

Reassessing the Relationships: Capturing Interdependence in  
Legislative Votes

Emily U. Schilling  
Washington University in St. Louis

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## **Abstract**

Since Woodrow Wilson's (1885) analysis of Congress, researchers assumed that members of Congress look to one another for information, cues, and advice on unfamiliar policy areas. The amount of time and effort that each legislator and their staffers would have to put in to make all of these voting decisions would be insurmountable. Fellow legislators are a resource to turn to for guidance or assistance. Legislators are able to influence their colleagues above and beyond each of their individual preferences. The members of Congress that are most influential will not necessarily be the same for every bill. The significant legislators may be one's co-partisans and the party leadership or they may be a group of legislators with whom they share a common interest. Spatial analysis allows researchers to look more explicitly at the relationships between legislators and their counterparts. Using spatial probit, I study these issues by examining the factors that influence voting decisions. I will look at NAFTA and NCLB to test which of the many relationships that every legislator has are most influential on their voting decision. The use of the spatial probit model provides an opportunity to test this relationship and see if even after controlling for other influences that there is dependence between legislators.

“Some representatives may vote together because of the influence of their associates; but others may vote together without there having been interaction on the subject, simply because of similarity in the constituencies they represent, or the similarity of their personal backgrounds (MacRae 1954, p. 192).”

One of the big questions in congressional research is what influences the decisions that legislators make every day. We want to know how legislators make decisions but the ability to decipher the influential actors is difficult. In his summary of potential influences, Kingdon (1981) discusses an extensive list of actors inside and outside the government and argues that legislators make decisions as a result of the pressures they feel from their constituencies, congressional and party leaders, the executive, interest groups, staff, media, and their colleagues within the legislature. In his interviews with the members from the 91st Congress, Kingdon finds that legislators mentioned their fellow congressmen as being important quite frequently (40% without prompting and 35% when prompted with a question). When looking at how important their fellow congressmen were in their decision, he finds that fellow legislators were determinative 5% of the time and were of major importance 42% of the time. To provide some measure with which to gauge this, we could look at constituency importance, which is researchers often look to as a major determinant in decision making. Kingdon finds that the constituency was determinative 7% of the time and of major importance 31% of the time. Although fellow congressmen were not the sole determinant of a legislator’s decision as often as their constituency was, the difference is only slight.

The importance of their colleagues is evident from these interviews. Legislating is a social process. Decades of congressional research emphasizes how each legislator’s decisions depend on those made by their colleagues, whether through logrolling, sharing information, or coalition formation. In many of the stories about legislative decision making, there is an implication that all individual decisions depend on the decisions made by the rest of the legislators. One legislator, on their own, cannot do much. The choices that MCs make in office are a result not only of their personal preferences and their constituency’s preferences but they are also influenced by the ex-

pectations that they have for the rest of their colleagues. The actions are made simultaneously and the decision of one MC is influenced by their relational ties to other legislators. To argue that this relationship only goes one direction would not be an accurate depiction of the story because there is a feedback relationship in legislative behavior. Legislator  $i$  not only influences the choices made by legislator  $j$  but the choices made by  $j$  also influence the decisions of  $i$ .

Yet, the study of legislative behavior for the most part has relied on the assumption of independence. This perhaps results from limitations in the empirical methods that have been used in previous research. Through the use of traditional quantitative methods, researchers assume that legislators make decisions independent of one another. As a result, the factors that have been included in these analyses are only those that are inherent to the legislators themselves. For example, one of the most commonly used measures of legislative behavior, their NOMINATE scores, assumes that each legislator is independent of one another and that each of the roll calls that is taken is also independent from other roll calls. As the quote from MacRae cited above alludes to, it is difficult to deduce whether the similarity in legislators' voting records is a result of similar constituencies and personal views or from the direct interaction that occurs between legislators. The empirical methods we turn to in legislative research do not allow us to parse out these relationships.

In order to better capture the interdependent nature of relationships between MCs, this project uses spatial analysis. Spatial econometrics is a burgeoning technique in political science but has rarely been applied to legislative behavior. Yet, it offers the opportunity to decipher the structure of interdependence in legislative decision making.<sup>1</sup> Typically, scholars attempt to capture fellow legislators' influence by controlling for the partisan composition of the chamber but this assumes that legislators make decisions independently whereas the theories emphasize interconnectedness. Spatial econometrics allows one to capture the simultaneous and interdependent nature of legislative decision making.

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<sup>1</sup>There has been a strong focus on network analysis in the study of legislatures, although Darmofal 2009, Hays and Kachi w.p. do use spatial modeling to study how legislators relate to the geographic neighbors (districts within states) based on when they announce their position on an issue.

With spatial analysis, the interdependence between MCs enters the model through the stochastic component, indicating that the spatial relationship is a nuisance that must be controlled, or the interdependence can enter through the latent observation of the other MCs behavior. The focus of this project will be on the latter. I am interested in how some MCs behavior influences the rest of the legislators. I assume that the effect that the relationships that MCs have on one another is more than just a nuisance in their decision making process that must be controlled. The spatial relationship enters the model through the structure of the spatial weights matrix. The entries of the spatial weights matrix are theoretically driven. In this paper, I will look at these relationships using data collected on the North American Free Trade Act (NAFTA) vote and the No Child Left Behind (NCLB) vote. The use of spatial econometrics offers a more appropriate method of analysis for answering the question of how legislators influence each others' decisions. This project adds to the literature by uniting theories that argue for attention to the interconnectedness between legislators with appropriate empirical methods for detecting this interdependence.

## **Literature Review**

It has long been held that MCs turn to one another for information, cue taking, and for advice on how to vote. It is not a guarantee that all representatives will need the assistance of their colleagues but they all have the potential to influence one another. The sway of each individual legislator is conditional on the characteristics of the bill and the legislator's own predispositions. These predispositions determine which colleagues will interact with one another. These interactions are determined by a variety of things such as party, one's position in the leadership or committee structure (or lack thereof), and the likeness that exists between legislators (Cherryholmes and Shapiro 1969). According to Caldeira and Patterson (1987), "interpersonal ties among members define the legislature, laying the basis for the dynamics of legislative leadership, supplying the texture for the partisan and other aggregations of members, establishing channels of communication, and provid-

ing the connections through which bargaining, exchanges of cues, and decision making transpire (p. 954).”

The necessity of communication between legislators is a result of multiple problems that legislators confront when they have to make a decision on a roll-call. The first problem is the sheer number of decisions that legislators have to make in any given Congress. In the 113th Congress, despite its relative lack of productivity, there were over 10,000 bills introduced and 1,000 roll calls taken (congress.gov). With the increasing number of bills, the scope of decisions that must be made everyday is also an insurmountable task especially given the time limitations that exist for legislators. Between doing research and work necessary for the committee assignments as well as the amount of time they have to dedicate to constituency interests legislators have very little time to spend on reading or researching the legislation that reaches the floor but is not pertinent to their areas of expertise. Finally, time constraints are exacerbated further by the fact that a lot of legislation requires specialized information. Without this specialized information it is difficult to ascertain how the policy will translate into outcomes. Even when the necessary information is readily available it may be too difficult to distill or the source may be unreliable. In order to solve these problems legislators need a source of information, a cue on how to vote, or someone to discuss their questions and issues. Their colleagues are generally the most accessible source that legislators have at their disposal (Kingdon 1981; Mathews and Stimson 1975). As Mathews and Stimson put it, “when a member is confronted with the necessity of casting a roll-call vote on a complex issue about which he knows very little, he searches for cues provided by trusted colleagues who – because of their formal position in the legislature or policy specialization – have more information than he does and with whom he would probably agree if he had the time and information to make independent decision (1975, pg. 45).”

Members of Congress want to “maximize their chances of being informed (Gomez 2001).” Not only is being informed electorally beneficial to legislators but having a reputation for being informed will increase their credibility and influence within Congress (Gomez 1999; Esterling, et.

al. 1997). Arthur Lupia (1999) argues that the attributes of the “cue giver” (i.e. their ideology, partisanship, etc.) will “affect a cue’s persuasiveness only if they are necessary to inform a cue seeker’s perceptions of cue giver’s knowledge or interest.” I assume that the distribution of information occurs through social interaction. When legislators decide to acquire information, they have to seek out a particular group of legislators. Legislators are not selecting one another at random which is why not accounting for this interaction is problematic when studying individual legislators.

