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The political economy of energy sanctions: Insights from a global outlook 1938–2017

Itay Fischhendler[a,1], Lior Herman[b,1], Nir Maoz[c,*,1]

[a] Department of Geography, The Hebrew University of Jerusalem, Israel
[b] Department of International Relations, The Hebrew University of Jerusalem, Israel
[c] Boalt Hall, University of California, Berkeley, School of Law, Berkeley, CA, United States

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ABSTRACT

This study—addressing the absence of a specific and focused analysis of energy sanctions in current literature—provides a longitudinal and quantitative study of economic energy sanctions based on a global perspective. We unpack the design of economic energy sanctions by distinguishing their goals, their measures, and how they are imposed and evolve over time, with the aim of better understanding their effectiveness, cost, and implementability. Drawing on a dataset of officially reported sanctions from 1938 onwards, we find that energy sanctions were particularly frequent between 1973 and 2002, with key senders being the US, Russia, and the UN, each using different sanction regimes, goals, and measures. Analysis reveals that energy sanctions target the distribution segment of the supply chain, and are paired with non-energy sanctions. Further, when variations and changes take place in the design of sanctions, they tend to trigger counter-sanctions. Thus, a possible explanation for senders' preference not to change or intensify sanctions is the high transaction cost associated with each change in the sanction design. We conclude that transformations and changes taking place in the global energy market are likely to influence the design of future sanctions.

1. Background

The use of sanctions as an instrument of foreign policy can be traced as far back as 432 BCE, when the Athenian Empire levied the Megarian Decree, leading to the Peloponnesian War [1]. Sanctions are measures that deprive the targeted actor of something (resources, recognition, membership status, etc.,) until it complies with a specified demand (or demands) [2]. Sanctions can be exercised through various means. Actors can use force or physical instruments, such as blockades or restriction of movement. But sanctions can also be of an economic nature, such as in the case of the Megarian Decree's banning of Megarians from entering and trading in Athens. Sanctions are sometimes mixed—composed of both economic and non-economic means.

Economic sanctions represent a major portion of the sanctions imposed worldwide. While their effectiveness is widely disputed [3–5], these sanctions attempt to exert economic pressure on the target by influencing economic relations between the sender and target countries, often involving other states as well. Typical economic sanctions include restricting exports and imports, freezing assets, and depriving states of financial and economic aid.

One important subset of economic sanctions is the sanctioning of energy. While not all energy sanctions lie in the economic realm—for example, the targeting of pipelines and power plants—the majority of these sanctions are of an economic nature [6]. Keeping with the analytical separation between economic and non-economic sanctions, we focus in this paper on economic energy sanctions, and for brevity refer to them as energy sanctions. We focus on energy sanctions for several reasons. First, energy sanctions are a major category of economic sanctions [6] and thus require closer attention. Indeed, scholars have noted the lack of theorization and conceptualization with regard to how and when energy is used in foreign policy for means other than energy goals [7]. Second, energy is a fundamental enabling element of modern life, and thus has a direct and critical impact on the functioning, well-being, and development of nations. This influence can be seen, for example, in the effects of the trauma of the 1973 "oil shock," specifically the perception that countries that control the oil wield an "oil weapon" [8,9].

While OPEC's 1973 use of the oil weapon led to fear that energy dependence might increase an exporting country's ability to use sanctions against their clients, energy sanctions can also be waged by importers and transit countries [6,10]. A case in point is the US and EU sanctioning in 2012 of Iranian oil purchases, linking oil and economic

* Corresponding author.
E-mail addresses: Itay.Fishhendler@mail.huji.ac.il (I. Fischhendler), nirmaoz@berkeley.edu (N. Maoz).
[1] Authors contributed equally and are listed alphabetically.

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rewards in the context of nuclear non-proliferation [9,11].

Abundant literature addresses the design of sanctions and their effectiveness. Many have argued that sanctions are ineffective, or that their goals are overambitious and nonrealistic [3,5]. Others argue that the assessment of effectiveness needs to take a more nuanced approach than the success/failure dichotomy; should address the issue of costs in a more comprehensive way; and needs to take into account political regime differences in the sender country as well as domestic factors [12–16].

Understanding the design of sanctions is particularly important, given the considerable influence that the components of the design have over the costs, audience, and effectiveness of the sanction. Nevertheless, while the design of sanctions has been extensively researched, only a small number of these studies have analyzed energy sanctions. These latter works tend to focus on single case studies, with a bias toward examining Russian- and Iranian-related sanctions cases. Furthermore, studies on energy sanctions lack longitudinal analysis, and fail to account for how sanctions are applied and change over time within a given sanction's regime or between different regimes and cases [17–19,9].

Works that investigate the design of sanctions are often descriptive, only explaining how each party reacts to a sanction measure [20,10,21]. The absence of any longitudinal and quantitative study of economic energy sanctions based on a wider, global perspective is rather surprising given that practitioners and policymakers have been engaged with questions regarding the use of economic energy sanctions for quite some time.

Because energy sanctions are multidimensional, researchers need to identify the range of energy sanctions available, identify those adopted, and identify if and how they change across time. We address this gap in this paper by providing a longitudinal and quantitative study of economic energy sanctions based on a global perspective. This study unpacks the design of economic energy sanctions by distinguishing between their goals, their measures, and how they are imposed and evolve over time. We compiled a global dataset of all formal economic energy sanctions—including oil, natural gas, and coal sanctions—imposed from 1938 to 2014. We seek to answer the questions: Who uses economic energy sanctions and why? When are economic energy sanctions imposed? What do economic energy sanctions target? And finally, how are economic energy sanctions designed and how do they evolve over time? We assume questions are key to eventually understanding the effectiveness, cost, and implementability of economic energy sanctions. By analyzing these sanctions, we can uncover the anatomy of economic energy sanctions and better understand how they operate and their importance to the energy sector.

1.1. Design of economic and energy sanctions

While the design of sanctions involves many components and considerations, they all relate to two main issues: the goal of the sanction and the measure serving it.

