

“Effect of Non-Militarized Disputes on the Economy: Natural Gas Disputes”

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Abstract

Liberalists attribute a positive effect to interdependence in that the more a disputing dyad is mutually economic dependent, the smaller the probability that that dyad goes to war. This theory is based on the assumption that militarized disputes disrupt the economy, assumption which has been empirically supported only by part of the literature on the topic. In this paper it is argued that even non-militarized disputes like natural gas disputes can play a key role in affecting the economy of disputing countries. The PP-NGARCH model shows moderate evidence of significant and negative effects of gas disputes on the economy of several European countries. Given the relevance of these crises at the international level, it is concluded that the militarization requirement entirely disregards a whole set of relevant disputes. This issue may be the cause of a systematic bias in the results of a large portion of the literature on the effects of political disputes on the economy.

Key Words: Non-Militarized Disputes, GDP, Gas Disputes, Pooled Panel Nonlinear Generalized Auto Regressive Conditional Heteroskedasticity (PP-NGARCH), Principal Component Analysis (PCA)

1. Introductory Theoretical Background

A lot of research has been done to study the influence of economic interdependence on the probability of war in political science. Above all, the Democratic Peace is probably the theory that has contributed the most to the growth of this field especially in the 90s. The origins of this theory can be traced back to several worksⁱ and also to Kantⁱⁱ, according to whom peace is the result of democracy (where leaders are not free to wage wars arbitrarily), morality (or respect of other people and other democracies), and economic interdependence, which makes negotiation and peace in general more preferable options over conflictⁱⁱⁱ. Democratic peace theorists like Maoz and Abdolali^{iv}, Bueno de Mesquita and Lalman^v, Bueno de Mesquita and Lalman^{vi}, and Oneal et al.^{vii} agree on the fact that the more economically entrenched a dyad is, the less likely it is that this dyad will be involved in an armed conflict. Similar conclusions are drawn by Domke^{viii}, Keohane and Nye^{ix}, Risse-Kappen^x.

The debate in political science, however, is often shaped in terms of whether the realist paradigm or the liberalist paradigm is more correct. According to liberalists, trade reduces the probability that two highly-trading countries start a war against each other. The assumption is that both countries' leaders expect that the trading benefits will be reduced or even completely removed^{xi}. To realists, however, trade has no significant effect on the probability of war^{xii}. Other scientists have actually discovered that asymmetric trade can actually lead to an increase of the probability of war^{xiii}. Although the differences of these empirical studies can be attributed to methodology, some others have argued that both realists' and liberalists' claims can be unified under the observation that the relationship between war and trade is curvilinear^{xiv}.

The liberalist proposition is based on three assumptions^{xv}: first, societies achieve a higher level of welfare by successfully trading with each other. Second, war in its most serious notation is assumed to have a significant and negative effect on trade. Third, countries' leaders are aware of the importance of trade for their societies, the potential impact of war on trade and base their decisions on this awareness. Results that offer no empirical support for any of these assumptions contradict the liberalist hypothesis. Other researchers have focused their attention on proving the liberalist assumption, where war disrupts trade. In particular, Barbieri & Levy^{xvi} find in their analysis (which excludes great power wars) no relevant trace of the validity of the second assumption upon which the liberalist claim rests.

Anderton and Carter^{xvii}, however, find reasonably strong evidence that war does indeed disrupt trade, finding which is further reinforced by similar, yet weaker, results regarding non-major powers. Strong and negative effects are found by other researchers^{xviii}, who also emphasize the fact that wars and other militarized conflicts are often followed by complete or partial embargos and by raising costs for private agents to engage in profitable trades^{xix}.

Despite the relatively large amount of literature describing the effect of militarized disputes on trade and more generally the economy, no relevant studies are found concerning the effect of non-militarized disputes on the economy. The literature described above relies on Jones, Bremer, Singer’ definition^{xx} of Militarized Inter-state Dispute (MID), according to whom militarization^{xxi} is a good indicator of the seriousness of a conflict^{xxii}. However, as noted by neoliberalists like Axelrod and Keohane^{xxiii} and Keohane and Nye^{xxiv}, the use of force is nowadays no more an affordable venture due to the high interdependence and wars’ high individual and social costs. To these authors, force is a remedy for resolving serious disputes that will be less and less relied upon in modern societies.

Thus non-militarized disputes cannot be ignored, especially in the case where one finds evidence that non-militarized disputes like gas disputes can affect the economy. This work is designed to investigate the relevance of non-militarized disputes in a politically and economically central area like Europe.

2. Research Design

Data

Gas disputed received widespread media attention especially after 2004, when large disruptions occurred, prompting protests and official complaints throughout Europe, especially among those countries that were affected the most. European institutions played an important role in defusing these conflicts, as emphasized by the 2006 Ukraine-Russia dispute, when several European customers reacted by harshly criticizing and urging the disputing parties to reach an agreement^{xxv}. Despite repeated European interventions, the intensity of these conflicts reached in the first decade of the third millennium a level that was unseen since the seventies. Political scientists have noted that especially those conflicts that started in 2004 or later can be justified not only in economic terms, but also, and more importantly, in political terms^{xxvi}.

