Allies as Armaments: Explaining the Specialization of State Military Capabilities*

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Scholars and practitioners have long maintained that, for capable states, a full-spectrum military provides the best security in an unpredictable anarchic world. However, not all states seem to make this choice, with some capable states have imbalanced, specialized militaries. Are specialized militaries that forgo the development of vital defense capabilities and overinvest in seemingly less necessary ones simply making mistakes? I argue that there are conditions under which states can reap the gains of economic efficiency that stem from specialization without sacrificing the security benefits of a full-spectrum force. Because defense alliances build trust, minimizes the risk of defection, and foster coordination, states with militarily-capable alliance partners can individually specialize in military capabilities that, when brought together, still comprise a full-spectrum military force. I substantiate these arguments with a new measure of military portfolio specialization using fine-grained data on state military assets from 1970-2014.

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1 Introduction

Despite constitutional restrictions on its military capabilities, Japan began shifting its military investments in the late 1970's. By 1982, Prime Minster Suzuki had draw up plans to overhaul Japan's military by investing primarily in air defense and light offshore surface ships (Modly 1985). Although the Soviet threat in East Asia ended a decade later, by the turn of the century Japan had doubled its air defense and short-range aerial capabilities and almost completely phased out its amphibious fleet and coastal ships, despite their clear utility for an island-chain state. Japan's military portfolio had changed fairly significantly by specializing in some capabilities and omitting others in a way that did not seem to align with the international security threats they were facing.

This is exemplary of a broader phenomenon of interest to international relations scholars. Why do some states possess seemingly sub-optimal militaries - under-producing some capabilities or over-producing others - while other states maintain a more diversified military portfolio? How states plan for conflict and the military tools this involves have much to tell us about war's causes and consequences. The combination of capabilities that comprise a military's toolkit determine the operations it plans for and undertakes, the types of threats it can credibly make, and the consequences of resorting to force (Buzan 1987). Assuming that the primary purpose of a state's military is to provide security against perceived threats (Waltz 1979, 102–14), most states should optimize their force structure by diversifying their capabilities because it compensates for the inherent weaknesses of any one set of capabilities and helps deal with unanticipated or opaque threats (Biddle 2005, 199–200). And yet, there are myriad examples of seemingly risky specialization like the US forgoing minesweepers in the 1980's even though 13 of the 15 US ships sunk since World War II were victims of naval mines (Till 2005), Albania in the early 2000's producing dozens of patrol vessels that could be deployed as far as western Portugal (Polak, Hendrickson, and Garrett 2009), or Estonia investing in sophisticated cyber

capabilities but having no combat aircraft despite warranted concern about Russian aggression (Andžāns and Veebel 2017). Why do some capable countries have gaps in their militaries that they could fill, but choose not to?

My central argument is that variation in the specialization or diversification of a state's defense capabilities can, in part, be explained by the presence of militarily-capable allied states. Alliance relationships allows states to reduce the cost of forgoing some capabilities and over-producing others. States can have their cake and eat it, garner the benefits of having both specialized and diversified military capabilities by individually specializing when the relationship with their allies can produce collective diversification. The result is variation in the composition of military capabilities across states - some being comparatively more specialized or diversified. I substantiate these arguments by examining the relationship between a state's military specialization and the nature of its alliance relationships from 1970 - 2014, and find that states with more militarily-capable alliance partners are able to specialize their militaries more than those with weak or non-existent defense partnerships.

In the next section, I detail existing research concerning the factors that determine a state's force structure in general, and more specifically why capable states sometimes pursue a specialized distribution of military capabilities, despite the security risks that engenders. Section 3 then introduces a shared production model of defense, theorizing that alliances can sufficiently minimize the risks inherent in military specialization. Section 4 provides an empirical test of this theory using a new entropy-based measure of a state's military portfolio specialization adapted from statistical ecology and applied to existing data on disaggregated national military capabilities. Section 5 concludes by discussing the implications of these findings and motivating future research on the characteristics of alliances that explain why they produce divisions of labor that vary in degree and in kind.

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2 Existing Explanations for Variation in the Distribution of Military Capabilities

Most recent research on military capabilities focuses on variation in the *size* of state militaries (Cappella Zielinski, Fordham, and Schilde 2017; Blankenship 2018). However, such research does not explain why militaries vary in their *composition*. Early discussions about the political determinants of a state's weapons development were framed around a debate between internal and external causes (Evangelista 1988). Theorists forwarding internal explanations argued that because there was no single authority for weapons development decisions (Allison and Morris 1975; Kossiakoff 1980), the composition of a state's military was determined by domestic factors like bureaucracy (Farrell 1997), constituency interests (Higgs 1988), or scientific R&D culture (Zuckerman 1982). In contrast, the external causes theorists argued that weapons acquisitions decisions were primarily motivated by a strategic response to foreign threats (McNamara 1967).

2.1 Internal Sources of Armament Decisions

Theories of internal sources of armament decisions have typically tried to explain weapons acquisition more generally, rather than identifying whether those weapons acquisitions are consistent with a specialized or diversified aggregate military portfolio. These theories examine factors like the economic motivation to support defense contractors (Kurth 1973), thus identifying the importance of the military industrial complex in shaping defense policy (Kotz 1988), although others believe this is limited by a regulatory environment that conditions lobbying efforts (Mawdsley 2018). Separately, re-election incentives may explain weapon developments that generate jobs or shore up nationalism (H. Smith 1988; R. G. Carter 1989) although there is disagreement about the empirical record (Lindsay 1991). Similarly, political

ideology and regime type may shape preferences for or against a particular military capability, as evidenced by trade protectionist support for battleship fleet development (Kehr 1975; Fordham 2019) and autocratic aversion to weapons that could be used in a coup (Brown, Fariss, and McMahon 2016).