The question then arises, who will a legislator look to for assistance or discussion? Many of the traditional studies of legislative behavior discuss the characteristics that we would expect these informants to have. With respect to which informants a MC turns to first, it usually comes down to two different but not necessarily distinct aspects, expertise and agreement. Expertise is important because legislators want to make informed decisions; they want to be able to defend their decisions when asked and they may not feel comfortable with doing this without a strong understanding of how the policy will change the status quo. This expertise can generally come in two forms: the legislators from the reporting committee and the party leaders. Legislators from the committee will have the most hands on experience with the individual bill under consideration. The expertise from the party leadership comes from the fact that they may not know the particulars of this bill but they are senior members of the party who probably have some experience with the issue and this may be enough to provide assistance. The previous experience these legislators have helps ensure that they will process and react to the policy before other legislators who have less experience will have an opportunity. Legislators often list leaders or more senior members of their party as being especially important in social interactions among their colleagues (Patterson 1959; Wahlke, et. al. 1962; Kingdon 1981; Mathews and Stimson 1975).

## **Importance of Agreement**

Legislators want to make decisions as if they were independently informed; legislators who will allow them to do this will be those who have the information and in particular those with the

information that is the most helpful for them to vote consistently with their own personal views. They want to make an informed decision but only if that informed decision fits with their voting record. Looking to the legislators with whom they share similar beliefs ensures that they can vote as if they were informed and can help by simplifying the the decision. The information provided will already be consistent with one's beliefs so it will not require any extra effort for them to use this information to make their decision (Kingdon 1981; Mathews and Stimson 1975).

Agreement between legislators can occur for a variety of reasons. First and foremost, legislators are likely to have similarity with their co-partisan colleagues. MCs spend the most time communicating with their co-partisans. They will be the people with whom you will have developed a friendship and a trust. Legislators form these friendships with their co-partisan because they foster "party unity (Ripley 1967 p. 197)" and "team spirit (Wahlke et al. 1962, p. 225)." Trust is an important quality because if legislators are unsure of how they should vote on an issue they want to receive information that they they know is not just someone trying to "con" them into voting a particular way. The large amount of communication between co-partisans will also help in ensuring that these relationships are not just a one-way relationship. In complex pieces of legislation, one legislator may not know all of the particulars and they may see the advantage of exchanging information with a colleague who can fill in the missing pieces (Cherryholmes and Shapiro 1969; Mathews and Stimson 1975; Kingdon 1981; Krehbiel 1991). In a dyadic analysis of roll-call voting agreement among Ohio Assembly members, Arnold, Deen, and Patterson (2000) find that co-partisans have a dominant impact on shared voting behavior (see also Peoples 2008).

It is important to note that cue-givers are not just individuals; cue-givers can be groups of people (Mathews and Stimson 1975). This includes political parties. Political parties are largely seen as a means of ameliorating collective action problems within as well as outside the government (Aldrich 1995). The party and its leaders have the ability and the means of influencing their members votes above and beyond what we would expect given their individual preferences. There has been a large debate in the literature on how much party effects the behavior of legislators. The two sides of



this debate focus on the preferences of the individual versus the preferences of party (Lawrence, Maltzman, and Smith 2006). On the individual preferences side, the argument is legislators enter office with personal policy preferences that derive from influences outside the party and they only work within those confines (Fiorina 1974; Brady 1988; Cooper and Brady 1981; Krehbiel 1993). Prior to the 1980s, congressional parties were seen as weak and ineffectual (Wilson 1885; Mayhew 1974; Dodd and Oppenheimer 1977; Weingast and Marshall 1988).

In opposition to these arguments, other scholars challenge the assumption that rank-and-file legislators restrict the party's preferences. There are two approaches to this argument; the conditional party government model and the party cartel model. Proponents of the conditional party government model argue that the formation of parties occur in order to reduce the transaction costs associated with building and maintaining a winning coalition. Under this model, parties are especially powerful when intraparty cohesiveness is high and interparty polarization is large (Rohde 1991; Aldrich 1995; Aldrich and Rohde 1997; 2001). Party cartel theory argues that party power is constant because the motivation of the party members to maintain a favorable position in the government does not change. Under this model, the majority party focuses on controlling the agenda and ensuring that legislation that is brought to the floor will win (Cox and McCubbins 1993; 2005; Kiewiet and McCubbins 1991). The party wants to ensure that their agenda is a successful one and in order to do so will induce loyalty from its members (Lawrence, et. al. 2006).

Homophily is an important consideration in determining which of their colleagues will be influential. Same party is a clear measure of homophily. The issue with focusing only on co-partisan is that if legislators are truly seeking out those with similar attitudes they may be more likely to turn to a smaller subset of legislators, those with similar ideological viewpoints. Oftentimes, more agreement exists within blocs or subsets of the party (Truman 1959; Schneider 1979; Arnold et. al 2000). These are coalitions like Blue Dog Democrats or Southern Democrats who share similar opinions and ideology that are distinct from the rest of their party on particular issues. Across a wide range of policies, Schneider (1979) finds strong amounts of consistency among ideologically

similar legislators and their voting behavior . Legislators are seeking out any “mechanism that reinforces and thus, promotes behavior stability (Kingdon 1981, 250).” In the case of Southern Democrats, there were situations in which turning to a Republican was more helpful in achieving that goal than a Northern Democrat.

Beyond party and ideological similarity, political friendship is especially important in determining the social interactions between legislators. Early on Congress was not a very stable community. The opportunities for social interactions were limited and once each session was completed those friendships that had been developed were usually separated by legislators returning to their homes. Even under these harsh circumstances, voting blocs were fostered through boardinghouses. Young (1966) argues that the networks fostered in the shared lodgings led to similar voting patterns. Other measures of proximity have also been found to be important. Seating arrangements are especially influential (Patterson 1972; Caldeira and Patterson 1987; Masket 2008).

Evidence from state legislatures also finds that geographic proximity was important in who legislators sought out. In these studies, as the geographic distance between legislative districts increases the amount of interpersonal interaction decreases. They argue that it is a result of familiarity with one another as well as the legislators being less likely to share similar interests and values (Patterson 1959; Caldeira and Patterson 1987; Clark, Caldeira and Patterson 1993). These friendship ties lead to changes in one’s behavior even when controlling for legislators coming from the same party or having similar ideological leanings (Arnold et. al. 2000). Within the House, Truman (1959) also finds evidence that geographic proximity was important. He argues that the state delegation will constitute a communication structure that is frequently used and leads to similarity in voting among its members. Across a sample of state delegations, he finds cohesion among the members without controlling for the diversity of factors that may also be influencing their decisions. The delegation generally faces a similar kind of electorate and thus has a reference base when looking towards these colleagues. In Mathews and Stimson’s (1975) study, state delegation is the most frequently mentioned cue-giver regardless of delegation size.

## **Interdependence across Policies**

In addition to which legislators are influential in the decision making process, there is also a large debate in the literature about when legislators will turn to one another. The first part of the debate is whether or not influence from their colleagues is constant. Most of the literature argues that it is only in certain situations that this interdependence will emerge (Clausen 1973; Mathews and Stimson 1975; Kingdon 1981). Schneider (1979) is one of the few pieces that finds a consistent relationship across a subset of policy areas (foreign policy, domestic liberalism, class allocation, race policy, and civil liberties). His focus was solely on the cohesion in voting among ideologically similar legislators but his findings suggest legislators tend to work together regardless of the policy issue.

On the other side of the argument, there is still some disagreement under which conditions legislators will be especially influential. In a similar study, Clausen finds that with some policies (government management, social welfare, and agriculture) legislators relied on one another (in particular, along party lines) while on other policies constituency or other Washington influences were much more important (civil liberties and international involvement). In addition to this focus on specific policy areas, there has been a more general discussion in the literature as well. This debate splits on whether or not one's colleagues will be more critical in situations in which there is a lot of controversy or in those situations in which is none (Mathews and Stimson 1975; Kingdon 1981). The argument for controversial policies is that legislators will have more conflicting signals coming from their other sources (like the constituency, interest groups, President, etc.) and that is why they will look to one another (Kingdon 1981). On the other hand, those decisions without any controversy, the everyday decisions, there will often be no signals from the forces outside of the chamber and their colleagues will be the only people that they will be able to provide any type of assistance.

