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Energy Trade Brinkmanship Between the European Union and Russia

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Abstract

This paper proposes a brinkmanship game of unilateral deterrence to model the dynamics of energy trade between the European Union and Russia. Nuclear deterrence and crisis bargaining theory is extended to show the relationship between a spectrum of risk and trade dependency. Russia and the EU are mutually dependent upon continued natural gas trade, but Russia has an asymmetrical incentive to disrupt the status quo in order to extract a concession from the EU. It can do so by initiating a crisis that escalates toward a mutually disastrous gas shutoff through sequential bargaining. The risk of a gas shutoff is autonomous and contingent upon transit uncertainty as determined by an outside actor, Ukraine. The equilibrium in the proposed brinkmanship model is determined by each player's risk tolerance for a given set of variables; as long as disaster does not occur before the equilibrium risk level is reached, the player with the greater resolve prevails.

Keywords

Europe, Russia, energy trade, natural gas, brinkmanship, crisis bargaining, nuclear deterrence, game theory

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1 Introduction

The EU–Russia energy dialogue is one of indisputable and growing interdependency. Russia is the EU's primary energy supplier and the EU is Russia's most profitable market for natural resource exports. It is curious then, that in the last two decades the international system has observed recurrent trade breakdowns and near–breakdowns. A partial list of instances that threatened or disrupted oil flow to Europe includes the Belarus–Russia crises in 2007 and 2009, the Russia–Georgia war in 2008, an oil cut to Latvia in 2005 and 2006, to Estonia in 2007, and to the Czech Republic in 2008. In regards to natural gas, suspensions to Europe occurred in 1992, 1993, 1994, 2006, 2008, the lengthiest and costliest shutoff to date in January 2009, and a near–cut during the summer of 2010. This list is expansive and the crises are not isolated.

Literature on energy trade across the Eurasian continent has focused on geopolitical power and interdependency, the EU's necessity to diversify its energy sources, and the bilateral conflicts between Russia and the former Soviet states. There is a lack of a formal model to explain the dynamics of this trade and the reemergence of the aforementioned crises. This paper attempts to fill this void by examining primarily the trade of natural gas and modeling it as a game of brinkmanship between Russia and the EU.

Presenting EU–Russia trade crises as games of brinkmanship is an instrumental contribution to the literature for several reasons. First and foremost, it is a compelling interpretation of the chronic gas shutoffs by Russia to the EU. Second, a formal model can serve in analyzing the variables that influence a state's relative bargaining power during a trade crisis. Third, it is a weighty example of how brinkmanship can manifest itself outside the scope of military security. Finally, this model can be generalized to understand the standoffs between Russia and the EU concerning other energy sources and transit routes.

The EU is dependent on Russian natural gas because of Russia's geographical proximity and market power in resource production and export. This dependency is not unilateral, as Russia's economy is driven by revenues from natural resource exports to the EU. A recent fall in the price of natural gas, when coupled with the inefficiency of Russia's gas industry and the drain of its heavily subsidized domestic market, has put pressure on Russia to exploit its Western market more aggressively. Transit states play a role in Russia's attempts to extract concessions from the EU. The collapse of the Soviet Union created bilateral monopolies on exporting energy to the EU; Russia retained the resource reserves, while the newly independent states retained control over the transit networks between Russia and the EU. This hold–up problem has been solved by the integration of transit capacities in nearly all but one transit state, Ukraine. Coincidentally, Ukraine has the largest transport capacity and direct control over the volume of gas flowing to the EU. Introducing the transit state into a bargaining game between Russia and the EU therefore accounts for the existence of some autonomous risk of gas shutoff. This transit uncertainty has been used as a source of threat credibility by Russia.

The rest of the paper is outlined as follows. I will provide background and history on the trilateral energy relationship between the EU, Russia, and Ukraine to establish the mutual dependency between Russia and the EU, Russia's incentive in disrupting the status quo, and the role of transit uncertainty in threat credibility. I will then propose an interpretation of this trade relationship by using nuclear deterrence theory to build the theoretical framework for a game of energy brinkmanship.

2 Background

The EU's natural gas consumption is rising, characterized by an increasing dependency on imports streaming from Russia. Its consumption is expected to grow at a rate of 1.5% for the next 25 years (Schaffer, 2008). Forecasts from Eurogas project that the EU will depend on imports for as much as 59% in 2010, and 87% by 2025 (Walker, 2007). Russia's gas exports to Western Europe have risen from 63 billion cubic meters in 1990 to 107 bcm in 2004 (Stern, 2005), and Gazprom, which currently controls 25–30% of European gas supply, is expected to become the main supplier to 28 European

countries (Schaffer, 2008). The EU's dependency on Russia relative to its outside options is a function of two factors: reserves and geography. Russia's 2009 level of proven natural gas reserves was estimated at about 27% of world reserves. This portion is sizeable when compared to European reserves, estimated at just 3% of world reserves (Energy Information Administration, 2009). Russia's control of reserves is further magnified when taking into account its standing as the single biggest buyer of gas from the next major producer – Central Asia (Pirani, 2009). Reserves aside, Russia's proximity to the EU and difficulties associated with transporting natural gas severely circumvent supply competition. Natural gas is not only costly to transport in absolute terms, but its cost of transportation rises more rapidly than it does for oil and other resources (Russel, 1983), implying that alternative suppliers are limited by distance. Baran (2007) makes a similar conclusion about the role of geography. Since pipelines are the most cost effective transport mechanism, but have high capital costs, then even if a supplier is geographically close, but holds marginal reserves, it will not enter the market.[1]

