ALL POLITICS ARE ORBITAL: TWO-LEVEL RIVALRY DYNAMICS AND THE US-SOVIET SPACE RACE

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ABSTRACT

While there has been some aggregate quantitative work on arms races and rivalry, this paper analyzes the space race between the US and the USSR as an in-depth quantitative case study of interstate competition. During the height of the Cold War, the United States and the Soviet Union engaged in a struggle to prevent the other side from dominating space. Here we test the popular notion that after the launch of the first Sputnik the Soviet Union and the U.S. engaged in a race to space, following previous patterns of competition between the major power rivals. Placing the analysis into the expanding rivalry literature, this paper employs a time-series analysis of the unfolding space rivalry between the two major power competitors. Using newly collected data on satellite and rocket launches into space, as well as presidential approval, conflict/cooperation scales, and economic indicators, we are able to illustrate the dynamic interaction between domestic and international competition. Specifically, applying VAR techniques to the data allows for the testing of various hypotheses related to reciprocity and two-level models of interstate interaction. The results show that the space race was fueled in large part by domestic considerations, rather than following a pure action-reaction sequence. Increased Soviet conflict did not inflate the likelihood of US launches, as one might expect. Instead, US launches followed dips in presidential approval. Historical documents and secondary sources further support the importance of domestic politics, although not to the exclusion of international variables. In total, the findings confirm a two-level logic for rivalry maintenance, whereby increased competition from an enemy is inflated by domestic politics and inflames further competition in the future.

INTRODUCTION

Are there patterns of competition between international enemies? We have several theories of international politics that suggest possible relationships, but very little in-depth evidence as to their empirical veracity. Theories of reciprocity suggest that competition in the international arena follows an action-reaction sequence, where conflict is parried with conflict, and cooperation met with cooperation (Leng 1983; Goldstein and Pevehouse 1997). Other researchers suggest that rival states follow a stable pattern until external shocks alter competition dynamics (Goertz and Diehl 1995). More recently, it has been suggested that the patterns in rivalry conflict do not stem exclusively from international actions, reactions, and exogenous shocks but also from the domestic political circumstances within states (Vasquez 1996; Valeriano 2003; Colaresi 2002). Leaders may feel domestic pressure to contest a rival, or may have their tenure in power threatened for failing to compete in a rivalry (Colaresi 2003).

In this paper, we suggest that a rigorous investigation into domestic-international rivalry linkages is afforded by using the space race, between the US and the Soviet Union, as an example of rivalry competition. A rivalry can be comprised of conflict over many issues simultaneously, not all of which will be equally salient domestically. If a leader or government will not be judged on its international policy in a certain issue area, it is less likely that leaders will react to domestic politics on the international stage. Conversely, if a conflict over a specific issue in a rivalry is highly salient, we may be more likely to find domestic-international linkages. Past studies have aggregated over all issues within a rivalry creating one measure of conflict or cooperation (Azar 1993). This procedure has been highly useful in a number of circumstances (see Goldstein and Pevehouse 1997). Yet, if we are able to isolate specific issue competition within the general rivalry conflict stream, new questions can be asked and new answer found. We do not know whether competition over one issue in a rivalry makes conflict more likely over other issues. What is the role domestic politics plays in rivalry competition, or is it mostly irrelevant as reciprocity theories assume? These seem to be quite important questions since rivalry competition has generated a large portion of wars, arms build-ups, and conflicts (Thompson 2001; Diehl and Goertz 2000).

The space race was part of the greater Cold War rivalry that encompassed many additional issues. By collecting information on American and Soviet launches, presidential approval (in the US), general events within the rivalry, and other factors, it is possible to analyze whether this particular case of rivalry competition was driven by purely international factors or whether a more complicated two-level logic better explains the competition. Similarly, we can test whether competition in the space race exacerbated or calmed the Cold War rivalry generally.

A time series analysis of the space race enables us to focus on specific hypotheses and relationships that may be lost in a more panoptic research design. It is our hope that in combination, macro and micro-level evidence can provide a better picture of political world than either could on its own. We find that the space race represented not only an international action-reaction sequence, but was significantly related to domestic politics in the United States. Furthermore, our evidence supports the notion that the space race served as a substitute for more general conflict within

the rivalry, as important Soviet launches decreased general conflict towards the US, while US launches did the same.

The paper proceeds in four parts. First, previous theories and tests of rivalry dynamics are critically reviewed. Next, we introduce the space race as an example of rivalry competition and explain why it is a useful test case. Third, we present our research design and methodology, which focuses on time series techniques. Finally, we present and analyze our VAR results linking international and domestic competition to the space race.

Small Steps and Giant Leaps: Rivalry, Reciprocity, and Domestic Politics

Recent work by Diehl and Goertz (2000) and Thompson (2001; 1995) have highlighted the importance of looking at streams of conflict between states. Rivalry relationships have been shown to produce more than their proportional share of wars, conflicts and disputes (Colaresi and Thompson 2002, Goertz and Diehl 1995 and Bennett 1997, 1998) Due to the strong external validity of large-n designs, we now have evidence that repeated crises make war more likely (Colaresi and Thompson 2002; Leng 1984), joint democracy and shared threat decrease the duration of rivalries (Bennett 1997; 1998), and World Wars can serve to both initiate and terminate rivalries (Goertz and Diehl 1995; Colaresi 2001).

However, there are several blind spots in our understanding of rivalry processes. The most important battery of questions gone unanswered in the rivalry research program involves the causes and consequences of rivalry behaviour short of war. What causes rivalry conflict, and what can explain the emergence of cooperation in some cases? We are of course not the first researchers to pose these questions. Scholars studying reciprocity in international relations have found significant evidence that rivals tend to answer conflict with conflict, and cooperation with cooperation (Goldstein and Freeman 1990; Leng 1984; Ward 1982; Goldstein and Pevehouse 1997). Therefore, rivalry dynamics resemble an action-reaction sequence, where the reaction matches the concomitant action. The theoretical underpinning of this literature draws on iterative game theory (Axelrod 1984), noting that reciprocal strategies are stable and successful over long time horizons.[1] The reciprocity research program has provided a number of answers where studies of war or disputes were mute. Using time-series techniques and event data as a more sensitive measure of rivalry behaviour, patterns of conflict and cooperation were illuminated.

Despite these breakthroughs, there are problems with resting an explanation of rivalry behaviour solely on reciprocity. First, even those studies that identify a tendency to answer conflict with conflict also find that this reciprocity can be dyadically asymmetrical, with one state muting its response more than the other. For example Ward (1982) finds that the US reacted only half as strongly to Soviet conflict as the USSR did to US conflict, and Israel tended to over-respond to United Arab Republic actions. More theoretically, some of the most important events in international relations history – for instance the Pearl Harbor attack, the German invasion of Poland, and the Somali offer to surrender its claims on the Ogaden in 1988 – have involved asymmetrical responses. If we only focus on the symmetry of

[1] Much of this evidence precedes the use of rivalry as a term in international relation. However the main evidence for reciprocity comes from the study of dyads that are now recognized as rivals, namely the US-USSS, US-China, and USSR-China rivalries among others (see e.g., Goldstein and Freeman 1990; McGinnis and Williams 1989).

actions and reactions, important escalations and de-escalations may be missed. Thus, it is likely that international-level reciprocity accounts for important parts, but not all of the variation and patterns in interstate competition. What can explain the variation in rivalry actions and reactions?

