

**Interest Groups, Political Party Control, Lobbying, and Science
Funding:
A Population Ecology Approach**

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DEDICATION

I dedicate this work to my beautiful and loving (if not occasionally frustrating) son Isaac Dmitry and your personality-to-be determined brother Daniel Nikola. I hope that you both manage to find your path in life with far less meandering than I did.

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ABSTRACT

Science plays an increasingly important role in public policy in a range of issues from national security to public health. Thus, scientists will play an increasingly important role in society. This dissertation first examines how federal science funding changes with partisan control of key political institutions. Next, science-related interests groups, including their formation, specialization, and lobbying activities, are examined. Interest groups are a growing aspect of the American political system. However, they are an understudied aspect of political institutions. While much of their activity occurs within the legislative branch, they also work in the executive and judicial branches to advocate their proposed position.

I find that federal science funding increases with Democratic control over Congress as well as the presidency. This holds when examining overall, basic, and applied research as well as funding that funneled through specific federal agencies. I use this as a starting point to study science-related interest groups. I find that the population of science-related interest groups has grown over time and grown as federal science funding has increased. This population has become more specialized over time well, likely as a way for groups to attract additional members without having to compete with broad, well established groups that attract huge numbers of scientists. Finally, the lobbying activity of these groups is examined. I find that the lobbying activities of these science-

related interest groups has increased over time and increased as federal science funding increased, although this finding is statistically insignificant.

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INTRODUCTION

Statement of Purpose

Science plays an increasingly important role in policy debates across a range of issue area, from national security to public health. As such, the political activities of scientists deserve study. This dissertation begins with an examination of the way that federal science funding has changed over time in relation to political party control of government institutions and follows with discussions of science-related interests groups and their activities. Because of the growing importance of science and technology in society, the activities of the groups they associate with become more and more important. This dissertation examines these science-related interest groups in a detailed, novel manner not previously discussed.

Literature Background

Political science scholars have been studying interest groups and lobbying for decades and the literature is sizable (although the literature is much more limited than broad research areas such as congress, conflict, and political economy). Each individual chapter provides a literature review focused on the specific theories or concepts being tested to discussed. Thus, this introductory chapter will serve to provide highlights of the interest groups literature and some

of the lobbying literature in a broad sense to provide the reader context in which to place the following chapters and discussions.

Interest groups: What are they and what do they do?

An interest group is any group or organization that makes demands upon government. The more appropriate term, and one that is gaining traction and popularity in the literature, is “organized interests” because many of the groups making demands on the government are not what we traditionally identify as “interest groups.” This definition includes universities, trade associations, professional associations, and business firms. Interest groups engage in a wide variety of activities, such as direct lobbying, asking citizen members to contact their legislators, publishing research reports, and making presentations to Congress. The tactics that interest groups use depend on the group’s perception of how legislators may help them achieve their goals, their policy positions, and their resources (Hojnacki and Kimball 1999). Legislative branch lobbying is the most common form of interest articulation and the one we will focus on in this analysis, though scholars have discussed both executive and judicial lobbying activities.

Interest group theory

The earliest work on interest groups rested on pluralism and the assumption that because humans are social creatures, people would band together and create groups to protect their shared interests. These groups, so

goes the pluralist argument, then articulate their demands to the government, adding to political stability (Truman 1951). Early group theory rested on the pluralist assumption that the best political outcome would result from group conflict and compromise, with the government acting as mediator (Baumgartner and Leech 1998). However, interest group research quickly evolved as scholars recognized that the pluralist assumptions of equal representation was untrue, with the wealthy and well-connected having far greater group representation in Washington (Schattschneider 1960).

Beyond pluralism

Early critics of pluralist theory claimed that ordinary citizens are relatively powerless against the desires of elites (Mills 1956). E.E. Schattschneider famously remarked that “the flaw in the pluralist heaven is that the heavenly chorus sings with a strong upper-class accent (1965, pg. 35).” Schattschneider also suggested that membership in the group system was biased by social class, as upwards of 90 percent of the population did not participate due to mobilization barriers (Schattschneider 1960). Scholzman’s (1984) empirical work supported this claim, noting that while only 16 percent of American adults are professionals or managers, they are represented by nearly 88 percent of Washington organizations.

As interest group theory developed, questions of collective action began to replace questions of group power and influence as centers of scholarly attention, leading to economists weighing in on interest representation in America. Early

research in the pluralist tradition assumed that self-interest provides a powerful incentive to form groups, and that the political system provides an institutional setting for interaction (Mitchell and Munger 1991). Olson's *Logic of Collective Action*, however, shows that forming and maintaining an interest group is not easy. The barriers to group organization identified by Olson help to explain the large bias toward business in the interest group universe (Olson 1965). In his later book, *The Rise and Decline of Nations*, Olson takes his argument further, arguing that some interests are better represented than others, and that these interests can retard economic growth and stifle political and economic development. Interest groups acting rationally in pursuit of their own interests can reduce the vitality of the system and restrict the menu of social choice of everyone else. In sum, Olson concluded that economic growth can be limited by a dense interest group system (Olson 1982). If groups are pursuing particularized benefits for their organizations or members of their organization, it follows that other organizations will have a smaller share of the budget.

Virginia School theorists (also largely economists) sought to develop an "interest group theory of government"—that is, a general theory that examines how groups affect the behavior of politicians, bureaucrats, and citizens. They proceed from the assumption that modern markets operate alongside powerful political institutions that may distort and slow down efficient market processes. Rent seeking by groups—often in the form of seeking monopolistic rights granted by government—is rational and predictable. Market privileges granted to interest

groups represent a welfare loss to consumers and taxpayers (Mitchell and Munger 1991). Tollison and others maintain that the source of and motivation for rent seeking is the power of the government to tax everyone through general measures and spend on specific groups (Tollison and McCormick 1981). Needless to say, members of the Virginia School consider rent-seeking unproductive.

Population ecology theories of interest groups

The study of interest group populations has benefited greatly from population theories of biodiversity. In biology, the diversity of populations is shaped by the environment. Babies are important only in the sense that they provide members for the population. In the interest group analogy, new groups add to the overall population, but the characteristics of said population are shaped by the environment. New interest groups forming are only part of the story for the overall populations – the external environment shapes the population as well. Formation and mobilization of groups can only partially explain overall populations (Lowery and Gray 1995). This theory is discussed at length in Chapter II.

Lobbying theory

In the exchange theory of lobbying, interest groups are rational opportunists who aim to seek rents for their own gain. Political science models assume here that legislators and lobbyists make mutually beneficial trades,

including campaign contributions and information (Morton and Cameron 1992). As lobbyists and legislators get to know one another, mutual confidence, trust, and understanding grow (Schlozman and Tierney 1986). We expect that lobbyists in our study are primarily giving members of congress information on how research funds would better their university and how this support would benefit their districts. This would also lead us to expect that the longer a university lobbies congress, the more relationships are cultivated and the more money we would expect to be allocated to that university. Lobbyists, in effect, are agents of exchange (Austen-Smith 1996).

A second theory involves the idea of lobbying as persuasion rather than exchange. Information exchange is at the heart of this theory. However, in contrast to earlier pluralist ideas, this information is viewed as not innocuous. Interest groups have a comparative advantage in gathering information that may be useful to legislators seeking to evaluate their reelection prospects. Lobbyists can use this information to persuade uncertain legislators that their reelection chances will be increased if they take a position that is friendly to the group (Hansen 1991). Lobbyists are thus able to persuade lobbyists to adjust their positions on the basis of the lobbying information (Wright 1996).

A third theory involves lobbying as a type of legislative subsidy. Lobbyists can match policy information, political intelligence, and labor to strategically selected legislators. In this theory, lobbyists assist their allies by “arming” them with “weapons” designed to help them advocate and vote for legislation that is

advantageous to the lobbyist and their group (Hall and Deardorff 2006). This theory assumes the following: (1) a legislator must work at it if he/she expects to have any influence on policy; (2) legislators' resources are scarce; (3) legislators have more than one policy concern at a time (though they care about some issues more than others); and (4) relative to legislators, lobbyists are specialists (Hall and Deardorff 2006). Thus, lobbyists are able to provide costly information, such as in-depth policy analyses and reports (Schlozman and Tierney 1986; Whiteman 1995), as well as political intelligence (Whiteman 1995; Wright 1996). Legislators structure the Congressional environment to channel relevant interest group influence and facilitate group access. Legislators affect their interactions with lobbyists by establishing lobbying enterprises, making known their information shortcomings. These lobbying enterprises allow lobbyists to coordinate their efforts with sympathetic legislators by coordinating legislators to advocate on behalf of their issue (Ainsworth 1997).

Lobbying activities and congressional influence

The "common" wisdom among journalists is that lobbying can have a substantial influence on how members of Congress vote (Birnbaum and Murray 1987; Edsall 1988; Birnbaum 1992). Academics have been far more skeptical. The traditional scholarly wisdom is that lobbying groups have little success in persuading or pressuring members of Congress. Any influence they do exert comes from reinforcing the decisions and actions of legislators. Lobbyists may also have some success at persuading undecided or weakly committed members

to their position (Smith 1995). One of the reasons lobbying may not have large persuasion effects is that changing a person's attitude, especially in the short run, is difficult. By and large, attempting to change a person's attitude is a long term proposition, which is why much lobbying occurs with those who already agree with the lobbyist (Bauer et al. 1972).

Not all scholars fully agree with Bauer, Pool, and Dexter that lobbying is ineffective. Smith suggests that while legislators' preferences are stable in the short term, they are not necessarily attached to specific pieces of legislation. Thus, lobbyists are able to shape and influence a member's perception of a piece of legislation that fits with the group's perception and opinion (Smith 1993). Groups help legislators interpret policies and proposals. This influence is certainly substantial, even if it can change over time (Smith 1984, 1993). We hope that our study of lobbying activity and federal research funding can get at this debate for this, albeit limited, policy area.

While much is unknown about the impact of lobbyists, scholars have made limited attempts to characterize instances where lobbyists do have a large amount of influence. Lobbyists will have more influence when legislators believe the expertise of the interest group exceeds their own (Rothenberg 1992). They will also have more influence when the group they represent is exclusive (Wright 1990), although large coalitions have also shown to have disproportionate influence (Fowler and Shaiko 1987). Lobbyists can also have more influence on

issues are of low salience to the general public, which federal research funding certainly is (Rothenberg 1992).

One of the first large scale studies of interest groups and policy was *The Hollow Core: Private Interests in National Policy Making*. The authors question how influential groups actually are in Washington. One of the key conclusions is that uncertainty is the key to understanding lobbyists. There is growing uncertainty as to the path that government will take, from the expanded significance of federal policies to increased committee power and the expansion of staffs. Groups now have multiple access points within Congress, but there is more competition for attention. Thus, the increase of groups in Washington is a result of more groups trying to minimize their uncertainty and advocate their desired state. However, groups do not know how much affect their work is having (Heinz et al. 1993). The authors found that unlike previously prevalent iron triangle arguments, where an interest group, legislator, and agency actor form a subgovernment controlling an issue area (Hayden 2002), there is no cohesive private elite consistently occupies a central, mediating position in the networks among representatives (Heinz et al. 1993).

By far the most influential book on lobbying of the 21st century has been *Lobbying and Policy Change: Who Wins, Who Loses, and Why*. The authors explain why lobbyists are far less successful than popular rhetoric would suggest (Baumgartner et al. 2009). However, massive opposition is also not something lobbyists are likely to encounter. Of the 98 issue areas studied, 17 percent had

only one side on the issue and 60 percent of issue areas had only two sides. Overall, 60 percent of the issue areas had no change from the status quo, 13 percent had modest change, and 27 percent of the cases experienced significant change. The status quo is a powerful impetus for change. Thus, once a university starts receiving appropriations, they are likely to continue to receive federal appropriations, making lobbyists' continued efforts an exercise in maintaining the status quo.

Dissertation approach

The literature presented in this dissertation presents inconsistent results on interest group formation, growth, and change, as well as an inconsistent discussion of the effects of lobbying. Not only is the literature looking at the growth of interest group populations and how these populations change over time inconsistent, the results are especially sparse. Thus, this dissertation contributes to the population ecology of interest groups literature by looking at a very unique set of interest groups. While previous political science research has attempted to look at how the federal budget is formed, this is the first attempt to determine the relationship between partisan control of key political institutions and federal research and development funding.

Scientists and scientific research are not discussed in depth in the traditional political science literature. This is unfortunate because scientific research affects all aspects of life in America, from national security to energy to the environment. Thus, the political activities of scientists are important to study. I

spend the majority of the dissertation examining the growth of science-related interest groups, how these groups change with external influences (specifically the amount of federal research and development expenditures), and the lobbying efforts of these groups. This contributes to political science knowledge by adding to the literature on the “population ecology approach to interest groups” based on population biodiversity concepts. I believe this second idea, of incorporating science and scientists in to the traditional political science literature, is especially important given the growing importance of science and technology in modern society.

Much scientific research and development is currently funded by the federal government. Accordingly, I believe it is also important to examine the macro political influences of increasing and decreasing science funding. Simple questions have not yet been addressed in the literature, let alone answered. Does political control of Congress affect R&D outlays? Does the party of the president matter? Does political control of Congress and the presidency matter for federal R&D funding from neutral, liberal, and conservative federal agencies. I address these questions at a very high macro level in order to frame the subsequent discussions in this dissertation of interest group growth and change.

This dissertation is the first attempt to bring scientists and scientific research in to the realm of interest group and lobbying research. Research on scientific organizations could provide future insight when thinking about the

implementation of wide ranges of policies, from national security to energy, in the United States.

Chapter Summaries

All of the chapters in this dissertation focus on federal research and development outlays or the ways that science-related interest groups have formed, changed, and act in relation to the political process. Chapter I examines how federal science funding has changed since the 1950s in relation to political control of the presidency, House, and Senate. I find that federal science funding increases with Democratic control of the House, Senate, and the presidency. This finding holds across seven agencies that all distribute science funding (Democratic control of Congress and the presidency increases federal R&D even from conservative federal agencies). Chapter II examines how the population of science-related interest groups has changed over time. I find that the number of groups increases over time and, more interestingly, increases as science funding increases. This supports the population ecology of interest groups literature, specifically, the energy, stability, area (ESA) theory developed by Gray and Lowery. This chapter is, specifically, models federal R&D funding as the “energy” aspect of this theory and provides a unique approach to this concept. Chapter III looks at how this interest group population changes over time. I find that as the number of groups increases, the population becomes more specialized. This specialization occurs with increased science funding as well. The results presented in this chapter also support the population ecology literature adapted to political science by Gray and Lowery. Chapter IV examines the lobbying activities of these groups since the Lobbying Disclosure Act of 1995 required

filing of lobbying expenses. I find that science-related groups have increased their lobbying activity over time as well as with increased federal science funding. However, while many of the results presented in this chapter have coefficients in the direction predicted by theory, the results are not statistically significant.

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CHAPTER I

SCIENCE AS A DEMOCRATIC INTEREST GROUP: THE FEDERAL SCIENCE BUDGET AND THE PARTY OF CONGRESS AND THE PRESIDENT

A version of this chapter is currently under review at *Review of Policy Research* as a single authored work.

The article is represented in the form in which it was submitted to the journal. The dissertation author conducted the entire data gathering and analysis, designed the figures and tables, and exclusively authored the paper.

Abstract

Science and technology play an increasingly important role in policy debates, from energy independence to national security. Because of its growing importance, it is necessary to examine science and research funding and how it changes over time. For years, it was assumed by the general public and elites that scientists are liberal Democrats, a perception that bears out in surveys of scientists. I evaluate this axiom by examining the federal science budget and how it has changed with party control of Congress and the party of the presidential administration. Examining the federal budget for science from 1951 until 2012, I find that federal funding *increases* when Democrats control Congress and the presidency, holding even when the funding more closely aligns with traditional Republican preferences, such as Department of Defense research. The relationship is less clear when expanded cross-nationally, with leftist control showing nearly negligible effects.

Published Work

Scientists, as a professional group, have long been perceived as a group of liberal Democrats. For example, their perceived support for policies such as combatting climate change closely mirrors the preferences of the Democratic Party. Moreover, for the last three elections, a high profile group of scientists – all of whom are Nobel Prize winners from physics, chemistry, and medicine – has issued letters supporting the Democratic presidential candidate. In 2012, 68 scientists signed the letter, claiming that Mitt Romney could “devastate a long tradition of support for public research and investment in science,” while President Obama would continue “America’s proud legacy of discovery and innovation,” ensuring progress on health, the economy, and the environment (Sarewitz 2013).

The idea that scientists lean Democratic and liberal is supported by surveys of the voting and ideological preferences of scientists. In a 2009 Pew Center survey, only 6 percent of scientists self-identified as Republicans, whereas 55 percent self-identified as Democrats and 32 percent self-identified as independents. Ideologically, scientists are far more likely than the general public to self-identify as liberal (52 verses 20 percent) or very liberal (14 verses 5 percent) (Kohut et al. 2009). As many scientists are reliant on government funding for their employment and/or to support their research, their support for Democrats, who typically advocate a larger role for government, is rational. Thus, we ask the question – is this support for Democrats *actually* rational given many

scientists' reliance on federal science funding? Given shared control over the federal budget, does federal science funding increase when Democrats control the presidency, House, or the Senate?

The United States has long been a world leader in research and development (R&D). The U.S. produces more research articles than any other country worldwide and has more top universities than any other country (World Bank 2013; THE 2013). With recent sequestration and continuing budget debates in an increasingly partisan federal government, the question of how federal science funding changes with partisan control of institutions is an important question – especially as the world faces increasingly technical challenges, from clean energy to national security. Science could offer important answers to these challenges, but progress is contingent upon funding. Some have claimed there is often a tension between the government and science regarding both politics and policy management (Lambright 2008; Bromley 2002), which is why understanding how science funding changing with partisan control of government is so important.