Natural gas is Russia's second highest revenue generating export after oil. Even though the EU accounts for a third of Russia's total gas sales, these sales represented two thirds of gas revenues in 2006 (Heinrich, 2008). The revenue differential between EU and non–EU exports is sizeable; in 2008, Western Europe generated $73 billion, while all other exports generated $14 billion (Pugliaresi, 2009). One factor contributing to the profitability of the European market is the EU's lack of a unified energy policy. Russia maintains bilateral contracts with separate countries, and benefits from what Walker (2007) calls "the classic case of divide and rule". States act tangentially to each other in their efforts to ensure individual energy security, giving Russia the ability to play countries against each other when securing energy deals (Parthasarathy, 2008, Baran, 2007). Consequently, Russia's energy policy is centered around maintaining its trade with the EU and preserving a system of bilateral contracts. Repeated gas crises weaken Russia's ability to sustain these separate deals because it loses reputation as a reliable supplier. A crisis that results in a full gas shutoff is costly because Russia loses

[1] Stulberg (2007) calls this the "tyranny of distance of gas pipelines"; the high capital costs of building new pipelines and the expenses of alternative modes for transporting gas give Russia an advantage.

significant revenue. A crisis that does not end in disaster is nonetheless costly, because Russia incurs a threat cost in the form of policy unification and source diversification by the EU.[2]

Gazprom is a state–regulated monopoly in control of the extraction, production, and export of natural gas. Several factors have caused its profits to sink. First, the European price of gas is correlated with the price of oil, so a recent drop in energy prices has hurt Gazprom's net revenues. Gazprom's 2008 export price to Europe of $409/million cubic meters dropped to $280/mcm in 2009, decreasing earnings by $26 billion. Indeed, Gazprom reported a 52% decline in net profits between 2007 and 2008, and expected a further decline in 2009. The second factor is Russia's inefficient gas industry structure. Ahrend (2006) finds that Russia's transition from a centrally planned economy resulted in productivity increases across every sector except for those that remained under state control. Statistics for the percent annual change in labor productivity between 1997–2004 for Russia's top thirty largest industries show a decrease in only three industries, the most drastic of which was a 5% drop in the natural gas industry. During this period, the gas industry also had the largest negative change in revealed comparative advantage in the international market (Ahrend, 2006). A further implication of government control is that resources are not fully capitalized upon. Gazprom owns the majority of resources with commercial value, so all gas sector investment decisions are driven by politics. Current production relies on three major fields, all of which were developed before 1991 and have reached productive capacity.[3] Heinrich (2008) proposes that the lack of strategic investment and declines at current fields may lead to a production shortfall by as early as 2010.[4] The third factor is the price–controlled domestic market, full deregulation of

[2] After the January 2009 gas shutoff, the EU drafted a common response policy in the event of future cuts ("The Commission adopts new rules," 2009, Hall, 2009, July 17), and formally signed plans to begin constructing Nabucco, a supply pipeline that will circumvent Russia ("Energy in Europe: he who pays for pipelines calls the tune," 2009).
[3] Production at the Urengoy, Yamburg, and Medvezhe fields peaked between 1980–1990 at 305, 179, 75 bcm/ year respectively; since 2003, reserves have been depleted by 48%, 39%, 75% respectively. The other major field, Zapolyarnoe, peaked at an estimated 100 bcm in 2005, and has also begun declining (Stern, 2005).
[4] See Nichol (2007) and Stern (2005) for a further expansion on the effect of depleting fields, a monopolistic industry structure, and inadequate investment on Russia's natural gas industry.

which is constrained by political considerations and a lack of cost transparency. Russia's domestic consumption increased 11% between 1999–2004, but was delivered at a significant $25 billion loss to Gazprom (Stern, 2005). A domestic pricing policy set by the government keeps prices at a level that just narrowly covers the cost of delivery.[5] These subsidies, along with a persistent nonpayment problem, have made gas cheaper relative to other fuels, resulting in severe overconsumption by consumers, and a lack of incentive for industrial efficiency and capital replacement (Stern, 2005). Gazprom's revenues directly affect the economic position of the state, so its current financial standing has put pressure on Russia to exploit its export market more aggressively and seek supplementary revenues.

With the fall of the Soviet Union, Russia and the newly independent states inherited a bilateral monopoly on exporting natural gas to the EU. Gazprom has sought aggressive regional integration with the former Soviet states and has been largely successful in vertically integrating export capacity. The Ukrainian government, however, has been averse to Gazprom acquiring equity shares in its infrastructure on political grounds (Stern 2005, Woehrel, 2009), and staunchly rejected Putin's 2002 proposition of a “joint consortium of Russian–Ukrainian pipelines” (Winrow, 2007). Ukraine has the largest networks in international gas trade and controls roughly 80% of the gas flowing to the EU (Stern, 2009). Repeated disputes between Russia and Ukraine over splitting rents–specifically over gas prices, transit tariffs, transport volumes, debts, and loans have resulted in gas crises since 1991. These are generally characterized as Ukraine's unwillingness to pay higher prices and Russia's subsequent gas shutoffs to coerce payment; or as Russia's unwillingness to pay higher transit tariffs and Ukraine's subsequent suspensions of gas transit. Since gas sold to Ukraine and gas sold to the EU flows through the same pipelines, Ukraine is able to divert European gas in order to make up for any reduction in its own supply or shut down transit entirely as retaliation against

[5] Heinrich (2008) also points to the sizeable subsidies for domestic and industrial consumption.

