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Global Energy Governance: Trade, Infrastructure, and the Diffusion of International Organizations

Introduction

The vital role of oil and gas in the modern world economy makes the understanding of the governance of global energy one of the most important issues in both economics and political science (Goldthau and Witte 2011; Looney 2012). Currently, about one fifth of global trade consists of flows of fossil fuels. Despite a growing energy interdependence between countries, the international system lacks a central authority to foster the coordination of energy policy. Thus, the role of international governmental organizations (henceforth, IGOs) which regulate oil and gas is crucial for understanding the dynamics of the international energy market. Surprisingly, few studies have as yet empirically explained the choice to join an IGO.[1] As a consequence, the reasons why countries decide to form or to join energy IGOs have yet to be explored. We fill this gap by developing a theory built on the diffusion literature and on trade and geo-strategic relationships between countries.

In this paper we make three contributions to the literature on governance and international cooperation. First, we argue that states use these organizations to improve or consolidate their market position while reducing the risk of suffering competitive disadvantage on the world market. Specifically, we show that a producer country joins energy IGOs in response to its main trade partners and direct competitors in the oil and gas sector having previously gained membership. On the one hand, we find that exports from energy producing countries allow us to predict the diffusion of their memberships in energy IGOs. For instance, Iran, whose main competitors and partners are Shanghai Cooperation Organisation (SCO) members, has been trying to enter the SCO since 2008.[2] Iran's concern is to be left out of the quickly developing energy business in Central Asia. On the other hand, we find no evidence that market competition between oil and gas consumers is relevant to

[1] One of these is Maoz (2011). However, the literature on cooperation in environmental policy, which is tangential to the literature on cooperation in energy policy, is large. For recent studies, see Urpelainen (2011) and Brochmann (2012).

[2] The Shanghai Cooperation Organisation, founded in 2001, involves six countries: China, Russia, Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan. Iran was granted observer status in 2005. Other observers are India, Mongolia, and Pakistan.

explaining membership in energy IGOs. We therefore detect a clear difference in the way producer and consumer countries perceive the role of energy governance.

Second, we argue that countries join energy IGOs to effectively coordinate energy policies in the presence of common geo-strategic and regional interests. Oil and gas transportation represents a pivotal element of both producer and consumer countries' energy security. Indeed, pipelines constitute a costly and long term investment; countries become sensitive to the energy policy implemented by other countries with which they share such an important infrastructure (Victor et al. 2006). Concretely, we demonstrate that states join the same energy IGO in response to a membership previously gained by countries with which they share oil and gas pipelines. To test this chain of diffusion, we use original data on pipelines, which include transit countries.

Finally, we provide evidence that the institutional design of energy IGOs impacts the evolution of the corresponding organizational field. Indeed, specific provisions included in or excluded from the treaties are responsible for speeding up—through oligopolistic provisions, for instance—or slowing down the proliferation of the individual energy IGOs. In doing so, we fill the gap in the existing literature, which has largely neglected the effect of the design of IGOs on the process of their diffusion.[3]

To test these hypotheses, we rely on a newly-compiled dataset that includes 34 IGOs, 153 countries and covers 38 years (1970–2007). We combine two different methods to explore the diffusion of energy IGOs. First, we use network analysis to describe the evolution of the energy IGO network from the 1970s to today. Specifically, we highlight the sequence in which IGOs were established, the main patterns of the emerging organizational field, and recent developments that are likely to affect energy governance in the coming decades. Second, we use spatial econometrics to estimate how interdependence between countries drives the diffusion of energy IGOs, as is emphasized by our theory. We model spatial interdependence using the insights gained by the network analysis and relying on the aforementioned concepts of trade and geo-strategic proximity rather than geographic proximity.

[3]The literature on policy diffusion has been well developed in every field of political science, i.e., American politics, comparative politics, and international relations. Seminal papers are Volden (2002), Gleditsch and Ward (2006), Franzese and Hays (2008), Simmons, Dobbin, and Garrett (2008), and Gilardi (2010). For an extensive recent survey of this literature, see Graham, Shipan, and Volden (2011).

This paper is structured as follows. The next section describes the evolution of the inter-organizational network of the relevant energy IGOs. The second section presents the theoretical framework which serves as the basis for the discussion and develops our two main hypotheses. The third part introduces the spatial econometric model and outlines the methodology used to test the hypotheses. The fourth section gives the empirical results of the econometric analysis. The fifth section provides additional evidence to support our argument. Finally, some conclusions and implications are drawn.

1 The Evolution of Global Energy IGO Networks of Oil and Gas

The description of sectoral global organizational fields is still in its infancy.[4] In the following section, we present selective network visualizations of the evolving organizational field in global energy, with a focus on IGOs regulating oil and gas. Over the past 40 years, IGOs and their membership has proliferated dramatically. According to our sample selection of such IGOs (see the Appendix for the sample and the selection criteria), the number of IGOs in force now is 34 and almost every country is now a member of at least one IGO. Moreover, the most important trade agreements, such as the Asian Pact, the EU, NAFTA, and Mercosur, include several provisions that regulate the energy sector. Surprisingly, given these facts, the strategic reasons for the diffusion of global energy governance organizations have been given little consideration in the International Relations (henceforth, IR) literature. Overall, explanatory approaches are still the exception in the literature on inter-organizational networks.[5] Before developing our theory explaining how trade and geo-strategic relationships affect the proliferation of energy IGOs, we will outline the main historical events that shaped the evolution of the energy IGO network.

As Colgan, Keohane, and Van de Graaf (henceforth CKG 2011) note in their historical overview of the global energy system, there was no structured energy co-

[4]For the concept of organizational fields, refer to Di Maggio and Powell 1983. For the interorganizational networks of IGOs, see Ingram and Busch 2005; Beckfield 2008, Haffner-Burton et al. 2009; Maoz 2011

[5]See Gulati and Gargiulo 1999; Thurner and Binder 2009.

operation between countries until the early 1970s.[6] This lack of cooperation was mainly due to the fact that the national energy markets had mostly been autarkic until WWII and that the US was the world's largest oil producer (CKG 2011: 7). As a consequence of an external shock, i.e., the Arab–Israeli War of June 1967, Kuwait, Lybia and Saudi Arabia formed OAPEC in 1968, with the aim of coordinating oil supply during crises of energy supply and military conflicts.

Although it was initially created by moderate Arab countries, in order to depoliticize the energy trade, hawkish Arab countries in the early 1970s such as Algeria, Egypt, Iraq, and Syria were admitted to membership, so that the organization was led towards anti-Western positions. These became effective during the Yom Kippur War of October 1973, when OAPEC imposed oil embargoes on the US and the Netherlands (and later on Portugal and South Africa) following their defense of Israel. OPEC, for its part, imposed a relevant price increase, and the major companies were no longer able to compensate from other production regions.

The uncoordinated and competitive reaction of oil importing countries to the crisis further worsened the negative impact of the oil shortage on their economies (CKG 2011: 9). As a result of the unsuccessful management of the oil crisis, US Secretary of State Kissinger suggested the creation of an IGO of oil consumers to counterbalance the power of OAPEC (Keohane 1978; Colgan 2009). Sixteen OECD countries took this suggestion, establishing the IEA at the end of 1974 (see Figure 1). IEA was mainly an organizational platform emanating from the OECD to develop and implement preventive crisis reaction rules and to build up special expertise. The organizational field thus experienced the formation of a so-called bi-component, indicating a clear polarization between producer and consumer countries.

[Figure 1 about here]

[6] OPEC was the genesis of the organizational field, as it is the first energy IGO. The formation of OPEC was a reaction of Iran, Iraq, Kuwait, Saudi Arabia, and Venezuela to a cartelized production and pricing regime established by Western companies. It was formed in 1960, but was originally organized not as an oligopolistic body to set prices and quotas, but as an instrument "to reduce dependence on the oil companies" (CKG 2011: 8). While we provide theoretical insights about the creation of energy IGOs which also apply to OPEC, diffusion models do not allow elucidating the establishment of the first IGO. OPEC is thus exogenous to our empirical analysis: in this paper, we do not explain the creation of OPEC, but we deal with all the subsequent energy inter-governmental organizations.

During the 1980s, the IEA undertook important changes in its regulations. For instance, the IEA created the coordinate emergency response measures (CERM), which allowed a more flexible approach to supply shortfalls. As a consequence of such amendments, by early 1990, membership in IEA had grown to include virtually every OECD country. Finland and France were the last Western European countries to join the IEA in 1992.

