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The Defense Cooperation Agreement Dataset (DCAD)*

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Abstract

The academic study of defense cooperation focuses heavily on formal military alliances. Yet, governments rarely sign new alliances, and the global alliance structure has remained relatively static for decades. By contrast, governments are increasingly active in *defense cooperation agreements* (DCAs). These bilateral framework treaties institutionalize their signatories' day-to-day defense relations, facilitating such wide-ranging activities as defense policy coordination, joint research and development, weapons production and arms trade, joint military exercises, training and exchange programs, peacekeeping, and information exchange. Nearly 2,000 DCAs have been signed since 1980. Preliminary evidence suggests that DCAs impact numerous security, military, and defense outcomes, and that governments increasingly incorporate DCAs as core elements of their security strategies. This article introduces the new DCA dataset (DCAD). I provide a brief historical background on DCAs and compare them to other commonly studied forms of defense cooperation. I then explain coding standards and describe the dataset in detail. Finally, I illustrate applications of DCAD to militarized interstate disputes and arms trade.

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Defense cooperation has long intrigued scholars of international relations. Thucydides' *History of the Peloponnesian War* is, perhaps most of all, a treatise on alliance politics. Like Thucydides, contemporary scholars have focused heavily on formal military alliances—and have produced a formidable literature.[1] Yet, governments rarely sign new alliances, and the global alliance structure has remained relatively static for decades. While alliance-making experienced a resurgence in the immediate aftermath of the Soviet Union's collapse, only a dozen new alliances have emerged since 9/11—most of them ententes or nonaggression pacts rather than mutual defense pacts (Gibler 2009).

When governments pursue cooperation in defense, military, and security issues, they increasingly turn not to alliances, but to a type of framework treaty known as a *defense cooperation agreement*, or DCA. Nearly always bilateral, DCAs establish broad legal umbrellas for the range of cooperative defense activities in which states might engage, from coordinating defense policies to conducting joint exercises to jointly producing weapons and technology. In short, DCAs facilitate the routine interactions that comprise day-to-day defense cooperation. Taken as a whole, these agreements provide insight into the pragmatic tools that governments have developed to address the complex threats, both interstate and nontraditional, that define the contemporary global security environment.

The distinctions between DCAs and other agreement types are apparent in their institutional characteristics. While alliances focus primarily on contingencies surrounding conflict, DCAs exclusively address cooperation. They contain no mutual defense or nonaggression commitments. Indeed, most DCA partners lack a formal alliance altogether. DCAs also fundamentally differ from status of forces agreements, strategic partnerships, and other commonly studied defense agreements. And unlike these other agreement types, DCAs have proliferated rapidly. DCAs are often extensive and ambitious in scope, implementing institutional frameworks for the entirety of their signatories' cooperative defense relations. They also tend to be relatively symmetric in the commitments they impose on signatories, and they endure for periods of 5–10 years or longer.

Anecdotal evidence of DCAs' significance abounds. After the loss of its Soviet sponsor in the early 1990s, Mongolia deployed a web of nearly three dozen DCAs to ensure access to defense-related training, education, materiel, weapons, and research.[2] A historic 2014 DCA between Russia and Pakistan led to arms transfers, counterterror drills, joint antidrug exercises in the Arabian Sea, and even the participation of a Pakistani warship in Russia's Navy Day parade.[3] More generally, Kinne (2018) shows that DCAs increase the frequency of joint military exercises, contributions to

[1] The alliance literature covers such diverse topics as origins of alliances (Walt 1987), alliance reliability (Leeds, Long, and Mitchell 2000), effects on conflict (Gibler 2000), institutional design (Mattes 2012; Poast 2012), burden-sharing and free-riding (Sandler 1993), deterrence politics (Huth 1989), alliances and trade (Gowa and Mansfield 2004), and many others.

[2] "Growth of Mongolia's Defense Cooperation," *The UB Post*, December 19, 2017.

[3] "Pakistan, Russia ink rare historic military cooperation Pact," *Pakistan Today*, August 9, 2018.

peacekeeping missions and multilateral uses of force, arms trade, and overall cooperative bilateral events, while reducing the frequency of militarized disputes. In short, DCAs are now central to governments' defense strategies.

In this article I introduce the inaugural version of the defense cooperation agreement dataset (DCAD). DCAD relies exclusively on human-coding methods, incorporating treaty data from (1) large repositories like the World Treaty Index (WTI) and United Nations Treaty Series (UNTS); (2) country-level sources, including government-published treaty series, legislative gazettes, and personal contacts in foreign, defense, and internal ministries; and (3) global newspaper, newswire, and transcript archives. The full dataset, which covers nearly 2,000 unique agreements, provides a comprehensive and exhaustive compendium of all known DCAs signed among all independent countries in the period 1980–2010. For many of these agreements, DCAD includes extensive information on institutional design features, such as duration, renewal conditions, issue scope, and asymmetry of obligations. DCAD thus provides hitherto unavailable insight into the institutionalization of routine defense interactions.

The article consists of five sections. First, I provide a brief historical background on DCAs. Second, I compare DCAs to other common forms of defense cooperation. Third, I explain in detail the data collection process and coding rules, and I describe the main features of the dataset. Fourth, as a matter of illustration, I present results from simple analyses of DCAD data in two commonly studied topics in international security: militarized interstate disputes and bilateral arms trade. The fifth section concludes.

A brief history of DCAs

Bilateral defense treaties are not new. In the late 1940s and early 1950s, the United States inked dozens of defense agreements with partners in Europe, South America, and Asia. Many of these agreements were created under the aegis of the Mutual Defense Assistance Act or its successor, the Mutual Security Act, and focused heavily on provision of military aid (Connery and David 1951; Kaplan 1980; Kolko and Kolko 1972; Scott 1951). Others focused on status of forces, establishment of US bases and/or troops, or airspace access for US military aircraft (Erickson 1994; Stambuk 1963). These agreements were highly asymmetric and designed to maintain or improve the preponderant military position of the United States. European powers established similar agreements with their former colonies (Martin 1995). Despite their asymmetries, these and related agreements bore skeletal similarities to present-day DCAs in that they established long-term, comprehensive defense frameworks.

Early explorations of mutuality in defense obligations took a limited form, such as agreements focused on protection of intellectual property rights for defense industries, which involved not only

the US and its European partners, but also European states themselves, including Sweden, France, Norway, and West Germany (Gapcynski 1972; Saragovitz and Dobkin 1968). Similar agreements emerged among Eastern Bloc states—particularly East Germany, Czechoslovakia, and Poland—and, to a limited extent, among governments in Southeast Asia and South America.

A basic template for framework bilateral defense agreements coalesced in the late 1980s and early 1990s. Kinne (2018) discusses in greater detail the historical motivations behind this trend, which included the waning of the Cold War, the decline of traditional interstate war, and the rise of nontraditional threats like terrorism, trafficking, transnational rebel groups, piracy, and nonstate weapons proliferation. Many governments publicly expressed a desire to redefine their defense relationships in light of new threats.[4] The first wave of DCAs emerged in the early 1990s, following closely on the heels of the Soviet Union's collapse. Post-Soviet republics in particular faced multifaceted threats from a declining superpower and latent transnational movements, and they pursued bilateral security ties accordingly (Cottey 1995). This wave nonetheless extended far beyond Europe, involving regional powers like Brazil, South Africa, Argentina, Turkey, and numerous others.

