Policy Punctuation or Politics As Usual?: The Congressional Dynamics of Science and Technology Policy

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Paper prepared for presentation at the 2017 Bi-Annual Meeting of the International Public Policy Association, June 28th – 30th, 2017, Singapore.

I. Introduction

In the field of public policy, the theory of punctuated equilibrium is utilized to explain why public policy tends to experience sustained periods of incremental activity interjected with sudden, dramatic policy changes (Baumgartner & Jones 1993, Krasner 1984). In this theory, institutions play a crucial role in supporting policy equilibrium, but can also be used to upset this equilibrium. One of the central institutions in this process is the legislature (Worsham 2006). In this paper, we examine the role the U.S. Congress plays in maintaining and disrupting policy equilibria in science and technology policy since World War II.

II. Why Science & Technology Policy?

The motivation for this paper arose from an ongoing discussion that concerns the relationships among science, technology, politics, and society. Since before Prometheus stole fire from the gods (Bacon [1885] 2011, 6:745-753), Daedalus dared to fly too close to the sun (Bacon [1885] 2011, 6:734-6), or mankind attempted to build a tower to the heavens (Genesis 11:1-9), science and technology have been subject to social regulation and popular concern. Science teaches us more about how things work, while technological innovations give us the ability to manipulate outcomes. Scientific knowledge provides those who know with power (Bacon 4:4). The popular support for science that President Eisenhower requested in 1958 after the Soviet launch of Sputnik, reinforces a prominent theme in the theoretical literature on science and technology. From a theoretical standpoint, technology is often regarded as the most important concern of the modern age. Ernest Braun argues, "The quest for Progress is the most characteristic feature of our time; indeed, progress is at the pinnacle of our collective desires" (1995, 1; also see Feenberg 1999, viii; Melzer 1993, 287-321; and Studer 1991, 1; Studer 1998,

219-20). We should care more about modern science than previous forms of science since the stakes seem to be higher than with previous types of innovation (Heidegger [1950] 1977; Marcuse [1964] 1991; Kline 1985): first, modern science is exceptionally rapid and pervasive, there may be no aspect of modern life that is untouched by technology; second, we demand ever-more refined innovations; and, they are heavily regulated. There is a very-real danger, theory suggests, that if we do not take seriously the potentials of modern science, we are at great risk (Winner [1977] 1980; Ellul 1980). Human beings wield significant power over nature, including human nature and our physical bodies. As such, we should care. Some of the theoretical literature further refines this proposition and suggests that science and technology need not be of concern to the general public; rather while there should be popular support of science, science and technology policy should be a concern for elites (Bacon 4: 13-21 and 3:127-166).

Indeed, in their contemporary theory of the policy process, Sabatier and Jenkins-Smith (1993) suggest that "the general public has neither the expertise, nor the time, nor the inclination to be active participants in a policy subsystem; that role is reserved for policy elites" (p.223). While the theoretical consensus suggests that people, at least elites, should care about science and technology policy since science and technology are pressing political and social concerns, the empirical evidence suggests that science and technology is not considered a pressing concern by the American public. According to an analysis of the "Most Important Problem" question asked by Gallup, somewhere between 0% and 1% of the population lists "Science & Technology" as one of the most important problems facing the U.S. Even after the Sputnik moment and President Eisenhower's call for a renewed focus on science and technology, barely 3% of the population chose science and technology as the U.S.'s most important problem (Johnson & Dolgoy 2014).

Indeed, several scholars suggest that there has been a decline in support for science and technology in the United States (Ellul 1980; Neal, McCormick & Smith 2008; Winner [1977] 1980). These critics often recall the 1950s when the Russian launch of Sputnik prompted the United States to critically evaluate the role of government in the promotion of science and technology. This time is often remembered as promoting new government programs, incentivizing the development of science and technology, along with generous budgetary appropriations. Many scientists, journalists, and scholars are calling for a renewal in support for the development of science and technology, fearing that the U.S. will fall behind in the global race to develop tomorrow's new technology (American Association for the Advancement of Science 2014; Neal, McCormick & Smith 2008).

This paper is part of a larger project that evaluates claims that the U.S. is not as committed to science policy as it once was and explores the political dynamics of the science and technology policy process. There are many ways one can examine the U.S. commitment to science and technology policy including an examination of the executive, legislative, and judicial branches as well as public opinion, interest group activity, and the media. Earlier work (Johnson & Dolgoy 2015) examined the role of the executive in science and technology policy. This paper focuses on an analysis of congressional involvement in science and technology policy. Congress is the place where bills are introduced, discussed, and either ignored, debated, or passed and thus, is an appropriate place to examine the politics of policymaking regarding science and technology policy. While there are many different ways Congress influences the public policy process, this paper focuses on an analysis of all congressional hearings and congressional bills related to science and technology policy since the Truman Administration.

Congressional hearings and bills are good indicators of issues that are currently on the systemic agenda and provide a sense of the variety of interests and attitudes towards these issues. Because one of the goals of this project is to understand the politics of science and technology policymaking, congressional hearings and bills provide a useful indicator of what Congress considers to be important issues of science and technology.

Congressional hearings take place within the purview of the legislative committee system and committees in Congress are well known for wanting to protect their turf (Davidson et. al. 2014; Deering and Smith 1997; Talbert, Jones & Baumgartner 1995; Worsham 2006). So, by examining which committees hold hearings and to which committees space, science, technology, and communications (SSTC) bills are referred, we can learn whether the science policy subsystem is stable or under threat. If the science policy subsystem is in equilibrium, we would expect to find that most hearings and bill referrals related to SSTC issues will be handled by the committees in Congress most closely related to this policy area (i.e. Committee on Commerce, Science, and Transportation in the U.S. Senate and the Science Committee in the U.S. House of Representatives). In the language of punctuated equilibrium theory, this would be evidence of a policy monopoly (Baumgartner & Jones 1993; Worsham 2006). According to Baumgartner & Jones (1993),

> "Every interest, every group, every policy entrepreneur has a primary interest in establishing a monopoly – a monopoly on political understandings concerning the policy of interest, and an institutional arrangement that reinforces that understanding. Nobody likes protracted conflict and continual competition. Much preferable to a system of constant conflict is one where each side retreats into a given area where its influence is uncontested" (p.6).