The founding of the Organization for African Unity (OAU) in the 1960s and the Latin American Energy Organization (OLADE) in the 1970s already indicates a clear regionalization of the global energy IGO network (see Figure 2). Interestingly, it already combines both consumer and producer countries. Nevertheless, the polarization between Western import countries (IEA) and the main producer countries remained despite these efforts. However, the past two decades have seen the formation of several energy IGOs comprising both producers and consumers (Stevens 2012). After the breakdown of the Soviet Union, the Energy Charter (see Figure 3) was a major effort to integrate Russian energy production with Eastern and Western European consumer countries. These efforts to institutionalize inter-governmental cooperation notably included investment and transit issues. However, this first major effort to bridge the interest between a major export country and the transit and import countries failed, because Russia was not willing to subscribe to the Energy Charter treaty.

The most important current example of harmonizing producer and consumer interests world-wide is the formation of the International Energy Forum (2002) whose members include key oil exporters, such as Brazil, Russia, and Mexico, as well as large importers, such as France, Italy, and Japan (see Figures 4 and 5). IEF's main goal is to improve the quality of the information available in the energy market, as the Joint Oil Data Initiative sponsored by IEF member countries shows (CKG 2011: 12). IEF is not the only case of an IGO formed by both oil and gas producers and consumers.

At a regional level, the formation of NAFTA, a trade agreement that also regulates the energy sector, includes a large oil importer (the US) and a large oil exporter (Mexico). According to Cameron and Tomlin (2002: 37), energy policy was a crucial issue in the negotiation of NAFTA. Similarly, since ASEAN countries encompass all of China's energy-shipping routes from the Middle East, Africa, and Latin America, Beijing insisted on making energy cooperation a cornerstone of the ASEAN-China

PTAs signed on the 4^{th} of November 2001. Moreover, regarding multi-purpose organizations, energy is a crucial issue in the G20, in which there are both large oil consumers and producers. Figures 2, 3, 4 and 5 show the proliferation of energy IGOs over the past three decades.

[Figures 2, 3, 4 and 5 about here]

What are the main macro-dynamics in the organizational field of global gas and oil? In the beginning, one observes a differentiation and sectoralization, as indicated by the founding of the OPEC and the IEA. A contemporary phase is characterized by a regionalization, with the creation of IGOs such as OAPEC, OLADE, ASEAN, and APPA. Only by the end of the 1980s does one see tendencies toward market-integrating organizations, as well as efforts at greater centralization at the global level, to reduce defragmentation and desegmentation. Since the 1990s one finds an acceleration of the founding of IGOs.

Many organizations are now competing at identical tasks. Figures 6 shows the current structure of the energy organizational field. We included information indicating as to whether an IGO (represented by a circle) or a country (represented by a triangle) is a net oil-and-gas importing (colour blue) or exporting (colour red) country.[7] The sizes of the triangles and circles are proportional to the net size of the importing and exporting entities, respectively. The network nodes (countries and IGOs) are placed in the field according to the spring embedder, which is an algorithm reflecting network centralities.[8] We see that IGOs such as OPEC or the GECF are quite central players in the organizational field. Note also that single countries such as Russia and Norway are highly centrally located.

To conclude, the take-away message from this historical overview of the energy IGOs proliferation can be summarized into the following points. First, the formation of the IEA was a direct result of the creation of OPEC and OAPEC. Second, there is evidence that both producers and consumers initially excluded from energy IGOs requested membership either to influence the decisions taken by such organizations or due to a fear of being cut off from the energy market and of losing

[7] The list of IGOs categorized in producer IGOs and consumer IGOs is provided in the Appendix.

[8] As the number of the intersections of lines should be as low as possible, those nodes in the middle of the field can be interpreted as relatively more central.

competitiveness. Indeed, the IEA includes now virtually every large oil and gas consumer, whereas OPEC and OAPEC include almost every large oil producer.[9] Third, although the energy IGO network remains mostly polarized and regionalized (see Figure 6), there is evidence of an increasing cooperation between oil and gas producers and consumers.

[Figure 6 about here]

2 Theory and Hypotheses

With these historical insights in hand, we now advance the argument that the diffusion of energy IGOs is a function of competition over the oil and gas market. According to the public choice view, governments establish international organizations in order to use them as international cartels of policy regulation (Vaubel and Willett 1991). Competition does not arise only between oil and gas producers and oil and gas consumers, but also within the groups of buyers and sellers. Our core argument is that the decision to join IGOs regulating oil and gas depends on whether other states, and in particular the main direct trade competitors (in the oil and gas sector), are already members of these IGOs. Specifically, countries react to an IGO in which a main direct competitor is a member by either establishing a competing IGO or joining the same IGO. We will explain the causal mechanism in detail in the following two subsections.

However, before proceeding to present our theory, a conceptual disclaimer is needed. There is a widespread debate in the literature as to what exactly is covered by the term "cartel". As Fattouh (2007) and Colgan (2011) have outlined, part of the literature considers oil producers' IGOs such as OPEC and OAPEC to have acted as cartels throughout their existence (see Krasner 1974; Moran 1987; Ikenberry 1988; Hyndman 2008). Other authors and energy experts state that these energy IGOs' control over the market has changed considerably over time (Adelman 1982; Mabro 1991; Kohl 2002; Smith 2005; Colgan 2011; Goldthau and Witte 2011). For instance, according to this view, OPEC operated effectively as a cartel only during the 1970s and 1980s, but its influence over the market has subsequently faded to a level that does not meet the definition of cartel. Furthermore, it is quite difficult

[9] As we show below, the GECF shows signs of having the will to establish a similar system for gas producers.

to prove the effectiveness of such regimes. Problems of self-selection loom large, as the very act of joining already indicates the willingness to subscribe to anticipated policy-decisions under the constitutional rules consented to. The mere existence of a consumer cartel such as IEA and its power accumulation may constitute a very effective threat even if important provisions have never been used, because the competitor organization accepts the credibility of these stipulations and other counter-measures. Finally, coordinated oligopolies may be effective in raising their rivals cost (Vaubel and Willett 1991).

In our analysis, we prefer the use of the term coordinated oligopoly (see Gilbert and Lieberman 1987; Stennek 1997; Fattouh 2007), as we acknowledge that the possibility of being a cartel does not solely rely on the scope of the organization and its members. It also depends on the financial and productive conditions of the market as well as on the stance of other market players, such as energy companies and consumer states. Thus, conditions favorable for the operation of an oil cartel have existed only in certain periods of history. We are instead in the presence of an oligopolistic system whose members coordinate themselves.

2.1 Reacting to Direct Competitors

Why should countries react when their direct competitors join energy IGOs? For producers, being excluded from such a coordinated oligopoly is costly for two main reasons. **First**, a producer excluded from an oil coordinated oligopoly is likely to have little impact upon oil and gas quota decisions and therefore upon price. Obviously, there are some exceptions. For instance, large and powerful producers such as Russia or producers that depend mainly on a single buyer, such as Mexico (which sells oil mainly to the US), are less concerned about being left out from a coordinated oligopoly. However, this does not hold for the majority of relatively small and less powerful producers. As Mingst notes (1977), the pressure for Arab countries to join OAPEC in the early 1970s was very high, since the initially restricted membership of this organization monopolized the most important decision-making processes in terms of energy supply. Moreover, Blaydes (2004) notes that small producers constantly free-ride in OPEC at the expense of Saudi Arabia, increasing their incentive to be members.

Second, the coordinated usage of energy resources as a political leverage to influence foreign and security policies was (and still is) widespread among producing countries. As for Arab countries, the cost of being excluded from OAPEC was particularly high, given the inability to have an impact on the Middle East turmoil in the early 1970s. For instance, the Saudi Petroleum Minister, Sheikh Yamani, said that OAPEC is "a means to realize success for Arab economic and foreign policy".[10] Beyond the Arab countries, being excluded by an energy IGO is likely to be costly for every country. For instance, Vietnam and Laos are two net oil producers which export mainly to ASEAN member countries, such as Singapore. Vietnam's and Laos's decision to join the ASEAN Pact in the 1990s was partially motivated by the increasing cooperation in the energy sectors among its member countries. This cooperation, developed in the Program of Action for Enhancement of Cooperation in Energy, and, later, the Plan of Action on Energy Cooperation, threatened Vietnam's and Laos's energy interests in the region vis-à-vis direct competitors, such as Malaysia and Indonesia (Nicolas 2009).