The goal refers to the "policy aim" of the sanction, such as democratization or stopping nuclear proliferation. A sanction's goals can include to change the target-country's policies through deterrence or coercion; to change the target country's regime through subversion; to disrupt a military adventure; or to impair the target country's military potential. During the Cold War and in attempt to reduce Soviet political influence and control in Western Europe, US President Ronald Reagan demanded a NATO boycott on building supplies going to Soviet gas pipelines intended to transport gas to Europe [22]. Energy sanctions can also be imposed with an energy objective as their goal, although these cases are rare and less documented in the literature or official documents [23]. One example is Israel's forced electricity grid interconnection between its own grid and that of the Palestinian electricity company in East Jerusalem. While this interconnection has certain political aims in terms of cementing Israeli sovereignty over Jerusalem, it was also a move to prevent the Palestinian company from competing with the Israeli electricity company's production and to increase Israel's energy security [24].

The measure of the sanction refers to how the sanction is carried out: for example, an embargo or freeze of financial and economic assets [25]. There are two broad categories of economic measures: (1) trade controls, such as export or import restrictions; and (2) financial freezes. Scholars differ in how they identify and treat these categories, particularly with regard to trade controls. Some databases distinguish trade controls simply as export or import, but others also include arms embargoes, as well as quotas, boycotts, tariffs, and bans on strategic goods: for example, the Morgan et al. [26] dataset divides trade controls into exports versus imports, and also includes a coding of carrots; whereas the Hufbauer et al. [6] dataset divides trade controls into exports versus imports and codes arms trade, but does not code for carrots. Although the literature does not address energy measures through a specific taxonomy, it seems, prima facie, that the same logic should apply to energy sanctions. Thus, trade controls can include full or limited oil, gas, and other energy resources export and import embargos, as well as electricity cutoffs. Freezing measures can be imposed on energy trade revenues held in foreign financial institutions or yet to be paid.

The goals and measures of sanctions are key in determining whether economic sanctions can be efficient or not. While some posit that realistic or modest goals can be achieved via economic sanctions [27], others argue that economic sanctions tend to be overambitious, particularly in proportion to the range of economic tools applied [5,28]. For example, Elliott [27] argues that the US oil embargo contributed to Uganda's powerlessness against Tanzania and rebel forces in 1978 [27], and that similar measures by the US and UK partially succeeded in changing Iran's expropriation of Western oil companies' assets once a regime change took place [29]. Lindsay [30], however, finds across 19 cases that sanctions will tend to fail if they attempt to achieve ambitious goals such as compliance, subversion, or deterrence. At times, sanctions address domestic audiences in the sender's country rather than effectively aiming at the target country, thus widening the expectations–capabilities gap between goals and measures. British Prime Minister Lloyd George was quoted to have said that the sanctions against Italy after its invasion to Abyssinia were put in place not to save Ethiopia, but rather to save the British Government from being accused of indifference and ineptitude [31].

The design of sanctions is also closely tied to whether they are targeted (smart) or comprehensive. Targeted sanctions are specific with regard to both their targeted audience and their means. Comprehensive sanctions do not differentiate between individuals and groups and are universally imposed on the targeted country [16]. In the context of energy sanctions, it appears that boycotts and cutoffs of energy supply are more likely to be comprehensive measures. One example is the case of the 2012 EU embargo on Iranian oil, which prohibited the import, purchase, and transport of oil and petrochemicals, as well as prohibiting energy-related activities such as financing, insurance, and transport of oil and petrochemical products [32].

Nevertheless, the issue of the comprehensiveness or smartness of energy sanctions has yet to be specifically addressed in the literature, and further research is needed of the conditions required for using either comprehensive or targeted energy sanctions. While this literary gap relates to the range of energy-sanctioning measures available, it also concerns the question of whether the use of energy sanctions is constrained by the type of regime in the target country. Scholars have recognized that since democratic regimes rely on popular support, they are more prone to responding to comprehensive economic sanctions. Because they do not need popular support, autocratic regimes will tend to be more influenced by smart sanctions [13,33]. Hence, the degree to which energy measures can be used for either targeted or comprehensive sanctions is also affected by the target country's regime.

Sanctions-related costs are another key element influencing the design of sanctions. Costs are borne by the target, sender, and third

parties. In the context of energy sanctions, costs to the target country include loss of revenues (for an exporting or transit country) or loss of trade (for an importing country) [34]. While these costs to the target country are often the very nature of the sanction measure, imposing sanctions come at a price for the sender country and other parties. The cost of an embargo lies in the denial of trade and revenues, which might increase if there are no substitute markets to export to or import from. The sender's costs also extend to the loss of heavy infrastructure investment; enforcement costs; costs to secondary and related sectors such as banking, insurance, and transport services; and compensations for third parties, like coalition and transit nations [5,14,35]. Costs are not always taken into consideration at the time of designing sanctions and are often underestimated, as was the case in the energy embargo on Iraq in the 1990s. The embargo not only led to the death of many innocent Iraqis and caused severe economic hardship, it also failed to meet its goals [36].

Three related issues of particular importance to energy sanctions are the chain of supply, sunk costs, and the relationship between energy and infrastructure and security. While these issues are also sometimes significant in other non-energy economic sanctions, they are critical elements in the design of energy sanctions.

First, the ability to impose energy sanctions is highly influenced by the specificity of the energy resource, or mean, and its supply chain. Some energy resources are traded through fragmented supply chains, making certain sanctions less effective. Thus, the ability to impose sanctions can differ across market segments [37]. Oil, for example, is a globally traded energy commodity, fragmented into a production chain that includes many state and market actors. This segments in the process include crude oil production; its transportation; its refinement; and the transportation of refined oil. The more actors needed for coordinated sanction and the more global the market, the less likely a sanction will succeed [37–39]. Unlike oil, natural gas is constrained into regional trade through pipelines. Because of natural gas' fixed infrastructure, the design of any sanction must consider the alternatives and means available to the sender country in terms of trade, and the costs associated with these alternatives [38]. This issue also illustrates that in the case of a fixed infrastructure, the more actors that are involved, the greater the sanctioning influence of one of them in terms of the disruption of trade. Ukraine, a gas transit country between Russia and Europe, is an example of an actor that has used gas disruptions to Europe as a counter-sanction against Russia [10]. It should be noted, though, that the characteristics of energy resource trade can change over time. The growing international trade in liquefied natural gas (driven today by East Asia and North America) has reduced dependence on fixed infrastructure and created a global market for gas [40,41]. While the creation of this type of market may take some time, it will decrease the ability to impose natural gas sanctions. Two further important developments will likely affect the design of energy sanctions: that is, the transition to renewable energy resources and the growth of cross-border electricity trade. With only a few exceptions, the literature barely addresses these issues with regard to sanctions and foreign policy [42,43]. Nevertheless, these questions are likely to surface more in the future in the context of energy sanctions, particularly as countries increase interdependence through electricity grid interconnections and joint renewable energy production projects: for example, cross-border hydro-energy projects such as the East African power pool and the Greater Mekong [44,45].