One possibility is that domestic politics plays a role in adding or subtracting conflict and cooperation from a pure stimulus-response pattern. Recently, there has been an increase in the emphasis on domestic level explanation for international conflict. Most notably, democratic peace theorists (e.g., Russett and Oneal 2001) have argued persuasively that domestic politics and institutions have a strong influence on the war proneness and cooperative behaviour of dyads (Leeds 1999). Also, Putnam (1988) has argued that domestic as well as international politics influence foreign policy choices. Specifically, political pressure on a leader may play a role in decision making at the international level. Studies such as Colaresi (2002) have found support for the notion that political pressure, even when self-perpetuated, restricts future foreign policy decision-making. Cooperation from a state labelled as an enemy may not be fully reciprocated because the leader fears losing domestic support (Colaresi 2003; Berend 1998). Additionally, conflict may be amplified if a leader believed that the increase in intensity would trigger a rally-effect and promote the leaders political ambitions (Pickering 2003; Mueller 1973).

Thus, we are left with the possibility that international actions set off a domestic chain reaction. A threat from a rival can serve to increase the domestic salience of a particular issue within the rivalry. The leader then reacts or does not react to the rival threat, and is then judged by his or her supporters and opponents on those actions. In this way, it is possible that domestic politics can mediate or amplify the stimulus-response sequence at the international level. A weakened leader may seize on an international issue to increase his or her standing. By relaying or exaggerating an international threat, the foreign policy leadership may be able to stimulate a rally-effect (see Pickering 2003; Mueller 1973). Conversely, a strong leader may not have the same incentive to over-react to an international threat. More directly, a leader may in fact be unpopular because they have failed to compete adequately in a rivalry, and may attempt to adjust for this in future rivalry policy.

For a number of reasons there have been few tests of the role domestic politics plays in rivalry dynamics. The first problem is data availability. Very few measures of leadership support are available cross-sectionally or across-time. However, evidence from Ostrom and Job (1986) and Fordham (1998) suggests that domestic politics may influence international competition dynamics. In each case, the authors find that leaders increase international conflict in response to low public support. On the other hand, one recent study by Moore and Lanoue (2003) uses Cold War event data and a measure of US Presidential approval to test whether domestic politics influenced the Cold War. They find no relationship between presidential approval and the hostility sent from the United States to the Soviet Union. Moore and Lanoue (2003) do find a relationship between the conflict received from other states and presidential support, echoing a possible “rally” in response to foreign threats.

Yet, several problems reduce the definitiveness of these previous tests. Authors examining the domestic-international connection, usually ask whether changes in presidential approval increase or decrease the total conflict sent to all states in the world, by one state. This is an extreme aggregation of many different issues and relationships. If a president increased conflict towards one state, possibly in

response to domestic pressure, but called for cooperation from another state, a general conflict measure would register no change. Similarly, if a president threatened a rival over basing rights, but offered cooperation on fishery policy, the measure would again register no change.

We have numerous theories that point out different issues and international relationships will have distinct saliencies in domestic politics. Vasquez (1993) and Huth (1996) forcefully argue that territorial issues are highly salient and dangerous. Hensel (2001, 186-7) points out that some dyadic relationships, most notably militarized rivalries, draw extremely disproportionate domestic attention (see also Holsti 1996, 66-7). Using a case study design, Colaresi (2003) finds that even among various rivalries Somali domestic politics reacted more strongly to Ethiopian conflict than either Djiboutian or Kenyan actions. If we aggregate over all issues and dyadic relationships, ignoring salience, we are likely to miss out on possible relationships.

The problem of aggregation is particularly acute when analyzing the relationship between domestic and international politics. Earlier, we noted that presidents might react to domestic pressure by increasing conflict or competition with a rival. This would only be the case if that competition would be expected to have some domestic benefit to the leader. An international issue with low to no salience domestically is unlikely to fit that criterion. Therefore, we are more likely to find a relationship between domestic and international politics over salient issues and high-profile relationships. Up to this point, it has been the norm to aggregate issues and sometimes various dyadic relationships. The event data measures that most of these studies rely on, code only the actors and actions in a conflict event. The statement, "the US threatened the Soviet Union" is categorized and scaled regardless of what issue or policy to which the threat referred.[2] Yet, when we are analyzing domestic political precipitants to and repercussions from international events, the salience of an issue is crucial. In fact, it is possible the conflicting findings on this issue could be related to the aggregation issue (see Moore and Lanoue 2003; also Enterline and Gleditsch 2000). No alternative measurement was previously available.

Below we offer a way out of this measurement conundrum using data on the space race. If we are able to separate and isolate competition over a single salient issue from the rivalry conflict stream in general, a more valid test of domestic-international linkages can be formulated. When an international issue is salient domestically, we would expect a strong relationship between leadership approval and competition over that issue. Similarly, successful competition over that salient issue is more likely to bring leadership rewards as compared to other less salient issues.

Additionally, the disaggregation of issues allows us to ask new questions regarding reciprocity and substitutability. Beginning with research by Most and Starr (1990; 1984) it has been hypothesized that states can deal with international stimuli in various ways. Thus, policies may be substitutes for one another. Conflict on missiles in Cuba, during the Cold War could be answered with increased pressure for transportation rights through Berlin. Morgan and Palmer (2000) and Bennett and Nordstrom (2000) find evidence for this type of multi-dimensional give and take, but only by looking at actions. For example, Bennett and Nordstrom present evidence that

[2] An even more general form of aggregation in this context would code the statements "the US threatened the Soviet Union" and "the US threatened Canada" identically, treating each as conflict sent by the US. Since even the same issues are likely to have distinct saliencies across dyadic relationships, this type of aggregation again biases tests against finding a domestic connection.

a domestic problem can lead to either an escalation or a termination of a rivalry. What we do not know is how issues fit into this picture. Does competition over a specific issue inflame or mediate conflict generally in the rivalry? Do states tend to reciprocate conflict and cooperation over similar issues, or do they answer conflict on one issue with conflict on a distinct issue dimension? These are questions that cannot be answered solely with aggregated international event data.

Below we argue that data on the space race solve many of the problems previously inhibiting exploration of domestic-international and issue linkages. First, the space race represented competition over a salient issue, space and missile technology, within the Cold War generally. In the US domestic context, the president was likely to attempt to win this race because it would boost his approval. Likewise, launching a successful program in the space race would be attractive to a president with descending ratings. Second, we can match competition in the space race to measures of general rivalry conflict and cooperation during this time. The comparison of the space race to Cold War conflict in general allows us to analyze how issues react to one another.

