Energy Resources and the Risk of Conflict in Shared River Basins

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Abstract

This study examines the effect of energy resources on the chances for militarized conflict between states on shared international river basins. We examine the trade-offs that states can make between energy resources such as oil and fresh water resources. Is conflict more or less likely if a downstream state has energy resources that an upstream state desires? Can upstream states increase their demands against downstream states if they have more energy and water resources than their downstream neighbors? Using data in shared river basin dyads from 1946-2001, we examine the influence of four types of energy/water and upstream/downstream configurations on interstate conflict. We find that conflict is less likely in shared river basin dyads when downstream states have energy resources and upstream states produce no oil or natural gas. Militarized conflict occurs most often in dyads where both riparian states are energy producers. We use the Amu Darya and Syr Darya river basins in Central Asia as representative cases of these general arguments.

Keywords: shared river basins, conflict, energy, oil, water, upstream, downstream, Amu Darya, Syr Darya.

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In August 2013, several Central Asian countries attended the Dushanbe Forum to discuss future water issues involving two major international rivers in the region, the Amu Darya and the Syr Darya. Negotiators discussed the use of river water resources with two competing positions arising, the "inefficient use" position posited by Kyrgyzstan and Tajikistan, and the "fair and rational use" position urged by Uzbekistan.[1] Kyrgyzstan and Tajikistan, both located in upper areas of the Amu Darya and the Syr Darya, are eager to construct more hydropower facilities on these rivers to supplement their deficient energy supplies. Uzbekistan and Kazakhstan as downstream states, have concerns about water shortages caused by power plants in the upstream countries.[2] Upstream and downstream countries in shared river basins in Central Asia have not fully agreed upon negotiated targets for water release and water distribution. Rather, the disputes over energy and irrigation sectors are still hotly contested (Libert 2008, 35). Water and energy problems marginalized the previous 1992 agreement between the riparian states.[3] In 2007-2008, when an unprecedented cold winter was followed by a dry spring and summer, a severe water crisis arose in the region. Kyrgyzstan extracted higher than normal levels of hydropower from its dams on the Syr Darya River to resolve its national energy crunch. As a result, it created water shortages in Uzbekistan and Kazakhstan, harming downstream farmers who depended on river water for irrigation in the spring and summer growing seasons (Libert, Orolbaev and Steklov 2008, 9). Even seven months before the meeting, Islam Karimov, the President of Uzbekistan, officially blamed upstream countries of the rivers. He aggressively argued that those in the upper stream such as Kyrgyzstan and Tajikistan should know that the Syr Darya and Amu Darya rivers are not their own property.[4] While tensions were high, the riparian states had signed cooperative agreements in 1992 and 1998 that allowed for downstream states to provide upstream countries with oil resources in exchange for greater water supplies in the spring growing seasons.

Thus while there have been disagreements over water resources, Central Asian riparian countries have been willing to cooperate with one another through high-level discussions

[1] "Central Asian countries discuss water cooperation at Dushanbe Forum" *The Times of Central Asia*. August 28. 2013.
[2] BBC Monitoring Central Asia Unit Supplied by CCV Worldwide Monitoring. August 23. 2013.
[3] After the dissolution of the Soviet Union, Kyrgyzstan, Tajikistan, Uzbekistan, Kazakhstan, and Turkmenistan in Central Asia established the Interstate Commission for Water Coordination (ICWC) in 1992, based on the formal Soviet system to regulate the water resource. They signed multilateral agreements to mitigate regional conflicts and to manage water resources in the Amu Darya and Syr Darya basins.
[4] "Uzbek President Karimov on the Soviet legacy and territorial disputes" *The Times of Central Asia*. January 30. 2013.

(Libert, Orolbaev and Steklov 2008, 9). This region demonstrates that situations where downstream states can trade energy resources for water resources from upstream states may be more cooperative than situations where the upstream state has exclusive control over water and oil resources or where neither side has energy resources to trade. We explore these situations more generally by examining whether downstream states can promote cooperation and reduce the chances for militarized conflict by trading valuable resources like oil.

We analyze the effect of energy resources on the chances for militarized conflict between states on shared international river basins. We consider states to have energy resources if they produce natural gas and or crude oil through onshore or offshore sources. Integrating upstream and downstream states' geographical position with energy resources information, we examine four related scenarios of states sharing rivers. The first scenario is where both upstream and downstream countries have energy resources. The second is where only a downstream state has energy resources, while an upstream state does not. The third situation is where only an upstream country has energy resources, the opposite of the second scenario. The last scenario involves riparian states with no energy resource production. We show that conflict is most likely to occur in dyads where states on shared rivers are also oil producers. Asymmetric situations where the downstream state has energy resources while the upstream state does not are more successful at reducing conflict over river resources, as the Central Asian case studies demonstrate.

The remainder of the paper is organized as follows. First, we review the literature on shared rivers and conflict between countries. The general arguments linking shared rivers, energy resources, and interstate conflict are then discussed. We use the Aral Sea river basins in Central Asia to illustrate the theoretical relationship between energy resources and the likelihood of conflict or cooperation in shared river basins. We formulate general hypotheses and conduct a large-N logit analysis using a shared river basin dataset combined with a petroleum dataset. In the last section, we discuss the results of the study and derive policy implications from our findings.

Conflict and Cooperation in Shared River Basins

Water is vital to not only an individual's survival, but to that of a nation's economy and society (Wolf 1998: 252; Brochmann and Hensel 2009: 394). With growing concerns for the environment and increasingly limited water resources, states are seeking stronger footholds to

secure water resources for their survival. States sharing river basins and freshwater supplies are more sensitive to guaranteeing state access to shared river water resources, especially if they depend on water supplies that originate outside their borders.[5] To manage shared rivers and water resources, interactions among riparian countries is inevitable. Scholars are interested in whether cooperation or conflict is more prevalent in these negotiations over transnational water resources.

