Are Bilateral Investment Treaties Really Bilateral?*

Yonatan Lupu
Department of Political Science
George Washington University

Paul Poast
Department of Political Science
Rutgers University

DRAFT
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Abstract

While the literature on the formation of Bilateral Investment Treaties (BITs) has made important theoretical advances about the factors that drive the formation of BITs, many of the empirical results on this issue are "surprising" or "puzzling." We argue that these results are due to previous studies conceptualizing the underlying BIT formation process as purely bilateral. Many BITs, though 'bilateral' in name, originate from multilateral processes involving the interactions of more than two states. After explaining this argument in detail, we use the 'k'-adic procedure outlined by Poast (2010) to model BIT formation as a multilateral process. Our empirical results resolve most of the counter-intuitive and counter-theoretical findings in prior work. Most importantly, we find that democratic states and states with legal systems that protect investor rights are less likely to form BITs because they need not use treaties to establish the credibility of their commitments to investors. Our results also resolve troubling prior findings with respect to the effects of economic growth, per capita income and colonial ties. Finally, we demonstrate that our models have significantly better fit and predictive power than equivalent dyadic models.

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1 Introduction

How does the international competition for capital affect whether states sign bilateral investment treaties (BITs)? Such treaties govern investment flows and drive the growing legalization of interstate relations. Understanding the remarkable proliferation of BITs over the last twenty years informs analyses of international capital markets and globalization more generally (UNCTAD 2000). BIT formation analysis also provides insights into competing theories of economic diffusion (Simmons and Elkins 2004).

While we have learned much about why states form BITs, the literature contains several puzzling findings that are inconsistent with underlying theory (Guzman 1998; Elkins, Guzman and Simmons 2006; Neumayer and Plümper 2010; Tobin and Busch 2009; Kerner 2009; Allee and Peinhardt 2010). Though democracies are expected to have more credible domestic institutions and, therefore, less need to establish credibility via BITs, empirical results do not support this. States with legal systems that have reputations for upholding investor claims should be less likely to form BITs, but empirical evidence shows that they are, in fact, *more* likely to do so. Finally, economic factors thought to drive the underlying demand for international investment sometimes have "the opposite effects" of what theory predicts (Elkins, Guzman and Simmons 2006, 840). Should these results lead us to reconsider our theoretical understanding of BIT formation?

We argue that, to the contrary, existing theory regarding why states form BITs is generally convincing, but theory regarding the process by which BITs are formed can be improved. While existing studies conceive of the BIT formation process as bilateral, we argue that the process is often multilateral. Many BITs, despite their name, result from explicitly or tacitly multilateral processes. The competition for international capital drives investment-seeking states to establish their credibility by forming BITs. States that compete for capital must take into account BITs formed by their competitors and the potential for such BITs to be formed. Conversely, investment-sending states must decide in which of many potential locations to invest and in which of those locations credibility should be enhanced by forming a BIT. BIT negotiations have even taken place in expressly multilateral settings. In other instances, the same underlying processes that lead to BIT formation have led to multilateral investment treaty negotiations, further suggesting an underlying multilateral process.

Because the BIT formation process is multilateral, we analyze it using a k-adic research design, in which the unit of analysis is a group of states with size k. K-adic data is a more general form of the dyadic data common to international relations research (Poast 2010). Bilateral processes can be analyzed using a dyadic research design, in which $k = 2$ states. The analysis of a multilateral process can be strengthened by using units of analysis that capture the characteristics of additional states. A k-adic research design allows us to capture characteristics of a group of states, whether that group contains 2, 3, 4 or more members. For example, a $k = 3$ k-ad could be the US-UK-France in 1950, a $k = 4$ k-ad could be the US-Germany-Russia-China in 1960, and a $k = 2$ k-ad (the classic dyad) could be US-Brazil in 1970.

In the case of BIT formation, the k-adic research design enables us to take into account the extent to which a BIT formation between a source and a target is affected by the characteristics of other states that may have competed with the target in the market for global capital. For example, if the United States and Costa Rica choose to form a BIT, the process for forming this BIT may have involved explicit or tacit negotiations between the United States and Costa Rica's competitors, most likely its neighbors in Central America.

Our results alleviate most of the theoretically puzzling results in the BIT formation literature. Democracies, we find, are less likely to form BITs, as theory suggests. Likewise, a reputation for a legal system that will honor the claims of investors leads to a smaller - not larger - probability of BIT formation, as investors need not use a BIT to make their investments safe. States experiencing economic growth are desirable locations for investment, so BIT formations with such states are more likely. Richer states are less likely to demand international capital, so they are also less likely to form BITs, while poorer states have a greater interest in luring investors in order to grow their economies. Finally, we find that some mechanisms of international competition lead to an increased likelihood of BIT formation while others reduce this probability. Unlike the findings in dyadic models, this result is consistent with theoretical arguments about the effects of competition and the lack of a "race to the bottom" in economic policies (Basinger and Hallerberg 2004; Cai and Treisman 2005; Konisky 2007; Plümper, Troeger and Winner 2009). The k-adic models also dominate equivalent dyadic models in terms of model fit and predictive power. This provides further statistical evidence supporting our theoretical justification for thinking that BITs follow a multilateral process.

The remainder of this paper is organized as follows. Section 2 identifies the surprising and counter-intuitive findings of previous studies, while section 3 explains why BIT formation is a multilateral process. Section 4 presents our k-adic research design for capturing this multilateral process, while section 5 presents our empirical results. Section 6 uses evidence on model fit to further support our contention that BIT formation follows a multilateral process. Section 7 concludes.

2 Puzzling Findings about BIT Formation

As BITs have proliferated, they have also become a major part of the international relations research agenda. A series of influential studies examines the formation of BITs and their impact on transnational investment (Guzman 1998; Neumayer and Spess 2005; Elkins, Guzman and Simmons 2006; Tobin and Busch 2009; Kerner 2009; Allee and Peinhardt 2010; Neumayer and Plümper 2010; Tobin and Rose-Ackerman 2011; Jandhyala, Henisz and Mansfield 2011; Poulsen and Aisbett 2013), resulting in a significant accumulation of knowledge. Leaders of developing countries seek economic growth, in part, by providing incentives for firms in rich countries to invest their capital in the developing countries. These firms – and the governments that represent them – know that capital invested in another country is subject to the host country's policies. The host country could significantly reduce the return on the investment by changing its tax policy or could expropriate the invested capital altogether. Investment sender states therefore seek credible commitments from potential investment hosts to protect the investment. Similarly, host states know that foreign investments may not be forthcoming unless they can credibly commit to protect them. BITs represent one solution to this problem, perhaps most importantly because they typically delegate enforcement to third-party arbitrators such as the International Centre for Settlement of Investment Disputes (ICSID) (Guzman 1998; Elkins, Guzman and Simmons 2006).

Unfortunately, the literature on BITs has produced many important findings that are inconsistent with this underlying argument. One explanation for such inconsistency could be measurement problems; some of the concepts crucial to BIT formation theory can be difficult to capture quantitatively. Another could be that our theories of BIT formation are inadequate. We have no doubt that BIT formation theory could use further refinement – and we offer some refinement below. Yet we argue that the key reason for these findings is that scholars have conceptualized the BIT formation process as bilateral and consequently modeled it using a dyadic unit of analysis. We argue that the process of BIT formation is multilateral – or k-adic – and should be modeled as such. Before developing this argument in detail, we briefly describe below the puzzling findings in the BIT literature.

2.1 Political Factors

Perhaps the most troubling finding in the BIT formation literature is that regime type does not significantly affect the probability of BIT formation. The need to make credible commitments to protect investments underlies host countries' motivations for agreeing to BITs. Thus, "governments with little inherent credibility are more likely to sign BITs than are governments known for their fair treatment of foreign capital" (Elkins, Guzman and Simmons 2006, 823). In large part because of their domestic institutions, democracies are better able to make credible international commitments (Milner 1997; Leeds 1999; Bernhard and Leblang 1999; Martin 2000; Lipson 2003; Mansfield, Milner and Pevehouse 2008). As a result, we would expect that investors would be more likely to trust democratic regimes to protect their property rights and not to renege on their commitments, without the need for delegating enforcement to a third party by signing a BIT. Elkins, Guzman and Simmons (2006) similarly expect a negative effect of host democracy, yet they find no significant effect, and neither do Neumayer and Plümper (2010).[1]

Like democracies, states with legal systems that have reputations for impartiality and for protecting contract and property rights may not need additional signals of credibility in this context. Recognizing this, Elkins, Guzman and Simmons (2006) include in their empirical model the measure of "Law and Order" provided by the International Country Risk Guide (ICRG), expecting this measure to have a negative relationship with BIT formation. Instead, they find in all the models they report that the measure has a positive and significant relationship with BIT formation. "Contrary to expectation, BITs were more likely to be signed by countries with better reputations for 'law and order.' ... the strong positive result is surprising," (Elkins, Guzman and Simmons 2006, 838-40). It is possible, as they note, that this finding could mean that the Law and Order indicator does not pick up on institutional protections for property rights, but nonetheless the finding is "puzzling" (Elkins, Guzman and Simmons 2006, 843). Given the central theoretical role of credibility problems, the finding might cast doubt on the theory of BIT formation.