## Expectations

Legislators will look to one another for help on some of the decisions that they have to make each day. Legislators do not have an endless supply of resources to address the multitude of decisions that they have to make each day. Their colleagues are an accessible resource to them. The interactions that occur in order to solve these issues will lead to interdependent behavior. Legislators are not making decisions independently of one another and it is important to consider which of their colleagues are the most influential. In this project, I focus on three groups that I expect to be especially influential, co-partisans, state delegations, and ideologically similar legislators.

Recently, parties have become especially important as they have grown farther apart from one another. For much of congressional history, the House was characterized as a committee government. At the height of committee government, all of the power was given to the reporting committees, in particular the committee chairs. During the 1970s, the implementation of reforms altered the way that the House operated, putting a large amount of power into the hands of the majority party. Further reforms were made in 1995 once Republicans gained control of the House that continued the increase in influence given to the majority party. As many of recent Congresses would indicate, the argument that parties do not matter would be particularly unfounded. That does not mean that this has always been the case and thus it is important that this study is conducted across time as well. Committee members were more likely to be influential in the years when committees were the driving force behind Congress. As time has passed and the majority party has made gains in its ability to influence legislation, the effect of co-partisans has also probably become more of a contributing factor. Not only have parties become more important, but legislation has also grown in complexity. As legislation becomes increasingly complex, legislators will have to obtain additional information about each of the bills.

Thus, I expect that party will be especially significant in recent congresses. The expectations would be that there would only be a spatial relationship between those legislators that are in the

same party if they are really dominant during this time. The focus of previous arguments is on the majority party making it unclear whether or not interdependence exists between members of the minority party. On the other hand, it is beneficial for the minority party to make sure that they show their solidarity with one another, specifically on very salient issues. Although they may be in the minority for the current Congress, this does not mean that they will be in the minority in future and if the bonds already exist it will not be necessary to develop them. For example, during the debates about the Patient Protection and Affordable Care Act, the Republicans, despite being in the minority, were trying to prevent members of their party from voting in favor of the ACA. This bill was especially salient and it was important for the Republican constituencies to show their solidarity for the party's position.

Party will be especially influential on issues that are very salient because of the importance during these situations to minimize the number of members that renege on their party position. On the salient issues, the majority party does not want to lose and the minority party wants to maintain its constituency base. In addition to saliency, for party to be especially influential, the bill will divide the party platforms. If the bill is one where Democrats and Republicans generally agree with one another, we would not expect there to be any interdependence between co-partisans. On the other hand, those issues that are particularly divisive, is where party will really matter. Parties will exert more influence when the policies under consideration are important pieces of the party's platform. On those policies that each of the parties hold ownership over, legislators are more likely to take cues from their co-partisans.

Interdependence is especially influential for those members who are a part of the party leadership. They control the types of legislation that becomes law through their ability to manipulate the agenda and the shaping of the alternatives available. In order to maintain these capabilities, party leadership will focus their energy on the passage of procedural votes. The party leadership also are those members with the most invested into the the party's reputation. They are the people responsible for "whipping" their members to vote along party lines on the salient and divisive policy

issues. The relational ties between a legislator and the party leadership is stronger than those ties that a legislator has with a rank-and-file co-partisan. I only look at ties among the party as a whole but this could easily be adapted to put more emphasis on the party leadership in these models. I expect that sharing a party with someone will result in a positive relationship between MCs and their co-partisans. This tie and the communication that occurs as a result will lead co-partisans to behave more similarly to one another. Thus, I expect a positive spatial parameter.

Although, I hypothesize legislators from the same party will be especially important, a shared party ID is a very broad measure of agreement. Theoretically, agreement was a very important quality, if not the most important quality, that legislators look for in their colleagues. Agreement comes from having similar interests or convictions. When dealing with controversial legislation, reinforcement of one's ideals is particularly important and something that legislators will try to find from their interactions with their colleagues. The entirety of one's party may not be able to do that. If one legislator is at one extreme of the party and the other legislator is at the opposite extreme the likelihood that they can promote stability in each other's behavior is lower than if they were more homogenous. Consider the historical division in the Democratic party into Northern and Southern Democrats. During this time period, influence among Democrats did not cross regional lines because of their differences in values.

In addition to divisions like this within the party, moderate legislators may also look outside of their party. They are more likely to receive conflicting pressures. This may result from the legislator themselves being more moderate than their party as whole or because the outside pressures they are receiving, from constituencies or interest groups, may prefer policy to move in an opposing direction. Moderate politicians will have more beliefs in common with the legislators outside of their party and will experience situations where they do not necessarily agree with their party's position. By looking only at same party, I will miss out on the interdependencies that will cut across the aisle. In order to account for intra-party coalitions as well as more moderate inter-party interactions, I argue that ideological proximity will lead legislators to influence one another. The

reinforcement provided by these interactions leads legislators to behave indistinguishably. This clustering will lead to a positive spatial relationship.

Legislators look towards those that are proximate to them. I have already hypothesized on the importance of ideological proximity but there are other standards of proximity. Proximate legislators may be those legislators who sit near one another on the floor or legislators who share the same office building or have their office on the same floor. Being close to one another is convenient and provides legislators with more opportunities to interact and develop a relationship. Professional ties are not the only ties that are important. Friendship can be equally important in determining where interdependence will occur. Outside of the chamber legislators can be influenced by their geography. As I discussed above, regional divisions were especially important among Democrats. The issues over which region is important will be small. State interests, on the other hand, cover a wider range of policies.

State delegations will turn to one another for a variety of reasons. For certain policies, one's colleagues from the same state will have a better understanding of one's constituency and how the policy will influence your district. As with other proximate relationships, the state delegation is also convenient and a place where friendship is easily developed. Additionally, state delegations may have worked with one another in their state assembly or senate and already know one another. The influence of this group may vary according to party but for this project I am focusing on the state delegation as a whole. If party is the determining factor for intra-state interdependence, then any findings in my analysis will only become more pronounced once split along party lines. Looking at the state as a whole may also wash out some of the intricacies that may be found if I were to restrict the group to only those legislators that share a district border with one another. Communication among state delegations will lead legislators to behave more similarly to one another, leading to positive spatial autocorrelation.

To summarize, I hypothesize that the ties that exist between legislators who are from the same party, state delegation, or are ideologically similar will lead these groups to behave more alike. As

a result of their empirical methods, the extant research on the influence of these relationships has struggled to parse out these group effects from the legislators individual characteristics. Thus, I use spatial econometrics to properly capture this interdependence.

## **Empirical Testing Strategy**

It is important to look at a variety of bills and see if there are any patterns that emerge in the types of relationships between legislators are influential in their voting decisions. Kingdon (1981) argues that fellow congressmen will become influential to one another when the issue being considered is controversial and there is conflict in the signals the legislator is receiving from their constituency and other outside influences. This should be especially important when the legislator has no experience or has strong concerns about the issue at hand. In order to try and capture these dynamics, I vary important aspects of the individual bills used to test the interdependent nature of voting. The first is to vary the technical nature of the bills that I study. Specifically, will legislators have difficulty predicting the outcome that will result from passing this bill and is the means of implementing this bill straightforward? Bills that require large amounts of specific knowledge will be those bills in which legislators do not have clear signals from their constituencies and legislators will not necessarily have strong concerns about how the bill because they do not fully understand the bill.

In order to capture the controversial nature of the bills I am studying, I need to vary the saliency of the legislation. This is not a perfect measure since oftentimes salient bills are those in which you may have most information from your constituency but salient bills are also those bills in which you may have the most conflicting signals. Looking at only salient bills will be a strong test of the argument that legislators are influencing one another decisions if this is the case. It will be important to look at a bill that is not salient to see how this effects the influence of one's colleagues. This is particularly important because despite the arguments that Kingdon (1981) makes about



the importance of controversy in legislators looking towards sources outside their constituency or personal opinions Matthews and Stimson (1975) argue the opposite. According to Matthews et. al., it is the normal (or non-controversial) decisions in which we would expect legislators to rely on one another more heavily. Additionally, it is important to not look at bills that fall under the same policy area. There may be policies in which party or ideological similarity is more important and those policies in which same state may be more important. In order to ensure that the findings are not just an artifact of the individual policy or policy area that I am analyzing, I select bills that focus on different issues. Finally, it is important to select bills from different time periods. For this project, I focus my attention on the “contemporary” Congress. The variation that I focus on is centered on the 1994 elections. Empirical and anecdotal evidence indicates that the two parties have been becoming more and more distinct from one another since the 1994 elections in which Republicans gained control of the House and instituted a variety of reforms that placed even more power in the majority party. Party influence may still be important in the pre-1995 era but the expectation is that it will be even stronger post-1995.

