the states in the system, and (2) determining the configuration of interstate relations, of which interstate commerce is of primary importance. Both of these factors play an instrumental role in the politics of the international system, and hence, the timing of peace and conflict. Thus, the international economy has an effect upon how nation states are configured in the system and how this configuration may change over time. This is the crux of the theoretical argument proposed in this research. That is, fluctuations in the economy and commerce ultimately precipitate changes in the distribution of power in the system.[40] Consequently, shifts in the distribution of

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[39]This assumption maintains a systemic level of analysis. Moreover, it lends support to the supposition that behavior in the international system can be observed in the system structure. That is, patterns witnessed in the system structure are not simply processes, but aggregations of actions taken by states in the system at a particular point in time.

[40]This is manifested for example, in the asymmetric gains from trade that accrue to states in the international marketplace, and general changes in macroeconomic conditions that occur over time. Both serve to increase or decrease the level of growth and wealth of nations.

power, increase apprehension and uncertainty about the level of security in the system. It is this source of uncertainty that serves to influence the level of conflict in the international system.[41] The question then becomes, what determines when the distribution of power in the system is likely to cause uncertainty about the international structure, and likewise, warrant the outbreak of conflict?

Consider the structural model of the international system depicted in Figure 2.4. The theoretical framework illustrated in Figure 2.4 is an amended neorealist argument about the distribution of power and its affect on the likelihood of conflict. Specifically, it illustrates how the economy and trade influence the distribution of power in the international system. Moreover, the distribution of power has an affect on the likelihood of conflict it terms of the uncertainty that it generates about the configuration of states in the system. That is, uncertainty stems from whether the new configuration will promote hostility or peace in the system. As the distribution of power changes over time, this creates uncertainty about the structure of the international system, which subsequently affects the likelihood of conflict.

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[41]Moreover, it is possible that some feedback exists among structural conditions in the international system. With respect to systemic conflict, we know that the ebb and flow of economic activity changes dramatically when great power war occurs. For example, aggregate prices increase, interstate trade is disrupted, and state production strategies change when war occurs. However, changes in the economy do not necessarily compel states to engage in conflict. Nevertheless, changes in the economy have an effect on power concentrations in the international system, the latter of which does influence the onset of conflict. This will be elaborated upon further in the discussion of exogeneity.

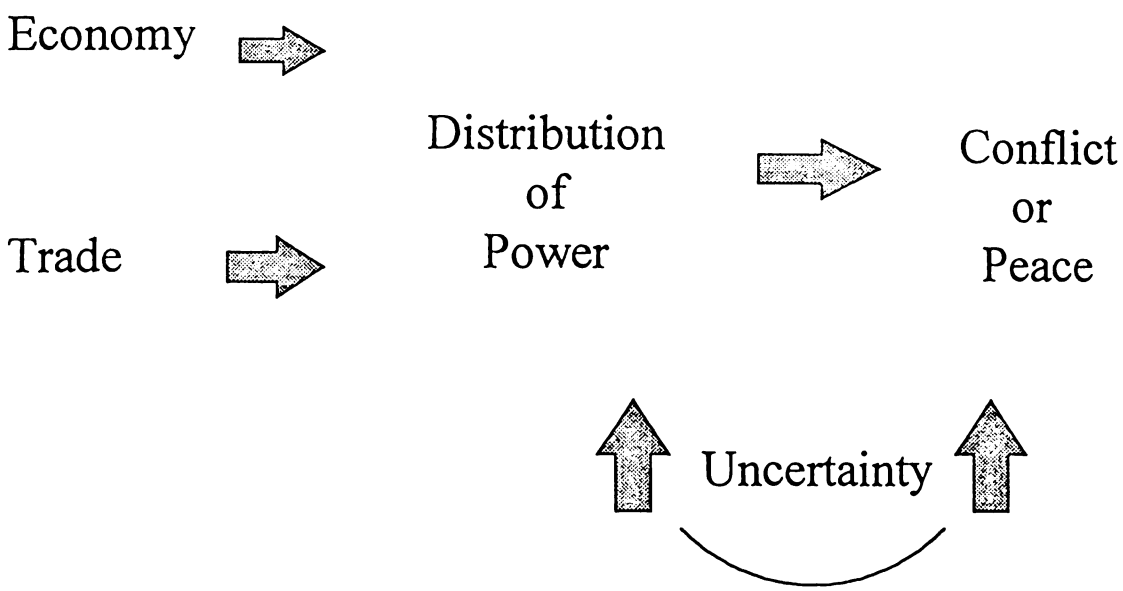

Figure 2.4 The Co-Evolving Systems Theory

Thus, from a systems perspective, the argument suggests that states monitor and respond to the level and direction of changes in the distribution of power, and other commercial and aggregate economic conditions.[42] Indeed, this is what determines the order and nature of the configuration of states within the system. To the degree that the level of conflict in the system is balanced with the structural change stemming from shifts in the distribution of power, then the system has achieved an equilibrium state.[43] However, it is important to note that as the structure evolves (e.g. cycles), so too will the appropriate level of systemic conflict. Thus, the aggregate "system" will never be at rest. That is, there does not exist one single equilibrium state in the international system. Instead, as the system continues to evolve (cycle), and the observed changes in commerce, the international economy, and the distribution of power occur, so too will the appropriate level of systemic conflict. As such, the structure contains a *moving equilibrium* that is attained whenever the level of conflict is an appropriate response to the expected changes in distribution of power.

However, what happens when the level of conflict is not an appropriate response to the changes in distribution of power. More importantly, why does this occur? In any given period, states responding to the general trajectory (i.e.

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[42]The reference to state here assumes the aggregation of states which comprise the international system. This additional assumption maintains a systems level approach.

[43] Note the definition of equilibrium here is distinct from that typically found in the literature examining structural transformation. Gilpin (1981), Doran (1989) and others seem to suggest that stability in the system is an equilibrium outcome, where stability is equated with peace in the international system. The definition of *equilibrium* in this study is different. In this research conflict is part of the equilibrium in the structure of the international system.

evolution) of the distribution of power and other economic and commercial activity in the system, may misperceive the type of structural change that has occurred, and thus, engage in conflict. To the degree that these expectations are incorrect, then states may engage in temporary (transient) conflicts. In the aggregate, such disturbances will cause *disequilibrium* between the overall level of systemic conflict and the distribution of power in the system. However, once the expectations are adjusted, the system will move towards its appropriate level of systemic conflict. As states recognize the disequilibrium between the distribution of power and the level of conflict in the system, then states will adjust their level of peace and/or conflict.

Given the arguments developed about systemic conflict equilibrium, and about the distribution of power and how it is affected by the economy and trade, the following proposition will be tested:

Proposition (4): The trend in systemic conflict will be in common with those associated with the distribution of power, trade and inflation in the international economy.

A related issue hinging on the formalization of the general theoretical framework developed in this research is the implicit exogeneity assumptions made about the interrelationship between, systemic conflict, the economy, trade and power distributions. Typically these issues have been ignored in the war-economy literature. However, given the theoretical arguments developed herein, I contend

that systemic conflict can and should be considered endogenous. Although systemic conflict is believed to share an equilibrium relationship with the economy, trade and changes in power distributions, the latter processes have been explicitly delineated to be driving changes in the level of systemic conflict. As such, the following proposition will be tested:

Proposition (5): Systemic conflict is endogenous to changes in the distribution of power, trade and inflation in the international system.

Again, it is crucial to emphasize the political process responsible for this change. That is, the distribution of power changes the configuration of interstate relations. As powerful nation-states rise and fall, new configurations of interstate relations subsequently form. This process tends to stimulate conflict among states as they seek to determine where they are configured in the new system, and most importantly how they relate to states in the new "equilibrium" within the system. As such, the dynamics associated with changes in the distribution of power are not only responsible for triggering out-of-equilibrium behavior in the system, but for *correcting* the system as well. That is, the adjustment in the power distributions in the system, are also responsible for achieving a new equilibrium path. This is a crucial insight into the development of an error correction model. To substantiate this contention, the following proposition will be tested:

Proposition (6): Disequilibrium among systemic conflict, the distribution of power, trade and inflation will create equilibrium error. When this error is eliminated, systemic conflict will move to its appropriate level.

Now that the precise nature between the constructs has been delineated, it is possible to specify a model in which to test the hypotheses. However, before a model can be specified, it is first necessary to determine whether the series in the model are individually integrated and, whether they together are cointegrated.

A Model of Co-Evolving Cycles

Before the development of an empirical model to capture the hypothesized relationships between the series pertaining to conflict, the economy, and trade, it is first necessary to determine whether each of the series under consideration are integrated. After performing these univariate diagnostic tests, the next step will be to test for cointegration. This involves determining whether the series being investigated share a common stochastic trend as proposed in proposition (4). Initially however, it is necessary to determine whether each series is integrated. A discussion of the diagnostic steps involved in examining a series for integration will first be preceded with a brief summary about the properties of stationary (e.g. nonintegrated) time series in order to discern the intuition behind the methods involved.

Properties of Integrated Series

Integrated variables are a specific class of nonstationary variables. They have statistical properties which cannot be ignored in the specification and estimation of time series models.[44] Integrated series, as defined by Engle and Granger (1987), have no deterministic component, but are characterized by a stationary, invertible, ARMA representation after differencing d times, and are therefore integrated of order d, denoted $x_t \sim I(d)$.[45] Table 2.2 below technically differentiates between I(0) and I(1) processes.

In a less technical sense, theoretically consider a times series x_t as a collection of random variables ordered in time to be characterized by a stochastic process.[46]

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[44]Although the problems associated with using nonstationary series has been written about and examined in great detail, numerous scholars continue to evade this technical issue in the specification and estimation of time series models. At least as far back as Granger & Newbold (1974), econometricians have implored their readers not to ignore the properties of integrated regressors. Granger & Newbold specifically warned against the spurious regression problem that would arise when two processes integrated of the same order (e.g. I(1)) are regressed upon one another. When this occurs, estimates obtained from an empirical model will have inflated t-stats because standard errors are typically underestimated, hence resulting in biased estimates.

[45]In fact, Wold's (1938) decomposition theorem states that a stationary time series process, with no deterministic component (e.g. time trend), has an infinite moving average (MA) representation. He proves that this MA representation can also be represented (by inversion) as a finite auto-regressive moving average (ARMA) process. Intuitively, I(0) series have: (I) a finite variance which does not depend upon time, (ii) have only a limited memory of its past behavior (e.g. the effects of a random shock are transitory), (iii) tend to fluctuate around the mean (which may include a deterministic trend), (iv) have autocorrelations that decline rapidly as the number of lags increase. I(1) series have: (I) have a variance that depends upon time and goes to infinity as time goes to infinity, (ii) have an infinitely long memory (e.g. the effects of a random shock will permanently affect the process), (iii) have a tendency to wander widely, (iv) have autocorrelations that tend to one in magnitude for all time separations (Engle & Granger, 1987).

[46]Stochastic processes (e.g. random processes) can be either discrete or continuous variables. The former characterize the series in this study (e.g. price index, exports, etc.), while for example, the recording of an electrocardiogram characterizes the latter (Maddala 1992, p.527).

Table 2.2

Properties of Stationary and Integrated Processes

Property[a]	I(0)	I(1)
Variance	Finite	Unbounded
	$(\sigma_1^2(1-\rho^2)^{-1})$	*(grows as* $t\sigma_2^2$*)*
Conditional variance	σ_1^2	σ_2^2
Autocorrelation function at lag *k*	$\rho_k = \rho^k$	$\rho_k = \sqrt{1-(k/t)} \to 1 \ \forall \ k$ *as* $t \to \infty$
Expected time between crossings of y=0	Finite	Infinite
Memory[b]	Temporary	Permanent

[a]This table is duplicated from Banerjee et al. (1994), p. 85.

[b] A series has a permanent memory if the effect of the shock does not disappear as $t \to \infty$.

[c] In a multivariate context, an integrated process may have some components that do not remain in the series indefinitely. If a series is integrated, there must be at least one component that will have permanent effects, but there may be others with temporary memory. For example, a random walk process would yield an integrated process, but memory would be permanent only for the random walk component.

A series is considered stationary (i.e. not integrated) if there is no systematic change in the mean of the variable and if no systematic variation exists over time.[47] That is, the series has a constant unconditional mean and variance over time. This is equivalent to implying that the random variables comprising the series are independent of the effects of time. This is a rather tenuous assumption.[48] As such, stationarity for a series is usually defined in a less restrictive manner where its mean is constant and its covariance depends only on its lag:

$$E(x_t) = \mu$$

$$Cov\ [x(t),\ x(t+\tau)] = \lambda(\tau)$$

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[47]This is equivalent to conditions associated with strict stationarity (Maddala 1992, p.528). Technically speaking, conditions associated with strict stationarity are based upon rather strong assumptions which are tenuous in practice. This is because strict stationarity implies that the distribution of x_t is independent of all *t*. As a result, not only are the mean and variance considered constant, but all higher order moments. However, if a series is assumed to be normally distributed, achieving stationarity is not as arduous a process. As the multivariate normal is characterized by only the first and second moments (i.e. (μ,σ^2)), the properties of a series higher order moments are not considered. As such, in the multivariate case, strict stationarity and weak stationarity are technically equivalent. For other distributional forms however, this may not be the case.

[48]Consider a series representing monthly unemployment rate for a 5 year period. Theoretically, it is hardly controversial to suggest that the current unemployment rate (x_t) is based in part upon last months unemployment rate (x_{t-1}), or that it can determine future unemployment levels (x_{t+1}) . Although the unemployment rate changes over time, generally, it does not fluctuate widely from month to month. However, in a technical sense, each unemployment rate recorded in time is random to the extent that its value is always "pertaining to chance" (Maddala 1992, p.527). Although implicitly, there is some dependence implied, technically, the current unemployment rate does not depend, in a deterministic sense on all previous months unemployment. Thus suggestive of an assumption of independence. Although series must technically be independent, this may not be a valid assumption given our theories and what they suggest about the distributional form of a series. In some cases a unit root is implied by many economic and political models. For example, in the former case the rational use of information by economic agents justifies the theoretical assumption of an integrated process. Moreover, modeling the budgetary process as an incremental process is also a justification for an *a priori* assumption of integration.

This is referred to as weak stationarity. Thus if a series is nonstationary (i.e. integrated), its mean is characterized by some systematic change (i.e. a trend) and the covariance associated with the series also depends on time.[49] In this case, most of the moments associated with the series distribution will depend on time and standard statistical assumptions relying on normal distributional properties will be violated.[50] As a result, conducting inference with such a series will be problematic.[51] Thus, because of the properties associated with integrated series, and the problems that can arise in estimation and inference, it is crucial to conduct stationary tests on all series comprising a model.