There are several characteristics of science policymaking generally that lends itself to policy monopoly. As was noted earlier, policymaking generally and perhaps science

policymaking in particular, is likely to involve elites. One of the elements that may lend itself to elite influence in science policymaking is its complexity. According to Gormley (1986), complex policies are policies wherein "specialized knowledge and training are needed if certain factual questions are to be satisfactorily addressed" (p.598). Clearly, many of the issues tackled by science policy can be characterized as requiring specialized knowledge. The need for specialized knowledge further supports the notion of science policymaking often being an elite endeavor. Additionally, the lack of attention and importance ascribed to science and technology policymaking by the public also means that science policy often lacks salience. As Eisner, Worsham, and Ringquist (2006) note in their book on regulation, we can expect policies with low levels of salience and high complexity to be areas that are dominated by policy subsystems wherein close relationships between regulators and regulated develop and Congress doesn't pay much attention.

III. Defining Science and Technology

One of the challenges to the study of science and technology policy is defining the boundaries of the field. Numerous scholars have noted the difficulties in discerning precisely what constitutes science and technology policy (Barke 1986; Lambright 1976; Neal et al. 2008; Nichols 1979; Trousset 2014). Indeed, even the moniker "science and technology policy" is not uniformly used by scholars. Some scholars refer to "research and development", "science policy", "research policy", "technology policy", and/or "innovation policy." These terms are sometimes used interchangeably in the literature. At other times, they are treated as distinct.

Neal et al. argue that "The term science can be used to describe both a process and an outcome – the process of obtaining knowledge, and the knowledge that is obtained" (2008, 5).

They describe technology as conscious efforts to apply scientific knowledge to achieve specific ends. While this discussion reveals the nature of the relationship between science and technology, Neal et al. are quick to point out that "science and technology" is NOT the same thing as "research and development". For them, research is conceptualized as "the process through which scientific principles are developed and tested" (Neal et al. 2008, 6) and they adopt the National Science Foundation (NSF) definition of "development" as the "systematic use of the knowledge or understanding gained from research, directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes"" (Neal et al. 2008, 6). Despite the fact that they make the case that research and development is not the same thing as science and technology, these processes are clearly intimately linked and the distinctions between them are often not particularly clear.

Academic concerns aside, from a practical perspective the view is also confused. Science and technology policy can be considered from two very broad positions. First, as policy for science, which is the direct application of policy for the conduct of science (Barke 1986; Brooks 1994; Jasanoff 2010; Neal et al. 2008, 11). Second, as science for policy, which considers how science informs the creation of public policy. This paper is primarily concerned with Barke's notion of *policy for science* (Barke 1986). Policy for science can be characterized as public policy that is about both the process of conducting science as well as how we manage the outcomes of that scientific process. This includes, for example, policy outcomes that influence scientific funding or regulation of information and legislative initiatives intended to regulate, fund, or control the conduct of science or the outcomes of science. This is not to suggest that science for policy is not important, but the goal of this paper, to examine the role of Congress in

science and technology policymaking through an analysis of congressional hearings and bills, best links with Barke's notion of *policy for science*.

IV. Data and Methods

The dataset analyzed in this paper consists of all congressional hearings and proposed bills related to space, science, technology, and communication (SSTC) since the beginning of the Truman presidency. We utilize two different sources of information to put this dataset together. First, we downloaded the complete congressional hearings dataset from the Policy Agendas Project (PAP) and congressional bills dataset from the Congressional Bills Project (CBP) website (Adler and Wilkerson 2015). Fortunately, Adler and Wilkerson (2015) utilize the policy topic codes of the Policy Agendas Project (PAP) and assign every proposed bill a major policy code and a policy subtopic code (Baumgartner and Jones 2013). Major policy codes capture broad policy areas like education, environment, immigration, and transportation. In this paper, we focus on an analysis of congressional hearings and proposed bills coded as part of the major topic code entitled "Space, Science, Technology, and Communications" (SSTC). This major topic code best overlaps with the definitions of what constitutes the study of science and technology as discussed above.

The SSTC code includes any actions that are primarily about what has been defined above as policy for science. This includes national engineering and science policy, space policy, automation and technological change, international scientific cooperation, computing and computer security, activities relating to the Federal Communications Commission (FCC), the Office of Science and Technology Policy (OSTP), National Aeronautics and Space

Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), NSF research funding, etc.