Second, as abovementioned, interstate energy relations include vast sunk cost investments. These costs increase dependencies on particular trade relations between energy suppliers and consumers, and can amplify or restrict the environment for the sanction to occur. Again, natural gas and certain renewable energies entail greater sunk costs than other energy resources, such as coal and oil [35]. Russia's energy influence today is based on its initial willingness to provide subsidized gas and create pipelines to the west, in turn creating an entire industry dependent on Russian gas with no alternative suppliers. Another example of the role of sunk cost investment can be seen in Israel–Turkey relations. In the aftermath of the Mavi Marmara Incident, which soured relations between these two countries, fear of possible future sanctions played a major role in delaying negotiations over laying a gas pipeline between them [46].

Finally, the functioning of modern life is almost totally reliant on energy—manifested through such basic activities as cooking and lighting, as well as transportation, production, national security, and so on. The 1973 Oil Shock provides an apt illustration of this reliance, yet dependence on energy has only increased since that time. The design of energy sanctions takes energy dependence into consideration in at least two respects: on the one hand, sanctions target sectors that are vulnerable; but on the other, the sanctions need to be sensitive to their adverse impact on those harmed by the sanction, as well as on the sender country itself. One case illustrating these latter two considerations is the 1990 energy sanctions against Iraq. These sanctions eventually led to the Oil-for-Food program, which allowed the sanctioning coalition to maintain coercive power over Iraq while reducing senders' costs and alleviating the wellbeing of Iraqi citizens [47].

Thus, energy is more than "another tool" within the security toolbox. It is a set of relations between exporters, importers, and even transit countries that concern using a variety of energy measures for a variety of goals [48]. These relations, based on both internal and external competing security concerns, influence how sanctions are designed.

2. Methods

2.1. Research database

The dataset constructed by Hufbauer et al. (hereinafter HSE) is the most extensive collection of sanctions observations to date, and includes 177 case studies between 1914 and 2000 [6]. Their dataset aims to uncover the effectiveness of economic sanctions. HSE, however, do not isolate the presence of energy in either the measure or goal of the sanction, but instead lump energy trade with economic trade in general. The database is accompanied by a published summary of each observed sanctions event, including its chronology. Our study extracts the energy component from the HSE database. To identify the cases involving instances of economic energy sanctions (hereinafter: energy sanctions), we searched for potential energy sanctions based on the presence of specific keywords (e.g.; energy; oil; petroleum; electricity; etc.) in the case summaries and descriptions of sanction cases. Once we identified that a particular case deals with energy; we extracted the necessary variables for each observation (each variable discussed in detail in this section). In the majority of cases; all of this information was readily available within the HSE case summaries. We did not evaluate any variables that were largely missing from the HSE dataset; but where information was missing for specific variables; we supplemented it from reputable news or government publications.

We focus on three energy sectors: oil, gas, and coal. These three sectors were selected because they make up the vast majority of energy sanctions. Moreover, while some instances of electricity or nuclear fuel sanctions may have taken place, it was too difficult to identify them—and in cases that were identified, these did not fall into the category of "energy" sanctions, as most limitations on nuclear fuel and technology related to anti-proliferation rather than to limiting the energy resources of the target country.

For sanction events occurring after the year 2000, or for instances where the HSE dataset entry is incomplete, we consulted published sanctions protocols from the United States Office of Foreign Assets Control (OFAC), the European Union External Action Service, and the United Nations Security Council Sanctions Subcommittee for supplementary information. We included records from these sources for the post-2000 period to ensure that our data contains only instances of official public sanction. This, however, marks a limitation of our study,

as it misses unofficial sanctions from countries, such as Russia or India, that often do not formally announce sanction implementations. As a result, sanctions like the Indian blockade against Nepal in 2015 are not included in the dataset. In this latter case, Nepal accused India of imposing an undeclared blockade due to its objections to Nepalese constitutional changes. The blockade (denied by India) included a restriction on petroleum exports, on which Nepal had absolute dependence [49]. Furthermore, our dataset only includes official cases in which energy is an explicit component of the goal or measure. Therefore, for the purpose of this study, complete trade embargoes that do not explicitly target energy in the design of the sanction are not considered energy sanctions. In total, our dataset includes 37 cases of energy sanctions (out of a total of 188 recorded and official economic sanctions) enacted between 1938 and 2014. Here, a case study refers to an occurrence of sanctions imposed by a sender state on a target state within a relatively bound time period.

2.2. Unit of analysis

The unit of analysis is a particular sanction design within a given case. A single case study can comprise more than one sanction observation if the sanction design changes during the course of the sanction's regime. For example, when Russia sanctioned Ukraine by increasing gas prices, we view this as one observation.[1] However, when Russia changed these sanctions to a full embargo, we consider this to be a new observation even though the target, sender, and goal remain static. Variations within measures are also considered new observations even though the general measure does not change. In other words, a change in the price of energy is a price fixing measure but a change in the magnitude the price (i.e., from price fixing at one rate to a higher or lower rate) is considered a new observation. For example, when the 1980s sanction regime against Libya added an export embargo on petroleum products when it already had an import embargo in place, we consider it as a new sanction observation, even though both fall within the same sanction measure (partial energy embargo; see below).

The design of sanctions evolves both *within* sanctions regimes and *between* them, potentially heavily impacting the way both sender and target states behave [50]. Hence, by measuring the changes of sanctions on a temporal scale, this study allows us to identify trends in when and how energy sanctions evolve or devolve over time.

This study only considers the design of the primary sender, which is defined as the state that takes the lead in the sanction campaign. For example, in the most recent sanctions against Iran, the US is considered the primary sender of the sanctions because it instituted and led the sanctions, with other countries joining or leaving the sanction regime at various points in time. When sanctions are imposed by a multilateral institutional body, such as the UN, we consider that institution as the primary sender. Throughout the duration of the sanctions, additional senders may join the sanctions campaign, but this study does not review their design. We do, however, code the presence of other parties that join the sanctions and note whether their presence is static or dynamic. For example, with respect to the sanctions against Iran, which began in 1984, while the US was the primary sender, we do record that other senders participate in the sanction (a variable we call "multi-sender involvement"). We also identify whether these secondary senders had a static presence (i.e., was part to the sanction regime throughout its entirety) or a dynamic presence (i.e., was part to the sanction regime for only part of the regime, including joining and leaving the regime multiple times, as was the case with the sanctions against Iran).