In this paper, I look at two different bills that vary the technical nature of the bill or more specifically, the ability at the time for legislators to decipher the outcome given the passage of the bill. Additionally, the two bills I look at also vary according the time period when they were passed and the bill topic. The first bill I will look at is bill that authorized the United States signing onto the North American Free Trade Agreement (NAFTA) in 1993. The second bill I will look at is No Child Left Behind (NCLB) in 2001.

## **North American Free Trade Agreement**

In order to test the interdependence between these groups, I examine the legislation that approved United States participation in the North American Free Trade Agreement (NAFTA) on November 17, 1993. NAFTA is an agreement between Canada, Mexico, and the US, that creates a multilateral trade bloc. In particular, it established open trade between the three countries and ended tariffs on

a variety of goods. This bill was heavily supported by Republicans in Congress but President Clinton also backed the agreement upon entering office. There are a variety of reasons to consider this bill. NAFTA was a particularly salient bill and is arguably one of the most comprehensive free trade agreements considered by Congress (Quinones 1994). The debate was largely between those members that were in favor of free trade and those that were more supportive of labor unions. The political dynamics of this bill also increased the salience of the bill. Clinton had just won the presidential election, running on the platform of being a “new” Democrat, or as a Democrat that was willing to face off against organized labor. Ross Perot also tried to use NAFTA as a way to show his political influence and despite being less than successful he helped keep the issues in the news. In addition to the organized interests and political debates that surrounded this bill, it was a complex piece of legislation and the outcomes that may result from signing onto the agreement were still unclear.

In the case of NAFTA, there were not clear divisions between the two parties. Republicans were very supportive of signing onto the agreement whereas Democrats were not as cohesive. NAFTA already fit into the agenda of most Republicans, since they are generally in favor of free trade and the agreement had been started by Bush but Democrats felt conflicting pressures. Democratic constituencies wanted them to vote against NAFTA but they also felt pressure from the President to vote in support. Thus, it may not be useful to just look at ties between co-partisans. In addition to looking at the relationship between co-partisans, I also will look at how ideologically similar legislators influence one another. This may be more appropriate given the divides between the Democrats. When looking at co-partisans, I do not expect to find a relationship because of the divisions between Democrats. On the other hand, I would expect there to be a positive effect for ideologically similar legislators.

Additionally, I examine those legislators who are from the same state. The few examples of spatial econometric studies of legislative behavior have looked at the influence of geography. Specifically, they have looked at how legislators are influenced by their neighboring legislators

(by district) when it comes to the timing of their position announcement (Darmofal 2009; Hays and Kachi w.p.). The expectation is that legislators from the same state may have similar interests in whether or not the U.S. signs onto NAFTA and may rely on one another for guidance on how they should vote. I would expect that legislators from the same state will tend to vote similarly to one another, regardless of their party affiliation.

## **No Child Left Behind**

The No Child Left Behind Act reauthorized the Elementary and Secondary Education Act of 1965 and passed the House on May 23, 2001. Although NCLB was reauthorizing a previous piece of legislation, it radically transformed the role of the federal government in education. The major changes that resulted from this education policy were focused on testing and accountability, through the establishment of measurable goals with the intent to improve individual outcomes. Each state was required to develop an annual assessment and their own standards of success in order to receive federal funding. Each year the schools were expected to improve upon the tests to show that they were making progress. If schools failed to show that they were making progress, they were penalized according to how many years they were noncompliant. A large part of George W. Bush's tenure as governor and his presidential campaign focused on educational reforms, despite education being considered a "Democratic" issue. As governor, he promoted annual testing in grades 3-8 and made it clear during his campaigning efforts that he wanted to do something similar at the national level. The bill was coauthored by Representatives John Boehner (R-OH) and George Miller (D-CA), and Senators Edward Kennedy (D-MA) and Judd Gregg (R-NH) in order to establish a bipartisan coalition across both chambers as a result of the small margins that existed in both the Senate and the House (McGuinn 2006; Hursh 2007).

The role of party in this piece of legislation should be very important. First and foremost, education is seen as a Democratic issue and the expectation was that a large portion of Democrats would support this bill, in particular those New Democrats that emerged during the Clinton years.

Some Democrats may have experienced some conflicting pressures with the standard party platform and the interest group and constituency pressures. The Democrats who received a lot of contributions from teacher's unions or had a large portion of the eligible workforce employed in public education would have been less likely to vote in favor of NCLB, as a result of the dislike that teachers had for the new standards that they would have to meet. Republicans were surprisingly very supportive of the increased federal role in the education system. This shift in opinion was a result of the pressure that they felt from Bush really pushing this agenda. After a rather contentious election, many Republicans felt that it was important to show that Bush's legislative agenda could have undisputed success. That is not to say that all Republicans were on board with the bill. There was a large portion of the House Republicans who would never support this kind of testing reform without the inclusions of vouchers. These cross pressures for this bill may diminish the importance of party and increase the significance of those legislators who have similar ideological views to you which is why I still look at the relationship between legislators who are ideologically similar to one another. Those Democrats who receive large pressure from teachers and teachers' unions likely are similar to each other when it comes to their ideology. The same can be said for those Republicans who are supportive of the voucher systems.

Legislators who come from the same state are especially important in this example because the assessment and standards were not established in the bill itself. The bill only required that the state establish their own system. Thus, we would expect that legislators who come from the same state would have similar interests in whether or not this bill would be beneficial for their state and that this relationship should matter regardless of the party ID of the members in the state contingency.

## **Methods and Data**

Spatial modeling is the focus of this dissertation, so this section provides an overview of this method and the particular models that I use in the analysis (spatial duration and spatial probit

models). Spatial econometrics have become increasingly popular in the political science world. As Robert Franzese and Jude Hays (2008) say in their review of spatial analysis in political science, “spatial interdependence is, in summary ubiquitous and often quite central throughout the substance of political science.” Political processes occur in specific locations with actors often interacting with one another. Rarely is the process of political science studied with units in isolation of all other units. Measuring this interdependence “can seldom be taken into account by simply adding another explanatory variable (Huckfeldt 2009).”

Before going into the technical nature of spatial econometrics, I want to highlight the intuition behind this method for my project. My dissertation seeks to address the gap between decades of congressional research which emphasizes how the decisions of each legislator depend on those made by their colleagues and the existing empirical methods that continually struggle to capture this interdependent behavior. The use of spatial analysis allows me to explicitly model this interdependence, or the process through which the outcome of unit  $y_i$  influences the outcome in  $y_j$  and vice versa. For the most part, the extant empirical work on congressional behavior assumes independence. Spatial econometrics breaks this restrictive assumption, the choices of each legislator no longer emerge independently of one another but rather depend on those made by their colleagues. Further, this analysis allows for this interdependence to emerge while separating it from the legislator’s individual characteristics making it easier to properly evaluate the influence of these ties. As a result of these non-random interactions, “the error terms are likely to be correlated across legislators in any regression that treats legislators as units, and legislative scholars should explicitly account for this interdependence using (for instance) spatial lag terms (Rogowski and Sinclair 2012).”

Earlier work trying to capture this relationship often relied on two different options. Most of the time spatial interdependence was considered to be a nuisance and had to be corrected (through the use of robust standard errors) or was captured through the use of dummy variables such as those states (or countries) that were considered to be “neighbors” or a variable is included for all

of the countries with whom country A shares an alliance. This type of modeling fails to capture the true interdependence between each pair of observations because it assumes that these relationships can be separated or ignored. This is problematic because in reality they are intertwined and often are substantively driven (Franzese and Hays 2007). Spatial modeling allows for a more dynamic relationship and there have been tremendous gains made in the study of political science in the spatial context. It is important to have a clear understanding of what spatial analysis actually means.