Out of This World: The Space Race and Rivalry Competition

In this section we outline the events of the space race and point out why this case opens a previously closed window into rivalry dynamics (for a summary of events, see Table 1). First, the space race is an example of rivalry competition over a specific issue. Second, this specific issue competition was salient domestically in the US, serving to provide a fair case for domestic political hypotheses.

After World War II, the US and Soviet Union began to identify each other as primary threats and competitors (Gaddis 1972, 1997). Crises over Berlin and Korea intensified the rivalry and hardened the perception that the superpowers' goals were incompatible. One specific goal incompatibility involved the exploration, monitoring and control of space.

Competition over space officially began with the launch of Sputnik I on October 4, 1957, but there was much jostling for position before that date. As reflected in RAND reports as early as 1946, US strategist identified the use of satellites as a vital solution to one of the most pressing issues the United States faced after World War II: the gathering of reliable intelligence of Soviet activity and capabilities.[3] Space, it was argued, would be a crucial "force multiplier" (i.e., aiding other existing strategic capabilities).

Worried about the potential legal and political fallout of an American-initiated space flight, the US attached itself publicly to the call of a large number of international scientists demanding to view space as human global commons. The US supported their goals of international space cooperation in forums such as the "International Geophysical Year"[4] and other (international) science-based space

[3] See McDougall (1985, 107-111).

[4] The IGY was a worldwide program of geophysical research that conducted from July 1957 to December 1958. In 1950 a group of geophysicists led by the American Lloyd V. Berkner proposed a third International Polar Year, an international scientific effort that would utilize the made in instrumentation, rocketry, and information since the Second International Polar Year of 1932–33 that would soon develop in scope to encompass a much broader range of issues. The parent body of international scientific organizations – the International Council of Scientific Unions – sanctioned the broadening of proposals for what became known as the International Geophysical Year. National IGY committees were then by scientific organizations in many countries, and more

initiatives. Simultaneously, the Soviets worked to prepare their first satellite for launch, announcing that they would achieve this goal before the end of the IGY.

Even the timing and content of the Sputnik launch was predicated on Cold War competition. The US had tested a Jupiter-C rocket on September 20, 1956 that had the potential to deliver a satellite into space, but did not. Fearing that the US was in the process of launching its own satellite, the Soviet Chief Designer, Sergei Korolev, ordered the first Soviet satellite to be dumbed-down for quicker deployment. The original satellite, Object D, was supposed to weigh 3,300 pounds and carry cameras, as well as instruments to measure the earth's magnetic fields and take radiation readings. The new *Prostreischiy Sputnik* ("Simple Satellite"), PS-1, was a 22.5-inch ball that weighed 184 pounds. PS-1, later named Sputnik I, carried only a radio transmitter and batteries. The launch date for Sputnik was set for October 6, 1957, but moved up to October 4 in reaction to new fears of being beaten into space by the US (Schefter 1999, 17-20).[5]

After Sputnik I, the development of satellites and launch vehicles by each superpower was accelerated. In Table 1, we present a time-line of events in the space race. Sputnik I and II were matched in the US by the creation of the Nation Aeronautics and Space Association (NASA) and the launching in 1958 of the first US satellite, Explorer I. In turn, each rival increased the complexity of missions. Both nations sent men into space in 1961, the Soviets first with Yuri Gargarin. That same year, the USSR space program sent Gherman Titov as the first man to spend a full day orbiting the earth. Only a year later, in 1962, the United States launched John Glenn into orbit around the earth. The first spy satellite, the Corona, was successfully launched by the US in 1960, and the Soviets followed suit in 1963 with their own spy satellite, the Zenit. Both countries conducted space walks in 1965, the Soviet being first, and began pursuing manned missions to the moon. The Soviets had sent Luna 3 to Orbit the moon in 1959, and Kennedy famously called for the US to land a man on the moon a May, 1961 speech. The space race to the moon was won by the United States with Apollo 11 in July 1969, and lost by the USSR with the destruction of the Soviet N-1 moon rocket and launching platform during that same month (see McDougall 1985).[6]

Throughout the period between 1957 and 1970, the space race remained highly salient in US domestic politics. Sputnik's launch was featured on the front

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than 70 nations ended up cooperating in IGY. The IGY pioneered in the use of rocketry to conduct studies high-altitude and upper-atmosphere phenomena. Several of the earliest artificial satellites launched by the Soviet Union the United States in the late 1950s were used to gather data for the IGY (see Encyclopædia Britannica 2003)

[5] Most commentators agree, that the United States could have launched a satellite at least a year prior to the launch of Sputnik I had it used the available military technology (i.e., the Redstone rocket as a carrier). The U.S. strategy, however, rested on the development of a civilian space program, as institutionalized in the creation of NASA and the integration of the satellite program into the IGY framework (for a discussion of the IGY from a space race perspective see Siddiqi 2000, 145-8; see also McDougall 1985, ch. 5).

[6] Not every event in space was symmetrically matched. The Russians originally wanted to land a person on Mars first, sent the first satellite to the Sun (although it was a mistake) and directed much of their technological knowledge to studying Venus. The US chose not to compete on any of these targets. The space race was also marked by the different organizational structures used by the two sides. The Soviet Union followed its internal logic of centralizing research, control, and resources in a concentrated space program, with an exclusive focus on military usage and control of any space-related technologies. The American program followed a more diverse strategy of limited agency competition and an emphasis on civilian usage, control, and development of space technology parallel to and at times even predominant over military space deployment (McDougall 1985; see also Schefter 1999).

page of most major newspapers, including the New York Times. After Sputnik II was launched with canine *Laika* aboard, the public and media elites were clamouring for a US response (Naugle 1991). Two days later, President Eisenhower announced that the US had successfully tested a re-entry nose cone, a public statement that would most likely have been made by a subordinate pre-Sputnik. Eisenhower next appointed James Killian to the new post of Special Assistant to the President for Science and Technology. That same year, Soviet activity and US inactivity in space became a high profile political issue, with 20 days of hearings, chaired by Lyndon B. Johnson, in the Senate Military Preparedness subcommittee (Newell 1980, 93). When briefed about a forthcoming Vanguard rocket launch, Eisenhower was worried that the "lower" planned orbit, as compared to Sputnik, would send a signal to the public that the US was weaker (see Ploman 1984). The failure of that Vanguard rocket only served to increase domestic unease (Naugle 1991).