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[49] However, another variant of the stochastic process described above, is a random walk. The mean and variance of these types of time series are also time dependent, however, when taking the first difference, the series is found stationary (Maddala 1992, p.513). This class of variables is also referred to as difference stationary processes (DSP). Generally speaking, deterministic trends are only linear projections, thus there is no change in the variance over time. However, a series with a trend in the stochastic component (TSP) leads to cyclical movements around the trend, and therefore the variance throughout time is changing. Fractional integration tests can be used to determine whether a series is of the TSP or DSP class. (See Granger & Joyeux 1980, Harvey 1991, Diebold & Rudebusch 1989, Dolado et al. 1990 for a description of these tests).

[50] Moreover, in many cases taking the first difference of the variable will not render it stationary. If the series is characterized by a trend, typically the next step is to determine whether the trend is deterministic or stochastic in nature. Integrated variables are characterized by unit roots which give rise to stochastic trends, as opposed to deterministic trends. In the latter, innovations to an integrated process are permanent, whereas in a stochastic trend they are transient. This has obvious statistical implications, but also theoretical implications as well. Whether a series has a deterministic or stochastic trend, hence permanent versus a transient memory process, has implications for the information that one is modeling. Specifically, whether one is modeling long-run and/or short term components, and whether one or the other is a valid representation of the theoretical framework under analysis.

[51] Aside from the issues necessitating diagnostics of the univariate properties of individual time series, there also exists methodological issues in the multivariate context as well. A widely noted problem in the multivariate case, necessitating the identification of the order of all variables (i.e. I(d)) in a statistical model, is the spurious regression problem mentioned previously (Granger & Newbold, 1974). Generally when two integrated variables (I(1) random walks) are regressed on one another, standard error estimates are biased downward. Consequently, OLS estimates will be biased. Specifically, the bias produces t-statistics that are inflated and a R^2 that is superficially high; hence, indicating a good fit of the model, when in fact there is not one.

Diagnosing Integration

Dickey and Fuller (1979, 1981) develop a class of statistics capable of discerning whether a series is integrated. Generally speaking, the Dickey-Fuller test (DF) consists of testing a single series against a null hypothesis of integration. Consider the series x_t again. Decomposing it into:

$$x_t = \beta_0 + \beta_{1t} + u_t$$
$$\textit{where: } u_t = \alpha u_{t-1} + \epsilon_t$$

and β_0 is a constant, while β_t represents a linear time trend.[52] Assume ϵ_t is a covariance stationary process with a mean of zero. The reduced form of this equation can be represented more generally as :

$$x_t = \gamma_0 + \delta_{1t} + \alpha x_{t-1} + \epsilon_t$$
$$\textit{where: } \gamma = \beta_0(1-\alpha) + \beta_1\alpha$$
$$\delta = \beta_1(1-\alpha)$$

If the reduced form is characterized by a unit root, then $\alpha=1$ and $\delta=0$, the latter suggesting the absence of a deterministic time trend.[53] The test statistic used in the analysis which follows is:

$$t(1) = \frac{\alpha - 1}{SE(\alpha)}$$

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[52]This notation follows the discussion found in Maddala (1992, p.583).

[53]As will be noted later, assuming $\gamma=0$ i.e. no drift, is not always appropriate. This technical point compels MacKinnon (1991) and others to derive alternative sets of critical values to take into account the possibility of drift and its effect on the distribution of α.

where α is the OLS estimate of a reparameterized version of the reduced form equation above and SE(α) is its corresponding estimated standard error.

Specifically, the DF test consists of generating the regression:

$$\Delta x_t = \gamma_0 + \delta_{1t} + \phi x_{t-1} + \epsilon_t$$

after which, a test is conducted on the significance of ϕ.[54] However, given the discussion above concerning the distributional properties associated with nonstationary series, the asymptotic distribution of this test statistic is nonnormal. Thus, standard t-tests based on normal distributional assumptions are inappropriate. Appropriate critical values are tabulated by D.A. Dickey (1975) and are reported by Fuller (1976). However, these critical values are tabulated for γ=0, e.g. they assume that there is no drift present in the series. When drift is present in a series, the distribution of the estimated coefficient on the lagged level of the series (i.e. ϕ) in a DF test depends on the value of the constant (i.e. γ). MacKinnon (1991) argues that if a series contains drift (i.e. $\gamma \neq 0$) then a time trend should be included in the DF regression, and hence, a new set of critical values should be used that capture the dependence between γ and the trend. MacKinnon provides correct critical values to test hypothesis for DF tests when $\gamma \neq 0$.[55]

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[54]Note the reparameterization consists of regressing the change of x_t on a lag of itself. This is done in order to determine if the change in the series, i.e. Δ, is a factor of the characteristic equation of x_t.

[55]MacKinnon (1991) emphasizes the point that several diagnostic decisions have to be made concerning the specific form that is appropriate to use for the Dickey-Fuller test for any particular time series under analysis. These issues are discussed in Banerjee et al. (1994).

The Dickey-Fuller test essentially involves regressing current changes on lagged levels of itself. The null of nonstationarity is tested by determining if the coefficient on the lagged levels is negative and statistically significant. If it is, the null is rejected, and the series is determined to be stationary (e.g. not integrated).[56] Again, if a series is characterized by stationary properties, it has an identifiable mean and finite variance around its mean. Thus, the mean and the variance are constant and not changing over time. Intuitively the expectation for ϕ on the lagged level above, if the series is stationary, should be negative and significant. Given that a stationary series exhibits mean reverting behavior, positive changes toward the mean at one time period, should be followed by negative changes toward the mean in the subsequent period. On the contrary, in a nonstationary series, current changes will not be associated with past levels. Because such series have nonconstant mean and infinite variance, the series will tend to depart ever further from any given value as time goes on. If this movement is predominantly in one direction the series is generally considered to have a trend.

Once a Dickey-Fuller regression has been estimated, it is necessary then to diagnose whether the residuals are characterized by serial correlation. If the error terms are serially correlated, then the usual suspects associated with autocorrelation arise (e.g. inefficient estimates, inflated standard errors, invalid

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[56]A variant of this procedure is also used in determining whether two series are cointegrated. In this diagnostic test however, the residuals from the cointegrating regression are analyzed with respect to their stationary properties. This will be elaborated upon further when discussing cointegrating regressions.

covariance matrix for significance testing, etc.), rendering the test statistic useless.[57] There are several tests used to detect serial correlation. The specification of these test largely depend upon whether or not a lagged endogenous term is part of the original regression.[58] If serial correlation is present, then it becomes necessary to add additional lagged changes of the series on the right hand side of the equation (as many as necessary) in order to achieve white noise. The test is referred to as the Augmented Dickey-Fuller (ADF).

$$\Delta x_t = \gamma_0 + \delta_{1t} + \phi x_{t-1} + \sum_{j=1}^{p} \theta_j \Delta x_{t-j} + \epsilon_t$$

The purpose in adding the additional Δx_{t-j} terms is to allow for ARMA error processes.[59] If the residuals are white noise from the regression above, tests for statistical significance will be reliable.

Four variable series are used in the model to test the theoretical hypotheses, they are systemic conflict, the distribution of power, inflation, and level of world trade respectively. Table 2.3 provides descriptive statistics for each of the series. The results of the Dickey-Fuller tests (DF) for these times series are presented in

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[57]See Phillips & Perron (1988) for a discussion of this issue and alternative tests for unit roots in time series models.

[58]See Appendix A for a discussion of the tests used for serial correlation in the analysis which follows.

[59]Thus p is selected on the basis of being sufficient large to insure that ϵ_t is white noise.

Table 2.4. Again, the DF tests the null of integration against the alternative hypothesis of stationarity. The DF critical values appropriate for this sample are calculated by using MacKinnon's formula and are presented in Table 2.5.

The results in Table 2.4 suggest several interesting findings:

(1) The systemic conflict series is an I(1) difference stationary process. It contains a stochastic trend, rather than a deterministic trend.

(2) The distribution of power series is an I(1) difference stationary process. It contains a stochastic trend, rather than a deterministic trend.

(3) The inflation series is an I(1) difference stationary process. It contains a stochastic trend, rather than a deterministic trend.

(4) The trade series is an I(1) difference stationary process. It contains a stochastic trend, rather than a deterministic trend.

Now that the nature of the trends in each of the series has been determined, it is possible to test whether these trends are common across the four series forming a cointegrating vector (Engle & Granger, 1987). This will subsequently enable the specification of an empirical model and a test of the remaining hypotheses.

Table 2.3

Descriptive Statistics

Series	Mean	Std. Dev.	Min.	Max.	N
Power	0.44	0.21	0.20	1.00	125
ΔPower	.0006	.0772	-0.540	0.493	124
Inflation	0.008	0.039	-0.193	0.137	125
ΔInflation	0.001	0.042	-0.287	0.121	124
Systemic Conflict	11.48	10.19	0.00	52.00	125
ΔSystemic Conflict	0.22	5.65	-20.00	24.00	124
Trade	205.53	43.35	350.00	119.00	125
ΔTrade	1.77	11.84	-36.00	30.00	124

Table 2.4

Dickey-Fuller Tests for Nonstationarity

Time Series[a]	DF[b]	Box-Pierce Q[c]	ADF	Breusch-Godfrey
		Levels		
Systemic Conflict[d]	-2.937	33.18	-1.75	.418
Power[d]	-2.113	27.21	-2.04	1.306
Inflation	-4.051	17.17	-2.25	3.047
Trade	-.209	50.26	-.616	1.48
		First Difference		
Δ Systemic Conflict	-14.61	31.86	NA	NA
Δ Power	-9.32	31.28	NA	NA
Δ Inflation	-14.39	57.69	-12.76	2.21
Δ Trade	-11.49	49.00	NA	NA

[a]The common logged value is used for the price series.

[b]The numbers reported in the table are the estimated t-statistics from the coefficients associated with the lagged level of the series for each DF and ADF regression. For a list of the appropriate critical values see Table 2.5.

[c]The tests for serial correlation are dependent upon whether the regressions used to test for stationarity include a lagged endogenous term. By definition, the DF tests does not include such a term and therefore the Box-Pierce Q is appropriate test for serial correlation. However, the ADF test does include a lagged endogenous term on the right hand side and necessitates the use of a Breusch-Godfrey test. For a discussion of these tests, the issues involved, and the appropriate critical values see Appendix D.

[d]This series contained a significant constant term that subsequently became insignificant in

Table 2.5

MacKinnon's Critical Values

n	Model[a]	Point (%)	ϕ_∞	SE	ϕ_1	ϕ_2	Critical Values[b] N=125
1	Constant, No Trend	1	-3.4336	0.0024	-5.999	-29.25	-3.48
		5	-2.8621	0.0011	-2.738	-8.36	-2.89
		10	-2.5671	0.0009	-1.438	-4.48	-2.58
1	Constant, Trend	1	-3.9638	0.0019	-8.353	-47.44	-4.03
		5	-3.4126	0.0012	-4.039	-17.83	-3.45
		10	-3.1279	0.0009	-2.418	-7.58	-3.15
2	Constant, No Trend	1	-3.9001	0.0022	-10.534	-30.03	-3.99
		5	-3.3377	0.0012	-5.967	-8.98	-3.39
		10	-3.0462	0.0009	-4.069	-5.73	-3.08
2	Constant, Trend	1	-4.3266	0.0022	-15.531	-34.03	-4.45
		5	-3.7809	0.0013	-9.421	-15.06	-3.86
		10	-3.4959	0.0009	-7.203	-4.01	-3.55
3	Constant, No Trend	1	-4.2981	0.0023	-13.790	-46.37	-4.41
		5	-3.7429	0.0012	-8.352	-13.41	-3.81
		10	-3.4518	0.0010	-6.241	-2.79	-3.50
3	Constant, Trend	1	-4.6676	0.0022	-18.492	-49.35	-4.82
		5	-4.1193	0.0011	-12.024	-13.13	-4.22
		10	-3.8344	0.0009	-9.188	-4.85	-3.91
4	Constant, No Trend	1	-4.6493	0.0023	-17.188	-59.20	-4.79
		5	-4.1000	0.0012	-10.745	-21.57	-4.18
		10	-3.8110	0.0009	-8.317	-5.19	-4.02
4	Constant, Trend	1	-4.9695	0.0021	-22.504	-50.22	-4.79
		5	-4.4294	0.0012	-14.501	-19.54	-4.18
		10	-4.1474	0.0010	-11.165	-9.88	-4.02

[a] The different model types depend upon the presence of a constant term and/or a time trend in a Dickey-Fuller specification.
[b] The critical values are calculated according to the following formula: $C(p)=\phi_\infty + \phi_1 T^{-1} + \phi_2 T^{-2}$

Diagnosing Cointegration

In order to test whether the three series comprise a common trend, it is necessary to estimate a cointegrating regression. First, consider *n* times series given by $x_{1t}, x_{2t},..., x_{nt}$. In the analysis which follows n=4; therefore we are interested in obtaining a set of residuals from a regression among the same four series tested for integration above. To accomplish this, it is first necessary to estimate a cointegrating regression of the following form:

$$x_{1t} = \gamma_0 + \sum_{j=2}^{n} \beta_j x_{jt} + z_t$$

Essentially this involves regressing the levels of systemic conflict on the other series representing the distribution of power, inflation and trade. If these series are cointegrated, analysis of residuals Z_t produced from their linear combination should be stationary. That is, the cointegrating residuals,

$$\hat{z}_t = x_t - \hat{y}_{1t} - \beta \sum x_{jt}$$

should be I(0). Engle & Granger (1987) suggest seven alternative tests for determining if z_t is stationary. In the analysis which follows, two of the tests they recommend will be conducted. The first is the Durbin-Watson statistic for a cointegration regression (CRDW) originally suggested by Sargan & Bhargava

(1983), while the second is simply a DF statistic for the cointegrating residuals (CRDF) (Dickey & Fuller, 1981).[60]

First the DW statistic for the cointegrating regression equation above (CRDW) should approach zero if the cointegrating residuals (i.e. z_t) contain an autoregressive unit root. As such, the test consists of computing a statistic similar to the conventional DW statistic:

$$CRDW = \frac{\sum_{t=2}^{T} (\hat{z}_t - \hat{z}_{t-1})^2}{\sum_{t=1}^{T} (\hat{z}_t)^2}$$

The null hypothesis being tested, using the CRDW statistic, is a single unit root. Thus, the test consists of rejecting the null hypothesis of non-integration if the CRDW is significantly different from zero, in favor of the alternative stipulating cointegration.[61]

Secondly, the DF for the cointegrating regression equation above (CRDF) is similar to the original DF's used to test for integration in a single series. In this

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[60]Critical values for these tests can be found in most econometric texts. For example, see Banerjee et al. (1994) and Maddala (1992).