Following Kinne (2018), I define DCAs simply as "formal bilateral agreements that establish institutional frameworks for routine defense cooperation." Consider the following illustrative excerpt from a 2006 DCA between France and India:

> 1.1 The purpose of the Agreement is to promote cooperation between the Parties in the defence and military fields, defence industry, production, research and development, and procurement of defence materiel.
>
> 1.2 This Agreement shall establish a framework which aims to cover all cooperation activities conducted by the Parties in the field of defence.[5]

Article 1.2 of the agreement illustrates the first criterion for DCAs. They are *framework* treaties that, at their most ambitious, attempt to institutionalize the entirety of their signatories' cooperative defense relations (Matz-Lück 2009, 2014). The text of a DCA typically describes only the broad areas of cooperation; subsequent protocols and implementing legislation provide the details. For example, a 2010 DCA between Indonesia and Vietnam clarifies that "the operational, administrative, and technical matters shall be subject to separate implementing arrangements to be concluded between both Parties."[6] Protocols and legislation make explicit their status as legally subordinate

[4] For example, see "New Era Forces US, Israel to Redefine Alliance," *The Washington Post*, July 28, 1992.

[5] *Agreement between the Government of the French Republic and the Government of the Republic of India on Defence Cooperation*, signed 20 February 2006, New Delhi.

[6] *Memorandum of Understanding between the Government of the Republic of Indonesia and the Government of the Socialist Republic of Vietnam on Strengthening of Cooperation between Defence Officials and Its Related Activities*, signed October 27, 2010, Hanoi.

to the DCA, while the DCA specifies each signatory's responsible implementing authorities, clarifies guidelines for implementation, and provides a legal umbrella for subsequent arrangements.[7]

A second criterion, implied by Article 1.1 above, is that DCAs do not endeavor grand mutual defense commitments but instead focus on routine forms of bilateral cooperation. Consider the following excerpt from a DCA between Sweden and South Korea:

> **Paragraph 2**
> *Scope and Areas of Cooperation*
>
> 1. With regard to identified areas of mutual interest, the Participants may cooperate in the following areas:
>
> a. exchange of defence related experience and information,
> b. research and development,
> c. defence industry,
> d. logistics and maintenance,
> e. military technical cooperation,
> f. military education and training,
> g. government quality assurance,
> h. military medicine and health services and
> i. other areas of cooperation, as jointly decided by the Participants.[8]

The breadth of the issue areas covered by this particular agreement, combined with the commitment in Section 2.1.i to extend cooperation into "other areas," identify it as a standard DCA, or what I below refer to as a *general* agreement. In practice, general DCAs address some combination of (1) coordination in defense policies and mutual consultation; (2) training, education, and exchange; (3) joint military exercises; (4) coordination in peacekeeping operations; (5) defense-related research and development (R&D) and industrial cooperation; (6) weapons procurement; and (7) security of classified information. While general agreements are by far the most common, governments sometimes opt for a series of narrower *sector* agreements, which address issue areas individually, rather than signing an umbrella agreement. In the 1990s and early 2000s, for example, Pakistan

[7] Many DCAs are signed as memoranda of understanding (MOUs). Some governments, such as the United Kingdom, have historically treated MOUs as "less than a treaty" (Aust 1986). In contrast, legal scholars tend to view MOUs as "legally binding [in] nature" (McNeill 1994). According to the International Law Commission, MOUs "are undoubtedly international agreements subject to the law of treaties" (International Law Commission 1966). Governments routinely register their signed MOUs with the United Nations Treaty Series. The US government publishes its MOUs alongside other formal treaties in its annual treaty series. DCAD thus includes MOUs.

[8] *Memorandum of Understanding between the Government of the Kingdom of Sweden and the Ministry of National Defense of the Republic of Korea concerning Cooperation in the Field of Defence,* signed June 24, 2009, Stockholm and Seoul.

and China promulgated a series of agreements on defense industries and officer exchanges before eventually consolidating their various piecemeal agreements into a single general framework in 2008. As detailed below, I disaggregate these sector agreements into unique categories.

Third, DCAs may be signed between any pairing of states and are not limited to specific events or to unique shared histories, such as postcolonial ties or a recent conflict. Indeed, DCAD is full of seemingly improbable ties. Indonesia and Sweden signed a DCA in late 2016 despite both governments' long-standing adherence to principles of neutrality and non-alignment.[9] This feature distinguishes DCAs from myriad security agreements that are unique to the parties involved, such as US treaties with Ukraine on denuclearization, South Korean treaties with North Korea on the demilitarized zone, French treaties with Spain on ETA, and so on. Such context-specific agreements are meant to address problems unique to a given pair of countries and are not generalizable frameworks for defense cooperation.

Fourth, DCAs typically rely on decentralized institutional mechanisms to achieve implementation, with only minimal delegation (cf. Abbott and Snidal 2000; Hawkins, Lake, Nielson, and Tierney 2006), promulgated through a combination of commissions, working groups, task forces, and joint committees.[10] Consider the following excerpt from a 2005 DCA between Sweden and Saudi Arabia:

> **Article 3**
>
> 1. A committee shall be established under the name (The Joint Military Committee) which shall be responsible for the follow up and development of military cooperations between the two countries and in case any obstacles that may arise regarding this MoU, and each party shall appoint his representative at a later time; the committee will meet annually in each country respectively. The committee raise its recommendations to the higher authorities in both countries to obtain approval.
>
> 2. The committee can form specialized task forces from each party to serve the military cooperation fields.[11]

Many DCAs further require signatories to develop annual defense cooperation plans, which detail summits, policy goals, exercises, exchanges, pending contracts, and so on. These plans may run dozens of pages in length and provide specific details on, in some cases, hundreds of unique events. A 2011 DCA between Czech Republic and Moldova illustrates:

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[9] "Sweden, Indonesia sign defense cooperation agreement," *The Jakarta Post*, December 21, 2016.

[10] Of course, domestic-level mechanisms, such as implementing legislation, may encourage compliance through signatories' domestic political and legal-juridical institutions.

[11] *Memorandum of Understanding concerning Military Cooperation between the Government of the Kingdom of Sweden and the Government of the Kingdom of Saudi Arabia,* signed November 15, 2005, Stockholm. Grammatical errors in original.

Article 4

Planning and Conduct

1. According to the provisions of this Agreement, the Parties shall work out and approve annually bilateral cooperation plans. The annual plan of cooperation for the next year shall be worked out by 1 December of the current year.

2. The annual plan of cooperation shall be elaborated on proposals submitted by the Parties.[12]

Fifth, DCAs are surprisingly symmetric, which is most evident in the texts of the treaties themselves. DCAs rely heavily on terms like "the Parties" and the "Signatories" in lieu of proper nouns. They also frequently incorporate language redolent of equality. A 2007 DCA between Indonesia and Singapore refers to "friendly relations and mutual cooperation," "mutually beneficial cooperative activities," "mutual access to [...] training areas," "mutually agreed joint projects," "mutual consent of the Parties," and so on.[13] Nonetheless, some DCAs impose overtly asymmetric obligations—especially when one of the signatories is a major power. As discussed below, DCAD includes an "asymmetry trigger" when an agreement appears to be asymmetric.[14]

Sixth, DCAs are signed for the long term. The shortest agreement in DCAD is two years. Nearly half of agreements are signed for ten years or longer. A substantial number of agreements are indefinite; they endure unless and until at least one signatory chooses to withdraw. While long-term agreements are certainly not unique in international law, this characteristic distinguishes DCAs from the numerous short-term security agreements, protocols, and contracts that fill treaty repositories.