Spatially dependent observations can arise in two different types of models. The first of these is that ideas, beliefs, and decisions diffuse between neighboring or similar units. This means that the interdependence between units arises from a spatial lagged dependent variable that captures this influence. This is referred to as a spatial lag model

$$\mathbf{y} = \rho \mathbf{W}\mathbf{y} + \beta \mathbf{X} + \varepsilon$$

where  $\mathbf{W}\mathbf{y}$  is the spatially lagged dependent variable weighted by matrix  $\mathbf{W}$  and  $\rho$  is the spatial autoregressive parameter for the spatially lagged dependent variable. The second form of interdependence represents dependence that arises through the error term. This often occurs through the clustering of a specific behavior usually resulting from exogenous conditions or common shocks. This is called the spatial error model (Anselin 1988; Darmofal 2006; Franzese and Hays 2007).

$$\mathbf{y} = \beta \mathbf{X} + \lambda \mathbf{W}\varepsilon.$$

$\mathbf{W}\varepsilon$  is lagged error term weighted by matrix  $\mathbf{W}$  and  $\lambda$  is the spatial autoregressive parameter for the lagged dependent variable. In both forms of spatial interdependence, the spatial matrix  $\mathbf{W}$  is a N by N symmetric matrix which expresses for each observation (the row) those units (columns) that are similar to that individual observation. The elements of the matrix not only indicate whether or not the units have a relationship but also what type of relationship exists between them. The spatial weights matrix captures the degree of the relationship. If the matrix is a contiguity matrix,

element  $w_{ij} = 1$  when observations  $i$  and  $j$  are neighbors and equals to 0 otherwise. The diagonal elements of the matrix are equal to 0 because unit  $i$  cannot be a neighbor to itself (Anselin and Bera 1998). The specification of the spatial weights matrix is up to the analyst. The most often used specification relies explicitly on geography or which states/countries are contiguous neighbors to one another. This generally creates a matrix with all of the elements equal to 0 or 1. Another use of geographic spatial relationships is through the use of distance between particular elements, whether this be the distance between capitals, voting precincts, or the distance from one's house to another house in their neighborhood. A spatial weights matrix does not have to be just about geography. For example, if the researcher wanted to study the spatial relationship between trade partners, it may be more important to put the degree of trade that Country A and B share rather than just that they are trade partners (Beck, Gleditsch, and Beardsley 2006). In this paper, I look at two different matrices that are not associated with the geographic location of legislators; co-partisans and ideologically similar legislators. In both of these matrices, I am capturing the degree or the strength of these relationships.

## **Spatial Probit Models**

Spatial interdependence can be found in many types of binary outcomes that are of interest in the study of political science. The study of legislative votes is one of these types of outcomes. This discussion has laid out how we might expect legislators to rely on one another in their decision making processes. The structural model for the latent variable of the spatial probit takes the form (under the assumption that it is a spatial lag model):

$$\mathbf{y}^* = \rho \mathbf{W}\mathbf{y}^* + \mathbf{X}\beta + \varepsilon \quad (0.1)$$

which can be written in reduced form as:

$$\mathbf{y}^* = (\mathbf{I} - \rho\mathbf{W})^{-1}\mathbf{X}\beta + (\mathbf{I} - \rho\mathbf{W})^{-1}\boldsymbol{\varepsilon} \quad (0.2)$$

The latent variable  $\mathbf{y}^*$  links to the binary outcome,  $\mathbf{y}$ , through the following equation:

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0. \end{cases} \quad (0.3)$$

The probability that  $y_i$  is one equals:

$$p(y_i = 1|\mathbf{X}) = \Phi_i \{[(\mathbf{I} - \rho\mathbf{W})^{-1}\mathbf{X}\beta]_i/\sigma_i\} \quad (0.4)$$

This gives the probability that the systematic component exceeds the error term,  $u_i$ . As a result of the lack of independence in  $y_i^*$ , the stochastic component is now distributed multivariate normal with mean 0 and variance-covariance  $[(\mathbf{I} - \rho\mathbf{W})'(\mathbf{I} - \rho\mathbf{W})]^{-1}$ . Unlike in the standard probit,  $\sigma_i^2$  may not be constant across all observations, introducing heteroscedasticity into the model. This is why the standard probit model is not appropriate when trying to capture spatial interdependence. The joint distribution of the outcomes is not the product of  $n$  univariate marginal distributions because we cannot separate out the distributions. They must be jointly maximized.

A spatial error model is relatively more simple when compared to the spatial lag model with respect to modeling discrete choices. For the probit model, it takes the following form:

$$\mathbf{y}^* = \mathbf{X}\beta + \mathbf{u} \quad (0.5)$$



where  $\mathbf{u} = (\mathbf{I} - \rho\mathbf{W})^{-1}\boldsymbol{\varepsilon}$  and the marginal probability of  $y_i$  being equal to 1 is:

$$p(y_i = 1|\mathbf{x}_i) = \Phi_i\{\mathbf{x}_i\boldsymbol{\beta}/\sigma_i\} \quad (0.6)$$

There is still heteroscedasticity in the spatial error model but since the dependence only operates through the stochastic term and not all of the  $\mathbf{y}^*$ , each observation depends on all observations of  $\boldsymbol{\varepsilon}$  but only on their own independent variable values (i.e.  $\mathbf{x}_i$ ).

Most of this research considers the spatial probit model with interdependence in the latent variable or the unobserved variable that structures probability of a binary outcome. McMillen (1992) suggested an EM algorithm, which made the spatial probit's non-additively separable log-likelihood estimable, but the strategy did not provide standard errors for  $\rho$  and required arbitrary parameterization of the heteroscedasticity that exists in spatial probit models. LeSage (1999, 2000) introduced a Bayesian strategy of Markov-Chain-Monte-Carlo (MCMC) by Gibbs sampling. The big issue with this estimator is the need to confront the fact that it must integrate over a multidimensional truncated normal distribution. In this analysis, I use code developed by Franzese, Hays, and Cook (2013) which uses LeSage's estimator but also allows for temporal dependence to exist.

## Data

### North American Free Trade Agreement

The data for NAFTA comes from Box-Steffensmeier, Arnold, and Zorn (1997) and I plan to use similar controls.<sup>2</sup> These controls capture the influences of constituency, interest group, institutional, and individual factors. The constituency factors that were included in their analysis were percentage of union membership in a representative's district, whether their district was on the Mexican border, the proportion of the district that voted for Perot in the 1992 presidential election,

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<sup>2</sup>The data in this analysis focuses only on the House of Representatives.

and the median household income in their district. The interest group factors controlled for the contributions made by corporate and labor-related PACs. The institutional factors were included to control for those members that were in a powerful institutional position such as the party leadership or a member of one of the committees that considered NAFTA. Finally, the party affiliation and ideology of the individual legislators were added in to control for their personal interests.

In addition to these controls, it is important to discuss how I plan to test the three relationships of interdependence: party influence, same state, and ideological similarity. As mentioned above, in order to analyze this interdependence, I have to structure my weights matrices in a particular way. The first relationship I will look at is the influence of party. The corresponding weights matrix connects legislators from the same party. For example, the  $ij$  entry in the spatial weights matrix will equal 1 if legislator  $i$  and legislator  $j$  are from the same party and it will equal 0 if legislator  $i$  and legislator  $j$  are from different parties. I will also look at ideological distance since the effect of co-partisans may not be as important on this bill as a result of the cross pressures Democrats experienced. I use DW-NOMINATE scores for the 103rd Congress to indicate the ideological position of each legislator. I calculate ideological similarity by taking the absolute distance between each pair of legislators in the 103rd Congress. For interpretation sake, I transform each entry by a distance decay function that will make sure that it is the similar legislators that are most influential.<sup>3</sup> Finally, I look at representatives who are from the same state. The entries in the spatial weights matrix will then be equal to 1 if the two legislators are from the same state and will be equal to 0 otherwise. All of these weights matrices will be row-standardized so that each of the rows will sum to one.

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<sup>3</sup>The distance decay function that I use was  $e^{-8*distance_{ij}}$  where  $distance_{ij}$  is the absolute distance between legislators  $i$  and  $j$ .

## **No Child Left Behind Act**

The controls for the No Child Left Behind Act are similar to those in NAFTA in that their intent is to capture the other potential influences on vote choice such as constituency influence, interest group influence, and individual factors. The individual factors that I control for in this vote was the legislator's party, their ideology (their DW-NOMINATE score), and whether or not they were on the committee. Unlike with NAFTA, I cannot control for whether or not the member was in the party leadership because all of the party leadership in both parties voted in favor of the bill and so they perfectly predicted success. In order to capture the influence of interest groups, I calculate the proportion of each member's PAC contributions that come from education and teacher's union PACs in the previous election. Finally, for constituency influence, I use two different variables. The first is the percentage of the school age population in each legislator's district that is enrolled in the public school systems. In the second variable, I calculate how much of the eligible population worked in the education system.