[61]Again, this test is similar to the original Durbin-Watson test in which the null assumes $\rho=1$. Hence, the test is the null that DW=0 against the alternative, which suggests the DW>0. Recall that DW $\approx 2(1-\rho)$. Thus when $\rho=1$, DW=0. Engle & Granger (1987) present the critical values of this test for 100 observations in the case where N=2. However, Engle & Yoo (1987) produce expanded critical values for 100 and 200 observations for a system of up to 5 variables. Because the sample used in this research is over 100, the latter critical values are used.

context, the series under analysis is the cointegrating residuals (z_t). That is, the CRDF statistic is based upon the OLS estimation of:

$$\Delta\hat{Z}_t = \gamma_0 + \gamma_1\hat{Z}_{t-1} + \sum_{i=1}^{p}\gamma_{2i}\Delta\hat{Z}_{t-1} + \epsilon_t$$

where a test of the significance of the coefficient on the lagged level of the residuals (i.e. γ_1) is conducted.[62] If γ_1 is significant then the residuals from the cointegrating regression are stationary, i.e. I(0), hence indicating that the four variables in the system form a cointegrating vector. Table 2.6 reveals the estimates derived from the cointegrating regression.

Although it is not appropriate to conduct inference from the estimated coefficients, in terms of the magnitude of their effect on systemic conflict, it is possible to get some initial insights about the hypothesized effects of the regressors. Specifically, proposition (1) proposed that inflation in the international economy will be *positively* related to levels of systemic conflict in the international system. Indeed the estimates reported in Table 2.6 suggest that inflation does have a positive effect on systemic conflict. Moreover, proposition (2) proposed that aggregate levels of trade in the international economy will generally be *inversely* related to levels of systemic conflict in the international system. Surprisingly, the estimates in Table 2.6 again do not give support to this proposition.

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[62]Again, the value of p in the above equation is selected on the basis of being sufficiently large to insure that ϵ_t is white noise. Note for a DF p=0, thus the system includes only one lagged endogenous term on the right hand side. Thus, in the case where $p \geq 1$, the test would be a augmented Dickey-Fuller specification for the cointegrating regression (e.g. CRADF).

Table 2.6

Cointegration Regression and Evidence of Cointegration

	Level of Systemic Conflict		
Independent Variable[a]	OLS Coefficient[b]	SE	T-Statistics
Levels of Power	14.255	4.011	3.554
Levels of Inflation	62.547	21.389	2.924
Levels of Trade	0.039	0.018	2.061
Constant	-3.413	4.438	-0.769
Goodness-of-Fit Measures		Residual Diagnostics (Z_t)	
R^2 = .184	SSE = 9.293	CRDF = -4.35 (p<.05)[d]	
Adjusted R^2 = 0.164	CRDW[c] = .529	Box-Pierce Q = 31.014	

[a]The results from the procedure were produced from *E-Views*, MicroTSP version 1.0

[b]Because of the nonstationarity of the individual regressors, the coefficients reported have nonstandard distributions. This subsequently makes drawing any inferences from them, in terms of their magnitudes and statistical significance, problematic (Engle & Granger 1987).

[c]The five percent critical values reported by Sargan & Bhargava (1983) have been revised by Engle & Yoo (1987) for a CRDW test with four series (i.e. N=4) for the following sample sizes (T) are: T=50 (1.10), T=100 (.65), T=200 (.48).

[d]Table 5 lists the critical values for the DF test of the residuals for a specification with n=4, with a constant and no trend (MacKinnon, 1991). Because the cointegration regression included a constant term, it is subsequently excluded in the DF regression specification used to analyze the residuals Z_t.

Proposition (3) contends that the distribution of power in the international system should be positively associated with systemic conflict. Indeed this relationship is borne out in Table 2.6. However, because of the nonstationarity of the individual regressors, the coefficients reported have nonstandard distributions. Thus, drawing inferences from these estimates, in terms of the magnitude of their effects or statistical significance, is problematic.

How well does proposition (4) perform? This proposition suggests that the trend associated with systemic conflict in the international system, will be in common with those associated with the distribution of power, inflation, and aggregate levels of trade in the international economy. Hence, this is an explicit hypothesis that the series form a cointegrating vector. Technically, if the variables used in the analysis share a common trend, then the residuals from the cointegrating regression will be stationary. If the variables comprise a cointegrating vector, this renders support to the proposition that these series comprise an equilibrium relationship. As evinced by the residual diagnostics of (Z_t) reported in Table 2.6, both the CRDW and the CRDF tests indicate that the series are cointegrated. Specifically, the CRDW statistic estimated from the cointegrating regression (.529) exceeds the critical value (.48) reported by Sargan & Bhargava (1983). Thus, it is appropriate to reject the null of no cointegration. Moreover, the CRDF statistic derived from estimation (-4.35) is smaller than the

critical values reported by MacKinnon (1991) listed in Table 2.5, hence rendering the null invalid.[63] Thus, we have support for proposition (4).

A related issue is the implicit assumption that there is a single cointegrating vector among the three series. This is explicitly examined by using Johansen's (1988) procedure for testing multiple cointegrating vectors. The results from the Johansen test are reported in Table 2.7. The estimates from the test reveal that the four variables together form at most, only one cointegrating vector. The estimate of the LLR statistic for the null hypothesis that there are no cointegrating vectors (e.g. $r \leq 0$) is significant, i.e. (49.848) exceeds the $p<.05$ level critical value (39.89). Moreover, the estimated LLR statistic for the null hypothesis suggesting $r \leq 1$, is significant, i.e. (24.708) exceeds the $p<.05$ level critical value (24.31). Both of these results suggest support for the existence of at least one cointegrating vector among the four series.

Thus the results from the analysis in this section also render support to the idea of modeling systemic conflict as an error correction process. The next sections turn to the task of developing an error correction model (ECM) and to testing the remaining propositions. However, preceding the development of the empirical model will be a discussion about the nature of causality, in an effort to test the exogeneity assumptions advanced in proposition (5).

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[63]Note, the CRDF test statistic is statistically significant at the $p<.05$ level.

Table 2.7

Johansen Cointegration Test

Null Hypothesis[a]	λ	LLR[b] Test Statistic	α=.05
r≤0	.190	49.848	39.89
r≤1	.131	24.708	24.31
r≤2	.052	7.995	12.53
r≤3	.014	1.677	3.84

[a]The results from this procedure were produced from *E-Views*, MicroTSP version 1.0

[b]These statistics were generated from a vector autoregression. The initial cointegrating regression was normalized on systemic conflict. The cointegrating regression included an intercept and time trend. Six lags were included for each of the endogenous variables in the system

The Nature of Causality in Cointegrated Systems

The Role of Exogeneity in Modeling

Exogeneity assumptions play a crucial role, theoretically and empirically, in causal modeling within the field of international relations. However, exogeneity as a concept is rarely evoked in discussions of theory building or in empirical specifications. This deficit is most apparent in the Long Cycles literature. This lack of dialogue serves to reinforce the benign neglect of (1) rigorously substantiating the veracity of specific claims presumed to depict the order of how processes and events occur or function in the world and (2) disregarding vital information crucial to the consistent and efficient estimation of models used to conduct inference. As Hendry (1993) notes, the word exogenous "connotes 'being determined outside of (the model of analysis),' and yet researchers frequently attempt to ascribe the status of 'exogenous' to a variable per se (as with, say, the sun's energy) and then deduce certain inferences therefrom (e.g. the variable is a valid instrument for estimation)." As will be demonstrated in the discussion which follows, exogeneity is crucial in determining the conditions under which processes responsible for generating the independent variables in a single-equation model can be ignored without compromising the consistent and efficient estimation of

parameters in a conditional model.[64] Thus exogeneity goes beyond theoretical issues associated with the temporal ordering of variables into the realm of estimation and how to achieve efficiency and consistency in empirical analysis used to make inferences about behavior or processes being modeled. In particular, this discussion will focus on the implications exogeneity has for estimation of cointegrating systems in general and error correction models in particular.[65]

Initially it is important to stress that exogeneity and causality in this discussion, in particular because of the emphasis of these issues on cointegration and error correction models, have both, theoretical and empirical implications. Theoretically the issue of how to specify a variable, as an endogenous or exogenous process, is crucial in terms of adequately assessing the viability of hypothesis emanating from our theories about how we think the world functions. For example, what moves cycles of peace and conflict? The very question suggests that I am interested in explaining the current levels of systemic conflict, hence endogenizing the process. However, what if the factors hypothesized to move cycles of peace and conflict are likewise effected by system conflict? What implications does this feedback have for exogeneity assumptions? Moreover, if

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[64]The conditional model generally speaking, is the model, or equation of interest, that contains the endogenous process under analysis. That is, the equation in which inference is based. The conditional model is sometimes referred to as the structural model (Granato & Smith 1994a, 1994b). The marginal model is the equation that creates the process generating a regressor found in the conditional model.

[65]The issues dealt with in this section are not new, however their application to cointegration and error correction models have not been widely considered. The following discussion draws upon the insights of Cooley & LeRoy (1985), Ericsson (1992), Granger (1988a), Granato & Smith (1994a & 1994b) and Hendry (1993).

subsequent analysis reveals sufficient justification for a cointegrating relationship (i.e. systemic conflict and inflation for example), what implication does this have for a hypothesized causal relationship? All of these issues have technical ramifications. Empirically, at stake is whether there is sufficient information about the process and the parameters of interest, to insure efficient and consistent estimation?[66] Thus, although theoretical reasons may exist for a particular specification, the technical ramifications of such a specification cannot be ignored.

In some respects cointegration brings up new issues associated with exogeneity and causality. Specifically, the symmetric relationship that is typically assumed between variables that comprise a cointegrating vector, e.g. the notion that they share a common stochastic trend, may pose problems to efficient and consistent estimation; hence, this has implications for exogeneity assumptions in error correction models. Technically however, under certain conditions, it is possible to specify restrictions on cointegrating relationships, specifically on the long-run component, which afford consistent and efficient estimation, and hence, valid inferences, in a single-equation ECM framework. However, as will be demonstrated, this can only be achieved under strong exogeneity assumptions.[67] It

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[66]For example, typically in times series models, such as auto distributed lags (ADL), simultaneous equation models (SEQ), vector autoregressions (VAR), etc., the history of the process under analysis is of interest. Moreover, other variables (in a static sense, the independent regressors) are also of interest, in addition to their past histories. Nonetheless, for purposes of parsimony or identification, many of these regressors are not modeled. However, it is necessary to consider whether the exclusion of this information compromises the consistent and efficient estimation of the model.

[67]Typically it might be assumed that weak exogenous conditions are sufficient; however, given the symmetric assumption in cointegrating relationships, resulting in dependence between parameters of interest in both the conditional and marginal models, efficient and consistent estimation of the conditional model is

is important to stress the theoretical implications these restrictions have for the processes under analysis. Specifically, *a priori*, their must be reason to believe that the processes comprising a cointegrating relationship have an asymmetric relationship. Technically, the asymmetric assumption implies that only the dependent process under analysis responds to equilibrium errors in the ECM. In terms of the theoretical framework developed in this research, the general systemic conflict equilibrium hypothesis satisfies this technical restriction on the ECM. Specifically, recall that the theoretical model specified earlier suggests that the distribution of power conditions the actions and reactions of states in their decisions to engage in conflict within the system. Thus, systemic conflict alone reacts to, or more generally, corrects changes in the equilibrium relationship it shares with the state of the distribution of power in the international structure, not vice-versa. How then are exogenous assumptions rendered viable, especially in the context of cointegration and ECM's ?

Hendry (1993) notes that more often than not, researchers resort to Granger causality tests to determine the validity of their exogenous assumptions. Granger causality is the technical condition that specifies the precedence or temporal ordering, of one variable's occurrence before another.[68] In the bivariate case, two

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compromised. Thus, asymmetric restrictions on the long-run components have to be specified; hence, the necessary introduction of Granger non-causality and strong exogeneity.

[68]The technical statement of Granger causality was initially developed in Granger (1969), although Granger himself acknowledges the roots of his thoughts derive from technical points originally espoused by Wiener (1956). See Freeman (1983) for an introduction of Granger causality in political analysis.

time series x_t and y_t, it can be shown that the series x_t, fails to *Granger cause* the series y_t, if in a regression of y_t on lagged values of y_t and lagged values of x_t, the coefficients estimated for the latter are zero; hence, signifying no significant effect. Specifically,

$$y_t = \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + u_t \qquad (i=1,2,...,k)$$

If $\beta_i = 0$, x_t fails to Granger cause y_t. However, the use of Granger causality tests to determine the appropriateness of exogeneity assumptions is flawed for several reasons. Specifically, it is inappropriate and can lead to Type I and Type II errors when trying to ascertain whether one variable *Granger causes* another.[69] Specifically, this is problematic not only because Granger causality tests do not examine *causality* between variables per se, but also, technically speaking, it is insufficient for establishing *a priori*, the prerequisite condition of weak exogeneity.[70] A brief discussion of exogeneity, both its technical and theoretical aspects will proceed in order to fully demonstrate the intuition and importance of these issues to the model purported in this research.

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[69]Generally, Type I and II errors can occur because Granger causality tests (1) lack power and (2) give no information about consistent estimation because, by design, they do not afford any insight into weak exogeneity. See Granato & Smith (1994a) for an intuitive technical discussion of these points.

[70]Granger causality tests, for example in the bivariate case, enable one to determine which variable has a greater *predictive* capacity in accounting for the other, in terms of variance explained. Therefore, its ability to render *causality* per se is limited in this technical sense. The limitations of Granger's test, in political analysis particularly, is discussed in Granato & Smith (1994a & 1994b).

Defining Exogeneity

Initially, consider the types of exogeneity discussed by Engle, Hendry & Richard's (1983), e.g. weak, super, and strong (strict).[71] Weak exogeneity is defined in the following manner:

weak exogeneity: A variable x_t is considered weakly exogenous to estimate a set of parameters λ, if inference for these parameters, which are conditioned on x_t, involves no loss of information.

More generally, weak exogeneity "is a relationship linking certain variables to parameters of interest and is precisely the condition needed to sustain valid inferences about those parameters in models which condition on contemporaneous variables" (Hendry, 1993, p.331). According to this definition, weak exogeneity implies that the marginal model for x_t would not depend on a conditional model. That is, the parameters within a conditional model are independent of a marginal model and there are no cross equation restrictions between the marginal and

[71]For the purposes of the following analysis, super exogeneity will not be discussed in great detail. Generally speaking, super exogeneity is the conjunction of weak exogeneity and "invariance." (The invariance condition is also referred to as *variation free*. Generally this concept assumes that knowledge about the value of a parameter provides no additional information on another parameter's range of value Ericsson (1992)). That is, if x_t has been established to be weakly exogenous, and parameters in the conditional model remain invariant to changes in the marginal distribution of x_t, then x_t is deemed super exogenous. Super exogeneity is used to insure valid policy simulations. Specifically, this concept is related to the Lucas critique which stipulates that coefficient estimates, specifically in a simultaneously equation model, should not be assumed to be independent of changes in the exogenous variables within a model (Maddala 1992, p.389). When trying to simulate a forecast, it is necessary to consider the possibility that optimizing behavior on the part of an agent, will lead to modified behavior, because the agent may know to expect that change is going to occur (i.e. an agent may know what a forecast is going to be before it actually takes place). This assumption is fundamental to rational expectations theory. See Lucas & Sargent (1981) for a discussion of this class of models.

conditional model.[72] Thus, under weak exogeneity a regressor of interest can be deemed independent of contemporaneous and future values of the error process in the conditional model. In effect, weak exogeneity establishes the conditions necessary for consistent and efficient estimation, and hence inference.[73]

Weak exogeneity is distinct from strong exogeneity, which is defined in the following manner:

strong (strict) exogeneity: Is the conjunction of weak exogeneity and Granger noncausality. If achieved a model is deemed viable for conditional forecasting. That is, if x_t is weakly exogenous, and not preceded by any of the endogenous variables in the system, x_t satisfies the conditions for strong exogeneity.