2.2 Economic Factors

Tests of the effects of economic factors on BIT formation have also produced surprising results. Holding factors that affect the credibility of government promises

[1] It should be noted that, in both studies, the standard errors on the democracy coefficient were very large. In neither study was it the case that democracy was "nearly significant" with a p-value of, for example, 0.11, meaning that these non-findings were not simply driven by lack of statistical power.

constant, we should expect factors that drive an increase in demand for foreign direct investment (FDI) to also make BIT formation more likely. Countries with relatively poor economic development are especially interested in attracting FDI as a means of growing their economy. This argument informs the modeling decision, common across the BIT literature, of categorizing the developed economies as potential investment "sender" or "home" states and other economies as potential "host" or "target". We therefore expect a negative and significant relationship between per capita GDP and BIT formation. Nonetheless, existing studies have found that this relationship is not significant (and in some cases that the effect is positive) (Elkins, Guzman and Simmons 2006; Neumayer and Plümper 2010). Economic growth is an indicator of an economy that is attractive for investors. Growth has been shown to increase levels of FDI (Li and Resnick 2003; Choe 2003; Hsiao and Shen 2003). Finally, economic growth may be an indicator that an economy is liberalizing its policies, which often includes seeking FDI. As a result, Elkins, Guzman and Simmons (2006) include in their empirical models a measure of GDP growth, expecting to find a positive and significant effect on BIT formation. Yet they find that this has a negative and significant effect (Elkins, Guzman and Simmons 2006). In the models reported by Neumayer and Plümper (2010), this variable has a positive and significant effect. The differences in findings may be the result of differences in model specification between the two studies.

2.3 Colonial Heritage

Another puzzling result from the BIT formation literature is the effect of common colonial heritage. States with former colonial ties may have cultural similarities that lead to a greater likelihood of BIT formation. It might reasonably be argued that, over time, these effects would be drowned out by other, more salient aspects of the states' relationship, so we would not expect this factor to affect BIT formation. Nonetheless, Elkins, Guzman and Simmons (2006) unexpectedly find that this factor has a negative and significant effect on BIT formation. They speculate that this may be because investors may perceive states with colonial ties to be less risky. By contrast, Neumayer and Plümper (2010) find that colonial ties have a positive and significant effect on BIT formation. Most recently, in a study on delays in BIT ratification, Haftel and Thompson (2013) find that former colonial ties are associated with significantly slower ratification of BITs that have been signed. They note that this finding is "surprising" and echo the speculation by Elkins, Guzman and Simmons (2006) as to why this might be.

2.4 Contagion

The final set of findings in the BIT formation literature that we discuss concerns the effects of international contagion. The competitive mechanisms by which BITs have diffused in the international system imply that states consider the BIT-formation decisions of other states when making their decisions. Both Elkins, Guzman and Simmons (2006) and Neumayer and Plümper (2010) estimate the effects of variables designed to capture these mechanisms,[2] finding that most of them have positive and significant effects on the probability of BIT formation (while the effect of other measures is not significant). Unlike with respect to the other findings discussed above, the authors of the extant literature do not find these results surprising or puzzling. We do, however. The notion that the various mechanisms underlying the international competition for capital will lead to exclusively positive effects on the probability of BIT formation is akin to a "race to the bottom" argument, implying that developing countries and LDCs will attempt to outbid each other in agreeing to BITs in order to attract investors. Yet international economic competition, including the competition for capital, has been shown to rarely lead to a "race to the bottom" (Basinger and Hallerberg 2004; Konisky 2007; Plümper, Troeger and Winner 2009).

Indeed, we expect that the mechanisms of the international competition for capital

[2] For details on how these are constructed, see Section 3 below.

will have mixed effects on the probability of BIT formation. Similar forms of competition are well-known to lead some competitors to exit the market (DeAngelo, DeAngelo and Rice 1984; Jensen 1993). We can think of FDI-seeking as one policy states can use to grow their economies, a policy for which there are substitutes. Likewise, we can think of BITs as one instrument investment-seeking states can use to encourage investments, again a substitutable policy. Some states may be inherently better endowed with factors that make them attractive to investors, such as natural resources and human capital. As the competition for international capital intensifies, states that are less competitive in the capital market may pursue other policies in order to grow their economies. In addition, some states may continue seeking international capital but seek mechanisms other than BITs in order to attract it, such as investing in the domestic infrastructure and education, or reducing government corruption and waste. Going a step further, Cai and Treisman (2005, 818) show that in a market with sufficiently large gaps in initial endowments,

> "the worse-endowed units will actually have less business-friendly policies in equilibrium...Knowing they cannot compete, governments in poorly endowed units will give up on pro-business policies and focus instead on either predation or satisfying the demands of local citizens."

Applied to the BIT context, their argument implies that competition may drive certain states away from BIT formation. Finally, as Elkins, Guzman and Simmons (2006) note, many BIT negotiations have a "take it or leave it" nature, in which an investor state presents a potential host state with a "Model BIT." This can prevent agreement, as certain potential host states will forego signing a BIT with an inflexible source state – and the source state may not have an incentive to increase its flexibility because it may be able to find other BIT partners. Our expectation, therefore, is that mechanisms of contagion should have both positive and negative effects on the probability of BIT formation.

3 BIT Formation as a Multilateral Process

Most studies of BITs conceptualize them as following a bilateral process (meaning the process results from the interaction of two states). Typically, scholars explain why BITs are signed in certain dyads by examining characteristics of the potential sender state, characteristics of the potential host state, and certain pre-existing connections and flows between the two. We acknowledge that some BIT formations may indeed follow a bilateral processes. We argue, however, that many BIT formations (and non-formations) result from multilateral processes involving more than 2 states.

Several scholars recognize that BITs do not result from purely bilateral considerations. Elkins, Guzman and Simmons (2006) include in their empirical models measures designed to account for aggregate contagion in BIT signing. Specifically, they use a count of BITs signed by other host countries weighted by a set of distance measures to the country in question. Elkins, Guzman and Simmons (2006) find that such spatial lags of BITs among market competitors are significantly associated with a higher probability of BIT signing, whereas spatial lags of BITs among states with similar religions, colonial history and language are not. Building on this, Neumayer and Plümper (2010) argue that we should control for several other potential forms of contagion by using additional spatial lags. Not only is controlling for extra-dyadic factors important when modeling BIT formation, but Neumayer and Plümper (2010) show that altering how we model such dynamics leads to drastically different conclusions. Importantly, in both papers, the extra-dyadic factors included in the empirical models are all weighted indicators of other BIT formations, rather than characteristics of states outside the dyad.

While we agree with the existing literature that BIT formations may be affected by prior BIT formations, we argue that BIT formation is fundamentally a multilateral process rather than a spatially interdependent process. To explain, we distinguish among three types of data-generating processes: (1) an independent bilateral process; (2) an interdependent bilateral process; and (3) a multilateral process. Let us suppose that states

A, B, and C are engaged in a process that may lead to outcome Z, which is a possible connection between them such as cooperation, conflict or exchange. In an independent bilateral process, the outcomes Z_{AB}, Z_{AC}, and Z_{BC} are the result of three separate processes that are affected by different factors and that do not affect each other. In an interdependent bilateral process, the outcomes Z_{AB}, Z_{AC}, and Z_{BC} are still the result of three separate processes, but factors that affect the probability of one of the outcomes may also affect the probabilities of the other outcomes. Finally, in a multilateral process (or in the case of this stylized example, a triadic process), a single process leads to a single outcome Z_{ABC}. Thus, understanding the results of a multilateral process requires us to understand the characteristics of A, B and C as a group. While the three dyadic components of this single outcome may be separately identifiable, they are nonetheless parts of a single outcome. Within larger groups, outcomes can be the result not only of the interactions between dyads, but also higher-order interactions, such as interactions between dyads and triads.

Perhaps the most intuitively multilateral outcomes in international relations are expressly multilateral conflicts and agreements (Poast 2010). Scholars have long lamented that dyadic data sets split such events into many bilateral events (Signorino 1999; Gibler, Rider and Hutchison 2005; Croco and Teo 2005). A canonical example of the problem might be World War I. In that case, the outcome is generally thought of as a single multilateral conflict rather than a series of bilateral conflicts. It is intuitive, therefore, to view the process that resulted in that outcome as a multilateral process, a view supported by the scholarship on the crises leading up to war (Levy 1990; Gartzke and Lupu 2012).

It may be less obvious that the BIT formation process is multilateral, given that its outcomes tend to be individual bilateral agreements (or lack of agreements). Below we provide a detailed argument as to why it is actually so. Before doing this, however, we note that the World War I case can provide useful intuition on this point. Let us suppose, hypothetically, that *the same multilateral process* that led to World War I had led, by chance, to a different outcome: a war only between Austria-Hungary and Serbia. Such an outcome did not seem implausible to observers at the time and could very well have occurred had Germany decided to stay out of the war (as it had in the First Balkan War) (Gartzke and Lupu 2012). The result of this thought experiment may now appear to be bilateral, yet it is not. We can only really think of it as bilateral if we ignore the multilateral process that led to it and if we ignore all the non-conflict outcomes within the group of states involved in it, which would surely lead us to misinterpret the causes of the conflict. Even had the war ended as a bilateral "Third Balkan War" between Austria-Hungary and Serbia, this outcome would nonetheless have been the result of a multilateral process involving Germany, Russia and many other powers. This example demonstrates that events in which the outcomes may appear to be bilateral can actually result from multilateral processes.