Given that the energy component is of primary concern in our research, analysis of the sanctions begins only once energy becomes part of the design. Nevertheless, we identify when a non-energy sanction precedes or follows an energy observation. This, in turn, allows us to identify when energy enters a sanctions regime and when it is lifted from a sanction regime. In total, we identify 65 energy sanction observations.

2.3. Goals and measures

As mentioned, there are multiple elements to consider when analyzing economic sanctions. The two primary components of a sanction are the goal and the measure.

For each case, we identify the primary goal of the sanction. We group various goals into four main categories: 1) energy-based goals; 2) goals to change political behavior; 3) goals to resolve territorial disputes; or 4) goals to change the regime. Other datasets addressing sanctions in general, such as Morgan et al. [26], use 15 different goal categories, but given the smaller size of our dataset, we opted for fewer categories.

When looking at the measure of the sanction, we first identify whether the sanction design uses a single or multiple means of economic coercion, and whether it targets energy or not. For example, the sender may only aim at the oil sector of the target, thus implementing a unidimensional sanction, or may include an arms embargo in addition to restricting oil trade, thus creating a multidimensional sanction.

When the measure targets the energy supply chain, we place it on an ordinal spectrum as follows: 1) *price fixing*, when the sender increases the price of energy; 2) *fixed quota*, when the sender places a set limit on energy trade; 3) *discretionary quota*, when the sender places a discretionary limit on energy trade (e.g., licensing agreements that allow executive offices to determine eligibility of trade contracts on an ad hoc basis); 4) *partial energy embargo*, when the sender partially limits energy trade to the target; 5) *beyond energy partial embargo*, when the sender partially limits energy trade to the target as well as placing partial sanctions on non-energy goods and services; 6) *full energy embargo,* when the sender places a full embargo on all import and export of energy including energy infrastructure; 7) *beyond energy full energy embargo,* when the sender places a full embargo on all import and export of energy including energy infrastructure as well as placing partial sanctions on non-energy goods and services; 8) *full embargo with exemptions*, when the sender places a full embargo on all import and export of goods and services but has an exemption in place for some energy trade; 9) *full embargo*, when the sender places a full embargo on all import and export of goods and services; and 10) *full embargo with secondary sanctions,* when the sender places a full embargo on all import and export of goods and services and imposes sanctions on third parties that continue trade, or certain types of trade, with the target. It is important to note that the spectrum of design does not make any assumptions about the cost to the sender or target, or about effectiveness. Tables 3 and 4 and the y-axis in Fig. 2 outline the spectrum of measures.

The presence of secondary sanctions, exemptions, and beyond energy measures is of special importance in the spectrum. While these variances may not directly target energy, they do influence the energy trade of both the sender and target states and indicate a design change affecting the measure. Secondary sanctions occur when the primary sender sanctions third-party states that continue trade with the target country. A secondary sanction dramatically increases the intensity of the sanction design, as it often leads to further sanctions on the target state by secondary senders. Exemptions are cases in which a sender includes a form of energy trade exemption in the design of the sanction, often due to an energy constraint on the sender (e.g., implementing a full embargo but allowing a limited amount of oil for humanitarian

[1] It should be noted though that Russian price increases may not be viewed prima facie as sanctions, since Russia was selling gas at below market prices to Ukraine (as well as to other countries), and the price increase raised the price to what can be considered as the market price. Nevertheless, we view this as a sanction for two reasons. First, sanctions are subjective in the sense that they need to be viewed and interpreted as such by the target. In the case of Ukraine, Russia's action has been viewed as punitive rather than a market correcting action. Second, the literature acknowledges the important interplay between carrots and sticks, whereby for some sanctions to be effective, they need to rely on the denial of a previously accorded carrot (i.e., price preference).

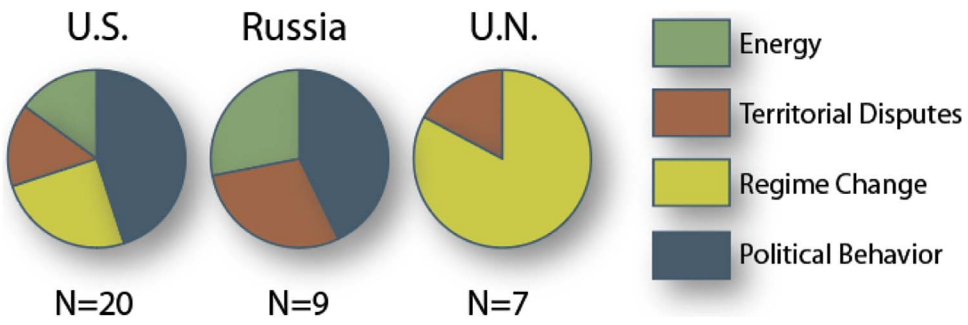

Fig. 1. Sanction Goals.
Each of the charts identifies type of sanction goals of the implemented sanctions of the respective sender states.

aid). Beyond energy measures occur when a sanction regime explicitly targets energy while also including non-energy related sanctions (e.g., implementing an arms embargo in addition to an oil embargo). Here, we also include financial sanctions that directly target the energy sector.

2.4. Variations

At times, there may be a variation within a sub-measure of an energy sanction, as in the case of an increase in a partial embargo or a change in the terms of an energy exemption. We identify the existence of such variations and their movement along the spectrum of measures. We also identify variations between measures as, for example, when a partial embargo changes into a full embargo.

We depict both types of variations in Fig. 2 and, when possible, quantify fluctuations within measures. For example, when the Oil-for-Food exemptions under the 1990 Iraq sanctions increased from $5.3 to $8.3 billion, we identify the magnitude of change and depict it graphically in Fig. 2 by showing how cases with two or more variations evolve or devolve over time (presenting each case in a different color). The entirety of each of the five cases is charted on the figure, with each observation (or line segment) placed on the y-axis (based on the sanction measure used) and on the x-axis to show when the measure starts and ends. The length along the x-axis of each segment is relative to the entire length of the sanction campaign. When two or more variations occur within one measure (depicted by multiple line segments connected with elbow connectors), their placement on the y-axis is proportional to the magnitude of the variation. For example, as seen in the last part of the Iraq sanctions, energy exemptions in the Oil-for-Food program place multiple observations at the same level on the spectrum, while our placement of the segments is proportional to the magnitude of the exemption.