The spatial weights used in the analysis are similar to those used for NAFTA with the exception of the same party weights matrix. This is because there are not enough Democrats that voted against the bill. Of the 211 Democrats in the House at this time, only six of them voted against NCLB and seven of them abstained. As a result there was too much multicollinearity between the spatial weights matrix for same party and the legislator's personal party ID so the standard errors were inflated. Just as with NAFTA, I use the DW-NOMINATE scores from the 107th Congress for each legislator's ideological position. To capture ideological similarity, I calculate the absolute distance between each pair of legislators and reshape each element of this matrix by the same distance decay function. Finally, I construct a spatial weights matrix in order to represent whether or not legislators are from the same state.

## Results

Table 1 reports the results of three separate spatial probit models for NAFTA, varying the spatial weight matrix in each of the analyses. The dependent variable indicates the member's vote on NAFTA, coded 1 for members who supported passage and 0 for those who are opposed. In the final vote on NAFTA, 234 legislators voted in favor of NAFTA and 200 legislators voted against NAFTA.<sup>4</sup>

In order to assess the degree and significance of spatial interdependence, consider the estimates of  $\rho$ . I expect that  $\rho$  will be positive. The results suggest that these relationships are very important in determining how a legislator would vote when it comes to signing onto NAFTA. Surprisingly, despite the strong divides in the Democratic party on the NAFTA vote, one's co-partisans had a strong and positive effect on the probability that a legislator will vote in favor of NAFTA. This finding is probably driven by the relationship between Republican legislators. The same relationship is found for legislators who were ideologically similar to one another. The similar economic interests that exists for members of Congress who are from the same state were also very influential on one's voting decision.

The independent variables that are statistically significant in this model vary across some of the models. Union membership is statistically significant across the models and for the most part it is in the expected direction with the exception of when I look at those legislators that are from the same state. Once I control for the relational ties that exist between legislators who are from the same state the relationship becomes positive. Household income and campaign contributions are also influence one's vote choice. Party ID was important in the first two models where I was looking at the influence of one's co-partisans or ideologically similar colleagues. These results are comparable to the naive probit model with the exception of the findings on party ID. There is no individual effect in the naive probit model but once I account for the spatial relationship among

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<sup>4</sup>I report the non-spatial probit results in the appendix.

Table 1: NAFTA Model using Spatial Probit

	Party	Ideology Dist.	Same State
Union Mem.	-5.610*** (1.300)	-4.137*** (1.239)	4.167*** (1.165)
Perot vote	0.970 (1.160)	-1.422 (1.081)	-0.238 (1.032)
Mex. Border	0.290 (0.429)	0.428 (0.436)	-0.692 (0.459)
Income	0.205*** (0.090)	0.217*** (0.087)	0.210*** (0.082)
Corp. PAC	1.835*** (0.740)	1.087*** (0.711)	1.176*** (0.716)
Labor PAC	-3.621*** (0.926)	-2.452*** (0.867)	-2.490*** (0.844)
Ideology	-0.268 (0.309)	-0.775*** (0.292)	-0.097 (0.305)
Party ID	1.355*** (0.508)	0.743*** (0.288)	-0.548 (0.303)
Com. Member	-0.145 (0.314)	0.194 (0.302)	-0.015 (0.307)
Rep. Leader	0.066 (0.393)	0.124 (0.367)	0.434 (0.399)
Dem. Leader	0.160 (0.148)	0.238 (0.145)	-0.166 (0.146)
$\rho$	1.772*** (0.430)	2.083*** (0.041)	1.610*** (0.088)
Constant	-0.716 (0.421)	-0.233 (0.320)	0.416 (0.329)
Observations	433	433	433

\*  $p < 0.1$ , \*\*  $< 0.05$ , \*\*\*  $p < 0.01$

co-partisans and ideological similarity party does become statistically significant.

Table 2 reports the results of two separate spatial probit models for NCLB, varying the spatial weight matrix in each of the analyses. The dependent variable indicates the member's vote on NCLB, coded 1 for members who supported passage and 0 for those who are opposed. The final vote on NCLB was much more lopsided in NCLB with 381 legislators voting in favor and only 41

legislators voting in opposition to NCLB.<sup>5</sup>

Table 2: NCLB Model using Spatial Probit

	Ideology Dist.	Same State
% K-12	-2.32* (1.435 )	0.104 (1.234)
% Teachers	-8.712 (10.088)	-6.846 (8.923)
Education PAC	0.109 (0.165)	0.004 (0.025)
Ideology	0.135 (0.378)	-0.887* (0.479)
Party ID	0.886** (0.355)	0.464 (0.461)
Com. Member	-0.113 (0.260)	-0.155 (0.263)
$\rho$	2.160*** (0.070)	1.915*** (0.174)
Constant	-0.998 (1.106)	-0.233 (0.320)
Observations	429	429

\* p<0.1, \*\*<0.05, \*\*\* p<0.01

The results from NCLB make it pretty clear that this was a party vote. With the exception of proportion of eligible population that was in public schools (K-12), the only variables that are found to be significant in these results are party ID and ideology and they are not consistent across both of the model. When looking at the same state model, the ideology of the legislator is important but once I control for ideological similarity among legislators that variable is no longer is significant. The opposite is found for the party ID variable, which was found to be significant when looking at ideological similarity but not when looking at the influence one's state coalition has on one's vote. Comparing these models to the naive probit model, there are some differences. The naive probit model also finds that ideology and party id matter. The non-spatial model also finds that

<sup>5</sup>I report the non-spatial probit results in the appendix.

the proportion of educators in the district matters which is never statistically significant in the spatial models. The spatial parameters are both found to be positively and statistically significant indicating that there is some influence coming from these two groups of people.

The issue with looking NCLB is that is an asymmetrical vote making it difficult to parse out who was actually influential in determining each individual legislator's vote. Party was very influential on this bill and the only people who really voted against NCLB were those Republicans who were not going to support the bill unless there was a voucher program added to the bill (only 6 Democrats voted against the bill and 7 abstained). Lopsided bills or those bills where people have a clear signal that they should vote in favor or against a bill are not the appropriate types of bills to be looking at since legislators are less likely to be having a discourse with one another over these particular bills.

## **Interpretation**

In order to assess the degree and significance of spatial interdependence, consider the estimates of  $\rho$ . The results suggest when legislators were deciding whether or not to agree to the U.S. signing onto NAFTA, they relied heavily on their fellow Congress members. Surprisingly, despite the strong divides in the Democratic party on the NAFTA vote, one's co-partisans had a strong and positive effect on the probability that a legislator will vote in favor of NAFTA. The same relationship is found for legislators who were ideologically similar to one another. The similar economic interests that exists for members of Congress who are from the same state also influenced one's voting decision.

The independent variables that are statistically significant vary across some of the models. Union membership is statistically significant across of the models and for the most part it is in the expected direction with the exception of when I look at those legislators that are from the same state. Once I control for the relational ties that exist between legislators who are from the same state the relationship becomes positive. Household income and campaign contributions are also

found to be influential on one's vote choice. Party ID was important in the first two models where I was looking at the influence of one's co-partisans or ideologically similar colleagues.