More socially-driven domestic considerations point to the importance of non-state actors and incentives, but are less tied to the assumption of egoistic profit motivations and political self-interest. Instead, the weapons a state develops may be decided by scientists and technologists (Zuckerman 1982), although this perspective has been challenged by further empirical examinations of the same Cold War case studies (MacKenzie 1993; Spinardi 1994). More sociological theories have posited that status concern explains particular weapons acquisitions like high-technology aircraft or naval carriers (Eyre and Suchman 1996; Hintz and Banks 2022) but only in limited empirical cases.

2.2 External Sources of Armament Decisions

The dominant "external cause" explanation for why a state has the military capabilities it does concerns that state's international threat environment (Nordhaus, Oneal, and Russett 2012), meaning variation in states' distributions of military capabilities is explained by the perceived best response to security threats, subject to economic capacity (Resende-Santos 2007). One important implication of this neo-realist assumption about the self-help international system concerns states as like-units (Parent and Rosato 2015). States with similar resource endowments should have similar distributions of military capabilities even when they face a common enemy (Resende-Santos 1996; Goldman and Andres 1999). Waltz (1979, 127) argues that even where material capabilities differ, "contending states imitate the military innovations contrived by the country of greatest capability and ingenuity. And so the weapons of major contenders,

and even their strategies, begin to look much the same all over the world." States facing similar threats should have similar militaries because "contemplation of a common fate may not lead to a fair division of labor - or to any division of labor at all" (Waltz 1979, 165). Because states cannot resolve the problem of credibly relying on one another, the self-help nature of the international system should prevent states from being able to functionally differentiate their military capabilities by relying on each other. While there is "functional specialization - an intense division of labor" *within* states and other organizations, "[t]he same is obviously not true of international politics. There, power is distributed more equally than in organizations. Moreover, it is distributed to protect no group purpose. There is no functional specialization among states." (Posen 1984, 36–37).

Since the absence of an international sovereign makes cooperation under anarchy difficult, states try to maximize their security through a full-spectrum approach to defense where each states individually acquires the military capabilities they deem necessary (and feasible) for their national security. This optimal distribution of capabilities is assumed to be a diversified one because "each weapon, unit, and technique possesses a unique set of capabilities and vulnerabilities. Taking full advantage of these military assets increases the likelihood that an armed force will fulfill its mission" (Millett, Murray, and Watman 1986, 52). The historical record also finds this logic among practitioners, as "a synergistic mix of platforms and weapons intended to produce a force or more capability than that represented merely by the sum of its parts, has always been justified by the argument that it provides a wide range of responsive options" (Till 1994).

2.3 Unexplained Variation in the Aggregate Composition of Military Capabilities

While domestic politics influences many aspects of force structure like acquisition decisions, production capacity, and innovation patterns, the predictions they generate for the overall

composition of a state's military are less clear. These theories do not try to explain why, for example, states with an influential military-industrial complex would have highly specialized force structures or why we should expect states with divided governments or protectionist politicians to have a more or less diversified force. Similarly, while threats certainly condition what capabilities a state chooses to arm itself with, these theories do not explain the empirically observed decision by capable states to specialize their militaries by omitting or over-producing capabilities given their threat environment. They assume states are like-units that, holding economic capacity and geography constant, should converge in developing similarly diversified full-spectrum militaries. Sameness and diversification are theoretically assumed, but not empirically substantiated.

3 A Theory of Specialization Within Alliances

States face a constrained optimization problem where the set of resources available to accomplish a given task are finite. So when allocating resources to defense, decisions about the capabilities a state should possess involve a zero-sum balance between efficacy and efficiency. States can manage this trade-off by allocating resources toward many capabilities (prioritizing efficacy) or toward a few (prioritizing efficiency). States prioritizing efficacy invest in a diversified military portfolio because it reduces their overall vulnerability, but at a relatively higher economic cost. In contrast, a state prioritizing efficiency invests in a specialized military portfolio because it comes with economies of scale and improved integration, but at the risk of not having capabilities it may need.

Business organization research on inter-firm cooperation has identified a way to manage this trade-off (Gulati, Nohria, and Zaheer 2000). Strategic alliances with like-minded actors can minimize the otherwise zero-sum trade-off between efficacy and efficiency by allowing func-

tional specialization via a division of labor. When this occurs, states can overcome part of the constrained optimization problem by individually specializing (efficiency gains) while collectively diversifying (efficacy gains). Specialization by capable states is thus not a questionable prioritization of efficiency at the expense of efficacy by states choosing to forgo the security benefits of a diversified military, but instead an optimality made possible by architectures of international cooperation.

This theory is motivated by a common set of assumptions about rational social choices by states.[1] States are rational insofar as their preferences are transitive, their actions purposive, and their criteria for evaluating interstate relations is instrumental rather than innate (Frieden 1999). In assuming that states act rationally, I do not presuppose complete information. States still suffer unintended consequences and make mistakes given uncertainty about the state of the world, including the true underlying values of the variables of interest that they regard with some unknown probability distribution. While recognizing that state preferences "arise in the first place from bargaining solutions to problems of order" (Mattern and Zarakol 2016, 634), I remain agnostic about the origins of these preferences as I am not trying to explain where state preferences come from.[2]

3.1 Costs and Benefits of Specialization

To justify explaining variation in the distribution of capabilities, I first identify the costs and benefits of both ends of the dimension of interest - specialization and diversification - summarized in Figure 1. Although the benefits of military specialization initially seem like economic

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[1]For contrasting views on the benefits and drawbacks of assuming rational decision-making in the specific context of the economics of arms acquisition, see Sandler and Hartley (1999) and Fevolden and Tvetbråten (2016).