2.5. Supply chain

Energy sanctions are generally targeted towards a specific point on the energy supply chain. Targeting certain points and not others enables more nuanced designs by sender states that aim to increase their effects on specific sectors of the target society, while perhaps avoiding harm to other vulnerable communities within the target state. Hence, for each observation, we identify which energy type is targeted (oil, gas, coal) and which point within the supply chain is targeted (production, transit, distribution). The various segments of the supply chain, in turn, become the pressure points of the energy sanction design.

2.6. Counter-sanctions

Finally, we look at whether a sanction observation elicits a counter-sanction. In the case of energy sanctions, a sanction at one point of the energy supply chain may often cause a counter-sanction at a different point in the supply chain [21]. For example, when Russia, on multiple occasions, increased prices or embargoed oil to Ukraine, the latter responded with increased transit fees on Russian gas pipelines traveling through Ukraine. Therefore, by looking at whether a sanction causes a counter-sanction, especially when the counter-sanction is energy-based, we are able to see how energy interdependencies are extended across multiple sectors within the economies of the sender and target states. When available, we also record any trigger or stimulus for the counter-sanction.

2.7. Time period

In addition to measuring when a measure starts and ends, we also take note of the time period in which the sanction observation start-date falls. We separate our data into three distinct time periods. Our first cutoff point is the Arab Oil Embargo of 1973. This was the first major instance of energy used as a measure. Scholars have identified 1973 as a watershed in the evolution of economic sanctions [51,6]. Our second cutoff point is in 2002 in the aftermath of 9/11. The Global War on Terror following the 9/11 attacks changed how primary senders perceived the Middle East [52,53]. Therefore, Period 1 includes all observations between 1938 and 1973, Period 2 includes all cases following the Arab Oil Embargo of 1973 until the North Korean embargo of 2002, and Period 3 includes all cases from 2003 to 2014.

3. Results

3.1. Why economic energy sanctions?

Of all economic sanctions recorded, 20% are energy sanctions imposed for a variety of reasons. This number, however, represents only the minimum energy sanctions, as it does not include blanket sanctions that did not explicitly target energy but nonetheless include energy trade under their umbrella, nor sanctions in which energy may have been the implicit goal. As seen from our results, the purpose of energy sanctions is primarily to achieve non-energy foreign policy–based goals as opposed to energy goals. Fig. 1 shows that sanctions are generally aimed at coercing target states to change their behavior (38%) or to promote regime change (30%). Different states, however, use sanctions differently [Fig. 1]. Russia, for example, uses sanctions to address territorial disputes (29%), to a much greater extent than the US, whose range of goals when implementing sanctions is much more diverse. International institutions, however, rarely use sanctions, and only do so for drastic reasons such as regime change.

3.2. When are energy sanctions implemented?

Energy sanctions are not distributed equally over time. Most sanctions occur during the period 1973–2002, both in terms of total quantity and average observations per year. This period also contains the highest percentage of sanctions episodes with multiple observations per case.

Energy sanctions are embedded in a wide political economic context, and as a result about half of them are preceded by non-energy economic sanctions, as seen in Table 2, column 2. This rate is even higher for the 1973–2002 period when 77% of the energy sanctions

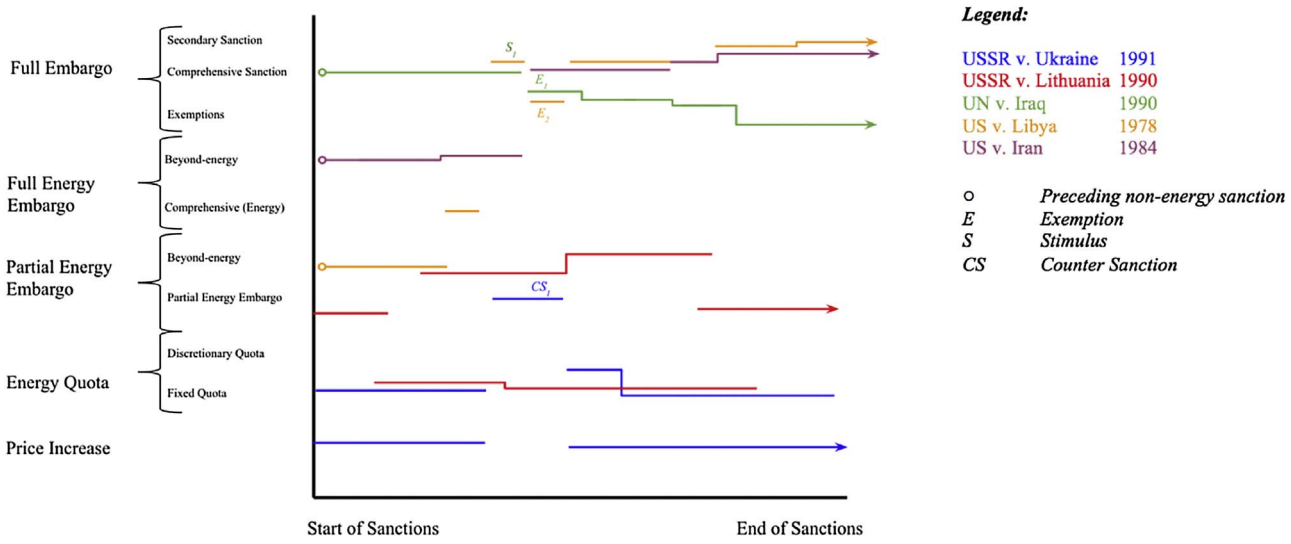

Fig. 2. Anatomy of Economic Energy Sanctions for Select Cases.
Each observation falls within one (or more) of these measures. A break in the line indicates a change between measures, whereas segments connected with elbow connectors indication a fluctuation within the measure. Where two or more jumps are presented, the magnitude of the jumps is proportional to each other based on the magnitude of the fluctuation.

were preceded by a non-energy sanction. For example, at the time of the 1990 sanctions on Iraq, agricultural credits were severely limited and an arms embargo was implemented months prior to the imposition of any energy restrictions.

In most cases, lifting the energy component of the sanction coincides with removal of the entire sanction. The only exception is Period 2, in which 28% of all energy sanctions transformed into non-energy economic sanctions after the energy component was lifted. For example, when the former Soviet Union lifted its oil and gas sanctions on Lithuania in 1990, it replaced them with increased tariffs on 200 strategic goods.