Finally, a given pair of countries may sign more than one DCA. In some cases, countries simply replace expiring agreements. In other cases, governments have adopted a piecemeal approach to defense cooperation via *sector* agreements, and they sign a *general* DCA to pull their various issue-area commitments into a single framework. Yet another possibility is that governments replace weak agreements with broader, more binding agreements (or vice versa).

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[12] *Agreement between the Ministry of Defence of the Republic of Moldova and the Ministry of Defence of the Czech Republic concerning Co-operation in the Defence Area*, signed May 16, 2011, Prague.

[13] *Agreement between the Government of the Republic of Indonesia and the Government of the Republic of Singapore on Defence Cooperation*, signed April 27, 2007, Tampak Siring, Bali, Indonesia.

[14] Note that even if agreements are symmetric de jure, they may be asymmetric de facto—for example, due to discrepancies in power and relative capabilities. Analysts must account for these possibilities methodologically, via control variables.

DCAs versus other agreement types

Browsing the "military matters" category of the UNTS reveals agreements on military cemeteries, radar stations, tobacco use by military personnel, and various other topics. Even seemingly trivial defense agreements are numerous. Accordingly, I distinguish DCAs from those defense agreements that have previously received scholarly attention, such as nonaggression pacts, mutual defense pacts, strategic partnerships, and status-of-forces agreements (SOFAs).

Defense pacts and nonaggression pacts have been heavily studied (e.g., Gibler 2009; Mattes and Vonnahme 2010; Walt 1987). Leeds, Ritter, Mitchell, and Long (2002) place both agreement types under the broader definition of a military alliance:

> Alliances are written agreements, signed by official representatives of at least two independent states, that include promises to aid a partner in the event of military conflict, to remain neutral in the event of conflict, to refrain from military conflict with one another, or to consult/cooperate in the event of international crises that create a potential for military conflict.

Alliances focus primarily on *conflict*, especially of the interstate variety. By contrast, DCAs exclusively address issues of *cooperation*. Of course, these substantive focuses may overlap. Alliances may require cooperation in order to achieve their goal of minimizing or preventing conflict. Indeed, some alliances promote forms of cooperation—working groups, exercises, training and exchange—that overlap with DCAs. Yet, while conflict-related obligations are a necessary condition for alliances, additional provisions regarding cooperative activities are not. DCAs, on the other hand, are defined precisely by their goal of institutionalizing routine cooperative defense activities. Indeed, DCAs overtly exclude the mutual defense commitments that define alliances as such.[15]

Even when alliances discuss cooperation more generally, they do not engender umbrella frameworks for the full range of states' defense activities. Provisions on peacetime cooperation are in fact uncommon outside of ambitious alliances like NATO. Leeds et al. (2002) find that while about half of alliances involve mutual consultation, less than 15% mandate interpersonal contact during peacetime. And while many alliances encourage "economic cooperation, protection of minorities, scientific or cultural exchange, environmental protection, etc.," these activities are overtly non-military (Leeds 2005: 30). By contrast, routine activities like joint exercises, officer exchanges,

[15] Public officials often explicitly emphasize this aspect of DCAs. For example, when China and Indonesia signed a controversial DCA in 2007, the latter's defense minster declared: "We only want to improve our defense cooperation with China. We have no intention of signing a defense treaty with China." See "RI Has No Intention of Concluding Defense Pact with China," *LKBN Antara*, November 8, 2007. Indonesia's president similarly described a DCA with Singapore as "not a military pact." See "Extradition, defense treaties signed in Bali," *The Jakarta Post*, April 28, 2007.

procurement and acquisition, joint weapons collaborations, and defense industrial cooperation are the core purview of DCAs.

The distinction between alliances and DCAs is straightforward. The primary goal of an alliance is to specify obligations contingent on armed conflict. The primary goal of a DCA is to establish generic frameworks for routine cooperative defense activities. The two agreement types are mutually exclusive. Alliance and DCA obligations are also empirically distinct. At the dyad-year level, the correlation between DCAs and alliances is typically less than 0.2. The vast majority of DCA partners lack a direct alliance of any form.

Distinctions between DCAs and other agreement types are even sharper. While SOFAs have been frequently studied by political scientists and legal scholars (e.g., Sari 2008; Schwartz 1953), they focus largely on jurisdictional issues—especially regarding foreign-deployed troops—and do not establish broad legal umbrellas (Erickson 1994). Strategic partnerships are also common, but these agreements are substantively thin and vaguely defined (Kay 2000), often focusing an a wide variety of non-military issues, such as trade, finance, diplomatic relations, public health, or the environment. Neither agreement type bears a strong resemblance to DCAs.

Collecting and coding the DCA data

The author and a rotating team of coders assembled an exhaustive dataset on DCAs for all countries in the world, covering the period 1980–2010. We paid particular attention to five of the criteria elaborated by Salehyan (2015).[16] Specifically:

1. We systematically and transparently assembled a large battery of primary sources. All coders consulted the same sources, and all sources were thoroughly documented.
2. We collected data from numerous supplementary sources in order to address potential gaps or oversights in the primary sources.
3. We utilized a diverse array of sources—from treaty repositories to country publications to global newspaper and newswire archives—in order to minimize any potential biases associated with specific sources.
4. We implemented an extensive, unambiguous set of coding rules. All coders were debriefed on the coding system and met routinely with a supervisor to address challenges and verify accuracy of the data.

[16] Salehyan (2015) also encourages scholars to consider automated or machine-coded data. I intentionally opted for human-coded over machine-coded data in order to avoid type I and II errors, and to maximize the accuracy of the resulting dataset. Human-coded data also allow for detailed institutional information on many DCAs.

5. We have arranged to provide free public access to the final dataset via academic websites, Dataverse repositories, and the *Correlates of War* data portal.

The data collection involved three sweeps. First, we consulted the WTI and UNTS. The WTI, first assembled by Rohn (1984), is an expansive resource, but its post-1980 coverage overlaps substantially with the UNTS (Bommarito, Katz, and Poast 2012). The UNTS, in turn, is plagued by at least two problems. (1) Despite the requirements of Article 102 of the UN Charter, governments often fail to report their signed agreements. This underreporting appears to be especially prevalent with agreements on security, defense, and military issues. (2) Even when governments register their signed treaties as required, bureaucratic backlogs cause multi-year lags between registration and eventual publication in the Series. Ultimately, the UNTS and WTI contribute only a small fraction of the observations in the final dataset.

The second sweep focused on individual country sources, including official treaty series, publications of defense and foreign ministries, gazettes and other legislative records, online databases, and unofficial governmental records. In many cases these documents were accessed via traditional print publications, fee-based online repositories, or publicly accessible ministry websites. We also directly contacted officials at foreign, defense, and legal affairs ministries, and we were often rewarded with data that, while not proprietary, would otherwise be publicly inaccessible. These country-level resources provided the vast majority of observations in the dataset. This phase of the data collection was extremely labor intensive and covered a period of nearly five years.