[2]For parsimony, I largely bracket the decisions and preferences of domestic actors and instead treat states as units with homogeneous preferences. Domestic considerations clearly play a role in state defense policy as an input into both the dependent and independent variable, but not in a way that invalidates the explanatory role of interstate relationships.

issues that should take a backseat to security considerations, the two are inevitably intertwined because a state's decisions about how to best provide for its defense occur within a constrained optimization environment. Thus, economically-conscious defense decisions impact how well a state will be able to provide for its security and how well various aspects of their defense portfolio work with one another during conflict. The three primary benefits of specialization stem from economies of scale, operational efficiency, and improved integration (Meier, Stephenson, and Perkowski 2019).
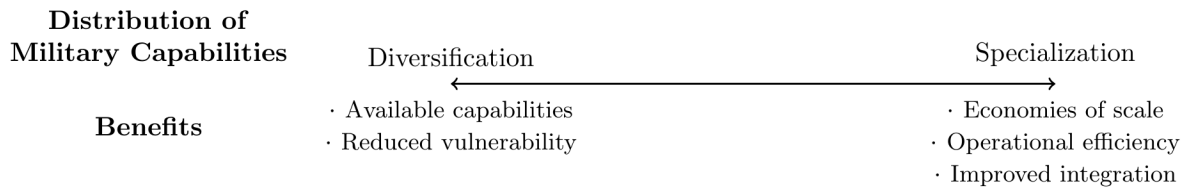
Distribution of Military Capabilities	Diversification	Specialization
Benefits	· Available capabilities · Reduced vulnerability	· Economies of scale · Operational efficiency · Improved integration

Figure 1: Varieties of a state's distribution of military capabilities.

First, the cost of setting up manufacturing and industrial plants as well as acquiring the materials for weapons acquisition often entail large up front investment. But the marginal cost of that investment goes down as a state decides to produce more of the same asset (Markowski and Hall 1998). For example, Germany has reduced the need for redundant infrastructure by centralizing car and light truck production all within the Bundeswehr-Fuhrparkservice GmbH which allows them to produce newer vehicles more quickly, although of less variety (Overhage 2013). This is still true for states that are primarily "arms buyers" as opposed to "arms builders", as maintenance and repair costs are reduced when there is a smaller list of components and end-use products involved. Economies of scales are also"active" in that they accrue as a state undertakes defense-related activities, so the more a state operates with a particular asset, the lower their marginal costs because of "learning by doing" (Postrel 2002).

Second, specialization allows a military to perform select missions more efficiently by stream-lining logistics and reducing the overall cost of learning how to use new equipment. Many assets require capability-specific investments that involve a fixed cost. A state with several

dozen different types of aircraft will require more complex pilot training than a state that only has to master the effective use of a few types of aircraft. One source of the internal debate over which NATO members should send main battle tanks to Ukraine concerns the Ukrainian military's familiarity with how those more complex systems work; they could immediately operate T-72 tanks sent from Eastern Europe, but training and logistics for the US Abrams tank would take months (Lanoszka and Becker 2023, 6–10).

Third, integration is easier as a country specializes since the complexity of integrating numerous types of platforms with various roles and responsibilities decreases. Even issues as fine-grained as the software used in various pieces of equipment are sufficient impediments to military operations that nations consider this issue carefully. NATO's Standardization Agreement (STANAG), for example, ensure broad fleet compatibility with the same fuel nozzle. Lest this seem like a story about NATO, in 2019 Jordan gave up its Chinese-built CH-4 drone fleet because successful integration with other platforms was going to require a costly overhaul of their communication systems (Penney 2020).

In contrast to specialization, the benefits of diversification manifest as the security gains of a full-spectrum military that makes combined arms warfare possible (Biddle 2005). States that engage in a full-spectrum approach to warfare instead of specializing benefit from having all the capabilities needed to defend themselves. No weapons system is perfect, and the nature of warfare means weapons systems that excel at one aspect of international conflict do so precisely because they lack other capabilities. Aerial bombers can sacrificed maneuverability so that they have carry a high payload. More maneuverable aircraft like fighters have to compensate for the benefits of speed and maneuverability with lower ordinate payloads in order to achieve those benefits.

Diversification also reduces vulnerability because failure to diversify makes it easier for the adversary to develop countermeasures. A state with a limited variety of military capabilities

has given their adversaries a shorter list of defense capabilities they must be able to defeat to prevail in conflict. Air defense systems, for example, come in three different varieties; surface-to-air missiles (SAM), anti-aircraft artillery (AAA), and aircraft armed with air-to-air missiles (AAM). These systems all differ in the altitudes they can target, stealth, reaction times, mobility, and cost. In a 1940 testimony before the Senate Appropriations Committee, General George Marshall noted the need for both aircraft and anti-aircraft artillery because the former is an area system that excels at searching while the latter is a point system designed to protect key assets. When asked by Congress which was preferable, he said "the whole thing is interwoven...all these matters have to be given proper weight to get a well integrated and balanced whole" (Hammel 2010). A state that has chosen to develop only one of these capabilities might have more in quantity (scale economies) and quality (operational efficiency and improved integration), but they are now vulnerable to the development of new missiles and aircraft designed to circumvent the strengths of their adversary's one air defense system.

States that have not embraced diversified militaries have consequently suffered. After the Yom Kippur war, Israel opted to specialize their military by cutting artillery and mechanized infantry in favor of a shift to pure armor-aircraft. This left them vulnerable to an anti-armor and anti-aircraft attack that set them back in the early stages of the 1973 war against Egypt. It was only after they reversed course that they were able to defeat the Egyptian air defense systems (Herzog 2018). Operating with a similar logic, India's primary defense planning document after World War II, the "Naval Plan Paper No. 1-Costs of Future Royal Indian Navy" (1947), also made the case for a "balanced naval task force" which was later clarified by Indian Vice Admiral W.E. Parry (1949) as "containing all types of ships and aircrafts, on the sea, over the sea, and under the sea" in a move to reduce India's vulnerability.