3.1 The Influence of Competition for Capital

International competition for capital means that states consider multiple options for where to send their capital. Sender states consider the economic desirability of those locations, as well as the factors that may or may not make those states' commitments to protect foreign investments credible. Based on all those factors, they decide to which states to send capital and in which of those states a BIT is needed. Competition also means that developing countries "will bid down the conditions" they require to sign a BIT in order to compete with each other (Guzman 1998, 672). This logic implies that, when individual potential host countries negotiate BITs with home countries, they also consider the interests and strategies of other potential hosts. Building on this, "theory predicts interdependent decision making among host countries that compete for the same sources of global capital" (Elkins, Guzman and Simmons 2006, 830).

Competition means that countries not otherwise considering BITs may enter into them if their competitors do (or if they anticipate that their competitors might). Potential investment hosts are often "price-takers" with respect to BITs because the sender countries can turn to other potential host countries. This means that the potential host, when deciding to form a BIT, will be influenced not just by the extent to which its competitors have formed BITs but also by expectation of potential BITs formed by its competitors and the sender. In examining variation in whether BITs delegate to the International Centre for Settlement of Investment Disputes (ICSID), Allee and Peinhardt (2010, 12) point out that the preferences and strategies of many actors, including many states, are involved in the process by which states decide to form or not form BITs. They write:

> "[w]hen a host government is dependent upon access to global markets and capital from abroad, it needs to send signals of good governance and to conform to the wishes of major international economic actors such as the International Monetary Fund, World Bank, regional development banks, and economically powerful states. As a result, it should be more likely to agree to the inclusion of ICSID clauses in its BITs, in line with the preferences of these international actors."

Similarly, consider the extent to which the arguments in the canonical study of BIT formation by Guzman (1998) describe a multilateral process. For example:

> "[A]lthough an *individual* country has a strong incentive to negotiate with and offer concessions to potential investors-thereby making itself a more attractive location relative to other potential hosts–developing countries *as a group* are likely to benefit from forcing investors to enter contracts with host countries that cannot be enforced in an international forum, thereby giving the host a much greater ability to extract value from the investment. Put another way, developing countries as a group have sufficient market power in the "sale" of their resources that they stand to gain more when they act collectively than when they compete against one another." Guzman (1998, 843)(emphasis in original).

Guzman continues:

> "If LDCs can act as a group, however, there is less competition. Imagine, for example, explicit collusion among all developing countries aimed at increasing the rents those countries earned from the "sale" of their resources to investors. If that collusion was successful, one would expect LDCs as a group to have

> some market power and, therefore, to be able to increase the "price" at which investment takes place and to extract some of the surplus of the transaction. The fact that the hosts are colluding, of course, will cause a reduction of the overall level of investment, but the gains from colluding would outweigh the losses to LDCs" Guzman (1998, 867).

Elkins, Guzman and Simmons (2006, 825-826) note that "In recognition of this dynamic, one finds cases of regional attempts to coordinate host resistance. In the Caribbean, for example, collective efforts have been made to reduce BIT concessions, though predictably the 'cartel' has been difficult to maintain." Two aspects of this argument imply that a multilateral process drives the demand for BITs. The first is the notion that an individual state's incentives with respect to BIT formation would be different if that state were not competing with other states for international capital. This means the state in question must take into account the anticipated BIT formations of its competitors when making its own decisions. This implies a multilateral process in the sense that individual decisions are not simply interdependent on the outcomes of other decisions but are also made in parallel with other decisions. Multiple potential hosts, anticipating that others will form BITs, will themselves decide to do so. Second, Guzman implies that we might observe a lower demand for BITs if LDCs could collude to refrain from signing them. The fact that so many BITs are formed is not the result of separate - or even interdependent - bilateral processes, but the result of the inability of a group of actors to coordinate in the face of competition. That is, this is a process in which a group of actors tacitly attempts to cooperate and fails to do so, which means the process is a multilateral one involving the entire group.

3.2 Multilateral Investment Agreements and Multilateral BITs Negotiations

While BITs, as outcomes, are bilateral by definition, investment agreements need not be. There is no global investment regime, but there are multilateral agreements that address aspects of international investment. Examples include the Energy Charter Treaty, the ASEAN Agreement for the Promotion and Protection of Investments, and the North American Free Trade Agreement. Existing multilateral investment agreements further indicate that the process of creating and negotiating agreements on this issue is not purely dyadic. While the process often yields sets of bilateral agreements, the theoretical and empirical potential for yielding multilateral agreements demonstrates that the underlying process is multilateral. The inability of states to agree on the Multilateral Agreement on Investment (MAI) in 1998 provides further evidence of this. After the MAI failed, many OECD member-states pursued their own BITs with developing countries. Had the MAI been agreed to, many such BITs would not have been formed. These BITs were clearly not the result of purely dyadic process, but rather the result of a multilateral process (specially, the failed attempt to create a multilateral treaty). Stated differently, multiple BITs are, in part, the result of a decision not to conclude one multilateral investment agreement. As the World War I example above shows, we miss much by inferring that bilateral outcomes are driven by bilateral processes.

There are also examples of explicitly multilateral BIT formation processes. As Elkins, Guzman and Simmons (2006) note, many BITs have resulted from explicitly multilateral negotiations. For instance, the United Nations Conference on Trade and Development (UNCTAD) has recently held many multilateral conferences during which developing countries have negotiated BITs with each other (UNCTAD 2002; Karsegard, Bravo and Blom 2006). At one such conference held in Switzerland in 1999, several developing countries signed BITs with each other, for a total of 8 new agreements. UNCTAD's press release following the conference noted that the multilateral setting allowed "countries the opportunity to share negotiating experiences" and "the possibility of exchanging information among negotiators." While there are no public records of the proceedings of these meetings, this language suggests that at these events individual dyads do not negotiate BITs in isolation, but rather do so in ways such that negotiations all influence one another. From 2000 to 2005, UNCTAD sponsored 9 additional BIT "facilitation meetings", leading to a total of 160 new BITs, which account for almost a quarter of those signed during this period (Poulsen 2011). For example, at Kyrgyzstan's request, UNCTAD held such a meeting in 2001 and invited 4 countries with which Kyrgyzstan sought to negotiate a BIT: Austria, Denmark, Latvia and Sweden. The joint negotiations at the meeting resulted in Kyrgyzstan signing a BIT with each of these countries. UNCTAD also regularly issues recommendations to developing countries to take actions such as "target the negotiation of BITs with countries that have the potential to become important sources of FDI", "develop a wider BIT network", and pursue "a new round of BIT negotiations." (Poulsen 2011, 132).

4 Research Design

Most studies of BIT formation use a dyadic research design common to the international relations literature. A dyadic model is intuitive, of course, and is implied by the very name of the agreements being analyzed. Yet if even some BITs are formed as a result of a multilateral process, then including these in the analysis without accounting for the multilateral nature of their formation will lead to flawed inferences. We therefore model BIT formation as a multilateral process by using the k-adic procedure proposed by Poast (2010),[3] with adjustments to ensure comparability with Elkins, Guzman and Simmons (2006) and Neumayer and Plümper (2010).[4]

[3] Alternatively, one might consider adopting a network analysis approach (Hoff and Ward 2004; Maoz 2008; Warren 2010; Cranmer, Desmarais and Menninga 2012). However, these methods are oriented towards monadic and dyadic relationships because individual states comprise the nodes (or constitutive elements) of the network and the core characteristic of network data, a node-to-node "edge" list, is inherently dyadic.

[4] We focus on BIT signing, not ratification, which can take several years to complete.

4.1 The k-adic Model

We set up the k-adic model in two steps: (1) obtain the "event" k-ads, and (2) obtain a stratified random sample of "non-event" k-ads.[5] We now explain each step.

First, we construct a data set containing only k-ads for which the event of interest occurred. These are the event k-ads. Here, the event is when all of the potential hosts in the k-ad sign a BIT with the source in the same year.

Because BIT formation is a directed relationship, we use a directed k-ad unit of observation. In this case, each k-ad contains one source country and anywhere from 1 to $k-1$ host countries. Following Neumayer and Plümper (2010), we use 23 states as source countries: the United States of America, Canada, United Kingdom, Ireland, The Netherlands, Belgium, Luxembourg, France, Switzerland, Spain, Portugal, Germany, Austria, Italy, Greece, Finland, Sweden, Norway, Denmark, Iceland, Japan, Australia, and New Zealand. We pair each source country with various groups of host countries. Thus, one event k-ad is the triad of USA-Jamaica-Trinidad and Tobago in 1994, because the United States (as the source country) signed BITs with both Jamaica and with Trinidad and Tobago in 1994. Using the BIT formation data from Neumayer and Plümper (2010), we construct an event data set with 115 dyadic BIT formations, 73 triadic BIT formations, 39 BIT quadratic formations, 15 BIT formations involving 5 states, 11 BIT formations involving 6 states, and 10 BIT formations involving 7 or more states (with the largest involving 11 states). Finally, in order to retain the panel structure of the original data set, the unit of observation is now the k-ad-year, where we have data for each of the k-ads from 1970 to 2000 (when the data is available and/or the countries in the k-ad existed). Overall,we have an event data set with 8,122 observations.

