# Agencies and Appropriations

by

William D. MacMillan

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Political Science)
in the University of Michigan
2012

Doctoral Committee:

Professor Walter R. Mebane, Jr., Chair
Professor Brian P. McCall
Professor Charles R. Shipan
Assistant Professor Jowei Chen

To Jacquelyn and Josephine.

## A C K N O W L E D G M E N T S

There are way too many debts I've accumulated during my training to acknowledge them all, so I wish to highlight one person's contribution. Walter Mebane turned around my career from being a lost graduate student to an academic with purpose and direction. Thank you, Walter.

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# ABSTRACT

**Agencies and Appropriations**

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**Chair: Walter R. Mebane, Jr.**

Federal agencies operate under conditions of uncertainty, of many types. In this dissertation, I examine how agencies make trade-offs between financial security and policy goals in order to protect themselves from political uncertainties. I develop a dynamic, discrete choice model of stochastic control of appropriations (the legal process by which agencies are granted budgets) to study the trade-offs made and the strategies used to protect policy goals. I find that agencies follow a strategy of preserving *status quo* policies. Agencies may prefer to increase output, but increasing budgets will be used to pad agencies' operating budgets, instead of increasing output, in order to protect current policies. This pattern is increasingly true as appropriations to an agency increase, to the point that agencies appear entirely unresponsive to changes in appropriations.

# 1

# Motivations

## 1.1 Introduction

Early in 2009, president Obama's appointee to the position of Assistant Attorney General-Antitrust (AAG-A), Cristine Varney, signaled the start of a boom time for antitrust enforcement. At the start of her tenure as AAG-A, Varney repudiated Bush-era reports calling for weaker antitrust enforcement and stated that a contributing cause to the 2008-2010 recession resulted from lax antitrust enforcement. The boom quickly turned to a bust by 2011. Varney had moved on from the position of AAG-A, and Congress and the president moved to cut the ADOJ's (along with the Federal Trade Commission) budget and close permanent field offices in Atlanta, Cleveland, Philadelphia, and Dallas. The bust threatens the policy goals of career antitrust enforcers. Careerists feel that the cuts and closures make little sense if the goal is to fight anti-competitive deals in a cost effective manner. "If we cost $20 million a year and collected $2 million a year, you'd have a good case for closing our office [...] but if IBM had an office that cost it $2 million a year and it collected $20 million a year, I dare say IBM wouldn't close that office" is how one lawyer responded to the proposed closures (O'Keefe, 2011). Jon Leibowitz, chairman of the FTC, expressed his disappointment about the budget cuts by saying, "We want to be able to handle all the anti-competitive deals, and not pick and choose among them" (Catan, 2011). Behind these quotes are two ideas: career bureaucrats feel that cuts threaten their policy goals, and that

they are formally powerless to fight against the cuts.

Congress and the president have a number of tools, formal and informal, to control the bureaucracy. Together, they can pass new rules and regulations, change the mission of an agency, and have the "Power of the Purse," appropriations. Individually, Congress can investigate the bureaucracy and the president can appoint a number of personnel. Informally, both actors frequently intercede in agency politics to achieve desired policy outcomes. Agencies, though they possess policy goals themselves, lack these formal tools to control their means of production. The only real formal tool they have is discretion regarding when and how to implement policy. What strategies do bureaucrats use to follow policy goals, considering that the only tool they have is policy itself? In what way are bureaucrats responsive to the formal signals from the president and Congress, when these signals conflict their policy goals? To answer these questions, we need to understand the structure of how policy choice impacts appropriations, and the weight that agencies place on policy, appropriations, and the future. Understanding the value of both policy and money is important, since the two relate to each other endogenously. The role of future rounds of policy making are important, since the structure of the politics is itself defined by a dynamic environment: appropriations. Lacking formal tools, agencies must do with the strategic capacity they have.[1]

Budget cuts represent a significant threat to how bureaucrats themselves view how policy goals should be accomplished. In the 2011 budget, cuts hit the Patent and Trademarks Office. In response, the director said, "I recognize that these measures will create new challenges for our ability to carry out our agency's mission, but we will continue seeking

[1]There is a conceptual fuzziness between agency *actions* versus *policy* versus *ideology* that runs through this work. I treat agency actions as being the realized work of a policy. The term I use for a aggregate count of agency actions is a "policy instrument." A policy, in this framework, should be thought of as a set of rules that guide actions by an agency. Ideology is the preferences an agency (thought of as a single actor) has over policies and actions. To that end, this work describes agencies as having preferences over actions (though I do not consider policy, *per se*.) An "activist" or "liberal" agency is one that prefers to increase output. A "conservative" agency is one that prefers *status quo* policies. The agency is conservative in the sense that it prefers to not alter the aggregate count of it's actions. For better or worse, I use the terms "policy," "policy instrument," and "actions" somewhat interchangeably throughout.

innovative ways to do more with less." Kappos (2011). In the face of budget cuts, the Patent Office is attempting to fulfill its original agency mission–or, at least, the mission that the Office sees itself as pursuing.

