Sanctions and Third-party Compliance with US Foreign Policy Preferences: An Analysis of Dual-use Trade*

Timothy M. Peterson
Arizona State University
tim@timothypeterson.org

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Abstract

Ostensibly bilateral US foreign policy actions, such as sanctions, can influence third-party compliance with US policy preferences. US sanctions simultaneously signal US preferences and demonstrate leverage, which can motivate third parties to avoid or change proscribed behavior proactively. Empirical testing of this strategic behavior typically is difficult given that it predicts non-events in a noisy signaling environment. However, I argue that the global trade of dual-use commodities—those with both civilian and military purposes—is a phenomenon where we can observe this process systematically. I isolate US sanctions that provide relevant context both by stigmatizing the target and signaling that third-party dual-use exports to the target would directly undermine US policy goals. Using newly-coded bilateral data spanning the post-Cold War period, I find evidence that relevant US sanctions are associated with lower third-party dual-use exports to US-sanctioned states. My findings have implications for scholars and policy-makers, suggesting a broad yet shrouded ability of sanctions to advance US foreign policy goals.

Introduction

The control of trade in dual-use commodities—those with both civilian and military uses—is a major aim of United States foreign policy.[1] Though geared primarily towards weapons of mass destruction (WMD) nonproliferation efforts, trade controls also hold implications for other contemporary problems such as terrorism, human rights abuse, and armed aggression. The commitment to control dual-use trade is codified in United Nations Security Council Resolution 1540, suggesting a broad consensus on—or at least lip-service to—this US goal. Yet compliance with export controls varies. The US departments of State, Energy, and Commerce aid non-proliferation efforts via international outreach, for example by providing less-resourced states with access to US expertise and training programs. While this US assistance could facilitate international compliance via capacity-building, compliance also depends on the willingness of states to institute export controls despite the fact that they could stand to lose out on lucrative export markets by doing so.[2]

In this paper, I explore the conditions under which US sanctions motivate third-party willingness to comply with export controls. I demonstrate that a synthesis of prior research on the strategic behavior inherent in the sanctions process (Drezner 2003; Krustev 2010), the third-party deterrent effects of sanctions (Peterson 2013; 2014; Miller 2014), the ability of sanctions to stigmatize targets (Peterson and Drury 2011; Biersteker 2015) and the emergent power of US financial sanctions (Drezner 2011; 2015; Farrell and Newman 2019) provides the theoretical grounding to explain how US sanctions could influence third-party compliance with a variety of

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[1] US leadership in dual-use trade control institutions demonstrates its continuing commitment to this issue. For example, the US took a leading role in the Coordinating Committee for Multilateral Export Controls (CoCom) during the Cold War. CoCom was aimed at preventing the export of sensitive technologies to the USSR and the Council of Mutual Economic Assistance (COMECON). A similar regime was formed with respect to China (ChinCom), but this was absorbed into CoCom in 1958 (Hufbauer et al. 2007, 11). Since the collapse of the Soviet Union, the US has maintained its leadership role in multilateral trade control regimes such as the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-use Goods and Technologies.

[2] The enforcement of export controls thus faces the same challenge that research has explored with regard to the enforcement of sanctions: better enforcement could result in reduced competitiveness of domestic firms (Bapat and Kwon 2015).

US policy preferences. I argue that dual-use trade is a phenomenon where one can observe third-party compliance across issues (Gartzke and Lindsay 2019) despite the challenges to inference inherent in empirical tests amid strategic behavior. US sanctions over actions such as nuclear proliferation, sponsorship of terror, militarized aggression, or human rights abuse inform third-party states of the US commitment to end these proscribed behaviors, stigmatize the target as a violator of international norms, and demonstrate US strength to punish individuals and states acting contrary to its preferences. Relevant context applies because US-sanctioned states can use dual-use commodities directly towards these proscribed ends. While third-parties might not restrict other commerce with sanctioned states (Early 2009; 2015), I argue that they would engage in lower dual-use exports to avoid the perception that they are directly thwarting US foreign policy efforts to deny sensitive commodities to prolific violators of international norms. There are two, complementary channels through which this process operates: a top-down mechanism where US sanctions motivate third-party leaders to enforce export controls, and a bottom-up mechanism where foreign firms perceive more risk and a higher cost of doing business associated with dual-use exports to US-sanctioned states.

I test my expectations using multiple sanctions data sources that incorporate country-based US sanctions programs as well as yearly tallies of entities included on the Specially Designated Nationals (SDN) list. I also create a concordance table linking dual-use commodities to the commonly-used and thus widely available Harmonized System commodity classification in order to identify the bilateral flow of dual-use commodities incorporating nearly all states over the post-Cold War years. Using error correction models, I find support for my expectations.

My argument and findings hold implications for scholars and policy-makers. Anti-proliferation efforts—like most US policy goals—require the compliance of states throughout the international system, particularly to deny regimes access to sensitive commodities and technology. I explore the impact of US sanctions beyond the sender-target dyad in order to provide evidence that the effects of sanctions transcend target policy concessions. This finding has important implications for the

broader understanding of how (rather than whether) US sanctions work (Baldwin 1985). The wide-ranging impact of ostensibly bilateral US sanctions is indicative of a potentially expansive yet shrouded ability of US foreign policy actions to influence behavior throughout the international system.

Finally, there is a pressing interest to improve our understanding of dual-use trade given the nefarious purposes for which dual-use commodities could be used by domestic groups as well as state leaders. For example, in the aftermath of the Assad regime's use of chemical weapons during the Syrian civil war, it came to light that German firms had exported diethylamine—a chemical with legitimate use in the production of pharmaceutical drugs that can also be used to produce nerve agents such as VX and sarin (Deutsche Welle News 2019).[3] The finding that third parties reduce dual-use exports to (some) US-sanctioned states suggests a positive impact of the policy tool on successful denial of sensitive commodities to US adversaries, improving security throughout the international system and potentially saving lives.

US sanctions and third parties: signals of preference and power

Academic inquiry into the effectiveness of economic sanctions has focused considerable attention on the question of whether and under what conditions sanctions successfully coerce target policy change (Hufbauer et al. 2007; Drury 1998; Pape 1997; Drezner 1999; Allen 2008; Martin 1993; Lektzian and Souva 2007; Bapat and Morgan 2009; Whang, McLean and Kuberski 2013; Early 2015). Perhaps the most important finding of modern sanctions research is that strategic behavior inherent to the coercion process creates a selection effect in which observed sanctions are those least likely to coerce target concessions because targets who fear sanction costs will acquiesce

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[3]These exports were in violation of EU restrictions on the export of materials useful to make chemical weapons without authorization.

before incurring them (Drezner 2003).

Although this finding has revolutionized the study of sanctions, it also raises the question of whether strategic behavior goes even further. Attention to the onset and outcome of sanction cases risks missing the fact that strategic target behavior could prevent sanction threats from originating if targets choose policies strategically in anticipation of the potential consequences. Assuming that states weigh the costs and benefits of a policy choice before implementing it, potential sanction costs are likely to enter into expected utility calculations. Even acquiescence to sanction threats could involve paying an audience cost (domestic and/or international) associated with backing down to a sender's demand (e.g., Lacy and Niou 2004). As such, target states who prefer to avoid or change behavior in order to ward off sanctions, and who expect sanctions to result from a given course of action, would not wait for a sender demand before altering behavior (Peterson 2014). In other words, while research has focused on the effectiveness of *explicit* sanction threats, we also must consider how *implicit* sanction threats influence behavior throughout the international system. The logic of sanctions thus parallels that of deterrence: behavior during episodes of immediate deterrence (a crisis during which sanctions are threatened or imposed) could affect the future stability of general deterrence throughout the international system, affecting the behavior of third parties who witness sanctions.