Second, we construct a sample of the non-event k-ads. An example of a non-event k-ad is a group of states in which there are no BITs. For instance, the triad of Sweden (the

[5] This can be executed using the Stata command *kadcreate*, which can be obtained by typing "findit kadcreate" into the command line of Stata.

one source country) and India and Haiti (the two potential host countries) in 1999 is a non-event k-ad because these countries have never formed a BIT. How many non-event k-ads do we require? We could apply the analog to dyadic data, i.e., including all possible combinations of k-ads in the data set. In practice, however, this would lead to large data sets that are computationally infeasible. For example, if one had 100 countries in a data set, all combinations of 100, 99, 98, 97, ..., down to 2 countries would result in a data set of 1.26765×10^{30} observations.

For this reason, we adopt an alternative approach by sampling from the set of non-event k-ads that is stratified by k. Sampling will create a feasibly sized sample of non-event k-ads. A random sample of non-event k-ads could result in bias because the event k-ads tend to have small values of k, whereas a random sample of non-event k-ads would include a disproportionately large number of k-ads with large values of k.[6] Thus, following Poast (2010) – who draws from King and Zeng (2001*a*,*b*) – we use choice-based sampling. Choice-based sampling works as follows. First, we consider the distribution of k in the event k-ads. Suppose 80 percent of the event k-ads have $k = 2$, 10 percent of the event k-ads have $k = 3$, 5 percent of the 'event' k-ads have $k = 4$, 3 percent of the event k-ads have $k = 5$, and 2 percent of the event k-ads have $k = 6$. Given this distribution, the analyst then creates a random sample of non-event k-ads that follow the same distribution. Hence, 80 percent of the non-event k-ads should have $k = 2$, 10 percent of the non-event k-ads should have $k = 3$, 5 percent of the non-event k-ads should have $k = 4$, 3 percent of the non-event k-ads should have $k = 5$, and 2 percent of the non-event k-ads should have $k = 6$. In other words, choice-base sampling entails creating a random sample of non-event observations that are stratified according to the distribution of observations in which the event occurred.

How many non-event observations should the analyst collect? According to King and Zeng (2001*a*, 702), one can collect anywhere from two to five times more 0's than 1's,

[6] This is because, a k increases, the number of possible k-ads in a given set of countries, increases exponentially.

though one should attempt to collect as many 0 values as is computationally feasible. As a simple example, suppose the event k-ads data set from step one contains 100 dyads that have BITs and 50 triads that have BITs. If this is the case, the non-event sample would contain 1000 non-BIT dyads and 500 non-BIT triads. Stated differently, if one is working with a binary dependent variable (where the dependent variable, Y, equals 1 when the event occurred, zero otherwise), then the final data set will have 100 dyads where $Y = 1$, 50 triads where $Y = 1$, 1000 dyads where $Y = 0$, and 500 triads where $Y = 0$.

In our data set, we have 2,065 non-event k-ads (920 dyads, 571 triads, 299 4-ads, 117 5-ads, 87 6-ads, 71 k-ads with 7 or more members). These numbers, along with the relevant number of event k-ads, are reported in Table 1. Once we account for the panel structure of the data, we have 44,355 non-event k-ad-years. Thus, combining the event and non-event k-adic data sets gives us 52,477 observations, though data availability for some of the independent variables will result in not all of these observations being included in the analysis.

Table 1: Number of Event and Non-Event K-ads, by K-ad Size

K-ad Size	Number of K-ads in Dataset
Event K-ads	
k=2	115
k=3	73
k=4	39
k=5	15
k=6	11
k=7 or more	10
Non-Event K-ads	
k=2	920
k=3	571
k=4	299
k=5	117
k=6	87
k=7 or more	71

Note: This table does not include the yearly observations for each k-ad.

To further clarify the structure of a k-adic data set, Table 2 provides a sample of the actual data. It shows the final seven years of k-ad number 1 (1994 through 2000) and the first five years of k-ad number 1829 (1970 through 1974). k-ad number 1 has three members (the sender state, the United States, and two potential host states from the Caribbean: Jamaica and Trinidad and Tobago), while K-ad number 1829 has four members (the sender state, Australia, and three potential hosts states from Africa: Guinea-Bissau, Nigeria, and Madagascar). The final column "BIT Formation?" indicates that the United States formed BITs with both Jamaica and Trinidad and Tobago in 1994. Of course, as explained below, since we are using survival analysis via a Cox model, the years 1995 to 2000 for the USA-Jamaica-Trinidad and Tobago k-ad drop out of the sample.

Table 2: Sample of K-adic Data

Kad-id	Year	Number of Members	Member 1	Member 2	Member 3	Member 4	BIT Formation?
1	1994	3	USA	Jamaica	Trinidad and Tobago		Yes
1	1995	3	USA	Jamaica	Trinidad and Tobago		No
1	1996	3	USA	Jamaica	Trinidad and Tobago		No
1	1997	3	USA	Jamaica	Trinidad and Tobago		No
1	1998	3	USA	Jamaica	Trinidad and Tobago		No
1	1999	3	USA	Jamaica	Trinidad and Tobago		No
1	2000	3	USA	Jamaica	Trinidad and Tobago		No
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
1829	1970	4	Australia	Guinea-Bissau	Nigeria	Madagascar	No
1829	1971	4	Australia	Guinea-Bissau	Nigeria	Madagascar	No
1829	1972	4	Australia	Guinea-Bissau	Nigeria	Madagascar	No
1829	1973	4	Australia	Guinea-Bissau	Nigeria	Madagascar	No
1829	1974	4	Australia	Guinea-Bissau	Nigeria	Madagascar	No

4.2 Advantages of the k-adic approach

The existing literature tends to use spatially interdependent dyadic models to analyze BIT formation. While such spatial interdependence models can capture the ways in which prior BIT formations outside the dyad may affect a dyad's propensity to form a BIT, they do not capture the ways in which a BIT formation may result from a multilateral process. As Poast (2010, 404) argues, "if the data are formed by interactions among $k > 2$ actors, then a dyadic format will not reflect this process regardless of how one models other interdependencies." In such models, the only factor outside the dyad included in the analysis is the extent to which other dyads have formed BITs; by contrast, k-adic models also include the various characteristics of the states in the k-ad that may affect BIT formation.

The differing intuitions behind the spatial interdependence model and the k-adic model of BIT formation are as follows. If BIT formation is spatially interdependent, then the probability that State A forms a BIT with State B is influenced by whether States A and/or B have BITs with other states. Those other BITs (or non-BITs) are treated as independent variables, while the potential BIT between A and B depends on them. If the BIT formation process is multilateral, however, then the probability of State A forming a BIT with State B is not simply dependent on other BITs but results from a multilateral process that generates multiple BITs (or non-BITs) and is affected by the underlying characteristics of multiple group members. A formal discussion of the difference between spatial interdependence and the k-adic approach is provided in Appendix A.

Let us consider a stylized example of State H, which is home to firms that, though desiring to invest in less developed countries, seek credible commitments to respect their property and contract rights. State H identifies a set of States A through G, which are potential hosts to these investments. State H then enters into negotiations (either explicit or tacit) with States A through G. Competition theory suggests that A through G, to the extent they are market competitors, will try to outbid each other, thus making the negotiations with these various states interdependent. Other forms of interdependence, such as cultural and linguistic similarities, may also result in interdependent BIT formation processes, yet a dyadic unit of analysis nonetheless assumes these are multiple separate processes (even if they are interdependent) by which H seeks commitments to protect its investments. But this does not reflect the true process: *State H is negotiating its investment agreements in a single process with multiple potential partners.*

The possible outcomes of the process include a single BIT between State H and a host state, several such BITS, or even a single multilateral investment agreement. Let us consider the difference between (1) a process that yields a single BIT between State H and, for example, State G; and (2) a process that yields BITs between States H and G, H and D, and H and A. In a dyadic model of BIT formation, we might include a unit of analysis for H and each of the other states. We would thus have three outcomes coded as '1' (where a BIT was formed) and four outcomes coded as '0' (where a BIT was not formed). By contrast, in a k-adic model, we might include a single unit of analysis that includes all of States A through H, with a dependent variable coded to indicate that 3 BITs were formed in the k-ad. The question then becomes which of these outcomes is a more accurate reflection of reality. The dyadic approach assumes that we have seven different (although spatially interdependent) processes, each of which has a binary outcome. Yet modeling the process in this way, while commonly accepted in the international relations literature, is a work-around that does not reflect reality. In this stylized example, State H has undertaken a single process of attempting to protect its investments abroad, one with a several potential outcomes.

4.3 Independent Variables

We construct our models based on those estimated by Neumayer and Plümper (2010), which are based on those in Elkins, Guzman and Simmons (2006). The k-adic framework requires us to code our independent variables differently from a dyadic model, and we explain how we do so below.