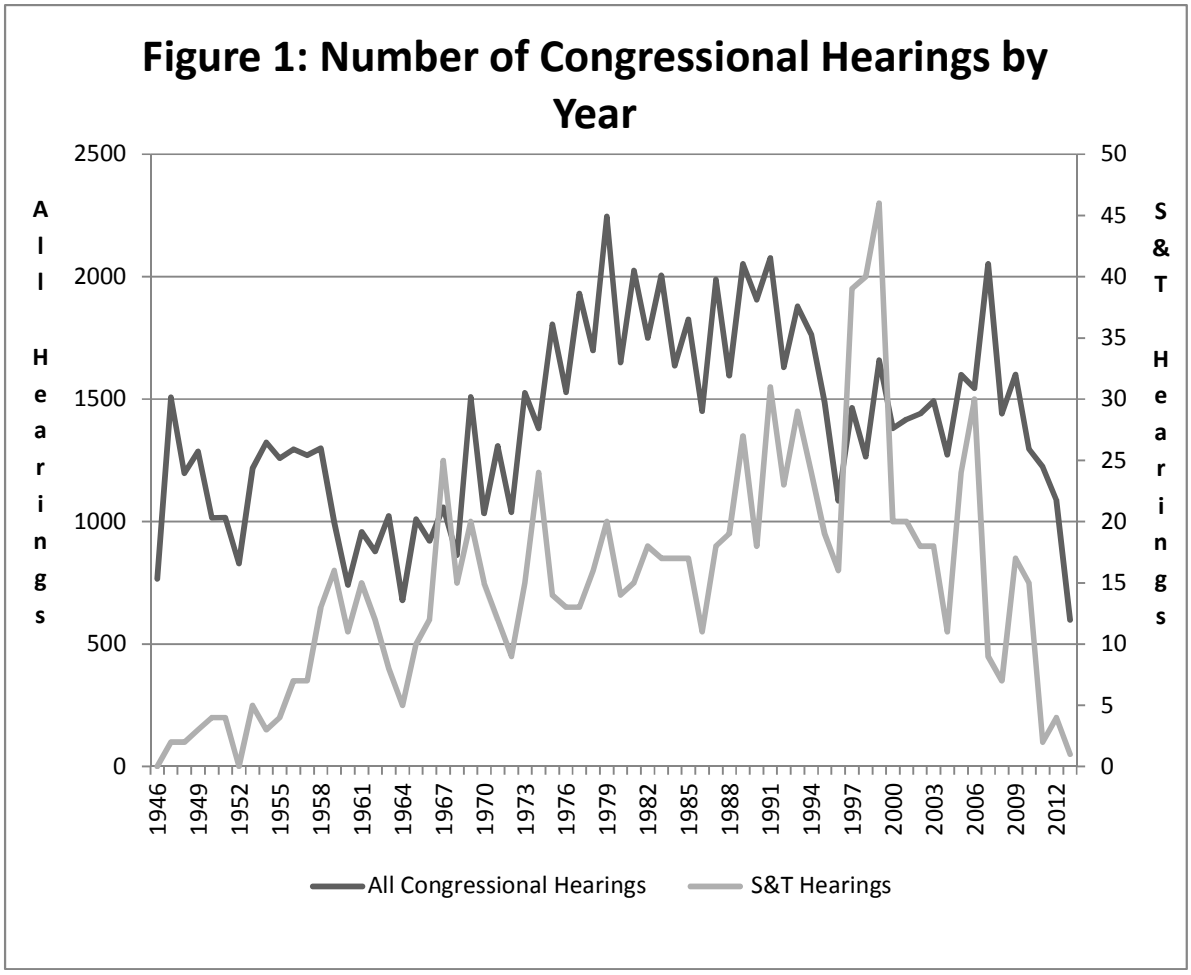
Not surprisingly, the Baumgartner and Jones (2013) coding mirrors much of the confusion over the definition of what constitutes science, technology, research, and/or development policy. While coders wading through the vast amounts of information contained in these datasets clearly have identified many public policy actions relating to science, technology, research, and development, these actions are only sometimes identified as being primarily about science and technology. Oftentimes, these actions are subsumed under other policy areas like healthcare, education, environment, or defense. While we are aware of these issues, we have not modified either the CBP or the PAP datasets and the analysis below focuses on an analysis of the congressional hearings and bills that the PAP and CBP datasets identify as being primarily about SSTC. As such, this analysis is likely to underestimate the amount of congressional activity on SSTC issues rather than overestimate it.

V. Findings

One of the central purposes of examining congressional hearings and bills is to establish whether concerns about a lack of U.S. commitment to science and technology are founded. From the beginning of the Truman administration through the end of 2013, there have been a total of 3,163 congressional hearings focused on space, science, technology, and communications (SSTC). This represents about 3.3% of all congressional hearings during this time period (95,060 congressional hearings in total) (see Figure 1). If Congress's attention was evenly divided amongst all twenty policy areas represented in the PAP dataset, we would expect about 5% of all congressional hearings to be related to this topic. So, in comparison to other

policy areas, this subject is underrepresented compared to other policy areas. However, a closer look at the general trends in hearings held on this subject reveals a more interesting story. Attention to this topic has waxed and waned over the years, but perhaps not always in the ways expected.