Admittedly, the pressure to join an IGO of consumers has less to do with the oligopoly argument, but still rests upon the public choice approach outlined above. For consumers, there are two reasons that we want to flesh out. The **first** reason has to do with information. Although some energy IGOs are often soft-law organizations, they provide information which is notably rare, and, therefore, highly valuable in the energy market (Harks 2010: 249). As Jackson (2009: 154) puts it, access to information "shapes their incentives regarding which relationships to form or maintain and ultimately affect the network structure". This diffusion of information through the network of energy IGOs is particularly relevant for consumer states because it is expected to lower transaction costs for countries by implementing common standards, improving the quality of the available data, and increasing the transparency in energy policies implemented domestically. In turn, lower transaction costs facilitate interactions between members.[11]

For instance, this argument, emphasizing the role of information, explains the success of the International Energy Forum (IEF) in bringing together both consumers and producers.[12] As the Director for Information and International Affairs

[10]Quote reported in Gilani (2009: 63).

[11]We acknowledge that information is a relevant issue both for consumer and producer countries. However, we speculate that consumers experience more difficulties in finding timely and reliable data to reduce market uncertainties because, unlike the producers, they do not control the energy sources. For a similar argument, see Bressand (2010).

[12]The role of the IEF as a vehicle of information and recruiter of data mainly serves the purpose of

for OAPEC, Wailid Khadduri (2005), argues, "a well-informed media with credible information and up-to-date data can provide better coverage and analysis to the interest of both producers and consumers." Membership in the IEF has boomed over the past decade. IEF member countries now account for more than 90 percent of global oil and gas demand, with fifty countries joining talks in the May 2008 meeting in Rome. We argue that this is a result of countries' perception that exclusion from an organization in which important trade partners (both oil and gas importers and exporters) take part and share crucial information has prohibitively high costs.

The **second** reason has to do with the *costs* that consumers face from being left out of an IGO. Energy security is a fundamental part of consumer states' national security. Fuel is vital for national defense, for the preservation of states' economic infrastructure, and it has to be obtained at affordable prices. Powers such as China and the US can compete over the direct control of energy assets, but the majority of buyers has not the economic and political strength to do the same. Thus, the main playground for consumers' competition is the creation of redundant and continuous networks of supply (Nicolas 2009).

The geo-strategic nature of the energy commodity makes markets of oil and gas particularly sensitive to external political pressures (Jakobson and Zha, 2006). For instance, the price of Brent rose in December 2011 when Iran threatened to close the Strait of Hormuz. It subsequently fell when the US affirmed that Iran's attempt to close the Strait of Hormuz would not be tolerated.[13] Moreover, resources are spread unevenly in the world, and for the most part lies in politically unstable areas.

The pressure to join an IGO has also to do with specific mechanisms that mitigate the impact of external shocks. Indeed, since its foundation, the IEA has designed a system to cope with oil supply shortages and disruptions. Specifically, the IEA requires its members to keep an oil reserve equivalent to their net consumption of oil for 90 days (CKG 2011: 9). In the event of a shock's shrinking the supply of oil, the IEA is allowed to distribute oil to its members so that their economies can

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providing consumer countries with credible news of energy production and supply from producing countries, as demonstrated by the Joint Oil Data Initiative (JODI). In exchange, producer states are directly involved in the framing of international energy security policies.

[13]See H. Stewart (12/28/2011). "Oil price falls after US warns Iran over threat to close Gulf supply route," The Guardian, accessed February 21, 2012, *http : //www.guardian.co.uk/business/*2011*/dec/*28*/oil − prices − iran − supply − threat*.

still run. This "safeguard" mechanism, encompassed in the IEA provisions, helps stabilize the supply of oil in the short term and so the price.[14] Thus, the members of IEA enjoy an economic advantage over other oil and gas consumers in the event of an energy crisis. As Rogoff (2005) notes, since consuming nations have become better adapted to oil volatility, oil price fluctuations no longer affect economic growth quite as much as in the 1970s and 1980s. We argue that the mitigating impact of IGOs on crises contributes to explaining why virtually every large oil consumer asked to join the IEA during the 1970s and 1980s. In sum, our main hypothesis can be put as follows:

Hypothesis : A country is more likely to join an IGO in which other competitors in the energy sector are already members. As such, an oil and gas producer (or consumer) should react to the formation of an IGO by other producers (or consumers) by asking to join that IGO or a competing one.

Every diffusion argument begs for an answer to the question: what explains the first energy IGO? As explained in the previous section, the first actions of the first energy IGOs, OPEC and OAPEC, were triggered by external shocks and traumatic transitions. Shocks and transitions in the energy market are often caused by conflicts. Since conflicts have occurred frequently in the Middle East over the past decades, external shocks are more common in the energy market than in other sectors. For instance, it is well documented that oil and gas price volatility is quite high, higher than that for the majority of other commodities (Harks 2010). In order to account for these volatilities reflecting latent or manifest conflict, we control for oil price in the econometric analysis.

3 Research Design

The model that we estimate includes a spatial lag of the dependent variable, weighted by trade relationships between countries, several alternative spatial lags, and con-

[14] A similar provision has been recently included by ASEAN Energy Ministers in the new ASEAN Petroleum Security Agreement (APSA). Specifically, in the case of a shortage, net oil exporters in Southeast Asia are expected to supply petroleum products to the countries in need at discounted prices. Similarly, in the event of an oversupply, net importing countries would purchase the products from those exporting countries.

trol variables that capture economic and political factors that might influence the formation of an IGO. We thus estimate the following equation (accelerated failure time [AFT] specification):

$$ln(t_i) = \beta_0 + \beta_1 X_{i,t-1} + \beta_2 W_{ij,t-1}\bar{y}_{i,t-5} + \epsilon_{i,t}, \tag{1}$$

where $ln(t_i)$ is the number of years without a country joining an IGO, β_0 is a constant, β_1 and β_2 are the coefficients, $X_{ij,t-1}$ is a vector of control variables, W_{ij} is the connectivity matrix whose specifications are described below, and $\bar{y}_{i,t-5}$ is a variable that takes the value one if country i has joined an energy IGO over the previous five years. As a result, $W_{ij}\bar{y}_{ij,t-5}$ is the vector of spatial lag terms. Finally, $\epsilon_{ij,t}$ is the error term.[15]

Our argument implies that for country i, the cost of being excluded from the energy IGO network should increase as such a network develops, i.e., as the number of countries that are members of at least one energy IGO increases. In econometric terms, we expect to fail at a faster rate as time goes on, i.e., the hazard rate increases monotonically. Thus, we opted for a parametric survival model. Per the Akaike Information Criterion (AIC) and the Bayesian Information Criteria, we selected the Weibull model. However, in the Appendix we show that our results hold also when using other parametric models such as the Gompertz model.[16]

As is common in panel data with a binary dependent variable, we use Huber (robust) standard errors (Beck 2008: 486). These standard errors take account of possible heteroskedasticity (serial correlation) or intra-group correlation of the data. Finally, to account for the multi-spells problem, we estimated the models presented above including an inverse-Gaussian distributed country-level frailty term that, as

[15] In line with advice contained in Ward and Gleditsch (2008), we checked whether the inclusion of spatial lags is appropriate by calculating the Moran index, using the total number of IGOs joined by each country. The result confirms that there are statistically significant spatial correlations (at 99 per cent level) between countries.

[16] Survival analysis is the appropriate approach because we are dealing with right-censored data. See also Beck 2008. The study by Elkins et al. (2006) of the diffusion of bilateral investment agreements also uses a survival model. Darmofal (2009) provides an extensive analysis of the use of survival models with spatial effects.

a Monte Carlo simulation shows, produces unbiased coefficients (Box-Steffensmeier and Jones 2004, 142).[17]

3.1 Dependent Variable and Main Covariates

To arrive at our dependent variable, for each country we coded whether it joins an IGO in a specific year. This allows us to calculate the time in years that a country goes without signing an IGO, that is, the hazard rate. In the baseline analysis, every accession scores one. However, in the section Additional Evidence, we relax the assumption that every organization is the same by looking at the design of energy IGOs and by distinguishing between types of energy IGOs.

In building our list of energy IGOs, we relied on Pevehouse Data, Yearbook of IGOs (2008–2009), as well as on original sources. Following Keohane (1984: 239), we considered those formal and informal organizations which act as energy regimes for countries, developing positive rules in the energy sector and providing effective stimuli for states to abide by those rules. For our analysis, we thus selected organizations which have energy policy and/or incentives for investments in the energy sector among their primary areas of cooperation.[18]

As a result, our database includes 28 of these IGOs (see Table 1).[19] Our model explains 481 failures during the period under investigation. The unit of analysis is the country-year. We analyse 152 countries that have data available across 38 years, i.e., from 1970 to 2007.

Table 1 about here

[17] The results are similar if we use Gamma frailty (see the Appendix).