Homer-Dixon (1994, 1999) argues that renewable resource scarcity and decreasing access to resources aggravates socio-economic frustration, resulting in violent conflicts. Urdal (2005) articulates a similar idea of relative deprivation associated with resource scarcity. These arguments, commonly called the 'resource curse', directly connect environmental issues and resource problems to human and national security, covering broad aspects of a society (Bennet 1991; Homer-Dixon 1999; Kaplan 1994; Myers 1993; Renner 1996; Suliman 1998). The resource curse arguments suggest that worsening resource scarcity and environmental problems give rise to social and political instabilities and increase security risks for individuals and state leaders. The theory suggests that people and states will engage in conflicts with one another to secure their access to resources essential to their survival and security. Research on lateral pressure theory suggests additionally that increases in population size raise the demands for natural resources, which can also increase the likelihood for resource conflicts between countries as states seek to secure access to natural resources outside their borders (Choucri and North 1975). This research shows that both demand side and supply side factors influence the relationship between resources and conflict.

However, shared rivers and water resources are not always associated with violent conflicts between countries. Sometimes states prefer peaceful solutions and cooperation to violent conflicts fraught with various risks (Fearon 1995; Morrow 1994). River claims and interstate disputes are more likely to occur where water resources are insufficient to meet high water demands. Yet, peaceful negotiations are also more likely to occur in these situations (Brochmann and Hensel 2009). Wolf (1998) argues that wars over water are neither strategically rational nor economically viable. States often have shared interests that overwhelm conflict-inducing factors. Other scholars have pointed out that water scarcity does not necessarily increase the chances of violent conflicts. Water scarcity can be resolved

[5] For example, Iraq and Syria depend on up to 85% of their total water supply from the Tigris and Euphrates Rivers, which flow from upstream Turkey into these states.

through peaceful agreements designed to share the resource. In fact, states more often cooperate over shared water resources than fight over them (Hensel et al. 2006; Tir and Ackerman 2007). Lonergan (2001) and Wolf (1998, 2002) also claim that interested actors sharing waters are more likely to solve shared water issues through cooperation, and once cooperative patterns are established, they have a tendency to be resilient over time. As we show in this paper, however, such situations for establishing cooperative solutions may vary based on other types of resources that riparian states have to negotiate.

Several factors influence whether countries in a shared river basin engage in conflict or cooperation over river water resources. One critical factor is the upstream/downstream relationship (Barrett 2003; Bernauer 2002; Kemelova and Zhalkubaev 2003), which results in interstate conflict more frequently than other types of shared river configurations such as mixed (states are both upstream and downstream on the same river) or sideways (the river forms the border) relationships (Brochmann and Gleditsch 2012). Related to the upstream/downstream configuration, power asymmetries in dyads along the shared river basin also influence the chances for conflict and the emergence of regional water governance institutions (Zeitoun and Warner 2006; Dinar 2009). The presence of a hydro-hegemon on the river, such as Egypt on the Nile or India on the Ganges, increases the potential for cooperation as the state can use its power advantage to negotiate a cooperative settlement. Moderate levels of scarcity might produce more conflict than situations of high scarcity, where riparians seek side-payments or institutional solutions to their resource conflicts (Dinar 2009). An imbalance in the supply and demand for water often provokes conflict over shared rivers (Bernauer 2012; Cai 2003; Elhance 1997; Glantz 2002). This is also related to the water scarcity issue and one that induces peculiar water governance problems among riparian states (Giordano, Giordano, Wolf 2005; Dinar 2009, Brochmann 2012).

Many of these factors have been explored in case studies of rivers in the Americas, Western Europe, and the Middle East, including the Ganges, Jordan, La Plata, Nile, Rio Grande, and Tigris and Euphrates river basins (Brochmann and Hensel 2009; Crow and Singh 2000; Daoudy 2009; Fishchhendler 2004; Kempkey et al. 2009; Lowi 1993; Swain 1997). While some scholars point to the potential for side-payments in cooperative agreements (Dinar 2009), we know less about the specific resources that are used as carrots in negotiations with other riparian states. Dinar's (2009) analysis of the Aral Sea river basin points to energy resources as an important form of leverage for downstream states. As he

notes, the river basin is quite interesting because there are power asymmetries between upstream and downstream states, different demand levels for water across riparian states, and varying levels of usage for water resources in the basin.

> Six Central Asian republics share the Aral Sea Basin, of which the Syr Darya and Amu Darya are the major rivers. On the Syr Darya, Kyrgyzstan is upstream while Uzbekistan and Kazakhstan are downstream. The Amu Darya originates on the border between Afghanistan and Tajikistan while Turkmenistan and Uzbekistan are downstream. For the entire Aral Sea Basin, Kyrgyzstan and Tajikistan produce about 77% of the water. Afghanistan…contributes about 10% of the inflow to the Basin…Interestingly, upstream countries use only 15% of the Basin's waters while downstream states use the rest. The basin's military and economic power dynamics are also very telling. Compared to Kyrgyzstan and Tajikistan, the downstream states are considered militarily and economically more powerful (Dinar 2009: 345).

The Aral Sea Basin is an interesting case for considering the relationship between water and energy resources. Downstream states in the basin have utilized energy resources to bargain for increased water resources. We describe this case in the next section and then consider how this relationship can be generalized theoretically to other river basins.

Conflict and Cooperation over Water and Energy: The Aral Sea River Basin

River water is an increasingly strategic resource in Central Asia. The two main rivers in the region, the Amu Darya and Syr Darya, flow across multiple countries impacting critical issues such as energy generation, the agricultural industry, environmental sustainability, and consequently, human security (Granit et al. 2010). As shown in Figure 1, six countries share the Amu Darya and Syr Darya rivers: Afghanistan, Kyrgyzstan, Tajikistan, Uzbekistan, Kazakhstan, and Turkmenistan. Among those six countries, the active states concerning river water managements are two upstream countries, Kyrgyzstan and Tajikistan, and two downstream ones, Uzbekistan and Kazakhstan. The Soviet Union established extensive irrigation systems to grow cotton in downstream states, directing upstream states to provide water in exchange for coal and natural gas from the downstream states (Dinar 2009: 346). The trading system for energy and water resources was thus mandated by the central government when all of the states were part of the U.S.S.R.