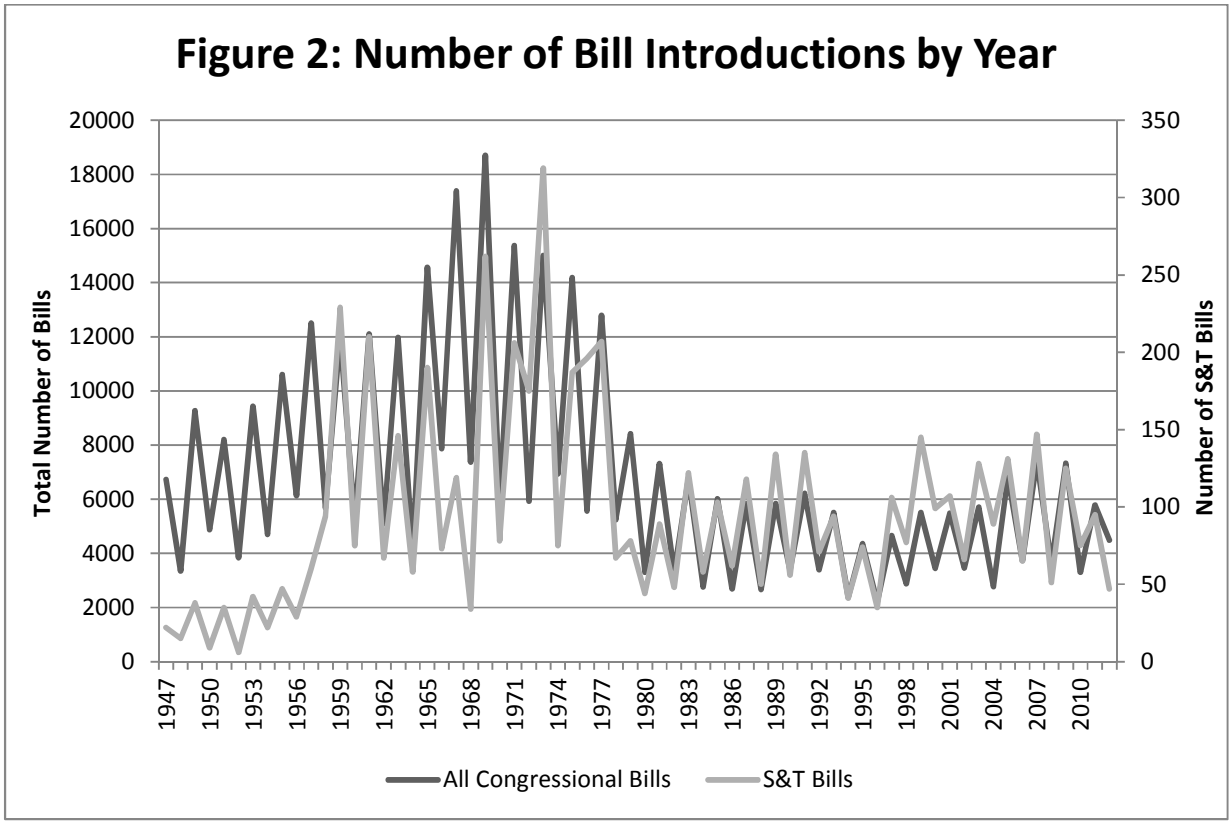
As noted earlier, the launch of Sputnik is often referred to as a defining moment for science and technology policy in the U.S. (Neal, Smith & McCormick 2009). While



not using this language directly, this literature seems to make the case for Sputnik providing a window of opportunity for significant policy change in this area. As such, we might think of

Sputnik as providing the impetus for a policy punctuation in science and technology policy. The data in Figure 1, for the most part, is consistent with this story. While there is significant congressional hearing activity immediately after World War II, there is very little hearing activity in the area of science and technology policy. However, there is a spike in congressional attention to this issue beginning in 1958 and 1959 at the same time there is an overall decrease in congressional hearings activities. Thus, there is solid empirical evidence for the notion of Sputnik as a defining moment for science and technology policymaking. However, contemporary narratives of science policy also lament the decline in focus on science and technology policy since that time. In terms of congressional hearings, however, there is little empirical evidence for this narrative. Indeed, attention to these issues seems to be sustained at an even higher level than prior to Sputnik throughout the 60s, 70s, and 80s. While the level of attention does lag behind other policy issues on the agenda, it is difficult to assert that Congress neglects these issues during this period. Then, in 1997-1999 there is a tremendous peak in attention to these issues followed by a return to post-Sputnik norms in attention. Not until the very end of the series do we see a return to pre-Sputnik attention levels in Congress.

Similarly, Figure 2 displays all bills introduced in Congress from 1947 through 2012 alongside all SSTC bills. While SSTC hearings don't always follow the same patterns as hearings generally, there seems to be a close relationship between all bill introductions and SSTC bills. Again, the time series begins with SSTC bills being significantly underrepresented in comparison to bills generally. However, as expected, there is a significant spike in SSTC bill introductions in 1958 and 1959. Bill introductions do seem to lag slightly behind patterns for bill introductions generally during the 1960s, but not dramatically so. And, while there is a decrease



in the amount of SSTC bills introduced after the late 1970s, this patterns mimics the bill introduction pattern generally found in Congress. In other words, this drop-off in activity does not seem to be peculiar to SSTC policy.

While Figures 1 and 2 do a good job of demonstrating both general levels of congressional attention to science and technology issues as well as how this attention compares to all other congressional activities, it does not tell us much about the nature of these activities. The tables that follow explore which committees are most active on these issues and whether committee-level activity provides any additional understanding in how attention to science and technology issues may have changed over time.