3.2 Individual Specialization Within Alliances

Given the relative costs of a diversified or specialized distribution of military capabilities, it appears the wise decision is to diversify as best as possible given an environment constrained by limited material resources. So, why do states specialize? In particular, why do some states consciously choose to forgo optimal defense simply to capture economies of scale? Doing so appears to be a decision to choose a sub-optimal defense posture that could be have been avoided. Specializing one's military is not sub-optimal if it is part of a cooperative division of labor that means a state gets access to a diverse range of military capabilities provided by allied states. After all, one way states can save resources in a constrained optimization environment is by sharing the production of international security with other states in a way that allows each state to allocate resources toward non-security functions (DiGiuseppe and Poast 2016). This can garner the security benefits of capability aggregation posited by the neo-realists as well as the economic benefits put forth by hierarchy theorists.[3]

A state's decision about whether to cooperate with other states over the ownership and use of security assets is a function of three factors - the gains from cooperation, the expected cost of opportunism, and the expected cost of coordination (D. A. Lake 1997). When the gains of cooperation exceed the expected costs of opportunism and coordination, they can specialize their militaries because cooperation means doing so does not sacrifice the benefits of a interstate diversified military force. Otherwise, problems of opportunism (Dekker 2004) and coordination costs (Oxley 1997) inhibit otherwise fruitful defense cooperation. The gains from cooperation include those previously outlined like economic benefits from economies of scale, political benefits from the efficiency gains of focusing on core competencies, and security benefits from

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[3]Auerswald and Saideman (2014, 229–33) also identify how specialization by alliance members can help individual states engage in cost-effective defense investments while maintaining an aggregate full spectrum combined-arms force, but reach the opposite conclusion in remaining skeptical that the risk of opportunism and cost of coordination can be adequately addressed. Their analysis is driven by European debates over the Smart Defence initiative that stalled due to fears that participating countries could refuse to participate in coalition warfare.

improved performance at particular security needs. The expected cost of opportunism is a function of the severity and likelihood of abandonment, entrapment, and exploitation (Snyder 1984). The expected cost of coordination concerns how much work is required to ensure the relationship achieves the expected benefits (Gulati and Singh 1998). When a state is confident they can rely on their allies for some defense capabilities and is willing to contribute their own capabilities to the defense of their allies, a state will specialize.

There are *gains to cooperation* in a security arrangement simply by virtue of having access to more resources. After all, one of the expected payoffs from developing relationships with similarly aligned states is the expectation that some aspect of your ally's military resources are available during war (Conybeare 1992). Ideally, the resource gains under cooperation would be more than the sum of its parts because there are scale economies in the production of defense through factors like standardization, repetition, fixed initial investment, and learning. Discussions in the US about a '1,000 ship Navy' are predicated on precisely this model; a navy that is "not a thousand gray hulls flying the American flag, but rather a voluntarily global maritime network that ties together the collective capabilities of free nations to establish and maintain a dramatically increased level of international security in the maritime domain" (Morgan and Martoglio 2005). Practitioners have recognized how having allies can foster focused specialization. US Naval Rear Admiral M. E. Smith (2013) noted that by having this cooperative approach, "each nation can avoid duplication and thereby reduce its proportional share of the expense. This is not simply about global maritime partnerships. It's about a focused and pragmatic approach to force allocation that acknowledges allies' existing contributions. Countries could immediately apply the freed resources to unique national missions for which a collaborative approach is impractical."

Concerning the *risk of opportunism*, both states must feel that mutual cooperation is preferred to mutual defection in cases where unilateral defection is preferred to unrequited cooperation

(Axelrod and Keohane 1985; Oye 1985). Otherwise, relying on another state that may renege when asked to contribute to your defense could seriously jeopardize a state's security. If this risk is seen as high, states should instead opt to produce security on their own. Opportunism via abandonment (shirking or buck-passing), entrapment (chain ganging), or exploitation can prove fatal to a state that depends on another for defense (Snyder 1984), especially if that dependence took the form of a specialization via omitting necessary defense assets. Avoiding this requires avenues for communication and routines for interaction that mitigate concerns about opportunism sufficient to encourage coordinated military strategies (Ikenberry 2001). Because relying on your partner to provide assets risks losing autonomy over the conduct of those assets during combat, there can be ambiguity about the effects of cooperation on a state's security goals (Morrow 1991). As Auerswald and Saideman (2014, 232) put it, "in alliance warfare, allies sometimes do not always show up when needed or they show up but are not able to do what is needed."

The *costs of coordination* are distinct from those incurred from opportunism (White 2005, 1385). While opportunism costs focus on uncertainty regarding your partner, coordination costs are about uncertainty regarding the task. You can have full confidence your partner will not act opportunistically if interests are perfectly aligned, but there still has to be coordination about who is specializing in what and a formal designation of roles. Despite this, international relations research on the problems of cooperation inspired by Williamson (1985) and the accompanying transaction cost framework have been less concerned with coordination costs, instead arguing that opportunism costs should be at the forefront (D. A. Lake 1996). Coordination costs may not be particularly salient in contexts where resources are simply pooled, but that is not the case in the security context (Overhage 2013). It is quite difficult to fight a war with another state's tools. In defense, "duplication of facilities, differences in requirements, coordination problems, lack of clear control and delays due to different budgetary systems all tend to increase the costs of collaborative projects" (R. Smith 1996, 69–70). Collaboration

requires communication, making adjustment in response to your partners actions. This is fundamentally an issue of information asymmetry, so creating a "common knowledge assumption" can induce and stabilize cooperation by reducing uncertainty about the other actor's payoffs structure and conveying one's own payoff structure to your partner (Gulati and Nohria 1992, 19).