Additionally, Kennedy's decision to publicly commit the United States to a moon landing was made within a dramatic domestic political backdrop. Key aids including NASA director James Webb, argued against promoting the moon as the "top" target, offering instead a more balanced program. Kennedy himself argued against diluting the goal of being the first to land on the moon. The President stated in a cabinet meeting on November 21, 1962 that beating the Russians to the moon was not just NASA's top priority, but the top priority for the entire government. During that same meeting Kennedy and his aids discussed the domestic political importance of John Glenn's orbital flight (Cabinet Meeting, November 21, 1962, Tape #63, Kennedy Presidential Library). The perception of a "missile gap" and growing Soviet achievements in space continued to trouble Eisenhower, Kennedy and future presidents.[7]

In sum, we have historical evidence that suggests that the space race was both embedded into a more general Cold War rivalry framework and domestically salient. Therefore, if we can procure a measure of space race competition, we can systematically test domestic-international political interaction in a more applicable setting than past research has found. In the next section we present a research design intended to more rigorously analyze these relationships.

RESEARCH DESIGN AND METHODOLOGY

In order to utilize the space race as a test of pure reciprocity versus two-level rivalry dynamics, we first construct a measure of superpower competition over space. There are several possible choices for quantifying the space race. For example, we could use the amount of government money spent on space related technology. Unfortunately, while the measuring of competition inputs is attractive for many reasons, this data does not exist in disaggregated form on the Soviet side.

Another attractive measurement strategy is to collect information on competition outputs. In this case, competition took the form of vehicles being launched into space. Therefore, we collect data on every launch by the USSR and USA from 1957 through 1970. The database we created is based on the data provided by Analytical Graphics, Inc. (AIG). AGI's collection of satellite databases gives users of the "Satellite Toolkit" (STK), a simulation software program developed by AGI,

[7] Most exerts agree that to the extern there was a "missile gap", it was in the US's favor (see Schichtle 1983; see also McDougall 1985).

access to the latest satellite data available to accurately simulate and analyze any object in space. The most extensive of these databases (stkSatDbAll) is an up-to-date catalogue of over 8,000 orbiting objects. It is maintained by the US Space Command and contains data on Two-Line Element (TLE) sets, Space Surveillance Catalogue (SSC) numbers, common names, launch dates and times, apogee, perigee, activity state and more. We have employed a subset of this dataset, the so-called "stkSatDb" database. This is a database of all payloads. If a TLE is not available for a given payload, the payload is still listed in the stkSatDb database. Since we are mainly interested in "successful payloads"[8] transported into space and not every single item that can be found there (including debris, rocket bodies, first-, second- and third-stage objects, etc.).Yet, it is clear that a dichotomous measure of launches (launch or no launch) is inappropriate. The relaunching of Sputnik I every year would not have been a very effective strategy for the Soviets. The United States and USSR did not merely react to the presence or absence of launches, but the evolving importance of the launches.

To capture this competition, we measure space race competition using the mass in kilogram launched into space by each superpower in a given month. Our proxy to measure "space capability" is weight of payload. Despite the differences in design of US and Soviet space technologies, bigger is better in almost any event. Every launch provides the opportunity to deploy a given payload at a relatively high, fixed cost. In other words, the higher the payload, the lower the cost per launch.

The mass measure has a number of very attractive properties. First, it captures the evolution of competition, as each rival attempted to outdo the other with more and more complex launches. During the space race, complexity came at a cost, mass and weight, exemplified by the fact that the Soviet wanted there first satellite to weigh over 3,000 pounds and be able to take numerous measurements in space, but settled due to production delays, for Sputnik I, which consisted merely of radio transmitters and batteries, and weighed 184 pounds. Similarly, putting a dog, monkey, and then a man and woman into space consisted of increasingly complex tasks. Our measure also has a great deal of face validity. It is generally thought that the Soviet Union began the space race ahead, with Sputnik I, Sputnik II and Laika, and the Yuri Gagarin flight, but the United State was able to catch up and surpass the Soviets with the Apollo program and moon landings. Figure 1 illustrates the space race with our monthly data on launch mass. The natural log is taken due to the presence of extreme outliers. The story is very similar to conventional wisdom.

In addition to space race competition it is necessary to measure domestic leadership pressure to capture the potential for a two-level dynamic (as described above). Ideally, we would want some measure that was applicable to both Soviet and American circumstances. While pressure from international events may be measured in the US context with a consistent time series of presidential approval (Burbach 2003; Holsti 1996; Mueller 1973), understandably there is no such information available for the Soviet Union. Yet, lack of information is less debilitating than the potential absence of Soviet space competition data. The hypotheses related to two-level dynamics, specifically the reciprocal relationship between rivalry competition

[8] "Successful" in this context means a payload that could be potentially useful, successfully transported into space. This definition does not discriminate between types of payloads, the functionality of payloads, or even the actual working condition of payloads. For example, this definition also includes the successful delivery of non-functional satellites.

and leadership support can still be tested within the US context independent of Soviet leadership data. While it would be ideal to be able to test these two-level hypotheses in the Soviet context as well (apart from anecdotal evidence), this does not diminish the importance of the US case. Presidential approval is taken from a series of Gallup polls that asked the question "Do you [approve/disapprove] of the way President [name] is handling his job as President?" The specific measure is the percent of the population that approved of the president in a given month. In those months when two polls were taken, the two scores are averaged. In the rare cases when no polls were taken in a month, the nearest poll was used.

Former work has shown that presidential approval reacts to domestic events within a country (Lewis-Beck and Stegmaier 2000; see Norpoth 1985; Erikson, MacKuen, and Stimson 2000). Thus, we also control for the economic status of the US during the space race. We use inflation and unemployment rate data to account for these economic concepts and to guard against the possibility that any international-approval dynamics are merely spurious to solely domestic considerations. Additionally, we collect information on the rivalry as a whole using conflict/cooperation events data. Events are coded from COPDAB and scaled according to the range proposed by Azar and Sloan (1975). The space race was undoubtedly entangled with the Cold War as a whole. By including general conflict and cooperation within the rivalry we can both illuminate the possible connections and control for spurious causes.[9]

We use vector autoregression (VAR) techniques (see e.g., Freeman, Williams, and Lin 1989; Sims 1980) to analyze the relationships between the space race, presidential approval, and the Cold War. All variables are included in levels, rather than differenced form (see Williams 2002). Although it is possible that some of the variables have unit roots,[10] there are four reasons for conducting a VAR on levels data rather than differenced variables.[11] First, the dynamic parameters of the model are estimated consistently even if some or all variables are non-stationary. Second, even if the true underlying VAR is in differences, many functions of the parameters and hypothesis tests based on a VAR in levels have the same asymptotic distributions. Third, in the extreme case where the asymptotic distributions are non-standard, the usual t and F distributions for hypothesis test have a Bayesian interpretation (see Hamilton 1994, 652). Finally, if a VAR is estimated with differenced data but is actually stationary, severe misspecification results.[12]

After specifying the variables to be included in the system of equations, lag length must be decided. As noted by Mills (1990), there is no universal criterion for selecting lag length. Here we follow several different procedures. First we check the changes in AIC, likelihood ratios, HIC, and BIC when different lags are selected, as suggested by Williams (2002). In this case, each fit-measure selected a slightly different lag. Next, we checked the stability and diagnostics of the VAR system with several different lags. A system with significant residual autocorrelations suggests

[9] Finally we include dummy variables for each US President from 1967 to 1970.