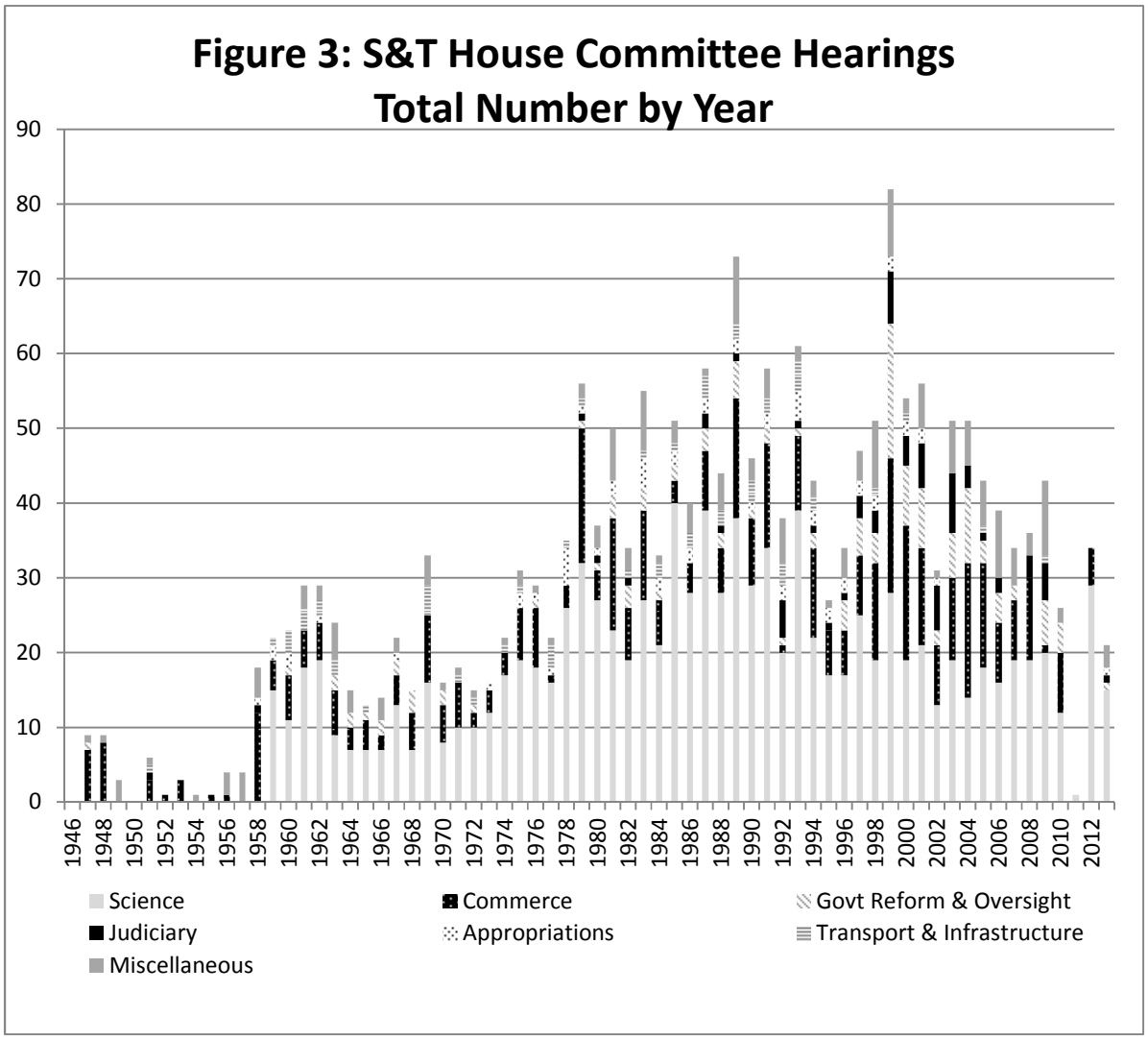
A central element for explaining the existence of policy equilibrium in any particular policy area is the notion of a policy subsystem (Baumgartner & Jones 1993; Worsham 2006).

Policy subsystems are composed of political actors with particular interests and expertise on a particular policy issue. There are a wide variety of conceptualizations of the policy subsystem concept in political science including advocacy coalitions (Sabatier & Jenkins-Smith 1993), iron triangles (Cater 1964), and issue networks (Heclo 1978). A policy subsystem with a unified vision for public policy within its domain can help to support and sustain a policy equilibrium. These equilibria, however, can be disturbed by a policy entrepreneur with new ideas that challenge the existing institutional arrangements, by policy learning within a policy subsystem that results in a challenge to the status quo policy, or by external events (like the launch of Sputnik) that focus attention on an issue that was not previously on the agenda.

Congressional activities, like hearings and bill introductions, provide a good opportunity to examine the structure and activities of policy subsystems. Congressional committees are the place where members of Congress can solicit information on public policy problems and where new legislation is crafted and vetted by those with an interest in a particular policy issue. Indeed, Davidson et al 2014 characterize them as "the centers of policy making" (163). However, committees are also notorious for wanting to protect their turf (Hardin 1998; King 1997; Worsham 2006). Because science policy can also be environmental policy, health care policy, transportation policy, or any number of other policies, many committees can ultimately have jurisdiction over science policy. This means that by its very nature science policy is less likely to be subject to the type of agenda control that has been demonstrated in areas like defense policy and agricultural policy. So, an examination of the distribution of congressional hearings and bill introductions by committee can tell us something about the political dynamics of science policymaking.

If a policy subsystem dominates a particular policy area, we would expect two things to occur in terms of congressional hearings: 1) we expect there to be relatively few hearings on the issue as hearings are often an indication of a problem being brought to the attention of a committee or a committee wanting to investigate an issue and 2) we expect that the committees that traditionally exercise control over a policy area will continue to do so. As such, when different committees begin to express interest in policy areas not traditionally in their purview or a large number of hearings occur, these are indications that there are challenges to subsystem stability in a policy domain. This is also one of many possible indications that policy change is possible in the future.