Figure 1: Map of Central Asia[6]

After the dissolution of the Soviet Union, problems began to emerge as states in the Aral Sea Basin sought to establish water rights. After failing to realize the 1992 agreement, Kyrgyzstan, Uzbekistan, and Kazakhstan announced another agreement over water resource managements in 1996. In the agreement, Kyrgyzstan guaranteed sufficient flow of water through the Syr Darya to the cotton fields of Uzbekistan and Kazakhstan. Uzbekistan and Kazakhstan, in return, promised to supply gas and coal to Kyrgyzstan.[7] Additionally, three Central Asian republics signed the Water and Power Accord in 1998, setting up the same trade between water and energy resources between countries.[8] However, the disputes over water resources were not resolved (Libert 2008). Kazakhstan blamed Uzbekistan for non-compliance with the water accord, while Uzbekistan officials denied Kazakhstan's claim, arousing controversy over water cooperation.[9] Furthermore, Kyrgyzstan, one of the essential

[6] Source: The World Bank. Map design by Philippe Rekacewicz, UNEP/GRID-Arendal. <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/0,,contentMDK:20634287~pagePK:146736~piPK:146830~theSitePK:258599,00.html>.

[7] "Central Asian reach common ground over water: An agreement signed at the weekend will improve cross-border deliveries of water and energy" *Financial Times*. April 9. 1996.

[8] "Central Asian Premiers Sign Water and Power Accord" BBC Monitoring Central Asia by BBC Worldwide Monitoring. March 19. 1998.

[9] "Uzbek official rejects Kazakh claims of non-fulfilment of water accord" BBC Monitoring Central Asia Unit by BBC Worldwide Monitoring. August 7. 2000.

actors of the Water and Power accord, did not follow the water-energy deal.[10] Noncompliance occurred because Central Asian countries have suffered increasing levels of water scarcity problems (Glantz 2002). For instance, when the 2008 record-breaking drought caused unprecedented water scarcity in Central Asia, riparian countries surrounding the Amu Darya and Syr Darya became more sensitive about the guaranteed river water necessary for their national survival and security (Bernauer and Siegfried 2012). Water shortages ratcheted up tensions between upstream and downstream countries. Riparian states were desperate to use river water for the sake of satisfying their national needs. Supply and demand became a substantial issue for these countries and made regional countries perceive shared water issues as security issues; this has been called the "securitization of water resource management" (Mosello 2008, 153; Phillips et al. 2006, 20). Countries in Central Asia became more likely to link the shared river waters and related issues to their national security concerns, giving them absolute priority (Mosello 2008, 153; Buzan et al. 1998, 24). As water scarcity issues become exacerbated, interstate disputes over shared river basins in Central Asia focused on water distribution and management issues (Allouche 2007). The recent increasing water shortage is one critical factor for explaining increased competition between neighboring countries over the shared river basins.

The other critical factor to influence the relationship between riparian states in Central Asia is the relative geographical location in shared river basins – whether states are located in upstream or downstream areas (Mosello 2008). In Central Asia, we can draw a clear line between upstream and downstream countries based on water interests. There is no sideway relationship in Central Asia, such as the way Slovenia and Slovakia are located in the Danube River. As shown in Figure 1, Afghanistan, Kyrgyzstan and Tajikistan are upstream countries located in the highland areas, while Uzbekistan, Kazakhstan and Turkmenistan are located in the downstream areas of the Syr Darya and Amu Darya river basins.

Related to this clear upstream/downstream configuration, there are critical water distribution issues for each riparian country and in particular for downstream countries having critical interests in agriculture using irrigation. As shown in Table 1, there is a huge discrepancy in water resources depending on the states' relative locations in the river basins. Downstream Kazakhstan has a mean annual runoff of 3.30km^3/year, only about 12% of

[10] "Kyrgyz fail to stick to water-energy deal – Uzbek TV" " BBC Monitoring Central Asia Unit by BBC Worldwide Monitoring. January 23. 2002.

upstream Kyrgyzstan's runoff in the Syr Darya basin. The situation is worse in the Amu Darya basin, where Uzbekistan has 4.70km^3/year, less than 10% of Tajikistan's annual runoff.

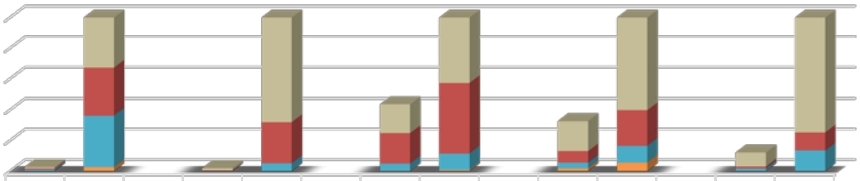
Table 1: Mean Annual Runoff in the Aral Sea Basin (km^3/year)[11]

Country	River basin			Total Aral Sea basin	
	Syr Darya	Amu Darya	Tedzhen-Murghab	km^3	%
Kazakhstan	3.30			3.30	2.8
Kyrgyzstan	27.42	1.93		29.35	24.8
Tajikistan	1.01	*59.45		60.46	51.0
Turkmenistan		0.68	0.3	0.98	0.8
Uzbekistan	4.84	4.70		9.54	8.1

* Includes 3.09 km^3 of Zeravshan river

Kyrgyzstan and Tajikistan have only limited gas and coal deposits and therefore suffer from energy shortages in the winter season, facing substantial energy insecurity at the national level. As Asian Development Bank (ADB) indicates, the power deficit of Tajikistan harms economic development because industries experience difficulties in maintaining their operations throughout winters. (ADB 2013, 159). This is clear in Figure 2; Tajikistan has to meet nearly 95% of energy need for economic sectors to sustain its national economy. In this sense, those upstream countries are more willing to develop their hydropower potential using highland upstream river flows (Mosello 2008, 157). As shown in Figure 3, Kyrgyzstan and Tajikistan mostly rely on hydropower, more than 90% of their power output, while Kazakhstan and Uzbekistan utilize their abundant fossil fuels such as natural gas and oil for power generation.