Data on federal science funding distributed to researchers at national labs, universities, and non-profits was compiled by the National Science Foundation (NSF). This data was reported as overall federal support for research and development (R&D), as well as parsed out as either basic or applied R&D funding. I use this data to examine whether science funding increases or decreases with Democratic control of the presidency, House, and Senate. The

data from the NSF is also divided in to overall, basic, and applied research as distributed by a variety of government agencies. Thus, I can examine if the amount of research money allotted to and then distributed by agencies changes with partisan control of the presidency, House, and Senate. This is interesting given that federal agencies range from conservative to liberal in their policies and workings.

There is also no reason for this phenomenon to be confined to the United States. Political parties can be classified on a left-right continuum based on their policies. I am especially interested in liberal (such as Social Democratic or other leftist parties) and conservative (such as Christian Democratic or other right parties) parties. Focusing on the OECD countries and using data from the World Bank of the percent of each nation's budget committed to research and development, I test the trends in the OECD countries. This data only considers the percent of the budget committed to overall R&D and is not parsed out in greater detail. However, it does allow us to see if the trends observed in the United States in regard to science funding and party are generalizable to the other OECD countries.

Party influence and the budget

Presidents have great power as unitary actors. This is especially true in terms of the budget. Presidents are given the opportunity to submit a first draft of the budget to Congress. Congress, of course, can change the details, but it rarely makes large scale changes to the president's budget. Much of the power of the

president in this regard derives from his status as a unitary actor. While the president rarely gets the last word on a policy issue such as the budget, he often gets to make the first move, shaping the landscape over which subsequent options range (Rudalevige 2010). Formulating his preferred budget is one way that the president can set forth an agenda and “big picture management” of his administration’s policies (Seidenfeld 1994). The president is the only elected official with a national constituency, and is thus in a unique position to influence policy, especially as it is carried out in the bureaucracy (Gleiber and Shull 1992; Hammond and Knott 1996).

I hypothesize that Democratic presidents are more likely than Republican presidents to support research with “benevolent” purposes, especially basic research, which offers less immediate applicable or profitable applications. While we know that the president wields influence over the budgetary process, we also know that Congress is very active in this process as well. Moreover, some scholars claim that congressional parties have gotten stronger over the previous decades as party voting has increased, the whip system has expanded, and rules regarding legislation have become more complex (Cox and McCubbins 1993). Parties have also become more polarized, leading to the idea that party could influence the budget in greater and greater ways (Lebo et al. 2007; Lowry and Shipan 2002; McCarty et al. 2006; Sinclair 2006; Roberts and Smith 2003).

Party is very influential in determining legislative voting behavior. But what exactly do we mean by “party influence” in this context? Legislators face

pressure from party leaders in the form of rewards and punishments tied to their votes (Snyder and Groseclose 2000). The member's vote is compared to the party position – a center of gravity that reflects a party's overall stance on a given issue (Krehbiel 2000). Rewards include favorable committee assignments, leadership positions, campaign funds, federal projects to the member's district, and expedited treatment for favored bills. Punishments may include dismissal from committees, roadblocks for bills, and decreasing federal funds for the district (Snyder and Groseclose 2000). Keeping members in line is important for parties because party labels serve as “brand names” and information shortcuts for voters. By keeping a consistent voting record on most issues, voters have more concrete ideas about what the parties represent (Cox and McCubbins 1993; Romer and Snyder 1994). There are also electoral consequences for legislators to cooperate as a party – parties wish to maximize legislative victories while minimizing electoral consequences of overpartisanship (Lebo et al. 2007).

There has also been scholarly work on the question of when parties matter. Political party affiliation is one of the best predictors of legislative voting behavior (Snyder and Groseclose 2000). According to Snyder and Groseclose, party influence appears most frequently on votes involving budgets, Social Security, social welfare policy, and the debt limit (2000). Federal spending is, perhaps, the most important indicator of policy preferences because it indicates to the electorate what groups they favor and represent (Kiewiet and McCubbins 1991). These types of votes set spending priorities, which supports the idea that

political party influence is important for federal outlays related to scientific research. Even scholars supporting a weak view of parties have noted that parties in the United States play an important, though not unlimited, role in federal outlays (Levitt and Snyder 1995).

In what follows, I offer basic three hypotheses to start the discussion:

Hypothesis 1: Democratic control of the presidency, House, and Senate lead to increased overall federal science funding.

Hypothesis 2: Democratic control of the presidency, House, and Senate lead to increased basic federal science funding.

Hypothesis 3: Democratic control of the presidency, House, and Senate lead to increased applied federal science funding.

In addition to setting aside part of the overall budget for scientific research, money must be allotted to individual agencies for distribution to scientists nationwide. Data from the NSF also breaks down research funding by agency in all three categories – overall funding, basic research funding, and applied research funding. I examine a variety of these agencies to determine if a more nuanced approach would be appropriate for a relationship between political party control and science funding. I look at overall, basic, and applied research funding for a variety of agencies. Specifically I examine (1) The Department of Agriculture, which typifies a politically neutral department; (2) The Department of Commerce and The Department of Defense, which are conservative; and (3) The Department of Energy, The Department of Education, the Environmental Protection Agency, and The National Science Foundation, all of which skew liberal (Clinton and Lewis 2008). Clinton and Lewis measure each of these

agencies' preferences based upon an expert survey and categorize them on the political spectrum. I have used the same scale in this study.

Hypothesis 4: Neutral agency funding will see small, if any, changes in science funding levels with Democratic administration.

Hypothesis 5: Conservative agencies will see lower levels of overall, basic, and applied research funding under Democratic control of Congress and the presidency than they will under Republican control of Congress and the presidency.

Hypothesis 6: Liberal agencies will see higher levels of overall, basic, and applied research funding under Democratic control of Congress and the presidency than they will under Republican control of Congress and the presidency.

Party control also matters outside the U.S. (Schmidt 1996). Schmidt, in fact, suggests that party composition of government should be featured more prominently in research (1996). This leads to my interest in party composition and science funding in a comparative context. While reliable data here is more limited (the World Bank provides data on scientific R&D funding as a percent of the overall budget), it should be of interest as a start to examining the role of science funding in a broader context.

According to the hypothesis of partisan influence, a major determinant of variations in policy choices across nations is the party composition of government (Hibbs Jr 1992). This has been shown especially often in empirical research on economic and social policy (Cameron 1978; Castles 1982; Alesina and Rosenthal 1995). Partisan theory rests on the assumption that politics serves as a marketplace of policies and ideas and the outcomes (i.e., policies) are based on institutional differences between countries. Differences between parties

matter for policy, which is why I include a comparative element in this work.

Leftist parties, for example, are more likely to spend more money on social policy, equality, and employment (Tufté 1980). Thus, for science funding, I expect to see similar relationships as we saw in the United States.

Hypothesis 7: As the percent of leftist control of government increases, the percentage of the budget devoted to research will increase.

Data and methods

Data on research and development funding comes from the National Science Foundation's 2012 Science and Engineering Indicators (NSF 2012). The National Center for Science and Engineering Statistics (a division of the National Science Foundation) maintains a database of current and historic federal funds for science and technology research.

Dependent variables

The overall federal funding data is provided from 1951-2012 in millions of dollars, as well as percent of the overall budget. For basic research, funding data is provided from 1952 onward and for applied data, 1956 onward. All of the funding data are in constant 2012 U.S. dollars according to the consumer price index (CPI) provided by the Bureau of Labor Statistics and is the valued used in these analyses.

Relying on the data from the NSF, I construct the following dependent variables: *Total R&D funding*, *Basic R&D funding*, and *Applied R&D funding*. Each of these dependent variables is a funding number corrected to constant

2012 U.S. dollars using Consumer Price Index data from the Bureau of Labor Statistics. Total R&D funding provides a value from 1951 to 2012. During this time period, the lowest value of funding observed was \$13,435,902,693 and the highest value observed was \$150,992,598,571. Values for basic R&D funding are included from 1952 to 2012 with a range of \$990,352,438 to \$35,180,274,854. Applied R&D funding is given from 1956 to 2012 and ranges from \$5,410,566,448 to \$33,622,282,819.

The dataset also contains information on the amount of federal research funding allotted to specific agencies annually for overall, basic, and applied research funding. For this study, I examine the overall, basic, and applied research funding for the following agencies: Department of Agriculture, Department of Commerce, Department of Defense, Department of Education, Department of Energy, Environmental Protection Agency, and National Science Foundation. These agencies were chosen because they all provide substantial R&D funding for both basic and applied research. These agencies were among those ranked by Clinton and Lewis and placed on the liberal-neutral-conservative ideological scale.

The data from the National Science Foundation allowed me to construct the following dependent variables relating to R&D funding from various agencies: *Overall Agriculture R&D funding, Overall Commerce R&D funding, Overall Defense R&D funding, Overall Education R&D funding, Overall Energy R&D funding, Overall EPA R&D funding, Overall NSF R&D funding, Basic Agriculture*

R&D funding, Basic Commerce R&D funding, Basic Defense R&D funding, Basic Education R&D funding, Basic Energy R&D funding, Basic EPA R&D funding, Basic NSF R&D funding, Applied Agriculture R&D funding, Applied Commerce R&D funding, Applied Defense R&D funding, Applied Education R&D funding, Applied Energy R&D funding, Applied EPA R&D funding, and Applied NSF R&D funding. These were used in a variety of tests to determine if partisan control of political institutions affected the amount of R&D funds available to various agencies.

Cross-national data on research and development funding as a percent of GDP was gathered from the World Bank (World Bank 2013). This allowed me to create the comparative political party dependent variable: *Percent R&D of GDP*. On this variable, I was able to collect data from all of the OECD countries from 1996 to 2010. These percentages ranged from 0.4562 percent in Greece in 1996 to a high of 4.13 percent in Sweden in 2001. The average value for this time period was 1.98 percent with a standard deviation of 0.8 percent. The countries included in this analysis were Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

Independent variables

The independent variables of interest are *Party of the President*, *Party controlling the House*, and *Party controlling the Senate*. Each is a dichotomous

variable, with “1” indicating Democratic Party control, and “0” indicating Republican control.

I also believed it was important to account for outside factors and I chose to focus on two specific events in recent U.S. history. I first included a control variable for whether or not the United States was involved in the Cold War. There was increased spending on research during Cold War in an attempt to overpower and out-militarize the Soviet Union (Bartels 1994). The Cold War defined American science. During the decade after World War II, the Department of Defense was the single largest patron of American science. While their share of R&D decreased steadily over the next two decades, this was reflected in the growth of the National Science Foundation, the National Aeronautics and Space Administration, and the National Institutes of Health (Leslie 1993). Thus, each year until 1990 was given a value of “1” on the variable Cold War, and a “0” otherwise.

It is also likely that recessions lead to less science funding, regardless of political party power. While much of the work in this area focuses on private R&D during recessions (Brockhoff 1998), it has been suggested that the government also will decrease R&D funding during recessions (Noll 2003). Thus, I create a second dichotomous control variable called *Recession*, which is assigned a value of “1” during recession years identified by the National Bureau of Economic Research (NBER 2013). Because my forthcoming analysis is a time series analysis, I take in to account that the occurrence of a recession may lag behind

actual allocation of R&D funding. During the statistical analysis, I consider up to a three year lag. However, all of the lags did not show significance and we close to zero. Thus, in the later analyses, I only present the results for whether or not the U.S. was in a recession the year in question.

Data on parties in parliament cross-nationally was gathered from the Comparative Manifestos Project, which classified each party as one of the following: ecological, communist, social democratic, liberal, Christian democratic, conservative, nationalist, agrarian, ethnic and regional, or special issue (Volkens et al. 2011). While percent of party vote was available, I opted to use percent that each party represented in parliament because, while popular support for parties is important, public opinion is unlikely to greatly sway R&D funding decisions. Thus, the percent of parliament controlled by social democratic parties is determined to be the most appropriate variable. The left-right measure of party composition in government that I am including in this study is the one most often cited in the literature and will also be used in this study (Schmidt 1996). I focus on the OECD countries because they have the highest levels of support for research and development (the countries included are listed in the dependent variables section). They are also the most likely to have fair and free elections with transparent budget processes. Thus, I created the following independent variables: *Percent Social Democrats in Parliament*, *Percent Conservatives in Parliament*, and *Percent Researchers in population*.

Methods

The data was constructed as time series. For each year, a dependent variable reflecting the R&D funding value in question is paired with the independent variables of interest as well as several control variables. This created a time series dataset. As such, all data analyses were performed in Stata using time series analysis. Several analyses suggested the data contained a great deal of serial correlation (as expected by the nature of the data). The Breush-Godfrey test, which tests for the presence of serial dependence and for autocorrelation in the errors of a regression model, was insignificant. The Durbin-Watson test, which is less general, tests for the presence of autocorrelation in the residuals and was significant, indicates relatively high levels of autocorrelation. This is intuitive – federal funding values do change annually, but administration are likely to use the previous year's budget as a starting point for the next budget. As such, the primary analysis tool is the Cochrane-Orcutt regression, a generalized least-squared method used in linear regression models where the errors are first-order serially correlated. This helps adjust a linear model to address the serial correlation.

Results and discussion

The results presented in this section follow our broadly defined hypotheses. In short, it appears that Democratic control of political institutions results in increased federal funding for scientific research and development.

Overall trends in federal research funding in the USA

We start by examining the overall trends present in research funding in the USA. Table 1 describes science funding, parsed out simply as overall funding, basic research funding, and applied research funding, in relation to political party control.

When examining overall research funding, the only significant variable is *Cold War*. This largely fits with what we know— that during the Cold War the United States continually sought to make the military (and especially the nuclear program) stronger, faster, sleeker, and more efficient. This required a large input of research funding. For both basic and applied research funding, variables signifying Democratic control of the presidency and the Senate are significant and positive. That is, Democratic control of these institutions is associated with more funding. Thus, the narrative in the media and popular culture of scientists as liberal Democrats seems to be rational. The data suggests that one reason scientists vote Democratic is because, amongst other things, funding that supports their livelihood largely increases during Democratic control of institutions, even after accounting for economic conditions. Examining both basic and applied research separately will allow me to analyze different research objectives. Basic research often supports more fundamental scientific research that rarely has immediate (or long-term) market potential. The idea that Democrats support science for the sake of knowledge is one that aligns well with the common perceptions of a Democratic party supportive of education and

Table 1. Three dependent variables (overall research funding, basic research funding, and applied research funding) and their relation to political party control.

Variable	Total R&D	Basic R&D	Applied R&D
Presidential party (0/1)	3,023 (2,196)	794* (448)	891* (589)
Party controlling House (0/1)	2,786 (2,931)	28.6 (600)	699 (894)
Party controlling the Senate (0/1)	1,084 (2,371)	984** (484)	1,248** (642)
Recession (0/1)	-1,377 (1,504)	72.7 (307)	-431 (418)
Cold War (0/1)	9,015* (5,712)	-209 (1,186)	-1,693 (1,473)
Constant	129,292*** (16,035)	49,302*** (10,550)	26,775*** (3,454)
R ²	0.1428	0.1751	0.1863
Number of Observations	61	60	56

Source: National Science Foundation

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

knowledge. The similar result in support of applied research is interesting in that applied research often has more market potential (though still, likely, not immediate). This suggests the importance Democrats may place on science funding when developing the budget and supports Hypothesis 1.

Overall federal science funding by agency in the USA

In this section, I examine the research and development budgets of seven agencies. These agencies were chosen because they distribute science funding (although to varying amounts) and, broadly, trend on the political spectrum. Agriculture is my “neutral” agency, Commerce and Defense trend conservative, and Education, Energy, EPA, and NSF trend liberal. In Table 2, the dependent variable is the overall (basic, applied, and development) funding that each agency distributes. The model contains the same independent variables I used in the first model.

Here, we find there are fewer statistically significant estimates. But the significant results that do exist support the idea that Democratic control is associated with higher levels of science funding, regardless of the nature of the agency in question. The designated neutral agency gets more funding under Democratic control of the Senate, but not much more--only a 2.6 percent increase above the constant. Interestingly, the conservative Defense Department also saw an increase when Democrats controlled the House, although this is a higher percentage increase above the constant at 4.3 percent. The largest increase in Defense science funding comes during the Cold War period.

Table 2. Overall research funding and its relation to political controls by agency.

Variable	Agriculture	Commerce	Defense	Education	Energy	EPA	NSF
Presidential party (0/1)	2.85 (37.4)	63.591 (47.248)	747 (1,470)	-25.9 (33.2)	743 (312)	73.2 (52.0)	259** (153)
Party controlling House (0/1)	-30.7 (49.9)	-15.439 (63.123)	3,127* (1,964)	2.02 (45.3)	279 (414)	10.1 (65.9)	-148 (205)
Party controlling the Senate (0/1)	63.2* (40.4)	-48.059 (51.030)	-513 (1,588)	36.9 (33.1)	82.1 (337)	-19.3 (48.4)	272* (165)
Recession (0/1)	-26.8 (25.6)	-26.944 (32.344)	-498 (1,006)	-25.8 (26.1)	-24.1 (215)	-18.2 (48.9)	81.8 (105)
Cold War (0/1)	-128 (96.7)	-37.768 (123)	11,777*** (3,845)	17.0 (69.8)	-14.3 (771)	25.1 (100)	6.53 (404)
Constant	2,389*** (232)	1,351*** (436)	73,263*** (13,094)	351*** (82.1)	9,441*** (1,127)	655*** (102)	5,998*** (2,166)
R ²	0.0938	0.0718	0.1921	0.0527	0.1340	0.0781	0.1169
Number of Observations	61	61	61	45	61	36	61

Source: National Science Foundation

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

This fits in with the results presented in Table 1, where overall research funding increased during this time period, mostly through Defense Department research. Lastly, the more liberal NSF saw an increase in funding under Democratic control of the presidency (4.3 percent above the constant), and Democratic control of the Senate (4.5 percent). It is interesting to note that conservative and liberal agencies saw larger increases than the more neutral Agriculture Department.