In sum, seemingly sub-optimal force structures - those that omit useful defense capabilities and/or overproduce others - can occur when a state has opted to specialize its military portfolio. A state is more willing to do so when the security risks of specialization are no longer prohibitive; a condition that is made possible by alliance relationships that reduce those security risks. Under these conditions, alliances represent a means to deal with the constrained optimization problem by taking advantage of capability specialization made possible by shared production. Specialization is thus an outcome of security alliances because they promote a division of responsibility and function.

4 Empirical Analysis

4.1 Dependent Variable

The dependent variable is the degree of specialization of a state's distribution of military capabilities in a given year. A state's distribution of military capabilities is defined here as the combination of military equipment that could be used by a state during conflict. This includes platforms like artillery, aircraft, naval vessels, armored vehicles, satellites, and transport ships.[4] I choose these scope conditions because military platforms are equipment that can be deployed, that other nations are likely to observe, that could be used to signal intent and resolve in a

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[4]The data do not include munitions like single-use bombs or ammunition or firearms used by individual military personnel. Existing research has made similar distinctions in what military capabilities are examined cross-nationally (Brooks and Wohlforth 2016; Caverley 2021).

crisis without actual use, and that are durable goods. The index is constructed using the rDMC dataset, which details national military portfolios by providing annual counts of 69 different military platforms across all states from 1970-2014 (Gannon 2021).

To measure military specialization at the country-year level, I create an index quantifying the differences across states' distribution of military capabilities identified as omissions and over-productions relative to the neorealist baseline assumption that states behave as like-units under anarchy and should consequently seek similarly diverse military capabilities subject to resource constraints. Assume that global defense in year t is composed of N countries and M military technologies. I construct an $n \times m$ interaction matrix for each year t such that each row n is a country and each column m is a technology. Each cell thus represents the observed count of a given technology in that country-year's military. In aggregate, this can be represented as $d_j = \sum_{i=1}^{N}(p'_{ij} ln \frac{p'_{ij}}{q_i})$ where N is the total number of countries in that year, p_{ij} is country i's possession of technology j divided by the total amount of technologies j, and q_i is the total number of technologies possessed by country i divided by the total number of technologies in the world.[5]

From this, I calculate the functional entropy of each country's military using a trait-based similarity measure based on Rao (1982)'s quadratic entropy calculation of the average difference across technology portfolios between each country and all other countries in a given year weighting the technologies by their relative abundance (Pavoine et al. 2017). This calculates the functional entropy of a country's military as: $R(p_i, D) = \sum_{k=1}^{S}\sum_{l=1}^{S}\sqrt{(p_k|i)}\sqrt{(p_k|j)}d_{kl}$ where $p_i = (p_1|i, ..., p_k|i, ..., p_S|i)$ is the vector of relative technology abundance within country i; S is the number of technologies; $D = (d_k l)$ is the matrix of functional dissimilarity between the technologies, and $d_k l$ is the functional dissimilarity between countries k and l (Pavoine 2020).[6]

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[5]This bipartite network structure is modeled after its use in ecological research (Alarcón, Waser, and Ollerton 2008).

[6]As this measure of functional entropy is developed by Pavoine et al. (2017), its formula is provided verba-

To provide some intuition, this measure of entropy calculates the degree of surprise or unpredictability produced by the difference between the amount of a military capability we expect a country to possess and what that country actually possess. This prior expectation is based on the distribution of technologies across all other states and within the state in question. For example, if most states possess, on average, twice as many transport helicopters as they do transport aircraft, we would expect a state with 10 transport aircraft to have roughly 20 transport helicopters. But if the state in question already possessed many more transport aircraft than everyone else, we would update our expectation since we know a way this quantity differs from other states and other capabilities. Our expectation for transport helicopters can thus be *re*-calibrated based on (1) the number of transport aircraft this states possesses relative to everyone else's transport aircraft, and (2) the number of transport aircraft this state possesses relative its other capabilities. If we now reproduce this method across all other capabilities, we get a revised prior expectation for the capability in question - transport helicopters. The closer the observed quantity is to our final re-calibrated expectation, the less entropy the quantity produces, and thus the lower the level of specialization since producing many more or far fewer transport helicopters than the model expects are both indications that the state has specialized by omitting or over-producing that capability relative to expectation.

Figure 2 shows the distribution of this index across all observations.[7] Among the most specialized observations are the United States in the early 2000's and Japan after 2010. The least specialized states include the Baltic states in the early 1990's and Barbados. This may initially seem counter-intuitive. After all, the conventional wisdom holds that superpowers possess full-spectrum military forces (Dombrowski and Gholz 2006, 8). Yet practitioners think about a full-spectrum force as involving the ability to "prevail, quickly, and cheaply, in any and all forms of conflict" (Powell and Persico 2010, 157). This is not mutually exclusive with

tim. In the original statistical ecology application, this measure uses Hill (1973) numbers to measure the dissimilarity between biological species based on observed traits, accounting for the rarity of those traits.