Strong exogeneity goes a step further and demands that a regressor of interest be independent of the contemporaneous, future, and past values of disturbances in the conditional model. Moreover, in the context of a bivariate relationship, it requires that an endogenous variable y_t, does not Granger cause another regressor x_t. If

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[72]Determining what the parameters of interest are within a model is hardly an innocuous decision (Engle, Hendry and Richard, 1983; Pratt & Schlaifer, 1984; Maddala, 1992). Parameters may be of interest for several reasons. Initially they are chosen because they are related to theories that a model is seeking to validate. However, with respect to determining exogeneity, parameters of interest are selected specifically for determining whether empirical relationships are constant over a given sample period, hence securing information about consistency and efficiency in estimation (Ericsson, 1992; Hendry, 1993).

[73]However, once weak exogenous conditions have been obtained, how does one proceed to test the validity of this assumptions? Granato & Smith (1994) note that there are not any straight forward tests unfortunately. An indirect test suggested by Granato & Smith is Dufour's (1982) parameter constancy test. Tests for parameter constancy can shed light on a lack of weak exogeneity because coefficient estimates that are unstable over time are often indicative of a structural change in the process generating regressor (i.e. x_t marginal model). When weak exogeneity holds, the structural model (conditional) will be invariant to such changes; hence, evidence of parameter instability (stability) provides some indirect evidence that weak exogeneity is invalid (valid).

weak exogeneity has been established first, then finding Granger non-causality from y_t to x_t, renders empirical support to the contention that x_t is strictly exogenous. Hence, Granger non-causality provides the additional restriction necessary to achieve valid conditional forecasting.[74]

The discussion of exogeneity to this point has centered on processes assumed to be stationary. It has been demonstrated that if the regressors in a model are deemed stationary, consistent estimation can be achieved under weak exogeneity.[75] As such, under conditions of weak exogeneity, it is possible to get consistent estimates from a single conditional model. However, what if the stability of the system is in question? What effect will this have on the system being analyzed? Moreover, what if one or more of the processes under analysis are integrated (i.e. nonstationary)? What effect does this have on the process under analysis? What additional technical issues must be addressed?

Exogeneity and Integrated Processes

In order to examine these questions, consider the simply bivariate relationship below:

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[74]From this discussion it should be evident that weak exogeneity cannot be analyzed using Granger causality tests. Granger causality tests are not designed to assess the lack of dependence between the conditional and marginal models that is necessary to efficiently and consistently estimate parameters of interest. As Cooley & LeRoy (1985) and Granato & Smith (1994a) stress, establishing Granger non-causality is only consistent with strict exogeneity, however it does not "unambiguously confirm such an assumption."

[75]An additional assumption is that the error in the conditional model are not serially correlated

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} \sim IN(\mu,\Omega)$$

$$\mu = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix}$$

$$\Omega = \begin{bmatrix} \omega_{11} & \omega_{12} \\ \omega_{21} & \omega_{22} \end{bmatrix}$$

where: μ is the column of means and Ω is the covariance matrix. Moreover, consider the equations below, which represent the conditional and marginal models respectively:

$$y_t = \alpha + \beta x_t + v_{1t} \qquad v_{1t} \sim IN(0,\sigma^2)$$

$$x_t = ky_{t-1} + \epsilon_{2t} \qquad \epsilon_{2t} \sim IN(0,\omega_{22})$$

$$\textit{where: } v_{1t} = e_{1t} - \left(\frac{\omega_{12}}{\omega_{22}}\right)\epsilon_{2t}$$

Regard k to reflect the linear dependence of x_t on y_{t-1}. If the parameters of interest in estimation are $\lambda_1 = (\beta,\sigma^2)$ for the conditional model, and $\lambda_2 = (k,\omega_{22})$ for the marginal model, then it is possible to conceive that x_t is weakly exogenous to y_t as the parameters of interest λ_1 do not depend in any way on the marginal model. That is, each model can be estimated independently. As such, weak exogenous conditions have been met and estimation can proceed under this assumption. However, this may not be the case if the stability of the system is in question.

Specifically, if the issue of stability in the conditional model arises, then weak exogeneity is most likely a problem.

When the stability of a system is in question, additional information is needed from the marginal model about the processes responsible for generating regressors in the conditional model. The stability of the system can be analyzed by examining the reduced form of the conditional model:

$$y_t = \alpha + \rho y_{t-1} + \epsilon_{1t} \qquad \epsilon_{1t} \sim IN(0,\omega^2)$$

where ρ is the root contained in the conditional model's reduced form, which is equal to $(\beta \cdot k)$. Recall that the stability of the system, as represented in the equation above, depends upon the value of ρ, such that:

$|\rho| < 1$ the process is stable
$|\rho| = 1$ the process is characterized by a random walk[76]
$|\rho| > 1$ the process is unstable (explosive)

If the stability of the system is in question, then the parameters of interest to conduct inference under weak exogenous conditions are no longer independent. Specifically, information is needed from both λ_1 and λ_2, because they each contain information needed to diagnose stability. That is, β and k are not independent of one another, as their joint distribution yields insights about the stability of the system under analysis. Essentially, establishing weak exogenous conditions will

[76]This assumes that the process will be stationary in its first difference.

be necessary, but not sufficient (Cooley & LeRoy 1983, Ericsson p.257, 1992, Granato & Smith 1994b).

Moreover, integrated processes, establishing weak exogenous conditions alone are not viable, strict exogeneity becomes the relevant concept for the case of nonstationary regressors. As Granato & Smith (1994) note, in the case of integrated regressors, exogeneity conditions have implications that extend beyond the issue of consistency, and hence, weak exogeneity. With integrated series, the distribution of certain coefficients in the conditional model are of concern. As previously discussed, integrated processes represent a cumulative function of past information (or history of a process). As such, the distributional properties associated with estimates and significance testing from such processes are non-normal. We can assume that x_t may affect y_t through the product of β and k. Namely, the past of y_t will condition contemporaneous values of y_t if the product of $(\beta \cdot k) \geq 1$, making the system unstable. That is, if $|\rho| \geq 1$, the system will be unstable, because y_t will be characterized by a unit root or an explosive root, both of which will yield inefficient and inconsistent estimates. Thus, in order to guarantee that inference will not be jeopardized strong exogenous conditions need to be specified. Valid prediction of y from the conditional model requires more than weak exogeneity. It requires the additional assumption of Granger non-causality. The requisite restriction is that $\omega_{12}=\omega_{22}=0$, i.e. that y_t does not Granger cause z_t (Ericsson 1992, Granato & Smith 1994b). Specifically, Granger non-

causality means that only lagged values of x_t enter into the marginal model, likewise lags of other variables do not enter the marginal model, other than values of x_t itself.

However, what if the two processes modeled are both I(1)? Engle & Granger (1987) would then consider the original conditional model a cointegrating regression because the stochastic trend associated with the unit roots of each series form a linear common form that is I(0). That is,

$$\hat{\epsilon}_t = y_t - \hat{\beta}x_t$$

is a stationary process. In this case, what are the implications for exogeneity and causality? In order to assure valid estimation of single equations, it is important that strong exogenous conditions hold. This involves the use of Granger causality tests. However, the use of these tests when regressor are integrated is problematic. Specifically, because Granger causality tests require that the levels of each variable be regressed on the lagged level of all the variables within a given system of equations (i.e. a VAR), the unit roots associated with a series will also be estimated. Thus, if the series are integrated, but not cointegrated, the coefficients will have nonstandard limiting distributions.[77] Granato & Smith (1994b)

[77]See Granato & Smith (1994b) for an intuitive technical discussion about the asymptotic theory of integrated processes and the ramifications these processes have for exogeneity tests.

demonstrate that a way to avoid "unit root asymptotics" is to estimate Granger causality tests as a system of error correction equations.[78] Specifically,

$$\Delta x_t = \Theta_{10} + \sum_{p=1}^{P} \delta_{1p}\Delta y_{t-p} + \sum_{p=1}^{P} \gamma_{1p}\Delta x_{t-p} - \alpha_1(x_{t-1} - \beta_1 y_{t-1}) + u_{1t}$$

$$\Delta y_t = \Theta_{20} + \sum_{p=1}^{P} \delta_{2p}\Delta y_{t-p} + \sum_{p=1}^{P} \gamma_{2p}\Delta x_{t-p} - \alpha_2(y_{t-1} - \beta_2 x_{t-1}) + u_{2t}$$

From this restricted VAR, the null hypothesis that y_t does not Granger cause x_t becomes:

$$H_0: \alpha_1\beta_1 = 0 \quad also \quad \sum_{p=1}^{P} \delta_{1p} = 0$$

Assuming that y_t and x_t are cointegrated, a finding of Granger noncausality from y_t to x_t renders support to the notion that x_t is strictly (strong) exogenous to y_t.[79]

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[78]This method was derived by Engle & Granger (1987) and is referred to as an restricted diagnostic VAR. Moreover, a similar test is utilized by Johansen (1991) in which the restricted VAR is a vector error correction model (VEC).

[79]As Ericsson (1992) notes, conditional ECM's assume the existence of weak exogenous conditions, by excluding the same cointegrating vector from appearing in both the marginal and conditional model. Again, this assumption could only be valid however, if *a priori*, ones theory was consistent with such a specification. As previously demonstrated, the war-economy equilibrium hypothesis is consistent with an asymmetric specification. Johansen's (1992) partial system specification affords a test for weak exogeneity between cointegrated variables. Also see Granger & Lee (1989) for a detailed technical account of partial system models.

A Test of Exogeneity

In light of the discussion above, it is highly unlikely that conventional Granger causality tests would prove adequate in determining exogeneity conditions in the system under analysis. As noted previously conventional Granger causality tests for diagnosing exogeneity assumptions among systemic conflict, prices and exports are inappropriate, not only because they fail to take into long-term causal components that tie cointegrated series together (Durr 1992), but also because when regressors are integrated, the normal asymptotic distribution of these test statistics are compromised. In order to demonstrate this point, conventional Granger causality tests were conducted on the series used in the model. Table 2.8 lists the results obtained from estimation.

The results of the conventional Granger causality tests, in which a model consisting of current levels of systemic conflict are regressed on a number of lags of itself, is compared with a similar model in which the same number of lags of power are included (along with inflation and trade respectively in separate tests), do not render support to the hypothesized causal relationships. Recall that Granger causality tests rely on an F-test to determine the degree to which controlling for the previous levels of the distribution of power in the system improves the total variance explained above simply analyzing systemic conflict alone.

Table 2.8

Systemic Conflict Granger Causality Tests

Independent Variables (6 lags)	F-Stat[a]
	Current Levels in Systemic Conflict
Levels of Power	1.526
Levels of Inflation	1.189
Levels of Trade	0.715
	Current Changes in System Conflict
Changes in (Δ) Power	0.892
Changes in (Δ) Inflation	1.168
Changes in (Δ) Trade	0.533

[a] The F-statistic tests the change in total variance explained (R^2) when lags of the independent variables are excluded from another equation that regresses current values of the dependent variable on six lags of itself plus six lags of the independent variable. The test statistic~ F(6,106), thus the following critical values are used: $p<.01$ (2.96), $p<.05$ (2.18).

Thus, if the exclusion of power from the model leads to statistically significant reduction in the explanatory power, then the tests would indicate that indeed, systemic conflict is endogenous to power, or more generally that power Granger cause systemic conflict. As the results from the tests indicate, none of the series in their levels or first difference form, were found to Granger cause systemic conflict.[80]

Nonetheless, when estimating a restricted vector error correction (VEC) model, a technique more suited to determining exogeneity when integrated process are involved that form a cointegrating vector, some support is rendered to the original hypothesized causal relationships. The VEC model is a restricted VAR designed to use with nonstationary data, which have been found *a priori*, to be cointegrated (Johansen 1991). Typically an unrestricted VAR does not impose cointegration on its variable. However, the VEC restricts long-run behavior of the endogenous variables to converge to their cointegrating relationship, while permitting the short-run dynamics to take there natural course. Again, the estimation of a VEC model necessitates that the series under analysis form a cointegrating relationship. Prior estimation of a cointegrating regression suggested support for cointegration, while a subsequent Johansen test rendered support to the notion that only one cointegrating vector was present among systemic conflict,

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[80]Specifically, the F-tests verify that neither, the distribution of power, inflation nor trade were able to explain, in a statistically significant manner, more variance in systemic conflict, than systemic conflict's own past history.

power, inflation and trade. After the number of cointegrating vectors has been established, the VEC model consists of taking the first difference of each endogenous variable and regressing them on a one period lag of the cointegrating equation (e.g. the long-run component of the model) and the lagged first differences of all the endogenous variables in the system (e.g. hence capturing the short-run dynamics). Because the model purported in this research examines four series, i.e. systemic conflict, the distribution of power, inflation and trade, the VEC is generalized to a four variable system. Specifically, the test consists of the null that y_t does not Granger cause x_t (i.e. Granger noncausality against the alternative of Granger causality), where x_t here represent the distribution of power, inflation and trade, in separate tests of the null. To simplify notation, the distribution of power, inflation and trade are represented as separate regressors x_t, while systemic conflict is represented as variable y in the hypothesis tests that follow. According to the model, systemic conflict is posited to be endogenous to the distribution of power, inflation and trade. As such, in each test, we are seeking to determine if each x_t (i.e. the distribution of power, inflation and trade) does NOT Granger cause y_t (systemic conflict). If this assumption is maintained, then it is valid to conclude that the distribution of power, inflation and trade are strictly (strong) exogenous to systemic conflict. In this context, the test can formally be expressed again as:

$$H_0: \alpha_1 \beta_1 = 0 \qquad \textit{also} \qquad \sum_{p=1}^{P} \delta_{1p} = 0$$

The results of the VER are in Table 2.9. The estimates obtained from the VER render some support to the notion of an asymmetric cointegrating relationship among at least two of the three series. First, the estimate of the long-run component in the VER is statistically significant in the equations representing systemic conflict and inflation but not in the power and trade equations.[81] Secondly, the lagged first differences of systemic conflict are not significant in either the inflation or trade equations in the system.[82] Both results suggest that systemic conflict does not Granger cause trade, with some mixed support for the distribution of power and inflation.