Figure 2: Final Energy Demand by Sector, Countries in Central Asia, 2010.[12]

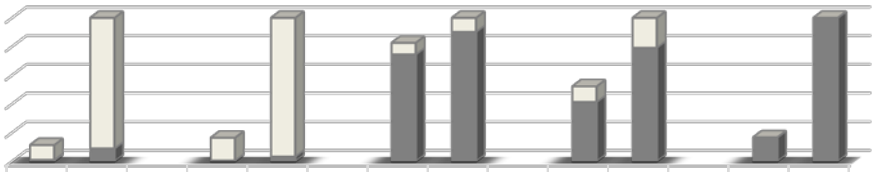


	Kyrgyzstan		Tajikistan		Kazakhstan		Uzbekistan		Turkmenistan	
	Mtoe	Share(%)	Mtoe	Share(%)	Mtoe	Share(%)	Mtoe	Share(%)	Mtoe	Share(%)
Other Sectors	0.9	32.7	1.4	67.9	18.7	42.7	19.6	60.1	9.1	74.6
Industry	0.8	31	0.5	26.9	20	45.7	7.6	23.3	1.4	11.9
Transport	0.9	33.6	0.1	5.2	4.7	10.8	3.6	10.9	1.7	13.5
Non-energy	0.1	2.7	0	0	0.3	0.8	1.9	5.7	0	0

[11] Author Edited from "Table 3 Mean annual runoff in the Aral Sea basin (km^3/year)", Ibid. P.212.

[12] Energy demands by other sectors include demands in residential, commercial, agriculture, and fishery. Mtoe = million tons of oil equivalent, Share (%) = the percentage of the total. Source: Asian Development Bank. *Energy Outlook of Asia and the Pacific. 2013.*

Figure 3: Power Generation Output, Countries in Central Asia, 2010[13]



	Kyrgyzstan		Tajikistan		Kazakhstan		Uzbekistan		Turkmenistan	
	TWh	Share (%)	TWh	Share (%)	TWh	Share (%)	TWh	Share (%)	TWh	Share(%)
Hydro	10.3	91	15.8	96.6	8	9.7	10.8	20.7	0	0
Fossil Fuels	1	9	0.6	3.4	74.6	90.3	41.4	79.3	16.7	100

The winter river water usage by upstream states consequently brings about great pains of downstream countries in the agricultural season. Downstream countries have critical interests in the agriculture industry in terms of their national economy. The cotton industry has been the only major product in the Kazakh southern region eligible for export and cash income to a number of small farmers and the cotton crop industry takes nearly one-fifth of Uzbekistan's hard currency revenues.[14] In other words, the shortage of water in the spring-summer season could seriously jeopardize downstream countries' national economy, thus stirring up social tensions in society.

Table2: Irrigation in the Aral Sea Basin[15]

Country	Area equipped for irrigation (AEI)	As % of	Area actually irrigated (AAI)	AAI as % of AEI
	(million ha)	total	(million ha)	(%)
Kazakhstan	1.30	13	0.83	64
Kyrgyzstan	0.42	4	0.42	100
Tajikistan	0.74	8	0.67	91
Turkmenistan	1.80	19	1.80	100
Uzbekistan	4.20	43	3.70	88

As shown in Table 2, Kazakhstan has only 64% of actually irrigated area and Uzbekistan 88%, while both upstream countries have fully irrigated areas. Thus, Kazakhstan and Uzbekistan, having vital interests in irrigation waters as downstream countries, try to guarantee a stable water supply by paying for electricity produced in the upstream areas,

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[13] Fossil fuels include coal, natural gas, and oil. TWh = terawatt-hour. Asian Development Bank. *Energy Outlook of Asia and the Pacific. 2013*.

[14] "Faltering Kazakhstan Cotton Industry" Ferghana Ru. Information Agency. May 7. 2008. http://enews.fergananews.com/articles/2412. "Irrigation water shortage could mean disaster for Uzbekistan" Ferghana Ru. Information Agency. December 5. 2008. http://enews.fergananews.com/articles/2375

[15] Author Edited from "Table 4: Irrigation in the Aral Sea basin" in Karen Frenken ed. 2012. *Irrigation in Central Asia in Figures: AQUASTAT Survey-2012*. FAO Water Reports 39. Food and Agriculture Organization of the United Nations (FAO). P.215.

consequently hindering these upstream countries' access to waste river water resources during the cold season (Libert, Orolbaev, and Steklov, 2008). This is a continuation from the Soviet era policy of having the downstream states provide oil and coal to the upstream states.