### 1.1.1 Road Map

In this project, I argue that agencies choose policy to protect the *status quo*. Agencies' dominant strategy in dealing with the appropriations process is to insulate themselves from uncertainty. Agencies have a long time horizon and consider strategy across both the long run and the short run. This leads to an observed state of the world where agencies appear selectively strategic. When budgets are tight, agencies act strategically by responding to an increase in funding by a corresponding increase in their workload. When budgets are less tight, agencies appear to be unresponsive to changing appropriations.

In the rest of this chapter, I discuss how scholars have approached the study of the interactions between bureaucrats and the appropriations process. In short, scholars are in disagreement about how the structure of the appropriations process is best understood. Assumptions about appropriations are consequential; the implications of the assumptions of structure and motivations lead to different understandings of how appropriations works, and heavily colors the empirical findings from any single specification.

In Chapter 2, I develop an endogenous, dynamic discrete choice model of policy choice by agencies. I build off the works of Krause (1999) and Carpenter (1996) implicitly, and Rust (1987) explicitly. Krause (1999) describes an endogenous, but relatively structure free model of policy choice. In turn, Carpenter (1996) describes a structural, but not endogenous model of budgetary signaling. I build off the theory described in Rust (1987) to create a stochastic control model of appropriations. I argue that agencies attempt to control the appropriations process in order to protect themselves, in terms of policy. The formal models I develop in this chapter also double as a research design. I derive functional forms to recover the primitive parameters in the utility function for agencies, and the means to

recover these parameters.

### 1.1.2 The Black-Boxing of Appropriations

A non-trivial assumption made in this project is that the appropriations process can be described as a simple transition function. I reduce the appropriations process to an incremental response to policy choice. In Chapters 3 and 4, I find if agencies choose to increase output, they are increasingly likely to see an increase in budget, and that they are generally unlikely to be punished for a particular policy choice.

Of course, this assumption requires turning a blind eye toward Congress regarding appropriations. I justify this assumption on a couple of grounds. First, this study is focused most directly on *agency policy strategy* and not Congressional organization, or the impact thereof. I am attempting to answer questions about how agencies interact with appropriations generally, and not answer questions about how Congress chooses to organize itself regarding appropriations. Second, while the appropriations process is complex, agencies find themselves at a disadvantage regarding tools to impact the process. Ultimately, agencies have one formal power to impact the appropriations process: the discretion granted to them by law and practice to choose policies. Because of the focus on agencies, and the lack of complex tools to affect appropriations, I chose to simplify the models on the side of Congress.[2]

### 1.1.3 The Rest of the Road Map

Following the theoretic development, I test the model I develop against the enforcement behavior of federal agencies. I begin by studying the Department of Justice's Antitrust division (ADOJ) in detail, and then move to examine the behavior of a number of agencies.

[2]In the modeling chapter, I do attempt to allow for more complex strategic reasoning on the side of Congress. I find that developing the models in this direction does not necessarily add much to the model for the amount of complexity it introduces. Primarily, this is because the model can still be solved in a decision theoretic manner, despite being developed as a strategic game. Further, solution concepts become much more dependent upon the functional forms being chosen which adds to the complexity of the models.

I find that agencies act to preserve status quo policies. The difference between the two regards the trade offs agencies make. The ADOJ maintains an activist policy position. In general, they would like to intervene in the economy more, but their strategy involves making a trade off for fiscal security. For a larger sample of agencies the two sets of preferences (over money and policy) act in coordination. *Agencies are conservative*, meaning that they prefer the status quo. This preference consideres both the utility they get from having a budget of a particular size, and the utility they get from implementing policy.

I conclude in Chapter 5. I discuss questions that are raised by the empirical findings here, and how to reconcile them with broader literature. Notably, I find that many agencies seem to operate in an "abdication" model (Lowi, 1979). Many agencies seem to operate without clear direction or punishment from political principles. I discuss how questions of discretion can be considered for future research based upon this work.