In this work the fact is taken into account that analyzing just European countries with high dependence on Russian energy might bias the results of the statistical analysis reported below. For this reason a total of nine countries were selected, three for each of the dependence level on Russian natural gas as described in Youngs^{xxvii}, based on their importance as members of the Council of the European Union^{xxviii}, an important legislative institution in the EU also in security and energy matters^{xxix}. The time frame spans from the first quarter 2003 to the fourth quarter 2009 for one model, which is here called GDP model (N=252). Such time span has been chosen given Youngs’ notation that especially after 2004 Russia has not hesitated using the gas weapon to achieve predefined political and economic goals, and . In doing so, it is hoped to capture a phenomenon that is relatively constant over the years analyzed, thus reducing the probability of making incorrect inferences. By measuring the effect of gas disputed on GDP the robustness of the findings presented here is reinforced that even non-militarized disputes can have an impact on the economy.

The use of quarterly data to long terms effects of these crises can be justified thanks to the fact that the start of these gas disputes coincides with the start of a new quarter (Table I).

Table I: Dates Corresponding to the Start of the Disputes Analyzed

Crisis	Start Quarter	Date negotiations failed
Belarus-Russia 2004	Q1-04	January 1, 2004
Moldova-Russia 2006	Q1-06	January 1, 2006
Belarus-Russia 2006	Q2-06	End of March 2006
Ukraine-Russia 2006	Q1-06	January 1, 2006
Belarus-Russia 2007	Q3-07	August 1, 2007
Ukraine-Russia 2009	Q1-09	January 1, 2009

In order to maximize the internal validity of the model, several other control variables have been introduced^{xxx}, here including variables measuring the exchange rate between the euro and the dollar, exchange rate between the local currency and euro (UK), exchange rate between the dollar and the euro, gas prices^{xxxi}, oil prices, domestic demand^{xxxii}, inflation^{xxxiii}, industrial production^{xxxiv}, exports and imports^{xxxv}, unemployment rate^{xxxvi}, balance of payments^{xxxvii}, real consumption^{xxxviii}, deposit/ lending interest, government consolidated gross debt^{xxxix} are used as controls^{xl}. The information content of a large portion of these variables has been condensed in just three variables created using Principal Component Analysis (PCA)^{xli} in order to minimize multicollinearity and avoid issues of insufficient degrees of freedom.

Statistical Approach

Based on the Interrupted Time Series models^{xliii} described by Campbell^{xliiii}, Campbell and Stanley^{xliiv} and McDowall et al.^{xliv}, the significance of the impact of the gas disputes and political reaction was represented by a set of ‘1s’ in correspondence with a particular shock or intervention and zeros before^{xlvi}.

Such models are more formally represented as

$$Y_t = b_{pre} + b_{post} + e_t$$

and also as

$$Y_t = N_t + I_t$$

Where the intervention function I_t can be represented as a variable consisting of zeros before the intervention and 1s during or after that. As suggested by McDowall et al., it is a closer look at the data that can suggest the possible economic effects of the natural gas disputes on the nine countries under investigation in this study.

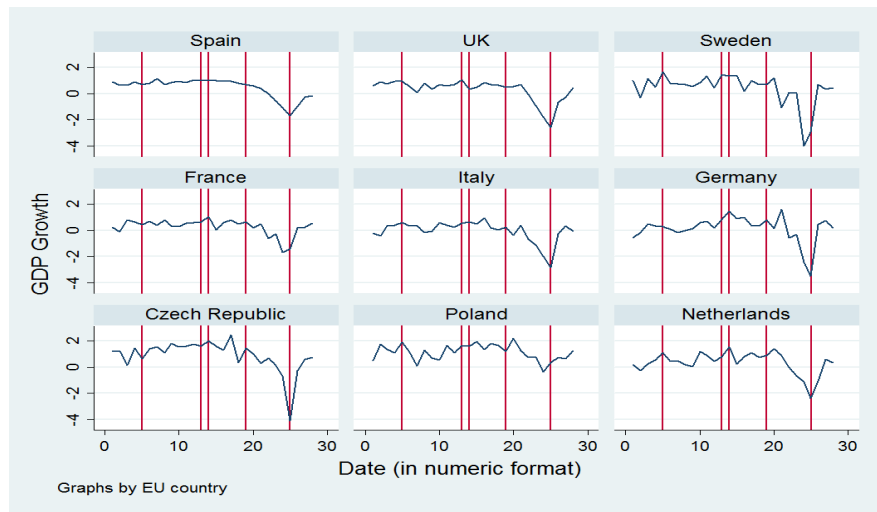


Figure 1: GDP Levels and Gas Disputes

The duration of the effect of gas disputes on external economies has been estimated by observing the dependent variable (Figure 1) and building hypotheses concerning the duration of the impact^{xlvii}. The results of this analysis are summarized in Table II.