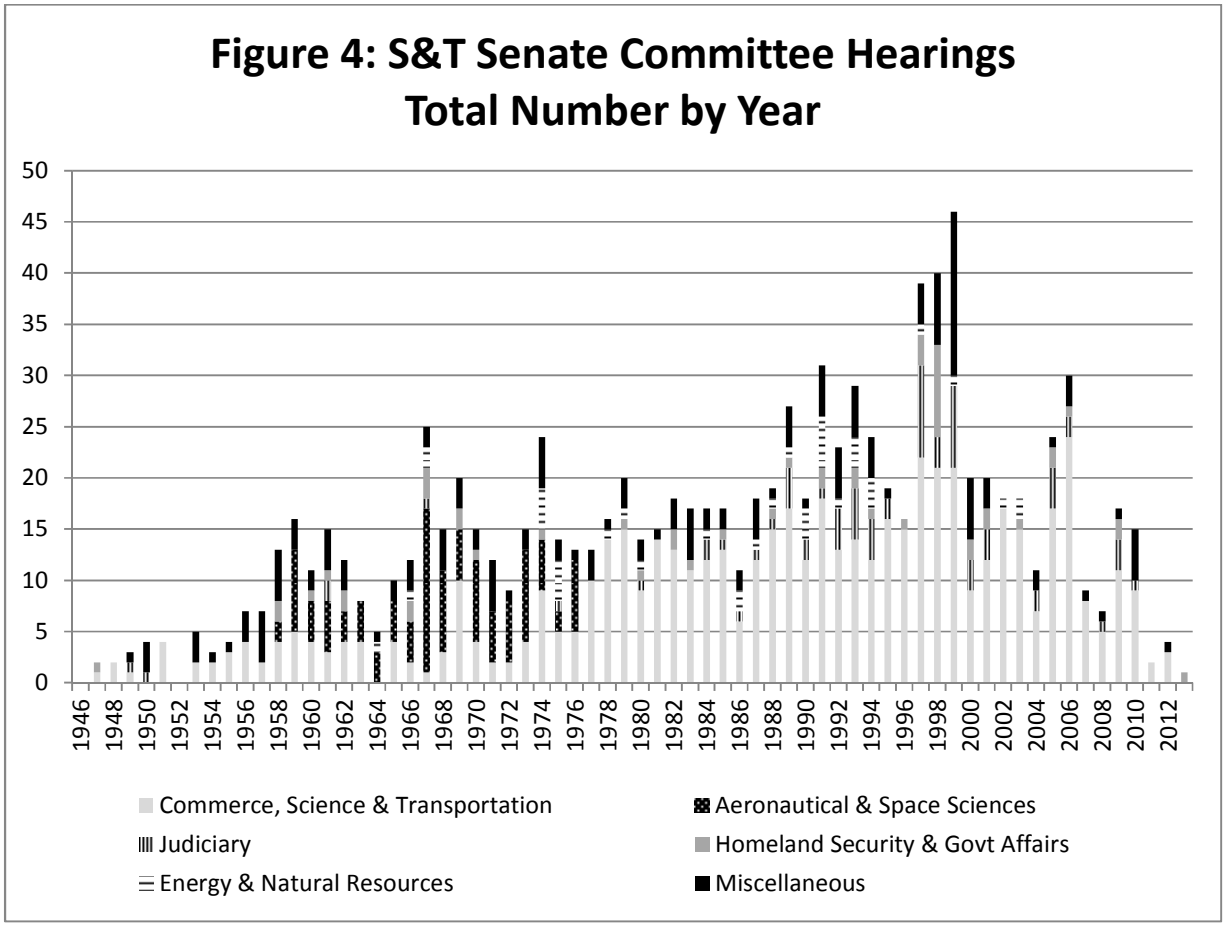
Figures 3 & 4 display all congressional hearings held in the U.S. House of Representatives and the U.S. Senate from World War II through 2013 by committee. The first thing to note is that the House did not even have a committee dedicated to the topic of science until the creation of the Committee on Science and Astronautics in 1959. This committee has undergone numerous name changes since 1959, but its contemporary incarnation is the House Committee on Science, Space, and Technology. The hearings activity of this committee is labeled as "Science" in Figure 3. In this figure, we again find support for labeling the launch of Sputnik as a policy punctuation. Prior to the launch of Sputnik, there is very little hearing activity related to science and technology and what activity there is occurs primarily within the purview of the House Commerce Committee. With the creation of the House Committee on Science and Astronautics, however, there is a sudden spike in hearings activities related to space, science, technology, and communications.



However, what happens in the data after this time period is also quite interesting. First, the House science committee remains quite active in holding hearings on science-related issues from the moment of its inception until the present time. Indeed, hearings activity by the science committee generally continues to increase throughout much of the time series. Such activity is not indicative of an indifference to the importance of science and technology and is not typical of a policy subsystem dominated by the status quo. Other research (Worsham 2006) demonstrates that non-threatened policy subsystems seem to experience both low levels of hearing activity as

well as few hearings being held by other committees. Neither of these can describe the time series displayed in Figure 3. Indeed, hearings activity on science and technology issues continues to increase until it reaches a peak in the late 1990s. Also interesting is the wide variety of committees that exercise their powers in investigating issues of science and technology. The graph displays the six committees that hold most of the hearings covering SSTC issues since World War II. It also includes a 7th category labeled as "Miscellaneous" that incorporates the numbers of hearings held by all other House committees during this time period.