The third sweep filled gaps left by the first two sweeps. Some countries lack the means or the motivation to make their treaty data publicly accessible. We thus used the Dow Jones Factiva database to access treaty information via global newspaper and newswire reports.[17] Coders were instructed to manually query Factiva using iterated combinations of relevant keywords. To ensure careful attention to search results, these queries focused on one country at a time, employing for each country a moving search window of 3–12 months over the entire 1980–2010 period. This tertiary source provides approximately one-third of the observations in the final dataset.

Coding rules

DCAD categorizes agreements along multiple dimensions. At the most general level, DCAs can be distinguished by agreement type, which bifurcates into *general* agreements and *sector* agreements. The *general* category consists primarily of agreements designated as *Full DCA*, which, like the examples cited above, attempt to coordinate and institutionalize the entirety of their signatories' current and prospective defense relations. The *general* heading also includes a specific subtype of DCAs known as defense industrial cooperation agreements. These *Industry* agreements are

[17] The specific categories included in Factiva queries were *Wires*, *Newspapers: All*, and *Transcripts – All*.

more strongly oriented toward military capacity than are full DCAs, but they are nonetheless far more extensive than the narrow weapons-procurement agreements discussed further below. *Industry* agreements promote a wide range of defense industrial activities beyond a typical DCA, including joint research and development, joint production, sharing of classified weapons-related material, exchanges of scientific personnel, collaborations between universities and other research institutions, collaborations and partnerships between defense firms, transfer of components and finished weapons, and numerous other activities. This breadth leads to the classification of these agreements as *general*. Because DCAD clearly distinguishes *Industry* agreements from the *Full DCA* category, users are free to alter this categorization as desired.

The *sector* type of agreement consists of four main subtypes:

- *Procurement:* These agreements establish frameworks for procurement and acquisition of weapons, equipment, spare parts, and possibly weapons-related training (Kinne 2016). Unlike *Industry* agreements, procurement deals typically do not involve industrial collaboration, joint research, information sharing, or similar activities. Rather, they facilitate weapons transactions. While some procurement agreements involve grants, loans, and/or offsets, those agreements that deal solely with military aid are uniquely asymmetric and, as such, are not included in DCAD.

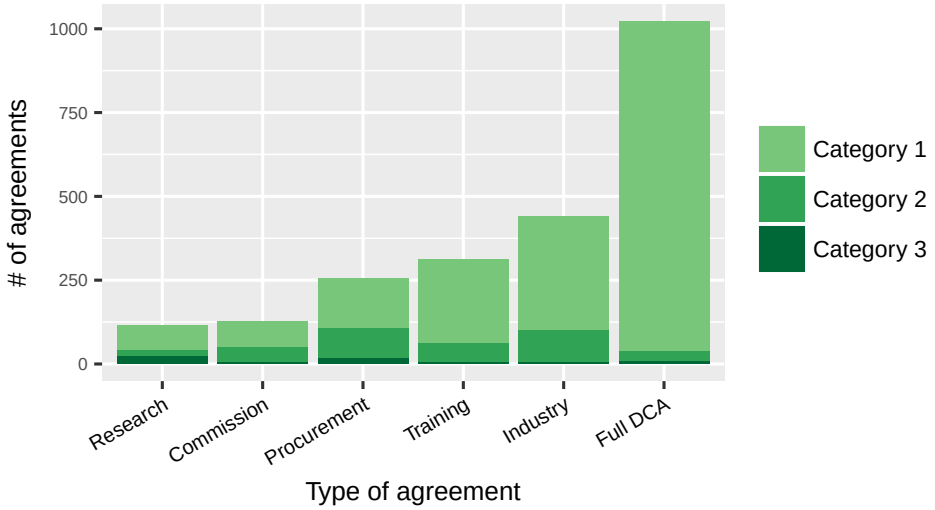
- *Training and exchange (TrEx):* These agreements create frameworks for officer exchanges, joint training and education, advanced coursework in foreign institutions, and other activities that involve movement of personnel for training and/or education purposes.

- *Research:* These agreements promote defense-related research. Research agreements are narrower than industry agreements and focus more on basic research—often involving universities, national labs, and similar facilities—than on immediate weapons applications. They also do not address procurement, acquisition, or arms transfers.

- *Commission:* These agreements establish recurring high-level consultation mechanisms, such as bilateral committees, joint working groups, and military commissions, with a focus on general defense policy coordination. While full DCAs also establish such mechanisms, the *Commission* subtype of agreement typically involves only consultation and does not address the wide range of activities covered by full DCAs. Because the goals and motivations of these agreements are often vague, they are generally the weakest of the *sector* agreements.

DCAs thus fall into one of two types (*general* or *sector*) and one of six subtypes or categories (*Full DCA*, *Industry*, *Procurement*, *TrEx*, *Research*, or *Commission*). In most cases, a given agreement easily fits into one of these categories. In some cases, however, categorization is not straightforward. For example, an ambitious *Research* agreement may discuss procurement and acquisition, raising the possibility that it should be categorized as *Industry*. Coders thus assigned up to three separate categories for each agreement. *Category1* indicates the most likely category, while *Category2* and

Figure 1: DCAs by category

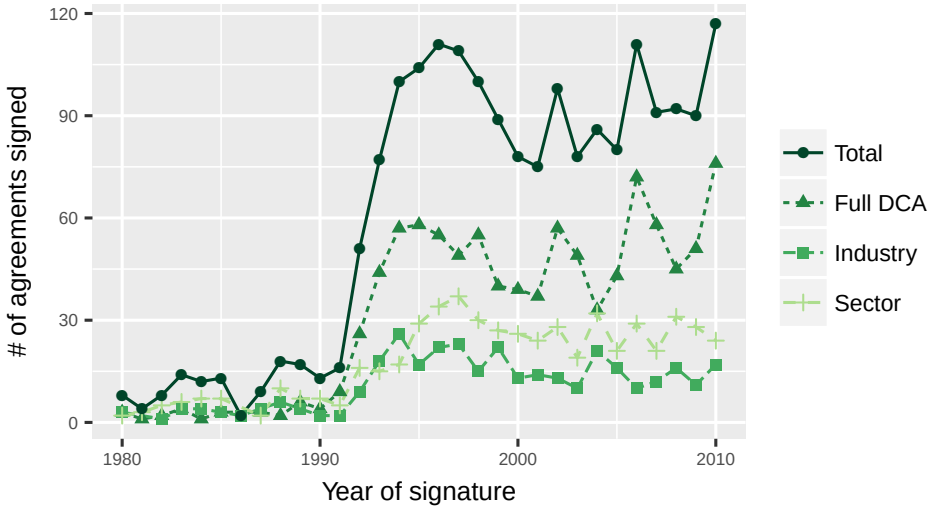


Category3, if used, indicate plausible alternative codings. Figure 1 illustrates the distribution of categories. Because full DCAs are readily identifiable, they are typically coded as *Category1*. Industry agreements, while less common than full DCAs, are more numerous than any individual sector-level subtype. Agreements that fall into the *Full DCA* and *Industry* subtypes—i.e., *general* agreements—clearly comprise the large majority of DCAs.