Russia. Ukraine has shown that it can do this in 2006 and 2009, and threatened to do so in 2008 (Pirani, 2009).[6]

Ukraine's decision to intervene in EU–Russia gas trade is determined by counteracting economics and politics. The 2007 economic crisis struck Ukraine's economy harder than any other Eastern European country; Ukraine's currency lost over 40% of its value, and its banking sector descended into severe crisis (Woehrel, 2009). An attempt by Russia to increase gas prices is therefore not only politically futile, given Ukraine's ability to retaliate, but also ineffective because of Ukraine's financial inability to respond. At the same time, Ukraine is a net energy importer, and estimates reveal that roughly 80% of its oil and natural gas comes from Russia (Woehrel, 2009). Ukraine's dependency on Russia is largely attributed to its industry structure; Nichol (2007) points out that Ukraine's inefficient industries are energy–intensive, and therefore heavily dependent on cheap Russian gas. This implies that Ukraine cannot quickly substitute into other forms of energy and may need to supplement its gas supply in the event of a reduction. Note however, that an automatic diversion of European gas is not a dominant strategy because it damages Ukraine's reputation as a reliable transit state. Ukraine joined the WTO in 2008, and is looking at potential EU and NATO membership. Consequently, Ukraine suffers a political cost by siphoning gas or prolonging a dispute (Woehrel, 2009, Pirani, 2009). The proposition then, is that a diversion of European gas is a function of Ukraine's internal factors that are beyond the direct control of Russia and the EU.[7]

3 Theoretical Framework

[6] Multiple sources have called the gas crises a proxy for a political battle between Kiev and Moscow, pointing to Moscow's geopolitical aspirations in regaining control of the former Soviet states. Ukraine's gradual orientation toward Western Europe and its Orange Revolution of 2004 is seen by Moscow as a direct attack on Kremlin. See Pirani (2009), Schaffer (2008), Pifer (2009), Woehrel (2009), et al. These political considerations are noted, but will be assumed out of model.

[7] For example, the January 2009 crisis was characterized by indiscernible allegations: Ukrainian politicians, gas industry leaders, and stake holding oligarchs accused each other of aggravating the crisis with Russia (Pirani 2009), implying once again that the cross of economic and political, as well as private and government interests, make the escalation of a gas crisis toward a full shutoff relatively outside of the EU–Russia relationship.

The theory of states' physical security can be applied to model states' energy security. Nuclear deterrence and crisis bargaining theory model strategic interactions between superpowers who are mutually dependent upon preventing nuclear disaster. The predictions these theories make can serve as a framework for analyzing the interdependency between states mutually bound by an energy trade relationship.

A game of chicken serves as a basic model for classical deterrence because it models two elements of deterrence theory.[8] It captures the mutual cost of disaster in the event that both players fail to cooperate; it also illustrates that even though both players would prefer cooperation to mutual defection, there is conflict over splitting the distribution of rents because each would prefer to maintain nuclear superiority. The development of nuclear power gave states an instantaneous second–strike capability that rendered defense impossible. Classical nuclear deterrence theory is the product of an attempt to explain the stability of deterrence by assuming the threat of an instant and certain counterattack to be credible. Indeed, Zagare (2000), and Powell (1985, 1990) indicate that classical deterrence theory assumes that players are bound to deterministic threats of full–scale retaliation to punish any attempt to disrupt the status quo. What follows is a stable deterrence equilibrium such that no player would ever rationally launch an attack in anticipation of a nuclear exchange. When applied to nuclear conflicts, the non–cooperative outcome in a game of chicken represents an onset of a nuclear war; within the context of EU–Russia trade it implies a trade breakdown. A game of chicken therefore captures a shared incentive to sustain trade, but a simultaneous conflict over splitting the gains from trade given Russia's interest in extracting a concession from the EU.

Under an assumption of complete information, a game of chicken always ends in a sub–game equilibrium; players anticipate an opponent's response and use backward induction to optimize their strategy. Relaxing this assumption, Zagare (1993, 2000), Powell (1987), Snyder (1971), et al. emphasize the significance of asymmetrical

[8] Brams (1968), Dixit & Skeath (2004), Ellsberg (1968), Powell (1985, 1987, 1988, 1990), Schelling (1966), Snyder (1971), Snyder & Diesing (1977), et al. build models of crisis bargaining and deterrence from a game of chicken.