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[81]That is,$(\alpha_1\beta_1 = 0)$ for the equations relating to the distribution of power and trade. Although, again the long-run component in the inflation equation is statistically significant at the ($p<.01$) level. Note that the estimates associated with the cointegrating equation represent the long-run components of the VEC, i.e. the error correction component for each equation in the system. Thus, if $(\alpha_1\beta_1 = 0)$ in one of the equations, then the long-run component is insignificant. As $(\alpha_1\beta_1 = 0)$ in both the distribution of power and trade equations, then this affords some initial support to the notion that systemic conflict does not Granger cause the distribution of power nor exports and hence, power and trade are strictly (strong) exogenous to systemic conflict.

[82]This statistical results relates to the second part of the null hypothesis, namely that:

$$\sum_{p=1}^{P} \delta_{1p} = 0$$

Thus, as systemic conflict is not statistically significant in either the inflation or trade equations, this yields some additional support to the notion that systemic conflict does not Granger cause inflation or trade. Note however, the second lag of systemic conflict is statistically significant in the inflation equation.

Table 2.9

Diagnosing Exogeneity: Restricted VEC Test

	Endogenous Variables[a]			
	Δ Systemic Conflict	Δ Power	Δ Inflation	Δ Trade
Cointegrating Equation[b]	-0.056	-0.001	0.009	-0.079
	(0.033)	(0.001)	(0.0002	(0.073)
	-1.727	-1.091	4.634	-1.076
Δ Systemic Conflict	-0.252	-0.0003	0.003	-0.003
(-1)	(0.094)	(0.001)	(0.003)	(0.003)
	-2.689	-0.210	0.559	-1.107
	-0.004	-0.004	0.001	-0.237
(-2)	(0.091)	(0.001)	(0.003)	(0.003)
	-0.047	-3.097	1.534	-1.133
Δ Power	-12.958	-0.039	0.008	1.601
(-1)	(0.094)	(0.090)	(0.042)	(14.459)
	-2.014	-0.436	0.189	0.111
(-2)	-2.040	0.041	0.092	-0.472
	(0.093)	(0.091)	(0.043)	(14.627)
	-0.313	0.447	2.181	-0.032
Δ Inflation	-22.93	-0.094	0.011	--64.12
(-1)	(2.385)	(0.001)	(0.090)	(0.089)
	-1.331	-0.390	0.097	-1.65
	9.872	-0.316	-0.128	-37.67
(-2)	(2.497)	(0.001)	(0.094)	(0.093)
	0.679	-1.547	-1.355	-1.153
Δ Trade	-0.011	-0.001	-0.000	-0.067
(-1)	(2.478)	(0.0006)	(0.093)	(0.092)
	-0.266	-1.912	-0.800	-0.701
	0.047	-0.0007	0.000	-0.014
(-2)	(2.405)	(0.0006)	(0.090)	(0.090)
	1.117	-1.159	0.176	-0.149
R^2	0.162	0.12	0.371	0.036
SE	5.364	0.075	0.035	12.055

[a]The results from this procedure were produced from *E-Views*, MicroTSP version 1.0. The estimated coefficients, standard errors and t-statistics are reported and listed accordingly.

[b]The cointegrating equation was normalized on systemic conflict.

Thus from this analysis, it is possible to conclude that there exists some support for the notion that trade is strictly (strong) exogenous to systemic conflict, while power and inflation may be strictly exogenous.[83] As such, it is possible to continue with a test of the last proposition. Specifically this will involve the specification and estimation of an error correction model (ECM). It is to this task that I now turn.

Specifying An Error Correction Model

I have hypothesized that short-term changes in systemic conflict can be understood as both, a response to changes in the distribution of power in the international structure, trade and inflation, as well as changes in the long-term levels of these variables. The latter is characterized as a *moving equilibrium* and represents the actual error correction portion of the model. An error correction model (ECM) is able to capture both the long term and short term effects that systemic conflict, the distribution of power, trade, and inflation have on one another.[84]

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[83]However, given that the evidence accumulated is not without problems, future endeavors should include to use a multivariate system estimator, similar to those proposed by Johansen (1988) and Stock and Watson (1988), in order to obtain consistent and efficient estimates for the coefficients of interest.

[84]Davidson et al. (1978) was the first study to introduce error correction models (ECM's). However, Granger (1983) was the first to connect cointegration and its application to ECM's.

Theoretically and technically, the notion of a moving equilibrium affords a more precise statement of how these phenomena are interrelated. The previous focus on cycles proved to be restrictive in a technical sense, as strict periodicity methods failed to find supporting evidence for long cycles. Moreover, the strict focus on cycles rendered little theoretical explanatory power about the interrelationship between systemic conflict, the distribution of power, inflation and trade in the international system. Theoretically, the equilibrium argument purported in this research captures the long term interrelationship between the variables over time. That is, how systemic conflict, the distribution of power, trade, and inflation are tied closely together throughout time. Moreover, the explanation purported in this research is able to explain what happens when the posited equilibrium is disturbed, i.e. the series are forced apart. Specifically, the model suggests that the equilibrium error is *corrected* over the long term as systemic conflict is aimed at a new level that is consistent with the equilibrium state in the international system.

To test proposition (6), an ECM will be specified. Their are several methods available to estimate an ECM. The most common form is the Engle-Granger two-step procedure. It involves estimating the equilibrium errors in a static linear regression of the level of systemic conflict on the independent variables, power, trade and inflation. The final error correction model will incorporate the equilibrium errors in order to estimate the rate of equilibration,

when controlling for the short-term effects (i.e. the first differences of the relevant variables in the system).[85]

The Engle-Granger Two-Step Method

Engle & Granger (1987) derive a two step methodology in which to estimate an ECM. It consists of the following steps:

(1) Regress Y on X in levels in order to obtain the cointegration vector Z_t

$$Y_t = \alpha + \beta X_t + Z_t ;$$

$$Z_t = Y_t - \beta X_t - \alpha$$

(2) Regress changes in Y on past changes in X, and on the equilibrium errors represented by cointegration vector Z_t

$$\Delta Y_t = g\Delta X_{t-1} - hZ_{t-1}$$

In order to test the remaining hypothesis, an ECM was estimated. Reports of the ECM estimation are located in Table 2.10. Proposition (6) is simply a test to determine whether or not an ECM is a valid representation of the adjustment process that has been posited to occur when the long-run relationship between systemic conflict, the distribution of power, trade, and inflation is offset.

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[85]This particular approach suggests that the equilibrium errors are corrected equally by all of the variables (i.e. whether they are dependent or independent) included in the first regression (i.e. the cointegrating equation).

Statistically, if equilibrium error is eliminated from the long-run relationship hypothesized between systemic conflict, the distribution of power, trade, and inflation, then systemic conflict is anticipated to move back to its "appropriate" level. Stated another way, the coefficient on the lagged level of the residual (i.e. Z_t) should be between (0) and (-1) if the hypothesized adjustment takes place as purported in the theoretical model.[86] As indicated in Table 2.10, the estimated coefficient is (-.213). This is well within the appropriate range of values.

The two-step estimation leads to the following error correction representation:

$$\Delta Conflict_t = -13.651\Delta Power_{t-1} - .213Z_{t-1} + \epsilon_t$$

where Z_{t-1} represents lagged equilibrium errors from the first step, i.e. the cointegration regression. From Table 2.10, Z_{t-1} may be expressed as:

$$Z_{t-1} = Conflict_{t-1} + 14.26*Power_{t-1} + 0.039*Trade_{t-1} + 62.547*Inflation_{t-1}$$

Substituting the latter equation into the former yields:

$$\Delta Conflict_t = 0.727 - 13.651\Delta Power_{t-1} - .213(Conflict_{t-1} - 0.039*Trade_{t-1} + 62.547*Inflation_{t-1} + 14.255*Power_{t-1}) + \epsilon_t$$

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[86] Generally speaking, the equilibrium error coefficient should always be between (0) and (-1). If not some egregious misspecification of the model has taken place. Moreover, technically the coefficient on the error correction component should always be negative. This is not to suggest that the error correction component negatively effects the dependent process in the typical "directional" sense. Rather, it is meant to imply that once some type of change has taken place in the equilibrium state, re-equilibrating will need to occur (hence the negative coefficient), whether it be a positive shift or a negative shift

According to the model, systemic conflict will be in an equilibrium relationship vis-à-vis prices and exports (i.e. the economy and trade) when the equation above is equal to zero. Likewise any shock to this equilibrium relationship will be corrected by changes in systemic conflict at the rate of 29% per year, beginning one year after the shock has occurred.[87] Thus support is given to proposition (6).

Conclusion

The theoretical framework examining the co-evolution of political cycles and economic waves in this research received support. In particular, the theoretical model and empirical framework advanced in this research has made several significant contributions, all of which integrate previous work, and extends new ideas to the long cycles literature. Theoretically, the co-evolving model developed in this research advances a more general, causal argument capable of explaining patterns of systemic conflict over time. Specifically, integration tests conclude that each of the time series under analysis are characterized by stochastic trends. In addition, a cointegration test empirically demonstrated that the individual trends among these series are in common. It is this latter result, the evidence of a common trend among these series (e.g. cointegration), which I

[87]This follows as (.286) is the estimated coefficient for the lagged residuals saved previously from the cointegration regression and as the series reflect annual observations over time.

contend to be crucial in uniting previous cycles research and in making novel extensions to this literature.

With respect to integrating previous research, this is accomplished in part by the theoretical approach advanced in this study, which contends that various cyclical phenomena have interrelationships that are co-evolving. Previous research studying cyclical phenomena, model them as distinct and non-interacting processes. These explanations fail to take into account the dynamic relationships among these series. The theoretical and empirical evidence reported in this research, demonstrates that these phenomena do affect one another over time.

This research affords novel insights by demonstrating that the cyclical phenomena in the model are cointegrated. That is, the series are empirically co-evolving, as the trends associated with each series are in common (i.e. they follow the same path over time). This empirical finding serves to extend research in this area as it negates the utility in (1) empirically substantiating the existence of individual cycles; and (2) in determining the duration of cycles and their most appropriate dating schemes. In particular, the approach advanced here advocates thinking about how the trends associated with these phenomena may drift together throughout time (i.e. follow an equilibrium path), and why these phenomena get detracted from their common path (i.e. experience deviations from the equilibrium).

Moreover, cointegration not only affords a rigorous test of the correlation among various cycles by examining the trends associated with these processes, but sets them within a rigorous empirical framework. This framework is capable of (1) testing exogeneity conditions specified in the theory, where systemic conflict is posited to be a strictly endogenous process, effected by exogenous phenomena related to power, trade and economic activity; and (2) delineating how these processes effect changes in systemic conflict through the test of an error correction model (ECM). Both of these technical issues afford scholars interested in the long cycles literature to rigorously test causal theories concerning the interrelationship between economic and political phenomena in the international system. Furthermore, exogeneity tests and ECM's also serve to extend novel contributions to this literature.

With respect to the former, specifying exogeneity conditions is fundamental in any causal theory and is especially crucial in studies examining dynamic processes over time. Specifically, exogeneity affords rigor in (1) determining the nature of the endogenous processes being explained in a theory; and (2) restricting the dynamic effects of exogenous factors in a model by delineating any anticipated feedback among the processes under investigation. Both of these issues have been largely ignored in the long cycles literature. Exogeneity tests conducted in this research found empirical evidence in support of the theoretical argument that systemic conflict is a strictly endogenous process responding to fluctuations in the

distribution of power, trade and the economy. Moreover, this evidence reinforces the notion that the cyclical phenomena under analysis in this research, are appropriately modeled in a "co-evolving" framework. Thus, it is possible to specify co-evolving models that can rigorously specify causal relationships from which inferences can be made about the dynamic interrelationships among political and economic phenomena.

Again, the results from the previous cointegration test supported the proposition that systemic conflict, power, trade and the economy share a common trend. Moreover, the results from the Johansen test demonstrate that there exists only one cointegrating vector. Together these results affirm the appropriateness of modeling the causal relationship among these phenomena as an error correction process.

Traditional studies of political cycles and economic long waves have neglected the use of causal models. The analysis reported in this research suggests that it is not only necessary theoretical, but it is empirically viable. Specifically, the theoretical argument advanced in this research contends that economic and commercial patterns over time serve to change the structure of the international system through redistributing, or alternating, the distribution of power among states over time. This framework, delineates systemic conflict as an endogenous process affected by changes in the concentration of power, economic activity and commerce in the international system. Advancing this particular theoretical

argument, extends the previous focus on the correlations between cyclical phenomena, into a causal framework. Indeed, this is important in order to make inferences about the exogenous processes within cycle theories (i.e power, trade, and the economy) and their affect, in terms of their magnitude and significance, on systemic conflict. The results from the ECM support the proposition that systemic conflict is the only cyclical phenomena reacting to shocks in the equilibrium relationship. That is, out-of-equilibrium behavior (e.g. exogenous shocks that stimulate deviations from the common trend among the series in the model) affects the level of systemic conflict. However, this change (i.e. deviation from the trend) corrects itself (i.e. adjusts) back overtime to a new equilibrium, in which the series follow a similar pattern once again (i.e. share a common trend).

Analyzing cyclical phenomena through the analysis of an ECM, extends research in this area because questions concerning out-of-equilibrium behavior can be explored. When cycles of systemic conflict, power, trade and the economy are not in equilibrium (i.e. following the same path), this framework suggests that it is because a shock has occurred in the system that has detracted systemic conflict from its normal trajectory. These shocks derive in large part from the uncertainty resulting from the alternating distributions of power, and hence the configuration of states in the system. The latter event may stimulate conflict in the system as uncertainty increases about the new equilibrium, or, type of configuration (e.g. peaceful or hostile) that characterizes the international system.

Although the ECM yields support for this explanation, two important issues remain unexamined that merit investigation in future research. First, the interrelationship between the exogenous processes need to be delineated more precisely. Specifically, the combination of factors that stimulate uncertainty need to be assesses. This will in part, involve the analysis of out-of-equilibrium behavior among the series used in this analysis. Uncovering these dynamics among the various cyclical phenomena will help discern the timing of systemic conflict in the international structure.

Secondly, efforts need to be taken to formally model co-evolving theories similar to the one advanced in this research. Generally, this type of theory is not conducive to game theoretic or decision modeling, because of the lack of strategic action among actors per se. However, dynamic models offer one form of formal modeling that is capable of delineating the interactions among systemic processes (Pudaite, 1991). The benefit of formally modeling co-evolving theories is the deductive manner in which the interrelationships among the processes can be described and logically deduced. This type of research endeavor will stimulate rigor in the long cycles research tradition. Attention to these research deficits will serve to inspire more novel contributions to this evolving literature. Moreover, scholarly attention to these issues will yield contributions that extend our present knowledge and understanding of the relationship between political cycles and economic waves in the international system.