Figure 2 illustrates trends in DCA signature over time. Full DCAs comprise about half of agreements signed in a typical year. Industry agreements are slightly less numerous than all combined sector agreements but are nonetheless signed at nontrivial rates of 15–30 per year. The last year of the dataset, 2010, was the most prolific year thus far, with nearly 120 separate agreements signed. Preliminary data collection beyond 2010 suggests that DCA creation continues apace.

The categorization strategy necessitates a transparent assessment of coder confidence. Coders reported confidence in a number of ways. The main indicator of confidence, denoted *categoryConf* in DCAD, is a four-point nominal scoring system. A scoring of "high" typically corresponds to an agreement where the full text is available, either in English or translatable to English, and the text clearly and unequivocally identifies the issue-areas covered by the agreement. A scoring of "medium" typically corresponds to an agreement where the full text is unavailable but the treaty is listed in treaty databases or official government records, and available sources—such as treaty archives, news sources, or other secondary sources—contain sufficient information to assign the DCA to a specific category with little ambiguity. A scoring of "low" typically corresponds to an agreement where full text is unavailable and secondary sources describe the agreement's scope only in vague terms or not at all. Even a treaty that appears in an official government treaty record may be assigned low confidence if the full text of that treaty is unavailable and

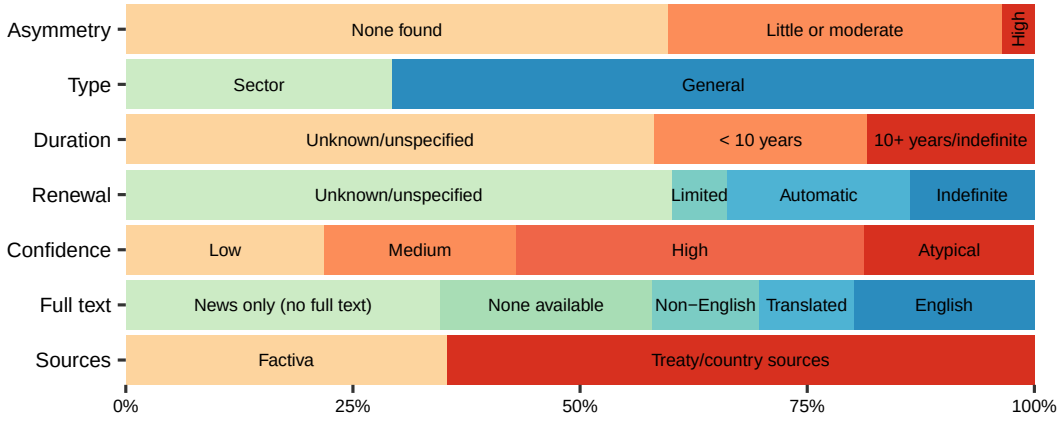
Figure 2: DCA signature over time



secondary sources provide little additional information. Coders also employed an "atypical" scoring, which corresponds to agreements that differ substantively from the archetypical category to which they've been assigned—for example, by including provisions common to other categories and/or incorporating high levels of asymmetry (see below). Due to the nonstandard nature of atypical agreements, the assigned category may be unreliable. When DCAs are the sole focus of an analyst's attention, as when they are the dependent or independent variable of interest, only high and medium confidence agreements should be used.

Given the difficulty in coding agreements from newspaper and newswire sources, which nearly always lack full treaty texts, coders also assessed confidence specifically with regard to the Factiva data. The variable *factivaConf* is a five-point numeric scale that indicates the coder's confidence that the following criteria are met: (1) a written international agreement was signed between two sovereign governments, with no ambiguity about the day, month, and year of signature; (2) the agreement covers issue-areas that correspond to those typically covered by DCAs; (3) the agreement does not appear to be motivated solely by idiosyncratic events, such as an ongoing war or activities of a specific terrorist organization; and (4) the agreement appears to correspond to the above-cited characteristics of DCAs, such as being long term and imposing relatively symmetric obligations. A five on this scale indicates maximum confidence, typically due to an abundance of highly detailed news reports on the given agreement. A one on this scale indicates minimal confidence and typically corresponds to agreements that are given only cursory mention in news sources and for which most of the details, including type and category, are not well known. A score of three indicates an agreement for which criteria #1 and #2 appear to be satisfied, but uncertainty remains about #3 and #4. If there is any ambiguity about an agreement's legal status—i.e., whether it is in fact a legal instrument or is instead a joint statement, declaration, protocol, addendum, or amendment—

Figure 3: A graphical overview of DCAD



Note: Horizontal bars indicate percentage of agreements that fall into each category.

factivaConf is no higher than two. When DCAs are the focus of an analyst's attention, only those agreements that score three or higher on the *factivaConf* scale should be used.

DCAD also includes an *asymmetry* indicator, which flags agreements that may involve asymmetric obligations. This variable is a three-point scale that equals one if the treaty text, news sources, and/or available secondary sources suggest that the agreement involves military aid from one signatory to the other, bases or other foreign deployment beyond reciprocal exchanges, explicit references to past colonial ties, or differing legal obligations in the agreement's core areas. Because such asymmetries are difficult to establish definitively, we code this variable generously. The mere suspicion of asymmetry leads to a coding of one. Thus, *asymmetry*=1 should be interpreted as indicating the *possibility* of asymmetry. The goal of this coding is to flag any potential cases of asymmetric obligations. In contrast, a coding of two indicates unequivocal evidence of (usually extensive) asymmetry. Given the nature of the coding, pooling agreements where *asymmetry*=0 with those where *asymmetry*=1 is acceptable. However, analysts should avoid pooling *asymmetry*=2 agreements with the other types.

When available, DCAD includes information on agreements' specified duration and renewal terms. This fine-grained information typically requires access to full treaty texts, though in some cases online treaty databases and even news sources include such information. DCAD specifically includes measures of an agreement's *span* in years, the conditions for renewal (denoted *renewType*), and the length of the renewal term in years (denoted *renewYears*). DCAD also includes a dummy variable indicating whether an agreement has terminated and an additional variable that lists, for terminated agreements, the full duration of the treaty in years. This information is particularly useful in constructing the dyad-year version of the dataset, as described below. Figure 3 summarizes DCAD's key characteristics.

Monadic vs dyadic versions

The main DCAD file contains agreement-year observations, where "year" is defined as the year of signature. The dataset thus includes one record per agreement. This data structure is readily amenable to country-year or "monadic" analyses. However, scholars of international relations are often interested in bilateral, country-pair, or "dyadic" relations, where the unit of analysis is the dyad-year. At the same time, many studies of defense cooperation focus on the *existence* of formal agreements, not merely the *creation* of those agreements.

Generating a dyad-year dataset of DCAs confronts two challenges. First, given that DCAs vary in issue scope (as well as in coder confidence), a researcher must make ex ante decisions about which agreements to include and which to exclude. Second, DCAD only includes information on duration for approximately half of agreements, typically because full treaty texts are not available or because the treaty itself is ambiguous about duration.

I address the first challenge by generating multiple versions of the dyad-year measure, focusing separately on *general* agreements, *sector* agreements, and all agreements in combination. Within each of these groupings, I further separate agreements with high and medium confidence codings from those with low or atypical codings. This approach yields six distinct dyad-year measures:

- *dcaGeneralV1:* This coding includes only *Full DCA* and *Industry* agreements with category confidence ratings of high or medium.
- *dcaGeneralV2:* Includes *Full DCA* and *Industry* agreements regardless of category confidence.
- *dcaSectorV1:* Includes only *Category1* sector agreements—i.e., *Procurement*, *TrEx*, *Research*, and *Commission*—with category confidence scores of high or medium.
- *dcaSectorV2:* Includes *Category1* sector agreements regardless of category confidence.
- *dcaAnyV1:* Includes both general and sector agreements with category confidence ratings of high or medium.
- *dcaAnyV2:* Includes general and sector agreements regardless of category confidence (i.e., all agreements).