These results support Hypothesis 4 in that the neutral agency (Agriculture) saw small changes based on party control of various political institutions. It is not supportive of Hypothesis 5, as conservative agencies still saw increases in science funding under Democratic administrations. And it is supportive of Hypothesis 6, as liberal agencies saw increases under Democratic Party control. Earlier, I showed that both basic and applied research increased under Democratic Party control. Next, I test to see if this relationship still holds when funding is parsed out by agency.

Basic research funding by agency

Basic research funding, attempting to address more fundamental questions of science, is distributed by a variety of agencies. Table 3 shows the results of my analysis of basic research funding for different agencies. Many of the findings confirm and support my previous findings. Despite the conservative or liberal leanings of an agency, funding levels tend to increase with Democratic control. This is statistically significant for Commerce when

Table 3. Basic research funding and its relation to political controls by agency.

Variable	Agriculture	Commerce	Defense	Education	Energy	EPA	NSF
Presidential party (0/1)	1.68 (20.5)	0.350 (7.81)	-72.9 (71.1)	4.43 (5.36)	155** (68.4)	-14.6 (10.0)	265* (173)
Party controlling House (0/1)	-23.2 (27.4)	16.568* (10.4)	-82.5 (94.2)	4.09 (7.16)	25.9 (91.6)	10.7 (12.8)	-179 (230)
Party controlling the Senate (0/1)	30.6 (22.2)	1.56 (8.44)	250*** (76.8)	-1.49 (5.30)	128* (73.9)	4.83 (9.46)	275 (186)
Recession (0/1)	-11.6 (14.1)	-1.34 (5.35)	43.7 (49.1)	3.53 (4.43)	17.2 (46.7)	5.11 (7.95)	80.5 (118)
Cold War (0/1)	-22.5 (53.2)	-2.81 (20.4)	-39.6 (170)	15.8* (8.41)	-148 (181)	-42.8** (17.0)	-81.3 (446)
Constant	1,038*** (132)	135** (61.0)	1,705*** (213)	6.95 (7.22)	6,653*** (1,720)	101*** (15.2)	3,605*** (1,046)
R ²	0.0536	0.0656	0.188	0.1380	0.2025	0.2039	0.0984
Number of Observations	60	60	60	60	60	60	60

Source: National Science Foundation

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

Democrats control the House, Defense when Democrats control the Senate, Energy when Democrats control the Senate and the presidency, and for the NSF when Democrats control the presidency. We see here that the Cold War has a statistically significant effect for both Education funding as well as the EPA. It is most interesting that funding for the EPA decreases during the Cold War. This is not entirely surprising, as Cold War research focused on nuclear issues rather than environmental concerns.

Once again, we find some support for Hypothesis 4 (the neutral committee shows small, statistically insignificant increases), no support for Hypothesis 5 (conservative agencies saw increases under Democratic Party control), and support for Hypothesis 6 (liberal agencies saw increases under Democratic Party control). The next section repeats this analysis again, but examines applied research funding levels.

Applied research funding by agency

In this section, we repeat the above analysis on the applied research funding data. If anything, I expect this to be the category of funding data least likely to increase under Democratic Party control.

Table 4 is unique in that it displays several negative coefficients. Interestingly, however, the political estimates are seldom significant. In other words, even when as funding decreases during times of recession or the Cold War, applied science funding is higher under Democratic Party control than under Republican Party control. The only statistically significant estimate we see

Table 4. Applied research funding and its relation to political controls by agency.

Variable	Agriculture	Commerce	Defense	Education	Energy	EPA	NSF
Presidential party (0/1)	-9.53 (26.1)	468 (418)	78.9 (249)	-16.0 (18.8)	-41.5 (109)	79.7** (34.2)	11.8 (26.9)
Party controlling House (0/1)	-15.1 (35.5)	-630 (637)	351 (340)	-4.75 (25.3)	183 (151)	-3.54 (43.6)	15.9 (37.2)
Party controlling the Senate (0/1)	29.3 (26.1)	-551 (452)	197 (248)	18.8 (18.5)	22.6 (108)	-13.6 (32.1)	4.51 (26.8)
Recession (0/1)	-10.8 (50.5)	3.43 (481)	-18.2 (196)	-43.4** (16.7)	-151* (84.8)	8.77 (26.5)	17.9 (21.0)
Cold War (0/1)	-86.4** (50.5)	-251 (529)	-148 (513)	-55.7** (25.5)	-790** (247)	30.6 (63.2)	-5.95 (60.7)
Constant	1,137*** (51.2)	1,683*** (434)	4,559*** (584)	224*** (21.0)	3,308*** (540)	438*** (62.5)	367*** (116)
R ²	0.0988	0.2131	0.0556	0.2764	0.2533	0.1341	0.0302
Number of Observations	48	48	48	48	48	30	48

Source: National Science Foundation

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

is on *Presidential party* in the EPA model. Overall, Table 4 provides little support for Hypotheses 4, 5, or 6.

Comparative science funding and leftist control of government

This final section examines science funding in a comparative context. The data from the World Bank is much cruder than the extensive, detailed data collected from the National Science Foundation. However, I was able to put the results presented above from the United States in some kind of perspective by comparing them to science funding in a cross-national context. Here, I focus on the percent of GDP that OECD countries devote to scientific research (the variable most related to the previous dependent variables of interest) by year. I limited my analysis to OECD countries because they are most likely to have free and fair elections that reflect the population and, largely, have party competition.

Table 5 shows that as leftist presence in government increases, there is a decrease in the percent of the budget devoted to scientific R&D. However, this decrease is very, very small. When one adds a variable for the number of scientific researchers in a population, the statistical significance of party control disappears (although the coefficient is still in the same direction). One of the problems here may be the time aspect. Here, my analysis only covers from 1996-2010, while data from the United States covers 1951-2012. However, overall these results suggest that in a cross-national context political control has little or no effect on budgets. Perhaps this is a result of vastly different budgeting systems across countries, especially as compared to the United States.

Table 5. Political control of governments as it relates to the percent of GDP devoted to research and development (R&D).

Variable	%GDP to R&D	%GDP to R&D
% Social Democrats in Parliament	-5.58e ⁻³ ** (2.52e ⁻³)	-2.24e ⁻⁴ (1.81e ⁻³)
% Conservatives in Parliament	-1.70e ⁻³ (2.74e ⁻³)	-8.81e ⁻⁴ (1.93e ⁻³)
% Researchers in population		2.57e ⁻⁴ *** (1.60e ⁻⁵)
Constant	2.23*** (0.237)	1.09*** (0.181)
R ²	0.1019	0.6065
Number of Observations	280	280

Source: World Bank, Comparative Manifestos Project

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

Commentary on the results

A cursory observation of the results presented in this chapter would reveal a lack of consistency across models and across analyses. In some models, Democratic control of an institution is statistically significant while it is not in others. In some models, control of the House is statistically significant while Senate and the presidency are not. Some models show statistical significance for the Cold War and not others. Or there could be some combinations of variables that are statistically significant.

Even though results aren't strictly statistically significant across all models, there is enough consistency to draw general conclusions. Largely, Democratic control leads to increased federal R&D funding. Even when the coefficients aren't statistically significant, they typically are in right direction to support our theory and hypotheses.

It is also important to note that the largest R^2 value we see across the models is 0.27. The R^2 value is a measure of how well the regression fits the actual data. That is, how much of the variation in the data is actually explained by our model. This means that in the model with the 0.27 R^2 model, 27 percent of the variance in the data is explained by the variables in our model. While this may seem like a low value, it has been suggested that the eternal quest for the largest R^2 possible in political science is actually a misleading venture. The authors suggest that it should rather be used to compare coefficients from models using the same data and methods. Thus, it can be used to determine the

most ideal set of variables that creates a model that most thoroughly supports your theory (King 1986).

A large reason that the R^2 is relatively low in disciplines like political science as compared to chemistry or physics is the presence of a political opportunity structure. The concept was originally introduced by Tarrow and has four aspects to the concept: 1) the openness or closure of political access; 2) the degree of stability or instability of political alliances; 3) the availability of strategic partnerships; and 4) political conflicts within and among elites. This concept addresses the configuration of power within the political structure (Tarrow 1983). Scholars have attempted to address and account for the political opportunity structure. These studies and models that address this issue typically make the model more complex and intricate by addressing State institutions and other formal institutional structures (Kriesi 1995). The political opportunity structure has also been addressed by comparative cross-national studies of similar policies across a variety of political structures (Kitschelt 1986). However, this study attempts to provide a clear, concise, and simple model of the relationship between federal R&D funding and Democratic control of political institutions. However, I believe that the fact that the models presented in this paper account for up to 27 percent of the variance in the data, without taking in to account the complex political structures present that could be represented by dozens, or even hundreds, of variables is, in this case, superior to the potentially complex formulation. I presented a simple model that provides information that addresses

when we see increases in federal R&D funding as it relates to partisan control of political institutions.

Scientists as an organized interest

The term “interest group” is often tinged with negative connotations and can invoke images of lobbyists taking legislators on lavish vacations or engaging in bribery. Many scholars are now moving to the term “organized interest” as a way to discuss these groups without these negative impressions (Baumgartner and Leech 1998). There is an image in the media and in society that paints scientists as liberal Democrats. Part of this likely comes from the association of scientists with institutes of higher education. Moreover, most scientists have advanced degrees, and universities have a reputation as bastions of liberalism in American. Scientists support policies designed to combat global warming, which is a liberal policy stance. They also work in areas including sustainability and environmental chemistry, which also trend liberal. But interest groups do not work as a one way street. If scientists lend support for Democratic policy stances and preferences, they should receive something in return.

And I do indeed find that scientists get something in return for their liberalness. When Democrats control key political institutions that affect the budget, outlays for scientific research increase. And they increase across time and across a variety of agencies. This occurs, largely, without formal, large scale lobbying efforts. Formal lobbying by science-related interest groups and is a topic that will be covered in depth in future work.

This paper suggests that future research could probe the relationship between increases in federal R&D funding under Democratic administrations and the overwhelming support among scientists for the Democratic Party. Do scientists vote Democratic because they support research? Do Democrats increase funding because scientists support them? Or is this a natural alignment of interests across the spectrum? Scientists, overall, are liberal, and science funding, which benefits all scientists, increases when Democrats control political institutions. This is not to say that formal interest groups, such as trade and professional associations, do not engage in formal lobbying. The author of this paper participated in several fly-in congressional lobbying days on behalf of the American Chemical Society. There, we talked with members of Congress and their staff about the importance of new appropriations for science funding and how it contributes to the vitality of the nation.

Conclusion

The federal government has a long history of involvement in science and scientific research. While American scientists began to form alliances with the federal government prior to World War II, it was during the war that the relationship grew most rapidly. The war showed the federal government how valuable science is in innovation. Science and engineering research, basic and applied, has been funded substantially by the federal government since then (Lane 2008).

Scientists have often been characterized as a liberal leaning group that supports Democrats and Democratic initiatives, leading them to be characterized as a Democratic organized interest or interest group. Surveys have shown that scientists overwhelmingly self-identify as liberal and vote Democratic. I have shown in this paper that scientific research and development increases when Democrats control the key political institutions of the House, Senate, and presidency. This support given to scientists as a whole supports the idea of considering scientists as an interest group.

The likely mechanism here is that Democrats are more likely to draft budgets will larger support for areas that play a major role or are supported by their party platform. Scientific research, especially basic research, is likely to be viewed as a public good for society and, thus, something to be supported by the federal government. Because scientists largely support Democrats and identify as liberal, Democratic lawmakers do not feel any conflict when suggesting budgets with large scientific research components. While some science-related interest groups do engage in formal lobbying, I do not think it will be a huge contributor to the increase in research funding we see under Democratic administrations. However, the role of science interest groups, including their formation and lobbying efforts, will be described in detail in future work.

One area of future work is to continue exploring science funding in a comparative aspect. What characteristics of different countries make them more or less likely to support science funding? This could be parsed out as basic and

applied research. It would also be interesting to study international collaboration. The United States spends more money on research than any other country, but many countries are collaborating and sharing resources, especially on large undertakings. The Large Hadron Collider at CERN (European Organization for Nuclear Research) is supported by 21 member states (CERN 2013). Science will continue to get “bigger” with costs of experiments, especially those that address the fundamental nature of our universe, rising steeply in cost. In a time of budget cuts and talks of austerity, international collaborations will become vital to the continuation of science, especially at the fundamental level.

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CHAPTER II

THE POPULATION ECOLOGY OF SCIENCE-RELATED INTEREST GROUPS AND FEDERAL SCIENCE FUNDING

A version of this chapter is currently under review at *Policy Studies Journal* as a single authored work.

The article is represented in the form in which it was submitted to the journal. The dissertation author conducted the entire data gathering and analysis, designed the figures and tables, and exclusively authored the paper.

Abstract

Since the government began funding research and development in the United States, science-related interest groups, specifically trade or professional associations focused on chemicals, biology, botany, chemistry, computer science, energy, geology, physics, or general science, have formed for a variety of reasons. In this paper, we explore how the growth of science-related interest groups is related to the increase in federal funding for science and how our findings conform to popular theories of interest group formation.

Specifically, we test Gray and Lowery's ESA theory to see if there is something inherently unique about science-related groups as compared to more traditional types of organized interests. Primarily, the concepts of population ecology will be used to examine the relationship between federal science funding and science group formation. The concepts are supported empirically for science-related interest groups. The population of science-related interest groups follows the same general trend that has been found for a variety of other populations over time, starting with lower overall numbers of groups and growing

over time. More interestingly, however, is the result that group formation also responds to changes in federal science funding. Specifically, we find that as federal research and development funding increases, so does group density. Statistical results indicate that each additional \$5.8 billion in research and development funding leads to the creation of one new science-related interest group. As federal funding increases, more groups will form to organize members and advocate for issues such as additional funding. This external stimulus provides motivation for group founders to organize.

Published Work

While priorities in the federal budget have changed over the decades, the scope of federal research funding has largely remained unchanged since the 1970s, as illustrated in Figure 1 (Drake 2002). In short, the government has steadily increased the amount of money it contributes to research and development since the late 1960s. Scholars have suggested that interest group populations are shaped by the environment in which they exist, suggesting that interest groups are simply responding to the system they are in rather than attempting to shape it. Are they right? This is the question we address here by examining science-related interest groups—trade or professional associations focused on chemicals, biology, botany, chemistry, computer science, energy, geology, physics, or general science. Previous work has shown that interest groups can be influential across a wide range of policy issues when looking at

federal discretionary funding (Lowry and Potoski 2004), so the growth of science-related interest groups and federal R&D is ripe for inquiry.

Government-funded science

Since the Manhattan Project, the government has steadily increased the amount of science research it funds, especially basic research. In fact, federal funds pay for approximately one-third of all research and development (R&D) in the United States. Roughly half of this research is related to defense or health (Blasgen 2002). In all, the U.S. spends more money on “R&D” than any other nation on earth. As a result, four of the five top science journals in the world are produced in the U.S., and as of 1997, 95 percent of journal articles cited by other articles were published in English (up from 83 percent in 1977) (Maratos-Flier 2002). Figure 1 illustrates the increase in federal research funds between 1958 and 2009 (in constant 2009 dollars), as well as the percentage of the overall federal budget dedicated to research. Federal research funding has helped lead to American research dominance.

