Defense Pacts and their Influence on Nuclear Proliferation: A Quantitative Analysis

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**Abstract:**

There appears to be a divide in political science and international relations that has been ongoing since the creation of the atomic bomb: Is it better for every country to have nuclear weapons or for no country to be nuclearized? Faced with the facts that it may be unrealistic to expect that every nuclear power would dismantle its arsenal in the foreseeable century, political scientists have set to studying how to effectively limit the spread of nuclear weapons through the use of sanctions. However, there is a consistently occurring gap in the literature. Previous quantitative studies have failed to examine countries that are feasibly capable of weaponizing nuclear material, but do not. This paper uses a large N analysis from 1970-1990 and examines what possible factors may influence a countries choice to nuclearize by looking at those who have succeeded and, for the first time, those who have never attempted.

INTRODUCTION: *The Friends Who Just Said “No”*

As a new addition to the constantly evolving discussion concerning nuclear-capable states, “Friends Don’t Let Friends Proliferate” (Helfstein 2010) is interesting in two regards; it simultaneously comes to a rather conservative and predictable conclusion while insightfully highlighting a weakness in both its own studies and its companion literature. Scott Helfstein of the United States Military Academy at West Point posits that nuclear-arming countries respond to threats of economic sanctions from countries with which they have had previous friendly relations - statistical proof of what others have discussed in theory before him. However, Helfstein then points out those cases which he has purposefully excluded in coming to this conclusion “…and it is important to note that the data gathered here only look at states sanctioned after pursuing nuclear weapons programs. A rational choice perspective would suggest that these states expected to pay some costs for their actions.” (284)

While this research is very compelling and could prove to be an important component of future nonproliferation framework, it is incomplete for that reason. That is to say Helfstein proved how to move countries away from nuclearization, it does not extend his model to include countries that have never pursued nuclear arms which ultimately proves problematic to his conclusions. It was this rather forthcoming admission that spurred my curiosity and I set out to see if any other quantitative models studying nuclear states had incorporated those countries which had both the structural and economic capacity to pursue a nuclear weapons program. After an exhaustive look at the literature surrounding nuclearization, I discovered that this problem was quite pervasive and that there existed no precedent for studying these countries. As a result of this discovery the remainder of this paper will be spent reviewing the focus of nuclear case and quantitative studies, the theoretical justification for why these countries should be included in those models and which nuclearization hypothesis should be focused upon first and finally a proposal for an inclusive model.

LITERATURE CONCERNING NUCLEARIZATION AND RELATED TOPICS

There seems to be a divide in political science and international relations that has been ongoing since the creation of the atomic bomb – is it better for every country to have nuclear weapons or for no country to be nuclearized? Faced with the facts that it may be unrealistic to expect that every nuclear power would dismantle its arsenal in the foreseeable century, political scientists have set to studying how to effectively limit the spread of nuclear weapons through the use of sanctions. However, as has been previously mentioned, there is a consistently occurring gap in the literature in that very few quantitative case studies have focused their research on those countries who, though capable of creating a nuclear weapons program, have not. Political Scientists and related researchers have, however, focused on a couple of areas related to weaponization to that degree. These can be divided as follows: sanctions and economically-restricting strategies, Rational Choice models as explanations for nuclearizing, why countries pursue nuclear weapons, why they do not, and when and why nuclear powers share their technology and discoveries.

At the forefront of the discussion concerning how to limit the spread of nuclear weapons is, of course, sanctions. The most comprehensive and generalizable research concerning sanctions is the compounding work of Hufbauer, Clyde, Schott and Elliott (and later Oegg). In 1985, in two sections released in 1990, and the most recent edition being released in 2007 these four international economists have tracked sanctions and their effectiveness for over a hundred years (Hufbauer, Clyde, Schott, and Elliott, 1985). In their work that goes beyond purely proliferation-related sanctions, Hufbauer et al. initially released ‘nine commandments’ concerning the maximizing of sanction effectiveness which, in the latest edition, changed to seven recommendations. Of these recommendations issues like putting in place the maximum amount of sanctions possible first rather than gradually increasing them and allied countries’ sanctions conveying a much stronger message than an adversaries’ are included (Hufbauer, Clyde, Schott, Elliott, and Oegg, 2008).