information as a factor in crises, without which there is never a risk of escalation and disaster. Under perfect information, any potential crisis ends before it begins, with either successful deterrence or a successful threat. A challenger knows the defender's payoffs, and therefore knows whether or not a threat will be defied. Using this logic, in a pure–threat game between Russia and the EU, if Russia anticipates compliance from the EU, it will threaten; but if Russia anticipates defiance, it will never rationally initiate a crisis. Introducing asymmetrical information into the game implies that decisions now become functions of a player's own payoffs and estimates of the opponent's payoffs, thus allowing for bargaining and risk escalation to enter strategic interactions. Now, at its initial decision node, Russia is uncertain about the likelihood that its threat will defied; there is some probability that the EU places a low value of the inside option and would rather suffer a gas shutoff than incur the cost of conceding. There is also, however, some probability that the EU values its trade with Russia enough to concede under certain conditions. Asymmetrical information is modeled by assuming that one or both players are uncertain about an opponent's payoffs; a player interacts with an opponent who is one of two types, one that will always defy and one that will comply under given conditions.[9]

The stability of deterrence predicted by classical nuclear deterrence theory rests on the assumption of threat credibility. This is an outstanding assumption, given that for a threat to be of any value it must first be believed by an opponent. Once this assumption is removed, classical deterrence theory unravels. Unless both players are credibly committed to full and automatic retaliation, a cooperative outcome is not sub–game perfect because each player has an incentive to secure an advantageous payoff by defecting. Consequently, the effectiveness of Russia's threat to instigate a gas shutoff in the event that the EU does not concede is contingent upon an unfailing credibility of threatening a costly gas shutoff. Relaxing this assumption means that if the EU does not concede, disaster does not happen automatically. Rather, Russia decides whether or not to instigate the shutoff. By cutting exports it incurs a threat cost and loses revenue; by not

[9] Powell, Zagare, Dixit & Skeath, et al. model uncertainty by having the challenger play against an opponent who is one of two types, and whose strategy depends on its type: a "hard" player who always defies, and a "soft" player who cooperates under given conditions. An outside player "Nature" chooses the probability of playing against each type of player.

cutting exports, it still incurs a threat cost, but continues to receive revenue. Knowing these payoffs, the EU is able to anticipate that as long as Russia is in full control of gas flow, a gas shutoff is never its dominant strategy. Consequently, Russia's pure threat is not credible and will never be issued.

Strategic nuclear deterrence theory builds on classical deterrence theory because it recognizes the transparent incredibility of threatening "mutual suicide" and attempts to explain this theoretical paradox.[10] Schelling (1960, 1966) and Powell (1990) argue that deterrence stability can rest simply on the fear of nuclear war, and therefore only requires moves that increase the likelihood of a nuclear exchange. This argument renders a pure–threat of an instant full–scale retaliation not only incredible but also unnecessary. Schelling (1960, 1966) pinpoints the role of risk in his widely cited theory of the "threat that leaves something to chance", or brinkmanship.[11] The strategy of brinkmanship as a source of credibility rests on the assumption that defiance by an opponent results in the mutually costly threatened action executed without the threatener's control. If the occurrence of disaster is strictly autonomous, then players are no longer bound to an incredible promise of a rational and deliberate decision to launch a mutual catastrophe.[12] Powell models threat credibility allowing an external player, "Nature", to execute the disaster. In the case of Russia and the EU, the role of Nature is played by Ukraine. The probability of a gas shutoff is dictated by transit uncertainty, and specifically by Ukraine's internal incentives and disincentives to siphon gas sold to Europe.

Crisis bargaining as "a competition of taking risks" that increases the exogenous probability of disaster over time implies the existence of some limit to escalation. This threshold manifests in one of two ways: either the occurrence of the mutually disastrous outcome, or surrender by one player. Ellsberg (1968) develops the widely cited notion of

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[10] Powell (1985, 1987, 1990) analyzes the assumption of perfect credibility in MAD and concludes that a pure threat of full–scale nuclear war is never credible; a state will never make the threat to rationally launch nuclear war knowing that other state will retaliate.

[11] Schelling (1960, 1966), Snyder(1971), Ellsberg (1968) et al. note other mechanisms of making threats credible, including changing own payoffs, removing options, public political involvement, building reputation, the interdependency of other commitments, etc.; this paper focuses on brinkmanship.

[12] For more on brinkmanship, see Schelling (1960, 1966), Powell (1985, 1990), Snyder (1971), Snyder & Diesing (1977), Zagare (2000) et al.

"critical risk" using an example of a blackmailer and a victim. In the three–step game, the blackmailer issues a threat, the victim decides whether to comply or defy, and the blackmailer decides whether or not to punish if the threat was defied. Ellsberg proposes that the victim's expectation of the probability of punishment determines the willingness to comply. He thus formulates the conclusion that the execution of punishment only needs to be sufficiently likely, rather than certain. Dixit and Skeath (2004) express the idea of risk tolerance by defining an "acceptability" and "effectiveness" condition for the equilibrium in their model of nuclear deterrence. Acceptability determines the maximum risk that the challenger tolerates before conceding, while effectiveness determines the maximum risk that the opponent tolerates before conceding. Powell (1987, 1988, 1990) defines risk tolerance as "resolve", which is the risk threshold at which a player is indifferent between escalating and submitting.[13] He models a brinkmanship crisis to show the role of resolve in determining the game equilibrium using what he argues as the three essential elements of brinkmanship: asymmetrical information, a gradual escalation of risk, and a series of decisions.[14] It begins with the challenger's decision to disrupt the status quo by issuing a threat. If a threat is issued, the decision moves to the opponent, who then decides whether to comply or defy. Defiance escalates the crisis such that disaster happens with some autonomous probability. If disaster does not occur, the decision returns to the challenger who now decides whether to back down or escalate the game further, and therefore create an even greater probability of disaster. The game thus continues until one player reaches its threshold tolerable risk. The relative values of each player's risk tolerance will determine who concedes first.[15]

[13] Also see Schelling, Snyder & Jervis, et al. for citations on resolve.