Neumayer and Plümper (2010) construct five measures of contagion (spatial lags) in year $t-1$ to test alternative mechanisms of BIT diffusion (i.e., mechanisms by which BITs are spatially interdependent). The first of these is *aggregate target contagion*, which is the weighted[7] sum of the target's BIT policy choices with all source states, not only the

[7] All of the contagion variables are weighted by a matrix of dyadic similarities in export products.

specific source in question. As Neumayer and Plümper (2010) note, this is similar to the BIT contagion measure used by Elkins, Guzman and Simmons (2006). In the k-adic framework, we code this by using the minimum of the aggregate target contagion values for all of the targets in the k-ad (i.e., the higher this value, the more the targets as a whole are impacted by contagion) in year $t-1$. For example, if the k-ad contains 4 target states with monadic aggregate target contagion values of 5, 4, 11, and 7, we code aggregate target contagion as equal to 4 for the k-ad. The second is *aggregate source contagion*, which is the weighted sum of the source's BIT policy choices with all other target states. This is a monadic variable, so because each k-ad has just one source state this variable is the same in the k-adic framework as in the dyadic framework. Like the other Spatial variables, this variable is measured in year $t-1$. The third is *specific target contagion*, which is the weighted sum of BITs signed by other capital-exporting source countries with the same capital-importing target country. In other words, while aggregate target contagion considers the impact of all other targets on the target j, this metric only considers targets that signed a BIT with source i. In the k-adic framework, we use the minimum of the specific target contagion values of the source-target dyads in the k-ad in year $t-1$. The fourth is *specific source contagion*, which is the weighted sum of BITs signed by other capital-importing target countries with the same capital-exporting source country. In other words, while aggregate source contagion considers the impact of all other sources on the target j, this metric only considers targets that signed a BIT with target j. In the k-adic framework, we use the minimum of the specific source contagion values of the source-target dyads in the k-ad in year $t-1$. The fifth is *directed dyad contagion*, which is the weighted sum of BITs signed between other source and competing target states. In the k-adic framework, we use the minimum of the directed dyad contagion values of the source-to-target dyads in the k-ad in year $t-1$.

In addition to the contagion measures, we include in our models several additional factors thought to affect BIT formation. Most of these variables measure characteristics of the potential host. We include several economic variables: the natural log of GDP, annual GDP growth, GDP per capita, net FDI inflows, the state's capital account as a percentage of its GDP, trade-to-GDP ratio, an indicator of whether the state has drawn on IMF resources that year, and the state's extractive industry dependence (summing the share of each country's exports of both fuel and "ores and metals," as recorded in the World Bank's World Development Indicators). We also include several political and institutional indicators: whether the state has a common law legal system, the Polity IV score, the Law and Order score provided by the ICRG, and the total number of embassies the state hosts and has established in foreign countries. For each of these variables, we include in our k-adic models the mean of the monadic values of that variable in the k-ad. Thus, for example, if the k-ad contains 3 potential hosts with Polity IV scores of -3, 5 and 7, the Polity score we include for the k-ad is 3. We also include two indicators of the host-sender relationship: an indicator for whether the source is the former colonial metropole of the host and an indicator for whether the source and host share a common language. For each of these variables, we include in our k-adic models the mean of the dyadic host-sender values of that variable in the k-ad.[8] Once we account for data availability, the k-adic data set contains between 29,117 to 38,185 observations (depending on the variables included).

4.4 Estimation Procedure

Because the k-adic data set is constructed using choice-based sampling, it is common to conduct statistical analysis with k-adic data using a rare events logit model. However, to ensure comparability with existing models of BIT formation (Elkins, Guzman and Simmons 2006; Neumayer and Plümper 2010), we conduct duration analysis using Cox proportional hazard models. This means that units are dropped from our sample in the

[8] Our set of independent variables mirrors those used by Neumayer and Plümper (2010), except for the addition of the Law and Order variable.

year after they form a BIT. [9] As Neumayer and Plümper (2010) note, BIT formation theory does not give a clear indication as to which form(s) of contagion may affect BIT formation. We begin by estimating 5 models that each include 1 form of contagion. We continue by estimating 4 additional models, each of which contain 2 forms of contagion, i.e., both types of aggregate contagion, both types of specific contagion, both types of target contagion, or both types of source contagion. Finally, we estimate a model that contains 4 forms of contagion; like Neumayer and Plümper (2010), we are not able to estimate a model that contains all 5 forms of contagion because of the high correlation between aggregate target and aggregate source contagion.

5 Results

Our results are reported in Tables 3 and 4. Several of the key results are summarized in Table 5. Many of the surprising and puzzling findings of dyadic BIT formation models appear to be rectified in our k-adic models. We begin with the effect of democracy, which is negative in all of our models and significant ($p < 0.05$) in 7 of them. This is one of our most important results because the notion that states with less credibility should be more likely to need to form BITs in order to attract investment is a key component of BIT formation theory. That extant studies did not find this effect created a significant inconsistency between theory and empirics that we hope we have resolved.

[9] Also, because the data set on which the model is estimated is a stratified sample, one must weight the observations from each strata by the inverse probability of being drawn from the sample. For example, if there are 4,950 total dyads, and Y=1 for 100 of these dyads, then there are 4,850 dyads where Y=0. Thus, each Y=0 dyad has a $\frac{1}{4{,}850}$ probability of being drawn. When estimating the model, each Y=0 observation in the sample should be multiplied by $\frac{1}{\frac{1}{4{,}850}}$, while each Y=1 observation should be multiplied by 1 (as the 1 indicates that the Y=1 observation are not being sampled). But applying an inverse probability weight is not without costs. Specifically, for k-ads of a sufficiently large size, the probability of a single observation being drawn is so exceedingly small and the corresponding inverse probability weight so massively large, that it can result in convergence problems for the model (i.e. the standard errors will not be identified). Fortunately, Fordham and Poast (2013) provide Monte Carlo simulations showing that, for samples where the inverse probability weights do not result in convergence problems, the difference in the coefficient estimates when applying inverse probability weights compared to not applying inverse probability weights is trivially small. Therefore, in the results that follow, we do not apply inverse probability weights.

Another inconsistency between theory and empirics was created by the finding that the Law and Order measure had a significant and positive effect on BIT formation in Elkins, Guzman and Simmons (2006). By contrast, we find that this relationship is negative, although it is only significant in 4 of our models. While this result is not sufficiently consistent to be conclusive, we can say that it is much more consistent with theory than the results of the dyadic models, which found the opposite effect of theoretical expectations. As Elkins, Guzman and Simmons (2006) note, the Law and Order measure is an imperfect measure of the ability of the legal system to protect contract and property rights – and this is a difficult concept to measure – so it is possible that enough noise is picked up in this measure to make the coefficient insignificant in many of our models.

Our findings with respect to economic factors are more conclusive. The effect of per capita GDP is negative in 10 models, as we expected, and significant in 8 of them. Unlike prior work, which found this factor insignificant, our results indicate that potential host states with richer populations have less demand for foreign capital and, as a result, are less likely to form BITs. This result is fairly intuitive: rich states are not competing in the same market for international capital as poor states, which is why we distinguish between the 23 potential sender states and the potential host states in our empirical models. While Elkins, Guzman and Simmons (2006) found that GDP growth has a negative and significant effect – the opposite of their expectation – we find that this factor has a positive and significant effect in all 10 models. Economic growth, as we expected, makes economies more attractive for investment. In addition, states that are opening their capital markets – and often growing as a result – also tend to be states that are seeking foreign capital investments.

We find that former colonial ties have a significant and positive effect on BIT formation in all 10 models. This result is in accordance with our expectations, and we believe it indicates that the surprising results in the opposite direction in Elkins, Guzman and Simmons (2006) and Haftel and Thompson (2013) were driven by empirical models that used a dyadic unit of analysis that was not optimal for modeling the data-generating process.

We now turn to our findings with respect to the effects of contagion. We find that specific source contagion has a positive effect on the probability of BIT formation. This indicates that when a host country's competitors have formed a BIT with a particular source country, the host is more likely to also form a BIT with that source country. In other words, capital-seeking states attempt to draw capital from individual sources away from their competitors.

With respect to several other mechanisms of contagion, our finding is of a negative effect. Both of the aggregate contagion measures have negative effects. The negative coefficient on aggregate target contagion means that the more BITs host states have formed, the less likely a potential sender state is to form a BIT with those target states. There may be two reasons for this. The first is that host states that have already formed many BITs and received significant FDI flows now have less need to signal their credibility by forming additional BITs. Such states may already possess reputations for protecting foreign investments. The second is that the investment market in such host states may be closer to saturation, leading potential senders to seek other locations. The negative coefficient on aggregate source contagion means that the more BITs source states have formed, the less likely they are to form additional BITs. Capital-exporting states that have already formed many BITs may have a sufficient number of BIT partners and need not form additional BITs. Interestingly, the substantive effect of this form of contagion on the probability of BIT formation is significantly larger than any other form of contagion.

To gain further confidence in our findings, we conduct a number of robustness checks. The results from these tests are reported in an appendix. First, because the non-event k-ads are the result of random draws, we re-estimate the models in Table 2 using a different draw of non-event k-ads.[10] This leaves our findings virtually unchanged. Third, one might be concerned that some of our k-ads of potential BIT targets are not all

[10] This is accomplished by setting a different seed for the random number generator.

comprised of countries from the same region. For example, one k-ad contains the potential targets of Honduras, Nicaragua, and Latvia. To address this concern, we limit our analysis only to k-ads where the potential targets are all located in the same region: Africa, Europe, Central Asia, Far East Asia, and Pacific, Latin America and the Caribbean, and Middle East and North Africa (MENA). While this reduces our sample size, it produces results that are substantively similar (both with respect to sign and significance of the coefficients) to those reported in Table 2. For example, the contagion variables are left virtually unchanged, while the coefficient on the democracy variable in five of the six models remains negative and has the same level of statistical significance. The one exception is the coefficient in the direct dyad model, which, while still negative, is now statistically insignificant. Second, because the non-event k-ads are the result of random draws, we re-estimate the models in Table 2 using a different draw of non-event k-ads.[11] This leaves our findings virtually unchanged from those reported in Table 2.