While conceptually straightforward, the identification of strategic third-party deterrence is more challenging given the potential noisiness of implicit threats associated with imposed sanctions.[4] However, research suggests that senders' previous behavior could serve as a useful summary indicator towards this end (Peterson 2013; 2014; Miller 2014). The potential for sanctions to signal sender disapproval widely throughout the international system has been discussed at least since Galtung (1967) and is implicit in their purpose dating back to the League of Nations. Yet

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[4]Research has explored conditions associated with stronger or weaker signals from sanctions, arguing, for example, that multilateral sanctions send stronger signals to potential protesters in the target state (Grauvogel, Licht and von Soest 2017). However, as I discuss below, what constitutes a "strong" signal could vary for different senders and audiences, particularly when considering linkage across issues.

early work was skeptical of systematic effects thereof (e.g., Lindsay 1986; Nossal 1989, 318). This pessimism likely resulted from its lack of theoretical nuance, particularly regarding how third parties' interpretations of international signals associated with sanctions—or any foreign policy behavior—depend on relevant context (Crescenzi 2007; 2018). Considering context explicitly, recent research has identified reputation effects where targets of US sanction threats update beliefs about US credibility after witnessing US behavior with respect to previous resistant targets (Peterson 2013). Studies have also found that imposed US sanctions over nuclear proliferation encourage some third-party states to avoid proliferation (Miller 2014), while US human rights sanctions can accelerate improved human rights practices, or at least forestall crackdowns, among third parties that are sufficiently similar to the sanction target (Peterson 2014).

The studies above demonstrate that US sanctions serve as international signals of US foreign policy preferences and the lengths to which the US will go to achieve its goals. The third-party deterrent effect of sanctions occurs when third parties who view themselves as similar to sanction targets fear that sanctions could follow from behaving like the sanction target. However, the scope of third-party reactions to US sanctions could transcend deterrence over the specific issue that originally led to sanctions. For example, previous research finds that some third parties seize on target weakness and pariah status associated with sanctions, leading to a higher incidence of militarized dispute initiation against sanction targets (Peterson and Drury 2011). Similarly (though focused on UN rather than US sanctions), research explores how sanctions could signal stigmatization of the target state (Biersteker 2015), which could influence third party behavior towards it.[5] However, previous research leaves open the question of whether—and under what conditions—US sanctions lead to broader third-party compliance with US foreign policy preferences.

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[5]These findings highlights a potential benefit of sanctions for senders beyond target acquiescence (e.g., Marinov 2005; Grauvogel, Licht and von Soest 2017; Heinrich, Kobayashi and Peterson 2017), which can in part explain why sanctions are used despite the low probability of coercing target policy concessions.

US sanctions, relevant context, and dual-use exports

Sanctions imposed against one country could result in increased third-party compliance with the sender's broader preferences if the third parties witnessing sanctions: 1) perceive themselves as vulnerable to the sender; and 2) update their beliefs that some action they might otherwise engage in could provoke the sender to exercise that leverage. Alternatively, if the imposition of sanctions stigmatizes the target (Biersteker 2015; Peterson and Drury 2011), third parties recognizing the normative legitimacy of the sender might respond by reducing cooperation with the target. For either of these mechanisms to apply, however, requires issue linkage, where third parties rethink relationships and planned interactions with states subject to sanctions. Given these stringent requirements, third-party compliance with the sender's foreign policy preferences could be rare and difficult to identify. However, I argue that we can systematically identify this mechanism by narrowing the scope to US sanctions over internationally salient (primarily security) issues and subsequent third-party dual-use exports to sanction targets.

First, the US is an international leader that continues—albeit with some variation across administrations—to expend resources to reinforce international security norms such as the non-proliferation of nuclear weapons, counter-terrorism, peaceful dispute resolution, and support for democracy and human rights. US sanctions over these issues can stigmatize targets as prolific violators of these widely shared international norms.[6] Additionally, essentially all states are vulnerable to US coercion (Drezner 2011). The emergence of the specially designated nationals (SDN) list has facilitated punishment with greater precision, extending relevance of US sanctions beyond the state level to firms and individuals. Extra-territorial provisions and secondary sanctions—notably employed against Iran and North Korea—demonstrate the growing reach of US power to states and firms who engage with US adversaries. Indeed, despite potentially diminishing hegemony,

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[6]Ikenberry (2011) refers to the US as a liberal hegemon, which pursues consent as well as coercion to enforce its preferences for international order. US sanctions likely influence third-party behavior through both of these channels.

the ability of US to pressure third parties to avoid commerce with sanctioned states has actually increased in recent years, particularly in the aftermath of 9/11, as US policy-makers learned of the considerable advantage afforded to the US by its central position in the global financial system (Drezner 2015; Farrell and Newman 2019). In short, the United States is unique in having both the willingness and opportunity to enforce its preferences internationally.

Second, I focus on the phenomenon of dual-use trade to get traction on third-party compliance because dual-use exports to states sanctioned by the US over issues such as nuclear proliferation would directly enable that proscribed behavior, directly undermining US foreign policy goals. As such, I contend that the issue of dual-use trade is linked to a number of issues over which the US commonly uses sanctions. The US has demonstrated consistent support for international controls of dual-use commodities including materials used in WMD or weapons delivery (e.g., rocketry), as well as high tech equipment—particularly computers and communications technology.[7] This US commitment should manifest most strongly towards (at least some of) its sanction targets, for which denial of sensitive materials and technologies is paramount (Rosenberg et al. 2016). Accordingly, third parties considering the export of dual-user commodities to a US-sanctioned state are more likely to infer that such behavior would empower an international pariah and potentially provoke a negative US response.[8]

Importantly, third parties will not reevaluate potential dual-use exports to the target following the imposition of just *any* US sanction. The US sanctions most likely to be linked to dual-use trade by third parties include those involving aggressive (in many cases militarized) target behavior. Yet, many US sanctions as coded in the Threat and Imposition of Economic Sanctions (TIES) data (Morgan, Bapat and Kobayashi 2014) are little more than escalated trade disputes. Though third-parties might learn from these episodes that the US vigorously defends its trade

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[7]According to Tucker (2010), bio-technologies are likely to become increasingly open to both civilian and militarized use, and as such compose the emergent frontier of dual-use policy.

[8]This logic is an extension of the arguments in Miller (2014) and Peterson (2014). In this case, vicarious learning by third parties (Crescenzi 2007; 2018) occurs across domains (Gartzke and Lindsay 2019), as dual-use trade is relevant for US deterrence over a variety of security issues.

interests, application of the lesson would likely be limited to the state's own trade relationship with the US. Other potentially less important, "low politics" issues include demands for environmental protection and financial reform. Third-party states might infer that they should avoid the kind of behavior that led to US sanctions, but it is unlikely that they would view their own dual-use exports to the sanction target as thwarting US security goals, nor would these sanctions sufficiently stigmatize the target that third parties would reconsider exports of sensitive commodities.[9]

Other sanctions issues are more clearly linked to dual-use exports. Nuclear proliferation—or WMD proliferation more broadly—provided the original impetus for export controls. Sanctions over proliferation likely send the clearest signals to third parties that the US disapproves of dual-use exports to its sanction targets because such trade could directly support the target's proliferation efforts. But other issues also could prompt this perception. For example, support for terrorism could at least indirectly contribute towards proliferation of WMD or conventional arms. Armed aggression is relevant given that the international community generally prefers to deny militaristic states easy access to goods and technology that might facilitate continued warmongering. Human rights abuse, particularly when conducted as part of a campaign to defeat rebel groups during civil conflict, similarly could provoke concern for proliferation of materials associated with oppression. Beyond the specific issue, the comprehensiveness of US sanctions likely affects the strength of the signal that other states witness. I contend that more substantial economic restrictions—trade embargoes and particularly financial sanctions and other targeted sanctions that matured in the post 9/11 period—will provide a stronger signal of how severe a response the US considers the target's behavior to deserve, while also demonstrating the long reach of US leverage (Drezner 2011).[10]

There are top-down (i.e., state-centric) and bottom-up (i.e., firm and individual-centric)

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[9]Narcotics trafficking is a gray area. In one sense, drug trafficking is merely a black market and might not link to the issue of dual-use trade. However, research finds that arms traffickers tend to follow in the footsteps of drug traffickers, making use of the infrastructure developed by the former (Griffiths and Jenks 2012).