The interpretation of these coefficients is made more difficult than the traditional methods of interpreting binary outcomes because of the fact that each of the coefficients is filtered through the spatial parameter and spatial weights matrix during estimation. Within-unit interpretations – the influence of  $x_i$  on  $y_i$  – now involved the feedback from  $i$  through the other units  $j$  back to  $i$ . Following Franzese, Hays, and Cook (w.p.) in order to interpret the spatial effects, I start by taking 10,000 draws from the standard normal distribution in order to calculate the structural errors. Then, these errors are multiplied by the spatial multiplier  $(\mathbf{I} - \hat{\rho}\mathbf{W})^{-1}$ , where  $\hat{\rho}$  is the estimated value of spatial parameter from the analysis. Then, I construct two different  $\mathbf{X}\hat{\beta}$  matrices, varying one of the independent variables for one of the legislators. This allows me to see how shifting one legislator's explanatory variable affects the legislators with whom they share relational ties. For illustration purposes, the results I present use the minimum value and the maximum value of the independent variable because the spatial spillover is minimal. After both of these matrices have been created, I multiply both of them by the spatial multiplier. I use these two components to create a predicted value of  $y^*$  such that

$$\widehat{\mathbf{y}}^* = (\mathbf{I} - \hat{\rho}\mathbf{W})^{-1}\mathbf{X}\hat{\beta} + (\mathbf{I} - \hat{\rho}\mathbf{W})^{-1}\boldsymbol{\varepsilon}$$

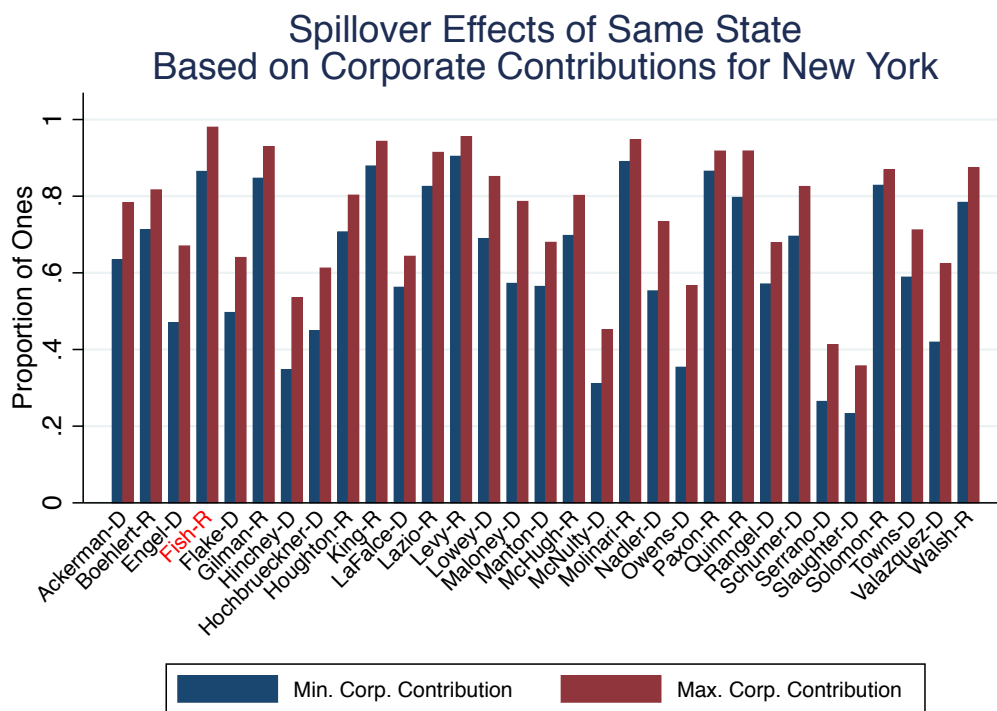
For each draw of the error term I have two different predicted latent  $y$ s, one for the minimum value of the independent and one for the maximum value. Each of these predicted values are then translated into the observed  $y$ . After the latent  $y$  is translated into 0s and 1s, the proportion of ones is calculated for each of the legislators across all 20,000 values of  $y$  (10,000 for the minimum, 10,000 for the maximum). Then, I take the difference between the two different proportions (the proportion of ones when the legislator is at the minimum value and the proportion of ones when



the legislator is at the maximum).

For illustration of this interpretation method, I have selected a case to present from NAFTA. I manipulated one of the legislators from New York (Fish, highlighted in red), altering his corporate contributions from the lowest proportion of corporate contributions to the highest proportion of corporate contributions that any legislator received. It is clear that from this graph that shifting the results for this one legislator influenced all of the rest of the legislators who come from his state. Some legislators experienced greater spillover from Fish's shift but the total change from this spatial model is much greater than with a non-spatial probit model where Fish where there is no spillover effect.<sup>6</sup>

Figure 1: Same State



<sup>6</sup>Under the non-spatial model, the first difference for Fish is 0.2658.

## Conclusions and Future Research

Evidence suggests that legislators are spatially interdependent under some of the relational ties that I have hypothesized in this paper. Legislators received positive influence from their co-partisans or ideologically similar colleagues and from the legislators with whom they share the common interest of coming from the same state. This means that having these relationships make it more likely that these legislators will vote in favor of legislation under consideration. This is especially important because this influence is above and beyond their personal preferences and the preferences of their constituency. The inability of traditional methods to properly capture these effects is problematic. With the application of spatial probit to the study of legislative behavior, I am better able to account for the influence of the relational ties that generations of scholars have theorized about.

It is important to note that the two bills I analyze are both very salient and it will be beneficial to also look at an assortment of bills that are less salient. This will allow me to look at the influence of these relationships on “normal” decisions. My expectation is that one’s colleagues become even more influential on these normal issues because most legislators will not be receiving cues from people outside of the chamber (i.e. their constituency or other people in Washington). In addition to exploring more bills on the saliency dimension, it also is important to look at more policy areas and in particular, those policy areas that are generally less technical. The bills that I have looked at do vary in their complexity. Comparing NAFTA and NCLB, legislators seemed to have a better idea of what the policy outcome would be once they passed NCLB versus what would occur when they ratified NAFTA. These two areas can still be very technical so considering a moral issue may be lower on that scale since policies that fall under that umbrella tend to be more straight forward. Another parameter that all the bills in this project have in common is they were all successful. One of the reasons that this interaction between legislators occurs is because they need to build coalitions and it may be interesting to study bills that were not successful in establishing a large

enough coalition.

Outside of collecting more data, I plan to adapt both of the models that I used in this project so that I can include multiple spatial weight matrices in the analysis at once. The ability to include all of the spatial weights matrices in the analysis at once will allow for me to test and see if one of the relationships is more important than the others in determining which legislators hold the most influential ties. For those bills that I find more than one statistically significant spatial relationship, once I am able to put them all into one model the three relationships can compete with one another.

Finally, the last two extensions would be look at different groups of legislators and different institutions. In this project, I focus on three relationships – party, same state, and ideological similarity. These are not meant to be exhaustive. There are a multitude of different ties that one could study. The next group that I plan to look at is women in Congress. There has been considerable amount of research on whether or not women are different from men when it comes to representing women's interests in Congress and state legislatures but there has been less research on how women work together (Thomas 1994; Reingold 2000; Swers 1998; Swers 2002; Bratton and Haynie 1999; Bratton, Haynie, and Reingold 2007; Osborn 2012). Limited evidence suggests that women behave differently in deliberative bodies; they are more collaborative (Kathlene 1994). I plan to look at how the Congressional Caucus for Women's Issues has changed over time, focusing on the more recent congresses where there has been an emergence of conservative women. If women are more collaborative, I expect that their decisions, on women's issues in particular, will be interdependent making spatial analysis an appropriate tool. The CCWI was bipartisan in nature but in recent years has struggled to maintain the cohesiveness that it had in the past.

Not only do I plan to look at a different group of legislators I also want to look at how interdependent legislative behavior is outside of the House of Representatives. Given the amount of variation that exists in state legislatures, they would provide an interesting comparison to my findings from this project. I would not be able to look at each chamber but instead would select a few to focus on. I will select my cases based on their legislative professionalism, leadership power,

and party control. Using these three measures will allow me to look not only at chambers that are similar to Congress but also at those chambers that are distinct. Unprofessional legislatures are often only in session for a short period of time, the representatives have other forms of employment, receive little to no compensation, and rarely have a large enough staff to support them. These are areas where legislators may rely heavily on one another since they have fewer places to gain the necessary information on their own. The study of legislative behavior lends itself to spatial analysis given the large amount of literature that focuses on the importance of these interdependencies. The future plans with this project that I have discussed here are only just the start of what research could benefit from further exploration of the intersection of spatial econometrics and legislative studies.