6 Model Fit

The results of the k-adic model are significantly more consistent with the theory of BIT formation than those of dyadic models. This supports our substantive justification for modeling BIT formations using a k-adic unit of analysis and have shown that the results of such models correct some of the counter-intuitive findings in the literature. Here, we demonstrate that the k-adic models are not only superior because they are more consistent with theory, but also fit the BIT formation data better than the dyadic models and have significantly better predictive power.

The first metric we use to compare the fits of the k-adic and dyadic models is the "Area Under the Curve" (AUC) based on "Receiver Operator Characteristic" (ROC) plots. These plots describe the relationship between the rate of false positives (i.e., the number of

[11] This is accomplished by setting a different seed for the random number generator.

Table 3: K-adic Models of BIT Formation, Cox Proportional Hazard Model

	1 Aggregate Target Contagion	2 Aggregate Source Contagion	3 Specific Target Contagion	4 Specific Source Contagion	5 Directed Dyad Contagion
Contagion	-0.01***	-0.37**	-0.01*	0.01***	-0.03***
	(0.00)	(0.03)	(0.01)	(0.00)	(0.00)
Extractive Indust./Exports	0.02*	0.00	0.00	0.00	-0.00
(Hosts)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common Law	-0.21	0.51	0.27	0.43	0.17
(Hosts)	(0.42)	(0.43)	(0.42)	(0.43)	(0.43)
IMF Credit	-0.35	1.43***	0.73*	0.59	0.42
(Hosts)	(0.40)	(0.46)	(0.44)	(0.45)	(0.44)
LN GDP	0.18***	0.32***	0.34***	0.32***	0.41***
(Hosts)	(0.04)	(0.06)	(0.06)	(0.06)	(0.07)
Per Capita GDP	-0.00**	-0.00*	-0.00	-0.00	-0.00**
(Hosts)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP Growth	0.13***	0.09***	0.12***	0.10***	0.13***
(Hosts)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
FDI Inflow	-0.15***	0.03	-0.08	-0.07	-0.08
(Hosts)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)
Capital Acct. (% of GDP)	-17.90	-1.17	-6.68	-5.54	-5.81
(Hosts)	(11.56)	(4.86)	(9.83)	(9.26)	(10.12)
Democracy	-0.03	-0.03	-0.07***	-0.08***	-0.06***
(Hosts)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Law and Order	-0.05	-0.05	-0.44***	-0.48***	-0.30***
(Hosts)	(0.09)	(0.10)	(0.09)	(0.09)	(0.10)
Diplomatic Rep.	-0.00	0.01	0.01	0.01	0.00
(Hosts)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bilateral Trade / GDP	-9.87	-8.86	-5.97	-4.47	-6.75
(Hosts)	(8.58)	(8.90)	(8.70)	(8.23)	(8.72)
Colonial Ties	2.77***	2.24***	2.81***	2.65***	2.56***
	(0.44)	(0.43)	(0.43)	(0.42)	(0.42)
Common Language	-1.01	-0.54	-0.83	-0.76	-0.73
	(0.64)	(0.53)	(0.54)	(0.53)	(0.55)
AIC | BIC	2924 | 3051	1890 | 2028	2197 | 2324	2185 | 2311	2136 | 2262
-ll	1447	935	1084	1078	1053
N	35,379	38,185	33,460	33,460	33,460

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: K-adic Models of BIT Formation - Multiple Forms of Contagion, Cox Proportional Hazard Model

	6 Aggregate Contagion	7 Specific Contagion	8 Target Contagion	9 Source Contagion	10 4 Forms of Contagion
Aggregate Target Contagion	-0.00***		-0.01***		-0.01***
	(0.00)		(0.00)		(0.00)
Aggregate Source Contagion	-0.36***			-0.43***	
	(0.03)			(0.03)	
Specific Target Contagion		-0.01**	-0.01		-0.00
		(0.01)	(0.01)		(0.01)
Specific Source Contagion		0.01***		0.01***	0.02***
		(0.00)		(0.00)	(0.00)
Directed Dyad Contagion					-0.02***
					(0.00)
Extractive Indust./Exports	0.01	0.00	0.01	0.00	0.01
(Hosts)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common Law	0.44	0.44	0.30	0.62	0.51
(Hosts)	(0.43)	(0.43)	(0.44)	(0.44)	(0.45)
IMF Credit	0.94**	0.58	-0.38	0.75	-0.64
(Hosts)	(0.47)	(0.45)	(0.45)	(0.47)	0.46
LN GDP	0.38***	0.32***	0.60***	0.34***	0.55***
(Hosts)	(0.08)	(0.06)	(0.09)	(0.06)	(0.08)
Per Capita GDP	-0.00**	-0.00	-0.00***	-0.00**	-0.00***
(Hosts)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP Growth	0.09***	0.10***	0.12***	0.07***	0.09***
(Hosts)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
FDI Inflow	0.01	-0.07	-0.08	0.07*	-0.08
(Hosts)	(0.05)	(0.05)	(0.06)	(0.04)	(0.06)
Capital Acct. (% of GDP)	-1.54	-5.32	-5.70	-1.22	-5.12
(Hosts)	(5.22)	(9.25)	(9.80)	(4.20)	(10.01)
Democracy	-0.03	-0.08***	-0.07***	-0.04**	-0.06***
(Hosts)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Law and Order	0.02	-0.47***	-0.13	-0.03	-0.15
(Hosts)	(0.11)	(0.09)	(0.10)	(0.11)	(0.11)
Diplomatic Rep.	-0.00	0.01	-0.02**	0.01	-0.03***
(Hosts)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bilateral Trade / GDP	-10.37	-4.55	-9.36	-7.74	-9.10
(Hosts)	(9.35)	(8.31)	(9.55)	(8.42)	(9.22)
Colonial Ties	2.28***	2.82***	2.78***	1.86***	2.67***
	(0.43)	(0.43)	(0.44)	(0.44)	(0.45)
Common Language	-0.53	-0.80	-0.75	-0.73	-0.66
	(0.55)	(0.53)	(0.58)	(0.53)	(0.57)
AIC | BIC	1889 | 2024	2183 | 2317	2098 | 2230	1784 | 1918	2060 | 2209
-ll	928	1075	1033	876	1012
N	33,270	33,460	29,117	33,460	29,117

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Summary of Findings

Variable	Expected Effect	Prior Results	Our Results
Democracy	Negative.	EGS: No significant effect. N&P: No significant effect.	Negative coefficient in all 10 models; significant in 7 models.
Law and Order	Negative.	EGS: Positive and significant effect. N&P: Not tested.	Negative coefficient in 9 models; significant in 4 models.
Per Capita GDP	Negative.	EGS: No significant effect. N&P: No significant effect.	Negative coefficient in all 10 models; significant in 8 models.
GDP Growth	Positive.	EGS: Negative and significant effect. N&P: Positive and significant effect.	Positive, significant coefficient in all 10 models.
Colonial Ties	Positive.	EGS: Negative and significant effect. N&P: Positive and significant effect.	Positive, significant coefficient in all 10 models.

incorrect predictions of BIT formation divided by the number of cases in which BITs did not form) and true positives (i.e., the number of correct predictions of BIT formation divided by the number of cases in which BITs were formed). The closer an ROC curve is to the top left corner of the plot, the better the ratio between these quantities. Thus, the predictive power of a model can be inferred from the area between the x-axis and the ROC curve - or the AUC (Ward, Greenhill and Bakke 2010). The second metric we use to compare the fits of the k-adic and dyadic models is the "expected Percent Correctly Predicted" (ePCP) statistic proposed by Herron (1999). This is a measure of the average of the probabilities that the model assigns to the correct outcome for a limited dependent variable. A key advantage of ePCP as a measure of fit over the more traditional "Percent Correctly Predicted" (PCP) statistics is that ePCP does not depend on discarding useful information by classifying each individual observation as being either "correctly" or "incorrectly" predicted based upon the category that has the highest predicted probability. The ePCP statistic is given by the formula:

$$ePCP = \frac{1}{N}\left(\sum_{y_i=1}\hat{p}_i + \sum_{y_i=0}(1-\hat{p}_i)\right)$$

where $\hat{p}_{i,1}$ is the probability that the model predicts a BIT formation.

In order to calculate these statistics, we needed to re-estimate our models using logit regression. For the sake of brevity, we limit this analysis to models 1 through 5 (although we obtain similar results for models 6 through 10). As with our rare-events robustness check, we address temporal dependence by including linear and polynomial measures of time (Carter and Signorino 2010). We also estimated the same models in a dyadic framework for comparison. Table 6 shows the AUC and ePCP statistics for these models. Importantly, our ability to compare AUC and ePCP across the k-adic and dyadic models is not threatened by the differences in sample sizes. All of the k-adic models have significantly higher AUC statistics than the dyadic models. This can also be seen in Figure 1, which compares the ROC curves for the k-adic and dyadic models. In addition, all of the k-adic models have significantly higher ePCP statistics than the dyadic models, although these differences are not as large as the differences in the AUC values.