[10]Relatively limited sanctions, perhaps most notably restrictions only on the sender's own imports from the target, would likely prevent linkage of the sanction by third parties to their own dual-use exports to the target.

mechanisms through which dual-use exports originate—and thus through which US sanctions programs could influence third-party dual-use exports to the sanction target.[11] At the state level, relevant US sanctions will underscore the broader US commitment to promote trade controls for dual-use commodities. Indeed, all UN members—essentially all states in the system—are legally bound by UN Security Resolution 1540, which states that "all States shall take and enforce effective measures to establish domestic controls to prevent the proliferation of nuclear, chemical, or biological weapons and their means of delivery, including by establishing appropriate controls over related materials" and, specifically "[e]stablish, develop, review and maintain appropriate effective national export and trans-shipment controls" towards this end.[12] Previous research demonstrates that compliance with this mandate varies as a function of state security concerns (Fuhrmann 2008; 2009; Kroenig 2010). I assume that states export dual-use commodities because they stand to profit by providing highly-demanded goods, which provides leaders with revenue as well as security in office. While the existence of legitimate civilian purposes for dual-use commodities lends exporting states plausible deniability that such goods would actually be used towards proscribed ends (Fuhrmann 2009, 182), the imposition of US sanctions should inform leaders both that the target is a pariah acting contrary to widely-shared international norms, and that the US is scrutinizing transactions with a given target. I contend that third-party state leaders will recognize that exporting dual-use commodities to a US-sanctioned state could enable continued proscribed behavior by a stigmatized state, and in some cases could provoke US

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[11]I focus on the consequences of imposed US sanctions for a few reasons. First, mere threats of sanctions might send less clear information to third parties (Peterson 2013). Second, sanction threats, particularly if the target backs down before imposition, would likely not stigmatize the target as a major violator of international norms, such that third parties would be less likely to reconsider dual-use exports to the target.

[12]A number of US agencies work to increase compliance with export controls primarily via the carrot of capacity-building. For example, the State Department's Export Control and Related Border Security Program (EXBS) provides technical assistance, training, and outreach. The Department of Energy aids in the procurement of materials and prevention of smuggling. The US Bureau of Industry and Security (BIS), which enforces U.S. export controls, aids in international corporate compliance (Arnold and Salisbury 2019). Previous work by Solingen (2012) shows that sanctions are most effective when combined with positive inducements. Training and outreach could serve a similar role with respect to my third-party causal mechanism. These inducements could complement the more coercive function of US sanctions.

retaliation that would threaten their own security. As such, states should increase enforcement of export controls against the targets of US sanctions.

Complementing the state-centric mechanism, US sanctions programs could influence third-party dual-use exports to target states through a bottom-up mechanism centering on the perceptions of firms and individuals. To the extent that US sanctions incentivize state enforcement of export controls, domestic actors would adjust their behavior to avoid violation of stricter standards.[13] However, domestic actors also should recognize direct, US-imposed consequences that they could face for violating US sanctions. According to Early and Preble (2020), the US has massively expanded international enforcement of its sanctions via large penalties on foreign firms that have engaged with US-sanctioned entities. For example, US legal action against the Chinese company ZTE for building telecommunications networks[14] in Iran and North Korea in violation of US sanctions led to a $1.2 billion civil penalty. Third-party firms should reduce dual-use exports to US-sanctioned states to avoid similar punishment. Accordingly, firms and individuals in a third-party state who are considering exporting dual-use commodities will recognize a higher cost of doing business with the targets of US sanctions. The argument above leads to my first hypothesis:

Hypothesis 1 *Bilateral flows of dual-use commodities will be lower in the presence of comprehensive US sanctions programs against the importing state.*

Beyond country sanctions programs, the United States Office of Foreign Asset Control (OFAC) regularly adds entities to the SDN list. Entities on the SDN list have all assets blocked; and US citizens and residents are largely prohibited from doing business with them. While in principle both the top-down and bottom-up mechanisms as described above could lead to reduced third-

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[13]Alternatively, one might expect sanctions merely to shift economic activity to the informal economy (Early and Peksen 2018). However, there is considerable risk with black market activity suggesting that not all commerce lost to formal economies would be replaceable. Further, in the case of Iran, there is some evidence that the multilateral sanctions harmed the informal economy more than the formal economy (Farzanegan and Hayo 2019).

[14]High tech equipment—particularly computers and communications technology—has emerged as an increasingly important subset of dual-use commodities (Tucker 2010).

party dual-use exports to states with a greater number of SDN entries, the bottom-up mechanism is particularly relevant as the SDN list informs sub-state actors in third-party states that the US is scrutinizing transactions at the firm, organization, or individual level. In addition to facing civil or criminal penalties for violating US sanctions against a specially designated national, domestic actors risk themselves being added to the SDN list, which would be massively detrimental to their ability to engage in *any* international commerce. The more entities listed on the SDN list from a given state, the more third-party domestic actors will be aware that the US is focusing on that specific state even in the absence of a country sanctions program. Firms and individuals could therefore perceive a higher risk associated with dual-use exports to states with more entities on the SDN list.

SDN entries could facilitate a faster reduction in dual-use exports by sub-national actors in third-party states than would the imposition of a country sanctions program. While US adoption of a country sanctions program might lead third party governments to consider strengthening enforcement of trade controls, it would likely take time for such practices to be adopted. Some third-party firms might attempt to increase dual-use exports before heightened enforcement begins, enabling stockpiling by the US sanction target (e.g., Afesorgbor 2019). Conversely, when a firm is targeted directly by the US and added to the SDN list, third-party firms will recognize that their own trade could be scrutinized at any moment. Firms in third-party states thus might adjust their behavior more quickly. My second hypothesis follows from this argument:

Hypothesis 2 *Bilateral flows of dual-use commodities will be lower in the presence of more SDN entities based in the importing state.*

Research design

To test my hypotheses, I code data on global bilateral dual-use exports in the post-Cold War period, and consolidate a variety of data sources to code indicators of contemporary US sanctions. My unit of analysis is the directed dyad year where state 1 is the exporter and state 2

is the importer. However, I omit the United States from the analysis (as exporter or importer) given my focus on third-party informing effect of US sanctions.[15] Data constraints limit years covered to 1995 (due to commodity trade data availability) through 2014 (due to control variable availability). However, the appendix presents models with fewer control variables that add one additional year (2015) to the analysis.

Estimation

While I expect US sanctions to influence third-party dual-use exports, the timing of such effects is not entirely clear. As noted above, to the extent that US sanctions stigmatize the target, it might take time for third party states to incorporate this information. Firms in these third-party states might attempt to take advantage of closing windows of opportunity to export dual-use commodities. Accordingly, I estimate error correction models in order to test my hypotheses while accounting for a potential equilibrium relationship between the volume of dual-use trade flows and the propensity of importing states to face US sanctions.[16] The ECMs estimate short- and long-run changes in dual-use trade flows associated with variation in US country sanctions programs and SDN entries against the importing state, allowing the data to determine the rate at which changes to the equilibrium relationship occur. The ECM can be written as:

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 \Delta x_t + \beta_3 x_{t-1} + \epsilon_t$$

Δy_t is the one-year change in the dependent variable; y, is its one-year lag. Δx_t and x_{t-1} denote the change and one-year lag of the explanatory variable, respectively. The coefficient β_2 records the immediate impact of a change in x on y. The long-run impact of a change in x is calculated as $\frac{\beta_3}{\beta_1}$; and this change occurs at a rate denoted by (the absolute value of) β_1 (De

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[15]The appendix presents models examining US exports given the interesting comparison with my primary results.
[16]All models are estimated in R version 4.0.2.