[18] We do not include IGOs that are global (i.e., that include virtually all the countries in the world) and for which energy policy is only a marginal issue. For instance, we do not include the WTO, the IMF, or the G20. We also decided not to include the EU, because energy has only recently gained preeminence in the organization, while our analysis considers the provisions established at the birth of the IGO and we disregard updates. The EU adopted a common energy policy in 2005, and the Lisbon Treaty (2007) is the first treaty which contains explicit reference to energy solidarity of member states and established a shared competence in energy matters.

[19] Since ASEAN and OAPEC were formed before 1970, they are not included in our dependent variable. However, both ASEAN and OAPEC are included in our spatial lags ($\bar{y}_{i,t-5}$), i.e., they trigger the formation of other energy IGOs in the five years after their creation.

The main independent variables are $N \times t$ spatial weight matrices. A spatial weight matrix measures the impact of a policy change in a country on all other countries. It uses specific factors, such as spatial proximity or degree of economic interdependence, to weigh the importance of a policy change in one unit for other units. In our case, the policy change is whether a country joined an IGO between one and five years ago. The variable is lagged by one year to avoid simultaneity bias. This may lead to an underestimation of the spatial effect if countries already react to other countries' announcement of negotiations of IGOs, but it also mitigates concerns about endogeneity (Beck, Gleditsch, and Beardsley 2006). The reason for the five-year cutoff point is that after some time, the external effect of an IGO should disappear, with countries either having successful joined an IGO or having adapted to the new situation.[20]

For an oil and gas producer, the risk of suffering a competitive disadvantage in a world market as a result of being excluded from an IGO is particularly high if such an IGO is formed by other producers. Similarly, an oil and gas consumer is particularly concerned of suffering a competitive disadvantage as a result of being excluded from an IGO formed by other consumers. We measure the degree to which two countries compete in the same market by identifying big exporters and big importers of oil and gas. We operationalize the argument by reasoning that country A should feel threatened by an IGO between B and C (D, E, ...) if (1) country A and country B are both large exporters of oil and gas, or (2) country A and country B are both large importers of oil and gas. In other words, if both country A and country B export large flows of oil and gas, we expect that country A should react to an IGO previously joined by country B by either joining the same IGO or forming a competing one. Conversely, we do not expect a reaction from country A, if country B does not export oil and gas.[21]

Data on bilateral trade flows in oil and gas are taken from the COMTRADE dataset (2009) and they are disaggregated at the sector-by-sector level using the SITC (Rev. 3) classification.[22] We lag the measure by one year to avoid simultane-

[20]The five-year cut-off point is also consistent with the operationalization used by Egger and Larch (2008) in explaining the proliferation of PTAs. Our results are not sensitive to a five-year cut-off point threshold: we obtain similar results changing this value to three or seven years.

[21]In the Appendix we show a chunk of the connectivity matrix as described in equation (2).

[22]SITC 3 did not exist until 1986 and there are problems of concordance between revision 2 and revision 3 (all these problems are documented in the Appendix).

ity bias.[23] More formally, the spatial weights of the variables Spatial Competition (producer) and Spatial Competition (consumer) for country A are:

$$Spatial\ Competition(producer)_A = \sum_{B,D,\ldots}^{n} \left[Total\ Export_A \times Total\ Export_{B,D,\ldots} \times IGO_{A;B,D,\ldots(t-5)} \right] \quad (2)$$

$$Spatial\ Competition(consumer)_A = \sum_{B,D,\ldots}^{n} \left[Total\ Import_A \times Total\ Import_{B,D,\ldots} \times IGO_{A;B,D,\ldots(t-5)} \right] \quad (3)$$

Since Spatial Trade and Spatial Competition are highly correlated, we estimate our main explanatory variables in separate models.[24] Figure 7 plots the value of these two spatial variables (producer) for a top producer, i.e., Nigeria, and for a top consumer, i.e., France, over time. Strikingly, high values of Spatial Competition (producer) and Spatial Competition (consumer) are associated to membership in energy IGOs. This is particularly true for Nigeria. The graph shows also that Spatial Competition (producer) does not increase monotonically over time, mitigating the concern about serial correlation.

[Figure 7 about here]

3.2 Control Variables

Besides reaction to trade and competition, several alternative causal mechanisms could drive the diffusion of energy IGOs. Thus, we include a set of control variables in our models to avoid overestimating the effect of the main explanatory variables.

[23] Because of outliers, we use the natural logarithm of this variable in our models below. Results shown below are not sensitive to this decision.

[24] We obtain similar results if we divide export and import (plugged into our connectivity matrices) by GDP. We do not opt for this operationalization in the main analysis since that is usually used as a proxy for trade openness, which is not part of our theoretical framework.

First of all, we include the variable Spatial Distance. This spatial lag term captures other diffusion effects that should be stronger between geographically close countries. This variable is particularly important since regionalization is one of the main features of the energy IGO networks (as described in the first section). We calculate this spatial lag by multiplying the reciprocal of (the logarithm of the) distance by the number of energy IGOs that the other country signed onto within the past five years. Data on distance come from the GeoDist dataset collected by Mayer and Zignago (2011).[25]

We include several economic and political control variables in our model. Most of these variables are lagged by one year to avoid endogeneity problems. Moreover, we include *per capita* GDP and the logarithm of Population. They measure economic development and size of a country and are collected by the IMF (2008) and the WDI (2008), respectively. We also control for the type of regime. Specifically, the variable Regime is the democracy score of country i at time $t-1$ from Polity IV. It combines the competitiveness and openness of executive selection, institutional constraints on executive authority, the competitiveness of political participation, and the rules that regulate political participation. Moreover, we control also for the number of absolute IGO membership (Total IGO) that states have individually joined. Data comes from the International Governmental Organization (IGO) Data (Pevehouse, Nordstrom, and Warnke 2004).

Finally, we include some variables related to the energy sector. Energy Intensity controls for the vulnerability of a country to energy supply disruptions. It is a measure of energy efficiency and it is calculated in units of energy per unit of GDP. Nuclear Share and Hydro Share as alternative sources of energy are expected to lower the dependence on oil and gas. Similarly, Oil Reserves and Gas Reserves are expected to decrease the incentives to join an energy IGO. Oil Price controls for energy shocks. Oil and Gas Production and Oil and Gas Production control for the level of oil and gas exports and imports, respectively. Since these last two variables are heavily correlated, $\rho = 0.82$, we include them in two separate models. Note: we lose half of the observations by including energy-specific variables. Thus, we omit them from the baseline models. Table 3 in the Appendix gives the descriptive statistics of the variables included into our models.

[25]The data are available at $http://www.cepii.fr/anglaisgraph/bdd/distances.htm$.

4 Baseline Findings

Model 1 shows the results for the baseline model, whereas Models 2–7 show the results for extended models (Table 2). Before discussing the findings, we evaluate the overall model fit using Cox–Snell (Cox and Snell 1968) residuals. Figure A-1 in the Appendix shows that there are no concerns regarding lack of fit by comparing the jagged line to the reference line.[26] Overall, the predictive power of our baseline model is therefore quite strong.

[Table 2 about here]

Regarding Spatial Competition (producer), the coefficient is positive and statistically significant at the 99 percent confidence level in every model. Interestingly, Spatial Competition (producer) remains positive and statistically significant also when we include Spatial Distance (which is positive and statistically significant, as expected). This finding is important for us since Spatial Competition (producer) aims to capture economic proximity in general, and competition between producers in the oil and gas market, in particular. The fact that Spatial Competition (producer) remains statistically significant even after having included Spatial Distance reinforces our claim that Spatial Competition (producer) is not a mere proxy for a diffusion process that is geographically clustered.

These findings on the variable Spatial Competition (producer) confirms our hypothesis that membership in IGOs regulating energy can be seen as a collaboration game, which may have a "race to the bottom" as equilibrium. If a competitor of country A joins an IGO, this substantially increases the benefit of the membership for A, to minimize the risks of exclusion.

Conversely, the variable Spatial Competition (consumer) is not statistically significant at the conventional level and the sign of its coefficient is always negative. Thus, there is no evidence that competition between consumers in the oil and gas market is a driver of the proliferation of membership in energy IGOs. As the next section will show, this result can be explained by the fact that IGOs of producers

[26]When plotting the Nelson–Aalen cumulative hazard estimator for Cox–Snell residuals, some variability is still expected, especially in the right-hand tail. This is because of the reduced effective sample caused by prior failures and censoring (Cleves et al. 2008: 216).

are very different from IGOs of consumers. While an IGO of producers can be considered an oligopoly (even if an imperfect one) from which it is costly to be excluded, being left out of consumer IGOs produces low costs, weakening the trigger mechanism and the effect of the spatial lag.