Table II: Observed Duration of Impact of Gas Crises (Quarters)

Dispute	Duration in quarters
Belarus-Russia 2004	1,2
Moldova-Russia 2006	1,2
Belarus-Russia 2006	1,2,4,5
Ukraine-Russia 2006	1,2
Belarus-Russia 2007	1,2,4
Ukraine-Russia 2009	1,2,3

The implementation of a GARCH model is required due to the presence of heteroskedasticity, as also supported by the significantly better fit of this model^{xlviii} and the visual inspection of residuals. Current GARCH models are the results of the findings of Engle^{xlix}, Bollerslev^l, who introduced into the model also p lags of the conditional variance^{li}, where p , as indicated above indicated the autoregressive lags and q the ARCH (moving average) order^{lii}. In addition, an ARIMA(p,q) model can be used to identify the p and $\max(p, q)$ ^{liii}.

A GARCH model can be generalized in order to allow it to take into account this property of the markets according to which negative turns of the market affect the returns more heavily than positive ones. Nonlinear GARCH models (NGARCH), are therefore represented as follows

$$\sigma_{t+1} = \omega + \alpha(R_t - \theta\sigma_t)^2 + \beta\sigma_t^2 = \omega + \alpha\sigma_t^2(z_t - \theta)^2 + \beta\sigma_t^2,$$

where it is evident that a negative piece of news ($\theta > 0$) has a greater effect than z_t , a positive piece of news ($z_t > 0$)^{liv}.

The presence of heteroskedasticity, which cannot be treated even by logging the dependent variable, requires the implementation of a PP-NGARCH model, fact that is also supported by the significantly better fit of the models^{lv} and the visual inspection of residuals showed in Figure 2.

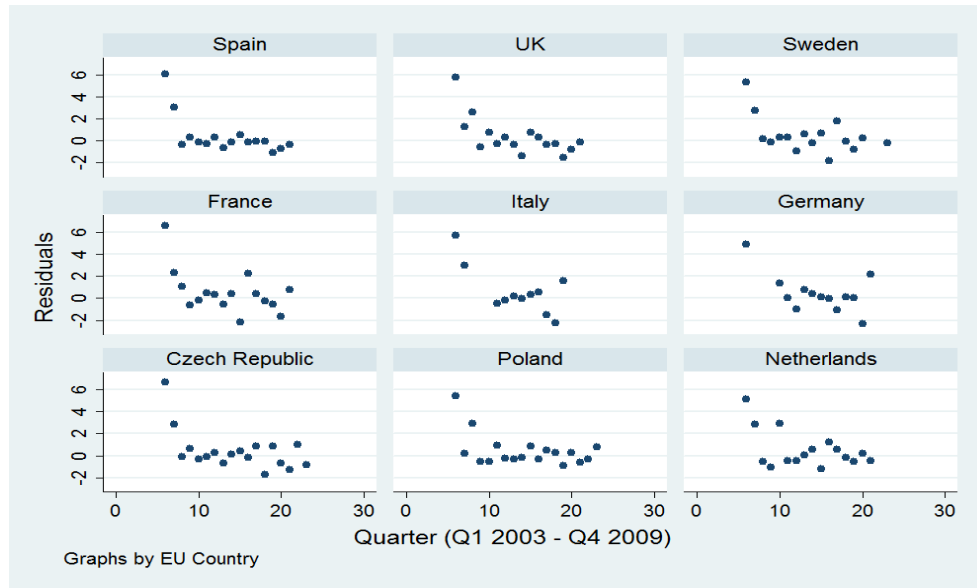


Figure 2: Residuals of a Pooled Cross Sectional GDP Model with First Order Autoregressive and Moving Average Disturbances

The Shapiro-Silk normality test shows that the residuals do not follow a normal distribution, results which are also confirmed by the Skeweness/Kurtosis test for normality^{lvii}. For this reason, robust standard errors are employed for a more reliable estimation of the standard errors^{lviii}. This model shows a better fit according to the AIC and BIC tests; it reasonably follows a straight line, but, as shown in Figure 3, it clearly fails to model some variance at the extremes of the distribution, suggesting that there are some minor residual patterns in the data.

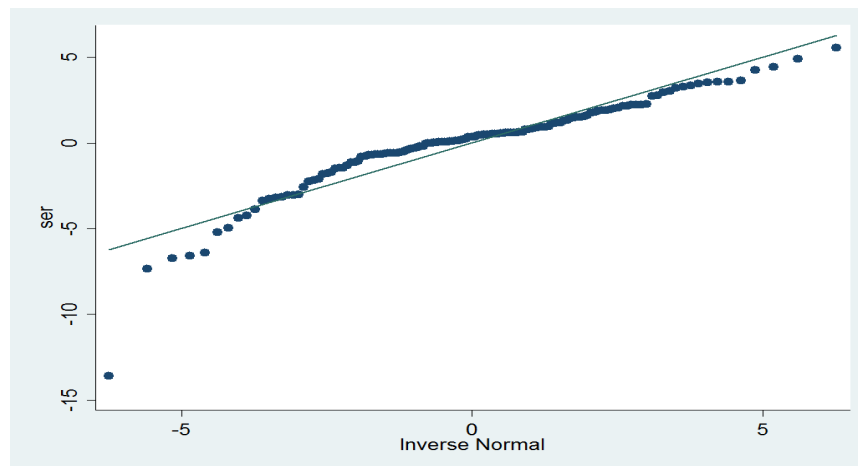


Figure 3: QQ Normal Scores of Standardized Residuals from the fitted PP-NARCH Model with AR and MA disturbances

The data collected, however, is affected not only by heteroskedasticity, but also by multicollinearity. The high multicollinearity stems especially from the macroeconomic data^{lviii}, which, as mentioned above, requires the generation of statistically independent factors through the use of PCA.