Boef and Keele 2008).[17] All ECMs are estimated using ordinary least squares.[18]

Coding bilateral dual-use commodity trade

Dual-use trade data are not widely available in an accessible format.[19] In a previous study, Fuhrmann (2008) uses data on US dual-use commodity exports by destination state aggregated over 11 years, obtaining these data from the Bureau of Industry and Security.[20] In order to obtain dual-use export data across all exporters and importers, I identify dual-use commodities at the Harmonized System 6-digit (HS6) level, a useful level of disaggregation by which states report trade values to the United Nations. Towards this end, I use a concordance table available from the European Union.[21] It matches EU export control numbers (ECN) to EU 10-digit commodity codes. The first six digits of these codes are the universally-shared HS-6 classifications. In some cases, the 10-digit codes further distinguish the HS-6 value, though many EU-10 codes do not; 491 of 1,213 unique 10-digit codes merely add 0000 to the HS6 code and thus offer no further disaggregation; and in no case does the EU-10 code add more than two non-zero digits to the HS6 code.

By considering all HS-6 codes that match to any EU10 code as dual-use commodities, I could risk over-estimating the flow thereof if an HS-6 code incorporates other, non-controlled

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[17] For an ECM to be appropriate, β_1 should fall between -1 and 0, which does occur in all the models presented in the main text and appendix.

[18] Results are robust to generalized least squared models that incorporate an AR1 residual structure; I present these models in the appendix.

[19] It is important to note explicitly that dual-use export flows are indirect measures of compliance with export controls. Cross-national information on domestic enforcement would be considerably more difficult—likely impossible at this time—to obtain.

[20] These data appear no longer to be available from BIS. Data availability could vary over time. At the time of writing this manuscript, BIS has made available via the internet limited US dual-use export data over the 2014-2018 period.

[21] Specific commodities facing export controls can differ somewhat across states (typically with the US enacting broader restrictions). As such, it might be problematic to use US Export Control Classification Numbers (ECCN) to HS6 commodity codes because not all states would agree that each commodity requires export controls. The use of the EU concordance table is thus practical (given preexisting availability) and theoretically justified in that most states would agree at least in principle that the identified commodities should be subject to export controls.

commodities.[22] However, as noted above, in many cases there is no further distinction. Perhaps more importantly, my broader classification might be useful because it highlights commodities quite similar to those that are explicitly export controlled as also potentially dangerous. For example, graphite of a certain purity is considered "nuclear grade" and thus falls under the dual-use classification. Yet less pure graphite might be imported and then refined locally to get around dual-use commodity rules. The HS-6 code 250410 broadly covers all graphite "in powder or in flakes." Conversely, individual state tariff schedules typically classify further. For example, the US Harmonized Tariff Schedule code 25041020 identifies "amorphous" graphite, which is cheaper but has many impurities; and code 25041010 identifies "crystalline" graphite, which is more expensive but has far fewer impurities.

Using data at the HS-6 level from the Atlas of Economic Complexity (AEC) (The Growth Lab at Harvard University 2019),[23] I sum to the directed dyad-year level all HS-6-level trade flows that match an ECN. Notably, I code only commodities with specific dual-use classification numbers. Export licenses could be required in other instances. For example, the US requires licenses for essentially all exports to countries listed on its list of state sponsors of terror. According to Fuhrmann (2008), approximately 3% of US dual-use exports (5.6 billion out of 187 billion) over the 1991-2001 period were classified EAR99—i.e., subject to export controls despite a lack of commodity code classification. Though I miss these flows, the small proportion of dual-use trade falling under EAR99 suggests that my results should not be biased.

I use a logged indicator of dual-use exports from state 1 to state 2, in 2005 US dollars. My first dependent variable is coded as a one-year change (from t-1 to t); and I also include the lagged value as an explanatory variable (for year t-1) in accordance with the ECM specification.

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[22] While my concordance strategy is useful for my purposes, the fact that it likely introduces false positives into the identification of dual-use trade renders it less suitable beyond research purposes. I would not recommend that BIS officials use these data for the definitive identification of dual-use exports.

[23] The AEC data clean up UN Comtrade data, in particularly making import and export flows more directly comparable on a single scale, reconciling deviations between exporter and importer reports. Results are consistent when I use raw Comtrade data (downloaded in January 2018).

Figure 1: Top-200 bilateral dual-use trade flows (2005). Note: larger red dots indicate exporter; smaller black dots indicate importer; black within red indicates that the state is both an exporter and importer

Figure 1 illustrates the largest 200 bilateral flows of dual-use trade for the year 2005—a useful year for illustration given that existing sanctions data sources as well as the new ones I code are available. While relatively few states dominate these top-200 flows, the data show that all 192 states in my data export at least some dual-use commodities, though not to all dyadic partners. The figure shows that, while most states dominating these top-200 flows are both exporters and importers, states such as Iran, Turkey, and India are present among these largest flows only as importers. Figure 2 presents another view of the top-200 dual use trade flows. This chord diagram illustrates the size and direction of these largest flows across the 43 states involved. Although Figure 2 lacks visualization of geographic patterns, it shows the relative level of participation among states engaging in the top-200 dual-use trade flows. The appendix presents additional summary statistics.