The government levels of research funding are at an all-time high level, which is occurring as more and more policy decisions involve science and scientific research. These policy issues range from national security to public health. Individual scientists may not realize that work is so necessary and relevant, but organizations have noted this importance for years. More and more science-related interest groups have emerged since the 1960s, and many hire

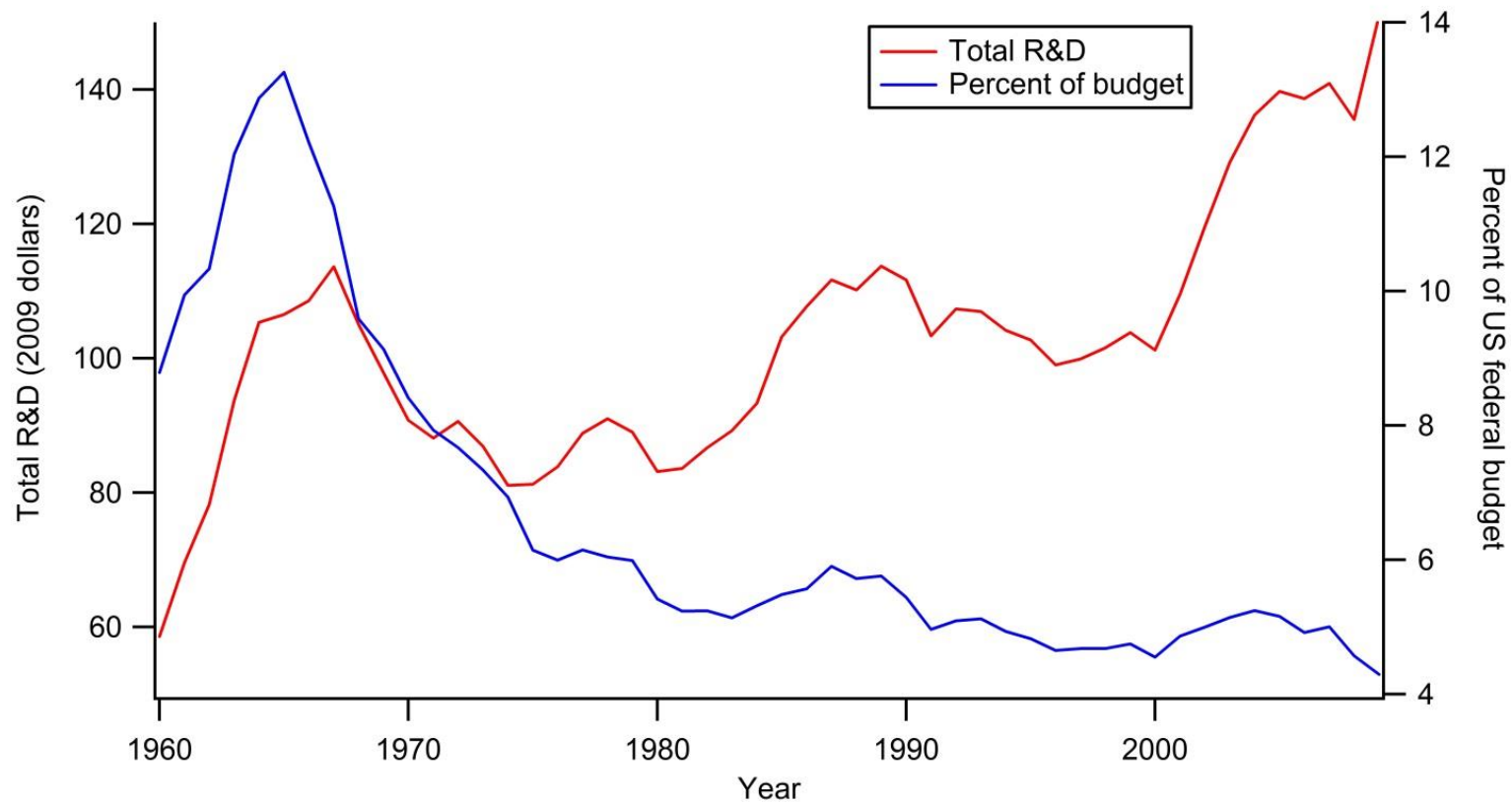


Figure 1. Overall U.S. funding for research and development and federal R&D funding as a percent of the overall budget (funding values are in constant 2009 dollars using the consumer price indexes from the Bureau of Labor Statistics).

full-time, in-house lobbyists. Indeed, the American Physical Society (the professional association for physicists in the United States) offers an entire section of their website towards advocacy tools for their members (APS 2013). Here, members can read on the activities of the lobbyists and see what bills and policies they are advocating for, write their member of congress, or volunteer to fly to Washington, D.C. to spend a day speaking with members of Congress and their staffers themselves. Because most physicists rely in federal science funding, many of their lobbying efforts include increasing funding levels or, more recently, keeping them consistent at the current levels.

Scientists often face a series lack of time. Scientists have to find research grants, write grants, author articles, provide peer reviews, and then, if they have time, perform actual research. Studying policy propositions is often not high on their priority list. However, interest groups, especially trade and professional associations, have stepped up to fill that gap. By hiring lobbyists to focus on these issues full-time, trade and professional groups allow scientists to work and spend less time considering the political and ideological aspects of their work. Because of the importance of science in the world today, it is important to study science-related organizations separately from other interest groups. In this paper, I specifically examine how these organizations have formed over time. More interestingly, however, I examine how these groups in relation to federal science funding. Federal science funding provides one source of motivation for groups to form – in order to advocate for continuing and increased federal science funding.

Interest group theory

Early interest group theorists, mainly subscribing to the pluralist schools, assumed that because humans are social creatures, people would band together and create groups to protect their shared interests. These groups, so goes the pluralist argument, then articulate their demands to the government, adding to political stability (Truman 1951). Early group theory rested on the pluralist assumption that the best political outcome would result from group conflict and compromise, with the government acting as mediator (Baumgartner and Leech 1998). However, interest group research quickly evolved as scholars recognized that the pluralist assumptions of equal representation was untrue, with the wealthy and well-connected having far greater group representation in Washington (Schattschneider 1960). Interest groups, still, can act as a transmission belt for preferences between the general public and decision makers (Rasmussen et al. 2014). The interest group literature is broad and interesting, and includes contributions from not only political scientists, but also economists and sociologists. The literature review here focuses on the concepts of population ecology at work in this paper, but broad literatures reviewing a range of theories are readily available (Baumgartner and Leech 1998; Mitchell and Munger 1991).

Population ecology theories of interest groups

The study of interest group populations has benefited greatly from population theories of biodiversity. Because we rely upon population ecology

theories here, we will say a little more about them. In biology, the diversity of populations is shaped by the environment. Babies are important only in the sense that they provide members for the population. The most important thing to shaping any population, whether it be wildflowers in Colorado or bears in East Tennessee, is the environment in which they enter, live, and survive. It matters how many bears are already living in the area and how much food is available to consume. It is the environment that shapes the bear population, not the bears themselves.

In the interest group analogy, new groups add to the overall population, but the characteristics of said population are shaped by the environment. Thus, we can begin to think about interest group populations. New interest groups are only part of the story for interest group populations – the external environment in which the population is situated is important as well. Formation and mobilization of groups matter (if the bear population is already near its maximum possible, several dozen additional bears will change things), but are only part of the story (Lowery and Gray 1995). The environment into which a group enters affects not only the group, but the potential influence the group can have on politics (Gray and Lowery 2000; Gray and Lowery 2001). Outside rules and regulations seem to have little influence on the groups that enter the population when compared to the influence of the environment (Lowery and Gray 1997; Gray and Lowery 1998; Brasher et al. 1999). Regional effects are also found to have little influence (Gray

and Lowery 1998a). This theory has previously been used to study interest group populations in both an American and comparative context (Lowery et al. 2008b).

Gray and Lowery used the general population ecology paradigm to explain overall numbers of groups in the states. Their theory asserts that interest group density is a function of potential constituents, potential government goods and services, stability of the political system, government age, and government size. Gray and Lowery use the energy, stability, area (ESA) theory of biodiversity to account for interest group populations. Interest group energy is defined as reflecting the resources available to lobbyists, including constituent interests and interest certainty (Lowery and Gray 1995). Stability is viewed via Olson's hypothesis about the relationship between the interest group system age and the group density (Olson 1982). Finally, area is analogous to the number of potential constituents (Lowery and Gray 1995). Potential membership available to organizations is strongly related to the size of the interest community (Gray and Lowery 1997). Thus, the population ecology theory considers responses to environmental constraints very important to population formation (Lowery and Gray 1995).

In our study, we focus on the energy component of this theory. I specifically examine the resource that is the federal science research budget. Each science-related interest group is interested in gaining additional resources (budgetary allotments for their specific field of research) for its members. Groups engage in many activities, including holding conferences and publishing journals,

but attaining research funds for members is important. Without funding, scholars have more trouble carrying out their research, which threatens the membership, and thus the existence of the group. Our motivation for examining a variety of science-related groups lies in the concept of population. In theory, a chemistry group has little reason for direct competition with physics groups.

Groups, like species, compete for resources within an environment (MacIntosh 1992). Thus, species will tend to divide into differing niches to lessen their competition for resources (Colinvaux 1978). There is competition among interest groups for both potential members and the deliverance of goods to meet their demands (Lowery and Gray 1995; Haider-Markel 1997). Groups avoid competition by segregating into small issue niches (Gray and Lowery 1996a). Species relying on different resources have no reason to compete because access by one does not exclude others from the resources they need (Lowery and Gray 1995). A greater density of groups should lead to a sharper partitioning of niches. Interest group diversity is an artifact of the interests found in the community (Lowery and Gray 1998), although there is a limit to the diversity possible (Gray and Lowery 1996b). For example, the oldest science organizations are the most general organizations, such as the American Association for the Advancement of Science. Since then, new interest groups have formed with more and more specialized foci.

For interest group populations, population density is a function of potential constituents, potential government goods and services, stability of the political

system, government age, and government size. In population ecology, as more species enter a system, previously existing species must either fight to survive, adapt to a changing environment, or exit the system. In reality, most organizations are characterized by strong inertial forces that limit how much they can change and adapt (Hart 1997). Adaption is possible, but difficult (Hannan and Freeman 1977). For example, Lowery and Gray (1993) found that state interest group density does *not* increase *pari passu* with economic size and complexity. At the state level, density in the smallest states appears partially to be an artifact of “natural” groups (such as those representing teachers, farmers, and bankers) that tend to exist in every state (Lowery and Gray 1993). In short, state economic growth and complexity need not trigger an explosion of groups (Lowery and Gray 1993; Wolak et al. 2002). The population ecology theory sets a limit on the overall number of groups, unlike earlier pluralist theories that assume there are an unlimited number of groups possible in an environment (Nownes 2010).

After taking various factors in to account that are unique for each distinguishable environment, the population that forms is optimized for that environment (Hannan and Freeman 1977). There is also an equilibrium number of groups for each unique environment. The carrying capacity for each environment is based on scarce resources needed for the groups to sustain themselves (Eldredge and Grene 1992). Interest groups are always seeking ways to survive (Lowery 2007).

Population ecology theories can also be used to examine the founding of organizations. When groups are first formed in an emerging issue area, few organizations will be formed because the groups and the issue itself must undergo legitimation to be viewed as important enough to be addressed. This legitimation process dominates at low group density. As an issue-area becomes legitimate, entrepreneurs can invest less effort in justification of their group and more time and resources on group organization. Thus, the number of groups will increase more rapidly. However, as the number of active groups increases, inter-group competition increases and dominates at high density. This increased competition will decrease the number of organizational foundings (Nownes 2004). The density dependence theory explains, for example, the growth of gay and lesbian rights groups. The number of homosexual rights group foundings started small and rose only slightly at first, when legitimization concerns dominated. Once the groups were considered legitimate, the number of foundings rose exponentially, peaked, and has declined slightly from inter-organization competition (Nownes 2004). The exit rate, not the entrance rate, seems to be contingent on the size of the interest group population (Gray and Lowery 1995).

These ecology-based models are more broadly consistent with the traditional pluralistic view of interest group politics than they are with public choice-derived theories, and they allow for a deeper understanding of group dynamics (Lowery and Gray 1995). Lowery and Gray describe a neopluralist

perspective where the collective action problem is not nearly as pervasive as Olson once suggested, although it exists at times (Lowery et al. 2005).

Uncertainty over a policy or course of government action is a strong motivator for citizen participation in membership groups. While there is certainly an inequality of resources among interests, few groups are without any resources in pursuing influence. Research within the neopluralist perspective examines organized interests across all stages of the influence process, and holds that policy outcomes influence mobilization and the structure of interest populations and the types of activities employed in gaining influence (Lowery and Gray 2004; Gray et al. 2007).

Theories related to the population ecology of interest group development will be used in this study because they allow us to focus on studying the relationship between interest groups and external stimuli. Pluralist and elitist theory focuses on the relationships among people within a group, while exchange theory focuses on the relationship between a group entrepreneur and members. Although aspects of economic theory of interest groups will be of interest in later studies, they move beyond actual group formation stimuli. They tend to focus on the way interest groups affect society at large. Here, we are just focused on how group formation is related to an external stimulus. Here, the external stimulus is federal science funding.

Data and measurement

In this paper, we rely upon *The Encyclopedia of Associations* for our data. It is important to note that this is not a perfect source. Because groups self-report to the *Encyclopedia*, groups may be excluded or choose not to identify. Some scholars have cross-checked this list with sources such as the *New York Times Index* (Nownes 2004). But the use of the *Encyclopedia* alone has precedent in the literature. Deborah Minkoff presented an event history analysis of national women's and minority membership organizations with an emphasis on differences in organizational strategies, goals, and formal structure (Minkoff 1993). She uses the *Encyclopedia of Associations* for organization listings with the acknowledgement that very small or short-lived associations are not adequately represented in the database (Minkoff 1993). She later uses the *Encyclopedia of Associations* to study women's and minority rights groups transitioning from protest groups to more professionalized associations.

Dependent variables

To create our primary dependent variable, *Number of nationally active science-related interest groups*, we use the *Encyclopedia of Associations*. This variable is a yearly measure, which sums the number of groups in nine categories listed in the *Encyclopedia*: (1) chemical trade associations; (2) biology groups; (3) botany groups; (4) chemistry groups; (5) computer science groups; (6) energy groups; (7) geology groups; (8) physics groups; and (9) general science groups. These groups are predominately trade and professional

associations for scientists. The primary dependent variable of interest, then, is cross-sectional time-series that is simply a sum of all of the groups in a scientific issue area in a given year. The cross-section is scientific issue area. The time-series is year. Therefore, the dataset is constructed as the number of groups in an area each year. It is then associated with various values for R&D funding as well as control variables. The data for this first dependent variable is collected from 1961 to 2009. The overall numbers of groups (across all disciplines) ranges from 157 (1961) to 419 (1996) groups. The scientific issue area with the largest number of active groups during this time period is energy, with a high of 70 groups.

I am also interested in the age of the group during any given year. The *Encyclopedia of Associations* lists the founding years of organizations, I confirm the volume's accuracy by examining groups' websites and other sources. Thus, we are able to determine the number of new groups that are formed each year. This gives the dependent variable of interest I the Foundings II section, *Number of annual interest group foundings*. The highest number of foundings occurred in 1982 with 24 new groups joining the population. We again are working with a cross-section time-series analysis.

Independent variables

The main independent variable of interest is *Total research and development funding from the federal government*, which is the total overall federal research and development funding calculated in billions of 2009 U.S.

dollars. Data on government funding of scientific research and development comes from the National Science Foundation. The National Center for Science and Engineering Statistics (a division of the National Science Foundation) maintains statistics related to education, business and industry, research and development, the scientific workforce, and federal government involvement in science, particularly in funding and expenditures for science. The organization specifically maintains a database of current and historic federal funds for science and technology research (NSF 2012). Data is provided for overall federal funding data. I use the consumer price index provided by the U.S. Bureau of Labor Statistics to convert all values to constant U.S. 2009 dollars.

I also include three dichotomous independent variables to examine the effects of party control of specific government institutions. They are *Party of the president*, *Party controlling the House*, and *Party controlling the Senate*. Each of these variables is given a value of 1 for a year in which Democrats controlled the institution and a 0 otherwise. I include these three variables in my model to control for the effects of partisan politics in scientific funding decisions. I include simple party control rather than a variable like majority size because, in many ways, party control is more important than relative party size. In times of party polarization, parties are much more likely to vote as a block rather than breaking away from the party, leading to a simple majority/minority dichotomy rather than control based on the size of one's majority.

For the second analysis, which examines the number of foundings as the dependent variable, I also include an independent variable that is *Density*, which is simply the number of groups that are already in the system the new group is entering. In order to complete a Poisson analysis, I also square the value for density and generate a $Density^2$ variable. These two variables together allow us to test the foundings-related hypothesis.

Methods

All of the data analyses performed in this paper are done in Stata. Because of the time-series aspect of this analysis, the author was careful to examine and account for the potential autocorrelation. Serial correlation could be present in both the dependent and independent variables. The number of groups one year is certainly based on the number the previous year. Federal R&D funding, while it changes annually, is certainly rooted in the amounts allocated the previous year. Correlograms suggested that lags were not significant in this study and Breush-Godfrey and Durbin-Watson tests also suggested a lack of serial correlation.

In the second analysis, I used a Poisson distribution. This is typically used when the dependent variable is an asymmetric curve. It is often used when examining rates of incidence. Here, the incidence we are interested in is the rate of foundings of interest groups annually. We also use robust standard errors coupled with this Poisson analysis.

Findings I: Science-related interest group density and federal R&D

Gray and Lowery use the theory of population ecology to predict the overall number of interest groups in the American states. Their theory asserts that interest group density is a function of potential constituents, potential government goods and services, stability of the political system, government age, and government size (Lowery and Gray 1995). Potential membership available to organizations is also strongly related to the size of the interest community (Gray and Lowery 1997). Based on their theories, I hypothesize that early growth of interest groups should correlate to increases in federal funding. This hypothesis is tentatively supported by the data presented in Figure 2, which plots the number of nationally active science-related interest groups over time (since 1960).

According the basic population ecology framework, the carrying capacity of the interest group system is a function of the overall federal science budget.

Based on previous research, we formulated the following general hypothesis:

Hypothesis 1: As the federal funding of research and development increases, the number of nationally active science-related interest groups increases.