Figure 8 illustrates the magnitude of the effect for Spatial Competition (producer). Moving from the minimum to the maximum value to the first two variables makes a country substantially more likely to form (or join) an energy IGO. The effect of Spatial Competition (producer) on the probability of forming (joining) an IGO is particularly high in the middle of our time span, i.e., the 1980s and 1990s, in which the region between the two curves widens substantially, i.e., by more than 0.2. Since almost every country in the dataset is a member of at least one energy IGO by the end of the time period, the effect of our spatial terms decreases after 2000. Overall, these results show that the impact of our spatial lags on the dependent variable is not only statistically significant, but also substantively large.

[Figure 8 about here]

Moreover, the other control variables have the expected signs (when they are statistically significant at the conventional level) adding plausibility to our results. Interestingly, the energy variables are never statistically significant though the sign of their coefficients is that which was expected. Finally, it is worth noting that $p > 1$ in the Weibull regression. This suggests that the hazard function is monotonically increasing. This result also supports our claim that as IGOs spread, it is increasingly more problematic for countries to be excluded from these organizations.

5 Additional Evidence

Our theoretical framework spells out specific causal mechanisms that explain the diffusion of energy IGOs. This section provides further empirical evidence of these mechanisms' validity. First, we investigate the argument that the presence of a common infrastructure such as an oil and gas pipeline increases the incentives for energy policy cooperation between countries. This further test is particularly important since we found that competition between producers in the oil and gas market is an important driver of the proliferation of energy IGOs. Second, we have already suggested that energy IGOs are different from one another. As such, we explore how their design impacts the mechanism of diffusion through competition. Finally, we distinguish between types of energy IGOs since, for instance, consumer IGOs pursue different goals than do producer IGOs.

5.1 Oil and Gas Pipelines and Energy Cooperation

The previous results show that trade relations increase the probability of cooperation in energy policy. However, trade is not the only variable of interest for countries when it comes to energy governance. We mentioned previously that Vietnam and Laos joined the ASEAN Pact to increase their cooperation in energy policy with the ASEAN members that rely heavily on oil and gas produced by Vietnam and Laos. This is not surprising given the emphasis on energy policy placed by ASEAN member countries. Indeed, since its formation, ASEAN has established four offices that manage 17 programs exclusively dedicated to promoting and coordinating energy research and addressing energy-related problems (Sovacool 2009: 2357). However, this cooperation reached a defining moment in the 1990s when ASEAN member countries decide to implement the trans-ASEAN gas pipeline (TAGP) network, an ambitious project to interconnect the centres of demand and supply for natural gas.

The ASEAN case highlights the importance of sharing a common energy infrastructure in general, and an oil and gas pipeline in particular, on the decision taken by countries about joining the same energy IGO. Building a pipeline is a huge investment for countries, with large sunk costs in the event that the project does not succeed. An energy IGO might mitigate the risk of a failing investment. Moreover, the construction of a pipeline creates geo-strategic interests and, in turn, might increase the incentives to institutionalize cooperation through an energy IGO. As such, for country A it is costly to be excluded from an energy IGO that include countries with whom country A shares an oil and gas pipeline. Concretely, we expect that country A join the same IGO in response to memberships gained by countries that share a pipeline with country A. To test the hypothesis that countries sharing a pipeline join the same energy IGO, we first use an undirected dyad-year unit of analysis building on our sample of 152 countries.[27]

[27]We use the minimum value of GDPpc, Population, Regime, and Total IGO, as is customary with undirected dyads.

There is, however, also the possibility that a country sharing a pipeline may join a rival energy IGO. This happens when a state perceives that the benefits of the pipeline are not being shared equitably among the states involved, i.e., when the pipeline creates or reinforces a path of dependence of one country on another. Let's take the Ukraine–Russia pipeline relationship as an example. Ukraine is heavily dependent on Russia for its domestic consumption of gas. It is also the main transit country for Russian pipelines to Europe. As the outcome of the gas crises between the two countries testifies, political factors (such as Russian interference in Ukrainian politics) and economic imbalance (such as the low transit fee that Kiev obtained for gas passing through its territory) have led to major difficulties in cooperating over energy infrastructure and trade (Pirani et al. 2009).

Ukraine has been seeking for alternatives to Russian pipelines. For instance, in 1994, it applied to and ratified the Energy Charter Treaty. While Russia also agreed to participate in the founding of that new organization, it was clear that it did not share many of its principles. Indeed, Moscow never ratified the treaty, and withdrew in 2009. In contrast, in 2010 Ukraine also joined the Energy Community, an EU-financed body, to extend the EU's energy regulation beyond its borders. This helped the country to advocate for its pipeline projects, which helped to ease its dependence on Russia and open new market routes to Europe (Shapovalova 2010).[28] The example shows that countries sharing oil and gas pipelines do not always have incentives to join the same energy IGOs. Concretely, in our model we also expect that country A joins a rival IGO in response to memberships gained by countries that share a pipeline.

In both the dyadic and monadic setting, our hypothesis leads us to expect that the pressure on an excluded country A to respond to an IGO joined by B (D, E, . . .) depends on whether a pipeline transits both country A and country B (D, E, . . .). Using the maps included in the World Energy Atlas 2009 and OME gas pipelines list (2010), we built a world dataset of oil and gas pipelines, which covers 70 years (1950–2020). The dataset groups pipelines by decade. It indicates their typology (oil, gas, or products) and which countries are traversed by each pipeline. In this way, it is possible to measure the number of infrastructural interconnections between every pair of countries in the world. This aspect is particularly relevant for studying

[28] An example is the White Stream pipeline project, proposed in 2005 and then included among the European "priority projects" in 2008.

the behaviour of transit countries. Part of such a country's choice of joining an IGO certainly comes from its internal energy situation as exporter or importer. Yet, its strategic position in the transport chain and the possibility of building energy hubs (as in the case of Turkey) is also a vector for its behaviour with regard to producer and consumer IGOs. We deal with the potential endogeneity problem by lagging the pipeline data by ten years and with outliers by taking the natural logarithm of the spatial term.[29] More formally, the spatial weights of the variable Spatial Pipeline for country A are:

$$Spatial\ Pipeline_A = \sum_{B,D,\ldots}^{n} \left[Pipeline_{A;B,D,\ldots} \times y_{A;B,D,\ldots(t-5)} \right] \quad (4)$$

We include the minimum value of the Spatial Pipeline in the dyadic baseline model. Note that in the dyadic model we do not include Spatial Competition (producer) and Spatial Competition (consumer) since the diffusion mechanism for these variables is mainly monadic.[30] Table 3 shows that the variable Spatial Pipeline has a positive coefficient, as expected, and is statistically significant at the 99 percent level in both the dyadic model (Model 8) and the monadic model (Model 9).

Moreover, as Figure 9 shows, the impact of Spatial Pipeline on the probability of joining an energy IGO is substantively large. Indeed, when Spatial Pipeline has a value of 15, the probability for a country such as the Ukraine or Slovakia to enter into an energy IGO is about unity after 20 years, i.e., in the middle of our time span. It is worth noting that the effect of the dyadic model is larger than the effect of the monadic model, i.e., the pressure to join the same IGO is bigger than that of joining a rival one. Since a pipeline is especially responsible for increasing the incentives to energy cooperation among countries that share this infrastructure, this finding makes theoretical sense, adding plausibility to our analysis.

[Table 3 about here]

[Figure 9 about here]

[29]Since building a pipeline takes long time, lagging this variable for one year, as it is customary, would not address the endogoneity issue.

[30]The correlation between Spatial Pipeline and Spatial Competition is 0.2.

5.2 The Design of Energy IGOs

So far, we have treated all energy IGOs as if they were the same. However, there is a great deal of variation in the design of these organizations. For instance, in some cases energy IGOs operate with considerable formal powers, but every decision must receive the unanimous approval of all member states. In other cases, powers and staff are rather limited but the organization gets a freer hand in its relations with member states.

In line with our theoretical framework, we look at two dimensions of the design of energy IGOs. First, we argue that for oil and gas producers, the incentives for joining energy IGOs are particularly high when an energy IGO is a coordinated oligopolistic system. Second, we claim that for oil and gas consumers, the incentives for joining energy IGOs are particularly high when an IGO provides aid in the case of an energy shortage. To test two corollaries to our main hypothesis, we use as lagged dependent variable of our spatial terms only those IGOs that are coordinated oligopolies or that provide aid. Concretely, we create two spatial variables, Spatial Competition Oligopoly (producer) and Spatial Competition Oligopoly (consumer), that include only those IGOs that are a coordinating oligopoly as in our coding scheme (see the Appendix). Similarly, we create two spatial variables, Spatial Competition Aid (producer) and Spatial Competition Aid (consumer), that include only aid energy IGOs, disregarding the others.[31]

Table 3 shows that the results are in line with our expectations. Regarding the oligopolistic energy IGOs, Spatial Competition (producer) has positive coefficients and is statically significant at the 95 percent level, whereas Spatial Competition (consumer) has a negative coefficient, though it is not statistically significant. This result is very important for two reasons. First, this result validates one of the causal mechanisms of the diffusion of energy IGOs as described in our theory. Specifically, it is costly for a producer to be left out of an IGO that is (or aims to be) a coordinated oligopoly. Second, this finding shows that some energy IGOs are more effective than others due to specific provisions of their design. As such, our results are suggestive of the presence of energy governance among oil and gas producers.