[7]There is a small, statistically significant, positive temporal trend that is accounted for in the statistical models.

a form of specialization that emphasizes some capabilities over others. Capable states with full-spectrum militaries are still subject to constrained optimization and are unable to excel at all forms of conflict simultaneously (D. R. Lake 2012, 91). Given the number of submarines, frigates, and destroyers the US possesses, having roughly a dozen aircraft carriers but less than three minesweepers is an unexpected form of naval specialization. Making priorities is both a product of luxury and of necessity. So while the United States may dominate in many military capabilities, that does not mean its relative dominance is equal across the board. Similarly, having a diversified military is not synonymous with having a lot of everything. States can have very little of everything, making them similarly *in*capable across the board.[8]
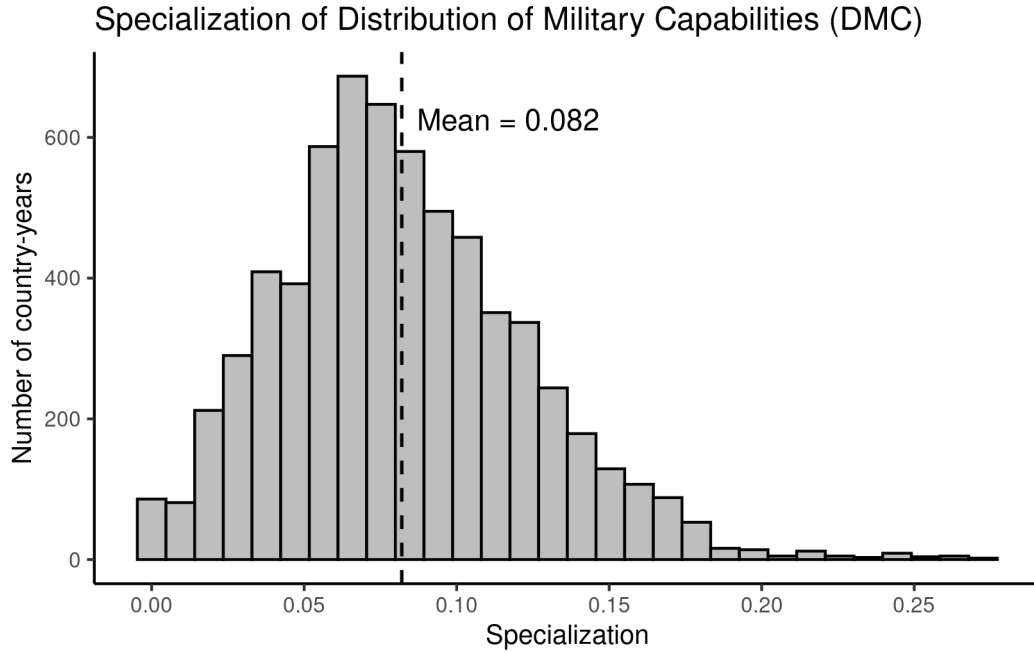

Figure 2: Distribution of the dependent variable (country-year military specialization). The measure is bounded between 0 and 1, with higher values representing higher specialization. 1 represents the highest theoretically possible level of specialization.

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[8]Nonetheless, these descriptive statistics identify the importance of the statistical model accounting for economic capacity to ensure the specialization index is not simply measuring the economic luxury of choice.

4.2 Independent Variable and Controls

The independent variable measures a state's alliance relationships. As most states have at least one formal treaty ally in a given year, existing research has modeled alliances as an independent variable by proxying for the importance of a state's allies to that state's security. I operationalize alliances at the country level two different ways; (1) as the logged sum of military spending of a state's allies (excluding itself) (DiGiuseppe and Poast 2016) and (2) the ratio between a state's CINC score and the sum of their alliance CINC scores (including itself) (Fang, Johnson, and Leeds 2014; Johnson, Leeds, and Wu 2015). For both variables, higher values indicate more important alliance relationships. These variables are both observable indicators of conditions conducive to military specialization because a state with more militarily capable allies should be more confident that specializing its military will not leave it vulnerable to threats because its allies will help provide for its defense. A state's allies are those with whom it has a defensive alliance pact whereby the partner state has made a promise to defend the state in question. Defensive alliances involve some form of structured defense cooperation through which states cooperate militarily or with defense capabilities beyond just mere coincidence. When a state formally agrees to defend another state in the event of attack, those states have a cooperative security relationship that suggests a mutual belief that the benefits of cooperation outweigh the risk of opportunism and the cost of coordination (Benson and Clinton 2016). Data on state participation in defensive alliance pacts is provided by the Alliance Treaty and Provisions (ATOP) data set, version 5 (Leeds et al. 2002).

I include a set of control variables that existing theories indicate could be causally related to the dependent and/or independent variables of interest. The models control for regime type, coding a country-year as a democracy if they score higher than 6 on the 21-point Polity V index. Democracies may build more capital intensive militaries because of casualty sensitivity (Gartzke 2001; Caverley 2014), spend less on defense (Fordham and Walker 2005), are generally

less likely to be involved in conflicts (Russett and Oneal 2000), and may be more or less reliable alliance partners (Gartzke and Gleditsch 2004; DiGiuseppe and Poast 2016). There is also a control for whether a country has been involved in an interstate war in the previous half decade, as states currently or recently engaged in conflicts may have different military capabilities than those not facing a salient military threat (Ghosn, Palmer, and Bremer 2004) and recent conflict experience may change patterns of innovation (Kollars 2015). The model controls for GDP, as resource-constrained states may be forced to specialize and may also be unable to replace labor with capital (Diehl 1994; Craig et al. 2018).[9] Finally, I control for CINC scores, as some states may harbor more global ambitions for which power projection capabilities are conducive and states with smaller militaries have greater incentives to specialize since the economic benefits of doing so are more salient (Markowitz and Fariss 2018).

4.3 Model and Results

The dependent variable is military specialization of country i in year j, measured with the functional entropy index described above. Higher values indicate more specialization and less diversification. As the dependent variable is a continuous measure, I estimate a series of ordinary least square (OLS) regressions. I estimate a series of models using the two different independent variables - (1) logged sum of allied military spending, (2) ratio of a country's CINC score to that of all its allies and itself. For each independent variable, I estimate a bivariate model then a model with all control variables plus temporal scaled cubic polynomials and country-clustered standard errors. Year scaled cubic polynomials appropriately account for temporal trends in specialization; technology evolves over time and militaries innovate; we should not expect the make up a state's military in 1980 to be composed of the same assets

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[9] Others question whether we empirically observed more specialization by states facing higher budget constraints. In the European context, many states have diversified their military portfolios despite the financial cost of doing so (Howorth 2007; Janning and Bauer 2007).

as 1990 (D. B. Carter and Signorino 2010). Country-clustered standard errors account for the non-independence between observations in panel data (Cameron and Miller 2015).