Coinciding with the aforementioned recommendations concerning international timing of sanctions, political scientist Daniel Drezner focuses several of his publications on when they have been the most effective. The most relevant of which to this project was his article entitled “Bargaining, Enforcement and Multilateral Sanctions: When is Cooperation Counterproductive?” (2000). He uses this article and its quantitative research to argue that a disorganized response from the international community is statistically less effective than a strong, unilateral response. Simply put, Drezner found evidence that one country placing harsh sanctions on a nuclearizing country is much more effective at stopping that weaponizationthan the entirety of the international community splitting on the issue and several, smaller sanctions being placed on the offending country. Drezner, much like Helfstein, also excludes analysis of the non-nuclear, though capable, countries.

In direct conversation with this demonstrable instance of a country not nuclearizing, is the quantitative research conducted by Tversky and Kahneman’s “Loss Aversion in Riskless Choice: A Reference-Dependent Model”. Due to a different phrasing being hard to find, they argue that “there is substantial evidence that initial entitlements do matter and that the rate of exchange between goods can be quite different depending on which is acquired and which is given up” (Tversky and Kahneman, 1991). In essence, they introduce the idea that a country may not pursue nuclear weapons because there is a measurable status quo bias. Simplistically phrased – a country may not go after nuclear weapons because they do not truly gain anything of advantage and their current state does not necessitate. Their research goes further than to merely affirm Singh and Way’s expression of external determinants because they show that it is possible to offer up the status quo as a preferable alternative even with a possible threat. These states may also anticipate the threat of sanctions which would make the status quo extremely net beneficial.

In the quite likely event that a sanctioned country is not responsive to its economic restrictions, the next step in attempting to deter a nuclear program’s continuation is to understand a country’s motives. Singh and Way writing in 2004 provide this information quite succinctly in “The Correlates of Nuclear Proliferation: A Qualitative Test”. The most referenced quantitative model concerning nuclear weapons since their publishing date, the authors identify three variables that drive a country’s desire for nuclearization: technological determinants, external determinants, and domestic determinants. First, technological determinants refers to a country’s increased literacy rate, increased scientific emphasis and economic development that result in nuclear weapons being almost “too cheap for a country to resist” (Singh and Way, 2004). Second, they refer to external determinants as being the presence (or lack) of a security threat and an alliance agreement from a powerful nation. The third and final category of variables is composed of domestic issues like the country’s increasingly democratic leaning, an autonomous domestic elite, and status motivations. Their ultimate findings show that these are quite accurate in predicting future nuclear states.

The next category of research is the inverse of the preceding; why nations choose not to pursue nuclear weapons or why they may not need their own. In the book, *Games of Strategy*, Arinash Dixit and Susan Skeath discuss the concept of ‘brinkmanship’ or the letting of a situation get just beyond ones control so as to increase the probability of a threat being followed on so as to maximize the likelihood of a recipient’s acquiescence to the instigating country’s demands (1999) . Dixit and Skeath attempt to demonstrate this concept by using the case study of the Cuban missile crisis and an odd mix of quantified outcomes meant to mathematically reinforce the risk-benefit analysis that results in what they contend was the most likely outcome. Chapter fourteen of Games of Strategy significantly contributes to the literature foundation to this paper by giving an example of a country that never has nuclearized, but also a reason as to why not: a superpower placed nuclear weapons on their land strategically, but also to benefit them as an ally. Cuba proves to be one of the first (accompanied of course by Turkey who is also known to have housed US nuclear missiles) countries that would otherwise be outliars in an evaluation of non-nuclear countries. Despite having an obvious nuclear-nation’s backing through the Soviet Union, having the external determinant of the United States as an adversary as Singh and Way identify, *Cuba did not nuclearize*. Jacques Hymans adds to this discussion the historical example of Australia who is believed to be incapable of producing a credible, independent threat if it were a nuclear power hence the country’s nuclear alliance with the United States (2006). Which leads one to hypothesize that a country who could nuclearize would choose not to because they have the protection (or even the oversight) of a protector country’s atomic weapons.