To address the second challenge, regarding DCAs of unknown duration, I code an *endYearEstimate* variable according to the following rules. (1) If the agreement is known to have terminated, *endYearEstimate* equals the appropriate year of termination or the final year of the dataset (2010), whichever is lower. (2) If a treaty is known to have *not* terminated at the time of data collection (for example, the agreement is listed as active in a country's treaty register), *endYearEstimate* equals

the final year of the dataset. (3) If a treaty's stated duration is indefinite and there is no evidence of termination, *endYearEstimate* follows the same rule as in #2. (4) If a treaty renews indefinitely, without required consent from signatories, *endYearEstimate* follows the same rule as in #2. (5) If a treaty has a finite duration and explicitly states that it may not be renewed, *endYearEstimate* equals the year of signature plus the stated duration of the treaty. (6) If a treaty is of finite duration but permits limited renewal(s) with the consent of both parties, *endYearEstimate* equals the year of signature plus the stated duration of the treaty plus the renewal period. (7) If a treaty permits renewal but the duration and terms of renewal are not known, *endYearEstimate* follows the same rule as in #5. (8) For any remaining missing values, *endYearEstimate* equals the year of signature plus the median span, in years, for all observations in the dataset where span is known. Give the time span of the dataset, *endYearEstimate* can never exceed 2010. I use *endYearEstimate* to determine whether a tie exists within a given dyad in a given year.

Given these coding rules, analysts should be cautious in using the dyadic data. When DCAs are the dependent variable of interest, analysts should focus on the *creation* of DCAs rather than on the *existence* of DCAs. The versions utilizing treaty duration are more appropriate when DCAs act as independent variables and the analyst can reasonably assume that agreements will exercise influence well past their year of signature. Most analysts will find *dcaAnyV1* to be the most sensible variable to use, given that it includes all agreements for which there exists a reasonable level of confidence.[18]

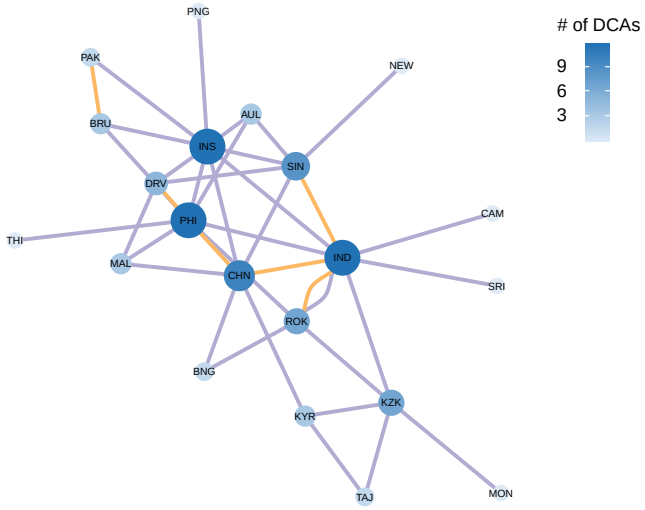
DCAs as a global network

DCAD is particularly valuable for the study of international networks. While many scholars now recognize that international relations are in fact *network* relations (Kinne 2013), IR data are not always amenable to network tools. For example, many studies operationalize military alliances as a traditional social network, where each network tie is separable from the others (e.g., Cranmer, Desmarais, and Menninga 2012; Cranmer, Desmarais, and Kirkland 2012; Maoz and Joyce 2016; Warren 2010, 2016). Yet, because many alliances are multilateral, they are better modeled as bipartite or "two mode" networks, which require unique data structures and a distinct estimation approach (Borgatti and Everett 1997; Snijders, Lomi, and Torló 2013). Network scholars have also studied militarized interstate disputes (MIDs) (e.g., Ward, Siverson, and Cao 2007); however, MIDs are transitory events rather than enduring social relations, which complicates the use of statistical tools designed for stable networks (Brandes, Lerner, and Snijders 2009).

To the best of my knowledge, DCAD is the first IR dataset collected and assembled specifically with network implementations in mind. Because DCAs are bilateral, they readily approximate the dyadic

[18] Note that both Kinne (2018) and Kinne and Bunte (2018) use a variant of the *dcaAnyV1* measure, focusing on tie creation.