Linear algebra allows the dimensional reduction of a complex database not simply by arbitrarily selecting those to be eliminated, but by using a scientific method that supports the generation of a set of statistically independent factors that retains the highest informational content, and dismissing the variables that represent just noise or that are redundant^{lx}. Control variables like the exchange rate between the Euro and the Dollar, Euro and British Pound, Oil price, Gas price were not processed with PCA in order to be able to test the ability of the model to estimate correct parameters for these control variables. Highly collinear variables (even if not significant) were not removed from the model in order not to bias the estimation of the parameters. By doing so, the average VIF equals 5.67, thus just slightly more than the value of 5 suggested by the literature^{lx}. To minimize multicollinearity, one variable was created to measure the effect of the 2006 and 2009 Ukrainian disputes, as shown below in Table III.

3. Empirical Results

The estimation of the PP-NGARCH model shows that 4 disputes had a significant effect (p-value < 0.1) on the analyzed European economies, namely the 2006 and 2009 Ukrainian disputes and the 2004 and 2006 Belarusian crises (Table III).

Table III: Regression Results of the PP-NARCH Model

Variables	Estimated parameter	p-value
Gas price	-0.05051	0.187
Oil price	0.000884	0.889
Exchange Euro-Pound	-0.73023	0.39
Exchange rate Euro-US Dollar	-2.1385	0.12
Factor 1	-0.02656	0.21
Factor 2	0.007612	0.556
Factor 3	-0.02982	0.217
Belarus 2004	-1.49683***	<0.001***
Belarus 2006	-0.41896**	0.021**
Moldova 2006	0.23299	0.169
Belarus 2007	-0.00304	0.981
Ukraine 2006 and 2009	-0.40146*	0.057*
Constant	4.251081	0.118

No significant relationship is found for the two remaining crises, the one between Moldova and Russia in 2006, and the one between Russia and Belarus in 2007.

Similar results (sometimes weaker, some other times stronger) are offered by alternative model specifications (Table IV). The vast majority of these models emphasize the strong significance of the variable measuring especially the 2004 dispute, as found also in the best model identified. Similar observations can be made for the crisis between the same countries in 2006, and, to a minor extent also for the two Ukrainian crises in 2006 and 2009.

Table IV Hypotheses Supported by Alternative Model Specifications

Model	Significant and Negative effect (Crises)
1. PP-NARCH, ma(1) ar(1)	Belarus 2004, Belarus 2006, Ukraine 2006 and 2009
2. PP-NARCH, ma(2) ar(2)	Belarus 2006
3. PP-NARCH	Belarus 2006
4. PP-ARCH (1), ma(1) ar(1)	Belarus 2004, Belarus 2006, Ukraine 2006 and 2009
5. PP-ARCH (1)	Belarus 2004, Belarus 2006
6. PP-GARCH (1,2)	Belarus 2004, Belarus 2006
7. FE (within) regression with AR(1)	Belarus 2004
8. PP-NAGARCH(1,0)	Belarus 2004, Belarus 2006, Ukraine 2006 and 2009

Despite the use of PCA to drastically reduce multicollinearity, gas price, oil price, exchange Euro-British Pound, and exchange Euro-Dollar are found to be non-significant, suggesting that these variables do not add anything new to the informational content of the other macroeconomic variables.

4. Theoretical Implications

The liberalist claim that interdependence lowers the probability of war seems to hold even in case of non-militarized conflicts like gas disputes. The results of this work emphasize that natural gas disputes (like the ones between Russia, some of its former satellites and several European institutions) can heavily affect the economy of at least one of the disputing parties. The absence of the militarization feature that characterizes the vast majority of the studies on war and trade does not prevent these unconventional political crises from being relevant and worthy of the attention of political scientists and economists altogether. This suggests that even if a conflict is not included in the definition of a MID because of a lack of militarization, other criteria should be included in order to better address the seriousness of a conflict and to avoid selection bias arising from studying only cases in which force was either used, displayed or threatened. The results presented here are robust given the relative conformity of the results of the alternative model specifications considered here and invites political scientists and economists to perform a similar study using a larger number of disputes, for example like those at the hostility level of 1 described in the MID data.

This research could be further enriched by better investigating possible issues of endogeneity, and applying the same analysis on Russia and the ex-Soviet countries involved in the disputes. However, given the paucity and the unreliability of the macroeconomic data (which can be arguably assumed to be even getting worse since the 1990s due to Putin's power centralizing efforts), it is here preferred to limit this work to the study of the effect of the gas disputes on the economy of nine important European countries, which represent a consistent portion of one of the parties involved in the dispute.