## Works Cited

- Anselin, Luc. 1988. *Spatial Econometrics: Methods and Models*. Kluwer: Dordrecht.
- Anselin, Luc and Anil K. Bera. 1998. "Spatial Dependence in Linear Regression Models with an Introduction to Spatial Econometrics." In *Handbook of Applied Economic Statistics*, eds. Aman Ullah and David E.A. Giles, New York: Marcel Dekker.
- Aldrich, John. 1995. *Why Parties? The Origin and Transformation of Political Parties in America*. Chicago: University of Chicago Press.
- Aldrich, John and David Rohde. 2000. "The Consequences of Party Organization in the House: The Role of Majority Minority Parties in Conditional Party Government." In *Polarized Politics: Congress and the President in a Partisan Era*, eds. Jon Bond and Richard Fleisher. CQ Press
- Aldrich, John and David Rohde. 2001. "The Logic of Conditional Party Government." In *Congress Reconsidered*, eds. Lawrence C. Dodd and Bruce I. Oppenheimer. CQ Press
- Banerjee, Sudipto, Melanie M. Wall, and Bradley P. Carlin. 2003. "Frailty Modeling for Spatially Correlated Survival Data, with Application to Infant Mortality in Minnesota." *Biostatistics* 4(1): 123-42.
- Beck, Nathaniel, Kristian Gleditsch, and Kyle Beardsley. 2006. "Space is more than Geography: Using Spatial Econometrics in the study of Political Economy." *International Studies Quarterly* 50: 27-44.
- Boehmke, Frederick J. 2006. "The Influence of Unobservable Factors on Position Timing and Content in the NAFTA Vote." *Political Analysis* 14(4):421-438.
- Box-Steffensmeier, Janet M. and Bradford S. Jones. 1997. "Time is of the Essence: Event History Models in Political Science." *American Journal of Political Science* 41(4): 1414-61.
- Box-Steffensmeier, Janet M. and Bradford S. Jones. 2004. *Event History Modeling: A Guide for Social Scientists*. Cambridge University Press.
- Box-Steffensmeier, Janet M., Laura W. Arnold and Christopher J.W. Zorn. 1997. "The Strategic Timing of Position Taking in Congress: A Study of the North American Free Trade Agreement." *American Political Science Review* 91(2):324-338.
- Caldeira, Gregory and Christopher J.W. Zorn. 2004. "Strategic Timing, Position-Taking, and Impeachment in the House of Representatives." *Political Research Quarterly* 57(4): 517-527.

- Cherryholmes, Cleo H. and Michale J. Shapiro. 1969. *Representatives and Roll Calls: A Computer Simulation of Voting in the Eighty-eighth Congress*. Indianapolis: Bobbs-Merrill Company, Inc.
- Cox, Gary W. and Mathew D. McCubbins. 1993. *Legislative Leviathan: Party Government in the House*. Berkeley: University of California Press.
- Cox, Gary W. and Mathew D. McCubbins. 2005. *Setting the Agenda: Responsible Party Government in the U.S. House of Representatives*. London: Cambridge University Press.
- Darmofal, David. 2006. "Spatial Econometrics and Political Science." *working paper*.
- Darmofal, David. 2009. "Bayesian Spatial Survival Models for Political Even Processes." *American Journal of Political Science* 53(1):241-257.
- Fowler, James H. 2006a. "Connecting the Congress: A Study of Cosponsorship Networks." *Political Analysis* 14(4): 456-487.
- Fowler, James H. 2006b. "Legislative Cosponsorship Networks in the US House and Senate." *Social Networks* 28(4): 454-465.
- Franzese, Robert J. and Jude C. Hays. 2007. "Spatial Econometric Models of Cross-Sectional Interdependence in Political Science Panel and Time-Series-Cross-Section Data." *Political Analysis* 15: 140-164.
- Franzese, Robert J. and Jude C. Hays. 2008. "Empirical Models of Spatial Interdependence." In *Oxford Handbook of Political Methodology*, Eds. Janet Box-Steffensmeier, Henry Brady, and David Collier, Oxford U.K.: Oxford University Press.
- Franzese, Robert J., Jude C. Hays, and Scott J. Cook. "Spatial-, Temporal-, and Spatio-Temporal Autoregressive Probit Models of Interdependent Binary Outcomes." *working paper*
- Hays, Jude C. and Aya Kachi. 2009. "Interdependent Duration Models in Political Science." *working paper*.
- Hays, Jude C., Aya Kachi, and Robert J. Franzese Jr. 2010. "A Spatial Model Incorporating Dynamic, Endogenous Network Interdependence: A Political Science Application." *Statistical Methodology* 7(2010): 406-28.
- Kingdon, John W. 1981. *Congressmen's Voting Decisions*. New York: Harper & Row Publishers.
- Krehbiel, Keith. 1991. *Information and Legislative Organization*. Ann Arbor: University of Michigan Press.

- LeSage, James P. 1999. *Spatial Econometrics*. <http://www.rri.wvu.edu/WebBook/LeSage/spatial/wbook.pdf>
- LeSage, James P. 2000. "Bayesian Estimation of Limited Dependent Variable Spatial Autoregressive Models." *Geographical Analysis* 32(1): 19-35.
- Lin, Tse-Min, Chin-En Wu, and Feng-Yu Lee. 2006. "'Neighborhood' Influence on the Formation of National Identity in Taiwan: A Spatial Regression with Disjoint Neighborhoods." *Political Research Quarterly* 59: 35-46.
- Lohmann, Susanne. 1993. "A Signaling Model of Informative and Manipulative Political Action." *American Political Science Review* 87(2): 319-333.
- Lohmann, Susanne. 1994. "The Dynamics of Informational Cascades." *World Politics* 47(1): 42-101.
- MacRae, Duncan. 1958. *Dimensions of Congressional Voting: A Statistical Study of the House of Representatives in the Eighty-First Congress*. Berkeley: University of California Press.
- Masket, Seth. 2008. "Where You Sit is Where You Stand: The Impact of Seating Proximity of Legislative Cue-Taking." *Quarterly Journal of Political Science* 3: 301-311.
- Matthews, Donald R., and James A. Stimson. 1975. *Yeas and Nays: Normal Decision-Making in the U.S. House of Representatives*. New York: Wiley.
- Mayhew, David. 1974. *Congress: The Electoral Connection*. Yale University Press.
- McMillen, D.P. 1992. "Probit with Spatial Autocorrelation." *Journal of Regional Science* 32: 335-348.
- Poole, Keith and Howard Rosenthal. 1985. "A Spatial Model for Legislative Roll Call Analysis." *American Journal of Political Science* 29(2): 357-384.
- Poole, Keith and Howard Rosenthal. 1997. *Congress: A Political-Economic History of Roll Call Voting*. New York: Oxford University Press.
- Quinones, Sherry Bennett. 1994. "The Political Economy of the North American Free Trade Agreement." Presented at the annual meeting of the American Political Science Association, New York.
- Rohde, David W. 1991. *Parties and Leaders in the Postreform House* Chicago: The University of Chicago Press.

Schattschneider, E.E. 1942. *Party Government*. New York: Farrar and Rinehart, Inc.

Truman, David B. 1959. *The Congressional Party: A Case Study*. New York: John Wiley.

VanDoren, Peter M. 1990. "Can We Learn Causes of Congressional Decisions from Roll-Call Data?" *Legislative Studies Quarterly* 15(3): 311-340.

Victor, Jennifer and Nils Ringe. 2009. "The Social Utility of Informal Institutions: Caucuses as Networks in the 110th U.S. House of Representatives." *American Politics Research* 37(5): 742-766.

Wilson, Woodrow. 1885. *Congressional Government*. Cleveland: The World Publishing Company.

Young, James Sterling. 1966. *The Washington Community, 1800-1828*. New York: Columbia University Press.



## Non-Spatial Probit Vote Models for NAFTA and NCLB

Table 3: NAFTA

	NAFTA
Union Member	-5.083*** (1.299)
Perot Vote	0.626 (1.164)
Mexican Border	0.346 (0.431)
Income	0.211** (0.090)
Corporate PAC \$	1.915*** (0.739)
Labor PAC \$	-3.804*** (0.931)
Ideology	0.071 (0.310)
Party ID	-0.194 (0.310)
Committee	0.096 (0.149)
Republican Leader	0.121 (0.397)
Democratic Leader	-0.150 (0.316)
Constant	0.240 (0.334)
N	433

\* p<0.1, \*\*<0.05, \*\*\* p<0.01

Table 4: NCLB

	NAFTA
% K-12	0.946 (1.391)
% Teachers	19.735* (10.683)
Education PAC \$	0.030 (0.166)
Ideology	-2.206*** (0.584)
Party ID	1.415** (0.589)
Committee	-0.274 (0.248)
Constant	-0.813 (1.209)
N	433

\* p<0.1, \*\*<0.05, \*\*\* p<0.01