Further, to provide additional evidence that my findings are not spurious, I code a second indicator of dual-use exports relative to non-dual-use exports. Previous research casts doubt on
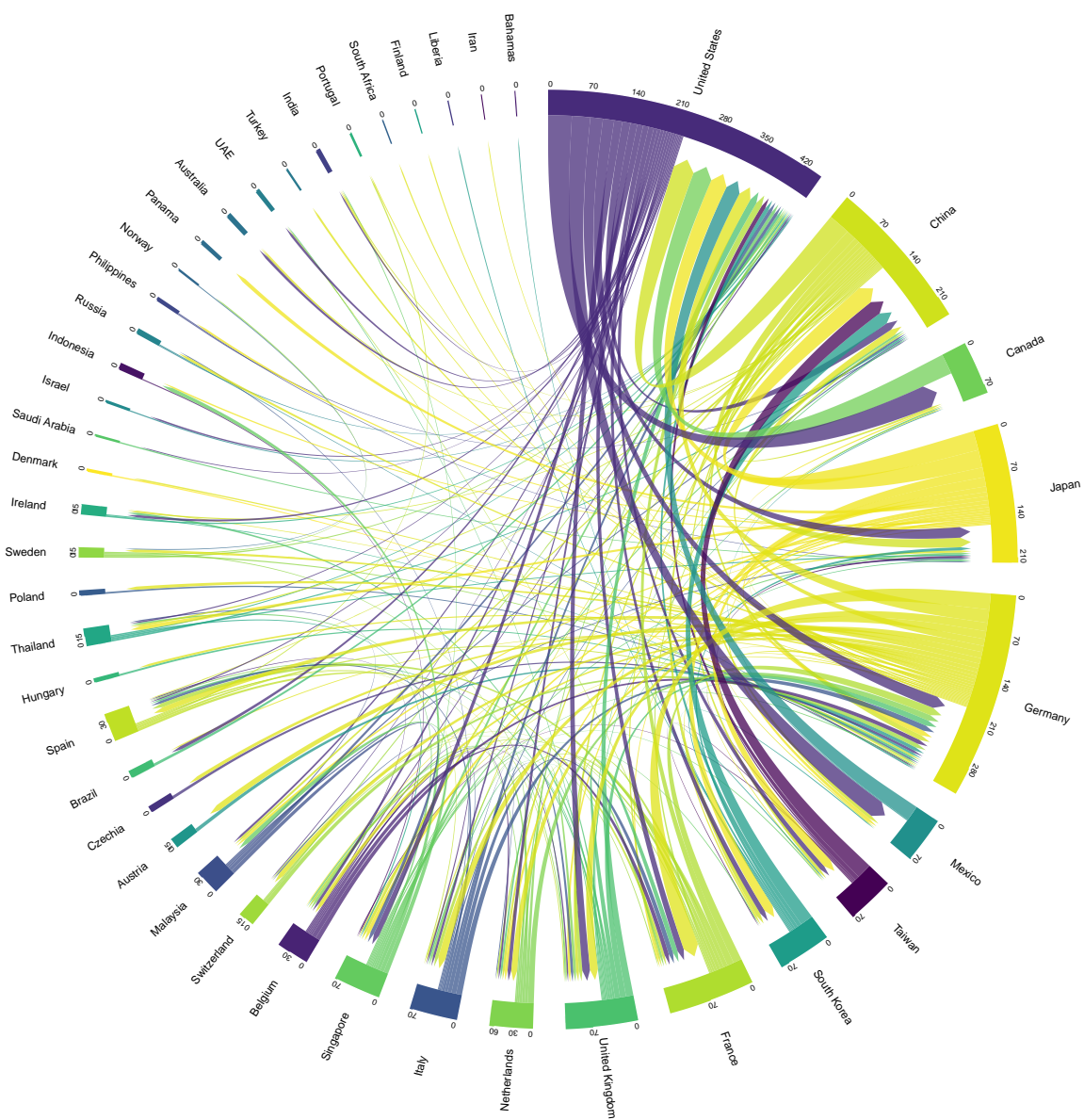
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Figure 2: Top-200 bilateral dual-use trade flows in billions of US dollars (data from 2005). Note: arrows point from exporter to importer; and chord lengths indicate each state's proportion of top-200 trade flows by value

the prospect that US signals of disapproval will lead broadly to decreases in third-party economic engagement with US-sanctioned states (Early 2009; 2011; 2015; Whang, McLean and Kuberski 2013). But while any trade might enrich a US-sanctioned state, dual-use trade is unique because it could contribute directly to military capacity, including the development of nuclear, chemical, and biological weapons and the ballistic missile technology needed to deliver them. Accordingly, by examining changes in dual-use exports relative to non-dual-use exports, I can provide stronger evidence specifically for my hypotheses against the alternative possibility that the class of states facing US sanctions import less of all commodities. I code this alternate variable as the difference between a logged indicator of dual-use exports and the value of logged non-dual-use exports.[24] Once again, I include both the change and lag of this differenced variable in ECMs.

Primary explanatory variables: identifying contemporary US sanctions

My primary explanatory variables code the presence of US sanctions against importing states. I use several different data sources to code the presence and extent of US sanctions by target through 2018.[25] Given these alternate measures of US sanctions, which cover different time periods, I run three different sets models as described below.

First, using the Threat and Imposition of Economic Sanctions data (Morgan, Bapat and Kobayashi 2014), I capture US sanctions over issues most likely to be linked to dual-use exports. I thus *exclude* the following issues: "deter or punish drug trafficking practices," "trade practices," "improve environmental policies," and "implement financial reform." These "low politics" (Drezner 2003) sanctions likely would not be linked to the issue of dual use trade by third parties. I further distinguish relevant sanctions as those that are sufficiently comprehensive in terms of

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[24] This difference in logged values is mathematically equivalent to the log of the ratio of dual-use exports to non-dual-use exports. This operationalization also preserves linearity as values in theory could span from negative infinity (0 dual-use trade) to infinity (0 non-dual-use trade).

[25] Given my theoretical focus on the US, and particularly given challenges obtaining comprehensive data, I do not consider sanctions by third-party senders. However, the appendix includes several models incorporating third-party and multilateral sanctions. My primary results are robust.

economic ties that are restricted. Embargoes (whether total or partial) and blockades, along with in asset freezes (a bilateral predecessor to modern US financial sanctions) are the most serious based on theory and evidence. Notably, I exclude import (to the sender) restrictions as relevant sanction types because it is not clear that third-parties would link these to their own exports to the target.[26] This indicator is available through 2005. I include both the change and lag of the TIES indicator in ECMs.

In order to examine more recent dual-use exports, I code US sanctions since 2001 using a table within a recent report from the Center for a New American Security (Rosenberg et al. 2016).[27] Unlike the TIES data, these CNAS data do not include cases of arguably "low politics" issues.[28] As such, in separate models, I use all country-based CNAS sanctions rather than distinguish for relevance as I do with TIES. However, the (updated) CNAS data are available for relatively few years (2001-2018, of which I can use only through 2014, coding both a change and lag to use in ECMs). Accordingly, as a robustness check, I also code more recent US sanctions using events data from the International Conflict Early Warning System (ICEWS), which uses a proprietary algorithm to scrape media stories (Boschee et al. 2015). ICEWS records imposition and easing of sanctions, along with respective threats or promises thereof. In many cases, ICEWS records multiple instances of sanctions imposition surrounding a country sanctions program, possibly due to repeated media mentions. I count the mentions of US imposed and eased sanctions by target-year to determine whether sanctions against a country exist in a given year, creating a cumulative measure of net ICEWS mentions of sanction impositions (less easing) over time in order to generate a yearly indicator of sanctions presence.[29] Unfortunately, distinguishing

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[26]The supplemental appendix presents models that include an additional variable for "minor" sanctions—those left out of the above coding. Results for my main variables are consistent, while minor sanctions appear either to have no association or a positive association with dual-use exports.

[27]I update the data provided in the report, which was released prior to the end of sanctions programs against some states, e.g., Sudan in 2018.

[28]These data also exclude some cases that began prior to 9/11/2001. For example, CNAS records sanctions against Iran beginning in 2010, whereas the US has imposed sanctions since the 1979 Revolution and hostage crisis.

[29]I count instances of code 163: "Impose embargo, boycott, or sanctions" where the source actor is the US

broad and thus relevant sanctions via issue and sanction type is not possible using these data. However, I take an alternate approach stemming from variation in the frequency of net mentions of sanction imposition, under the assumption that more comprehensive sanctions will receive more attention in the media stories scraped by the proprietary ICEWS algorithm.[30] I code years where net cumulative sanctions impositions are greater than or equal to the mean plus one standard deviation as relevant.[31] This indicator covers 1995-2018, though I can use only 1995-2014 in my models. Again, I include both the change and lag of this variable.

To test hypothesis 2, I also code the (logged) count of entities within the importing state that are on the US Specifically Designated Nationals (SDN) list each year.[32] Specifically, I code a cumulative count of all SDN additions and removals from 1994 to 2018. The final count of SDN entities for a particular importing state in a given year is the cumulative sum (since 1994) of additions less the cumulative sum of removals. Once again, it is critical to identify relevant sanctions that would influence state behavior regarding dual-use commodities. Many SDN entries fall under anti-narcotics sanctions programs (specifically, Foreign Narcotics Kingpin Sanctions and Narcotics Trafficking Sanctions). Including entities classified within the these programs could introduce error given that it is unclear that third-party states would view such sanctions as a signal with respect to dual-use exports. Indeed, including these programs leads Mexico and Colombia each to have more than 300 entries on the SDN list, falling into the top

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government and the target actor is the target state or government. I also count code 085: "Ease economic sanctions, boycotts, or embargoes" in order to determine if sanctions are ongoing in a given year (Raytheon BBN Technologies 2015). For years where it is unclear whether sanctions exist, I further consider sender refusal to ease (code 1244) and sender expressions of intent to ease (code 354), both of which indicate that sanctions are in place.