Figure 4: The DCA network in Asia in 2010

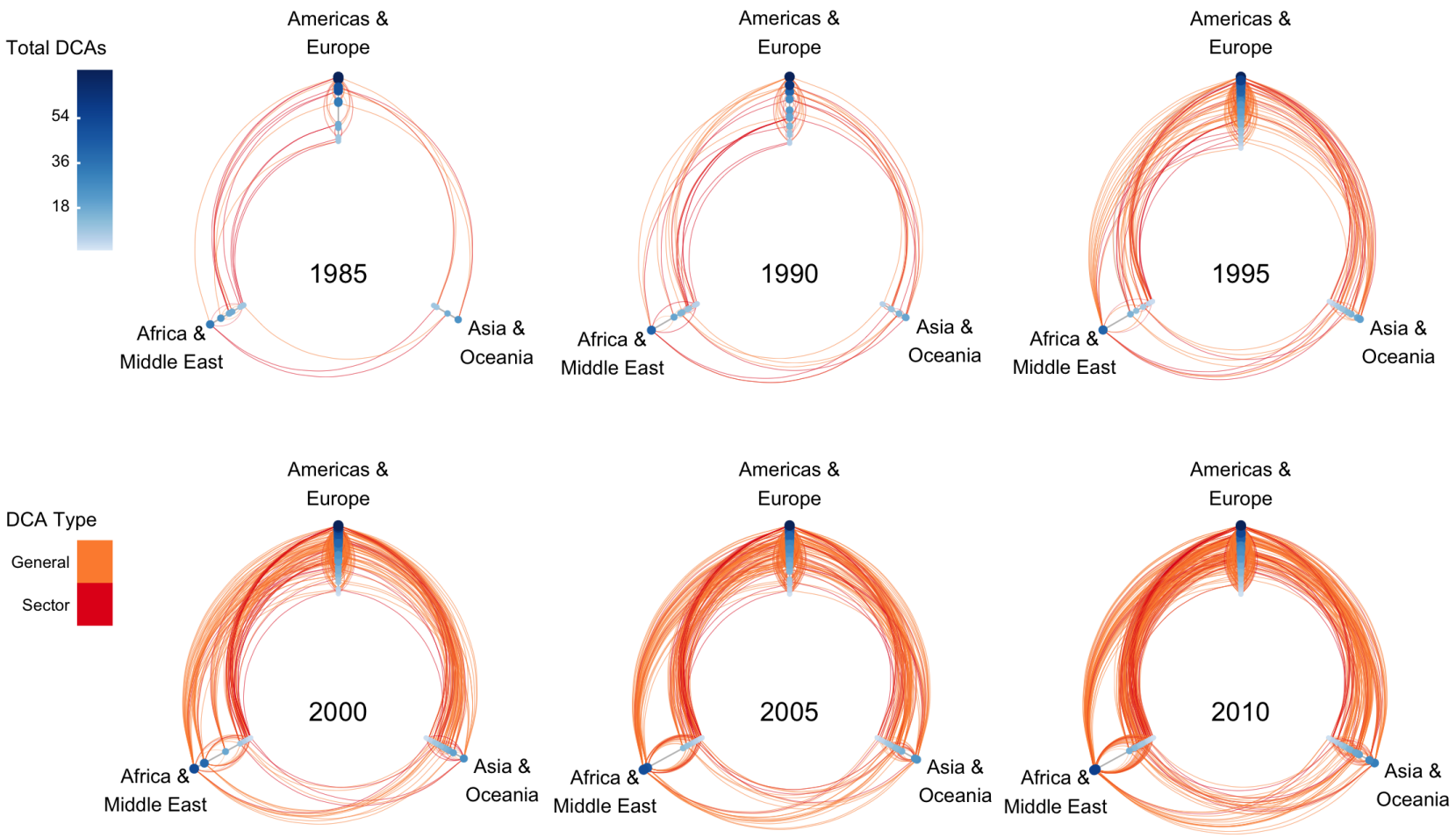


Note: Figure uses *dcaAnyV2* dyad-year version of DCAD. Nodes are countries. Purple edges are general agreements. Orange edges are sector agreements. Node size corresponds to number of ties.

relations that comprise traditional social networks. Figure 4 illustrates the DCA network in Asia in 2010 using a standard network graph, which helps identify central players (India, Philippines), peripheral players (Mongolia, Cambodia), relative prevalence of *general* versus *sector* agreements, and other structural features. Figure 5 uses hive plots to illustrate the changing topology of the global DCA network. The overall network was quite sparse until 1995, when a plethora of agreements emerged between governments in Europe, North America, Asia, and the Middle East—with relatively less activity between governments in Asia and Africa / Middle East. These trends have continued, with some regions showing much stronger DCA activity than others, and the overall network gradually densifying through 2010.

The dyadic version of the dataset allows analysts to define longitudinal networks of arbitrary length (i.e., within the 1980–2010 time period). Further, because DCAD includes day, month, and year of signature, networks can be constructed at the monthly, weekly, or even daily levels. This feature allows DCAD to integrate seamlessly with global event data, which are often available at high temporal resolutions. While inferential network models sometimes encounter difficulties in estimation (Schweinberger 2011), DCA data are highly amenable to network modeling. I have successfully estimated all mainstream inferential network models on DCAD, including exponential random graph models (Robins, Pattison, Kalish, and Lusher 2007), stochastic actor oriented models (Snijders 1996), and social relations and latent space models (Dorff and Ward 2013; Hoff, Raftery, and Handcock 2002).

Figure 5: Hive plot illustration of increasing density in the global DCA network



Hive plot panels illustrate DCA network at five-year increments, using *dcaAnyV2* dyad-year measure. Nodes are countries. Node color and axis position determined by number of ties. Red edges are *sector* DCAs. Orange edges are *general* DCAs.

Future releases

DCAD is currently limited to the 1980–2010 period. This 31-year coverage ensures approximately a decade-worth of data from each of three key epochs: Cold War, post-Cold War, and post-9/11. The 2010 end year reflects limitations both on data availability and on the labor-intensive process of collecting original treaty data. Many governments do not maintain up-to-date treaty databases, and global registries like the UNTS are woefully incomplete. Assembling a comprehensive dataset therefore requires consultation with hundreds of unique, disparate sources. Online sources frequently go offline or change URLs. Hard-copy sources may only be available through overseas libraries, directly from government ministries, or via other difficult-to-navigate avenues. Many sources require translation to English.

At the same time, the data coding procedure is labor intensive. Coders must closely read treaty texts, which often run dozens of pages in length, in order to extract quantifiable information. Coding from news archives, such as the Factiva database, is uniquely time consuming, as coders must query the database individually for every country in the world using narrow 3–12 month increments (totaling at least 100 queries per country), and must then filter hundreds or thousands of results per query.

Given these constraints, I anticipate updating DCAD at five-year intervals, using the basic framework discussed above. The project thus far has compiled an exhaustive collection of country-level data sources, and has also made personal contacts in foreign ministries and streamlined the protocol for Factiva queries, all of which will substantially reduce the anticipated time, effort, and costs of updates.

Illustrative analyses

To illustrate DCAD's usefulness in tackling prominent research questions, I estimated simple regression models for two outcomes: MIDs and bilateral arms trade. The study of MIDs is well established. The study of arms trade attracts less attention but has recently blossomed into a thriving literature, driven largely by high-quality data from the Stockholm International Peace Research Institution (Holtom, Bromley, Wezeman, and Wezeman 2013). These two outcomes represent distinct potential effects of DCAs. Arms-related issues often function prominently in DCAs, and a subset of DCAD consists solely of procurement and defense industrial frameworks.[19] By contrast, MIDs are related to DCAs only indirectly. While many defense partners express an interest in peace, DCAs themselves do not include mutual defense triggers. Insofar as DCAs affect conflict propensity, they most likely do so via their indirect effects on coordinated defense policies,

[19] See Kinne (2016) for analysis of arms trade and procurement deals or "weapons cooperation agreements."

alignment of interests, and agglomeration of nascent security communities (Beardsley, Liu, Mucha, Siegel, and Tellez 2018; Kinne 2018).

I do not here develop causal explanations for why, how, and when DCAs affect MIDs and/or arms trade. Such questions are fodder for later research. The current analyses simply show that, using standard model specifications for both MIDs and arms trade, DCAs appear to be related to these important outcomes. Of course, many other outcomes warrant consideration. At the domestic level, the relationship between DCAs and defense spending, troop levels, modernization, or military capacity may deserve attention. Areas of inquiry at the international or bilateral level include the effect of DCAs on joint military exercises, contributions to peacekeeping missions or multilateral uses of force, or even such non-security issue-areas as trade and investment.

DCAs and militarized interstate disputes

I specify a standard ij dyad-year MIDs model, using the Correlates of War (COW) project's data as the dependent variable of interest (Palmer, D'Orazio, Kenwick, and Lane 2015). The control variables include total bilateral trade, log transformed (Barbieri and Keshk 2012); common memberships in intergovernmental organizations, or IGOs (Pevehouse, Nordstrom, and Warnke 2004); military alliances (Gibler 2009); shared democracy (Boix, Miller, and Rosato 2012); the lower of i and j's respective COW CINC scores, log transformed (Singer 1987; Singer, Bremer, and Stuckey 1972); and the lower of i and j's per-capita GDP, in current-year dollars, log transformed (Feenstra, Inklaar, and Timmer 2015). I also include a count of the number of years since i and j had a MID, as well as the square and cube of this term (Carter and Signorino 2010). Because data on IGOs and CINC scores end in 2005 and 2007, respectively, I estimate models both with and without these variables.