Another political scientist looking into what sanctions have been most effective and what deters nuclearization, Lewis Dunn analyzes the influence of a superpower ally. In his defense, however, Dunn does discuss these countries at length and even posits the theory that it is because there is a nuclear superpower that is protecting these nations. However, Dunn never statistically analyzes this across the board to soundly prove the theory. He argues that defense alliances, particularly formed during the Cold War, almost made nuclear deterrence a ‘free good’ for all of its members since only a few had nuclear missiles, yet all were protected. He then adds Taiwan and South Korea to Dixit and Skeath’s case study of Cuba. Two more countries, who despite other existing determinants like external threats, democratically-oriented governments, and a literate base of people, did *not* start a nuclear weapons program. For the same reason as Cuba, their alliance with the United States provided that safety and the obtaining of such weapons weakened said alliance. Two case studies, I would also like to note, that also lent proof to Tversky and Kahneman’s loss aversion analysis. Furthermore, Dunn goes on to speculate that just because a country did not nuclearize before a certain point at time or even by this point in time, one cannot rule out the inevitability of such an action thus justifying this paper’s use of cross-sectional analysis.

This analysis proves to be quite useful to this paper’s overall objective; had Singh and Way incorporated countries who have not weaponized they may have been able to identify an existence or a lacking of one or more of these determinants functionally making their research falsifiable and far more compelling.

Even more recent than Singh and Way’s work, Matthew Kroenig released his findings in “Exporting the Bomb: Why States Provide Sensitive Nuclear Assistance” in 2009. Kroenig finds and further assumes that a country’s primary means to starting a nuclear program is through help from sympathetic nuclear powers. So, his work provides insight into this area of research in two additional ways: his working hypotheses on why and who is willing to give this enabling nuclear assistance and a reason as to why a recipient state may not follow through on their nuclear program. Kroenig uses a statistical approach as well to prove that states are far more likely to provide nuclear assistance if they share a common enemy with the recipient country. Opposite of this though, he finds that states are much less likely to share sensitive nuclear information if they are either more powerful relative to a possible recipient state or if the nuclear state who could give information to another state is dependent upon a superpower. With these variables demonstrating why and when a nuclear state would see it as advantageous to share such information, Kroenig also is able to demonstrate that the recipient state may not want a nuclear program. The primary reason being that it would restrict that country’s ability to use conventional weapons and warfare against other states because this would lock them into a nuclear stalemate with rival nations. Of all of the political scientists who actualize their theories, Kroenig comes closest to expanding the nuclear analysis to countries who have not nuclearized, but who may have a vested interest. In Table 2 of his article, Kroenig lists his “Noncases of Sensitive Nuclear Assistance” composed of country pairings who have, through his thorough research, been capable of spreading nuclear information and paired countries that were allied with the possible disseminator of nuclear information.

Given the aforementioned factors that have been studied concerning nuclearization and the subsequent gaps in research there is one reoccurring variable that a majority of the researchers agree upon; the influence of a superpower pact. Thus the research question this paper will attempt to answer, or in the very least, lay the foundation for answering is whether or not nuclear powers and their pacts disincentivize nuclear proliferation and whether or not the incorporation of non-nuclear states in the model will influence the outcomes.

Using Helfstein’s, Singh and Way’s, and Kroenig’s determinants for relation statuses, I hope to demonstrate that these types of relationships correlate with a lack of proliferation and that the inclusion of non-nuclearized nations

THEORETICAL BASIS

The objective of this research is to fill an existing gap in nuclear studies. Like most gaps, this hole can be filled in order to test both its and the surrounding structures’ (or theories reliant upon this assumption) resiliency. In order to strengthen the existing research that shows the effectiveness of certain sanctions on nuclearizing countries, non-nuclearizing countries must be used as the control. As a result of the new data sets that will accompany these historically overlooked countries, I anticipate the results to lend some proof to pre-existing theories of Mutually-Assured Destruction (MAD) and deterrence. To more formally state the above-mentioned research question –*Hypothesis: If a state who has the economic capacity to pursue nuclear weapons chooses not to, it is because of their alliance with a nuclear power.* Theoretically, if a country feels threatened it would build up its defenses and ability to make a counter-threat. That counter-threat in its most extreme, and arguably effective form, is the obtaining of nuclear weapons.As an extension of this, rational choice deterrence theory dictates that an adversarial country will avoid conflict at all stages (nuclear, ground warfare, etc) for fear of the aggravated country’s nuclear capability (Paul, 1995). However, if that country, hypothetically smaller and developing or only recently developed, is protected by some other country’s nuclear weapons then there is no incentive for them to create their own weaponization program.