CHAPTER 3

REGIME STRUCTURE, LEADERSHIP UNCERTAINTY AND THE MAINTENANCE OF COOPERATION: THE GAINS IN MODELING INTERNATIONAL ECONOMIC REGIMES AS ORGANIZATIONAL TEAMS

Introduction

Conventional models addressing the initiation and maintenance of cooperation within international regimes have been modeled as public goods problem (Kindleberger 1981, 1986; Snidal 1985; Conybeare 1987), or more generally as reciprocal arrangements among states (Axelrod 1984; Axelrod & Keohane 1985; Cline 1982; and Dobson 1991).[1] However, these solutions typically fail to take into account the organizational complexity characterizing the structure of regimes. Regimes, especially those with more than two actors, are complex, both in terms of the distribution and configuration of states that comprise them, and the level and type of information that is exchanged among the members. The theoretical framework purported in this research seeks to tackle the

[1]The use of the term *regime* is not narrowly considered in any particular context other than economic, in order to accommodate a variety of institutional settings. Thus, general reference will be made to international economic regimes as examined in Keohane (1980).

complexity under such conditions by regarding the structure of international regimes to be similar to organizational teams.[2] By drawing upon the *production by teams* analogy, it is possible to ascertain a solution capable of explaining the maintenance of cooperation among a group of nation-states, especially when incentives exist to violate such commitments.

Specifically, the role of leadership is examined in terms of its ability to achieve and enforce cooperation within the context of an international economic regime. The notion of leadership described in this research varies from the role that is typically assigned to a hegemon in the traditional literature examining regimes.[3] Hegemonic stability theory typically assigns two types of hegemony to dominant states, benevolent and coercive. In the former, the hegemon unselfishly takes on the burden of initiating and maintaining a regime, where in the latter case, the hegemon, acting out of pure self interest, pressures states to comply with its own particular preferences. The conception of leadership in this research is general enough to take into account both types of hegemony. This is reinforced by the fact that a leader is not simply appointed because of its capabilities. In fact, leadership can also be a function of states designating an actor with institutional authority to reward and punish other states comprising the organization.

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[2]See Alchian & Demsetz (1972) and Groves (1973, and 1977) for an example of this class of models.

[3]For example see Kindleberger (1986).

As will be demonstrated, the inclusion of leadership is integral to maintaining cooperation within a production by teams framework. Because consumption on the part of actors within regimes is conditioned on their level of production, the maintenance of output is important to the survival of the regime over time. To the degree that defection is difficult to determine, a leader is useful because of its ability to distinguish noncooperative behavior. This is especially important when the structure of the regime is comprised of multiple actors, making defection from production commitments more likely, and more complicated to discern.

Using the Bianco & Bates (1990) model, the following research applies and generalizes their initial insights by (1) using their framework to analyze the configuration of international regimes, (2) generalizing the model to capture multiple actors (i.e. the *N*-person case), and (3) modeling the dynamic effects of leadership uncertainty by incorporating Bayesian updating into the belief structure of the actors in order to analyze changes in cooperative behavior. Generally speaking, the model finds that it is never in a state's best interest to defect if the probability of confronting a strong leader is high. In general, as the probability of strong leadership increases, the players fear punishment more often and tend to benefit more from cooperation. In addition, the model finds that as the probability of confronting a weak leader, which is capable of punishing, increases, the payoffs for defection actually increase. Thus, the results of the analysis suggest that it is

not in the best interest for a weak leader to bluff about its type. States are more likely to defect if they witness a weak leader punish, rather than a weak leader that continues to reward.

International Regimes As Organizational Structures

Economic Policy Regimes

The theory of international regimes is still developing. It has emerged slowly over the last decade and grown into a dominant research agenda within the subfield of International Organization.[4] Although numerous definitions abound, international regimes are generally conceived to be:

> "...implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations (Krasner 1977, p.1-21)."

This definition of regimes, albeit ambiguous, has been used to describe how states organize to tackle substantive issues. From macroeconomic policy to free trade, international regimes have been the primary heuristic tool in which to study collective action by states to form international economic policy.

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[4]See Haggard & Simmons (1987) for a excellent discussion on the development of the theory on international regimes.

Undoubtedly, the need for international coordination in monetary policy, trade, and finance has corresponded with the increasingly interdependent nature of the international economy.[5] Multinational and transnational corporations have flourished throughout the last five decades and have subsequently expanded international capital markets. The surge in capital integration has caused fluctuations in trade balances, resulting in economic policy changes at the national level. Within the last couple of decades, international trade imbalances have induced nation-states to alter trade, monetary and fiscal policies in their domestic economies as well as unilaterally alter their policy strategies in the international economy. This general type of policy change on the national level has served to stymie, if not decrease, the level of policy coordination in the international economic environment, leaving scholars to ponder the causes and consequences of such trends.

Capital integration, as a general indicator of growing interdependence between nation states, tends to foster conflicts of interest between a state's national objectives, e.g. domestic growth and wealth, and international objectives, e.g. free trade and stable markets. As a general result, governments unilaterally manipulate economic policies to reconcile national economic objectives with international market pressures. As a result, international economic objectives are subordinated to national economic objectives. This results in political leaders defecting from

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[5]International economic regimes is used in this research to generally encompass any type of policy coordination (e.g. trade, monetary, financial, etc.), among nation states in the international system.

international regimes, in an effort to maintain domestic support. This subsequently threatens the survival of international regimes designed to coordinate collective action in pursuit of common goals. For example, the World Trade Organization (WTO) represents a collective coordination effort on the part of advanced industrialized countries to promote and expand free trade in the international system.[6] However, its success as an international regime is called in to question, as its ability to effectively monitor and sanction defectors from free trade principles continues to be challenged. As a result, increasingly many scholars conclude that multilateral policy coordination will be difficult to secure in the next century.

What type of regime structure and incentives can induce states to maintain cooperation in international economic regimes? It is the analysis of this general question that motivates the current research. Fundamental to understanding how the maintenance of cooperation can be achieved within an international regime, is analyzing the organizational factors, which characterize the structure of regimes, in addition to the incentives used to induce states to (1) join such an organization and (2) participate (e.g. maintain cooperation) over time. This research contends that this task can be accomplished by drawing an analogy between organizational teams and international regimes.

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[6]The Bretton Woods system is an example of a monetary policy regime.

Organizational Teams

The analysis of international regimes is formalized by drawing upon literature addressing production by teams and informational economics in an effort to explain and predict under what circumstances cooperation can flourish within an international economic regime (Alchian & Demsetz, 1972; Bianco & Bates, 1990). With the nation-state as the unit of analysis, an international regime is conceived as a team comprised of multiple actors which have a joint maximizing goal to reap gains from coordination. Thus, regimes are analogous to teams to the extent that each state seeks to acquire a good that would not be produced unless some formal structure existed to secure its production.[7] Thus, regimes and teams are similar, in that they are formal institutions, each composed of a set of actors with an established hierarchy among the members, and similar goals in producing a joint good. An implicit assumption is that states have an incentive to join regimes in order to obtain benefits they would otherwise not be privy to if they were not committed to the organization.[8] Fundamental to joining an institution then is the assurance that benefits will be awarded to members. In the teams analogy, the distribution of benefits is maintained through a hierarchical relationship among an

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[7]Thus to some degree the provision of public goods problem is relevant, but not entirely adequate. For example, consider the WTO. The WTO has exclusivity associated with its members. That is, not every state in the system is a member. Moreover, some policy orientations within WTO are asymmetrical. Specifically, developing countries are permitted to violate certain free trade principles because of their relative disadvantage to other states in the international market place.

[8]For example, consider the most favored nation status (MFN) that is accorded to all members of the WTO. Every state that is a member of the WTO is privy to MFN status and therefore gets the same trade privileges afforded any other nation in the organization. MFN status is a benefit for member states which comprise the WTO and is not guaranteed to nonmember states.

anointed leader and the respective members (i.e. followers), comprising the organization.

Thus, the regime itself is analogous to a long-run contractual agreement between a set of nation-states. Thus, the regime is characterized by long-term commitment. Informational concerns come into existence during the life of the regime as the possibility of encountering moral hazard arises.[9] Moral hazard is manifested in hidden action (Kreps, 1990). When nation-states within an economic policy regime contract to produce a given level of cooperation, it may not always be possible to ascertain the exact nature of the form of action that each nation-state has produced. This is the essence of the problem associated with hidden action. As such, perfect monitoring and enforcement may be an impossibility. This is because the total aggregate output produced by the regime is characterized by noise.[10] Thus, the structure of the regime needs to be designed in a manner that will provide a disincentive for member nation states to seek actions which go against the design of the initial contract. This is where the role of leadership becomes important.

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[9]Informational concerns will arise throughout the duration of the contract and not simply during its initiation. Morrow (1994) argues that problems of monitoring and sanctioning in a regime can be alleviated by controlling for informational problems in the initiation phase. However, the dynamic nature of regimes suggest that continued revisions of regimes will necessitate monitoring and sanctioning activities.

[10]That is, it may not be possible for any particular actor to discern when a defection has taken place. Formally, this is an issue arising from imperfect information (Kreps, 1990). This will be elaborated upon further in the discussion of the model.

Leadership

As the success of an international regime is contingent upon its survival over time in promoting cooperation, then structural disincentives to defect from production need to be incorporated among the actors comprising the organizational team. To achieve this, the theoretical framework proposed in this research suggests that some form of authority must be appointed that maintains a superior level of information about nation states (e.g. members of the team) within the regime. Again, the necessity of a leader to monitor regimes is one of the fundamental assumptions made by proponents of hegemonic stability theory (Kindleberger, 1986; Gilpin, 1987).[11] However, instead of focusing on the coercive versus benevolent aspects of the theory, an important issue to consider is the ability of the leader to credibly pose a punitive threat to potential defectors. Thus, a related issue to consider is how cooperation can be achieved as an equilibrium outcome among a set of nation-states, one of which is designated as a leader, when uncertainty exists about the capabilities of the leader?

The previous question is important to the degree that it sheds light upon the evolutionary aspects of leadership. Specifically, by formally determining how cooperation can be maintained within regimes, especially when dominant powers responsible for the maintenance and survival of the institution begin to lose their

[11]Moreover, the lack of leadership is associated with increases in noncooperative behavior (i.e. defection), and hence, the decline of regimes in general. However, the decline of the United States in its role as hegemon over the last several decades has not resulted in the dismantling of all regimes.

power, it will be possible to specify the conditions in which peace and cooperation can be maintained in the midst of power transitions within the international system. Thus, the model explores the operations of an international economic regime under conditions of strong and weak leadership.

As such, the teams model moves well beyond most analyses of international regimes by accounting for both the actions of a leader and the other members of the organization in an iterated N-person strategic environment. By accounting for how members interact with one another and with a leader, the model is able to demonstrate the conditions where international cooperation within the structure of a regime can be attained over time.

The presentation of the model will proceed in two steps. First, the basic form of the game is presented and trigger strategies under conditions of partially complete and perfect information are discussed. This part of the game draws upon an iterated production by teams model developed by Bianco & Bates (1990). Second, incomplete information is incorporated into the game and Bayesian perfect equilibria conditions are delineated. These conditions are then used to test several propositions about the evolution and maintenance of cooperation.

Toward A General Formal Model

The game involves N actors, where n represents an individual actor, $n \in N$, within an international economic regime. The regime is a long term economic agreement among a set of member nation-states. Thus, there is an assumption of future interactions between the nation-states which comprise the regime. As such, the game is characterized by an infinite repetition, discounted formulation. The nation-states interact over a period of time modeled as a series of rounds in a game, where each iteration is designated as t, where $t \in T$. The game consists of a leader and a set of followers. Moreover, each nation-state moves simultaneously, without knowledge of the other nation-state's actions, and the leader moves after the followers. The model is formalized first by narrowing the strategy space to a dichotomous choice between cooperation or defection. This affords a simple way in which to calculate the costs and benefits of cooperating. Consider the following, where s_t is the strategy choice, and $B(s_t)$ represents the total benefits accruing from a vector of strategy choices from N actors comprising the regime, and c_n represents the costs associated with cooperation:

$$s_t = 0 \quad (\textit{Defect})$$
$$s_t = 1 \quad (\textit{Cooperate})$$

Where:
$$B(S_t) = a_1(s_{1t} + s_{2t} + \ldots + s_{Nt})$$

Note, the benefits accrued within the regime are a linear function of the number of nation states that cooperate.[12] Thus, general payoffs for each state *n*, at iteration *(t)* can be represented by:

$$V_{nt}(s_{nt}) = \frac{B(S_t)}{N} - C_{nt} \qquad (Cooperate)$$

$$V_{nt}(s_{nt}) = \frac{B(S_t)}{N} \qquad (Defect)$$

It is assumed that mutual cooperation makes all actors better off. However, a unilateral incentive exists to defect such that each follower possesses a dominant strategy to defect at each iteration of the game. Defection will always be the dominant strategy given the equation which derives individual benefits. This holds even if more than one nation state decides to defect. However, the outcome associated with all actors cooperating is always better than the outcome associated with all actors defecting. Thus, the free rider problem is borne out in this scenario. Figure 3.1 demonstrates this relationship. Regardless of the number of actors *N*, within the regime that can benefit from cooperation, an individual state always has an incentive to defect. This is also demonstrated in Table 3.1 where the payoffs associated with an individual defection are always higher than those associated with cooperation. How then can nation states under such conditions be persuaded to cooperate?[13]

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[12] Refer to Appendix B, section 3.1, for further details.

[13]Cooperation in this context means the production of a good. For example, the maintenance of a stable free international market structure (Kindleberger 1986).