Testing this hypothesis is straightforward. We cast a time-series cross-section OLS regression model in which the dependent variable is *Number of nationally active science-related interest groups*, and the primary independent variable of interest is *Total research and development funding from the federal government*. To control for party control, we also include our three party control variables in

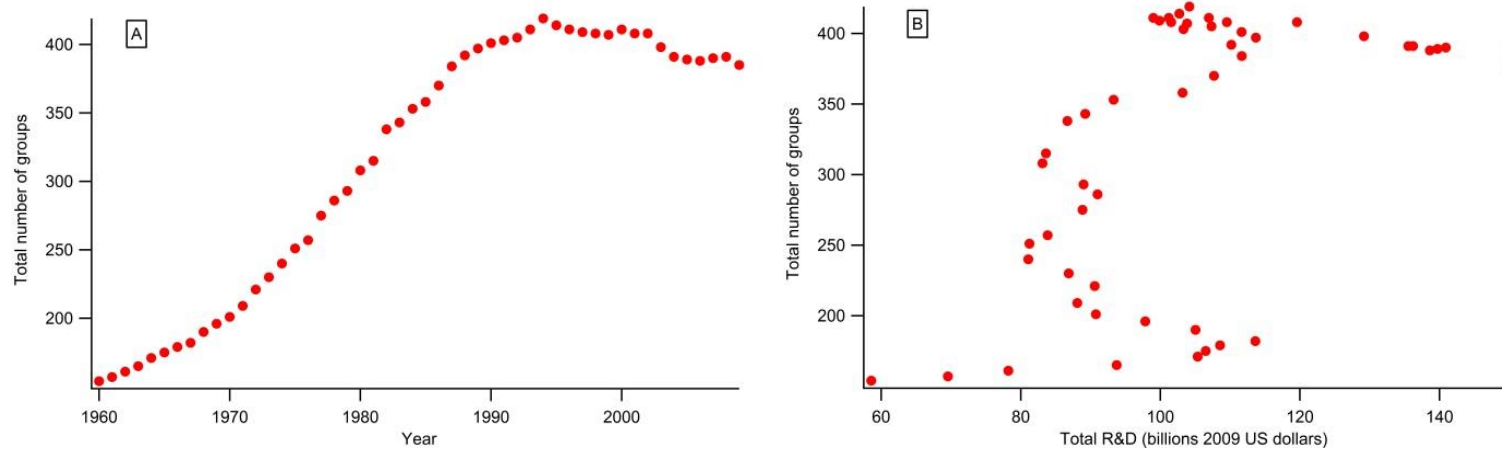


Figure 2. The overall growth of science-related interest groups over time (a) as well as how the growth has correlated to overall science funding (corrected to constant 2009 dollars) over the same time period (b).

the model. The results of the cross-sectional, time-series Stata analysis is shown in Table 1.

The data shown in Table 1 support Hypothesis #1, as the coefficient for *Total R&D Funding* is positive and statistically significant. In sum, the results show that as the overall federal science budget increases, the number of science-related groups increases as well. Specifically, the statistical results indicate that for each additional \$1 billion in science funding, there will be 0.197 more groups in the population. Put another way, each additional \$5.8 billion is associated with one additional group in the population. This holds true even when controlling for party. This idea coordinates with what we know theoretically.

As more money is available for science, scientists will have more of an incentive to organize and advocate for funding, and more money is available for extant groups to thrive. Organizing also makes it easier to share information. By setting up conferences and meetings, organizations make it easier to set up collaborations and learn about the newest research. Federal funds make it possible for more scientists to attend these meetings, connecting federal funds to the growth of the organizational population. These results support Gray and Lowery's (1995) ESA theory. Specifically, federal research funds provide a source of energy for science-related interest groups. The more energy--federal research funds--present in the environment, the more groups the environment can support.

The findings on the effects of party control are also interesting. Previous

Table 6. Cross-section, time series regression results for the overall number of groups in the population.

Variable	No. groups
Total R&D Funding	0.197*** (0.028)
Party of the President	-2.76*** (1.02)
Party controlling the House	-6.42*** (1.45)
Party controlling the Senate	-5.54*** (1.26)
Constant	24.50*** (5.22)
R ²	0.1933
Number of Observations	450

Source: Author's data, National Science Foundation

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

work has shown that Democratic control of the House, Senate, and presidency leads to increases in federal science funding (Milojevich 2014). The coefficients in Table 1 suggest that Democratic control of the presidency, House, and Senate lead to fewer interest groups. One reason we may see this relationship comes from the political party-science funding relationship itself. If one reason these groups are forming is to lobby for additional science funding (a position espoused on several groups' websites), if Democratic administration are already increasing science funding, groups may feel less of an impetus to form. During Democratic administrations, funding levels are likely increasing regardless, so fewer groups may be interested in forming and becoming active in the interest group population.

Findings II: Interest group foundings

We are also interested in the founding of new interest groups. We expect that the number of foundings will be relatively low initially, but increase as the population of groups in the issue area increases. Eventually, however, as per the density dependence hypothesis, when the population reaches a certain size the number of foundings will decrease. This leads to our second hypothesis, which is a variation of the general density dependence hypothesis:

Hypothesis 2: The number of science-related interest group foundings will be related in a curvilinear fashion to the overall number of nationally active science-related interest groups.

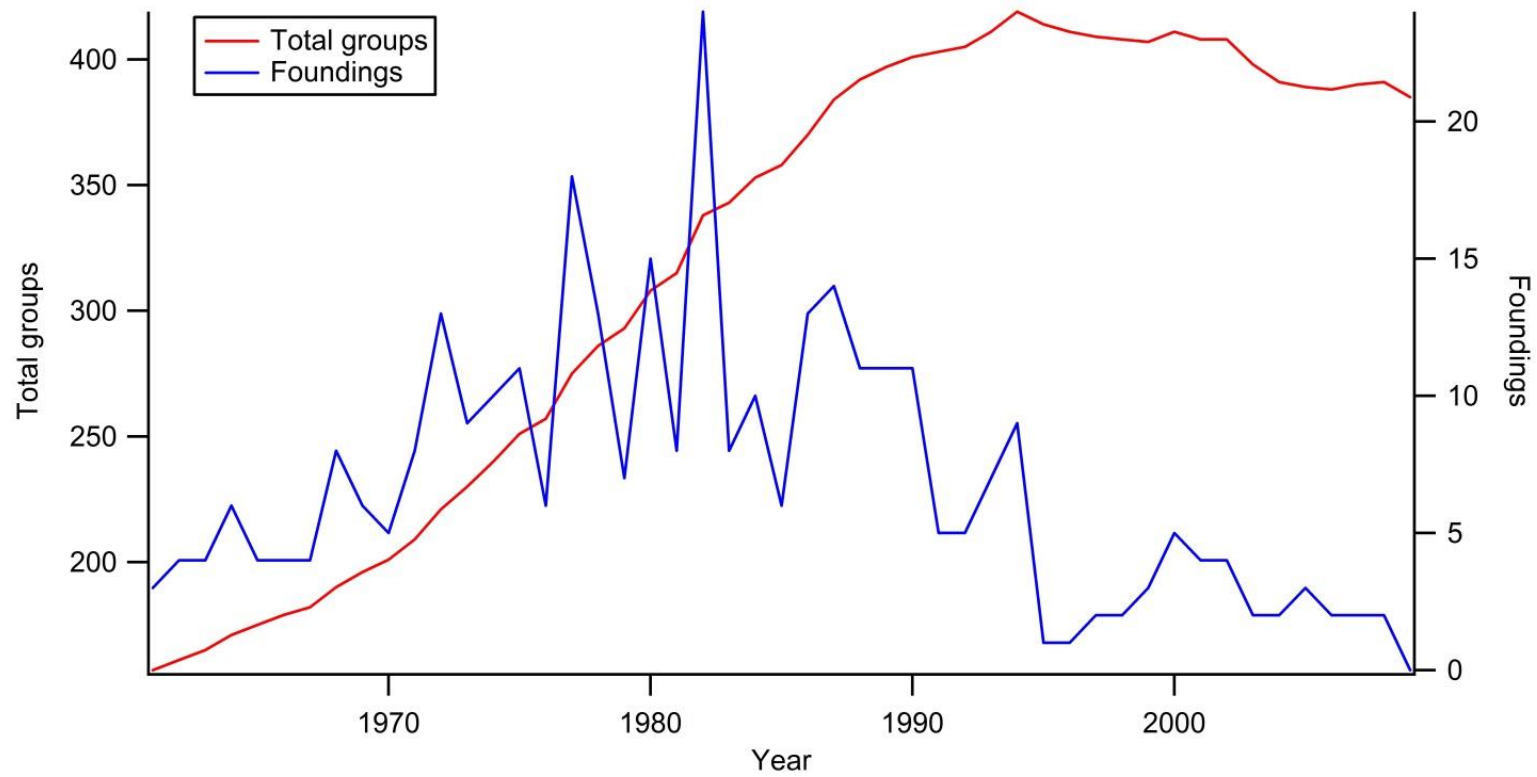


Figure 3. Total number of groups plotted with the number of founding of groups annually from 1961 to 2009. The number of groups founded each year decreases as the total density of groups increases.

A basic graphical test of this hypothesis is found in Figure 3, which plots both group density and group foundings. Figure 3 is suggestive. As per the general density dependence hypothesis, Figure 3 shows that the number of foundings is highest when density is increasing, and approaches zero as the overall number of groups levels off. This connects to theory—as interest groups in a specific area become more legitimized, new groups will form and existing groups will thrive.

To quantitatively test Hypothesis #2, we examine the founding of science-related interest groups in relation to both federal research funding and group density. Here, the dependent variable is the *Foundings*, which is the number of science-related interest groups foundings in a given year. As independent variables, we include *Density*, *Density*², *Total research and development funding from the federal government*, and the party control variables. Because our dependent variable is a count variable, we utilized Poisson regression. The results of this analysis are shown in Table 2.

The results support Hypothesis #2. Specifically, the positive coefficient on *Density*, and the small, negative coefficient on *Density*² indicate that we do, indeed, observe a non-monotonic relationship as predicted. The value of the coefficient on *Density* is not only statistically significant, it is also much larger than the coefficient on the funding variable. Thus, we may conclude that as the

Table 7. Cross section, time series analysis of the number of interest group foundings annually in relation to federal funding and the density of groups using a Poisson distributional analysis.

Variable	Foundings
Total R&D Funding	-0.016*** (0.004)
Density	0.115*** (0.022)
Density ²	-0.001*** (0.001)
Party of the President	-0.87 (0.122)
Party controlling the House	01.14*** (0.216)
Party controlling the Senate	0.118 (0.140)
Constant	-1.96*** (0.575)
Log likelihood	-510.7
Number of Observations	450

Source: Author's data, National Science Foundation

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

number of overall groups in the population increases, the number of group foundings will also increase. The negative coefficient for the square of the density indicates that this independent variable will eventually decrease at some critical point. Prior work has also supported the idea that the formation of groups will increase while the overall population is increasing, but decline once a critical population is reached (Nownes 2004). The coefficient on our funding variable is statistically significant, leading us to believe that overall federal research funding does play a role in a group's decision to form.

Conclusion

This paper examines the population of science-related interest groups over time and supports the ESA theory of interest group formation developed by Lowery and Gray (1995). This is the first study to specifically look at federal science funding and how it creates to the formation of interest groups, especially trade and professional organizations. Federal research funds provide the energy necessary to support an interest group population. As federal funding increases, more groups are founded. Specifically, another group will be founded for each additional \$5.8 billion in federal research funds.

We also find that the number of group foundings follow a non-monotonic "inverted U" shape that is mostly dependent on the density of groups in the system. While federal funding does affect group formation, it is a small component compared to the effect of population density. More groups will form

as the density of groups increases, but will decline once a critical density, a carrying capacity, is reached.

This study does not, however, examine the composition of each of these interest group populations. Future studies will examine not only the growth of these populations in relation to their external environment, but how these populations change over time. It has been suggested that as interest group populations grow and become more dense, groups will differentiate and seek different niches to fill. This characteristic will be examined in future work. We will also examine specific lobbying efforts of groups in these populations to examine how they change in relation to their external environment.

As science takes a more and more prominent role in society and public policy question, it is vital that we look at the political activities of scientists. This study of the formation of science-related interest groups is the first that attempts to explain how scientists organize themselves and how this organization has grown over time. It is a vital first step to a more thorough explanation of how scientists may, or do, exert influence over the political and/or policy process.

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CHAPTER III

THE SPECIALIZATION OF SCIENCE-RELATED INTEREST GROUPS OVER TIME

A version of this chapter is currently under review at *American Politics Research* as a single authored work.

The article is represented in the form in which it was submitted to the journal. The dissertation author conducted the entire data gathering and analysis, designed the figures and tables, and exclusively authored the paper.

Abstract

A derivation from population ecology theories of interest is the theory of niche specialization. As the overall number of interest groups in a field increases, groups tend to become more specialized in order to decrease the amount of inter-group competition. While this theory has been discussed at length, has not yet been quantified over time. This study fills that gap. We find that for each ten additional groups added to a population, the population on average is likely to become nearly 5 percent more specialized. We also find that as federal research and development funding increases, groups become more specialized as well, likely because groups will be looking to distinguish themselves and their members' research. This also supports population ecology and niche formation theory connecting competition to specialization.

Published Work

Public choice theorists have pointed to rent-seeking by interest groups as a driving force behind government spending (Leech, Baumgartner, Pira, &

Semanko, 2005). The federal government has steadily increased the amount of money it contributes to research and development since the 1950s. Thus, if public choice theorists are correct, one should observe an increase in the number of interest groups, specifically those related to science and scientific research, as federal science funding increases. Prior quantitative work has shown this to be true (Milojevich, 2012). Anecdotally, scientists have noted that the amount of lobbying activity by scientific organizations has increased, as have the number of grassroots appeals from groups to scientists (Drake, 2002).

Extant research indicates that interest group populations are shaped by the environment in which they exist. Specifically, theory suggests that as more groups enter an interest group population, groups are likely to become more specialized, forming distinct niches in which to operate. Is this notion correct? This is the question we address here by examining science-related interest groups—trade and professional associations focused on chemicals, biology, chemistry, computer science, geology, physics, or general science. We also examine the effect of federal science research and development funding on niche-seeking. While this theory has been discussed qualitatively in the literature, this study is the first to illustrate this concept quantitatively on an interest group population.

Science in the United States

Since the Manhattan Project, the federal government has steadily increased the amount of science research it funds, especially basic research. In

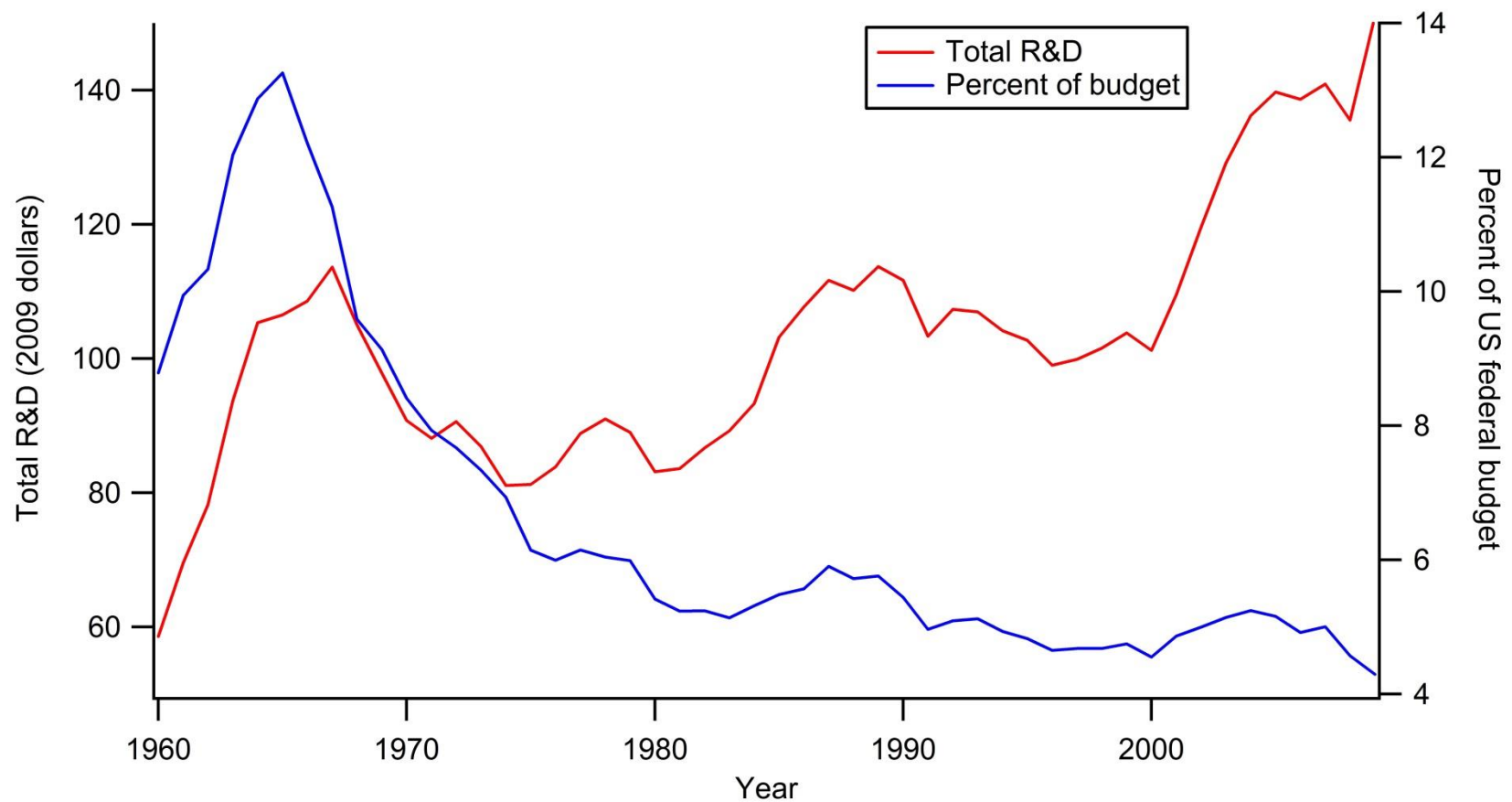


Figure 4. Overall U.S. funding for research and development and federal R&D funding as a percent of the overall budget (funding values are in constant 2009 dollars using the consumer price indexes from the Bureau of Labor Statistics).

fact, federal funds pay for approximately one-third of all research and development (R&D) in the United States. Figure 1 illustrates this increase.