Table 6: Comparison of K-adic and Dyadic Model Fit

	1		2		3		4		5	
	K-adic	Dyadic	K-adic	Dyadic	K-adic	Dyadic	K-adic	Dyadic	K-adic	Dyadic
AUC	0.9586	0.8058	0.9678	0.8039	0.9822	0.8310	0.9836	0.8427	0.9822	0.8026
ePCP	99.08	97.30	99.36	97.30	99.31	97.34	99.31	97.37	99.31	97.30
N	35,379	30,300	38,185	30,300	33,460	30,300	33,460	30,300	33,460	30,300

7 Conclusions

We argue that previous studies of BIT formation have produced counter-intuitive and counter-theoretical findings because analysts have conceptualized the process of BIT formation as bilateral. But BITs, despite their name, result from multilateral processes. Rather than forming comprehensive multilateral investment treaties, states desire the flexibility offered by forming many BITs. This suggests that while BITs are 'bilateral' in

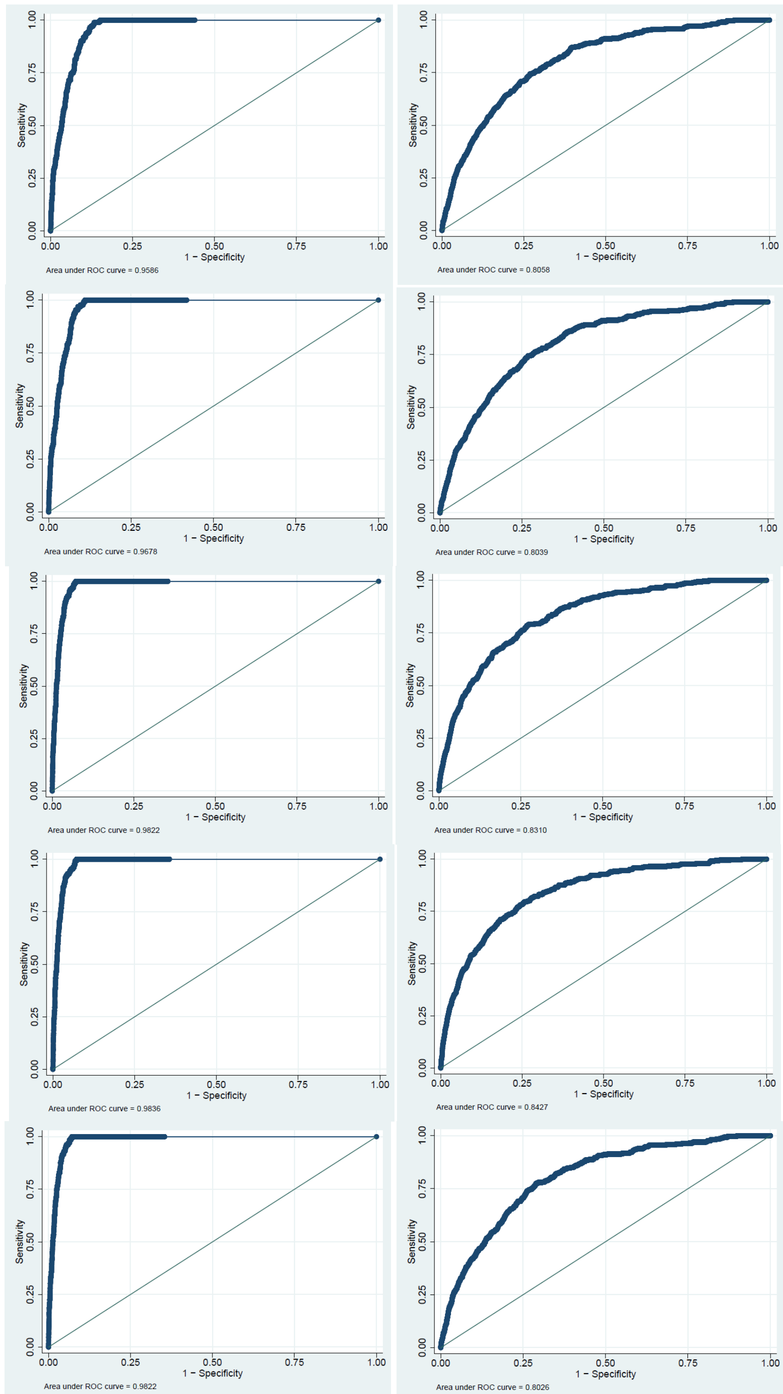

Figure 1: Comparison of ROC curves. K-adic models 1-5 are on the left, and dyadic models 1-5 are on the right.

name, the process leading to their creation is driven by interactions between multiple states. We model BIT formation as a multilateral process by using the k-adic data procedure recommended by Poast (2010). Our results alleviate most of the theoretically troubling results in the BIT formation literature.

This study shows how outcomes that appear to be bilateral can be driven by multilateral processes and that modeling such processes in the k-adic framework can improve inferences. The unit-of-analysis problem has long been important to international relations research (Kaplan 1957; Singer 1961; Wendt 1987; Buzan 1995; Lake 1996). In the last twenty years, the state dyad has become a dominant unit of analysis in both conflict research (Bueno De Mesquita and Lalman 1992; Russett, Oneal and Davis 1998; Gartzke 2007; Cunningham, Gleditsch and Salehyan 2009; Hegre, Oneal and Russett 2010; Dorussen and Ward 2010) and international political economy research (Mansfield and Reinhardt 2003; Elkins, Guzman and Simmons 2006; Judith, Goldstein and Tomz 2007; Mansfield, Milner and Pevehouse 2008; Tobin and Busch 2009). But as several studies have recently noted, dyadic models can overlook the ways in which dyadic events are non-independent and the ways in which extra-dyadic connections affect dyadic outcomes (Elkins, Guzman and Simmons 2006; Maoz 2008; Warren 2010; Neumayer and Plümper 2010; Cranmer, Desmarais and Menninga 2012; Lupu and Traag 2013). While non-independence can and should be addressed as these scholars have suggested, doing so can still lead to biased inferences when the underlying data-generating process is k-adic (Poast 2010). Even outcomes that appear to be bilateral can be driven by multilateral processes.

Our findings also have major implications for future research in other areas of international relations. First, a significant literature has studied the effects of BITs on FDI by using dyadic units of analysis. Yet if the determinants of BITs are k-adic, then it could be that their effects are k-adic. For instance, they may encourage the signing of other BITs and, in turn, investment flows outside the dyad. Second, if apparently bilateral phenomena such as BITs result from k-adic processes, then other seemingly bilateral interactions could also be driven by a k-adic process. Hence, one should consider reevaluating the onset of bilateral wars, Preferential Trade Agreements, and bilateral alliances, just to name a few, as k-adic processes.

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Appendix A: Comparison to Spatial Interdependence Models

The difference between a k-adic model and spatial interdependence models can also be explained formally. Here, we specifically discuss the spatial interdependence specification of Franzese and Hays (2007b,a,c, 2008), which can be used when an outcome in country i is influenced by the connection country i has with country j. Let N be the number of countries and T be the number of years. Let $\mathbf{W}$ be an $NT \times NT$ block-diagonal matrix where element w_{ij} reflect whether or not countries i and j have a BIT in force. In a typical spatial dependence model, a standard $\mathbf{W}$ matrix is expressed as:

$$\left[\begin{array}{c|c|c}
\begin{matrix} w_{11_1} & w_{12_1} & w_{13_1} & \cdots & w_{1n_1} \\ w_{21_1} & w_{22_1} & w_{23_1} & \cdots & w_{2n_1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ w_{n1_1} & w_{n2_1} & w_{n3_1} & \cdots & w_{nn_1} \end{matrix} & 0 & 0 \\
\hline
0 & \ddots & 0 \\
\hline
0 & 0 & \begin{matrix} w_{11_T} & w_{12_T} & w_{13_T} & \cdots & w_{1n_T} \\ w_{21_T} & w_{22_T} & w_{23_T} & \cdots & w_{2n_T} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ w_{n1_T} & w_{n2_T} & w_{n3_T} & \cdots & w_{nn_T} \end{matrix}
\end{array}\right] \tag{1}$$

If country i and country j have a BIT in force then $w_{ij} = 1$. Otherwise $w_{ij} = 0$. Hence, this block-diagonal matrix can be re-written as

$$\left[\begin{array}{c|c|c}
\begin{matrix} 0 & 1 & 0 & \cdots & 0 \\ 1 & 0 & 1 & \cdots & 1 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 1 & 1 & \cdots 0 & \end{matrix} & 0 & 0 \\
\hline
0 & \ddots & 0 \\
\hline
0 & 0 & \begin{matrix} 0 & 1 & 0 & \cdots & 0 \\ 1 & 0 & 1 & \cdots & 1 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 1 & 1 & \cdots 0 & \end{matrix}
\end{array}\right] \tag{2}$$

where the diagonal in each matrix is zero (as it contains “self-referencing entries; e.g. w_{11} contains the impact of country 1 on country 1). Having constructed this spatial-weighting matrix, the impact on BIT-making policy y of country i by country j is captured with

$$\mathbf{y} = \rho \cdot \mathbf{W}\mathbf{y} \tag{3}$$

where $\mathbf{y}$ is an $NT \times 1$ vector of outcome observations stacked by time (i.e. time 1, country 1 to N, then time 2, country 1 to N, through time T). Combined, $\mathbf{Wy}$ reduces to a vector, where the parameter ρ captures the impact the spatially-weighted outcome of countries $-i$ has on the outcome of country i. Franzese and Hays (2007b) recommend row standardizing the resulting spatial weighting matrix by replacing the ones in each country's row in the weight matrix with $1/N$, where N is the number of countries with which the country has a BIT in force. This procedure normalizes the sums across rows of cell entries to 1 and creates a non-uniform weighting matrix.