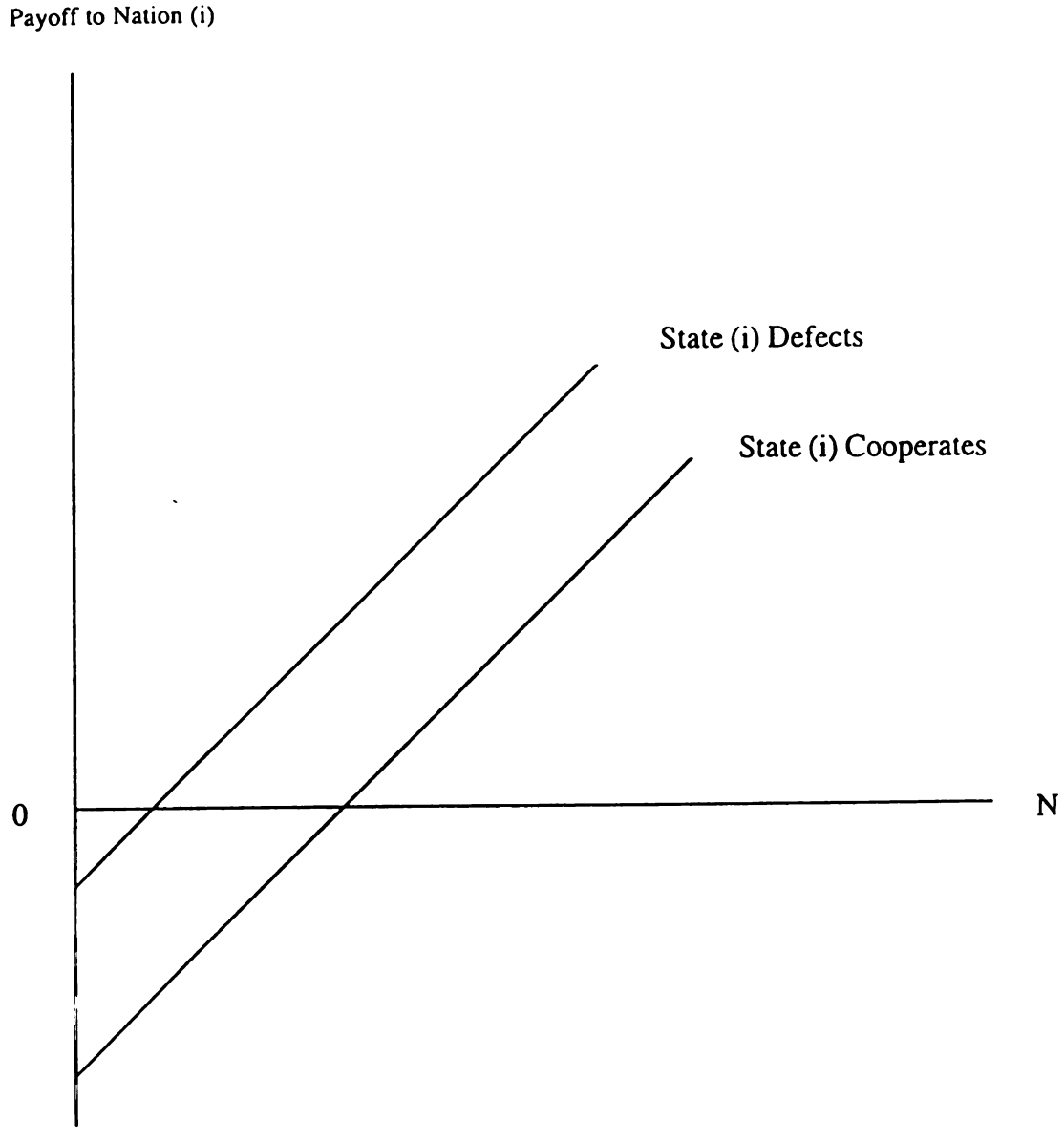

Figure 3.1 N-Person Cooperative Dilemma

Table 3.1

N_i payoff when a_i=2 and c=1

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs* s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	1.8	1.6	1.4	1.2	1.0	0.8	0.6	0.4	0.2	0.0

*Note the payoffs are calculated according to the formulas given for the individual benefits for a nation-state pursuing one strategy over another, i.e. cooperating or defecting.

First, the solution to the model lies in the development of mechanisms which prohibit the unilateral incentive to defect from cooperation in the structure of the regime. One way in which to deter noncooperative behavior of potential defectors, is through the manipulation of trigger strategies. Specifically, the folk theorem maintains that if discount rates exist, which are high enough ($d^t: 0 < d^t < 1$), full cooperation can be maintained as a subgame-perfect equilibrium if actors have the ability to employ *trigger strategies*.[14] For example, the manipulation of a trigger in the context of a free trade regime (i.e. GATT), would be an action akin to the threat of cutting off most-favored nation status (MFN) to states which erect barriers to trade. Here erecting trade barriers would represent defection from GATT and withdrawing MFN status would be a form punishment to a recalcitrant state.

Secondly, because the regime is configured similar to an organizational team, the presence of a leader charged with the duties of monitoring and sanctioning followers is assumed.[15] A dominant nation state is encouraged to take on the responsibility of leadership through several institutional incentives. The first, is the prestige of the role and the power distinction that enables the state to

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[14]Present gain from defecting is weighted more heavily, while future gains from cooperation are weighted more lightly. As such, if a discount rate (d) is sufficiently high, a game will most likely be one-shot. Thus any game that depends on a large number of repetitions also relies on the discount rate not being too high (Rasmusen, 1989).

[15]The leader is analogous to a state in the international system that has superior capabilities to the other member states, or more generally a higher concentration of power relative to the other states in the regime. Separate payoff functions will be specified for the leader because of the costs associated with punishing defectors.

manipulate the production of the good according to its own preferences.[16] Second, the leader is able to obtain residual benefits. Consider that leaders, to some degree, are responsible for distributing the benefits produced by the regime to the followers, and in so doing, reward and punish.[17] As a residual claimant, leaders receive a share equal to σ, where $(0 < \sigma < 1)$, which is a proportion of each benefit plus all undistributed remaining benefits.

Third, to understand the evolutionary nature in the role of leader and to capture variance in the type of leader that may exist overtime, leaders are characterized as either weak or strong. Strong leaders are designated as L_s and weak, L_w. The primary distinction between the two types is that weak leaders face a real cost associated with sanctioning a recalcitrant member of the regime. Thus the payoff configurations for a leader vary according to not only the number of defections that take place, but also according to the weight in which the cost of punishment burdens the leader. Because weak leaders are more likely to have

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[16]For example, consider the good to be the initiation and maintenance of a free trade structure. Without question, variance in previous leaders (e.g. hegemon) preferences for maintaining free markets. Some scholars contend that Great Britain's tenure as hegemon in the late 18th century enabled it to carve a market structure amiable to its own industrial development by initiating various bilateral agreements (Gilpin 1987; Kindleberger 1986). This contrasts with the United States reign as hegemon, in which it maintained free trade by pursing multilateral strategies (Yarborough & Yarborough, 1992). An interesting question is what domestic and international factors explain why this variation exists?

[17]Note that the term follower refers to nation states that are part of the regime. For example, in this conceptualization, the G-7 are led by the United States, while Great Britain, Japan, Germany, France, Canada and Italy are considered to be the followers.

fewer capabilities at their disposal than strong leaders, the weight, represented by ω, will generally be larger for weaker nations than it is for strong nations.[18]

Given these preliminary assumptions about the structure of the model, it is possible to specify the payoffs for a leader as follows:

Leader's Payoffs

$$v_{it}(s_t) = \left[\sigma b(s_t) + \frac{x}{n(1-\sigma)\ b(s_t)}\right] - \omega x$$

Again, the payoffs associated with cooperating entails a cost parameter. To the extent that cooperation constrains state behavior, a type of domestic opportunity cost is levied upon the followers.[19] As such, payoffs for followers represent a portion of the sum total of benefits produced by the regime, minus the costs associated with cooperating, represented by τ. The payoffs for followers are:

Follower's Payoff

$$\begin{aligned} v_{it}(s_t) &= \left[\frac{(1-\sigma)\ b(s_t)}{N}\right] - \tau && A_1 \textit{ cooperate get reward} \\ &= -\tau && A_2 \textit{ cooperate get punished} \\ &= \frac{(1-\sigma)\ b(s_t)}{N} && A_3 \textit{ defect get reward} \\ &= 0 && A_4 \textit{ defect get punished} \end{aligned}$$

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[18]Note that the cost of sanctioning defectors affects the strategies of weak leaders. This will be elaborated upon later in the development of the model.

[19]For simplicity, costs are assumed homogenous and are held constant for each interaction.

Thus, the regime, as an organizational team, consists of a leader and follower. To guarantee that each state plays fair, each type of actor requires its own respective trigger strategy to insure that cooperation is encouraged and maintained in repeated rounds. Note however, that the followers need two types of trigger strategies. The first is necessary to restrict defection by fellow followers and to insure that the leader distribute benefits accordingly. This is the *g-trigger*:

g-trigger	$t = 0$	*cooperate*
	$t > 0$	*cooperate if* $b(s_t) = B_n$ *for all* $(t^* < t)$, *defect otherwise*

It is the grim trigger strategy. It specifies that a follower will cooperate until another follower defects or in the event a leader fails to reward cooperative behavior. With respect to the latter, it is conceivable that a leader may at times defer or deny benefits to member states without fear of reprisal. This is analogous to a malevolent hegemon argument. Thus, in order to restrict such activities, followers need this trigger strategy to specifically address retributions stemming from noncooperative behavior of a leader.

The other trigger for the followers is the *s-trigger*, which is used as a strategic maneuver for a follower wanting to defect because it is in their own best interest.

s-trigger	$t = 0$	*cooperate*
	$t > 0$	*cooperate if* $b(s_t) \geq B_{n-1}$, *the leader rewards follower on all* $(t^* < t)$, *defect otherwise*

Proposition (1): In a game where followers can use the g-trigger and s-trigger, full cooperation can be sustained as a subgame perfect equilibrium if and only if $d \geq (10\gamma/B_9) - (B_{10} - B_9)/B_9$.[20]

The leader also has a trigger strategy. However, the manipulation of the trigger will vary among different types of leaders, which is determined by the variance in their capabilities.[21] Although followers in the regime have triggers available to induce members to cooperate over the long run (e.g. the grim trigger), leaders also play an important role in maintaining cooperation through their own duties associated with rewarding cooperative behavior and punishing defection. Generally speaking, the leader serves the role of distributing the benefits produced by the regime. The strong leader punishes would be defectors at a cost lower that weighted less than for a weak leader. Below is the trigger for the strong leader:

L_s-trigger	$t = 0$	*reward all followers*
	$t > 0$	*reward follower if* $s_{nt} = 1$ *on all* $(t^* < t)$, *punish nation-state* n_i *otherwise.*

Since a weak leader will feel the effects of punishing more so than a strong leader, weak leaders have a separate and distinct trigger strategy at their disposal. The main distinction between the two triggers is that the weak leader will punish a defector, only when the benefits of doing so outweigh the costs of sanctioning (e.g. Benefits-Costs > 0). Moreover, the weak leader merely distributes the residuals,

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[20]Refer to Appendix B, section 3.2 for the proof of this proposition.

[21]To simplify the analysis, variance in a leader's capabilities are dichotomized into a strong leader (L_s) and a weak leader (L_w).

rewarding all followers and sanctioning no one if the costs of punishing are too high.

L_w-*trigger* $t = 0$ *reward all followers*

$t > 0$ *reward follower if* $s_{nt}^{*} = 1$ (*cooperate*), *additionally if*

$$\left[\sigma b(s_t) + \frac{x}{n(1-\sigma)b(s_t)}\right] \leq \omega x$$

punish all followers if $s_{nt}^{*} = 0$ (*defect*), *additionally if*

$$\left[\sigma b(s_t) + \frac{x}{n(1-\sigma)b(s_t)}\right] > \omega x$$

Proposition (2): A leader's trigger strategy can deter defection by a follower if and only if $d \geq (10\gamma/(1-\sigma)B_9) - (B_{10} - B_9)/B_9$.[22]

Generally speaking, when followers know they face a strong leader, they can be induced to cooperate. However, under weak leadership, their is a potential for followers to get away with defection. Moreover, an additional issue that may arise, concerns the credibility of a leader's ability to punish. That is, if the capability of the leader begins to diminish, such that the costs of punishing outweigh the benefits the leader would obtain from maintaining cooperation in the regime, how will the behavior of the followers change? These issues will be tested with the propositions that follow.

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[22]Refer to Appendix B, section 3.3, for the proof of this proposition.

Proposition (3a): The higher the probability that a follower will confront a strong leader θ, the less likely the follower is to defect in a subsequent round.

As a corollary, the following proposition will also be tested:

Proposition (3b): The convergence of defection will not be effected by the probability of punishment given a weak leader, γ.

Proposition (4a): The higher the probability that a follower will confront a weak leader $(1-\theta)$, the more likely the follower is to defect in a subsequent round.

As a corollary, the following proposition will also be tested:

Proposition (4b): The convergence of defection will be effected by the probability of punishment given a weak leader, γ. As γ increases, so will defection.

The Maintenance of Cooperation Under Leadership Uncertainty

Bayesian Updating

In order to examine propositions (3a), (3b), (4a) and (4b) it is necessary to consider how followers obtain information about the leaders capabilities and how they use this information to determine their course of action in a subsequent round. Again, when followers know they face a strong leader, they can be induced to cooperate. Under weak leadership however, there is a potential for getting away with defection. If followers do not know whether they face a strong or weak

leader, they observe the actions of a leader over time to form a belief about the type of leader they face. This process, i.e. updating of beliefs by the followers about the type of leader, can be modeled as a Bayesian process. As such, the followers beliefs will be updated through a number of interactions, that will be calculated according to Baye's rule. Generally speaking, followers are unable to distinguish strong leaders from weak leaders as long as weak leaders punish defection. This is analogous to a pooling equilibria. As soon as a leader fails to punish defection however, followers then know they face a weak leader. This is similar to a separating equilibria, where actions of the types of leaders are distinguishable.

To estimate the probability of punishment for defection, a follower estimates the chances that they face a weak or strong leader, θ, and the chances that a weak leader will punish, γ. These estimates are updated over the course of the game through the use of Bayes' theorem, where:

$$u_f(t|s) = \frac{p(t)\ \pi_1(s|t)}{p(t)\ \pi_1(s|t) + p(t')\ \pi_1(s|t')}$$

The specific assumptions made about the structure of the updating process are:

(1) A leader's type is determined by nature's move. A leader is strong with probability (θ), and is weak with probability ($1-\theta$).

(2) The game has an infinite number of rounds with no discernable conclusion.

(3) The leader does not punish a follower who cooperates.

(4) A follower's beliefs about the leader's true type (strong or weak) are based on the outcomes of the previous round(s), as revealed by the leader's sanctions.