ⁱ See Clarence Streit, *Union Now: A Proposal for a Fedreal Union of the Leading Democracies*. (Harpers, New York, 1938), Dean Babst, 'Elective governments - a force for peace', *The Wisconsin Sociologist*, 3(1), 1964, pp. 9-14, R. J. Rummel, 'Libertarianism and international violence'. *Journal of Conflict Resolution*, 27(1), 1983, pp. 27-71, R. J. Rummel, 'Libertarian propositions on violence within and between nations: A test against published research results'. *Journal of Conflict Resolution*, 29(3), 1985, pp. 419-455, Erich Weede, "Democracy and war involvement". *Journal of Conflict Resolution*, 28(4), 1984, pp. 649-664, Erich Weede, "Some simple calculations on democracy and war involvement". *Journal of Peace Research*, 29(4), 1992, pp. 377-383, Michael W Doyle, 'Liberalism and world politics'. *The American Political Science Review*, 80(4), 1986, pp. 1151-1169, David Garnham, 'War-proneness, war-weariness, and regime type: 1816-1980'. *The Journal of Peace Research*, 23(3), 1986, pp. 279-289, T. Clifton Morgan and Valerie Schwebach, 'Take two democracies and call me in the morning: A prescription of peace?' *International Interactions*, 35(2), 1992, pp. 187-211, Bruce Russett. *Grasping the Democratic Peace: Principles for a Post-Cold War World* (Princeton: Princeton University Press, 1993), Stuart A Bremer, 'Dangerous dyads: Conditions affecting the likelihood of interstate war, 1816-1965'. *Journal of Conflict Resolution*, 36(2), 1992, pp. 309-341.

ⁱⁱ Immanuel Kant. 1991 (2nd edition). *Perpetual Peace*. In Hans Reiss, editor, *Kant's Political Writings*. (Cambridge: Cambridge University Press, 1795).

ⁱⁱⁱ Michael W Doyle, 'Liberalism and world politics'. *The American Political Science Review*, 80(4), 1986, pp. 1151-1169.

^{iv} Maoz Zeev and Nasrin Abdolali, "Regime types and international conflict, 1816-1976". *Journal of Conflict Resolution*, 33(1), 1989, pp. 3-35.

^v Bruce Bueno de Mesquita and David Lalman, 'Domestic opposition and foreign war'. *The American Political Science Review*, 84(3), 1990, pp. 747-765.

^{vi} Bruce Bueno de Mesquita and David Lalman, *War and Reason* (New Haven: Yale University Press, 1992).

^{vii} John R Oneal, Frances H. Oneal, Zeev Maoz, and Bruce Russett. 'The liberal peace: Interdependence, democracy, and international conflict, 1950-85'. *Journal of Peace Research*, 33(1), 1996, pp. 11-28.

^{viii} William K Domke, *War and the Changing Global System* (New Haven: Yale University Press, 1988).

^{ix} Robert O. Keohane, and Joseph S. Nye (3rd edition), *Power and Interdependence*. Addison Wesley Longman, New York, 1989).

^x Thomas Risse-Kappen, *Cooperation among Democracies: The European Influence on U.S. Foreign Policy*. (Princeton: Princeton University Press, 1995).

^{xi} See Michael W Doyle, *Ways of War and Peace* (New York: W.W. Norton, 1997) and John R Oneal, and Bruce Russett. 'The Classical Liberals Were Right: Democracy, Interdependence and Conflict, 1950-1985,' *International Studies Quarterly*, 41(2), 1997, pp. 267-294

^{xii} See Barry Buzan, 'Economic structure and international security: The limits of the liberal case'. *International Organization*, 38(4), 1984, pp. 597-624, Jack S Levy, 'The causes of war: A review of theories and evidence'. In