The upstream/downstream relations in Central Asia are substantial when examining interstate relations among riparian countries over shared river basins. Yet, it is too early to reach a conclusion that this geographical factor is the only factor increasing the risks of conflict. In spite of competing interests between upstream and downstream countries in Central Asia, the parties have engaged in a great deal of cooperation in the post-Soviet era (Vinogradov 1996). The countries in the shared river basins of Amu Darya and Syr Darya have developed multilateral institutions to manage shared river resources, embracing both upstream and downstream countries (Micklin 2002). For instance, in 1992, the five main riparian states established the Interstate Commission for Water Coordination (ICWC) as the basic principle of sharing the rivers among countries. In 1998, Kyrgyzstan, Uzbekistan, and Kazakhstan signed a trilateral agreement, the "Agreement between the Government of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan on the Use of Water and Energy resource of the Syr Darya Basin." More recent forums in 2013 focused on balancing the riparians' water and energy needs, with downstream states voicing concerns about plans by Tajikistan and Kyrgyzstan to build major power plants on the rivers. The Uzbek president went so far as to warn that "Things can get worse, and it [the dispute] can cause not just serious confrontations but even wars. Therefore, when we speak about trans-border rivers, we must comply with what the world and the international community have decided, that is agreement of all countries that are along the courses of these rivers is an essential condition."[16]

Thus there are still unresolved issues due to the conflicting interests between upstream and downstream countries over shared rivers. Due to power generation needs in the wintertime, the upstream countries have failed to keep to the promised schedule of water releases. This damaged the downstream countries' trust toward the upstream countries. At the same time, compensation delivery issues for natural gas and oil have aggravated the disputes over shared river basins in Central Asia. One possible way to resolve both energy deficiency and irrigation needs is that downstream states provide upstream countries with electricity or

[16] "Central Asian states discuss water cooperation at Tajik forum." BBC Monitoring Central Asia Unit by BBC Worldwide Monitoring. August 23. 2013.

oil resources as the rewards for their water saving until the spring-summer season. This is one part of the previous agreement among countries in Central Asia. Yet, these commitments were not executed as promised; some downstream countries kept delaying compensation and others were incapable of fulfilling their obligations (Petrenko 1999).

Energy and water resources are important catalysts creating interstate behavioral patterns in Central Asia (Libert, Orolbaev, and Steklov, 2008, 11-13). It is nearly impossible to disentangle the effect of energy resources from the likelihood of conflict and cooperation over shared river basins in Central Asia. If upstream countries suffer from energy shortages that threaten people's survival, governments have no option but to release waters to produce needed energy sources in the wintertime, no matter which agreements they are involved in. This consequently leads to disputes with downstream countries who are damaged by such water releases. Kyrgyzstan was vulnerable due to its critical energy shortage, so it made an agreement with Kazakhstan; as reward of refraining from hydroelectric generation in the winter, Kazakhstan should provide enough oil and gas to guarantee energy sustenance in Kyrgyzstan. However, Kazakhstan failed to keep this agreement stopping energy deliveries to Kyrgyzstan. This exacerbated tensions between the two countries, increasing the chances of interstate conflicts over the shared river basins. In sum, energy resources could be used as both positive and negative strategic means, bringing about conflicts as well as cooperation in shard river basins (Libert, Orolbaev and Steklov 2008; Glant 2002; Glanit 2010). Therefore, it is very useful to examine the chances of conflicts and cooperation in shared river basins by integrating upstream/downstream factors with energy resource production. The two critical factors - upstream/downstream states and energy resources possession - can change the direction of interstate relations, whether intensifying conflicts or enhancing cooperation.

Theory

Energy resources, entangled with upstream/downstream geographical factors, induce complex dynamics for the likelihood of conflict or cooperation over shared rivers, as seen in the Aral Sea Basin in Central Asia (Libert, Orolbaev and Steklov 2008; Glant 2002; Glanit 2010). If an upstream country has enough energy resources, free from energy insecurity, the country would be more willing to negotiate and cooperate with neighboring downstream countries over shared rivers. However, an opposite direction is also logically possible: if upstream countries have sufficient energy resources, they have fewer incentives to cooperate with downstream countries, leading to potentially non-cooperative behaviors of upstream

states over shared river basins. It could be possible that a downstream country who has enough energy resources would give an upstream country energy sources to resolve its energy problems. In this scenario, energy resources could serve as a useful media to mitigate conflicting interests over shared river waters, leading to more cooperative interactions in shared river basins.

The literature on energy resources often finds a positive relationship between oil production and interstate/intrastate conflict. Fearon and Laitin (2003) show that oil producing states experience higher risks for civil wars. Theisen (2008) reaches a similar conclusion, finding that energy resources like oil increase the likelihood of intrastate armed conflict. Lujala (2009) suggests that oil and gas in a conflict zone increases the severity of a conflict. These studies focus on armed civil conflicts, but the suggestion is that energy resources and the chance of conflicts are correlated. Sandler, in his economic analysis of conflicts, also argues that disputes over resources are one of the leading causes of interstate conflicts (Sandler 2000, 724-725). Yet, it is important to note that not all states with petroleum resources are aggressive in their foreign policy behavior. Colgan (2010) notes that Kuwait has as many oil and military capabilities as Libya, but its leaders have behaved far less aggressively. Thus energy resources are said to have two contradictory effects. On the one hand, energy resources can have conflict-enhancing effects, by reducing the national leaders' risk of domestic punishment for foreign policy adventurism and increasing the state's military capacity. On the other hand, energy resources can have conflict-reducing effects by increasing economic incentives for peaceful international trade and stability in the economic market and social situation (Colgan 2010: 662).[17]

When water and energy resources are being traded between countries, as in the case of the Central Asian states, we may see such interdependent exchanges promoting cooperation. Peterson (2013) argues that increased sensitivity to trade partners' actions resulting from dependence influences crisis perceptions and interactions between states. A state importing fuel or minerals on which its economy is highly dependent may be more vulnerable to interrupted trade (Peterson 2013, 227). As seen in the cases of the Amu Darya and Syr Darya, states could have more incentives to cooperate with each other if they are highly dependent on the other side's resources to maintain overall stability in their economy. More generally, a

[17] Colgan (2010) argues that this difference can be explained by whether a state has a revolutionary regime in power.

number of interdependence scholars argue that growing economic interdependence encourages cooperative behaviors among political actors (Keohane and Nye 1977; Mansfield and Pollins 2001; Polachek 1980, 2010; Stein 1993). Especially among contentious and contiguous dyads, highly connected economic relations and trade are important to induce cooperation and peace (Oneal et al. 1996). In cases where states have different comparative advantages in the production of water and energy resources, we are more likely to observe cooperation. This is the case we discussed in Central Asia; the upstream states can provide access to enough water to the downstream countries for their use in agriculture, while, at the same time, those downstream countries provide energy resources to help countries in the upper river basins to meet their national energy needs. Without such an arrangement, the upstream states have incentives to build hydro-electric dams to meet their citizens' energy demands, actions we have seen in many river basins globally.