(5) The probabilities with the leader's strategies are denoted as follows:

π_1(punish|strong)=1
π_1(reward|strong)=0
π_1(punish|weak)=γ
π_1(reward|weak)=1-γ

A follower's beliefs about the leaders type are calculated according to Bayes' Rule delineated above. Since it is assumed that prob(leader rewards|leader is strong)=0, and u_f(leader is strong|rewards)=0, then conversely, u_f(leader is weak|rewards)=1. Essentially this means that when a follower observes that the leader has rewarded a defector, she knows without a doubt that the leader is weak. On the other hand, the leader does have an incentive to punish a follower when it is both strong and weak. Its decision to punish or reward is based on a cost-benefit analysis, where a leader punishes defection when the benefits exceed the costs. Recall that the costs of punishing defection for a weak leader are represented by a concave cost function ωx, where x equals the number of defectors being punished, ω equals the cost of each follower sanctioned for noncompliance, and $0<\omega<1$. A weak leader punishes a follower(s) who defects when:

$$\sigma b(s_t) + \frac{x}{N(1-\sigma)\ b(s_t)} > \omega x$$

In contrast, a leader is unable to punish defections when the costs of punishment exceed the benefits, or when:

$$\sigma b(s_t) + \frac{x}{N(1-\sigma)\ b(s_t)} < \omega x$$

Thus, a follower's beliefs about a leader's type (i.e. whether the leader is strong or weak) are calculated as followed:

$$u_f(\textit{strong leader} \mid \textit{punish}) = \frac{p(\textit{strong}) * p(\textit{punish} \mid \textit{strong})}{p(\textit{strong}) * p(\textit{punish} \mid \textit{strong}) + p(\textit{weak}) * p(\textit{punish} \mid \textit{weak})}$$

$$u_f(\textit{strong leader} \mid \textit{punish}) = \frac{\theta}{\theta + \gamma - \theta\gamma}$$

$$u_f(\textit{weak leader} \mid \textit{punish}) = \frac{p(\textit{weak}) * p(\textit{punish} \mid \textit{weak})}{p(\textit{weak}) * p(\textit{punish} \mid \textit{weak}) + p(\textit{strong}) * p(\textit{punish} \mid \textit{strong})}$$

$$u_f(\textit{weak leader} \mid \textit{punish}) = \frac{\gamma - \theta\gamma}{\gamma - \gamma\theta + \theta}$$

A Simulation

A follower can determine its expected payoffs from either cooperating or defecting from the international regime, utilizing the information obtained about the leader's type through the leader's actions in the previous round. The leader determines the payoff function and the other followers shape the actual payoff associated with this function. Recall that a follower can receive one of the three payoff functions: A_1 when it cooperates; A_2 when it defects; A_3 when it cooperates and is punished; and A_4 when it defects and is punished by the leader. The order of preferences is: $A_2 > A_1 > A_3 > A_4$. However, the expected payoff function for

cooperating will always be A_1.[23] The expected payoff function for defection is based upon the beliefs the follower has about the leader's type and the leader's reaction (reward or punish). Given that defection has taken place in the previous round (assume here that round two is being played, where t=2), the expected payoff functions are:

$$EP(Defect) = A_2(belief\ leader\ is\ weak) + A_3(belief\ leader\ is\ strong)$$

$$EP(Defect) = \frac{A_2(\gamma - \theta\gamma)}{\theta + \gamma + \theta\gamma} + \frac{A_3\theta}{\theta + \gamma + \theta\gamma}$$

Given that A_3=0, the equation above reduces to:

$$EP(Defect) = \frac{A_2(\gamma - \theta\gamma)}{\theta + \gamma + \theta\gamma}$$

In order to empirically test how the follower's beliefs affect the strategies in an iterated game, we calculate the expected payoffs across various probability values for θ and γ in the equations generated for the expected payoffs for followers. Theta, the probability that the leader is strong, is varied from .99 to .01. Gamma, the probability that a weak leader punishes, varies from 0.8 to 0.2 for

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[23]For simplicity it is assumed that in the payoff function A_3 (i.e. where the follower cooperates and is punished by the leader) is not realistic. Future research will incorporate this payoff function.

each separate value of theta. The values for A_2 (benefits received from defecting) are taken from the second row of Table 3.1. The calculations are located in Tables 3.2 through 3.16.

Several conclusions can be drawn from a comparison of the various parameters and their respective payoffs. In Table 3.1, the payoffs for defecting always exceed the payoffs for cooperating, resulting in collective action problems. In the first model, full cooperation can be maintained by the leader if discount rates are high enough. When the leader's true costs for punishment are not revealed to the followers, payoffs for cooperation often exceed the benefits for defection. How does the leader's privileged information encourage cooperation?

First, the presence of a strong leader diminishes a follower's payoffs for defecting. As θ (0→1), the payoffs for defection decrease overall, (EP|defection)→0. The values range from a high of 1.8 (θ=.01, γ=.8, $\sum s_t$=9), to a low of .0004 (θ=.99, γ=.2, $\sum s_t$=1). At small values of θ (.01) however, the payoffs for defecting always exceed those from cooperating. This produces the same result as model 1. When θ>0.25, it is always better to cooperate if two or less other followers defect. In addition, payoffs for cooperation are better than those for defection at low values of γ when as many as 5 players defect. The overall trends for values of θ from (0→1) demonstrate the importance of leadership. As the probability of strong leadership increases, the players fear punishment more often, and benefit from a strategy of cooperation.

Table 3.2

N_i payoff when θ=0.99 and γ=0.8

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	.01	.01	.01	.01	.008	0.8	0.6	0.4	0.2	0.0

Table 3.3

N_i payoff when θ=0.99 and γ=0.5

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	.009	.008	.007	.006	.005	.004	.003	.002	.001	.000

Table 3.4

N_i payoff when θ=0.99 and γ=0.2

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	.004	.003	.003	.002	.002	.002	.001	.001	.000	.000

Table 3.5

N_I payoff when θ=0.75 and γ=0.8

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_I	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{II}=1 cooperate	1	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{II}=0 defect	.38	.34	.29	.25	..21	.17	.13	.08	.04	0.0

Table 3.6

N_I payoff when θ=0.75 and γ=0.5

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_I	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{II}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{II}=0 defect	.26	.23	.20	.17	.14	.11	.09	.06	.03	.00

Table 3.7

N_I payoff when θ=0.75 and γ=0.2

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_I	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{II}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{II}=0 defect	.11	.10	.09	.08	.06	.05	.04	.03	.01	.00

Table 3.8

N_i payoff when θ=0.5 and γ=0.8

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	.80	.71	.62	.53	.44	.36	.27	.18	.09	0.0

Table 3.9

N_i payoff when θ=0.5 and γ=0.5

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	.60	.53	.47	.40	.33	.27	.20	.13	.07	.00

Table 3.10

N_i payoff when θ=0.5 and γ=0.2

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	.30	.27	.23	.20	.17	.13	.10	.07	.03	.00

Table 3.11

N_i payoff when θ=0.25and γ=0.8

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	1.27	1.13	.99	.85	.71	.56	.42	.28	.14	0.0

Table 3.12

N_i payoff when θ=0.25 and γ=0.5

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	1.08	.96	.84	.72	.60	.48	.36	.24	.12	.00

Table 3.13

N_i payoff when θ=0.25 and γ=0.2

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_i	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{ii}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{ii}=0 defect	.675	.60	.53	.45	.375	.30	..225	.15	.08	.00

Table 3.14

N_I payoff when θ=0.01 and γ=0.8

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_I	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{II}=1 cooperate	1	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{II}=0 defect	1.8	1.6	1.4	1.2	.99	.79	.59	0.4	0.2	0.0

Table 3.15

N_I payoff when θ=0.01 and γ=0.5

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_I	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{II}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{II}=0 defect	1.8	1.6	1.4	1.2	.98	.78	.59	.39	.20	.00

Table 3.16

N_I payoff when θ=0.01 and γ=0.2

	Number of Nation-States Which Select the Strategy s_i=1 (cooperate)									
Payoffs s_i for N_I	Σs_i=9	Σs_i=8	Σs_i=7	Σs_i=6	Σs_i=5	Σs_i=4	Σs_i=3	Σs_i=2	Σs_i=1	Σs_i=0
s_{II}=1 cooperate	1.0	0.8	0.6	0.4	0.2	0.0	-.2	-.4	-.6	-.8
s_{II}=0 defect	1.7	1.5	1.3	1.1	.95	.76	.57	.38	.19	.00

How does γ, the probability that a weak leader punishes, affect the follower's payoffs for defection? As γ increases from 0.2 to 0.8, the payoffs for defection in comparison to the payoffs for cooperation increase. For example, the examination of Tables 3.8 through 3.10 illustrate this point when θ=0.5. When, γ=0.8, the payoff for defecting when $\sum s_t$=9 equals 0.8. When γ decreases to 0.2, the payoff for defection when $\sum s_t$=9 equals 0.3. Thus it does not pay for a weak leader to bear great costs for punishing defectors, because it appears that the followers will not be fooled. They are actually more likely to defect when a weak leader punishes, than when it rewards. A weak leader's best strategy is to be straightforward about its type, and to punish only when the benefits of doing so exceed the costs.

Conclusion

Most models analyzing cooperation and coordination in regimes have focused exclusively on the leader, while ignoring the role of followers. The hegemonic stability literature in particular focuses on the role of the hegemon, neglecting how followers influence one another. The model described in this research contributes to this literature by explicitly analyzing how followers are affected by variances in the capacity of a leader to punish within the institutional structure of an international regime. The simulation of the formal model found

that the payoffs for defecting generally never outweigh the payoffs for cooperating.

Moreover, the formal model developed goes well beyond typical explications of two actor models by incorporating multiple actors in an iterated environment. By conceiving international regimes in terms of a production by teams model, the dynamics of nation-states seeking to coordinate policy in an economic regime can be captured and examined under various conditions of leadership and information structure. Results from the simulation suggest that the payoffs from cooperation under conditions of strong leadership, do not change for regimes with two or more states (followers) cooperating. However, for conditions in which there exists some uncertainty in a leader's ability to punish (i.e. a weak leader with a low probability of punishing), there exists little incentive for states to cooperate. The payoffs from defecting under such conditions outweigh the payoffs for cooperating. This result seems to generally hold for regimes with four or more states (followers) defecting.

Generally speaking, the theoretical framework developed in this research affords a generalization away from traditional hegemonic stability theory and its effect on the survival of a regime, by illustrating the importance of both leadership and followers. This is especially crucial as international regimes tend to have multiple actors which interact. These interactions subsequently affect the nature and duration of regimes. Although this research does not specifically delineate

how follower's interact, other than formally illustrating the potential threat of triggering punishment, this is a topic that future research in this area should explore. Specifically, the role of Bayesian updating among followers can afford insights into the credibility of punishment as a deterrent upon a state's defection, even under conditions of weak leadership. In fact, this insight would serve to formally explain why it is that cooperation is maintained within international regimes during periods of hegemonic decline, when hegemonic stability predicts otherwise.

APPENDICES

APPENDIX A

Serial Correlation Tests

Because most series are characterized by AR(1) processes, the assumption is typically made that most series are characterized by some degree of serial correlation. Similarly as the univariate properties of a series are analyzed to determine their cross correlations, residuals from time series regressions are analyzed to diagnose whether serial correlation is present.

There exists numerous tests for autocorrelation. However, despite the limitations of the Box-Pierce Q-statistic, most statistical software packages report this statistic (Maddala 1994, p.542). This statistics is inappropriate when a lagged endogenous term is present in the equation from which the residuals are extracted. When a lagged endogenous variable is present, an alternative diagnostic tool needs to be utilized, such as the Breusch-Godfrey test (Maddala 1994, p.541). Both the Box-Pierce Q and Breusch-Godfrey are discussed below.

I. Box-Pierce Q

$$Q = T \sum_{j=1}^{L} r_j^2 \sim \chi^2 \ (L \ dof)$$

$$where \ r_j^2 = \frac{\sum_{t=j+1}^{T} e_t e_{t-j}}{\sum_{t=1}^{T} e_t^2}$$

The test is the null (H_0: Autocorrelation) against an alternative (H_a: white noise). When L=20, the appropriate critical values are: (.01) 28.4, (.05) 31.4, (.10) 37.6. Note this diagnostic test is inappropriate in autoregressive models (or models with lagged endogenous variables).

II. Breusch-Godfrey (use with lagged endogenous variable present).

$$TR^2 \sim \chi^2 \qquad (P\ dof)$$

The test consists of regressing the OLS residuals (saved from regression of interest) e_t on x_t, e_{t-1}, e_{t-2}, ..., e_{tp}(filling in missing values for lagged residuals with zeros). TR^2 is the statistic to calculate, which is subsequently used to compare with a set of critical values distributed as a chi-squared distribution., using P degrees of freedom. (i.e. the number of lagged residuals on the right hand side of the equation). The test consists of a null of (H_o: autocorrelation),against the alternative of (H_a: white noise). When P=1, the appropriate critical values are: (.01) 2.71, (.05) 3.84, (.10) 6.63.

APPENDIX B

Formal Model Proofs

Note: The formal model presented is a generalized version of a model developed in Bianco & Bates (1990). As such, most of these proofs, albeit generalized to the n-person (nation state) case, are derived in the Appendix of Bianco & Bates (1990). Where relevant I make the necessary amendments to fit my model.

3.1

Total benefits derived from nation-states which cooperate in the regime:

$$B(S_t) = a_1(s_{1t} + s_{2t} + \ldots + s_{Nt})$$

Where a_1 represents a constant rate of cooperation among nation-states. For the purposes of this model it is assumed that a_1 is a constant term with a value greater than 0. Thus, the amount of benefits will be a linear function of the number of nation-states which cooperate.

3.2

Suppose that we are referring to an economic regime in which G-10 countries are members.

$$d \geq \frac{\frac{10C}{B_9} - (B_{10} - B_9)}{B_9}$$

From Table 3.1 we have the values associated with total sum of benefits produced by a regime, conditioned on the number of followers cooperating (i.e. B_{10}=10, B_9=9, etc.). Total benefits are a linear function of the number of followers that cooperate. This equation essentially maintains that a nation-state will choose not to cooperate unless the outcome for cooperating is greater than the outcome for

defecting. Moreover, the latter situation will not hold unless the discount factor is ($d \geq .01$). This is equivalent to the equation below.

$$\frac{\frac{B_N}{N-C}}{1-d} \geq \frac{B_{N-1}}{N}$$

3.3

If an individual nation-state (n_1), along with the other member nation-states, uses a trigger strategy, the payoff for n_1 for the entire game is:

$$\frac{\left[\frac{(1-\sigma)B_N}{N} - C_n\right]}{1-d}$$

However, if nation-state (n_1) defects and the leader retaliates, (n_1)'s payoff is:

$$\frac{((1-\sigma)\ B_{N-1})}{N}$$

Thus a leader is credible only if:

$$\frac{\left[\frac{(1-\sigma)\ B_N}{N} - C\right]}{1-d} > (1-d)\ B_{N-1}$$

Likewise, if the leader defects on the first round (t), thereafter, the other member nation-states would employ their trigger strategies in the following rounds i.e. (t+1). Thus, this would give the leader a payoff (BN + 0).

However, if the leader continues to use a trigger strategy, the payoff from iteration (t) forward is:

$$\frac{\sigma B_N}{1-d}$$

Thus, the trigger strategies for the member nation-states is an effective threat against the leader if:

$$\frac{\sigma B_N}{(1-d)} \geq B_N$$

This is equivalent to:

$$d \geq (1-\sigma)$$

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