At the same time, more and more policy decisions involve science and scientific research, ranging from national security to public health. Individual scientists may not realize that work is so necessary and relevant, but organizations have noted this importance for years. More and more science-related interest groups have emerged since the 1960s, and many hire full-time, in-house lobbyists. Indeed, the American Physical Society (the professional association for physicists in the United States) offers an entire section of their website towards advocacy tools for their members (APS, 2013). Here, members can read on the activities of the lobbyists and see what bills and policies they are advocating for, write their member of congress, or volunteer to fly to Washington, D.C. to spend a day speaking with members of Congress and their staffers themselves. Because most physicists rely in federal science funding, many of their lobbying efforts include increasing funding levels or, more recently, keeping them consistent at the current levels.

Scientists often face a series lack of time. Scientists have to find research grants, write grants, author articles, provide peer reviews, and then, if they have time, perform actual research. Studying policy propositions is often not high on their priority list. However, interest groups, especially trade and professional associations, have stepped up to fill that gap. By hiring lobbyists to focus on these issues full-time, trade and professional groups allow scientists to work and

spend less time considering the political and ideological aspects of their work. Because of the importance of science in the world today, it is important to study science-related organizations separately from other interest groups. In this paper, I will specifically examine the specialization of this population of groups over time.

Interest group theory

Pluralists assumed that because humans are social creatures, people would band together and create groups to protect their shared interests. These shared-interest groups, so goes the pluralist argument, then articulate their demands to the government, adding to political stability (Truman, 1951). Early group theory rested on the pluralist assumption that the best political outcome would result from group conflict and compromise, with the government acting as mediator (Baumgartner & Leech, 1998). These ideas have informed more recent interest group theory, specifically, population ecology approaches to explaining group formation and survival.

Population ecology theories of interest groups

The study of interest group populations has benefited greatly from population theories of biodiversity. Because we rely upon population ecology theories here, we will say a little more about them. In biology, the diversity of populations is shaped by the environment. New individuals are continually added to the overall population, but the characteristics of the population at large are

shaped by the environment, not necessarily by the new babies in the population themselves. In interest group theory, new interest groups forming are only part of the story for the overall populations – the external environment shapes the population as well. Formation and mobilization of groups can only partially explain the nature and size of overall populations (Lowery & Gray, 1995). Competition within an environment is also important to this theory.

For interest group populations, population density is a function of potential constituents, potential government goods and services, stability of the political system, government age, and government size. Gray and Lowery use the energy, stability, area (ESA) theory of biodiversity to account for the size of interest group populations. In biological populations, energy is needed to sustain individuals and species. Greater energy leads to more species that can be supported in that environment (Wilson, 1992). Interest group energy reflects the resources available to lobbyists, including constituent interests and interest certainty (Lowery & Gray, 1995). Biological stability is the absence of fluctuations in the environment that can stress organisms (Pimm, Jones, & Diamond, 1988). Stability in interest group populations is viewed via Olson's hypothesis about the relationship between interest group system age and group density (Olson, 1982). Finally, area is analogous to the number of potential constituents in the environment (Lowery & Gray, 1995). The relationship between area and the density of a population is positive and curvilinear (Wilson, 1992). Potential membership available to organizations is positively related to the size of the

interest community (Gray & Lowery, 1997). In this initial study of the diversity of the science-related interest group population, we focus on the energy aspect of this theory by characterizing interest group energy as the amount of federal research and development funding available

Interest group populations are also shaped by the formation or emergence of new groups. As more groups enter a system, previously existing groups must either fight to survive, adapt to a changing environment, or exit the system. In reality, most organizations are characterized by strong inertial forces that limit how much they can change and adapt (Hart, 1997). For example, Lowery and Gray (1993) found that state interest group density does *not* increase *pari passu* with economic size and complexity. State economic growth and complexity need not trigger an explosion of groups (Lowery & Gray, 1993). The population ecology theory sets a limit on the overall number of groups, unlike earlier pluralist theories that assume there are an unlimited number of groups possible in an environment.

Groups, like species, compete for resources within an environment (MacIntosh, 1992). Thus, species will tend to divide into differing niches to lessen competition for resources (Colinvaux, 1978). There is competition among interest groups for both potential members and the delivery of goods to meet their demands (Lowery & Gray, 1995). Groups avoid competition by segregating into small issue niches (Gray & Lowery, 1996). Species relying on different resources have no reason to compete because access by one does not exclude others

from the resources they need (Lowery & Gray, 1995). A greater density of groups should lead to a sharper partitioning of niches.

Ecology-based models are more broadly consistent with the traditional pluralistic view of interest group politics than they are with public choice-derived theories, and they allow for a deeper understanding of group dynamics (Lowery & Gray, 1995). Lowery and Gray describe a neopluralist perspective in which the collective action problem is not nearly as pervasive as Olson suggested.

Uncertainty over a policy or course of government action is a strong motivator for citizen participation in membership groups. While there is certainly an inequality of resources among interests, few groups are without any resources in pursuing their political goals. Research within the neopluralist perspective examines organized interests across all stages of the influence process, and holds that policy outcomes influence mobilization and the structure of interest populations and the types of activities employed in gaining influence (Lowery & Gray, 2004).

In our study, resources are broadly defined as the federal science research budget. Each science-related interest group is interested in gaining additional resources for its members. Interest groups engage in many activities, including holding conferences and publishing journals, but attaining research funds for members remains very important. Without funding, scholars have more trouble carrying out their research, threatening group membership and, thus, the existence of the group. Our motivation for examining a variety of science-related groups lies in the concept of population.

In what follows, we draw upon population ecology models to posit a relationship between the behavior of science-related interest groups and their external environment, specifically focusing on federal science funding. Pluralist and elitist theories focus on the relationships among people within a group, while exchange theory focuses on the relationship between a group leader and group supporters. Although aspects of economic theories of interest groups may be useful for other purposes, they do not tell us much about group formation.

Data and measurement

In this paper, we are specifically concerned with the overall specialization of science-related interest group populations annually, the annual federal R&D budget, and the size of the existing population.

Dependent variable

We rely upon *The Encyclopedia of Associations* to build a list of interest groups active during the period 1978-2009. It is important to note that this is not a perfect source. But its use has precedent in the literature. Deborah Minkoff, for example, relied upon *The Encyclopedia* in her analysis of national women's and minority membership organizations (Minkoff, 1993). Minkoff acknowledges the weaknesses of *The Encyclopedia*, but maintains that it remains a good source for information about groups over time.

Here, we rely upon *The Encyclopedia* to build a population list of science-related interest groups. To create our primary dependent variable, *Group specialization*, we first create a list of interest groups for each year from 1978 to

2009. This group is subdivided by category by each of the following types of groups (as defined by the *Encyclopedia of Associations*): (1) chemical trade associations; (2) biology groups; (3) chemistry groups; (4) computer science groups; (5) geology groups; (6) physics groups; and (7) general science groups. These categories create the panel aspect of our cross-section time-series dataset.

Each group is assigned a score from one to three based on how specialized it is. We coded the dependent variable ourselves, based on information in *The Encyclopedia*. A more general group will be assigned a “1” while more specialized niche groups will be given a “3” score. Specifically, each score is based on:

1 – the group name and/or mission statement only mentions the science area in which it is based (chemistry, biology, etc.)

2 – the group name and/or mission statement mentions a subset of a scientific area, but nothing more specific (analytical chemistry, microbiology, reactor physics, etc.)

3 – the group name and/or mission statement is a specialized niche beyond a subsection of a scientific area

Thus, each group, every year, will be given a score of 1, 2, or 3 based on how general or specialized the group’s focus is. This is based on both the title of the group as provided in the *Encyclopedia of Associations* as well as the description of the group. The *Encyclopedia of Associations* asks each group listed to not only

provide a group name, but also basic statistics and a description of their mission statement and activities. For the author, using self-provided descriptions is preferable to potential outsider subjective measures because gives a sense of how these groups self-identify. This is how the group views themselves as part of the interest group population.

An example will also help illustrate how we coded each groups. For each year in the study, we assigned each chemistry group a ranking of 3 (which indicates a very generic group such as The American Chemical Society that does not mention any chemistry specialization), 2 (which indicates a more specialized group such as The Association of Analytical Chemists, which focuses on one of the five main areas of chemistry but does not specify any further), or 1 (which indicates an obviously very specialized group such as The American Leather Chemists Association). We acknowledge that there is some level of subjectivity in this measure; however, the rubric aims to minimize the subjective nature of this measurement. The groups were also coded using the same rubric by a scientific expert (an individual with a chemistry Ph.D.) with a resulting 0.96 intercoder reliability.

Once every group is coded for every year, we can create the dependent variable *Group specialization*. This variable is actually the average of all the groups in each of the seven scientific issue areas described above. Thus, we have a description for how general/specialized the entire population of, say, chemistry-related interest groups is for that year. The variable changes each year

based on the interest group population that year. Thus, our dependent variable is a continuous variable from 1 to 3 based on how specialized the entire population is that year.

Independent variables

Our first independent variable of interest is *Total number of interest groups*, which is a yearly measure of the size of the overall science-related interest groups each year. This is a count variable that is set up as a cross-section time-series data that lists the overall number of groups in a population by scientific issue area annually. Our basic hypothesis is that the higher the group density, the more likely specialized groups are to emerge. Population ecology theory is also based on competition. There is competition among interest groups for both potential members and goods that can be delivered (Lowery & Gray, 1995). Groups avoid competition by segregating into small niches (Gray & Lowery, 1996). Species relying on different resources have no reasons to compete because access by one does not exclude others from the resources they need (Lowery & Gray, 1995). A greater density of groups should lead to a sharper partitioning of niches.

Our second independent variable of interest is *Total research and development (R&D) funding*. Data on government funding of scientific research and development comes from the National Science Foundation. The National Center for Science and Engineering Statistics (a division of the National Science Foundation) maintains statistics related to education, business and industry,

research and development, the scientific workforce, and federal government involvement in science, particularly for funding and expenditures for science. The organization specifically maintains a database of current and historic federal funds for science and technology research (NSF, 2012). This variable is a yearly measure of the total amount of research and development funding provided by the federal government. All values were converted to constant 2009 dollars using the Consumer Price Index.

Methods

All data analysis was performed in Stata by first declaring the dataset to be both a panel dataset (by area of scientific inquiry as described above) and time series (1978-2009) for a total of 224 observations. Thus, the data was set up as an average specialization of the population each year in each category. Cross-section time-series ordinary least squares regression was used to obtain coefficients. Analysis on the errors indicated that lags were not largely significant in this analysis, although they were considered.

Niche formation findings

In short, we are primarily interested in examining the relationship between interest group population density, and interest group specialization. We are also interested in examining the relationship between federal government funding of science and interest group specialization. Here, we test two broad hypotheses:

Hypothesis One: As interest group density increases, the interest group population will become more specialized.

Hypothesis Two: As federal government science funding increases, interest groups will become more specialized.

To test these hypotheses, we cast a time series cross-section regression model in which *Group specialization* (range = 1-3) is the dependent variable, and *Overall number of interest groups*, and *Total federal research and development funding* are our two independent variables.

The results of our analysis are found in Table 8. The results indicate that the overall interest group population, indeed, becomes more specialized as more groups join the population. New groups joining the population are more likely to be specialized niche groups than not. Based on the coefficients, for every one group that joins a population, the group population will become 0.479 percent more specialized. Thus, an additional ten groups leads to a nearly 5 percent increase in the overall group specialization score. We see a similar result for total R&D funding. For each additional \$1 billion in federal science funding, the interest group population becomes 0.43 percent more specialized. The constant, 1.7, indicates that group populations are initially moderately specific at the start of the study, 1978, and as groups form and join the population, the population becomes more specific over time, filling more niches. The overall population becomes more specialized as the number of groups increases and federal funding for science research increases. The possibility also exists that this specialization also occurs from the death of generalization groups, but this seems unlikely. Many general science groups, such as the American Chemical Society (founded in 1876) and the Institute of Electrical and Electronic Engineers

Table 8. Cross-section, time series regression results with the overall niche score as the dependent variable and the overall number of groups in the population and total R&D funding as the independent variables of interest.

Variable	Group specialization
Total number of groups	0.00479** (0.00191)
Total R&D Funding	0.00429*** (0.00100)
Constant	1.697*** (0.131)
R ²	0.2737
Number of Observations	224

Source: Author's data, National Science Foundation
Note: Numbers in parentheses are standard errors
*** p < 0.01; ** p < 0.05; *p < 0.1

(IEEE, founded in 1884) have long histories and large memberships. An investigation of the dataset indicates the death of no such interest group.

Discussion

These results support the niche-seeking interpretation of interest groups offered by population ecology theory. Our findings indicate that as more groups enter a population, the overall group population becomes more specialized. New groups forming and joining the population are more likely to be specialized to fill a niche. When new groups form and join a population, they are likely to be a specialized group looking to represent more specialized subfields in order to both to avoid competition with larger, more general groups, as well as to recruit additional members. Thus, the overall population becomes more specialized from these new specialized groups

A more specialized focus may also give groups a unique way to recruit members. Many scientists are already members of well-established general groups. The American Chemical Society, an organization representing chemists formed in 1876, has a membership of over 160,000 and almost 2,000 employees (ACS, 2013). While chemists may be hesitant to join a group that is newly formed that addresses similar issues as the ACS, they may be more likely to join specialized groups that do not directly compete with the ACS. In short, there are good reasons for groups in crowded populations to specialize.

By becoming more specialized and moving into a niche, groups are able to avoid competing with other groups. The Society of Cosmetic Chemists faces

little direct competition for members from the International Society for Fluoride Research, even though both largely draw from chemists as their members. If a scientist performs fluoride-related research, they are likely to be the only researcher at their university or company participating in that research. Thus, joining of such a society provides an opportunity to attend conferences and find collaboration partners in their narrow field of research without them having to divert large amounts of their time to this endeavor. Similarly, the group is able to keep their members informed of relevant policies without the members themselves having to devote their time to reading the Federal Register or other such publications.

Groups are also able to differentiate themselves in ways other than their research interests. In 2009, for example, the following chemistry groups were operational – the North American Chinese Clinical Chemists Association, the Iranian Chemists' Association, and the National Organization for the Professional Advancement of Black Chemists and Chemical Engineers. Groups such as these allow members to connect with people they might may not meet otherwise—for example, scientists with different specialties may be able to meet scientists with whom they share race or ethnicity. This creates a sense of community where it may be lacking within an individual sub discipline.

Our findings also show that in addition to the number of groups driving specialization, increased federal research and development funding also drives specialization. As the federal government funds additional scientific research,

science-related interest group populations become more specialized. In this study, federal funding is analogous to “energy” in Gray and Lowery’s ESA theory (Lowery & Gray, 1995). More federal science funds mean increased energy, which leads to more groups. From here, more groups lead to a more specialized population.

Using the above example, members of the Society of Cosmetic Chemists are not necessarily competing for research funds against members of the International Society for Fluoride Research. They each are applying for money from different research pools. However, the research funding pool must exist if their members are going to receive anything. Thus, an increase in federal funds overall can result in group specialization by the desire for funds aimed towards the group’s target audience.

Increasing federal funds also provides energy to interest group populations by giving the groups a target for their members. Additional science funds provide incentives for groups to become more specialized by trying to advocate additional or earmarked funds for their members. Thus, specialization becomes an important factor to think about when considering science-related interest group populations.

Conclusion

We find in this paper that science-related interest groups have become more specialized over time, as both federal funding for science and group density have increased. The population becomes nearly 5 percent more specialized for

every 10 additional groups that enter it and nearly 4 percent more specialized for each additional \$10 billion in federal research and development funding.

Ultimately, our data demonstrate specialization and niche formation within an interest group population over time. Thus, they provide support for the population ecology perspective, which is increasingly used to explain group population trajectories, as well as individual group behavior. This concept has been discussed at great length in the literature, but this is the first study to the author's knowledge that illustrates this concept quantitatively on an interest group population.

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CHAPTER IV

THE LOBBYING ACTIVITIES OF SCIENCE-RELATED INTEREST GROUPS

A version of this chapter is currently being prepared for review at *Interest Groups & Advocacy* as a single authored work.

The article is represented in the form in which it will be submitted to the journal. The dissertation author conducted the entire data gathering and analysis, designed the figures and tables, and exclusively authored the paper.

Abstract

Science and technology play an increasingly important role in policy debates, from energy independence to national security. Because of its growing importance, it is necessary to examine science and research funding and how it changes over time. Since the Lobbying Disclosure Act, organizations and individuals have been forced to disclose the amount of money they spend lobbying Congress. In this paper, I am specifically interested in the lobbying expenditures of science-related interest groups and federal scientific research and development funding. Examining lobbying expenditures of trade and professional associations related to chemistry, biology, geology, and physics from 1998 to 2012 and federal research and development funding, I find there is no statistically significant relationship between the two. This lack of statistical significance holds even when parsed out among basic and applied research and among various scientific disciplines. So what does affect levels of funding? The answer is control of political institutions. When Democrats control the House and

the Senate, scientific funding tends to increase, which correlates to results presented earlier.

Published Work

There has generally been a divide between scholars and journalists as to the role of interest groups and, in particular, lobbying in American politics. The narratives offered on Fox News and MSNBC suggest that evil lobbyists shape every event and every piece of legislation that comes to committee, let alone full chamber vote in Congress. The common wisdom espoused by journalists is that interest group lobbying can have a substantial influence on how legislators vote (Edsall 1988; Birnbaum 1992; Birnbaum and Murray 1987). Scholars are dubious. While there is evidence suggesting that lobbying and associated activities such as PAC giving are important, there are also studies suggesting that there is little correlation between lobbying and PAC donations and legislative outcomes. Here, I am interested in a topic that has received scant attention in the political science literature – federal funding of scientific research and development.