[14] Snyder (1971), Snyder and Diesing (1977) define a crisis as a case in which "a threat is issued and is initially resisted", thus paralleling Powell's assertion about the role of sequential decisions.

[15] Note that Powell acknowledges the role of resolve in determining the sequential equilibria in bargaining games, but challenges the predominant proposition that the player with greatest resolve will unconditionally prevail in a crisis. He argues that beliefs about an opponent's resolve are just as important as actual resolve. Asymmetrical information allows for bluffing and misperceptions such that the longer a game continues, the more certain a player may become that an opponent is "resolute", and therefore may chose to yield before reaching its own resolve.

4 Brinkmanship Model

I now develop a brinkmanship model of unilateral deterrence under asymmetrical information to model sequential interactions between two agents in a single game in which one player attempts to preserve the status quo, and the other to disrupt it by means of a successful threat. Russia's objective is to extort a concession from the EU; the EU's objective is to maintain uninterrupted gas flow without transferring a concession to Russia. This game is modeled in Figure 1.[16]

The game begins with a neutral player, Nature, choosing a probability p that the EU places a low value on the inside option, such that the value of concession, denoted c, is larger than the value of uninterrupted gas trade, denoted v. This type of EU player is denoted EU_{Low}. Implied is that there is a probability $1 - p$ that the EU places a high value on its inside option, such that the value of continued trade is greater than the cost of conceding. This player is denoted EU_{High}. Consequently, EU_{Low} will never concede, and EU_{High} will concede under some conditions. Russia is aware that for EU_{Low}, $c > v$, and for EU_{High}, $c < v$, but is uncertain about the probability of playing against each type of player, or the relative values of each player's variables. This means that at its initial decision node, Russia's decision to initiate a crisis is determined by the expected value of its status quo payoff and the expected value of initiating a crisis given its beliefs about the EU's payoffs and the probability of playing against an opponent that will never concede. Russia's status quo payoff is the value of revenue from uninterrupted gas exports, denoted g. By initiating a crisis Russia incurs a threat cost, denoted t, which is assumed to be sunk and constant. Threat cost is smaller than the value of the EU's potential concession, otherwise the decision to issue a threat would not be rational. The value of the concession is smaller than the value of continued trade to model Russia's dependency on gas exports, but a potential to gain extra rents. To summarize, assume that $t < c < g$.

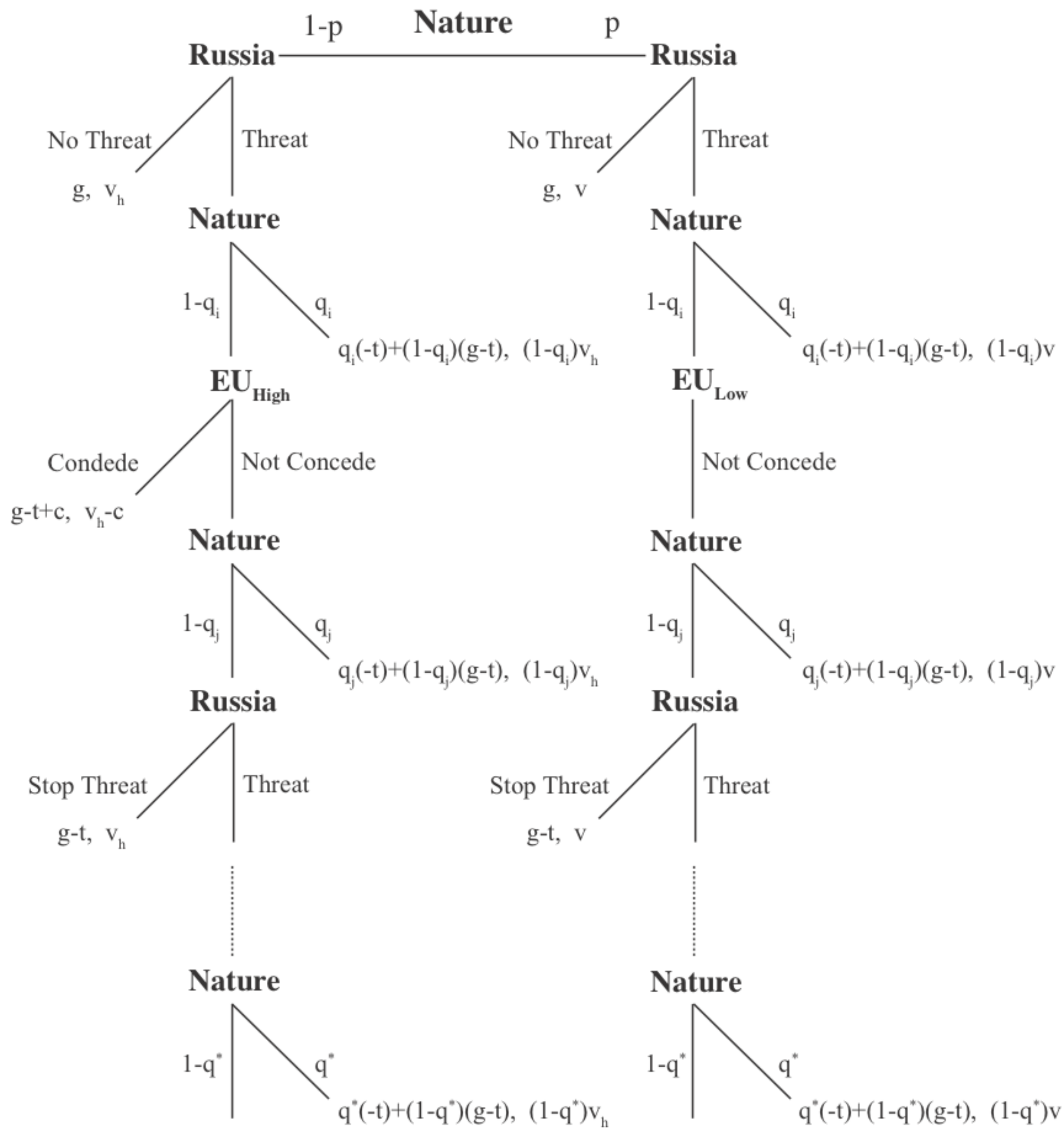
If Russia makes an initial threat, it creates a small risk of gas shutoff, denoted q. Nature moves next by executing disaster with this probability q; the game progresses to the EU with a probability $1 - q$. If Russia is playing against EU_{Low}, the EU will escalate until disaster occurs with certainty. If Russia is playing against EU_{High}, the EU will