[31]To be sure, regarding Spatial Competition Oligopoly, we want to check if oligopolistic IGOs alone trigger the diffusion of IGOs. Thus, as from equation (1), $\bar{y}_{i,t-5}$ includes only the oligopolistic IGOs, whereas $ln(t_i)$ (i.e. the dependent variable) includes the entire sample. We use a similar approach with Spatial Competition Aid.

Regarding the aid energy IGOs, there are no differences between these results and those of the baseline models. Thus, there is little evidence that providing aid in case of an oil and gas shortage is a relevant feature of the energy IGOs' designs. This confirms that competition between oil and gas consumers has no effect on the diffusion of energy IGOs. Another explanation is that, as we show in the Appendix, aid energy IGOs have usually a shallow design and so the incentives for being a member might be lower than those for deeper IGOs.

5.3 Types of Energy IGOs

As Table 1 shows, some of the energy IGOs included in our analysis are trade agreements that not only regulate the energy sector, but also address trade and trade-related issues. Previous studies have shown that the proliferation of these trade agreements is a function of the amount of trade diversion faced by countries that are excluded from a trade bloc (Baccini and Dür 2012). To make sure that our results are not driven by trade concerns which have little to do with the energy sector, we estimate Models 12 and 13, excluding trade agreements from the sample of energy IGOs.

Table 4 shows that the sign and level of significance of our main explanatory variables do not change, reinforcing the validity of our argument. This result is important. It shows that if we replicate the analysis excluding organizations that are only about energy, our findings still hold. Thus, we can confidently claim that our results are not sensitive to the selection of a a particular sample of energy IGOs.

[Table 4 about here]

6 Conclusion

Our analysis has focussed on the role of economic relations (in general) and trade relations (in particular) in explaining the proliferation of energy IGOs and the increase in their membership over the past four decades. On the one hand, our analysis emphasized the timing of the formation of an energy IGO as a response to the creation of an IGO by one's main competitors (for producers) and by countries sharing geo-economic interests (for consumers). On the other hand, our models explained that when the incentives to coordinate energy policy are high, being excluded from existing energy IGOs is too costly for those countries that had originally decided to not cooperate. These two mechanisms in combination are responsible for the development of the "energy regime complex" developed analytically by CKG (2011) and described in the first part of the paper.[32].

More particularly, we made three specific contributions to the literature on governance and international cooperation. First, we showed that producer countries form and join energy IGOs in response to memberships gained by their main trade partners and direct competitors in the oil and gas sector. Conversely, we found no evidence that the same mechanism holds for consumer countries. Second, we demonstrated that countries which share pipelines are more likely to join the same IGOs. Third, we showed that the design of energy IGOs affects the development of the network. Indeed, specific provisions included in or excluded from the treaties are responsible for speeding up or slowing down the proliferation of energy IGOs.

The second finding speaks to the Regional Security Complex Theory literature on energy (Buzan et al. 1998; Buzan and Wæver 2003). Energy systems emerge where countries placed in a specific geographic area feel the need to secure their energy policy under the umbrella of a regional energy IGO. A common infrastructure, such as a regional pipeline, requires a common management and a united response in case of external shocks, e.g., oil and gas shortages. Thus, the existence of pipelines calls states to collectively administer the infrastructure through institutionalized cooperation, i.e., through membership in an energy IGO.

The third finding on the importance of IGO design is particularly noteworthy for at least two reasons. First, while the literature on the diffusion of international organizations and international institutions is large, little attention has been paid to their design (Elkins et al. 2006; Beckfield 2008; 2010; Baccini and Dür 2012). Our study showed that in explaining the diffusion of IGOs, the design should be taken into account both theoretically and empirically. For instance, the strong effect of the variable Spatial Competition Oligopoly (producers) demonstrated how relevant provisions about oligopoly are when export states have to decide whether to join an energy IGO. Indeed, countries include or exclude specific provisions from the treaty to gain a relative advantage over their economic and political competitors. Thus,

[32] For an empirical application of the energy regime complex in environmental policy, see Keohane and Victor (2010).

the influence of design touches both the countries' energy trade choices and their geo-strategies.

Second, our paper suggests that provisions included in the treaty of an IGO are not independent from provisions included in treaties of similar IGOs. For instance, forming an IGO (e.g., OPEC) which includes provisions creating an oligopolistic system triggers other IGOs (e.g., OAPEC) to have similar provisions in their treaties. Future studies should further explore the role of geo-strategic variables in the formation of energy IGOs and develop their operationalization. Subsequent studies should also model the process of diffusion of the design or template of international organizations using *ad hoc* spatial terms instead of limiting the analysis to only the formation of such organizations.

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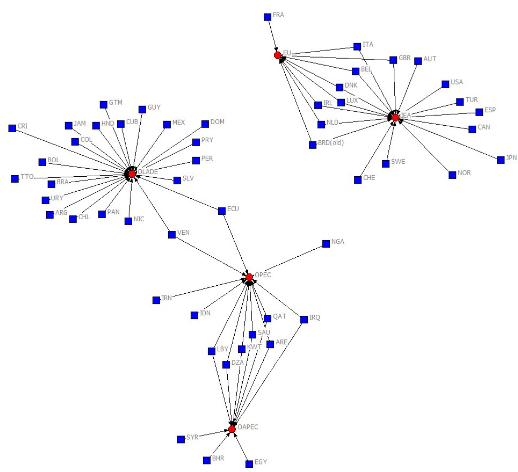

Figure 1: Energy IGOs Network – 1974.

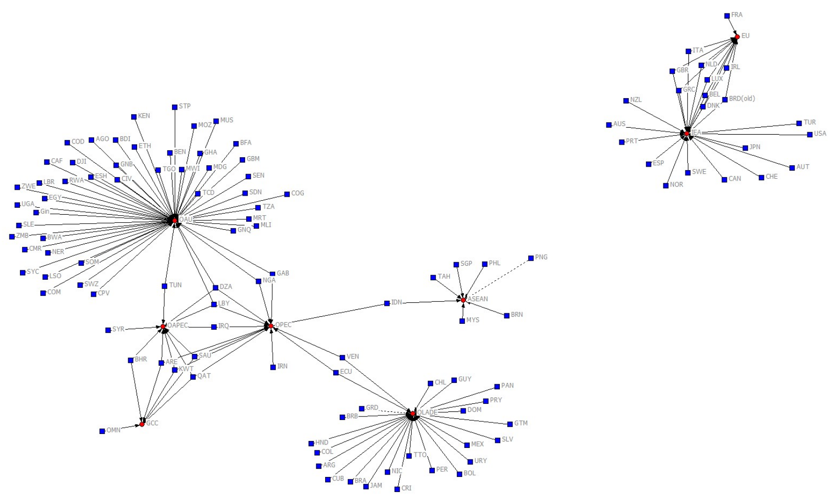

Figure 2: Energy IGOs Network – 1985.

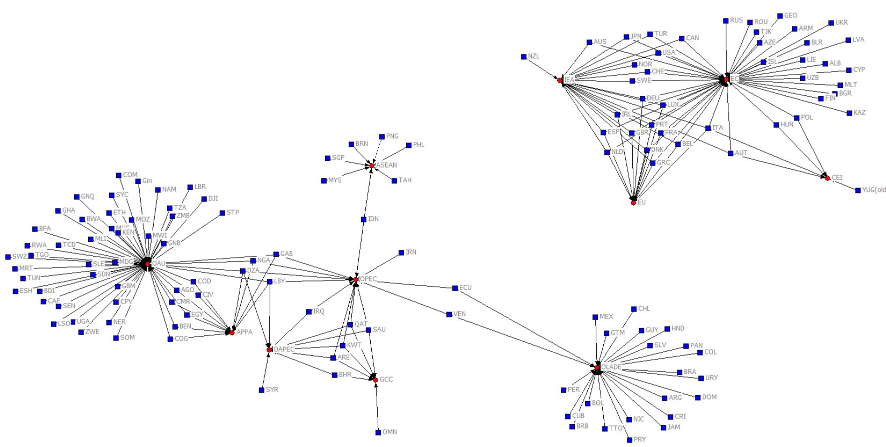

Figure 3: Energy IGOs Network – 1991.