Table 1 shows the results of all four models. The results from Models 1 and 2 demonstrate that allied military spending is positively associated with military specialization with statistical significance of at least the 0.05 standardized level. Although allies' CINC ratio is negative associated with military specialization (Model 3), the inclusion of control variables and temporal dependencies (Model 4) reverses the association and provides results that are consistent with the other models and theoretical expectations. In aggregate, these results provides suggestive evidence that states that have militarily capable alliance partners have more specialized military portfolios - omitting certain capabilities and over-producing other capabilities - relative to states that are reliant upon self-defense. We present the OLS results here as they are most easily interpretable and consistent with modeling specifications in existing research with similar data (Brownlee 2019). Nonetheless, these results are robust to a series of alternate model specifications provided in the appendix that relax assumptions about the underlying distribution of the dependent variable and temporal and country-specific trends. Similar results are found using fractional logit and beta regressions, Bayesian zero-inflated and ordered beta regressions, and with alternate specifications for year-fixed effects and robust clustering of standard errors.

The relationship between alliances and military specialization is also substantively significant. Holding all control variables constant, a one standard deviation increase in allies' CINC ratio (independent variable in Models 3 and 4) is associated with a 1.4% increase in a state's military specialization; which is how much more specialized Japan's military became between 1982 and 2000. Despite what what is traditionally understood as a lopsided division of security responsibilities, US and Japanese security responsibilities have been purposefully divided (Ando 2015). Japan's 1982 capability realignment described in Section 1 signaled the start of a new

Table 1: Model results

	Model 1	Model 2	Model 3	Model 4
Allies' Mil Spend. (log)	0.003**	0.001*		
	(0.002)	(0.016)		
Allies' CINC Ratio			−0.045*	0.025*
			(0.022)	(0.035)
Democracy		−0.002		−0.0002
		(0.485)		(0.958)
Interstate War (5yr lag)		0.0009		0.002
		(0.879)		(0.674)
GDP (log)		0.012***		0.013***
		(<0.001)		(<0.001)
CINC		0.200		0.203
		(0.218)		(0.278)
Year		0.006***		0.006***
		(<0.001)		(<0.001)
Year^2		−0.0002***		−0.0002***
		(<0.001)		(<0.001)
Year^3		0.000 003***		0.000 003***
		(<0.001)		(<0.001)
Num.Obs.	4629	3900	4568	3900
AIC	−7330.0	−9104.1	−7079.8	−9067.4
BIC	22 468.3	15 287.5	22 265.1	15 324.2

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001
[a] All models include country-clustered standard errors.

era of coordinated military cooperation with the United States, with the joint communique issued by Prime Minister Suzuki and President Reagan (1981, 3) stressing "the desirability of an appropriate division of roles between Japan and the United States". Japan was entrusted with protecting its sea lines of communication (SLOCs) 1,000 nautical miles off its coast and providing logistical support to offensive US operations as needed. Figure 3 illustrates how one result of the alliance relationship was a more specialized Japanese distribution of military capabilities. Japan doubled its SAM and far-from-shore naval capabilities like destroyers and utility helicopters and significantly downsized its amphibious and coastal fleets. The alliance relationship with the United States allowed Japan to carry the "defensive shield" by specializing in capabilities for SLOCs and "rear-area support" while forgoing attack-capable surface ships and high-tech long-range aircraft where the United States excelled by serving as the alliance's "offensive spear" (Schoff 2014).
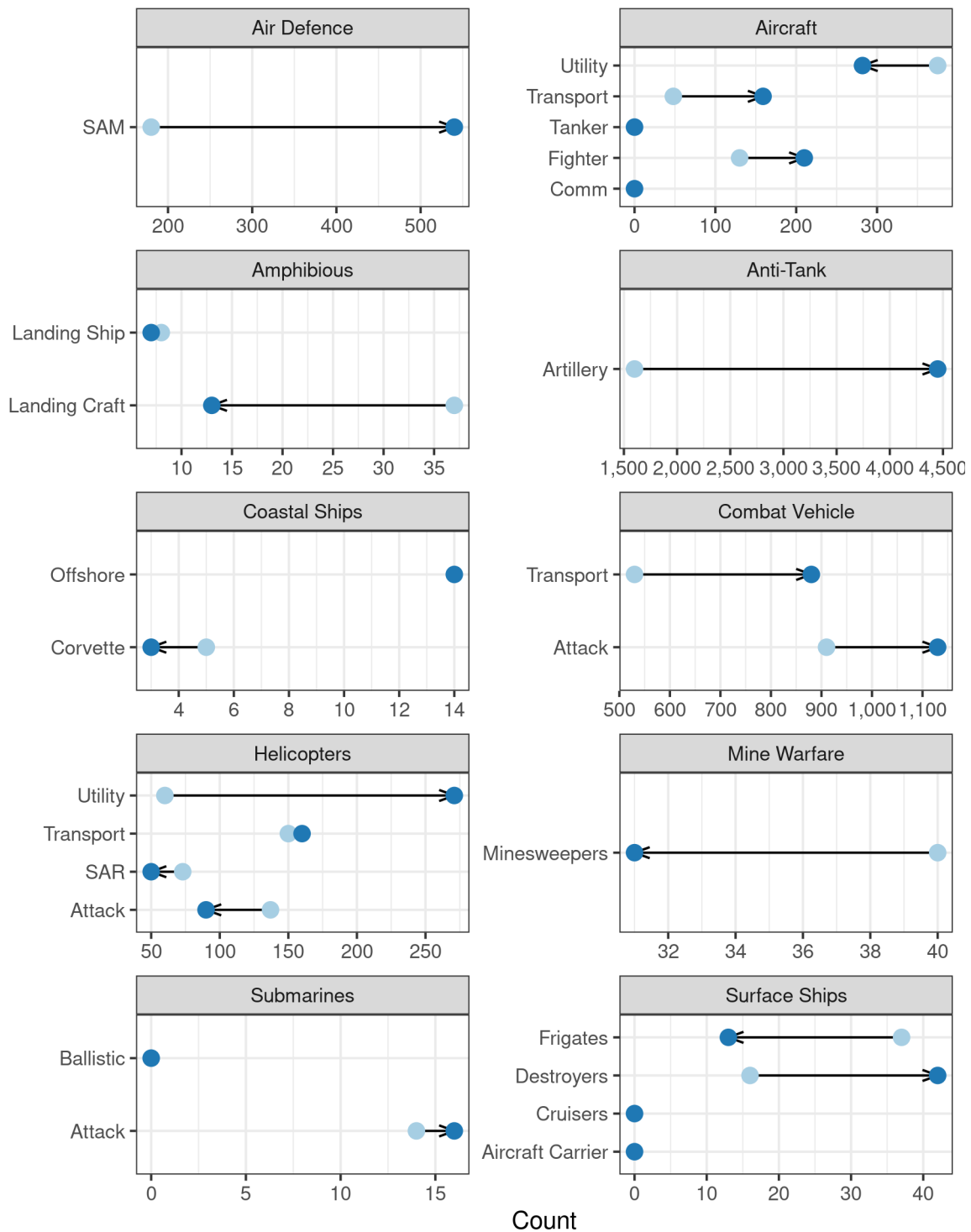
Figure 3: Change in Japan's distribution of military capabilities between 1982 and 2000. Capabilities Japan did not possess at any point during this time period (eg ballistic missiles and drones) are omitted.