[16] Payoffs are listed in the order "Russia, EU"

escalate until it reaches its critical risk tolerance. Russia's decision to escalate is determined by its expected value of capitulating given the incurred threat cost and the expected value of persisting. Each time that a player escalates, the probability q that Nature will instigate a trade breakdown slightly increases. In other words, Russia and the EU will gradually heighten q, such that $q_i < q_j$ for $i < j$, where $q \in [0,1]$. If a breakdown does occur, the game ends and Russia receives a payoff of $-t$, while the EU receives a payoff of zero. If disaster does not occur, the game ends at q^*, which represents threshold risk of gas shutoff at which the player with the lower risk tolerance will stop escalation. At this juncture either Russia will cease threatening, or the EU will transfer a concession.

The difference between Russia's status quo payoff and its payoff for surrendering once it has unilaterally disrupted the status quo models a difference in the expected value of initiating a crisis and escalating a crisis. Russia's resolve is lower at its initial decision node, and increases for escalation decision nodes once it incurs a threat cost. Here emerges the value of the assumption of Russia's imperfect information. Given full knowledge of the EU's payoffs and the probability of playing against a player that will never concede, Russia will never rationally initiate a crisis if it anticipates its resolve being lower. If however, it misjudges and unknowingly initiates a crisis, its resolve may now increase enough to surpass the EU's resolve. Uncertainty may result in the initiation of a crisis that would not have happened under perfect information, and subsequently allow a player with lower initial resolve to prevail.

Figure 1



Brinkmanship Model Equilibrium

The following three equilibrium conditions determine the players' resolve functions. These resolve functions will determine the game equilibrium and are modeled in Figure 2.

1. **The Initiation Condition:** determines when it's in Russia's interest to initiate a crisis. This decision is determined by the expected value of initiating a crisis and the expected value of the status quo payoff. Russia