3.3. What do energy sanctions target?

Most sanctions are multidimensional, thus targeting energy as well as a non-energy goods or services simultaneously. This is frequently manifested in the form of an arms embargo in tandem with an energy sanction, as seen in Table 1, column 2. As opposed to simultaneous sanctions that target energy as well as a non-energy good, unidimensional sanctions usually target only one element of the supply chain and one energy resource exclusively, as seen in Table 2, columns 3–4.

Table 1, columns 6–7 indicate that sanctions on oil constitute the majority of energy sanctions, but natural gas sanctions appear to replace them over time. Additionally, as seen in Table 1, columns 4–5, most sanctions target the distribution segment of the energy supply chain, and those that target production or transit segments often do so in conjunction with distribution segments. For example, in the case of the dispute over dual citizenship between Russia and Kazakhstan shortly after the fall of the Soviet Union, the Russians not only restricted oil deliveries to Kazakhstan but limited Kazakhstan's access to processing facilities, hence targeting both production and distribution points. In recent decades, however, sanctions target distribution points to a much greater degree.

3.4. How are energy sanctions designed?

Table 3, which highlights the distribution of the ten energy measures we identify along the sanctions spectrum, shows that the use of a partial energy embargo, often accompanied by sanctions on non-energy goods and services, is by far the most popular measure of energy sanctions. Furthermore, the use of comprehensive measures has completely disappeared over the past decade. For example, Period 3 demonstrates that in the last decade, major sanction campaigns—such as US vs. Sudan in 1992 and 2011, US vs. Syria in 2011, and UN vs. Libya in 2011—opted to use partial embargoes rather than full embargoes.

It is also important to note that the average sanction observation

Table 1
Design of Economic Energy Sanctions.

	Average Observation Duration (Months)	Observations Exclusively Targeting Energy	Observations with Countersanctions	Supply Chain Type			Observations with Simultaneous Supply Chain Points	Energy Type			Observations with Simultaneous Energy Types
				Production	Transit	Distribution		Oil	Gas	Coal	
Period 1 (Pre-1973)	52	18%	0%	31%	23%	46%	18%	100%	0%	0%	0%
Period 2 (1973–2002)	56	25%	21%	27%	17%	56%	21%	74%	19%	7%	13%
Period 3 (Post-2002)	N/A	0%	0%	0%	25%	75%	20%	75%	25%	0%	0%
Total	55	22%	16%	27%	18%	55%	20%	81%	17%	5%	9%

The N for Period 1, Period 2, and Period 3 is 11, 48, and 5 respectively. The standard deviation for average duration for all three periods is above 70. Given the overlap between supply chain target points, the N for Period 1, Period 2, and Period 3 for the % of supply chain type is 13, 75, and 4 respectively. Given the overlap between energy type, the N for Period 1, Period 2, and Period 3 is 10, 42, and 4 respectively. We do not show the average duration of observations in Period 3 because out of the 5 observations, 4 are of ongoing sanctions.

Table 2
Sanction Design and Longevity.

	Average Case Duration (Months)	Cases With Non-Energy Sanction Preceeding	Cases With No Change Between Measures	Cases With No Change Within Measures	Sanction Continues without Energy	Energy Continues after Lifting Non-Energy
Period 1 (Pre-1973)	53	36%	100%	100%	0%	0%
Period 2 (1973–2002)	96	77%	50%	77%	28%	0%
Period 3 (Post-2002)	N/A	50%	100%	75%	N/A	N/A
Total	78	49%	73%	86%	20%	0%

The N for Period 1, Period 2, and Period 3 is 11, 22, and 4 respectively. The standard deviation for average duration of cases is above 50 for all three periods. We do not show the average duration and post-sanction information for Period 3 given that of the 4 cases, 3 are ongoing.

lasts around 55 months [Table 1, column 1], but the standard deviation is over 70 months for all three periods. Some sanctions are as short as a month, such as US vs. UK in 1956 (price fixing), while others are longer than 290 months, as in the case of Azerbaijan vs. Armenia (partial embargo). Furthermore, since the duration of a sanction does not correlate with any other variables measured, we are unable to draw any conclusions about the duration of sanctions.

When analyzing the design of sanctions in this study, we also attempt to identify correlations between the factors influencing the design of sanctions [Table 5]. Although the correlations are few and weak, the findings may shed additional light on the design process. The weak correlations seen in Table 5 show that it is difficult to predict the design of a sanction based solely on the characteristics of sender states and their intended targets. However, it also shows that as the number of segments along the supply chain with simultaneous targeting increases, the severity of the sanctions employed increases. Similarly, Table 5 also indicates that when the sanction is imposed by multiple parties (or by a larger coalition), more severe measures will be employed.

3.5. Who sanctions and how sanctions evolve?

The US, Russia, and the UN constitute the vast majority of primary senders, but there are significant differences in the way they implement their sanction campaigns. Table 4, which presents the spectrum of energy measures by primary senders, shows that the US has used a diverse set of measures in its energy sanctions. Russia (former USSR), on the other hand, has favored price fixing, quotas, and partial embargoes. UN sanctions fall into the partial or full embargo with exemption categories. Furthermore, 70% of all energy sanctions are directed toward energy imports.

Table 2, columns 3–4 shows that once an energy sanction is implemented, economic sanctions remain static over time both within and between measures (70% of all observations). For example, the US sanction on China in 1950 lasted for nearly 20 years and remained as a petroleum embargo throughout its lifespan, without undergoing any design changes. The only exception is the increased variation between sanction measures during Period 2 [see Table 2, column 3]. On the other hand, in the case of the US sanctions on Libya in 1978, the sanction design changed six times with an increase in sanction severity each time: beginning with a beyond energy partial energy embargo and ending with a comprehensive embargo with secondary sanctions attached.

The minority of energy sanctions (30%) vary within and between measures, often around the midpoint of the sanction regime. Of the cases that do vary, 45% have at least two variations. Fig. 2 shows that when sanctions variate they generally intensify along the spectrum of measures. For example, the Iran sanctions campaign began with an energy embargo but quickly increased in magnitude and eventually escalated to a full embargo with secondary sanctions. The case of Iraq is the single exception in which sanctions declined in magnitude, beginning with a comprehensive embargo and eventually decreasing substantially due to increased exemptions within the Oil-for-Food program, as well as to other concerns in the target states that forced the sender to change its design [see point S1 on Fig. 2].