I specify a logit model with dyadic fixed effects to account for the substantial unobserved heterogeneity that plagues cross-sectional time-series IR data (Green, Kim, and Yoon 2001). I consider three different versions of the dyadic DCA variable. *dcaAnyV1* records any DCA between i and j, whether general or sector, that meets a medium or high level of confidence. Model 1 in Table 1 lists the estimates. While the estimate for *dcaAnyV1* is negative, it is not significant at conventional levels. In Model 2, I swap this variable for *dcaGeneralV1*, which includes only *general* DCAs of high or medium confidence. Because these are the most ambitious and extensive DCAs, they may be the only agreements that matter for militarized conflict. Indeed, the estimate is negative and significant at the 1% level. The estimate also appears to be substantively meaningful; the odds ratio indicates that a general DCA reduces the probability of a MID by 70%, all else equal.

In Model 3, I replace *dcaGeneralV1* with *dcaSectorV1*, which includes only sector-level agreements coded with at least "medium" confidence. The estimate for this variable is *positive* and significant

Table 1: Effect of DCAs on militarized interstate disputes, 1980–2010

	Model 1	Model 2	Model 3	Model 4
dcaAnyV1	−0.367			
	(0.305)			
dcaGeneralV1		−1.202**		−1.518***
		(0.386)		(0.313)
dcaSectorV1			0.975*	
			(0.456)	
IGOs	−0.025*	−0.021*	−0.032**	
	(0.011)	(0.011)	(0.010)	
Trade	−0.224***	−0.224***	−0.226***	−0.196***
	(0.041)	(0.041)	(0.041)	(0.032)
Alliance	0.148	0.226	0.111	−0.011
	(0.362)	(0.363)	(0.365)	(0.282)
Democracy	−0.132	−0.116	−0.123	−0.432**
	(0.189)	(0.190)	(0.189)	(0.164)
Power (low)	0.504*	0.449	0.592*	
	(0.257)	(0.257)	(0.256)	
GDP (low)	−1.542***	−1.536***	−1.572***	−1.514***
	(0.170)	(0.170)	(0.170)	(0.145)
Peace	1.097***	1.101***	1.111***	0.724***
	(0.086)	(0.086)	(0.086)	(0.065)
$Peace^2$	−0.105***	−0.106***	−0.106***	−0.060***
	(0.009)	(0.009)	(0.009)	(0.006)
$Peace^3$	0.003***	0.003***	0.003***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
N	225534	225534	225534	267859
AIC	24774	24765	24771	25937

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Logit models with dyadic fixed effects

at the 5% level. This result is unexpected and deserves consideration in future research. Quite possibly, the less ambitious sector agreements are more common among countries with a history of contentious relations. Model 4 drops the *IGOs* and *Power (low)* control variables, thus extending the analysis to the full 1980–2010 period. The estimated effect of *dcaGeneralV1* is larger and more precise, with the odds ratio showing a nearly 80% reduction in the probability of a MID.

Note that throughout the MID models I obtain insignificant estimates for traditional military alliances. I explored alliances from many angles, including by considering only defense pacts, separating out NATO from other alliance types, and also considering NATO partnership-for-peace countries (cf. Kinne 2018). I consistently obtained a null estimate.

Table 2: Effect of DCAs on bilateral arms trade, 1980–2010

	Model 5	Model 6	Model 7	Model 8
dcaAnyV1	0.070***			
	(0.003)			
dcaGeneralV1		0.066***		0.058***
		(0.004)		(0.003)
dcaSectorV1			0.102***	
			(0.006)	
Trade	0.007***	0.007***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)
Alliance	0.006	0.007	0.007	0.010*
	(0.005)	(0.005)	(0.005)	(0.004)
UNGA Ideal Point	0.003**	0.003**	0.002*	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Democracy	0.005***	0.005***	0.006***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Power (low)	0.011***	0.011***	0.010***	
	(0.002)	(0.002)	(0.002)	
GDP (low)	0.010***	0.011***	0.011***	0.009***
	(0.001)	(0.001)	(0.001)	(0.001)
Lagged DV	0.492***	0.493***	0.493***	0.495***
	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.239	0.239	0.239	0.242
Adj. R^2	0.202	0.202	0.201	0.208
N	463220	463220	463220	505470

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Dynamic panel model with dyadic fixed effects

DCAs and bilateral arms trade

I next consider arms trade. The dependent variable is defined as j's arms imports from i in the current year, as measured by SIPRI's trend-in-value (TIV) indicators, log transformed. I control for some of the same variables used in the MIDs equation, including *Trade*, *Alliance*, *Democracy*, *Power (low)*, and *GDP (low)*. I also include a measure of i and j's dissimilarity in voting patterns in the UN General Assembly, which captures dyadic foreign-policy affinities. Because arms-trade patterns exhibit substantial inertia, I include a one-period lag of the dependent variable. I estimate a dynamic panel model with dyadic fixed effects.

Model 5 in Table 2 lists the results of the first estimation, which uses the *dcaAnyV1* variable. The parameter estimate for DCA membership is positive and highly significant. The substantive effect of DCAs dwarfs other dummy variables, including democracy and alliances. In Model 6, I employ the *dcaGeneralV1* measure. While the estimate remains highly precise, it is smaller in magnitude

than the more encompassing measure. Model 7 considers only sector-type agreements, as measured by *dcaSectorV1*. The estimate is now much larger in magnitude. Given that numerous sector agreements focus specifically on procurement and acquisition, this result is perhaps not surprising. This variation in magnitude suggests that DCAs have wide-ranging but heterogeneous effects—an issue ripe for deeper exploration. Model 8 drops the IGO and capabilities measures in order to extend the temporal duration of the model, which slightly reduces the estimate for *dcaGeneralV1*. Consistent with Kinne (2016), DCAs appear to be strongly correlated with arms trade. As with the MIDs model, I obtain a null estimate for alliances.

Conclusion

International defense cooperation is a complex, heterogeneous phenomenon. While military alliances dominate the study of this topic, countries routinely engage in defense cooperation outside of alliances. This article draws attention particularly to defense cooperation agreements, which are ambitious agreements that establish institutional frameworks—or legal umbrellas—for the entirety of their signatories' cooperative defense activities. DCAs promote substantive, routine, day-to-day interactions between governments, militaries, defense industries, and other actors relevant to global security. Not only have DCAs exploded in number in recent decades, but anecdotal evidence suggests that governments view DCAs as essential elements of their global security strategies. Preliminary statistical evidence further suggests that DCAs may have tangible effects on a wide range of activities, from arms trade to peackeeping to bilateral lending and militarized interstate disputes (cf. Kinne 2016, 2018; Kinne and Bunte 2018).

The defense cooperation agreement dataset provides scholars with an exhaustive compendium of all DCAs signed from 1980 through 2010. Not only does DCAD distinguish between different types of DCAs, but it also provides institutional information on many DCAs, including details on entry into force, duration, and renewal terms. Carefully recorded confidence indicators allow analysts to filter out less reliably coded agreements and conduct sensitivity checks.

This resource should be highly useful for security scholars. While alliances are vitally important to international security, new alliances are rarely signed. Alliance variables exhibit little over-time variation, especially in the post-Cold War period. DCA activity allows researchers to observe ebbs and flows of security cooperation that are simply not visible in the alliance network. At the same time, there are inherently interesting questions worth exploring at the intersection of alliances and DCAs, such as whether alliances function more effectively when their members are also bound by DCAs, or whether DCAs function as a more tractable form of security cooperation among governments that find alliance commitments difficult to maintain. These and many other questions remain to be explored.

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