To consider the interactions between geographical configurations in river basins and water-energy interdependence relations, we identify four possible scenarios in Table 3 and construct hypotheses based on each different case.[18] The first scenario, *Joint Energy*, is a case where both a downstream country and an upstream country have energy resources, such as U.S. and Mexico in the Rio Grande. The second scenario, *Downstream Energy*, indicates a situation where an upstream country has no energy resources while a downstream country does, such as the Syr Darya case discussed earlier. *Upstream Energy*, the third scenario, illustrates a case where an upstream country has an energy resource, but the downstream country does not, such as Brazil and Paraguay on the La Plata River. Finally, *No Energy* represents the remaining cases where neither the upstream nor downstream countries have significant energy resources, such as Nicaragua and Costa Rica on the San Juan River.

If we look at the empirical relationship between these four types of scenarios (χ^2=145.9; p<.001) and the occurrence of militarized disputes in contiguous shared river basin dyads from 1946 to 2001 in Table 4, we see that conflict is generally most likely to occur in dyads that do not produce oil or natural gas (857/1,515 or 56.6% of the total). However, it is interesting to compare the militarized disputes that occur among these four scenarios. We see that *Joint Energy* dyads have the highest risks for MIDs (15.5%), while *Downstream Energy* dyads have the lowest rate of MIDs (6.3%). This shows that the Central Asian river dynamics

[18] Our analyses treat energy producers as any states that have a non-zero value of oil production. Future analyses may consider thresholds to identify larger oil producers from smaller ones.

may generalize to other regions where militarized conflict is least likely when downstream states have oil or natural gas and upstream states do not.

Table 3: Four Types of Energy Resource and Upstream/Downstream Relationships

		Upstream Country Energy Resources?	
		Yes	No
Downstream Country Energy Resources?	Yes	***Joint Energy*** Example: Rio Grande	***Downstream Energy*** Example: Syr Darya
	No	***Upstream Energy*** Example: La Plata	***No Energy*** Example: San Juan

Table 4: MID Onset, Energy Resources, and Upstream/Downstream Relationships

Scenario	No MID Onset	MID Onset	Total
Joint Energy	1,630 (84.5%)	300 (15.5%)	1,930 (10.9%)
Downstream Energy	2,905 (93.7%)	196 (6.3%)	3,101 (17.4%)
Upstream Energy	1,880 (92.1%)	162 (7.9%)	2,042 (11.5%)
No Energy	9,849 (92.0%)	857 (8.0%)	10,706 (60.2%)
Total	16,264 (91.5%)	1,515 (8.5%)	17,779

Let's consider the dynamics of the *Downstream Energy* case where an upstream country has no energy resources but a downstream country does, exactly the situation happening in Central Asia. A downstream country can utilize its energy resources as the strategic means of guaranteeing its national interests concerning shared river basins. In these situations, as we see in the negotiations involving Kazakhstan and Kyrgyzstan, there is a side-payment possible that the downstream state can make to the upstream state in exchange for water. The lack of oil production by the upstream state makes it more amenable to a cooperative solution. Our general expectation is that if a downstream country has energy resources to trade with its upstream counterpart state who is not an oil producer, the country could use energy resources as a means for inducing cooperation with its upstream neighbor, guaranteeing both sides' interests without the use of violent tactics.

Our primary hypothesis captures this relationship:

> *Hypothesis 1: Militarized conflicts are less likely over shared river basins under the **Downstream Energy** scenario - where a downstream country produces energy resources while an upstream country does not – than in other scenarios.*

Thinking through the chances for conflict in the other scenarios becomes more complicated. In general, we think conflict is more likely in scenarios where the upstream state has oil resources (*Joint Energy*, *Upstream Energy*) relative to the *Downstream Energy* scenario, a pattern we observe in Table 4. If both states have energy resources (*Joint Energy*), then the downstream state is in a weaker negotiation position and more likely to use force to protect its water interests. The fact that both states are energy producers may increase the chances for conflict if the two sides are in relative power parity. In the upstream energy scenario (*Upstream Energy*), the upstream country has more leverage for using river water without any seasonal or volume restrictions. In this situation, downstream countries have fewer resources to trade in riparian negotiations. Situations where neither state has energy resources (*No Energy*) are governed by other factors that we mentioned earlier such as relative power in the river basin dyads, the degree of water scarcity, and the history of conflict or cooperation in the region. Our analyses take a very simple model of conflict onset in shared basin dyads to see how the interaction of energy resources and upstream/downstream locations influence the chances for militarized conflict.

Research Design

To test the effects of energy resources on the chances for militarized conflicts, we construct a shared river basin dataset by merging various existing data sets. The first dataset is the shared rivers dyadic dataset from Brochmann and Gleditsch (2012). This is a revised and updated version of the Owen et al. (2004) dataset and includes 788 river-sharing dyads in 261 river basins. Yet, Brochmann and Gleditsch's data set does not include variables indicating geographical location of upstream and downstream countries, thus we integrate this data from the Shared River Basin Database from PRIO. We pool upstream and downstream variables from this dataset and merge them into the basic Brochmann and Gleditsch dataset. The second important data source is the petroleum dataset from PRIO or

PETRODATA v.1.2.[19] The petroleum dataset allows us to study the relationship between armed conflicts and natural resources. It excludes solid forms of hydrocarbons and includes only natural gas and crude oil, consisting of 884 records for onshore and 378 records for offshore occurrences in 114 countries, from 1946 to 2003. Additionally the data include the year for the first discovery in the region as well as the year production took place for the first time, with other relevant information concerning natural resources. The river basin dataset covers from 1816 to 2002, but the petroleum dataset covers the period from 1946 to 2003, thus our analysis is limited to the period from 1946 to 2002.