Fig. 2 also shows that as the sanction moves higher along the spectrum, we find increasing variation within measures, primarily due to the changing terms of exemptions. Thus, a comprehensive sanction places various limits on the sender state, such as budgetary constraints or humanitarian concerns within the target state, leading to small changes to the design.

Sometimes sanctions and their design changes are connected to counter-sanctions, as seen in Table 1, column 2. These counter-sanctions may cause a shift in the direction of the sanction. For example, in 1993, Russia sanctioned Ukraine with an oil quota, which eventually increased to an oil embargo. When the Ukrainians counter-sanctioned Russia by siphoning off oil from Russian pipelines going through Ukraine [Fig. 2, point CS1], the Soviets downgraded their oil embargo back to a quota about a week later.

4. Discussion

In 2013, more than 5202 mega tonnes of oil equivalent (Mtoe) were traded across the globe, almost 40% of the 13,542 Mtoe of the total primary energy supply [54]. According to British Petroleum's Energy

Table 3
Spectrum of Energy Measures by Time Period.

		Energy Quota		Partial Energy Embargo		Full energy embargo		Comprehensive Embargo		
	Price Fixing	Fixed Quota	Discretionary Quota	Partial Energy Embargo	Beyond-Energy Partial Embargo	Full energy embargo	Beyond-energy Full energy embargo	Full embargo w/energy exemption	Full embargo	Secondary Sanctions on Full Embargo
Period 1 (Pre-1973)	13%	0%	13%	0%	50%	13%	0%	0%	13%	0%
Period 2 (1973–2002)	4%	10%	4%	14%	37%	2%	2%	10%	12%	8%
Period 3 (Post-2002)	20%	0%	0%	20%	60%	0%	0%	0%	0%	0%
Total	6%	8%	5%	12%	40%	3%	2%	8%	11%	6%

The N for Period 1, Period 2, and Period 3 is 8, 52, and 5 respectively.

Table 4
Spectrum of Energy Measures by Primary Sender.

		Energy Quota		Partial Energy Embargo		Full energy embargo		Comprehensive Embargo		
	Price Fixing	Fixed Quota	Discretionary Quota	Partial Energy Embargo	Beyond-Energy Partial Embargo	Full energy embargo	Beyond-energy Full energy embargo	Full embargo w/ energy exemption	Full embargo	Secondary Sanctions on Full Embargo
United States	4%	0%	11%	7%	36%	0%	4%	4%	21%	14%
USSR/Russia	17%	28%	0%	28%	22%	6%	0%	0%	0%	0%
United Nations	0%	0%	0%	0%	73%	0%	0%	27%	0%	0%

The N for the US, USSR, and UN is 28, 18, and 11 respectively.

Table 5
Correlation of Sanction Observation Factors.

	Measure	Secondary Sanction	Energy Type	Supply Chain
Measure	1.00000			
Secondary Sanctions	0.48187	1.00000		
Energy Type	−0.18551	−0.03811	1.00000	
Supply Chain	0.55552	0.33034	−0.13841	1.00000
Multiple Senders	0.47266	0.25934	−0.33553	0.18385

The table shows the Pearson correlation coefficient for the selected variables in the matrix. (Measure) uses the spectrum of measures identified, from weak to severe, as explained in the methodology section of this paper, ranging from 0 to 10. (Secondary Sanctions) is a dummy variable, recognizing the presence of a secondary sanction from the sender state. (Energy Type) uses a spectrum of energy types targeted: coal; natural gas; oil; and multiple. (Supply Chain) uses a spectrum of points targeted on the supply chain: production; transit; distribution; and multiple. (Multiple Senders) is a dummy variable, recognizing the presence of more than one sender or a coalition of senders implementing a sanction on the target state.

Outlook Report, by 2035 a 37% increase in the world energy demand is expected, which will drastically increase the flow of energy [55]. Much of the demand and consumption of oil and other energy sources is concentrated among a few key players, including Russia and OPEC countries on the exporting side and the US, China, and the EU on the importing side [54]. As energy trade increases, so does the risk of disruption by energy sanctions. Hence, the aim of this study is to introduce a new empirical framework by unpacking and characterizing how energy sanctions are used by various players and how sanctions evolve over time.

This unequal distribution of energy sanctions suggests that several preconditions must be met for a country to impose these measures. The literature on economic sanctions suggests that senders should have pre-existing energy trade with the target state, have a diversified energy market that can withstand either supply or demand changes incurred due to the sanction, and have the political capital, both domestically [56] and internationally [57], to enact sanctions legislation. The demands of this capability, also known as “energy power” [58], explains why most sanctions occur at the hands of the US and Russia—given their large economic leverage in the global market as well as their vast political will [9]. The high bar for both imposing and implementing energy sanctions may also explain why most of the sanctions analyzed in our study are static in time. Given that sanction implementation often faces issues of domestic compromise and debate, implementing sanctions multilaterally is even more complicated due to the added number of actors in the international arena and difficulty of enforcement. Therefore, an increased transaction cost comes with each design change, perhaps contributing to the static nature of sanctions. These findings are extremely important for sender countries, which should be aware that although a variety of sanctions is available, sender countries are bound to certain conditions that shape their sanction practices. For example, as scholars have already identified, Russia has a broad strategy of using carrots and sticks to coerce its neighbors, often by removing subsidized energy prices [10]. This Russian practice illustrates the connection between energy carrots and sticks, whereby the provision of a carrot enables a future sanction. Hence, if subsidies are provided by the sender country, they are a fertile ground for future sanctions in the form of price fixing and quotas. At the same time, the UN has difficulty imposing and enforcing sanctions due to the multilateral nature of UN negotiations and the operation methods of the Security Council. Thus, the UN is likely to make limited use of sanctions, corresponding with limited measures, such as partial energy embargos used only under extreme cases. The US, as opposed to the other senders, has a wider choice of measures, which can be attributed to its ability to leverage its purchasing power over energy suppliers, especially as it continues to diversify its energy sources.

Our finding that most countries implementing energy sanctions are concentrated among a few specific players, each implementing sanctions differently for different purposes, can facilitate policymakers’ and scholars’ understanding of the likely sanctioning implications of trade under different conditions with specific countries. Our findings also indicate what might be expected once a trade sanction is imposed. It is likely that sanctions will target exclusively the distribution segment within the energy supply chain. The prominence of sanctions targeting the distribution segment can perhaps be attributed to the decline of centralized control over the means of production. This decline is evident in the growing availability of infrastructure and knowledge supplied by multiple parties, making distribution a more effective sanction target [59]. In fact, today, with the exception of natural gas, “few traded goods are supplied by way of national permanent infrastructure and long-term supply arrangements” [35].