It is probably these assumptions and line of rationale that results in non-nuclearized states being passed over for analysis. When countries that are capable of nuclearizing have chosen not to do so they are then not considered a threat, much like Australia, and thus are not studied alongside those that are. However, they may provide the key to how to prevent nuclear weapons from spreading further than they already have which is a need that has already been recognized:

“The argument of selection bias in cases of deterrence has been made convincingly by Achen and Snidal (1989), and attempts at more rigorous empirical -study of deterrence are now underway (see Russett and Huth, Tsebelis 1989). Exactly the same logic applies to sanctions. Suppose that some social scientist persuaded by these arguments does her best to collect cases of nonsanctions and add them to the H-S list in order to eliminate the selection bias they present. An empirical study of this extended list would provide much more complete, unbiased, and impartial insights into the sanctions phenomenon” (Tsebellis, 1990)

Sanctions and weapons of mass destruction specialists have already identified control and dependent variables, coded them, and developed comprehensive regression models and varying degrees of significance in order to identify relevant relationships. The task at hand is to synthesize all of the relevant variables and existing models and add these countries that had been previously overlooked. This section of the paper is concerned with first explaining why these cases are not studied, discuss the possible reasons as to why they exist, and then the implications of the information resulting from this model.

Within the nuclear sanctions literature the unit of analysis is consistently individual countries who are seeking nuclear arms; however countries which could become nuclear powers are omitted. There are a couple of reasons that might explain this aside from the aforementioned lack of threat that these countries pose. They may be overlooked or purposefully omitted for a series or even a combination of a multitude of other reasons. For instance, there are dozens of countries that are not nuclear powers, however that number becomes severely constrained when one determines which countries are financially capable of sustaining such a program. A problem that is compounded when one looks at these countries through a time series-based model because it reveals, while not many, more countries beginning to nuclearize (Iran, Democratic People’s Republic of Korea) and thus fewer countries that one would have to look to as non-nuclear. Then while that category of countries shrinks, political scientists and economists simultaneously become distracted by the new case study that has begun to nuclearize.

The third reason as to why these countries may not be studied, aside from their lack of both intimidating and quantifiable presence, can be simply stated as the researcher’s desire for instant gratification. That is to say political scientists have been interested in showing sanctions’ immediate effectiveness as opposed to its possible deterrent effect. Furthermore, it’s quite difficult to have a state government admit it is intimidated by the financial repercussions of nuclearizing. It is this final point that highlights a flaw in their logic, namely, that this particular reason for states being written off is the same reason that they should be included in the evaluation of states that have begun nuclearizing. This importance, however, will be discussed in the third point concerning this research’s implications.

There are a series of possible causes as to why states who are financially stable and capable of producing nuclear weapon research facilities do not. For instance, they choose to adhere to international or interstate treaties to the effect of not nuclearizing or testing nuclear weapons. Another reason may be that there exists no impetus for the states in question to arm themselves and create either a deterrent effect or counterbalance an adversarial country’s nuclear weapons. If they are not concerning themselves with creating mutually-assured destruction this may very well be because of their reliance on international trade that prevents militaristic disputes. Theoretically, if all other possible alternative variables ie Non-Proliferation Treaty members, Disputes, and Trade interdependence fail to provide a strong correlation coefficient amongst these countries this increases the probability that the threat of sanctions (which is loosely tied to Trade Interdependence according to Helfstein) becomes the more probable of the explanatory variables.

Thus one realizes the significance of such research. With these control variables proving to be less statistically significant than was previously thought due to the inclusion of non-nuclear, but capable states there are a couple of ramifications. It means that even if sanctions prove ineffective on the recipient country, they are providing a general deterrent effect to other countries as has been mentioned by Paul. Although this paper is attempting to further the work of Helfstein and Kroenig specifically in isolating nuclear protection as guaranteed by a powerful ally as a reason why states do not nuclearize, the end result may prove inconclusive when non-nuclear states areincluded in the analysis. However, this would still be a significant contribution to sanctions and nuclear research as a whole in dispelling what has become commonly accepted in the research field.