In terms of identifying whether upstream and downstream countries have energy resources or not, we adopt the production variable from PETRODATA. First, the petroleum dataset considers two different pieces of information related to natural resources – the discovery of resources and the actual production of resources. Concerning our hypotheses, the issue is whether a country has actual energy resources which make a country freer from potential external dependence on energy sources. Also, if a country begins the production of energy resource such as natural gas or crude oil, it is logical to assume that it won't stop until the energy is used up and finally depleted. This is a reasonable choice for a country because energy resources can be of huge material benefit to the national economy. Even if an energy resource is continually exhausted, a country can have production during the given time period because it takes a lot of time for the energy resource to be completely depleted. Therefore, we adopt the production information and create a variable indicating whether a country has energy production or not. We code energy production as 1 if production status and year is known. If production year is unknown while we recognize production status, we adopt discovery year as the alternative time indicator. If we discover information when production status is unknown, we code energy production as 1 by using those discovery information. We merge this information with states' position in the river basin dyad. If an upstream country in a dyad produces energy resources, it is coded as one and zero otherwise (36.7% of all cases). If a downstream country in a dyad produces energy resources, it coded as one and zero otherwise (41.6% of all cases).

Based on these variables, we construct measures for our four scenarios relating energy production and upstream/downstream location on a shared river. *Joint Energy* variable is a

[19] Nadja Thieme, Jan Ketil Rod, and Paivi Lujala. The Petroleum dataset codebook.

dichotomous variable, coded as 1 if both the upstream and the downstream country in a dyad produce oil and 0 otherwise. *Downstream Energy* variable is a dichotomous variable, coded as 1 if the upstream country does not have an energy resource but the downstream country has an energy resource and 0 otherwise. *Upstream Energy* variable is a dichotomous variable, coded as 1 if the upstream country has an energy resource but the downstream country does not have an energy resource and 0 otherwise. *No Energy* variable is a dichotomous variable, coded as 1 if neither the upstream nor the downstream country produces oil resources. We see in Table 4 that of the 17,779 total shared contiguous river basin dyads from 1946 to 2001, 10.9% are *Joint Energy*, 17.4% are *Downstream Energy*, 11.5% are *Upstream Energy*, and 60.2% are *No Energy*. We have estimated models using different categories as the omitted baseline. We present estimates using *No Energy* dyads as the omitted category in order to see how the presence of oil production in one or both riparian states alters the chances for conflict.

The dependent variable for our analysis comes from the Militarized Interstate Dispute (MID) dataset as coded by Brochmann and Gleditsch (2012). This captures the onset of a Militarized Interstate Dispute (MID) in a given year with the value of one and zero otherwise; this includes both originators and joiners to a MID.[20] Our models include several control variables: 1) the lowest democracy score in the dyad (from Polity IV), 2) a dummy variable for the presence of one or more major powers in the dyad, 3) the natural log of the differences in capabilities between the two states (using CINC scores), and 4) year and polynomials of year to capture temporal dependence in the data (Carter and Signorino 2010). We also estimate models with the level of oil production per capita in each state (Humphreys 2005) to control for the level of energy production and the total population size in each state (from Correlates of War National Material Capabilities dataset v4.0) to capture the demand for energy resources. We exclude the cases of mixed (e.g. where states are both upstream and downstream) and sideways river relationships (e.g. where the river forms a border) because the notion of the upstream/downstream position is unclear, making out theoretical argument less relevant in such cases.

[20] Some scholars argue that a fatal Militarized interstate Dispute is a better indicator for interstate conflicts because the MID data include various types of conflicts such as verbal threats considered as low-level hostilities (Brochmann and Gleditsch 2012, 522; Toset et al. 2000). Yet, most international water conflicts are not full-scale wars, but rather conflicts including diplomatic disputes or using non-militarized tactics (Wolf 1998: Yoffe et al. 2003). We think focusing on fatal MIDs is too restrictive of a condition.

Empirical Analyses

Recall that our hypothesis predicts that conflict is least likely in the *Downstream Energy* scenario where a downstream state has oil resources that it can use in negotiations with its upstream riparian neighbors who do not have energy resources to trade. We begin with an analysis of our four energy/geography scenarios without any control variables in the models. As noted above, we estimate models using different omitted categories to ensure that the results are consistent, as presented in Table 5.

Table 5: Effect of Energy/Geography Scenarios on MID Onset

Variable	Model 1	Model 2	Model 3	Model 4
Joint Energy	0.83*** (0.08)	0.79*** (0.10)	1.05*** (0.10)	Omitted
Downstream Energy	-0.22** (0.08)	-0.26** (0.11)	Omitted	-1.05*** (0.10)
Upstream Energy	0.04 (0.09)	Omitted	0.26** (0.11)	-0.79*** (0.10)
No Energy	Omitted	-0.04 (0.09)	0.22** (0.08)	-0.83*** (0.08)
Constant	-2165.91*** (488.56)	-2165.87*** (488.53)	-2166.21*** (488.54)	-2165.08*** (488.58)
Sample Size	17,983	17,983	17,983	17,983

Note: standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; coefficients for year polynomials not shown

In Table 5, we find strong support for our primary hypothesis when we estimate models with our key energy-basin types and year polynomials to control for temporal dependence. The *Downstream Energy* scenario has a lower likelihood of MID onset in shared river basin dyads relative to all other energy-basin types: *No Energy* (Model 1), *Upstream Energy* (Model 2) and *Joint Energy* (Model 4). *Joint Energy* dyads experience more conflict than all other dyads. *Upstream Energy* dyads experience more conflict than *Downstream Energy* dyads (Model 3), but less conflict than *Joint Energy* dyads (Model 4). Also, the predicted probabilities of the energy-basin types are presented in Table 6. We see that the *Downstream Energy* configuration has the lowest chance for MID onset (0.0632), a probability one third the size of the predicted probability for *Joint Energy* dyads (0.1612).