24

5 Conclusion

"Make-or-buy" in the context of international security is better thought of as "make/buy-or-rely". States can "make/buy" and provide for their security on their own in the anarchic self-help international system or they can "rely" and pool resources with others. In relying on militarily capable allies, states may rationally opt out of diversifying their military. Even if states' fear of exploitation is most salient where survival may be at stake, military alliances can sufficiently manage uncertainty about cooperation under anarchy by providing gains to cooperation that exceed the expected cost of opportunism and coordination. In doing so states can specialize their own militaries, garnering specialization's efficiency benefits while minimizing its efficacy costs.

A shared production model of military capabilities does not necessarily run counter to conventional wisdom advocating military portfolio diversification; it simply represents a re-framing of the unit of analysis. Allies influence armaments. A state's security can be improved not just by their own defense efforts, but those of similarly aligned states (Yarhi-Milo, Lanoszka, and Cooper 2016). Without discounting the role that domestic and external threat considerations play in armament decisions, this paper's contribution is explaining how states differ in the composition of their military portfolios and the role that alliances play in explaining some of that variation.

Whether it is wise for states to omit or overproduce military capabilities on the basis of their alliance relationships is a separate question this paper has not tried to answer. Specialization may make states better off, since they can "take advantage of economies of scale in the provision of defense and to benefit from specialization by coordinating training, equipment, and procedures. By pooling their efforts and/or cooperating with states that have different comparative advantages, leaders hope to create a stronger joint fighting force (Leeds and Anac

2005, 185). On the other hand,"fear that the other will not live up to the terms of the agreement" (D. A. Lake 1996, 15) may be well-warranted and, importantly, consequential for how well a state fares when it actually comes time to partner together on the battlefield (Cranmer and Menninga 2018).

A few shortcomings in this paper provide avenues for future research. There are a variety of forms of governance that allows states to "rely" to different degrees and for different reason; the analysis here simply looks at defense pacts and operationalizes reliability in alignment with existing research. But differences in interest alignment, symmetry, and coercion across alliances may influence who specializes in what (Lanoszka 2013). Future work could investigate the characteristics of an alliance that are most conducive to this division of labor by looking at these factors as well as different types of security alignments like defense cooperation agreements (DCAs) (Kinne 2020), how alliance treaties are negotiated (Poast 2019, 174–75), long-term alliances versus temporary coalitions (Kreps 2011), and the number of alliance partners (Fordham and Poast 2016).

The insights here can help inform current debates about changing alliance relations and identify the consequences of allies trusting each other less than they used to. These debates often turn to the question about whether allies are contributing enough to the alliance. But by looking at *what* states are contributing to the common defense, rather than *how much* they are spending, new perspectives on burden sharing and the value of the alliance emerge (Gannon 2022). Japan's defense strategy has not remained static, and contemporary discussions about their increased militarization in response to Chinese, North Korean, and Russian threat have put the US-Japan alliance front and center (Cooper and Sayers 2023). On the European front, then US ambassador to NATO Ivo Daalder (2013) gave a speech in which he noted that the problem was not that NATO countries were not spending enough money on defense, it was that they were not spending that money wisely. In both cases, discussions surrounding the

US relationship with its allies has largely still concerned burden-sharing *costs* rather than burden-sharing *configurations*. An ally's defense spending matters because of what military capabilities they spend those resources on. If US allies feel confident they can rely on the United States, we should see them continue to specialize their militaries. Conversely, if US allies begin diversifying their military portfolios, that may be evidence that they are hedging their bets in seeking to defend themselves with a diversified full-spectrum force rather than counting on the United States to provide capabilities they are omitting.

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