[10] Augmented Dickey-Fuller and GLS Dickey-Fuller tests produced different findings depending on lag length.

[11] We leave the possibility of fractional integration for further research. Other fixes, such as fully-modified VAR, have additional problems, for example an increased probability of making a type II error.

[12] We also explored the possibility of a vector error correction model, but Johansen procedures failed to reject the null hypothesis that there were no cointegrating relationships. Multiple bivariate tests of cointegration also found not evidence of cointegration.

that dynamics are unaccounted for. Similarly, an unstable system is not interpretable, and a VAR system of equations with non-normal errors violates several assumptions associated with hypothesis testing in the VAR case. Finally, we report results for several different lag lengths (10, 11, and 12) in order to compare the robustness of our findings (see Table 2). The stability conditions are met and the residuals are white noise for all three lag lengths. To interpret the results we present impulse response functions and cumulative impulse response functions, which illustrate how a shock (impulse) in one variable affects the dynamics (response) of another over time (see Figure 2-Figure 6).[13] The standard errors for the impulse response functions were bootstrapped, with 200 replications.

Findings

Our VAR results strongly suggest that an action-reaction sequence was at work during the space race. Table 2 illustrates the relationship between US and USSR launches using granger causality tests. Granger causality tests analyze whether one variable affects the dynamics of another variable, controlling for the response variables past history, as well as the other variables in the system. In five of the six cases, the tests indicate that an action-reaction sequence was present (at the .05 level). Increases in US launches impacted on USSR launches, and vice versa (see Figure 2). It should be pointed out that the relationship linking USSR launches to changes in US launches is more uncertain, given the weaker significance of the granger causality tests. The impulse response functions show that a one standard deviation increase in the US launches leads to a lagged increase in the mass of USSR launch changes. In the reciprocal direction, USSR launches seem to have a more complex effect on US launches. There is a temporary insignificant increase, and then a decrease that fades after several months. Therefore, the results support an action-reaction process, but with qualification, since the dynamics do not seem to be equally symmetrical (see Ward 1982).

While the space race seems to have been stimulated by international actions and reactions, domestic politics was an important part of the story as well. Again, the granger causality results in Table 2 support importance of changes in presidential approval as both a cause and effect of the space race. Changes in presidential approval "granger-caused" changes in US launches in two of the three lag specifications. Further, the cumulative impulse-response-function in Figure 4 shows that a positive shock to presidential approval decreases US launch mass. Reciprocally, presidents seem to have been applauded but not blamed for changes in the space race. Shocks in US- and USSR-launch mass granger-caused changes in presidential approval, in all three lag specifications. However, the cumulative impulse response functions show that a positive shock in US launches led to increases in presidential approval.

[13] These have been discussed in depth in Freeman, Williams, and Lin (1989), and Mills (1990). Impulse response functions depend on identifying assumptions concerning simultaneous correlations to give them validity. In this case, we assume that the system of equations is recursive. Specifically we order the variables as unemployment, inflation, US events data, USSR events data, US launches, USSR launches, and Approval, proceeding from "less" exogenous to most. For example, in this ordering errors in approval are assumed to be correlated instantaneously with all the other variables (all the those listed before them), while unemployment is not. This represents the assumption that public opinion may change quickly to international or economic events, but other variables take longer to react. Many different ordering were analyzed and the results varied little, increasing our confidence in the results presented.

The relationship between USSR launches and presidential approval was more ambiguous (see Figure 4). In total, these relationships offer support to the notion that rivalry competition is driven, at least in part, by domestic politics. Here we see that decreases in presidential approval are expected to lead to increases in US launches, and that those US launches in return increase presidential approval. It is also interesting to note that changes in presidential approval granger caused changes in USSR launches. This suggests a possible strategic angle to USSR space strategy, where Soviet launches could have been timed to take advantage of weak presidents. More research is needed to further analyze this possibility.

Additionally, there is some evidence of substitution between competition in the space race and conflict generally during the Cold War. An increase in satellite launches by both, the US and USSR, decreased general conflict directed at each rival. This process is illustrated in Figure 5 (the first row of graphs), and is significant in the granger causality tests in Table 2.[14] On the other hand, increased conflict within the rivalry elicited a more ambiguous response in satellite launches. Therefore, the graphs here suggest that increases in space race competition could have served to decrease competition within the rivalry.

However, one possible rejoinder to this assertion could be that US launches increased Soviet conflict, instead of US conflict generally. In that case general conflict level may actually be unaffected (or increased) since any decrease in US or USSR conflict towards the other superpower might be reversed by a subsequent increase in the other's conflict towards them. Figure 6 checks for this possibility by plotting the impulse response functions for the effect of US launches or USSR conflict, USSR launches and US conflict, and the reciprocal relationships. These impulse response functions show that increases in launches did not lead to more conflict from the rival. Likewise, general conflict within the rivalry did not seem to have a clear-cut positive or negative influence on the space race. Thus the main interaction between the space race and the Cold War in general seems to have been to decrease general conflict levels in both parties.[15]

CONCLUSION

The space race provides an ideal laboratory to investigate the relationships among international and domestic variables. Specifically, by collecting data on a domestically salient international issue, a more valid test of the presidential pressure-rivalry event link could be conducted. Moreover, by separating out space race competition from the more general Cold War conflict stream it is possible to look in greater detail at the question whether the space race competition mediated or inflated US-Soviet enmity.

Our VAR findings strongly support the inclusion of two-levels of explanatory variables in a model of rivalry competition. As expected from a reciprocity frame of reference, the space race did roughly follow an action-reaction sequence, whereby US launches led to Soviet launches and vice-versa. However, on the domestic level, there is also evidence that political pressure on the president (falling approval) caused

[14] This finding is sensitive to lag structure. Longer lag lengths were more significant. Including 14 month lags increased the significant for both US launches→US events and USSR launches→USSR events.

[15] As expected both inflation and unemployment granger caused changes in presidential approval, while the presidential change dummy variables were also significant in that equation.

increases in US launches. Reciprocally, the president received a political boost from US launches. Finally, we also uncover evidence that superpower conflict in the space race may have diverted conflict in other areas. US launches served to decrease other forms of conflict behaviour towards the USSR, and Soviet behaviour followed a similar patter.

More research into specific issues, and the domestic politics of rivalries are called for. While the micro-level evidence offered in this paper highlights some important relationships, an accumulation of knowledge from other sources will be needed to increase the external validity of this study. For example, it is unlikely that if we could analyze competition over territory apart from other rivalry issues, that we would find the same conflict reduction (Huth 1996). Equally, more data collected on international issues, candidate policy positions and public opinion would allow for a dynamic analysis of how events, positions, and opinions coalesce influencing rivalry interactions. It may be that the key to rivalry bellicosity lies neither at the international nor domestic level, but through the interaction of the two.