While such a model emphasizes the joint determination of outcomes, it does not allow us to properly estimate the multilateral process by which these outcomes (in our case, BITs) are created. Above, the weighting matrix captures the ability of state i to influence state j on policy y. In other words, it captures whether or not i and j have a BIT, which is precisely what the model seeks to estimate. This means that whereas the spatial regression model treats $\mathbf{W}$ as an independent variable, $\mathbf{W}$ is actually the element one needs to estimate as a dependent variable. For this reason, spatial interdependence regression is inappropriate for modeling k-adic data. While spatial lags may account for certain ways in which extra-dyadic factors may influence a dyad's propensity to form a BIT, they lock us into a unit of analysis that does not reflect the true data-generating process.

Appendix B: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
Aggregate Target Contagion	169.465	149.286	7.381	550
Aggregate Source Contagion	37.591	28.717	4.227	100
Specific Target Contagion	9.464	15.702	0	111.071
Specific Source Contagion	6.245	16.119	0	193.173
Directed Dyad Contagion	53.193	42.53	1.868	182.937
Extractive Industries/Exports (Hosts)	8.285	10.628	0	50
Common Law (Hosts)	0.141	0.2	0	0.833
IMF Credit Dummy (Hosts)	0.291	0.24	0	0.889
LN GDP (Hosts)	20.337	4.339	5.237	27.812
Per Capita GDP (Hosts)	2080.135	2540.843	34.841	27229.287
GDP Growth (Hosts)	3.375	4.048	-26.479	35.625
FDI Inflow (Hosts)	1.478	2.214	-19.784	28.137
Capital Account (\ % of GDP) (Hosts)	0.003	0.024	-0.02	1.35
Level of Democracy (Hosts)	0.203	5.718	-10	10
Law and Order (Hosts)	2.156	1.143	0	6
Diplomatic Representation (Hosts)	20.724	14.965	0	84.5
Bilateral Trade to GDP (Hosts)	0.006	0.018	0	0.457
Colonial Ties	0.008	0.075	0	1
Common Language	0.043	0.172	0	1

Appendix C: Rare Events Logit

K-adic Models of BIT Formation - Multiple Forms of Contagion, Rare Events Logit Model

	1 Aggregate Target Contagion	2 Aggregate Source Contagion	3 Specific Target Contagion	4 Specific Source Contagion	5 Directed Dyad Contagion
Contagion	-0.00	0.00	-0.00	0.01***	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Extractive Industries/Exports (Host)	-0.00	0.00	-0.00	-0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common Law (Host)	-0.15	0.36	0.56	0.74	0.55
	(0.42)	(0.45)	(0.45)	(0.46)	(0.45)
IMF Credit Dummy (Host)	2.17***	2.26***	1.73***	1.50***	1.71***
	(0.51)	(0.60)	(0.54)	(0.55)	(0.54)
LN GDP (Host)	0.01	0.18***	0.25***	0.23***	0.25***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Per Capita Income (Host)	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP Growth (Host)	0.09***	0.08***	0.07***	0.06**	0.07***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
FDI Inflow (Host)	0.02	-0.01	0.09***	0.10***	0.10***
	(0.04)	(0.05)	(0.03)	(0.03)	(0.03)
Capital Account (% of GDP) (Host)	2.21	4.03	9.12***	8.48***	9.14***
	(2.97)	(3.92)	(1.87)	(1.84)	(1.85)
Level of Democracy (Host)	0.01	-0.02	-0.02	-0.02	-0.02
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Law and Order	0.18**	-0.02	0.17**	0.13	0.18*
	(0.08)	(0.09)	(0.09)	(0.09)	(0.10)
Diplomatic Representation (Host)	0.01	-0.00	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bilateral Trade to GDP of Host	-5.38	-6.37	-5.88	-4.94	-6.03
	(6.63)	(7.34)	(7.03)	(7.02)	(7.12)
Colonial Ties	2.59***	2.83***	2.48***	2.47***	2.47***
	(0.51)	(0.52)	(0.51)	(0.51)	(0.51)
Common Language	-0.16	-0.17	-0.58	-0.55	-0.55
	(0.53)	(0.59)	(0.56)	(0.55)	(0.56)
Time since last bit Form	-0.03**	-0.01	-0.03**	-0.03**	-0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
time2	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
time3	-0.00*	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-4.82***	-8.80***	-10.05***	-9.43***	-10.06***
	(0.53)	(0.71)	(0.77)	(0.71)	(0.77)
Number of Observations	35,379	38,185	33,460	33,460	33,460

Log Likelihood not reported for Rare Events Logit
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix D: Cox Proportional Hazard Model (Different Draw of Non-Event K-ads)

K-adic Models of BIT Formation - Multiple Forms of Contagion, Cox Proportional Hazard Model (Different Draw of Non-Event K-ads)

	1 Aggregate Target Contagion	2 Aggregate Source Contagion	3 Specific Target Contagion	4 Specific Source Contagion	5 Directed Dyad Contagion
Contagion	-0.01***	-0.37***	-0.01*	0.01***	-0.03***
	(0.00)	(0.03)	(0.01)	(0.00)	(0.00)
Extractive Industries/Exports (Host)	0.01	-0.01	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common Law (Host)	0.02	0.65	0.43	0.62	0.32
	(0.42)	(0.44)	(0.44)	(0.45)	(0.44)
IMF Credit Dummy (Host)	-0.02	1.86***	0.87*	0.64	0.72
	(0.41)	(0.48)	(0.48)	(0.49)	(0.48)
LN GDP (Host)	0.17***	0.34***	0.36***	0.33***	0.43***
	(0.04)	(0.07)	(0.07)	(0.06)	(0.07)
Per Capita Income (Host)	-0.00**	-0.00	-0.00	-0.00	-0.00**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP Growth (Host)	0.15***	0.10***	0.13***	0.11***	0.14***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)
FDI Inflow (Host)	-0.17***	-0.00	-0.09*	-0.09*	-0.11*
	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)
Capital Account (% of GDP) (Host)	-17.72	-1.79	-7.35	-5.70	-7.56
	(11.33)	(4.21)	(9.74)	(8.86)	(10.50)
Level of Democracy (Host)	-0.02	-0.02	-0.08***	-0.09***	-0.06***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Law and Order	0.12	0.19*	-0.22**	-0.26***	-0.07
	(0.09)	(0.11)	(0.09)	(0.09)	(0.10)
Diplomatic Representation (Host)	-0.00	-0.00	0.01	0.01	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bilateral Trade to GDP of Host	1.84	2.75	5.88	6.62	5.28
	(5.00)	(4.28)	(4.29)	(4.12)	(4.48)
Colonial Ties	2.56***	1.96***	2.06***	1.94***	2.14***
	(0.44)	(0.45)	(0.43)	(0.42)	(0.43)
Common Language	-1.14*	-0.64	-0.68	-0.54	-0.86
	(0.62)	(0.56)	(0.56)	(0.55)	(0.57)
Number of Observations	34,134	37,070	32,360	32,360	32,360

Log Likelihood not reported for Rare Events Logit

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix E: Cox Proportional Hazard Model (Only Potential Targets that are all in the same region)

K-adic Models of BIT Formation - Multiple Forms of Contagion, Cox Proportional Hazard Model (Different Draw of Non-Event K-ads)

	1 Aggregate Target Contagion	2 Aggregate Source Contagion	3 Specific Target Contagion	4 Specific Source Contagion	5 Directed Dyad Contagion
Contagion	-0.02***	-0.40***	-0.03***	0.01**	-0.03***
	(0.00)	(0.04)	(0.01)	(0.00)	(0.01)
Extractive Industries/Exports (Host)	0.01	0.00	-0.00	-0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common Law (Host)	-0.11	0.31	-0.05	0.02	-0.11
	(0.54)	(0.56)	(0.54)	(0.55)	(0.54)
IMF Credit Dummy (Host)	-0.02	1.28**	0.88	0.73	0.56
	(0.56)	(0.64)	(0.60)	(0.61)	(0.60)
LN GDP (Host)	0.12	0.13	0.08	0.07	0.13
	(0.08)	(0.10)	(0.09)	(0.09)	(0.10)
Per Capita Income (Host)	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
GDP Growth (Host)	0.12***	0.11***	0.13***	0.11***	0.14***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
FDI Inflow (Host)	-0.04	0.01	-0.04	-0.04	-0.03
	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)
Capital Account (% of GDP) (Host)	-20.50	-4.96	-16.23	-15.54	-12.55
	(17.01)	(11.55)	(16.17)	(16.14)	(14.59)
Level of Democracy (Host)	-0.02	-0.01	-0.05**	-0.06***	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Law and Order	0.02	0.05	-0.38***	-0.41***	-0.24**
	(0.13)	(0.14)	(0.11)	(0.11)	(0.12)
Diplomatic Representation (Host)	0.00	0.01	0.03***	0.03***	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Bilateral Trade to GDP of Host	-42.52*	-37.02	-35.69	-29.47	-37.44
	(23.36)	(23.52)	(23.62)	(22.47)	(23.81)
Colonial Ties	2.29***	1.83***	2.70***	2.36***	2.19***
	(0.56)	(0.56)	(0.56)	(0.56)	(0.56)
Common Language	-0.88	-0.86	-1.30*	-1.24	-1.13
	(0.79)	(0.75)	(0.76)	(0.76)	(0.76)
Number of Observations	17,130	17,212	14,324	14,324	14,324

Log Likelihood not reported for Rare Events Logit

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$