- Philip E. Tetlock, editor, *Behavior, Society, and Nuclear War*, 4. 1989, ^{xii}Norin M Ripsman and Jean-Marc F. Blanchard, 'Commercial Liberalism under Fire: Evidence from 1914 and 1936', *Security Studies*, 6(2), 1996/97, pp. 4–50, Robert Gilpin, *The Political Economy of International Relations* (Princeton: Princeton University Press, 1987), Geoffrey Blainey (3rd edition), *The Causes of War* (New York: Free Press, 1988).
- ^{xiii} See Stanley Hoffman, *The State of War* (London: Pall Mall, 1965), Mark J. Gasiorowski and Solomon W. Polachek, 'Conflict and interdependence: East-west trade and linkages in the era of détente'. *Journal of Conflict Resolution*, 26(4), 1982, pp. 709–729, Robert Gilpin, *The Political Economy of International Relations* (Princeton: Princeton University Press, 1987), Robert O. Keohane, and Joseph S. Nye (3rd edition), *Power and Interdependence*. Addison Wesley Longman, New York, 1989), John A. Kroll, 'The complexity of interdependence'. *International Studies Quarterly*, 37(3), 1993, pp. 321–347, Theotonio Dos Santos, 'The structure of dependence'. *The American Economic Review*, 60(2), Papers and Proceedings of the Eighty-second Annual Meeting of the American Economic Association), 1970, pp. 231–236, Richard Rubinson, 'The world-economy and the distribution of income within states: A cross-national study'. *American Sociological Review*, 41(4), 1976, pp. 638–659, Immanuel Wallerstein, "The rise and future demise of the world capitalist system: Concepts for comparative analysis". *Comparative Studies in Society and History*, 16(4), 1974, pp. 387–415.
- ^{xiv} Barbieri Katherine, *Does economic interdependence reduce dyadic conflict?* In the annual meeting of the International Studies Association, Washington, D.C., 1994.
- ^{xv} Charles H. Anderton and John R. Carter, 'The Impact of War on Trade: An Interrupted Times-Series Study'. *Journal of Peace Research*, 38(4), 2001, pp. 445–457.
- ^{xvi} Barbieri Katherine and Jack S. Levy, "Sleeping with the Enemy: Impact of War on Trade", *Journal of Peace Research*, 36(4), 1999, pp. 463–479.
- ^{xvii} Charles H. Anderton and John R. Carter, 'The Impact of War on Trade: An Interrupted Times-Series Study'. *Journal of Peace Research*, 38(4), 2001, pp. 445–457.
- ^{xviii} See John R Oneal, and Bruce Russett. 'The Classical Liberals Were Right: Democracy, Interdependence and Conflict, 1950–1985,' *International Studies Quarterly*, 41(2), 1997, pp. 267–294, Philippe Martin and Thierry Mayer and Mathias Thoenig, 'Make Trade not war?'. *Review of Economic Studies*, 75(3), 2008, pp. 865–900, Glick Reuven and Alan M Taylor, 'Collateral Damage: Trade Disruption and the Economic Impact of War', *The Review of Economics and Statistics*, 2010, John R Oneal, Bruce Russett, and Michael Berbaum, 'Causes of Peace: Democracy, Interdependence, and International Organizations, 1885–1992,' *International Studies Quarterly*, 47(3), 2003, pp. 371–394, S. Brock Blomberg, and Gregory Hess, 'How Much Does Violence Tax Trade?' *this REVIEW* 88:4, 2004, pp. 599–612.
- ^{xix} See S. Brock Blomberg, and Gregory Hess, 'How Much Does Violence Tax Trade?' *this REVIEW* 88:4, 2004, pp. 599–612.
- ^{xx} Stuart A Jones and A. Bremer and J. David Singer, 'Militarized Interstate Disputes, 1816–1992: Rationale, Coding Rules, and Empirical Patterns.' *Conflict Management and Peace Science*, 15(2), 1996, pp. 163–213.
- ^{xxi} The authors define militarized disputes as "a single military action involving an explicit threat, display, or use of force by one system member state towards another system member state" (Jones, Bremer, Singer (169).
- ^{xxii} The threat of use of force requires the sporadic application of force in order to be credible.
- ^{xxiii} Robert Axelrod R. Keohane, 'Achieving Cooperation under Anarchy: Strategies and Institutions', *World Politics*, 38(1), 1985, pp. 226–254.
- ^{xxiv} Robert O. Keohane, and Joseph S. Nye (3rd edition), *Power and Interdependence*. Addison Wesley Longman, New York, 1989).
- ^{xxv} See Jim Nichol, Steven Woehrel and Bernard A. Gelb, *Russia's Cutoff of Natural Gas to Ukraine: Context and Implications*. CRS Report for Congress. 2006, <<http://www.au.af.mil/au/awc/awcgate/crs/rs22378.pdf>>. Accessed: April 1, 2014 and Yhiah. "Nemtsov: Russian part in RosUkrEnergo looks as improper as Ukrainian one". 2008, <<http://www.unian.info/world/103241-nemtsov-russian-part-in-rosukrenergo-looks-as-improper-as-ukrainian-one.html>>. Accessed: April 1, 2014.
- ^{xxvi} In the literature, political scientists attribute this new Russian approach towards Ukraine, Belarus and Moldova not only to the Russian desire to collect as many financial resources as possible from these countries, but also to use the financial leverage gained by increasingly expensive gas exports to gain economic and political control over these countries, as emphasized by recent developments (March 2014) in the relationship between Russia and Ukraine over Crimea. In fact, Putin himself recognized the importance of gaining access to the old Soviet pipeline system in order to restore, at least in part, Soviet prestige (Youngs 2009). It is probably a secondary goal to secure a steady flow of gas and oil through its former satellites, when one compares it to that of establishing a tighter economic and political relationship with those areas that play an important role in the Russian economy. The relevance of this topic, however, is not in the expansion of Russian political influence *per se*, as it was the case during the Cold War. The concern of the highest European spheres stems from the growing suspicion that Russia may also use the energy weapon to advance its political agenda in Eastern and Western Europe.
- ^{xxvii} Richard Youngs, *Energy Security: Europe's New Foreign Policy Challenge* (London: Routledge, 2009).

^{xxviii} The total number of votes of the countries considered in this work amounts to 59.42% of the total available to all EU countries. Data relative to Russia and Ukraine, Moldova or Belarus have not been included due to availability and interpretation issues (Bartholdy 1997, Koen 1994,1996).