[30] I used the period of overlap between TIES and ICEWS (1991-2005) to confirm that, in a given target-year, the average net imposition in ICEWS is dramatically higher for the subset of TIES cases that I categorize as relevant.

[31] I choose this cut-point because most TIES minor sanctions fall below it, while most TIES major sanctions fall above it. The appendix presents additional models with a variety of alternate specifications for the ICEWS variables; main results are robust for each. Ultimately, future work should continue to refine the use of events data such as ICEWS. However, given the resource-intensive nature of coding data such as TIES, I contend that is worthwhile to make use of more widely available machine-coded data.

[32] I use the entity address to identify target states. If no address is provided and the entity falls under a country program, I code that country as the target.

25% of states with entries. Accordingly, my final count of SDN entities excludes all entities that fall under these programs unless they also fall under a relevant sanctions program.[33] As with other explanatory variables, I include both the change and lag of this variable in ECMs. These variables are available for the years 1994-2018, though I can use only 1995-2014 in my models.

Figure 3 illustrates sanctions presence by data source for 2005—the latest year in which all data sources are available. The upper plot shows that there is some disagreement between data sources, though all three sources highlight sanctions against Cuba, North Korea, Sudan, Syria, and Zimbabwe. The lower plot illustrates SDN entity count (categorized using a logged scale) in 2005. Notably, the SDN indicator spans more states than any of the other data sources, unsurprisingly given its focus on entities throughout the system.

Other explanatory variables

I include control variables intended to reduce the possibility of spurious correlation and to improve model fit. Except where noted, all controls are included as changes and lags. First, given prior evidence that states consider security implications of dual-use exports (Fuhrmann 2008; 2009), I use data on UN voting similarity (including abstentions) from Strezhnev and Voeten (2012) to capture dyadic political affinity. These indicators also account for the broader tendency for trade to "follow the flag" (Pollins 1989). I also include indicators of each state's affinity with the United States. These indicators are intended to account for the fact that reputation effects of sanctions are likely context-sensitive, where, for example, US allies might be less responsive to US sanctions against US adversaries (Peterson 2013; 2014).

Given that reductions in dual-use exports to US sanction targets could follow from reaction to the behavior that led to sanctions rather than the imposition of economic restrictions *per*

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[33]Additional models including these programs show very similar results; all main findings are robust. It is worth noting that, despite excluding this one issue, my operationalization nonetheless includes a wide variety of sanctions programs, such as the arguably most relevant Weapons of Mass Destruction Proliferators Sanctions Regulations, but also programs such as the Global Terrorism Sanctions Regulations and Global Magnitsky Sanctions.

Relevant country sanctions programs in 2005
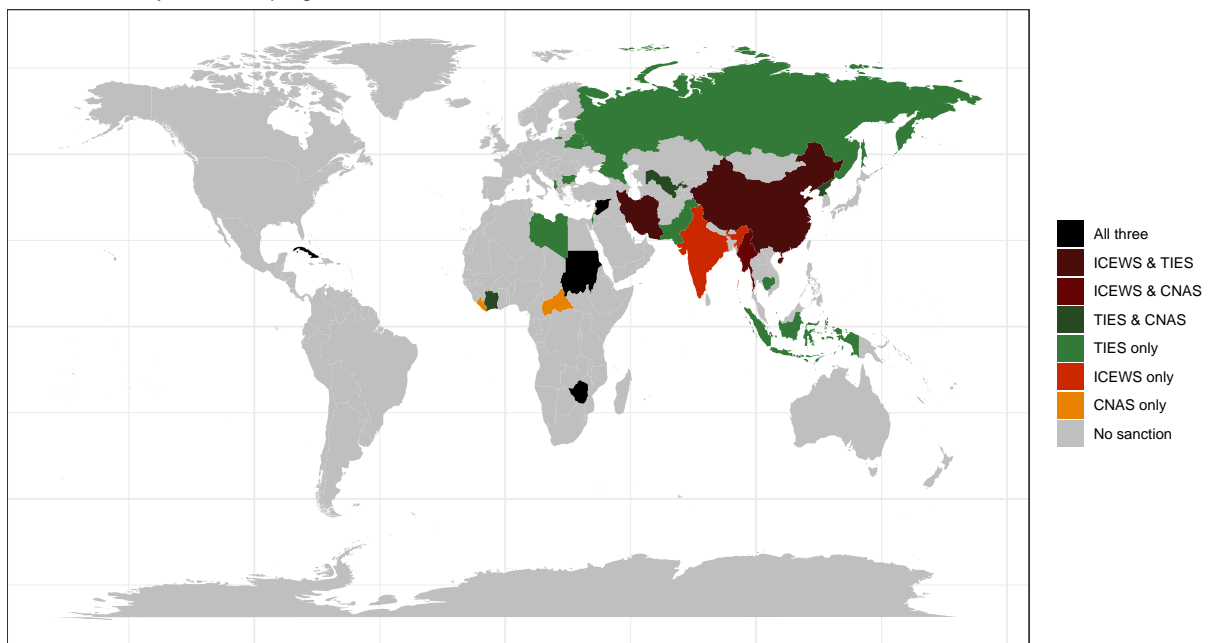
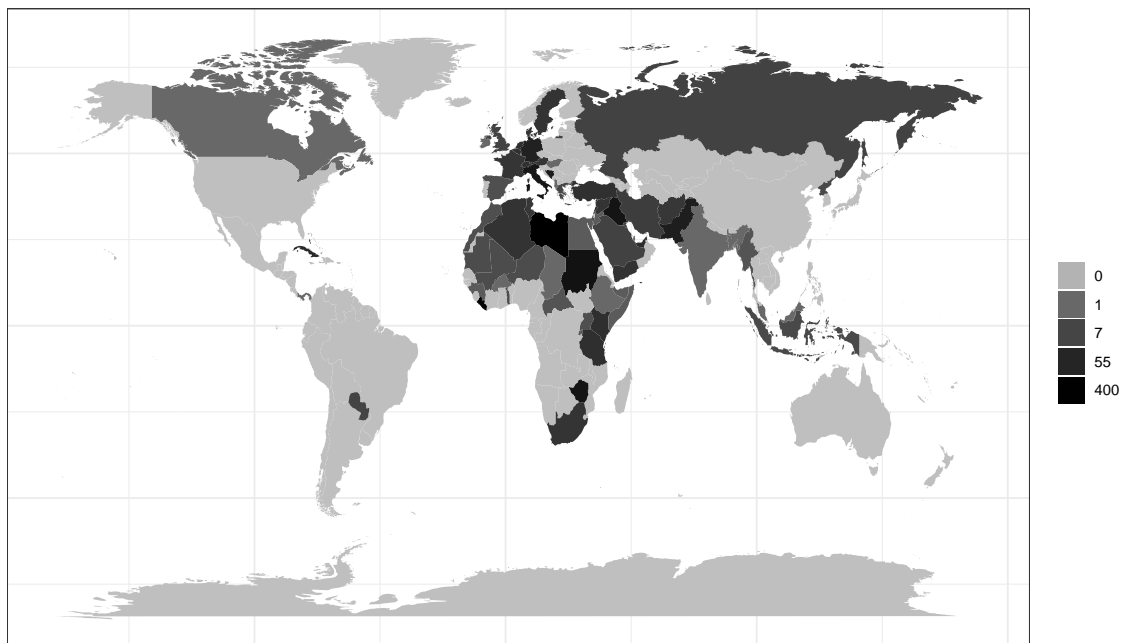SDN entities in 2005, log scale. Note: drug trafficking programs excluded

Figure 3: US sanctions by data source (2005)

se, I also control for "proscribed behavior" by the importing state in the directed dyad. While capturing the full range of proscribed behaviors that a state could perform is difficult, I focus on factors that apply directly to the issues over which I expect US-imposed sanctions to affect dual-use exports. As such, the variable for "proscribed behavior" takes the value of 1 if any of the following conditions apply: first, if the importer is believed to be a nuclear weapons proliferator or has nuclear weapons;[34] second, if the importer is listed as a state sponsor of terror by the United States; or third, if the importer has engaged in political violence either internally or externally—specifically if the state has experienced one or more major episode of political violence (MEPV) (Marshall 2017).[35]

Complementing the control for target proscribed behavior, I also code a variable identifying the exporter's membership in major multilateral export control regimes (MECRs). Specifically, I code a dichotomous variable identifying whether the exporter belongs to any of the major MECRs: the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies, the Nuclear Suppliers Group, the Australia Group, or the Missile Technology Control Regime.