Yet, our results suggest that the supply chain can act as a double-edged sword, either limiting or expanding the availability of sanction measures. Furthermore, the decline in oil sanctions and the rise of natural gas sanctions coincide with the global increase in natural gas trade (up 47% in 2015). The rise of natural gas, and hence the increased instability of supply, including through the increased use of sanctions, has already been anticipated by some scholars [35]. With this rise, however, comes an increase in sunk costs, possibly creating an even more fertile environment for sanctions on natural gas and its infrastructure.

The anatomy of energy sanctions depicted by this study also provides target countries with some warning signs of when to expect the imposition of sanctions, as they are likely to be preceded by non-energy sanctions. Furthermore, it signals the difficulty of predicting the length of these sanctions given the extreme variability found in their duration. Our findings also indicate that the lifting of energy sanctions will most likely coincide with the lifting of the entire sanction campaign. Finally, the few correlations detected within the design of sanctions seem to indicate that sender countries apply a tactic of combined methods in designing an arguably more comprehensive trade restriction to increase the effectiveness of sanctions imposed. They also signal a possible positive feedback that may exist between measures, and how the use of

one measure legitimizes the use of another.

For both senders and targets, our findings predict a shift in how sender states impose sanctions. It is likely that the profiles of future importers and exporters will change drastically, as the US will likely shift from a natural gas net importer to a natural gas net exporter. Russia, although projected to remain the leading energy exporter with only small declines in the global market share [55], will experience increasingly problematic energy revenues challenges [60]. With these changes, and with the US remaining a substantial oil importer, it can be expected that the US will become an even stronger energy sanctioning country, targeting both imports and exports. This could imply greater diversity within US sanction designs, which may include increased use of quotas and price fixing on export sanctions. Russia, on the other hand, can be expected to decrease its use of sanctions given its increased need for revenues in a changing global market.

Additionally, on a global scale, sanctions are generally static (i.e., they do not change over time); but when variations do take place, they lead to a slippery road of complex nuances and counter-sanctions. These effects illustrate that sanctions are often "a one-time shot" due to the high transaction costs involved with each design change.

Another valuable lesson for both sender and target is the decline of comprehensive embargos and the rise of targeted sanctions in the future. Many of the traditional sanctions in our dataset are being replaced by financial sanctions, which correspond with the rationale of smart sanctions discussed earlier. It appears that countries are switching to smart sanctions because they impose similar, if not greater, costs on the target, while avoiding the negative impacts that come with comprehensive sanctions, such as widespread negative humanitarian impact on the target's population [61]. For example, whereas the 1978 sanctions on Libya were comprehensive, including a full trade embargo, the 2011 sanctions on Libya were targeted, freezing the assets of specific entities, including oil producing companies that were fueling Gaddafi's regime. It is important to note, however, that although we see an increase in the preference to impose smart sanctions over traditional trade sanctions, the effectiveness of the latter remains disputed [62].

5. Energy sanctions: a new research agenda

This study marks the first quantitative analysis of the design and anatomy of energy sanctions. The literature so far on this topic has been limited, largely descriptive, and lacked longitudinal perspective. This research gap is surprising given the extensive use of energy sanctions in foreign policy. The aim of this study is to begin filling the gap and to introduce a new empirical framework to unpack and characterize how energy sanctions are used and evolve over time. In doing so, we also propose a rudimentary explanation for some of our findings.

Yet, the limited scope of this study leaves many questions unanswered, questions that can set a new research agenda for scholars interested in the interface between geopolitics and energy. Some of this new agenda should focus on the underlying reasons behind the anatomy of energy sanctions. For example, how are energy sanctions lifted and why: Is it due to the target's compliance or because the sender's cost (both political and economic) has become too big to bear? For both options, we will need to unpack the spectrum of sanctions that this study unravels, and identify how the range of options affected the cost-benefit ratios of sanctions imposed under different social contexts. While some have attempted to answer this question by identifying the cost associated with maintaining and lifting economic sanctions, their studies have been restricted to general economic sanctions. Hence, there is much to be discovered with regard to the applicability of these studies in relation to energy. Another overarching question is why sanctions are so static: Is it because of high transaction costs associated with each design change? If the lack of change is due to underlying constraints, we must further study the elements of the transaction costs of imposing each measure, and how they are a function of international economic and internal political concerns. Alternatively, perhaps the static nature of sanctions is an outcome of the difficulty in maintaining a sanctions coalition (as was the case in the recent Iran sanctions), which results in energy sanctions being "one-shot deals."

Another unaddressed research direction is how to better quantify the effectiveness of these sanctions and their implications for the various energy sectors, as not all energy users are likely to be equally vulnerable to different economic sanctions. For example, embargos on exporters can also encourage an increase in domestic consumption within the target country, as the alternative benefits from energy exportation are no longer available.

Also, while some have explored the domestic impact of sanctions and the difficulty of imposing and maintaining effective multilateral sanctions, it is unclear whether the findings on economic sanctions are applicable to energy sanctions. Of interest to energy scholars is the domestic impact of smart energy sanctions that seem to have replaced the traditional energy sanctions.

Finally, because this paper addressed the design of energy sanction, its focus was on the sender rather than on target countries. Nevertheless, the literature points to the fact that sender states tailor the design of sanctions in accordance with the probability of effectiveness, with effectiveness being also a function of the target's specific characteristics [63,64]. While the limitation of our dataset to 38 target countries does not allow us to meaningfully engage with this issue, we do find that certain senders have imposed energy sanctions on a select number of target countries over the years, while the US has imposed sanctions on a large number of states, perhaps with lesser adaptation to the target countries' specific characteristics. Further research is needed on target countries, as well as on the interaction between targets and the sender in the design of sanctions.

Given the growth of the energy trade and its unique nature—including its supply chain, associated sunk costs, and interplay with global security and the global economic market—scholars should look specifically at energy sanctions, isolating them from sanctions in general. By looking at sanctions through this unique energy frame, scholars and policymakers alike will be able to better understand how energy sanctions evolve and how sanctions will be designed in the future—issues that impact the ability of the energy sector to absorb these sanctions.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.erss.2017.05.008.

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