^{xxix} See Federiga Bindi, *The foreign policy of the European Union: assessing Europe's role in the world* (Washington, D.C, Brookings Institution Press, 2010) and Richard Youngs, *Energy Security: Europe's New Foreign Policy Challenge* (London: Routledge, 2009).

^{xxx} Primary data source: Eurostat.

^{xxxi} European natural gas prices cannot be easily accessed. Some agencies release this kind of information only under the payment of a fee, but for privacy reasons the identity of all traders and the prices charged by them are not disclosed. For this reason, Nymex Henry Hub Natural Gas prices were chosen, futures that are traded on the New York Mercantile Exchange (NYMEX), as a measure of the level of gas prices in Europe. It is here assumed that the prices levels by these quarterly figures of these futures well approximate the same trend of gas prices in Europe.

^{xxxii} Data is seasonally adjusted and adjusted data by working days. Percentage of GDP.

^{xxxiii} Minimum sampling frequency: 1 month. Base year: 2005.

^{xxxiv} Data is seasonally adjusted and adjusted by working days. Percentage of GDP. Minimum sampling frequency: 1 month.

^{xxxv} Data is seasonally adjusted and adjusted by working days. Millions of euro, chain-linked volumes, reference year 2000 (at 2000 exchange rates). Minimum sampling frequency: quarters.

^{xxxvi} It refers to EU citizens between 15 and 64 years. Minimum sampling frequency: quarters.

^{xxxvii} Millions of Euro. Current account, Goods and services. Minimum sampling frequency: quarters.

^{xxxviii} Final consumption expenditure. Data is seasonally adjusted and adjusted by working days. Index, 2000=100.

^{xxxix} Government consolidated gross debt. Percentage of GDP. Minimum sampling frequency: quarters.

^{xl} Other political variables like research expenditure and country regime (Polity 4 data) were considered, but dropped given their annual measurement frequency. See for example Gerald Schneider and Vera E. Troeger, 'War and the World Economy: Stock Market Reactions to International Conflicts'. *Journal of Conflict Resolution*, (50), 2006, p. 623, Bruno S Frey and Marcel Kucher. 'History as reflected in capital markets: The case of World War II'. *Journal of Economic History* 60 (2), 2000, pp. 468–96, James D Hamilton, 'What is an oil shock?' *Journal of Econometrics*, 113, 2003, pp. 363–398.

^{xli} See following section "Statistical approach".

^{xlii} These models have been widely applied to behavioral data (Donald P Hartmann and John M. Gotrman, Richard R. Jones, William Gardner, Alan E. Kazdin, And Russell S. Vaught, 'Interrupted Time-Series Analysis And Its Application To Behavioral Data'. *Journal of Applied Behavior Analysis*. 133(4), 1980, pp. 543-559; John A. Rubin Wagner and Paul A. Callahan, Thomas J., "Incentive payment and nonmanagerial productivity: An interrupted time series analysis of magnitude and trend". *Organizational Behavior and Human Decision Processes*. 42(1), 1988, pp. 47-74; Trevor A Sheldon, Nicky Cullum, Diane Dawson, Annette Lankshear, Karin Lowson, Ian Watt, Peter West, Dianne Wright, John Wright. 'What's the evidence that NICE guidance has been implemented? Results from a national evaluation using time series analysis, audit of patients' notes, and interviews'. *BMJ*, 329(7473), 30 October 2004, p. 999, doi:10.1136/bmj.329.7473.999), medical applications (W W. Tryon, "A simplified time-series analysis for evaluating treatment interventions". *Journal of Applied Behavioral Analysis*. 15(3), 1982, pp. 423–429; Fowler, S., A. Webber, B. S. Cooper, A. Phimister, K. Price, Y. Carter, C. C. Kibbler, A. J. H. Simpson and S. P. Stone, 'Successful use of feedback to improve antibiotic prescribing and reduce Clostridium difficile infection: a controlled interrupted time series'. *Journal of Antimicrobial Chemotherapy*, 2007, doi:10.1093/jac/dkm014; C. Grijalva and J. Nuorti, P. Arbogast, S. Martin, K. Edwards, M. Griffin, 'Decline in pneumonia admissions after routine childhood immunization with pneumococcal conjugate vaccine in the USA: a time-series analysis'. *The Lancet*, 369(9568), 2007, pp. 1179-1186) and also to social science (Barry S. Rundquist and David E. Griffith. 'An Interrupted Time-Series Test of the Distributive Theory of Military Policy-Making'. *The Western Political Quarterly*, 29(4), 1976, pp. 620-626; Bonham, Carl, Edwin Fujii, Eric Im, And James Mak. (). 'The Impact of the Hotel Room Tax: An Interrupted Time Series Approach'. *National Tax Journal*, 45(4), 1992, pp. 433-41; Reuven Glick, and Andrew K. Rose, 'Does a currency union affect trade? The time-series evidence'. *European Economic Review*, 46(6), June 2002, pp. 1125-1151). In the political science field, interrupted time series analysis has been implemented to assess the effect of war on trade (as seen in Charles H. Anderton and John R. Carter, 'The Impact of War on Trade: An Interrupted Times-Series Study'. *Journal of Peace Research*, 38(4), 2001, pp. 445–457), the impact of reforms on taxation and expenditures (David R Morgan and John P. Pelissero, 'Urban Policy: Does Political Structure Matter?' *The American Political Science Review*, 74(4), 1980, pp. 999-1006), to test the impact of change of social order on the level of crime and deviance (William Alex Pridemore, Chamlin, Mitchell B., Cochran, John K. 'An Interrupted Time-Series Analysis of Durkheim's Social Deregulation Thesis: The Case of the Russian Federation', *Justice Quarterly*, 24(2), 2007, pp. 271-290), or to measure the impact of anti-terrorist policies on the frequency of terrorist acts (Bryan Brophy-Baermann and John A. C. Conybeare, 'Retaliating against Terrorism: Rational Expectations and the Optimality of Rules versus Discretion'. *American Journal of Political Science*, 38(1), 1994, pp. 196-210), just to name a few of the most significant applications. See also Gerald Schneider and Vera E. Troeger, 'War and the World Economy: Stock Market Reactions to International Conflicts'. *Journal of Conflict Resolution*,