I include dichotomous variables identifying joint democracy and joint autocracy within the dyad. Joint democracy is coded 1 when both states' 21-point Polity combined score is 7 or higher (Marshall and Jaggers 2014). Joint autocracy is coded as 1 when both states' Polity combined score is coded as -7 or lower. Mixed regimes therefore compose the reference category. Traditional gravity covariates come from CEPII (Mayer and Zignago 2011). Specifically, I include for the exporter and importer: logged GDP (in 2005 US dollars) and logged average distance between states. The distance variable is included only as a level and not as a change given that it is nearly constant over time. Finally, I also include a dummy variable equal to 1 starting in 2001, capturing the post-9/11 environment during which states might exercise additional scrutiny in

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[34]Results were consistent in alternate models where I excluded the five members of the Non-Proliferation Treaty allowed nuclear weapons from this coding.

[35]To be classified as an MEPV, an episode must involve at least 500 directly-related deaths.

the export of dual-use commodities. This variable is included only as a level and not as a change. This variable is excluded in models using the CNAS sanctions variable given that 2001 is the first year the CNAS data are available.

Analysis

I find strong evidence that US sanctions are associated with substantially lower dual-use exports to the target. Effects are robust when considering dual-use commodities in terms of (logged) dollar value or relative to non-dual-use trade. Results are consistent across three different measures of US sanctions programs with different time coverage. Further, I find that the impact of country sanctions programs is consistently significant in the long run while there is more variation in the immediate impact. Conversely, both short- and long-run negative associations between SDN entries and dual-use exports are statistically significant.

Table 1: Partial table of coefficients and standard errors examining US sanctions and third-party dual-use trade: key variables and long-run multipliers. Full table can be found in the appendix.

	ΔDual-use	ΔDU-NDU	ΔDual-use	ΔDU-NDU	ΔDual-use	ΔDU-NDU
	TIES (1995-2005)		CNAS (2001-2014)		ICEWS (1995-2014)	
Δ importer sanctions program	−0.07	−0.10	0.01	0.01	−0.41*	−0.37*
	(0.19)	(0.17)	(0.14)	(0.13)	(0.18)	(0.16)
Lag importer sanctions program	−1.01***	−0.20**	−0.43***	−0.24***	−0.62***	−0.48***
	(0.08)	(0.07)	(0.07)	(0.06)	(0.08)	(0.07)
Δ importer SDN entries	−0.06***	−0.03*	−0.12***	−0.05***	−0.08***	−0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Lag importer SDN entries	−0.04***	−0.03***	−0.10***	−0.03***	−0.10***	−0.03***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Lagged DV	−0.73***	−0.85***	−0.73***	−0.86***	−0.73***	−0.85***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Long run multipliers						
Importer sanctions program	−1.40***	−0.23***	−0.59***	−0.28***	−0.85***	−0.57***
	(0.08)	(0.07)	(0.07)	(0.06)	(0.08)	(0.07)
Importer SDN entries	−0.05***	−0.04***	−0.14***	−0.04***	−0.14***	−0.04***
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	144,776	144,776	234,629	234,629	312,368	312,368
Adjusted R^2	0.35	0.42	0.36	0.42	0.35	0.42
Residual Std. Error	6.68	6.13	6.65	5.86	6.68	5.97
F Statistic	3,134***	4,234***	5,4008***	7,088***	6,785***	9,017***

* p less than 0.05, ** p less than 0.01, *** p less than 0.001

Table 1 presents coefficients and standard errors for six error correction models.[36] Models 1 and 2 include a variable for US sanctions against the importing state from TIES (covering 1995-2005), while Models 3 and 4 use the version from CNAS (covering 2001-2014), and Models 5 and 6 use ICEWS data (covering 1995-2014). All six models also include variables for importer SDN entities. Odd-numbered columns in Table 1 present results for models where the DV is the logged value of dual-use exports, while the DV in even-numbered columns is dual use exports relative to non-dual-use exports.

The coefficient for the change in US-imposed country-based sanctions programs against the importing state is negative and significant only in two of the six models—models 5 and 6, which is coded using ICEWS data. The lack of significance for this variable in four of six models indicates that a new imposition (or removal) of US sanctions against a given target is not consistently associated with an immediate change in dual-use exports to that state. Conversely, the lagged indicator of country sanctions programs—and more importantly, the long-run-multiplier—are negative and highly statistically significant in all six models. Accordingly, my results indicate that imposed US sanctions programs are associated with a long-run decrease in dual-use exports to the targets of US sanctions. The lack of a consistent immediate impact of US sanctions on third-party trade could follow from the time it takes state governments to institute stronger enforcement of trade controls. This possibility is further supported by the fact that the coefficients for SDN entries—both the change and the lag, as well as the long-run multiplier—are negative and statistically significant in all six models. Firms witnessing SDN entries will recognize that they could be targeted directly by the US and thus might immediate rethink dual-use exports to US-sanctioned states.

Coefficients provide limited information about the substantive impact of each explanatory variable on third-party dual-use exports to US-sanctioned states, particularly given that the dependent variable is logged. Accordingly, Figure 4 illustrates the relative magnitude of associations