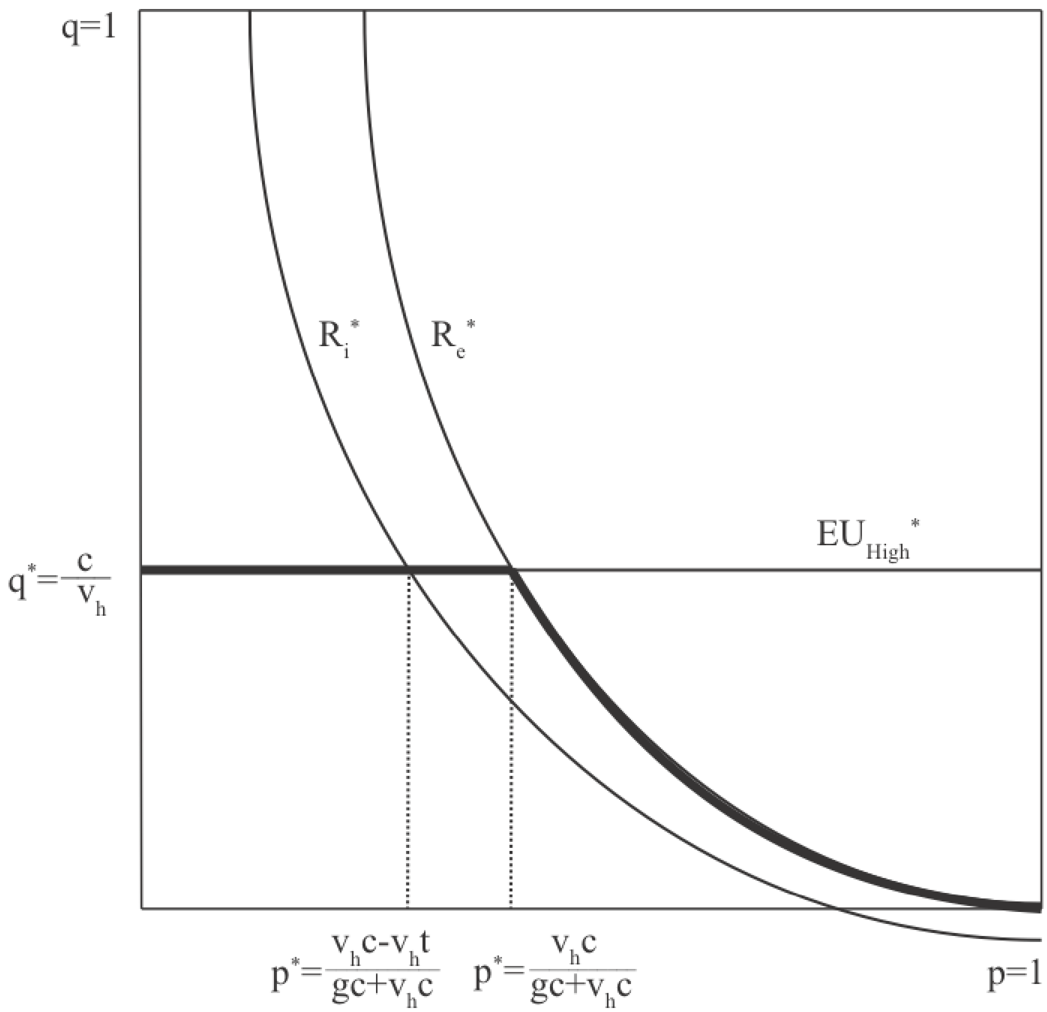
issues a brinkmanship threat if $EV_{Threat} > EV_{NoThreat}$, or $p(g-t-qg)+(1-p)(g-t+c) > g$. Implied is that if the risk of disaster renders $EV_{Threat} < EV_{NoThreat}$, status quo stands. This means that Russia will initiate a crisis as long as the risk of disaster is $q < \frac{c(1-p)-t}{pg}$.

2. **The Escalation Condition:** determines how long Russia will continue to escalate a crisis. Russia's decisions to escalate will now weigh the expected value of the status quo payoff minus the threat cost against the expected value of continuing coercion. If an initial threat has been issued, Russia will escalate a crisis as long as $EV_{EscalateThreat} > EV_{StopThreat}$, or $p(g-t-qg)+(1-p)(g-t+c) > g-t$. Implied is that once escalation reaches a risk of disaster at which $EV_{EscalateThreat} < EV_{StopThreat}$ Russia will stop escalation. This means that Russia will escalate a crisis as long as $q^* < \frac{c(1-p)}{pg}$. Where $\frac{c(1-p)-t}{pg} < \frac{c(1-p)}{pg}$, demonstrates that a challenger's risk tolerance rises once a crisis has been initiated.
3. **The Defiance Condition:** determines how long the EU will continue to defy Russia's threats. The length of EU's resistance is determined by the expected value of conceding and the expected value of escalating. EU_{High} will escalate a crisis by defying Russia's threat as long as $EV_{Concede} < EV_{NotConcede}$, or $v_h - c < v_h - qv_h$. Implied is that once escalation reaches a risk of gas shutoff at which $EV_{Concede} > EV_{NotConcede}$, the EU will make a concession. This means that the EU will escalate as long as the probability of disaster is $q^* < \frac{c}{v_h}$.

Figure 2 illustrates the three equilibrium conditions. Russia's initial resolve function is denoted R_i^* and shifts to R_e^* for decisions at escalation nodes. EU_{High}'s resolve is denoted EU_{High}^*. Assuming that each player escalates q precisely until it reaches its own critical risk, and a gas shutoff does not occur before one player reaches this threshold, then for a given p the player with the higher resolve will prevail. The maximum risk threshold is represented by the bolded line. For $p < p^*$, Russia will be

successful at extracting a concession from the EU; for $p > p^*$, the EU will win the bargaining game by resisting until Russia yields.

Figure 2



Given the presence of asymmetrical information, Russia's optimizing strategy depends on the probability of playing against a player that will never relent. Russia's resolve function intersects EU_{high}'s resolve function at $\frac{c(1-p)-t}{pg} = \frac{c}{v_h}$. For values p below $p = \frac{v_h c - v_h t}{gc + v_h c}$, the likelihood of playing against an EU_{Low} that will always defy a threat is sufficiently low that Russia's optimal strategy is to initiate a crisis. For values p above the specified function, the likelihood of playing against an EU_{Low} renders the risk of being defied too dangerous, so Russia's strategy is to

maintain the status quo. As derived in the Escalation Condition, Russia's risk tolerance increases for decisions at escalation nodes relative to its initial decision node; its new resolve function intersects EU_{High}'s resolve function at $\frac{c(1-p)}{pg} = \frac{c}{v_h}$. Russia is now willing to continue escalation against a higher probability of facing EU_{Low}, or for values p below $p = \frac{v_h c}{gc + v_h c}$. As before, for values p above the specified function, the EU's resolve will surpass Russia's. In summary, $\frac{v_h c - v_h t}{gc + v_h c} < \frac{v_h c}{gc + v_h c}$.