The objective of this research is to fill an existing gap in nuclear studies. Like most gaps, this hole can be filled in order to test both its and the surrounding structures’ (or theories reliant upon this assumption) resiliency. In order to strengthen the existing research that shows the effectiveness of certain sanctions on nuclearizing countries, non-nuclearizing countries must be incorporated.

RESEARH MODEL

**Population**

Using Kroenig’s analysis and preliminary work, quantitative analysis showed a strong correlation between countries with nuclear allies being uninterested in pursuing their own arsenal (Kroenig, 2009). A time-series analysis will most likely be necessary to both produce statistically significant figures but also allow the exploitation of other variables like changes in relationships with other countries. In the very least, this is the consensus reached by most quantitatively-oriented political scientists. First, Lewis A. Dunn provides, in part, this type of time constraint as his model for experimentation revealed that the decision for a country is an issue and time sensitive matter (Dunn, 2006). Thus working off of a section of his time range for at least one model may reveal a greater correlation between the independent variable and the dependent variable. This is the finding that Helfstein comes to in his experiment concerning the effectiveness of nuclear sanctions (2010). With this theoretical framework laid, the models resulting from this project will look from 1970 until 1990 as a large chunk of countries managed to nuclearize and many more developed the economic capability to acquire nuclear weapons and for this reason that span of time will be a constraint on the variables. Furthermore, it is worth noting that post 1990, the data becomes complicated by the collapse of the Soviet Union. Countries like Chechnya and Belarus became “nuclear powers” because of the Soviet warheads that were still within their then recently autonomous borders (Godsberg, 2010). This timeframe also serves to cut at least a few countries who have in the last two decades begun to secretly nuclearize eliminating some of the problems that would accompany coding those countries in their partially “nuclearized” stage. Given this time period, we will be looking to countries that have nuclearized and will be coded as a “1” and then countries that have not nuclearized which will be coded as a “0”. Two different types of countries will be analyzed: the pre-existing data sets as supplied by Singh and Way, Kroenig, and Helfstein that include states that are both nuclear and/or have pacts with the United States with the addition of nuclear-capable states that do not have explicit defense pacts. Since the countries that have not nuclearized because they cannot would skew the test of what effects a country’s decision to nuclearize, this variable will be selected based on the “National Material Capabilities Data Documentation” compiled by the Correlates of War project in combination with the work of Singh and Way. Singh and Way ingeniously sorted out nations with a capacity for nuclear weapons by evaluating each country’s electricity-generating capacity. They came to the conclusion that the electricity capacity required to sustain a nuclear production is approximately 5,000 Mega Watts or greater and who are producing their own steel (Singh and Way, 2004, 868). Therefore, non-nuclear countries that have the infrastructure and production capacities to hypothetically have their own nuclear weapons program will be added to the regressions that had previously been limited to countries that had weapons or were in the process. In the proceeding table it should be noted that the countries being examined are selected based upon their meeting the two, above-mentioned constraints of minimum electricity capacity and steel and iron production if and when a country case falls beneath one of those two criterion it is no longer evaluated. Additionally, some of the proceeding analysis is restricted by what is covered by the “National Material Capabilities Data Documentation” and is identified below.

Table 1. List of Qualifying Countries

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Albania (Post 1980)

Algeria (Post 1962 - Data only for 1970)

Angola (Post 1979)

Argentina

Australia

Austria

Bangladesh (Post 1972)

Belgium

Brazil

Bulgaria

Canada

Chile

China

Colombia

Cuba

Czechoslovakia

Denmark

Ecuador (Post 1980)

Egypt

Finland

France

Germany

Greece

Hungary

India

Indonesia (Post 1974)

Iran (Post 1973)

Iraq (1978-1982)

Ireland

Israel

Italy

Japan

Luxembourg

Mexico

Morocco (Post 1963 - data sets only available from 1970)

Netherlands

New Zealand (Post 1983)

Nigeria (Post 1976)

North Korea

Norway

Pakistan

Peru

Philippines (Post 1978)

Poland

Portugal

Qatar (Post 1979)

Romania

Russia

Saudia Arabia (Post 1976)

South Africa

South Korea

Spain

Switzerland

Taiwan

Thailand

Tunisia (Post 1966 - data sets only available from 1970)

Turkey

Uganda (Prior 1983)