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[36]As the full Table 1 is very long, I present it in the appendix. Here, I present a cut table of key coefficients.
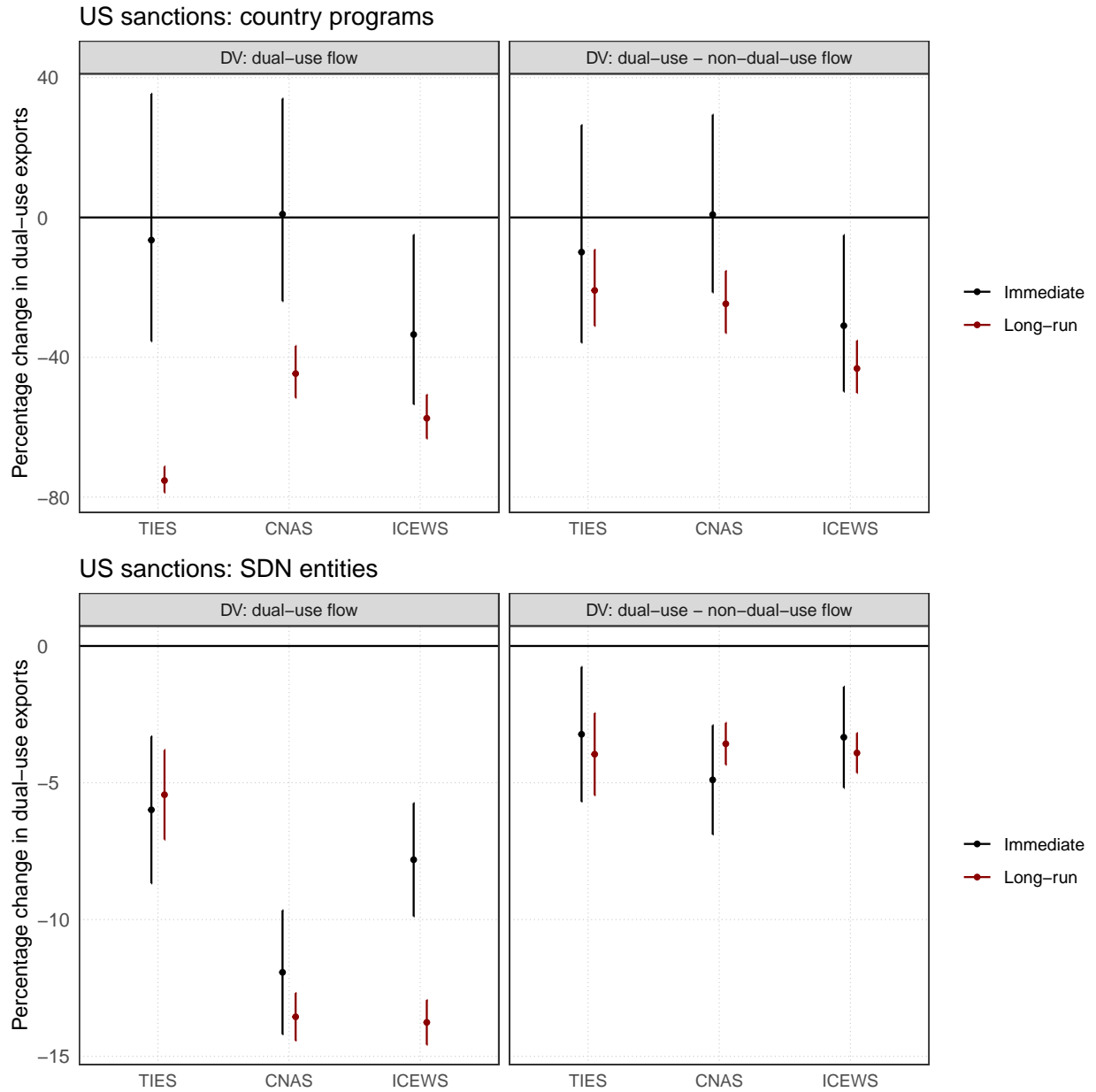
Figure 4: US sanctions against the importing state and dual-use exports. Predictions and 95% confidence intervals from Models 1-6.

from Table 1. The figure is divided into four groups to examine the impact of country sanctions programs (top plots) and SDN entries (bottom plots) on the two dependent variable types: change in dual-use flow (left plots) and change in dual-use flow relative to non-dual-use flow

(right plots). The plots report the immediate percentage change in dual-use exports in black, and the long-run change in red. In the upper plots, the substantive interpretation for each coefficient is that the predicted dual-use export flow will change by $\exp(\beta) - 1 \times 100$ % relative to the baseline, where β is the relevant coefficient. These percentages are displayed along the y-axis for each model, using an indicator of sanctions programs from TIES, CNAS, or ICEWS data, respectively. The predictions across models are similar: for dual-use flows, we see no immediate change, but a long-run reduction averaging around 60%. For relative dual-use flows, long-run percentage reductions are smaller on average: around 30%. The largest magnitude with respect to relative flows follows from the use of ICEWS data. Indeed, sanctions imposition is associated with a (statistically significant) 35% immediate reduction in relative flows when using ICEWS data.

Turning to the lower plots, given that the SDN entries variable is logged (along with the DV), the substantive interpretation of the coefficient is that a 100% increase in the explanatory variable is associated with a $\beta \times 100$% change in the dependent variable. Accordingly, we can interpret the y-axis percentages as the change in dual-use exports associated with moving from one to two SDN entries, or from two to four, from four, to eight, etc., keeping in mind that the average number of SDN entries is approximately 12. Notably, the explanatory variable is identical in each of the six estimates presented in the lower plots. The x-axis labels describe the data used to code the country sanctions program variable included in the same model. Results are largely consistent across all six models. The lower-left plot shows that the immediate impact of a 100% increase in SDN entries is approximately a 7% decrease in dual-use flows. The long run looks similar, with a decrease of over 10%. The lower-right plot shows that both the immediate and long-run decrease in relative dual-use flows is more modest, averaging about 4%.

To save space, I do not plot the the change in dual-use exports over time. However, given that the LDV coefficients are consistent (approximately -0.73 in models examining dual-use flow and -0.85 in models examining relative dual-use flow), I find that adjustment to the long-run

equilibrium is relatively fast: appropriately 73% of this change in flows occurs in the first year, with 73% of the remainder (for a total of 93%) by the second year. For relative flows, these percentages are 85% and 98%. US sanctions thus lead to a relatively quick adjustment in dual-use exports by third parties.

Discussion and Conclusion

I find strong evidence that US sanctions—both country programs and SDN entries—are associated with reduced exports of dual-use commodities to the target by third party states. This pattern holds across multiple data sources and associated time periods. My results suggest that US sanctions carry a reputation effect that increases third-party compliance with export controls of dual-use commodities. These findings serve as a reminder that the consequences of sanctions, and therefore their effectiveness, depend on more than target response to sender demands. US foreign policy holds the promise to affect behavior throughout the international system.

This study identifies one realization of these broader effects that is particularly relevant to policy-makers. Prevention of WMD proliferation remains a central goal of US foreign policy. Previous work finds that sanctions fail to prevent proliferation in the target state, but can motivate third parties to avoid similar behavior (Miller 2014). The failure of imposed sanctions to directly undermine US non-proliferation effects can perhaps best be illustrated with the case of Iran, which restarted its efforts to develop nuclear weapons after the Trump administration re-imposed sanctions, withdrawing from the Joint Comprehensive Plan of Action (JCPOA). However, my results suggest that US sanctions can motivate third party states to avoid aiding US sanction targets to develop WMD—or to engage in a variety of behaviors facilitated by dual-use commodities and technology.

Future research should continue to explore additional sanction consequences, whether beneficial or detrimental, and whether intended or unintended. For example, future research can build

from these findings by considering nuance and conditionality with respect to the causal mechanisms I explore here. As a first step into a complex phenomenon, I necessarily make a number of simplifying assumptions: I treat all dual-use commodities as equivalent; I group sanctions across a number (though not all) sanctions programs covering issues as disparate as WMD and democratic backsliding; I treat political affinity (both dyadic affinity and third-party affinity with the US) as control variables rather than moderators. All of these assumptions deserve further theoretical and empirical scrutiny. Furthermore, this study does not distinguish between unilateral US sanctions and those with multilateral support. While US financial leverage throughout the international system is at present unmatched, its normative legitimacy might not be. Future work would benefit from considering whether sanctions stigmatize targets more when the US benefits from the backing of other states or international institutions.

Finally, given that the third-party effects of US-sanctioned states could be a consequence of signals stigmatizing the target state as an international pariah in violation of broadly recognized norms, future work should consider whether US normative legitimacy towards this end varies over time. Some have argued that the Trump administration has eroded US legitimacy and potentially accelerated the decline of US hegemony (Cooley and Nexon 2020). It could be fruitful to operationalize this admittedly ambiguous concept in order to quantify variation over time. Scrutiny of this issue would also help to distinguish the stigmatizing impact of US sanctions (where third parties view the sanction target as a norm violator and reduce cooperation) from the broadly coercive impact (where third parties fear they could be next to face US sanctions if they do not comply with US preferences). Even in the absence of normative legitimacy, the US might retain broad influence throughout the system following from its coercive power. Accordingly, the manner in which the US is likely to exercise power in the future is important to understand.

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