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Figure 1: Graphical Representation of the Space Race.

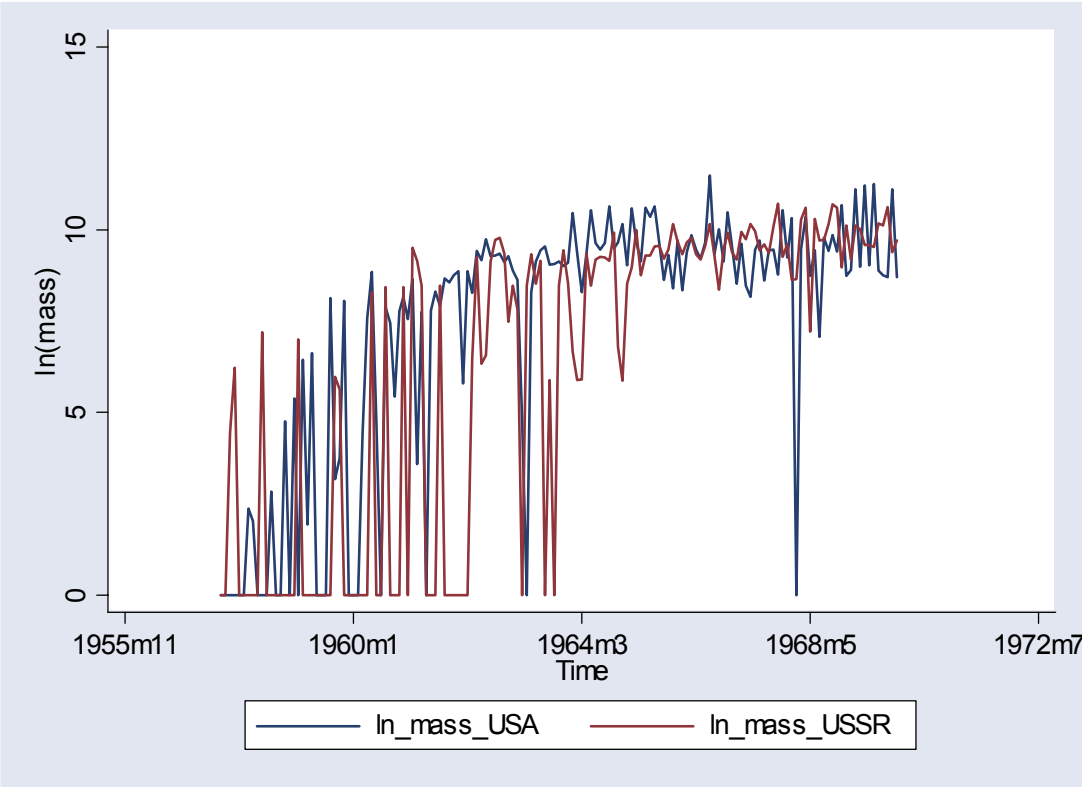

Figure 2: Impulse Response Functions for Space Race Launches

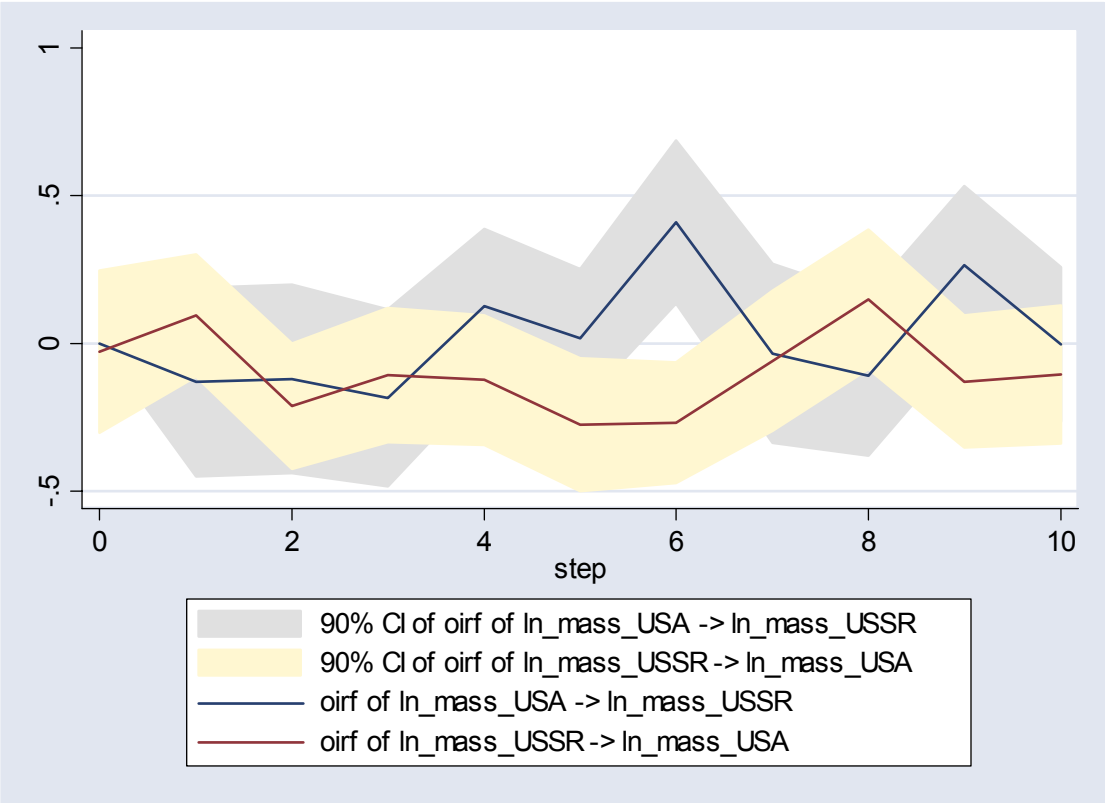