- (50), 2006, p. 623 and Martin Brunner, 'Does politics matter? The influence of elections and government formation in the Netherlands on the Amsterdam Exchange Index', *Acta Politica*, 44(2), 2009, pp. 150-170.
- ^{xliii} D. T. Campbell, *From Description to Experimentation: Interpreting Trends as quasi-experiments* (Madison, Wis: University of Wisconsin Press, 1963), pp. 212-242.
- ^{xliv} D. T. Campbell and J. C. Stanley, *Experimental and Quasi-experimental Designs for Research* (Chicago: Rand McNally, 1966).
- ^{xlv} David McDowall and Richard McCleary and Errol E. Meidinger and Richard A. Hay, Jr. *Interrupted Time Series Analysis* (London, Beverly Hills: Sage Publications, 1980).
- ^{xlvi} Zeros and an X's are used in the original description by D. T. Campbell and J. C. Stanley, *Experimental and Quasi-experimental Designs for Research* (Chicago: Rand McNally, 1966).
- ^{xlvii} The disputes presented in the figure are ordered chronologically: Belarus (2004), Moldova (2006) and Ukraine (2006), Belarus (2006), Belarus (2007), Ukraine (2009).
- ^{xlviii} AIC and BIC for the pooled cross sectional time series GDP model equal respectively 418.4 and 455.7, compared to the PP-NARCH(0,0) model's values of 361.8 and 408.8.
- ^{xlix} Robert F. Engle, 'Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of United Kingdom Inflation.' *Econometrica*. 50(4), 1982, pp. 987-1007.
- ^l Tim Bollerslev, 'Generalized Autoregressive Conditional Heteroskedasticity'. *Journal of Econometrics*, 31, 1986, pp. 307-327.
- ^{li} For recent applications of GARCH models in political science see Schneider and Troeger (2006) and Brunner (2009).
- ^{lii} See Jonathan D Cryer and Chan Kung-Sik, *Time Series Analysis With Applications in R*. (New York, NY: Springer, 2008), page 289 and Robert F. Engle, 'GARCH 101: The Use of ARCH/GARCH Models in Applied Econometrics'. *The Journal of Economic Perspectives*, 15(4), 2001, page 160.
- ^{liii} Cryer and Chan (294) suggest to first fit a GARCH(p,q) model and then to estimate q by looking at the significance of the estimated ARCH coefficient. Since mixed autoregressive and moving average processes are usually hard to define, Cryer and Chan (116-117, 294) suggest the use of the Extended Autocorrelation Function (EACF) of the squared observations. The best combination of p eq value will correspond to the upper-left vertex of the triangle of zeros, where p is the row and q is the column.
- ^{liv} See D. Gujarati and D. Porter (4th Edition), *Essentials of Econometrics* (McGraw Hill, 2009) and Peter F. Christoffersen, *Elements of Financial Risk Management* (New York: Academic Press, 2003)
- ^{lv} AIC and BIC for the pooled cross sectional time series GDP model equal respectively 418.4 and 455.7, compared to the PP-NARCH(0,0) model's values of 361.8 and 408.8.
- ^{lvi} P-values are less than 0.0001.
- ^{lvii} Bollerslev, Tim, and Jeffrey M. Wooldridge, 'Quasi-maximum likelihood estimation and inference in dynamic models with time-varying covariances'. *Econometric Reviews*, 11, 1992, pp. 143-172.
- ^{lviii} Mean VIF=151,934.33.
- ^{lix} More specifically, PCA rotates the original matrix so that the main axis is aligned with the most important dimension, the second axis, perpendicular to the first one, is aligned with the second most important axis and so on and forth. The rotated matrix is also centered on the mean of the distribution.
- ^{lx} Charlotte H Mason and William D. Perreault, Jr. 'Collinearity, Power, and Interpretation of Multiple Regression Analysis'. *Journal of Marketing Research*, 28(3), 1991, pp. 268-280.