Table 6: Predicted Probability of Four Types of Energy-Basin

Variable	Pr (MID)
Joint Energy	0.1612
Downstream Energy	0.0632
Upstream Energy	0.0803
No Energy	0.0772

Note: The year polynomial variables are set to their mean values when calculating the predicted probabilities.

Table 7: Effect of Energy/Geography Scenarios on MID Onset Including Controls

Variable	**Model 1**	**Model 2**	**Model 3**
Joint Energy	0.90*** (0.09)	0.99*** (0.09)	0.94*** (0.09)
Downstream Energy	0.003 (0.09)	0.07 (0.10)	0.04 (0.09)
Upstream Energy	0.22** (0.09)	0.25** (0.11)	0.24** (0.10)
Low Democracy	-0.04*** (0.005)	-0.04*** (0.01)	-0.03*** (0.005)
Major Power	0.43*** (0.09)	0.46*** (0.10)	0.05 (0.11)
Ln Capability Ratio	-0.29*** (0.03)	-0.28*** (0.04)	-0.29*** (0.03)
Upstream State Oil Production	---	-0.92 (0.67)	---
Downstream State Oil Production	---	0.07 (0.71)	---
State A Total Population	---	---	0.00** (0.00)
State B Total Population	---	---	0.00** (0.00)
Constant	-968.02* (506.13)	22.57*** (5.94)	-1212.23** (530.6)
Sample Size	17,983	11,940	17,616

Note: standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1; coefficients for year polynomials not shown

In Table 7, we add several control variables to our models including low democracy, the presence of major powers, and the natural log of the capability ratio (all three models). In Model 2, we also control for the level of oil production per capita in the upstream and downstream states. Model 3 estimates the effect of total population size for each state. The analyses confirm our primary hypothesis that conflicts are less likely in the *Downstream Energy* dyads relative to other oil producing scenarios (*Joint Energy, Upstream Energy*). However, the chances for MID onset in the *Downstream Energy and No Energy* (omitted category) dyads are not significantly different from each other when we add other control variables. Yet among the configurations where riparians produce oil, the situation where a downstream state produces oil while the upstream state does not produces the lowest chance for militarized conflict. The predicted probability of three energy-basin types are presented in Table 8, confirming the lowest MID onset chance for *Downstream Energy* dyads.

Table8: Predicted Probability of Three Types of Energy-Basin

Variable	Pr (MID)
Joint Energy	0.1575
Downstream Energy	0.0705
Upstream Energy	0.0850

Note: The control variables are set at their mean values when calculating the predicted probabilities.

In terms of the control variables, we find that more democratic and more asymmetric power dyads experience less militarized conflict over their shared rivers. Major powers are more likely to use force to contest their shared rivers than pairs of minor power states. In Model 2, we can see that production levels are not significantly related to MID onset for either upstream or downstream states. In Model 3, total population size is positively and significantly related to MID onset in riparian dyads. This is consistent with the notion that increases in population raise the demand for natural resources and the potential that states will clash with their neighbors to secure such resources.

The results show that the Central Asian river basin story generalizes to other contexts in the (mostly) Cold War era. Dyads in which downstream states have energy resources to trade with upstream riparians show lower rates of conflict than other pairings of dyads. Conflict is most likely between pairs of riparian states that both have some type of domestic energy production. The civil war literature's finding of a linkage between oil resources and

intrastate violence may have parallels to the interstate conflict side when water resources are shared across transnational boundaries.

Conclusion

In this paper, we examine how energy resources and upstream/downstream configurations in interstate river basins influence the chances of militarized conflict in river basin dyads. We find that the most cooperative configurations involve downstream energy producers who can trade such resources for water with upstream states that are not energy producers. We illustrate the theory using the Aral Sea Basin in Central Asia, which includes the Syr Darya and Amu Darya rivers. The Soviet era legacy of having downstream states provide coal and oil to upstream states in exchange for water has been carried forward in the post-Cold War world by the successor states in the region. While some countries have not fully complied with water sharing provisions in cooperative treaties to manage these rivers, they have been able to avoid escalating their conflicts to militarized levels. On the other hand, the dynamics in other energy dyads are more complex. We see joint energy producers having more militarized conflict than other types of dyads, while at the same time observing higher rates of militarized conflict in pairs of states with no energy production. This fits with our earlier observation that even though there is an ongoing clash of interests between upstream and downstream countries, particularly concerning water and energy resources, the countries do not show a consistent trend of interactions, such as only engaging in conflict or cooperation. Rather, states have tendencies to fluctuate back and forth between conflict and cooperation. This fits with Colgan's (2010) argument about the two-sided effects of oil. As the representative cases of Central Asia indicate, if a downstream country has energy resources which can be used as effective tools to manipulate the relationship between upstream and downstream countries, states are likely to use them to make more beneficial cooperative outcomes in shared river relations.

This study sheds light on new aspects of the likelihood of conflicts in dyads within shared river basins. By investigating the effects of energy resources on the chances of conflicts, we can achieve a more improved understanding of complicated mechanisms of cooperation in shared river basins. Future research will explore other possible resources that could be traded in riparian negotiations. We will also consider states' dependence on external suppliers for goods like oil and natural gas. Countries that are more vulnerable to outside suppliers may be even more likely to strike peaceful accords with their riparian neighbors.

There could be cases where private multinational companies are in charge of oil or gas production facilities and make contracts with countries. In this case, the relationship between a company and a state could yield other effects on the chances for conflict and cooperation in a given shared river basin. Also, this study does not cover how many energy resources a given country produces. It is possible that one country has a tremendous amount of energy resources compared to others in the river basin or vice versa. If one country has an enormous amount of energy resources, it leads to other potential byproduct effects such as monetary profits and political influences, thus altering the costs and benefits of militarized strategies in shared river basins.

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