This lack of attention to science funding is surprising given the vital role that science plays in a wide range of issue areas. Science and technology play a role in energy security and independence, environmental preservation, education, national security, medical advancements, and transportation. All of these are areas that affect and are affected by politics and political decisions. Funding for research and development and how it changes is, thus, an important

area to study and understand. This study is the first of its kind to examine the relationship between lobbying by science-related interest groups and the growth of federal scientific research and development funding. Previous work has examined the growth of science-related interest groups and the growth of federal scientific research and development (R&D) funding. This research showed that for each additional \$5.8 billion in overall federal R&D funding, another group will join the interest group population. Here, I examine the lobbying activities of science-related groups, which are predominantly trade and professional associations. I find that the lobbying expenditures of these groups has no statistically significant relationship to increases or changes in federal science funding. Even after parsing out funding by scientific area (chemistry verses biology verses geology verses physics) and lobbying performed by their associated interest groups, there is no correlation between lobbying expenditures and federal science funding.

Lobbyists: What are they, what do they do, and is it effective?

An interest group is any group or organization that makes demands upon government. The more appropriate term is “organized interest,” because many of the groups making demands on the government are not what we traditionally identify as “interest groups.” This definition includes universities. Interest groups engage in a wide variety of activities, such as direct lobbying, asking citizen members to contact their legislators, publishing research reports, and making presentations to Congress. The tactics that an interest group uses depend upon

its perception of how legislators may help them achieve their goals, their policy positions, and their resources (Hojnacki and Kimball 1999). The legislative branch is the most common target of lobbying, and is the focus of this analysis.

Theories of lobbying

The exchange theory of lobbying views interest groups as rational opportunists that aim to seek rents for their own gain. Exchange models assume that legislators and lobbyists make mutually beneficial trades, including campaign contributions and information (Morton and Cameron 1992). As lobbyists and legislators get to know one another, mutual confidence, trust, and understanding grow (Schlozman and Tierney 1986). Exchange theories would portray science group lobbyists as agents who provide members of Congress with information on how research funds would better their universities and how this support would benefit members' districts. This would also lead us to expect that the longer a university lobbyist lobbies Congress, the more relationships are cultivated and the more money would be allocated to that university. Lobbyists, in effect, are agents of exchange (Austen-Smith 1996)

A second theory involves the idea of lobbying as persuasion rather than exchange. Information lies at the heart of this theory. The information that lobbyists provide, according to this theory, is not innocuous. Interest groups have a comparative advantage in gathering information that may be useful to legislators seeking reelection. Lobbyists can use this information to persuade uncertain legislators that their reelection chances will increase if they take a

position that is friendly to the group (Hansen 1991). Lobbyists are thus able to persuade legislators to adjust their positions on the basis of the lobbying information (Wright 1996). Here, a lobbying for an organization like Intergovernmental Panel on Climate Change may spend a portion of their time talking to Members of Congress (or, more likely, their staff) trying to use information on climate change to try to persuade climate change deniers to change their position or, more likely, persuade the members with little or no opinion to support climate change legislation.

A third theory involves lobbying as a legislative subsidy. In this theory, lobbyists match policy information, political intelligence, and labor to strategically selected legislators. Lobbyists assist their allies by “arming” them with “weapons” designed to help them advocate and vote for legislation that is advantageous to the lobbyist and his/her group (Hall and Deardorff 2006). This theory assumes the following: (1) a legislator must work at it if he/she expects to have any influence on policy; (2) legislators’ resources are scarce; (3) legislators have more than one policy concern at a time (though they care about some issues more than others); and (4) relative to legislators, lobbyists are specialists (Hall and Deardorff 2006). Thus, lobbyists are able to provide costly information, such as in-depth policy analyses and reports (Schlozman and Tierney 1986; Whiteman 1995), as well as political intelligence (Whiteman 1995; Wright 1996). Legislators structure the Congressional environment to channel relevant interest group influence and facilitate group access. Legislators affect their interactions

with lobbyists by establishing lobbying enterprises, making known their information shortcomings. These lobbying enterprises allow lobbyists to coordinate their efforts with sympathetic legislators by coordinating legislators to advocate on behalf of their issue (Ainsworth 1997). This could prove to an important role for the lobbyist for a science-related interest group. There are an abysmally small number of legislators with a science background (even if physicians are counted among the scientists), yet they make decisions on a regular basis that involve science and technology. A lobbyist could provide information that informs a decision, whether it be a floor vote, writing a piece of legislation, or co-sponsoring a bill. A lobbyist for the American Nuclear Society, for example, could provide information on public opinion, economic impacts, and job projections for a new nuclear power plant in a member's district.

Lobbying activities and congressional influence

The “common” wisdom among journalists is that lobbying can have a substantial influence on how members of Congress vote (Birnbaum and Murray 1987; Edsall 1988; Birnbaum 1992). Academics are far more skeptical. The traditional scholarly wisdom is that lobbying groups have little success in persuading or pressuring members of Congress. Any influence they do exert comes from reinforcing the decisions and actions of legislators. Lobbyists may also have some success at persuading undecided or weakly committed members to their position (Smith 1995). One of the reasons lobbying may not have large persuasion effects is that changing a person's attitude, especially in the short

run, is difficult. By and large, attempting to change a person's attitude is a long term proposition, which is why much lobbying occurs with those who already agree with the lobbyist (Bauer et al. 1972).

Not all scholars agree that lobbying is ineffective. Smith (1993) suggests that while legislators' preferences are stable in the short term, they are not necessarily attached to specific pieces of legislation. Thus, lobbyists are able to shape and influence a member's perception of a piece of legislation that fits with the group's perception and opinion (Smith 1993). Groups help legislators interpret policies and proposals. This influence is certainly substantial, even if it can change over time (Smith 1984, 1993).

While much remains unknown about the impact of lobbyists, scholars have identified some circumstances under which lobbyists are most likely to be influential. Studies suggest that a lobbyist will have more influence when legislators believe his/her expertise exceeds their own (Rothenberg 1992). Lobbyists can also have more influence on issues of low salience to the general public (which federal research funding certainly is) (Rothenberg 1992).

In perhaps the largest study of lobbyist ever, *The Hollow Core: Private Interests in National Policy Making*, Robert Salisbury and his colleagues question how influential groups actually are in Washington. One of their conclusions is that uncertainty is the key to understanding lobbyists. There is always uncertainty about the path government will take, due to many things including the expanded significance of federal policies and the expansion of staffs. Groups

now have multiple access points within Congress, but there is also more competition for attention. Thus, the explosion of groups in Washington is a result of more groups trying to minimize their uncertainty and have their say. However, groups do not know how much impact their work has (Heinz et al. 1993). The authors found that unlike previously prevalent iron triangle arguments, where an interest group, legislator, and agency actor form a subgovernment controlling an issue area (Hayden 2002), there is no cohesive private elite consistently occupying a central, mediating position in the networks among representatives (Heinz et al. 1993).

By far the most influential book on lobbying of the 21st century is *Lobbying and Policy Change: Who Wins, Who Loses, and Why*. The authors explain why lobbyists are far less successful than popular rhetoric would suggest (Baumgartner et al. 2009). Of the 98 issue areas studied, 17 percent had only one side on the issue and 60 percent of issue areas had only two sides. Overall, 60 percent of the issue areas had no change from the status quo, 13 percent had modest change, and 27 percent of the cases experienced significant change. The authors conclude that the status quo is very difficult to change. Thus, once a university starts receiving appropriations, it is likely to continue to receive federal appropriations, making lobbyists' continued efforts exercises in maintaining the status quo.

Some of these notions are likely to be at play here with research funding. Traditionally, members of Congress are not experts in science and engineering

and, thus, are in a poor position to help make these types of decisions. Thus, they must rely on information from lobbyists which, in our study, are representatives of research universities. While executive agencies play a role in research funding allocation, Congress is able to allocate vast amounts of money to universities themselves. Lobbying by universities provides a much needed source of information from a reputable organization.

Science-related interest group lobbying and federal funding

The literature on lobbying has produced mixed results on the effectiveness of lobbying on specific policy change. Previous chapters in this dissertation have shown that political control of key institutions (the House, the Senate, and the Presidency) is an important determinant in federal research and development funding. Democratic control tends to lead increased levels of federal R&D funding. Another previous chapter provided evidence that increased federal R&D funding is correlated with an increase in science-related interest groups. Thus, this chapter attempts to discover the relationship between lobbying by these interest groups and federal R&D funding. The theory would provide that increased efforts of lobbyists from science-related interests groups, providing information on the importance of scientific funding, would lead to increased federal science funding regardless of party control of political institutions. Thus, all of the hypotheses, presented later in the paper, relate the increase of lobbying expenditures to the increase of federal research and development funding for scientific research.

Data and methods

The unit of analysis here is lobbying expenditures by science-related interest groups. The primary source for information on the interest group population (that is, what groups exist in the realm we are interested in), is the *Encyclopedia of Associations*. It is important to note that this is not a perfect source, but its use has precedent in the literature (Minkoff, 1993). We rely upon the *Encyclopedia* to build to population list of relevant science-related interest groups and cross check the list with groups that are identifying as science-related on www.opensecrets.org and in their disclosure forms filed in accordance with the Lobbying Disclosure Act.

Data on research and development funding comes from the National Science Foundation's 2012 Science and Engineering Indicators (NSF 2012). The National Center for Science and Engineering Statistics (a division of the National Science Foundation) maintains a database of current and historic federal funds for science and technology research.

Dependent variables

The dependent variables are variations of federal scientific research and development funding. Federal R&D funding is parsed out in a variety of ways to determine if different types of federal R&D funding relate differently to lobbying efforts by interest groups. The initial analysis looks at federal spending on research and development across disciplines. For the initial analysis, we use the dependent variable *Overall R&D*. This is used in millions of 2013 U.S. dollars. I

then break down this variable into two of its components--basic research funding, and applied research funding, creating two additional dependent variables--*Basic R&D* and *Applied R&D*. I did not include funding earmarked for development. I made this decision because much of this money is granted to private companies that are looking to develop research produced at the basic and applied level into market appropriate technologies.

I classify funding by scientific discipline to see whether any general trends observed with the overall funding across disciplines could be carried through when disciplines were examined individually. Were chemists more effective lobbyists than biologists? I analyzed four disciplines as to both their basic and applied research and development funding. This allowed me to create eight additional dependent variables-- *Chemistry basic R&D*, *Chemistry applied R&D*, *Biology basic R&D*, *Biology applied R&D*, *Geology basic R&D*, *Geology applied R&D*, *Physics basic R&D*, *Physics applied R&D*. Taken together, these dependent variables allow me to examine both macro funding by the government and more specific funding. For all of these variables, I use the time period 1998-2013. All values are also corrected using the Consumer Price Index to constant 2012 U.S. dollars.

Independent variables

The key independent variable of interests is *Lobbying Expenditures*. I am specifically examining the lobbying expenditures of science-related interest groups. I predominantly use trade and professional associations that are listed in

the Encyclopedia of Associations and gather data on their lobbying expenditures from the website www.opensecrets.org, which collects and distributes data from the Senate Office of Public Records (Center for Responsive Politics 2014). I cross check this data with information from databases available from the House and Senate websites about the Lobbying Disclosure Act of 1995 (Office of Public Records 2014; Office of the Clerk 2014). Unfortunately, this variable limits the time period of this study because the law only required lobbying expenditure reporting from 1998 onward. This variable is set up as cross-section time-series data. Each group has values based on the thousands of dollars they spent lobbying from 1998 to 2013. Thus, the group is the cross-sectional aspect and the years are the time.

In my models, I include controls for partisanship. I show previously in this dissertation that the political party controlling the House and the Senate affects overall federal funding. I code my partisanship variable as a dummy; if the Democrats hold more seats, it is coded as a “1,” and if the Republicans hold more seats, it is coded as a “0.” I also create two additional independent variables— *House* and *Senate*. These dichotomous variables allow me to make connections to previous work indicating the importance of political institution control for funding changes.

Methods

All of the analyses in this chapter were performed in Stata with panel time series datasets. When dealing with cross-section time-series data, it is possible

to use either a random effects or a fixed effects model. A fixed effects model explores the relationship between a predictor and outcome variable within an entity. It also assumes that something within the individual may impact or bias the predictor or outcome variable. Fixed effects remove the effect of time-invariant characteristics so the net effects can be analyzed. In a random effects model, the variation across categories (here, individual interest groups) is assumed to be random and uncorrelated with the predictor or the independent variables within the model. Here, differences between categories have some influence on the dependent variable. To determine which error is appropriate to use, a Hausman test is performed, which determines if the unique errors are correlated with the regressors. Estimates are stored for both a fixed effects model and a random effects model and stored in Stata. A subsequent Hausman test revealed an insignificant χ^2 (chi-squared) value, leading to the conclusion that a random effects estimator is appropriate. A Breusch-Pagan Lagrange multiplier test indicates that a standard OLS regression is inappropriate, necessitating the need for random and time series effects. In the end, I chose to use a random effects model for these analyses, leading to the conclusions in the upcoming discussion.

Results and discussion

In this section, I present a series of analyses that probe the relationship between the lobbying expenditures of science-related interest groups and federal research and development spending. The first set of analyses examines the

relationship between total lobbying expenditures of all groups for the period 1998-2013 and overall federal R&D funding, basic R&D funding, and applied R&D funding. While this is a relatively short time period (due to lobbying expenditure reporting requirements), the large number of groups in the population results in a large-N. The next set of analyses examines the relationship between lobbying expenditures and funding in different areas.

Total lobbying and federal research and development funding

The first analysis looks at the connection between overall, basic, and applied research and development funding and lobbying expenditures. I test the following three general hypotheses, labeled as Models 1, 2, and 3:

Hypothesis 1: As lobbying expenditures increase, overall federal R&D funding increases.

Hypothesis 2: As lobbying expenditures increase, basic federal R&D funding increases.

Hypothesis 3: As lobbying expenditures increase, applied federal R&D funding increases.

In the statistical models, I control for the party controlling the House and Senate.

The results of this general analysis are shown in Table 1. The independent variable of interest is *Lobbying expenditures*. The results in Table 1 support none of my hypotheses. In no model is the coefficient on *Lobbying expenditures* statistically significant (though the coefficient is in the expected direction in the first model). The coefficients on my party control variables are significant in all three models. The results indicate that *ceteris paribus*, if Democrats control the Senate, overall science R&D funding increases more than 4.5 percent (a nearly

Table 9. Changes in federal R&D funding from 1998-2011. The values for R&D funding are given in thousands of 2013 U.S. constant dollars.

Variable	Model 1	Model 2	Model 3
Lobbying (thousands)	0.066 (0.028)	-0.020 (0.055)	-0.027 (0.065)
House (0/1)	20,319*** (384)	2,740*** (80.5)	2,179*** (95.8)
Senate (0/1)	5,605*** (335)	2,611*** (70.3)	2,469*** (83.6)
Constant	120,677*** (240)	27,799*** (50.2)	27,909*** (59.8)
R ²	0.3603	0.3233	0.2071
Number of Observations	5,728	5,728	5,728

Source: Author's data, National Science Foundation, Lobbying Disclosure Act website

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

\$5.6 million increase from the constant of nearly \$121 million). The effect is even greater when Democrats control the House. In short, Democratic control of Congress is strongly related to all forms of science funding.

Chemistry Lobbying and R&D funding

Because the previous analyses did not support any of my hypotheses, I took a closer and more nuanced look at the relationship between lobbying and science funding. Instead of looking at the lobbying efforts of *all* science-related interest groups, I broke the groups into categories based on issue area. While a multitude of issue areas were represented, I focused on groups in four areas – chemistry, biology, physics, and geology. These are also four areas of science with significant federal R&D funding.

In the following analyses, the general dependent variable (federal research and development funding) is broken into four subcategories. Specifically, I examine how much the government spends on basic chemistry R&D, and applied chemistry R&D.

Hypothesis 4: As chemistry-related lobbying expenditures increase, basic chemistry-related federal R&D funding increases.

Hypothesis 5: As chemistry-related lobbying expenditures increase, applied chemistry-related federal R&D funding increases.

Table 2 contains the results of two new analyses. Listed next to each new chemistry-specific analysis is the corresponding general analysis from Table 1.

Table 10. Chemistry basic and applied R&D as compared to all basic and applied R&D across disciplines.

Variable	Model 4	Model 2	Model 5	Model 3
Lobbying (thousands)	-1.39 (1.87)	-0.020 (0.055)	-2.05 (3.47)	-0.027 (0.065)
House (0/1)	-9,967*** (2,583)	2,740*** (80.5)	50,009*** (4,802)	2,179*** (95.8)
Senate (0/1)	85,429*** (2,435)	2,611*** (70.3)	-56,320*** (4,527)	2,469*** (83.6)
Constant	961,951*** (1,562)	27,799*** (50.2)	763,907*** (2,905)	27,909*** (59.8)
R ²	0.2274	0.3233	0.0502	0.2071
Number of Observations	4,214	5,728	4,214	5,728

Source: Author's data, National Science Foundation, Lobbying Disclosure Act website

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

Once again, the coefficients on the independent variable of interest—*Lobbying expenditures*—are not significant. In short, there is no evidence here that more lobbying by chemistry-related groups leads to more funding chemistry-related R&D. In fact, the direction of the coefficient in both chemistry-specific models suggests that additional lobbying efforts may actually *decrease* the level of chemistry-related funding (though again, the coefficient is not significant). Again, the coefficients on the party control variables indicate that party control of Congress profoundly affects levels of science (in this case chemistry-specific science) funding.

Biology Lobbying and R&D Funding

Next, using the same approach I use in the previous section, I examine the impact of biology-specific science funding.

Hypothesis 6: As biology-related lobbying expenditures increase, basic biology-related federal R&D funding increases.