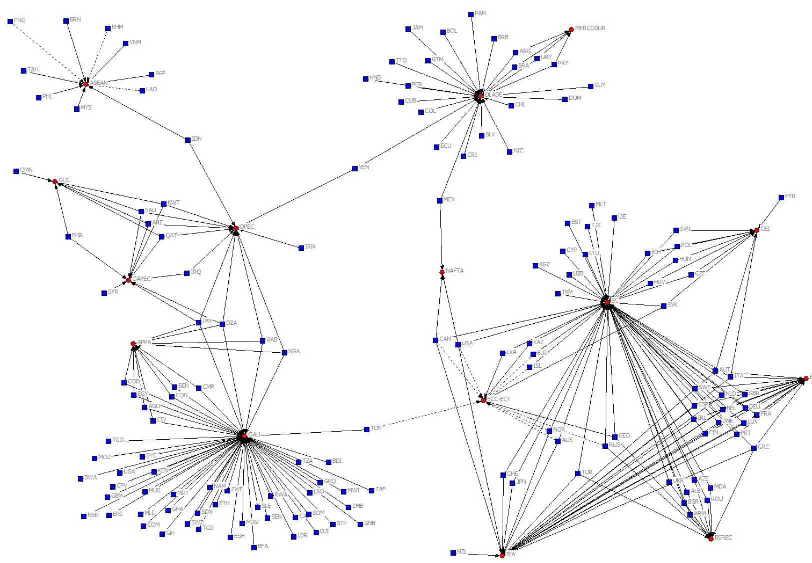

Figure 4: Energy IGOs Network – 1995

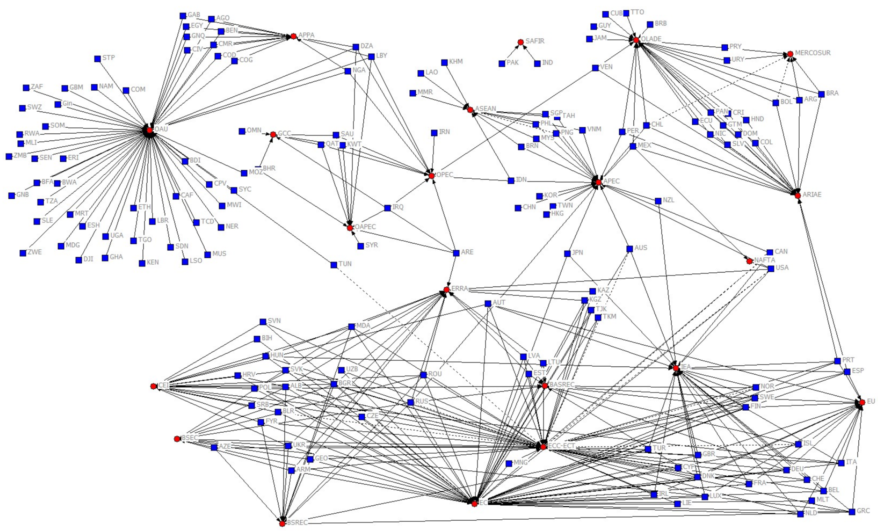

Figure 5: Energy IGOs Network – 2000.

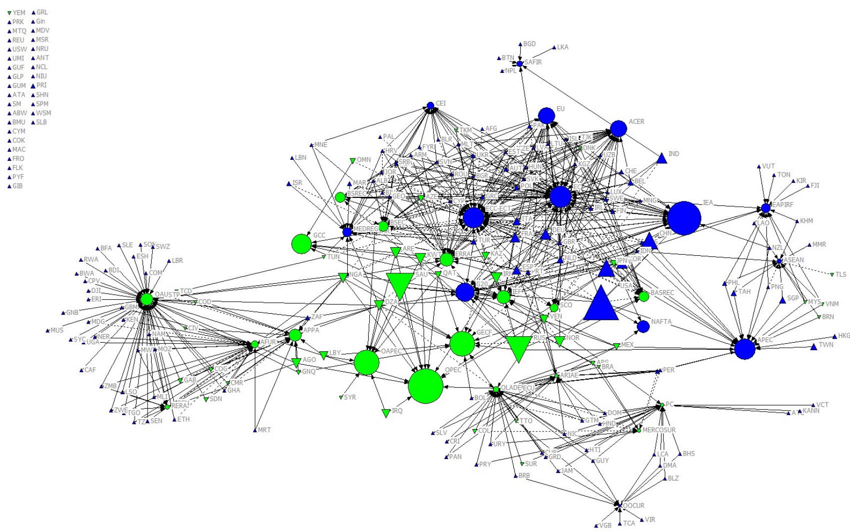

Figure 6: Energy IGOs Network: Producers vs. Consumers – 2009.

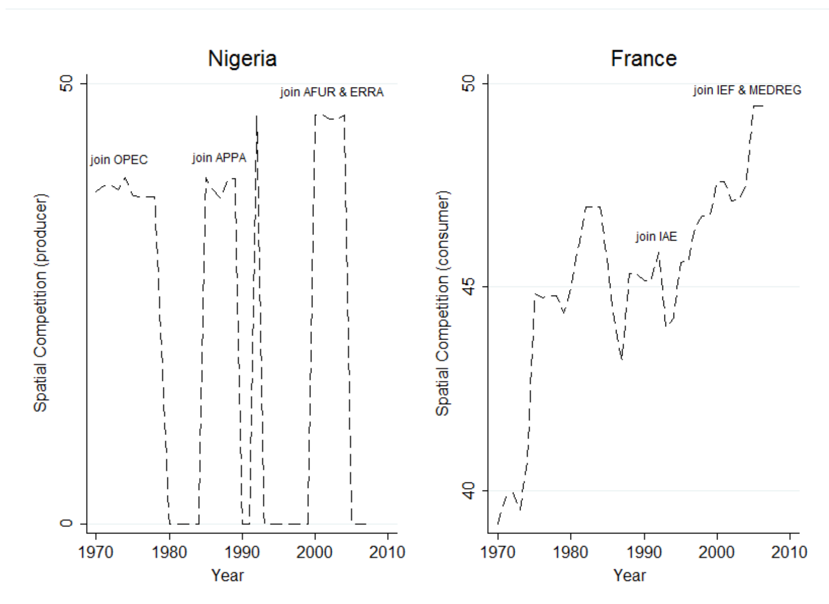

Figure 7: The value of Spatial Competition (producer) for Nigeria over time (left). The value of Spatial Competition (consumer) for France over time (right).

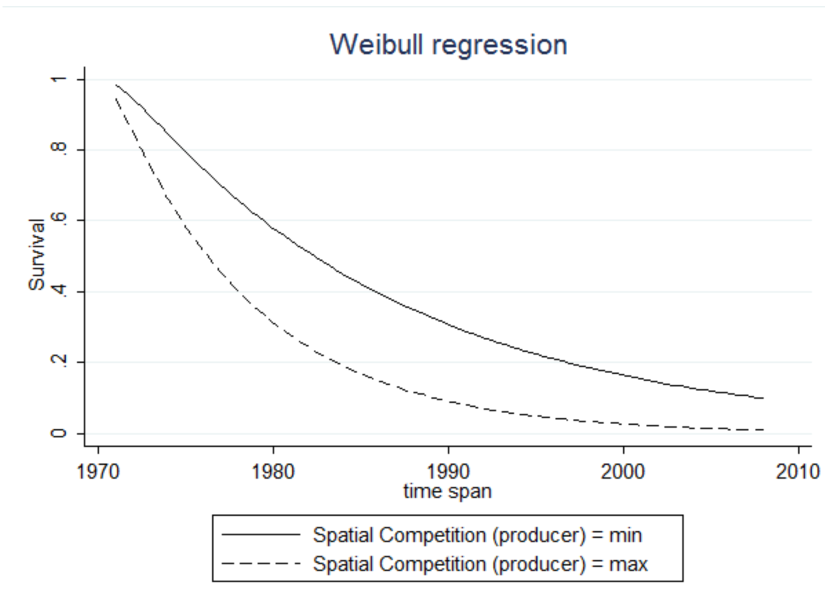

Figure 8: Survival estimates: Spatial Competition (producer).