United Kingdom

United States

Uruguay

Venezuela

Vietnam (Post 1964 - data sets only available from 1970)

Yugoslavia

Zimbabwe

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|  |

**Independent Variable**

Since the purpose of this research is functionally to provide an alternative hypothesis to Kroenig and to ideally strengthen or weaken the correlation Helfstein discovers with allied states and sanctions, the purpose of this analysis will be to test non-nuclear states against the control variables (which are listed below) along with their alliance with a nuclear power. Much like the dependent variable, the I.V. is a dichotomous measurement where a “Superpower Pact” will be coded as “1” and lack thereof will be measured as a “0” (Kroenig, 2009). To elaborate, Kroenig indexes multiple instances of countries sharing sensitive nuclear information and/or placing nuclear weapons within an allied country’s borders. The argument here is very clear; if a non-nuclear power wields the threat of nuclear retaliation from a super power alliance then it’s impetus to pursue nuclear weapons is removed. Kroenig’s model incorporates this dichotomous variable for his population of countries, as has been noted previously this data set is smaller than the model proposed by this project therefore his variable is being researched and applied to the additional states.

**Dependent Variable**

This variable will be a measure of whether or not a state has nuclearized. While Kroenig’s data does code for “partial nuclear” states, this project’s models look only at those states who are known to have a nuclear arsenal and those that do not. This is for a couple of reasons. First, leading up to Kroenig’s work, prior quantitative studies only evaluated the bifurcation of this model and those can be utilized. Second, due to the time constraints, several states who are known to be pursuing nuclear warheads now the Democratic People’s Republic of Korea and the Islamic Republic of Iran, for instance were not prior to 1990 and so those would be omitted. Third, it is difficult to evaluate whether or not states have nuclear capabilities until they complete a successful test. Prior to that stage, several countries pursue nuclear weapons, but may not have successfully completed their program (Kroenig, 2009). As a result of this analysis, this model will code non-nuclear states as “0” and states that have successfully tested a nuclear weapon as “1”.

**Control Variables**

The effect of the nuclear alliance will be tempered by running a couple other variables in the regression analysis against the independent variable and these include the following: existence of sanctions, participation in the Non Proliferation Treaty, Disputes, Democracy, and Trade Interdependence. Based off of the work of Kroenig, Singh and Way, Helfstein and the different qualitative discussions surrounding nuclearization the above mentioned variables are the theorized alternative motivations behind a country’s nuclear pursuits.

*Sanctions*

The first and foremost discussed reason for discouraging this type of weapon acquisition is of course, economic sanctions. This is also arguably the most complex of the alternative variables to approach. However, because this serves as a dummy variable for the models so this variable will be dichotomized. This model is not concerned with whether or not sanctions were effective or to what degree they were employed as this is not the question at hand. This variable is operationalized as those countries that have had sanctions placed on them as “1” and those countries that have never had nuclear sanctions placed upon them as “0”.

*Non-Proliferation Treaty Members*

Another theory as to why capable nations have not pursued nuclear weapons is that they are abiding by the Non-Proliferation Treaty. This variable becomes concerning when applied to the nuclear countries who have signed the NPT and then promptly disregarded it, however it is not a variable that can be overlooked as some countries have abided by the Treaty and used their consistency as leverage in the international ring. Countries who have ratified the Treaty and abide by its safeguards are coded as “1” and non-members as “0”. The one exception to this is Colombia who, while not having ratified the document have agreed to the full-scope safeguards (Goldberg, 2010).

*Trade Interdependence*

One of the two control variables that is not directly linked to nuclear weapons, trade interdependence is discussed as an influential variable as well. Logically, if a country has a large segment of its economy reliant on international trade (with a focus on imports) then they would not wish to risk their stability and economic well-being on nuclear weapons. Additionally, idealists in international relations argue that countries that have a greater stake in international trade will be less inclined to go to war (Angell, 1912). It follows then that if there is no anticipation of war, then there is no need for the deterrent effect of nuclear weapons. Singh and Way’s pre-existing data organization stands as a model for this variable as well. Their variable of *Economic Interdependence and Liberalization* is determined by adding the exports and imports as a part of a country’s GDP to determine a country’s interdependence and this model will utilize their existing data sets and adapt it so that it may be applied to the additional countries being tested (2004, 870).