Figure 3: Impulse Response Function for Launches→Approval

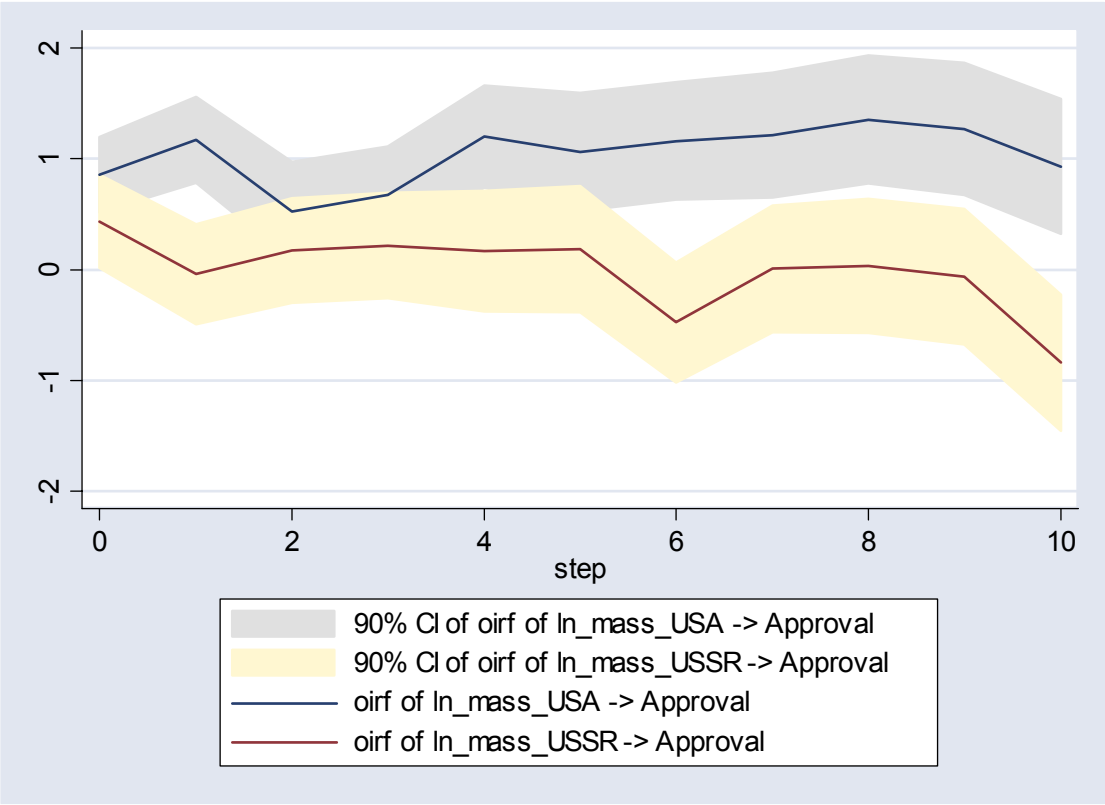

Figure 4: Cumulative Impulse Response Function for Approval→US Launches

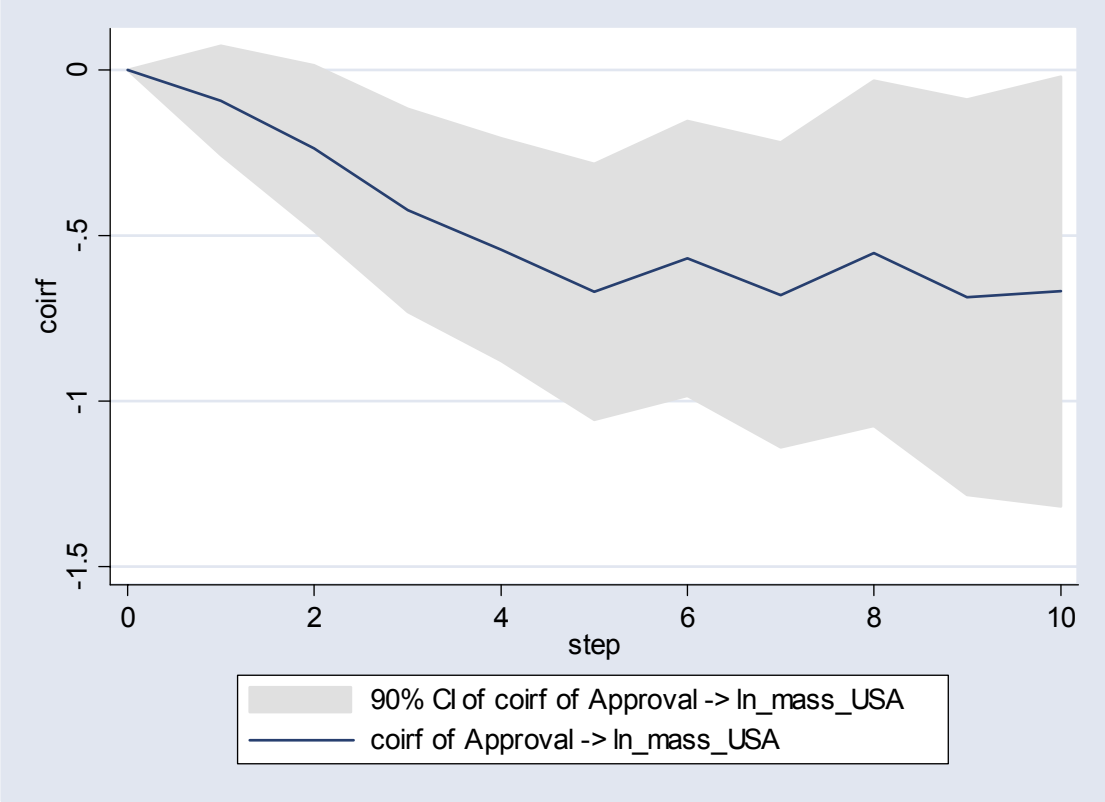

Figure 5: Impulse Response Function for Competition Substitution.