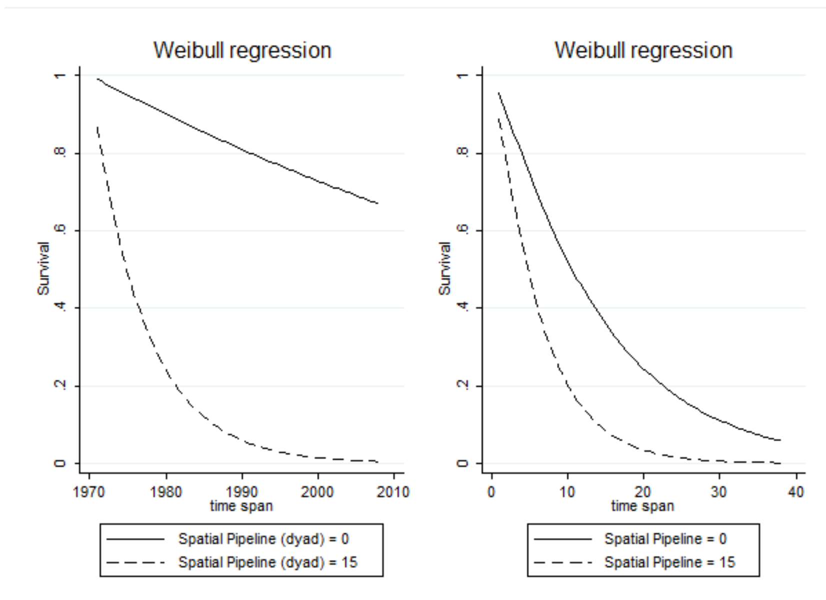

Figure 9: Survival estimates: Spatial Pipeline – dyad-year (left side) and Spatial Pipeline – country-year (right side).

Table 1: List of the 28 IGOs regulating energy included in the econometric dataset.

Name	Acronym	Year	PTA
Association of Southeast Asian Nations (Energy Initiative)	ASEAN	1967	yes
Organization of Arab Petroleum Exporting Countries	OAPEC	1968	no
Latin American Energy Organization	OLADE	1973	no
International Energy Agency	IEA	1974	no
Gulf Cooperation Council	GCC	1981	yes
African Petroleum Producers Association	APPA	1987	no
Asia-Pacific Economic Cooperation (Energy Working Group)	APEC	1989	no
Central European Initiative	CEI	1989	no
European Energy Charter/Energy Charter	EC	1991	no
MERCOSUR	MERCOSUR	1991	yes
North American Free Trade Agreement	NAFTA	1994	yes
Baltic Sea Region Energy Cooperation	BASREC	1995	no
Black Sea Regional Energy Centre	BSREC	1995	no
Organization of the Black Sea Economic Cooperation	BSEC	1999	no
South-Asian Forum for Infrastructure Regulation	SAFIR	1999	no
Asociacion Iberoamericana de Entidades Reguladoras de la Energia	ARIAE	2000	no
Energy Regulators Regional Association	ERRA	2000	no
Gas Exporting Countries Forum	GECF	2001	no
International Energy Forum	IEF	2001	no
Shanghai Cooperation Organisation	SCO	2001	no
African Forum for Utility Regulators	AFUR	2002	no
Organization of Caribbean Utility Regulators	OOCUR	2002	no
Regional Electricity Regulators Association	RERA	2002	no
East Asia and Pacific Infrastructure Regulatory Forum	EAPIRF	2003	no
European Regulators' Group for Electricity and Gas	ERGEG	2003	no
Petrocaribe	PC	2005	no
Energy Community	EnC	2006	no
Mediterranean Gas and Energy Regulators Assembly	MEDREG	2007	no

Table 2: Spatial Competition – Weibull model with inverse gaussian frailty, robust standard errors clustered by country.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Spatial Competition (producer)	0.026***	0.023***	0.029***	0.026***	0.028***	0.012**	0.03***
	(0.007)	(0.007)	(0.007)	(0.009)	(0.010)	(0.005)	(0.01)
Spatial Competition (consumer)	-0.012*	-0.014**	-0.007	-0.015	-0.011	-0.007	-0.01
	(0.007)	(0.006)	(0.008)	(0.012)	(0.014)	(0.007)	(0.01)
Population	0.070	0.088	0.081	-0.015	0.008	-0.097	-0.02
	(0.066)	(0.064)	(0.072)	(0.101)	(0.115)	(0.089)	(0.15)
GDPpc	-0.038***	-0.016	-0.047***	-0.036**	-0.037**	-0.022**	-0.04**
	(0.013)	(0.013)	(0.016)	(0.015)	(0.017)	(0.009)	(0.02)
Regime	0.058***	0.054***	0.060***	0.088***	0.110***	0.049***	0.11***
	(0.016)	(0.016)	(0.020)	(0.029)	(0.028)	(0.015)	(0.03)
Total IGO	0.006	0.006	0.003	0.013	0.010	0.003	0.01
	(0.006)	(0.006)	(0.007)	(0.011)	(0.012)	(0.006)	(0.01)
Spatial Distance		0.541***					
		(0.154)					
Oil Price			-0.000				
			(0.000)				
Energy Intensity				0.744**	0.739**	0.391**	0.75**
				(0.310)	(0.310)	(0.160)	(0.31)
Nuclear Share				0.537	0.766	0.104	0.90
				(0.632)	(0.755)	(0.438)	(0.77)
Hydro Share				-1.085**	-1.173**	-0.361	-1.15**
				(0.522)	(0.530)	(0.317)	(0.58)
Oil Reserves					0.007***	0.002	0.01***
					(0.003)	(0.001)	(0.001)
Gas Reserves					-0.075	-0.115*	0.19
					(0.103)	(0.061)	(0.24)
Oil & Gas Consumption						0.209**	
						(0.104)	
Oil & Gas Production							0.09
							(0.16)
P	1.94***	1.77***	1.73***	2.06***	2.12***	1.12***	2.20***
	(0.13)	(0.13)	(0.29)	(0.33)	(0.52)	(0.26)	(0.54)
Constant	-5.004***	-7.526***	2.649	-9.929***	-5.282	-6.239***	-4.49
	(1.081)	(0.385)	(0.159)	(0.237)	(0.228)	(3.731)	(4.01)
No. of countries	152	152	152	86	86	86	85
No. of failures	397	397	353	241	222	222	217
Observations	4,630	4,630	4,027	1,979	1,871	1,871	1,818

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Spatial Pipeline & Design of Energy IGOs – Weibull model with inverse gaussian frailty, robust standard errors clustered by dyad (Models 8 and 9) and by country (Models 10 and 11).

	(8)	(9)	(10)	(11)
Spatial Competition (producer)		0.015***		
		(0.004)		
Spatial Competition (consumer)		-0.004		
		(0.004)		
Spatial Pipeline (dyadic)	0.17***			
	(0.01)			
Spatial Pipeline		0.061***	0.057***	0.062***
		(0.011)	(0.013)	(0.011)
Spatial Competition (producer) – Oligopoly			0.008**	
			(0.004)	
Spatial Competition (consumer) – Oligopoly			-0.005	
			(0.004)	
Spatial Competition (producer) – Aid				0.014***
				(0.004)
Spatial Competition (consumer) – Aid				-0.001
				(0.003)
Population	0.03***	0.017	0.032	0.016
	(0.01)	(0.032)	(0.032)	(0.032)
GDPpc	-0.12***	-0.014**	-0.008	-0.014**
	(0.004)	(0.007)	(0.006)	(0.007)
Regime	0.02***	0.029***	0.033***	0.028***
	(0.002)	(0.009)	(0.009)	(0.009)
Total IGO	0.01***	-0.002	0.001	-0.002
	(0.001)	(0.003)	(0.003)	(0.003)
P	1.00***	1.14***	1.13***	1.13***
	(0.01)	(0.05)	(0.05)	(0.05)
Constant	-4.83***	-3.402***	-3.557***	-3.369***
	(0.15)	(0.542)	(0.561)	(0.544)
No. of countries	152	152	152	152
No. of dyads	13,750			
No. of failures	5,373	397	397	397
Observations	417,295	4,630	4,630	4,630

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Type of energy IGOs – Weibull model with inverse gaussian frailty, robust standard errors clustered by country.

	(12)	(13)
Spatial Competition (producer)	0.026***	0.026***
	(0.007)	(0.007)
Spatial Competition (consumer)	-0.015**	-0.011*
	(0.007)	(0.007)
Spatial Pipeline		0.090***
		(0.017)
Population	0.069	0.037
	(0.068)	(0.058)
GDPpc	-0.068***	-0.053***
	(0.018)	(0.018)
Regime	0.065***	0.060***
	(0.017)	(0.016)
Total IGO	0.009	0.002
	(0.007)	(0.007)
P	1.88***	1.93***
	(0.14)	(0.13)
Constant	-5.024***	-4.481***
	(1.109)	(0.997)
No. of countries	152	152
No. of failures	385	385
Observations	4,630	4,630

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1