Given the population of countries and the identified variables, there are two models run using mulitivariate and least-squared regressions; one model that will include the population of non-nuclear states and one without those countries included. The latter model will be used to demonstrate consistency with prior research work and as a control against the new, more incorporative model. Bivariate regressions and least-squared regression formulas are utilized by both Kroenig (2010) and Singh and Way (2004).

*Democracy*

The Polity IV Project: Political Regime Characteristics and Transitions, 1800-2009 that ranks countries on a scale of 1-10 with 10 representing the highest democratic rating and 1 being the lowest or closest to an autocratic state.

RESULTS

The end goal of this project was meant to provide a greater falsifiability to classic quantitative nuclear studies with a slight emphasis on stressing the influence of defense pacts with nuclear powers on preventing the proliferation of nuclear weapons to other states. The means by which one evaluates whether or not this goal was achieved requires a comparison between the population sample and analysis that Kroenig offers and the statistical output of a larger sample as was employed with this research. This comparison reveals mixed results, but also a handful of interesting results that provide a framework for future research.

There were a total of 1284 cases analyzed under the new parameters composed of 65 countries greatly broadening the countries affected by proliferation policy and that could theoretically support a nuclear weapons program. The first control, *sanctions*, was predictable in that a bivariate correlation revealed that 29% of the cases listed that were coded as nuclearized were being sanctioned. This number is understandable given that the beginning of the time series, 1970 is almost twenty years after the United States, the USSR, and the United Kingdom managed to produce atomic bombs and thus beyond having economic sanctions placed on them. This note, in conjuction with the fact that sanctions are meant to *prevent* weaponization reveals that this analysis has no underlying revelation.

The second dummy variable, *Non-Proliferation Treaty membership,* proved more difficult as the 2-tailed significance level exceeded acceptable confidence levels when tested for correlation with a country’s weaponization.

The third and final control variable one evaluates prior to the independent, democracy, revealed slightly more promising results while also being somewhat surprising. Found significant at the 0.01 level and beyond revealed a Pearson Correlation of .132 between the dichotomous value of “1” for weaponization has occurred with a “1” where the country is the most autocratic type of regime. This finding becomes interesting when contrasted with Kroenig’s own findings because while they do suggest a high-trend in nuclear weaponization amongst more dictatorships, it leaves room for countries considered more democratic along the spectrum to be considered as just as high if not higher of a correlation because of the resulting remainder. The reasoning here being quite simple; historic proliferation has been fueled by democratic allies such as the United States in order to secure a powerful stronghold amongst more free societies.

Aside from the bivariate correlations observed in the dummy variables, the independent variable of the existence of a *Superpower Pact* is the one of interest. However, as can be noted in Table 2, the degree of confidence one can have in the correlation of weaponization and Superpower pacts is near non-existent. The broadening of the population base minimized the correlation which does indeed appear to be reasonable given that countries which would have been nuclear capable on their own, theoretically, include Bulgaria and Romania which under the Warsaw Pact meant that they would never nuclearize on their own because of USSR ownership.

| **Table 2. Bivariate Correlation between Weaponizing and Superpower Pacts** | | | |
| --- | --- | --- | --- |
|  |  | weapons | spact |
| weapons | Pearson Correlation | 1 | .015 |
| Sig. (2-tailed) |  | .601 |
| N | 1284 | 1284 |
| spact | Pearson Correlation | .015 | 1 |
| Sig. (2-tailed) | .601 |  |
| N | 1284 | 1284 |
|  |  |  |  |

FURTURE RESEARCH

Inevitably with a larger number of cases there is a greater variability in the results and it was anticipated that correlations would be minimized because of the expansion. However, this does not imply that the research should once again be restricted to only nations who have made pronounced or aggressive attempts at creating nuclear weapons and the countries which have successfully completed such a program. In all actuality, this implies that more control values need to be accounted for beyond trade interdependence and conflicts. This would control the much more unpredictable base while simultaneously maximizing the accuracy of the results and overcoming the selection bias that has perpetuated in this literature base. Additionally, this research model is a relatively simplistic start in that it did not utilize many of the dyadic computations that other authors like Singh and Way have placed a greater emphasis on. Incorporating these numbers may also yield more controlled results and a higher level of correlation.

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