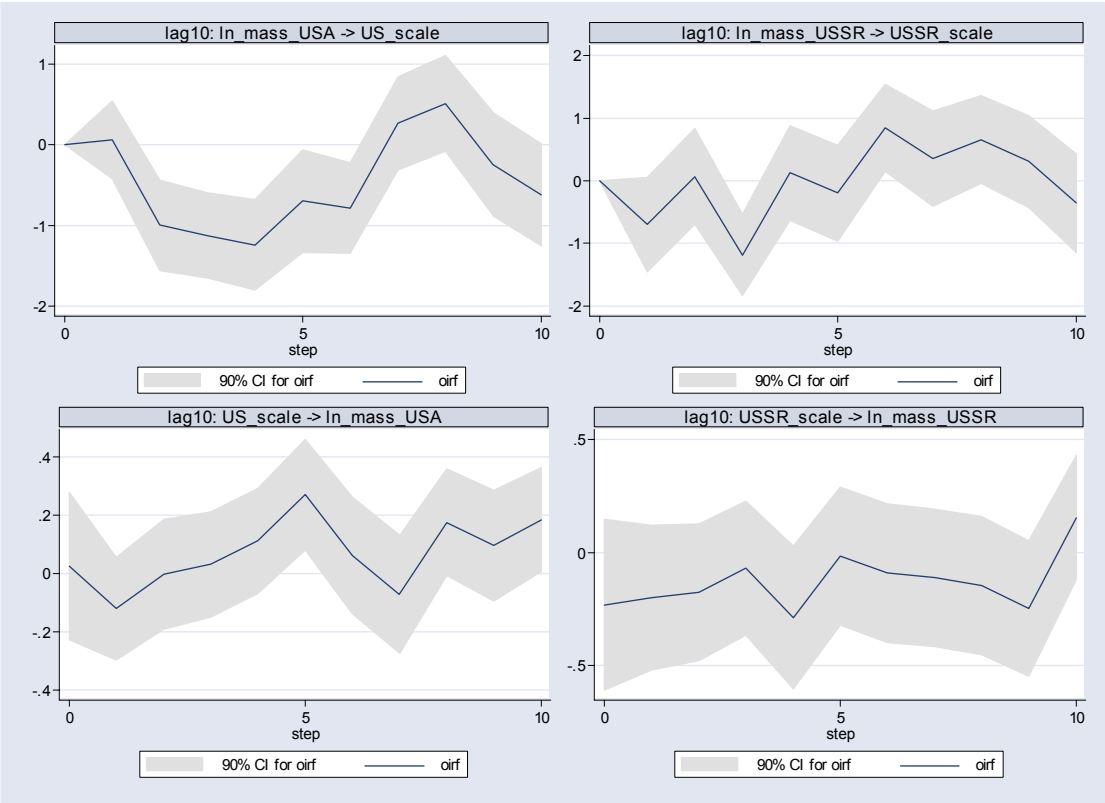

Figure 6: Impulse Response Function for Crossover Substitution.

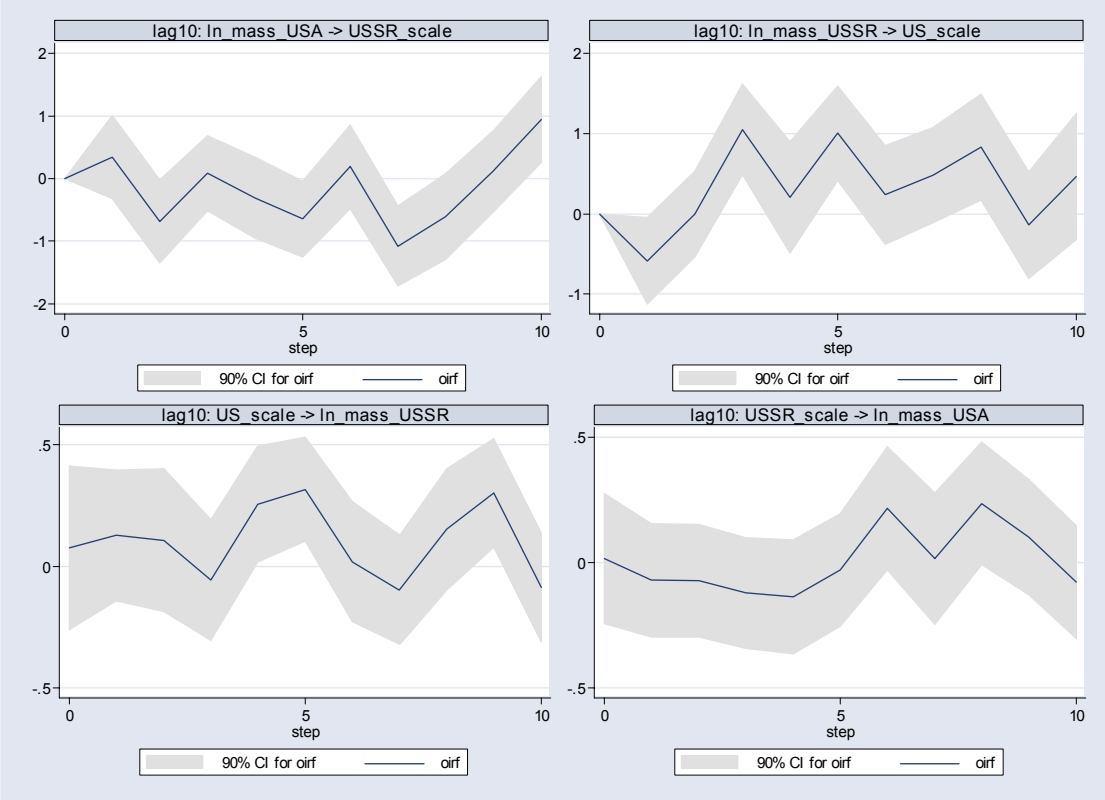

Table 1: A Time Line of Major Events in the Space Race (1957-69)

Time	USSR Events	USA Events
1957	Sputnik I(1), Sputnik II	
1958		NASA started, Explorer 1
1959	Luna 3 Moon Orbit(1)	
1960		Corona Spy Sat.(1)
1961	Man in Space(1), Full Day Orbit(1)	Man in Space, Kennedy Moon Speech
1962		Man in Orbit
1963	Woman in Space(1), Zenit Spy Sat.	
1964		
1965	Space Walk(1)	Space Walk
1966		
1967	Soyuz	
1968	Zond 5 Moon Orbit and Return(1)	Apollo 8 Manned Moon Orbit(1)
1969	N-1 Moon Rocket Fails	Apollo 11 Man on Moon(1)

Note: (1) indicates the first time a certain event was achieved.

Table 2: Granger Causality Tests for Launch Mass, International Events and Presidential Approval

Table 2: Granger Causality Tests for Launch Mass, International Events and Presidential Approval

			10 Lags		11 lags		12 Lags	
Category	Indep. Var.	Dep. Var.	Chi2	p-value	Chi2	p-value	Chi2	p-value
Launches	US Launches	USSR Launches	54.595	<0.001	48.704	<0.001	59.645	<0.001
	USSR Launches	US Launches	17.456	0.065	39.896	<0.001	38.034	<0.001
Launches/Approval	US Launches	Approval	27.979	0.002	44.733	<0.001	45.979	<0.001
	Approval	US Launches	25.850	0.004	39.984	<0.001	29.874	0.003
	USSR Launches	Approval	28.529	0.002	39.984	<0.001	38.577	<0.001
	Approval	USSR Launches	25.929	0.004	33.188	0.001	32.963	0.001
Events	US Events	USSR Events	36.141	<0.001	38.132	<0.001	31.338	0.002
	USSR Events	US Events	20.888	0.022	21.214	0.031	37.420	<0.001
Launches/Events	USSR Launches	USSR Events	13.030	0.222	20.970	0.034	18.417	0.104
	USSR Events	USSR Launches	20.286	0.027	11.589	0.395	27.113	0.007
	US Launches	US Events	36.015	<0.001	39.821	<0.001	55.643	<0.001
	US Events	US Launches	18.367	0.049	43.711	<0.001	42.522	<0.001
	US Launches	USSR Events	15.980	0.100	15.750	0.151	16.609	0.165
	USSR Events	US Launches	16.277	0.092	27.282	0.004	25.459	0.013
	USSR Launches	US Events	42.767	<0.001	44.991	<0.001	65.281	<0.001
	US Events	USSR Launches	25.631	0.004	15.751	0.151	12.666	0.394

Note: Results not shown for Unemployment and Inflation, as well as several other comparisons.
Dummy variables for US Presidents were included as exogenous variables in each equation.