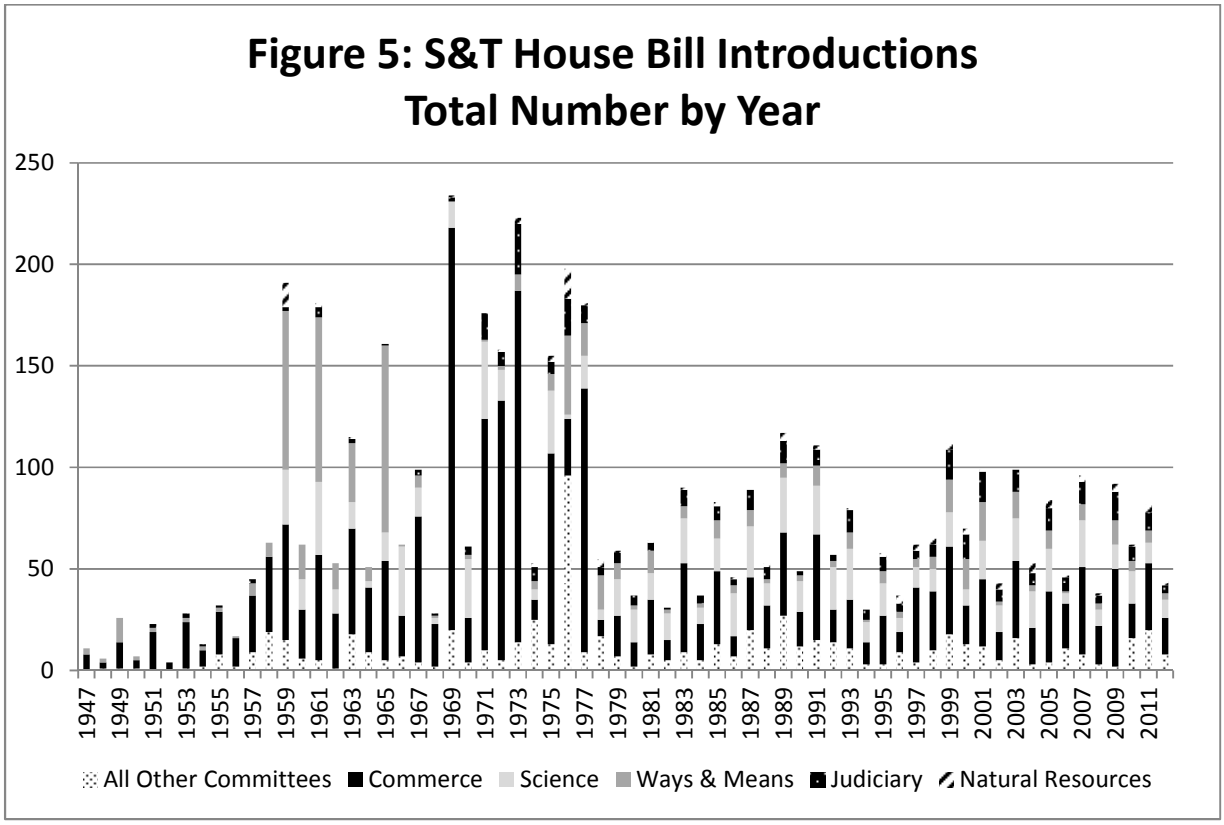
Interestingly, the House Energy and Commerce committee, the committee that was active on these issues prior to the creation of the Science and Astronautics committee in 1959, becomes quite inactive after the creation of the new committee. However, this committee seems to re-assert its authority in the 1970s and continues to be quite active on these issues up to the present time. Additionally, the House Oversight and Government Reform Committee, while showing some interest in these issues sporadically throughout the time series, appears to become quite active on these issues beginning in the late 1990s. The tremendous upsurge in hearings activity coupled with the wide variety of House committees involved in these hearings challenges the notion that issues of science and technology are not of importance in U.S. politics and it also suggests that there are competing visions as to what issues in the policy domain are or should be important. Do these patterns hold in the U.S. Senate as well?



Like the House, the Senate did not have a standing committee dedicated to science policy until 1958 with the creation of the Senate Committee on Aeronautical and Space Sciences. Also like the House, the committee that focused most on science issues prior to this time was the Senate Committee on Interstate and Foreign Commerce. After 1958, the newly created Aeronautical and Space Science Committee becomes quite active in holding hearings on science and technology issues, but the Commerce Committee remains modestly active as well. This is indicative of what Worsham (1998) refers to as a competitive coalition. Despite the creation of a new set of congressional institutions after the launch of Sputnik, the Senate Commerce committee does not completely cede authority on this policy issue to the newly created

Aeronautical and Space Science Committee. And, in 1977, the Aeronautical and Space Science Committee ultimately gets absorbed into the newly-named Senate Committee on Commerce, Science and Transportation (which continues under the same name today). In the Senate, then, we do see some evidence for arguments that science and technology issues do not have the same status today as they did in the aftermath of the Sputnik moment. Despite folding science issues into commerce issues, however, hearings on SSTC do not return to their pre-Sputnik levels. Indeed, we can see that the Senate Commerce, Science, and Transportation Committee dominates hearings on this topic after 1977 and that activity actually increases. Interesting, however, is that like the House, the latter part of the time series also indicates increasing competition over this topic from other committees in the Senate including Homeland Security, Judiciary, and various other committees.

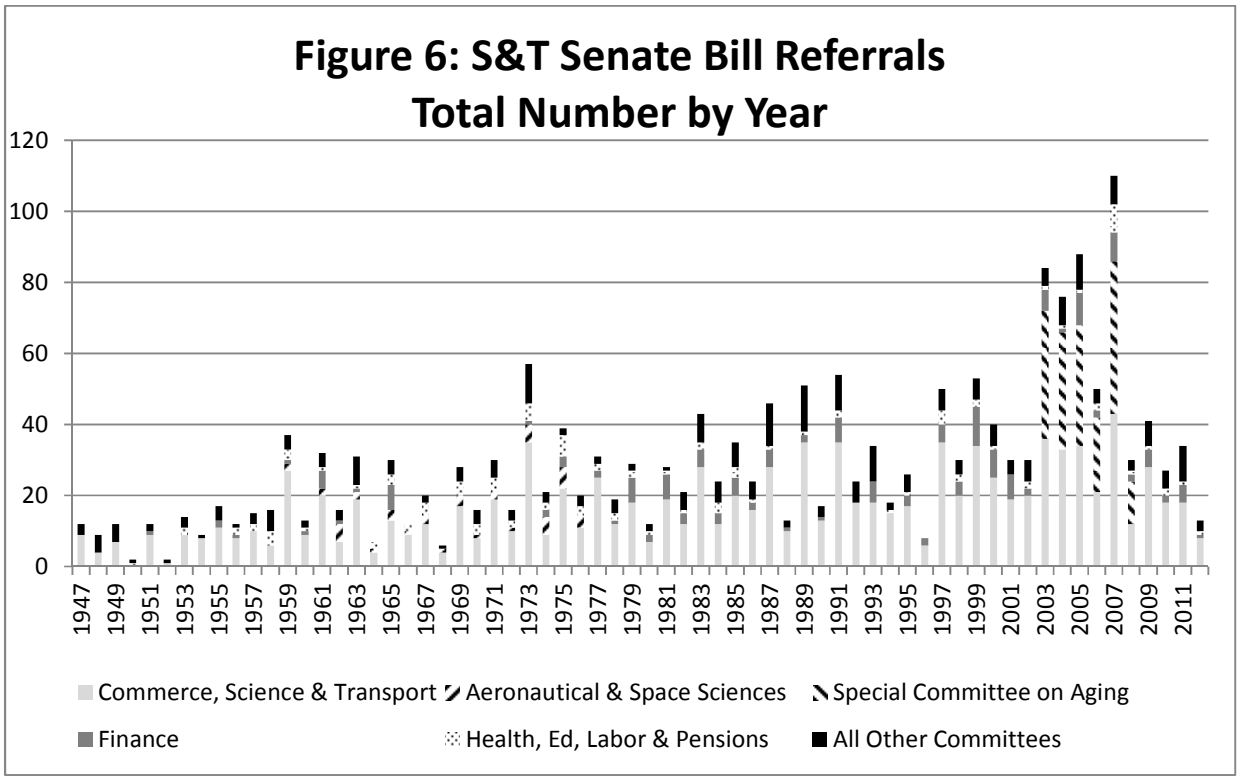
In addition to hearing activity, bill introductions can also help us understand subsystem dynamics in science and technology policymaking. Like congressional hearings, bill introductions allow us to examine which committees are active on issues related to SSTC. Figures 5 & 6 display the number of bills introduced on science and technology issues in the House and Senate from World War II through 2012.