Russia's initial resolve function intersects a certainty of gas shutoff $q = 1$ at $p = \frac{c-t}{g+c}$. For values p below than the specified function, Russia is willing to issue pure deterministic threat because the probability of playing against EU_{low} is markedly low. Russia's willingness to issue a pure threat increases further once the crisis has been initiated, making it willing to issue a deterministic threat for values p below $p = \frac{c}{g+c}$. Regardless, brinkmanship is the preferred strategy once credibility is taken into account.

Comparative Statics

A shift in a player's resolve function represents a change in its risk tolerance; a shift up implies that a player is willing to bargain longer and tolerates a higher risk of disaster, and vice versa. A decrease in Russia's valuation of gas exports increases its risk tolerance because it suffers a lower loss in the event of a crisis. All else equal, for lower revenue levels, Russia is willing to escalate to a higher probability of disaster. Consequently, Russia's dependency on continued revenues from its trade with the EU is a determinant of its relative bargaining power. A change in the threat cost only affects Russia's decision to initiate a crisis; an increase in the threat cost shifts Russia's initial resolve down because a higher potential sunk cost makes Russia less likely to initiate a crisis. A change in the probability of playing against an EU that will never comply represents a shift along Russia's resolve function. A higher probability of facing an EU that places a low valuation on the inside option constitutes a higher probability of

unsuccessful threat, so Russia tolerates a lower risk of disaster. For the EU, a decrease in the value of Russian gas imports shifts its resolve up. A lower value means that the EU is less dependent on Russia as a trade partner, so its risk tolerance of a trade breakdown is higher. On the other hand, an increase in its valuation of the inside option decreases its resolve, showing that the EU's dependency on continued trade with Russia is a determinant of its relative bargaining power. The value of the potential concession represents the rents bargained over; subsequently, a change in the magnitude of this variable affects both players' resolves in the same direction. A larger concession is costlier for the EU and increases its tolerance of disaster; a larger concession represents more potential gains for Russia, and also increases its tolerance of disaster.

5 Application

During the summer of 2009, a standoff between Russia and the EU escalated toward a trade breakdown when Russia issued a threat of another gas shutoff unless the EU assisted Ukraine in paying its gas bills and debts. Beginning in May 2009, Russia voiced concerns about Ukraine's ability to make its gas payments and suggested that it may need financial assistance from the EU (Shiryaevskaya, 2009). The EU resisted on the basis of budget concerns, declaring that financial aid to Ukraine would be “difficult, if not impossible” (Hall, 2009, June 1). By June, Russia's Prime Minister Vladimir Putin issued a formal warning of Ukraine's approaching deadlines, and of a gas suspension to Ukraine if it failed to meet them (Kanter, 2009). An adamant resistance by the EU manifested an internal discussion document calling to stand firm on Russia’s demands (“Energetic blackmail,” 2009). Tensions increased as each side tested its opponent's willingness to escalate, knowing that a gas shutoff was largely dependent upon Ukraine. On July 17, European Commission President Jose Manuel Barroso informed Putin that financial aid may be possible, but not until late autumn, citing the extensive time needed to put together an international loan (Iago, 2009). Just 12 days later, the IMF released a loan of $3.3 billion[17] to Ukraine, specifying that these funds be used for gas reforms (“Premier says new IMF tranche to help Ukraine,” 2009). On July 31, The European

[17] The loan was part of a $16.4 billion general economic aid package.

Commission approved another loan package of $1.7 billion to assist Ukraine with its payments and industrial restructuring (Hall, 2009, August 4). This sequence of events demonstrates the significance in modeling this bargaining crisis as brinkmanship. A direct threat of a gas shutoff was never declared; rather, each side escalated the risk of disaster by prolonging negotiations that may have eventually resulted in the mutually costly shutoff being triggered by Ukraine. By helping Ukraine pay its debts and higher gas prices to Russia, the EU eliminated the exogenous risk and ended escalation.

Returning to the crises listed at the beginning of this paper, a trend similar to the one just described emerges. Russia has consistently used transit states as a way of relinquishing control of escalation during trade crises. This was the case in a four–day gas dispute with Belarus in June 2010 when Russia insisted that any reductions in gas flow to the EU were caused by Belarus' failure to make its payments (Schwirtz, 2010). Another instance, the most prominent and severe gas crisis to date, occurred in January 2009 after a price dispute between Ukraine and Russia caused a suspension of gas to Europe for nearly three weeks. Media analyses were quick to liken the crisis to the 2006 gas crisis, specifically because escalation was once again triggered by transit uncertainty.[18] A notable bargaining sequence occurred also during the Russia–Georgia conflict in 2008. After the EU accused Russia of breaking international law (Waterfield, 2009), Russia threatened the EU's energy supply by bombing around, but never directly at, the oil transit networks to Europe (McElroy, 2008).

Brinkmanship captures an element that is nearly universal to these crises. A threat of trade breakdown is never directly issued. Nor does it need to be, because probabilistic threats hinged upon autonomous risk are often effective at fulfilling motives. Applying nuclear deterrence theory to model EU–Russia energy trade as brinkmanship, such that the risk of disaster is driven by transit uncertainty, therefore provides an interesting explanation for the persistence of trade breakdowns that would not otherwise seem logical.

[18] See Stern (2006), Pirani (2009), and Pirani, Stern, Yafimava, & Oxford Institute for Energy Studies (2009) for more on the details of the 2006 and 2009 gas disputes.

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