Hypothesis 7: As biology-related lobbying expenditures increase, applied biology-related federal R&D funding increases.

The results of these analyses are found in Table 11.

Table 11. Biology basic and applied R&D as compared to all basic and applied R&D across disciplines.

Variable	Model 6	Model 2	Model 7	Model 3
Lobbying (thousands)	1,329 (1,355)	-0.020 (0.055)	1,303 (1,293)	-0.027 (0.065)
House (0/1)	343,429 (236,538)	2,740*** (80.5)	1,056,722*** (225,788)	2,179*** (95.8)
Senate (0/1)	1,332,625*** (223,534)	2,611*** (70.3)	1,046,017*** (213,375)	2,469*** (83.6)
Constant	9,001,983*** (149,823)	27,799*** (50.2)	6,506,530*** (143,013)	27,909*** (59.8)
R ²	0.1329	0.3233	0.1680	0.2071
Number of Observations	294	5,728	294	5,728

Source: Author's data, National Science Foundation, Lobbying Disclosure Act website

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

Once again, the results fail to illustrate a lobbying effect. Again, in neither new model is the coefficient on *Lobbying expenditures* statistically significant. And once again, the effects of party control seem profound.

Geology Lobbying and R&D Funding

I also took a closer look at Geology-specific science funding.

Hypothesis 8: As geology-related lobbying expenditures increase, basic geology-related federal R&D funding increases.

Hypothesis 9: As geology-related lobbying expenditures increase, applied geology-related federal R&D funding increases.

Once again, the results were nil. The coefficient on *Lobbying expenditures* in the two new models is not statistically significant. Again, party control seems to matter a great deal.

Table 12. Geology basic and applied R&D as compared to all basic and applied R&D across disciplines.

Variable	Model 8	Model 2	Model 9	Model 3
Lobbying (thousands)	-4,791 (5,212)	-0.020 (0.055)	-5,788 (20,864)	-0.027 (0.065)
House (0/1)	-40,594 (109,805)	2,740*** (80.5)	-140,048 (439,610)	2,179*** (95.8)
Senate (0/1)	14,141 (90,450)	2,611*** (70.3)	-178,436 (362,121)	2,469*** (83.6)
Constant	505,534*** (56,594)	27,799*** (50.2)	574,951*** (226,576)	27,909*** (59.8)
R ²	0.1553	0.3233	0.2030	0.2071
Number of Observations	14	5,728	14	5,728

Source: Author's data, National Science Foundation, Lobbying Disclosure Act website

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

These results do not support our theory, but are consistent with previously reported results.

Physics Lobbying and R&D funding

Finally, I took a closer look at physics-specific lobbying.

Hypothesis 10: As physics-related lobbying expenditures increase, basic physics-related federal R&D funding increases.

Hypothesis 11: As physics-related lobbying expenditures increase, applied physics-related federal R&D funding increases.

The pattern here is the same – the new models provide no support for the notion that lobbying affects government support, and a great deal of support for the notion that party control of the legislature matters a lot.

Table 13. Physics basic and applied R&D as compared to all basic and applied R&D across disciplines.

Variable	Model 10	Model 2	Model 11	Model 3
Lobbying (thousands)	-43.4 (60.8)	-0.020 (0.055)	97.7 (101)	-0.027 (0.065)
House (0/1)	22,174 (24,401)	2,740*** (80.5)	114,251*** (40,468)	2,179** (95.8)
Senate (0/1)	140,037*** (22,572)	2,611*** (70.3)	43,512 (37,435)	2,469*** (83.6)
Constant	2,296,810*** (15,751)	27,799*** (50.2)	931,417*** (26,123)	27,909*** (59.8)
R ²	0.3946	0.3233	0.1696	0.2071
Number of Observations	70	5,728	70	5,728

Source: Author's data, National Science Foundation, Lobbying Disclosure Act website

Note: Numbers in parentheses are standard errors

*** p < 0.01; ** p < 0.05; *p < 0.1

Conclusions

In this paper I examine the relationship between the lobbying expenditures of science-related interest groups and federal research and development expenditures. Included in this analysis were membership groups, trade associations, and professional associations. In sum, in none of my models did I find a statistically significant relationship between the independent variable of interest and government spending on science. In my general models as well as my specific models, lobbying expenditures just did not seem to matter. The statistical models were, however, informative. The political control variables I included in each model (dummies for each chamber) produced significant results in almost all cases. In short, the data show very clearly that the level of federal science funding is profoundly affected by which party controls Congress. Specifically, Democrats are much better for funding science than Republicans are.

Previous studies on the relationship between lobbying and legislative outcomes are mixed. My findings are not mixed at all—all of my data points to the conclusion that lobbying does not matter much. The findings do emphasize, however, the importance of political control of Congress for policy outcomes. The implication of this finding for interest groups is clear—they may get more “bang for their bucks” by trying to affect election outcomes rather than policy outcomes.

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CONCLUSION

As more and more of our public policy decisions involve science and technology, the political activities of scientists becomes more important. This dissertation is a baseline study for the activities of these activities. Interest groups are studied less frequently in the political science literature, providing a critical need for this study. This dissertation is an attempt to bring the political activities of science and scientists in to the realm of traditional political science research.

The first chapter concluded that, largely, federal R&D funding increases under Democratic control of key political institutions. This is, perhaps, an intuitional conclusion. The Democratic Party has long been associated with liberal policy stances towards topics like the environment, clean/green energy, and welfare. This leads one to logically conclude that the Democratic Party would be more likely to support enterprises like scientific research and technology, activities which do not have immediate market applicability. This is could be especially true in basic research, which attempts to address and answer fundamental questions about life, the universe, and everything. While much basic research has eventually led to market innovations (cell phones would not be possible without basic research on transistors and advanced materials), this is not immediate and not guaranteed. In support of this line of logic, I quantify the change and show that, largely, federal R&D funding increases when Democrats control the House, Senate, and presidency. This holds when examining overall

R&D funding, basic research funding, and applied research funding. I also find that conservative, liberal, and neutral agencies tend to allocate higher R&D funds when Democrats control these three political institutions. This is especially interesting to me because I would expect to see lower levels of funding, or at least smaller increases in funding, to, say, the Department of Defense when Democrats are at the helm. The DoD is infamous for its support from the Republican Party, so the fact that even their R&D funding increases under Democratic administrations is especially interesting. It is also interesting that the control variables have the direction expected – science funding increased during the Cold War and decreased during economic recessions. America was especially interested in building their military and increasing their capability to make war during the Cold War, and investment in science and technology is key to military advances. It is also logical for funding to decrease during economic recessions because resources will be diverted elsewhere.

Future iterations of this paper will certainly include a more distinct examination of how science funding changed and was affected by the terrorist attacks of September 11. I think this could be especially interesting because I suspect one would find a sharper partition between basic and applied research than I find at the high level examined in my dissertation. Especially with the creation of the Department of Homeland Security, I think that I would find that the government invested large amount of money towards groups investigating applications of previous research, especially in the area of trace detectors for

nuclear and chemical agents. There will also be large investments towards deployment of technology as compared to basic scientific inquiry. I think this would also be an interesting way to study how the allocation of funds changed. I suspect that nuclear engineering departments saw a large upswing in their funding after 9/11 that has either leveled off or decreased over the last several years. I would perhaps also include a qualitative examination of, for example, one specific agency over time. For example, we could examine how Department of Defense funding has changed over the years. I suspect we would find large investments in basic research through the 1960s and 1970s that moved towards a focus on applied research over the decades.

Additionally, I would be interested in studying the role of large, international collaborative efforts on science funding and science output. The idea of “big science,” where large organizations spend large amounts of money to build huge, massive, and expensive scientific equipment designed to be used by large numbers of users. The Large Hadron Collider built at CERN (the European Organization for Nuclear Research) in Switzerland is the largest particle accelerator in the world and is used by hundreds or thousands of users annually for a wide range of scientific research. The increase in these types of resources has fundamentally change the way that science, especially fundamental science, is done worldwide. It would be an interesting study to try and determine if these large scientific enterprises are taking funds away from smaller groups that don’t focus on fundamental questions requiring things like

particle accelerators, or if the additional funding for “big science” projects is in addition to and on top of more traditional research.

The second chapter of this dissertation focuses on the way that science-related interest groups have grown since the 1960s. The major contribution to the literature is the idea that the science-related interest group population has not only grown over the previous five decades naturally, the increase in federal R&D funds has contributed to that growth. An additional \$5.8 billion in research funding contributes to an additional group joining the population. This is a novel take on the “energy” aspect of the ESA theory developed by Virginia Gray and David Lowery.

This chapter also provides commentary on the founding of new science-related groups in an interest group population. This follows work done by Gray and Lowery and Nownes that shows that the number of foundings annually follows a Poisson distribution, rises quickly, then decreases once a maximum carrying capacity is reached. This chapter specifically contributes to this literature by linking the number of foundings annually to federal R&D funding. I find that increased federal R&D funding leads to an increase in group foundings for a given year. However, this effect dissipates eventually when the number of new founds again decreases.

Future iterations of this paper would focus on interest group growth in one specific area. I think an area ripe for study would be to examine the growth of defense related groups conducting research and development. It is likely that,

like other interest group populations, defense interest groups have grown in number and specificity have grown over the decades. We could specifically examine the growth of these defense related groups in relation to R&D outlays by the Department of Defense.

Future studies would also benefit from inclusion of groups from the *New York Times* index to make sure that the list garnered from the *Encyclopedia of Associations* is correct and complete. While the *Encyclopedia* certainly includes many groups, it is likely that several are missing. Those most likely to be missing are those that are mobilizing to counter an extremely salient policy issue and is relatively short lived.

The work connecting R&D funding to new interest groups entering the population naturally leads to my third chapter, which looks at how the overall interest group population becomes more specialized over time and in relation to federal R&D funding. The major contribution to the literature that Chapter III provides is quantitative evidence that interest group populations get more specialized both over time and with the increase in federal R&D funds. Interest groups studies are said to be theory heavy and data poor. Thus, this study attempts to quantify this long theorized idea. Science-related interest group populations become more specialized over time and with increased funding. This supports the theory because as the size of a population increases, groups tend to specialize (making the population more specialized overall) to segregate in to niches and avoid competition. Additional R&D funds also cause groups to

become more specialized because the more specialized because groups that are segregated in to niches are less likely to compete with one another for federal R&D funds.

Another interesting addition to this paper in future iterations will be to include a section on how groups changed in response to 9/11. After the 9/11 terrorist attacks, Congress created large amounts of new budget money to spend towards defense and anti-terrorist activities, including R&D activities (especially in detection and crisis response). In response to this, I suspect a large number of new groups formed. I also suspect that groups were more specialized than the population that was already in place. A highly specialized group would be more likely to mobilize their members to lobby Members of Congress and the bureaucracy for R&D funding. They could use their specialization as a way to illustrate the high priority for research in their issue area. An especially interesting area for study would be the specialization of defense-related groups who perform government-support research and development and the increase in R&D funding from the Department of Defense.

The fourth chapter focuses on the lobbying efforts of the groups studies in Chapters II and III. Much to my surprise, lobbying by these groups produced no statistically significant results on changes to the federal R&D budget. This is in keeping with some of the literature and in opposition to the rest. I do happen to think there is some relationship between lobbying and federal R&D funding, but I

think that I will have to focus and/or refine the dataset to tease out the relationship.

An obvious first step to moving forward is focusing on lobbying efforts for a specific law. It is not unreasonable to believe that the effect of lobbying is lost when looking at such a broad policy decision like R&D funding. But looking at a specific law, such as a House resolution for new money devoted to R&D in a specific research area, might allow more clarity as to the effect of lobbying. A very specific law that would influence, say, analytical chemists would bring out more lobbying efforts than large, expansive budgetary exercises in Congress with no specific allocations in mind.

It could also be interesting to study specific areas of federal R&D funding more completely and thoroughly. For example, climate change research has been expanding over the previous three decades. The number of groups advocating for climate change, from a variety of perspectives, has also grown over the previous three decades. The connections between the lobbying and advocacy of these groups and attention to the climate change issue are an important relationship and one that has not previously been studied in the political science literature. Once a relationship between lobbying/activism and political attention and salience is established, the connection to climate-related R&D funding can be ascertained. I think that, at least in the case of climate change, the connection will be easier to find. Climate change did not naturally come to be important to lawmakers and decision makers; it had to be brought to

their attention by interested individuals and groups. These same groups also had to teach decision makers about the importance of scientific research to study the causes and potential solutions to climate change problems and to make sure funds were allocated.

Another area of study, though one that would require a complete research redesign, is to study the R&D tax credit. The Research and Experimentation Tax Credit is a general business tax credit for businesses that are incurring R&D expenses within the United States. While this isn't strictly government output or outlays for scientific research, taxes that are withheld can certainly be viewed as support of R&D. This is an especially interesting take on federal R&D spending because many of the activities are taken by large, private firms. Since the R&D tax credit's original expiration date of December 31, 1985, it has been extended fourteen times. While the extension would seem to be certain, individuals (either lobbyists or staffers or even Members of Congress themselves) still have to take it upon themselves to bring up the tax credit for renewal and extension. It would be interesting to find a connection between lobbying efforts of firms that take the R&D tax credit and lobbying efforts of similar large businesses not conducting R&D. This could be a difficult project to tease out results from because large firms that also perform R&D, such as Johnson and Johnson and Apple, lobby on a wide range of issues, not just issues related to the R&D tax credit. However, this important tax credit has not been studied in the realm of political science and

especially lobbying and interest groups, so this is an important and potentially ripe area of study.

Overall, there are many ways that the political activities of scientists and science-related groups can be brought in to the realm of traditional political science literature. There have been several articles and books published on the activities of lobbyists. However, there has been no work done on how lobbyists are perceived by Congressional staffers. Several years ago, I spent the summer in Washington D.C. and during that time, I spent time interviewing Congressional staffers about how they receive information from lobbyists and their relationship with them. As it happens, at the end of the summer I had completed 20 interviews that lasted thirty to forty-five minutes each. I interviewed five Republican House staff members, five Democratic House staff members, five Republican Senate staff members, and five Democratic Senate staff members by the end of the summer.

The broad conclusion that I garnered from all of these interviews is that their relationship with lobbyists is similar to what we have learned from interviews with lobbyists. This is interesting because it confirms previous political science work in the realm of interest groups and lobbyists. Almost all of the staffers confirmed that they meet with lobbyists from groups that both support and oppose the policy stances of their Member of Congress. However, they tend to meet more regularly with lobbyists who are on the same “side” of a policy issue.

They also tend to believe and rely on information provided by lobbyists who fall on the same side of a policy issue.

For example, one staffer (the lead legislative assistant for environmental and energy issues) from an extremely liberal House member's office commented that every year, a lobbyist from the coal industry meets with her and discusses why they believe the Member of Congress should support pro-coal legislation. She comments that they are always polite to one another, even though they both know they are not going to change each other's minds. She accepts his "glossy pamphlets" and files them away. When asked why she thought he meets with her annually, she commented that she thought it was because he just wanted to stay on her radar, make sure she knows there is someone from the coal industry that she can call when she needs, and, perhaps most importantly, to check off to his boss that he met with a large number of staffers (regardless of their receptiveness to the policy issue). This was especially interesting to me because her comments complement what scholars have heard from lobbyists about why they meet with Congressional staffers who do not necessarily agree with their policy stance.

Continuing this set of interviews and writing the conclusions will be an interesting and, I think, impactful contribution to the literature. We have some idea of how lobbyists spend their days. This study asks the question – is this time spent well? Or are lobbyists' activities wasted efforts? I think that there is a

mutual understanding between staffers and lobbyists about the role each other plays and furthering this study could address this question.

It would also be interesting to study the day-to-day activities of science-related organizations. Scholars have spent time following lobbyists for days or weeks at a time to determine what they do during their daily activities. It would be interesting to see if lobbyists for science-related groups spend their time pursuing the same activities as their counterparts for non-science groups. I suspect that the lobbyists for organizations such as the American Chemical Society spend a significant amount of time working with scientists and studying the issues from a technical perspective.

I think it will also be important to interview scientists themselves (not lobbyists for science-related groups) to determine how much they know about the political activities of groups of which they are members. We could also use this opportunity to ask them about their individual activism and whether they think it matters. I suspect that we will find that many scientists spend little to no time thinking about the lobbying efforts of groups they participate. However, I think the same scientists who do not participate in activities like emailing their Members of Congress would also admit that politics and Congress have an effect on their work because of how much science is federally funded. This relationship between a vested interest in the federal government due to funding issues and lack of participation is an interesting application of Mancur Olson's collective action problem. I do think, however, that we could meet during these interviews

scientists who recognize the importance of politics in science and spend at least some effort following policy debates in Washington and emailing their Members of Congress, even if it is at the urging of trade and professional associations in which they are members.

Science is playing and will continue to play a more important role in national policy debates, from defense to the environment. Thus, the political activities of scientists are a rich area for study to increase our understanding, from a political science perspective, of policy changes over time.

VITA

Allyn K. Milojevich was born February 28, 1983 (*not* a leap year). She graduated with a BS in chemistry from Washington and Lee University in 2004. After graduation, she completed a MS degree from Virginia Polytechnic Institute and State University in December 2006. While trying to find herself, she spent one year as an instructor at Virginia Western Community College in Roanoke, Virginia. After starting a PhD in chemistry at the University of Tennessee, she realized she made a huge mistake and, with little forethought, enrolled in graduate level coursework in political science. Her main research interests lie in interest group activity and the interplay of politics and science.

Allyn has accepted a post doc at Oak Ridge National Laboratory in the Global Security Directorate supporting the Chemical Security Engagement Program. She lives in Knoxville with her husband, Chris, and two little boys, Isaac and Daniel.