Not unlike the congressional hearings data, the congressional bills data also demonstrates that two House commitees, Commerce and Science, are the primary committees to which bills related to science and technology issues are referred. Unlike the hearings data, however, bill introductions are dominated by the Commerce Committee rather than the Science Committee. Additionally, the surge in bill introduction activity occurs just after the Sputnik moment and continues through the 1970s. After the 1970s, the average level of bill introduction activity decreases, but is still much more active than in the pre-Sputnik era (and this decline is consistent with bill introduction activity generally). Also after the 1970s, bill referrals are spread across a wider variety of House committees than in the previous time period. More than two committees regularly vying for agenda access on policy issues is indicative of what Worsham (1998)

describes as transitory politics; a situation in which there are multiple competing interests active on a policy issue. Again, this indicates that SSTC issues remain on the congressional agenda.

However, as shown in Figure 6, the bill referral story on the Senate side is quite a bit different from the House side. In this case, bill referrals are predominantly referred to the Senate committee on Commerce, Science, and Transportation. There is a slight uptick in activity



around the time of Sputnik, and a slightly increased trend towards bill introductions, but not as many dramatic spikes in activity that we see on the House side. Interestingly, even with the creation of the new Committee on Aeronautical and Space Sciences in 1958, most bill referrals relating to SSTC occur in the Senate committee on Interstate and Foreign Commerce. Putting the hearings and bill referral activity in context then, there does seem to be some support for the notion that the policy punctuation created by the launch of Sputnik in 1957 led to a surge in

interest in science issues, but eventually, the Senate saw no need for a committee dedicated solely to issues of science and incorporated science issues into larger issues of commerce.

Towards the end of the time series, an interesting phenomenon emerges in which a series of bills are referred to multiple committees. From 2003 through 2008, the Senate Commerce, Science and Transportation Committee along with the Special Committee on Aging experience a significant uptick in bill referral activity in which a significant number of bills are referred to both committees at the same time. According to Worsham (1998), such activity is indicative of competitive politics. In this case, the traditional authority of the Senate Commerce, Science, and Transportation Committee is being challenged by another committee.

V. Conclusions

The data analyzed reveals some interesting trends in the use of congressional hearings and bill introductions to influence national science policy, all of which require additional analysis. First, as is already discussed in the literature, the launch of Sputnik and President Eisenhower's call to attention does seem to have served as a policy punctuation for science and technology policymaking. This is evident both in the institutionalization of science as an important topic in both the House and the Senate (although more so in the House) and in the general increase in congressional hearings and bills related to space, science, technology, and communications.

Second, based on narratives in the academic literature as well as the popular press, we expected to see a significant decline in SSTC activities after the Sputnik moment. On the whole, we find little support for decreased SSTC activity in Congress. We also find that there is a significant divergence in trends in the House and the Senate on SSTC issues. The House seems

to remain quite engaged in SSTC activities throughout the time period with a spike in bill introductions in the 1970s and an increase in hearing activity in the 1990s. However, both of these periods also suggest the emergence of entrepreneurial policy activity in that the House Science Committee does not always dominate this activity. In particular, the House Commerce and Judiciary committees seem to be active both as a locus for bill introductions and hearings activity.

Like the House, Senate committee hearings and bill activities do not seem to dwindle after the Sputnik moment. On the other hand, the Senate Commerce, Science, and Transportation Committee does seem to dominate hearings activity and bill introductions since 1977 when the Aeronautical and Space Science Committee was integrated into the Commerce Committee. While this committee certainly does not exercise exclusive control over SSTC issues, there are far fewer challenges to its authority in comparison with House activity.

Given the low salience and high complexity of science and technology issues, coupled with popular narratives of the demise of science in the U.S., we were surprised to find that Congress remains as active as it is on issues of science and technology. Research in political science has typically found that the combination of low salience and high complexity means that there is typically little to be gained by members of Congress in pursuing such issues either through holding congressional hearings or introducing new legislation. However, this analysis suggests that there is a more complex dynamic occurring on issues of science and technology than we might expect.

In order to further examine these findings we are currently coding the content of these congressional hearings and bills in order to discern what aspects of science and technology this congressional activity is focused on. We are primarily interested in whether the focus of

congressional hearings and bills is to increase or decrease support for science and technology initiatives. Additionally, we are also examining the interest groups involved in this legislative activity by coding for the types of witnesses called to testify at congressional hearings. In the future, we also plan to link our congressional findings to media portrayals of science and technology policymaking as well as bureaucratic responses to congressional oversight efforts.

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