## 1.2 Bureaucratic Motivations and Strategies

Agency funding and how it effects policy is a topic of broad popular appeal and has long been an interest of political scientists (Lindblom, 1979, 1959; Fenno, 1966; Wildavsky, 1964). Extant literature makes assumptions about these two dimensions, which influence the conclusions the authors make about agency behavior and strategies. These reductions are meant to simplify an otherwise highly complex formal problem. The appropriations process is a fluid, repeated interaction between Congress, the president, and agencies as they battle over both policy and appropriations (Ting, 2001).

Extant work has assumed that agencies are policy driven, or they are not, or that they are fluid and dynamic, or that they are not. These investigations have shown that agencies are, to some degree, all four. The open question then regards to what degree are they driven by money or policy, and to what degree they are dynamic versus static. How far into the future do agencies look? What balance between policy and money do agencies strike? How

do these things interact with each other? What is lacking is a method to determine to what degree agencies are policy driven and dynamic.

Niskanen (1971) argues that budgets drive agencies' utilities. In this economically oriented set of arguments, bureaucrats are driven entirely by their concern for their own budget. Policy is a non-factor, unless a particular policy choice impacts their resource availability. Alternately, scholars have assumed that agencies are entirely policy driven (Miller and Moe, 1983; Ferejohn and Shipan, 1990; Bendor and Moe, 1985). Agencies gain utility from policy, and not at all from budgets. The budgetary signaling literature contends that budgets contain information about policy, and agencies seek to minimize a policy loss function (Wood and Anderson, 1993; Wood and Waterman, 1994; Carpenter, 1996).

A second area of contention between scholars is the dynamic nature of appropriations. Qualitative literature describes the relationship between budgets and policy as a complicated, yet rational one. "Budgeting proceeds in an environment of reciprocal expectations that lead to self-fulfilling prophecies as the actions of each participant generate the reactions that fulfill the original expectations" (Wildavsky (1964), pg. 23). While rational, the relationship is dynamic in the sense that previous rounds are crucial to determining the state of the current round. Wildavsky (1964) argues "budgets are never actively reviewed as a whole every year in the sense of reconsidering the value of all existing programs as compared to all possible alternatives" (15). The budgetary signaling literature, by comparison, has focused on static games. The model described in Bendor and Moe (1984) and implemented in Wood and Waterman (1994) and Wood and Anderson (1993) is a memoryless game, where only the absolute value of appropriations matters. Contrasting this is the punctuated equilibrium approach (Davis, Dempster and Wildavsky, 1966; Baumgartner and Jones, 2009; Padgett, 1980) where dynamic models of appropriations and agency behavior are based on the previous year's policies and budgets. By comparison to the budgetary signaling literature, punctuated equilibrium models do away with static models and

place the emphasis on the relative and current (versus absolute) levels of the budget.

An alternate emphasis on strategic interaction leads to different conclusions about agency behavior. Many strategic models focus on a version of a one shot game, with no institutional memory from one year to the next (Bendor and Moe, 1985; Weingast and Moran, 1983; Wood and Anderson, 1993; Wood and Waterman, 1994; Ferejohn and Shipan, 1990). These models assume money has very little value as a thing in itself; instead, money is the only means for achieving a policy goal Agencies do not balance both money and policy concerns, under this framework. Wood and Anderson (1993), a study of antitrust policy, implement the model described by Bendor and Moe (1985). In the formal model, called an aggregate production model, agencies operate at a production possibility frontier. This means that agencies use all available resources when implementing policy. Wood and Anderson use the rationality assumption to justify entering appropriations as a linear term with antitrust investigations as the regressors. The authors find that appropriations significantly effect the number of investigations performed by the ADOJ for 1970-1989. This area of work has made strong contributions to the understanding of the impact of appropriations in a global way. However, it is more difficult to use these works to speak to the dynamic, contextual affect of appropriations. Across the two areas, strategic models and punctuated equilibrium models, there are complementary findings, though they are difficult to connect. Agencies have a global concern for policy as well as a more contextual balance of policy and appropriations. The open question regards the balance of these two interests.

Previous work has set up two dimensions of division over the arguments: a strategic versus dynamic dimension, and a money versus policy dimension. Most pieces enter into this argument with an assumption about where they lay on these two dimensions. In both figurative and literal senses, the model I develop integrates these two dimensions to uncover to what weight agencies place on money versus policy, and the weight of long run versus short run concerns. Figuratively, I advance the discussion by highlighting that previous work has made implicit assumptions about either time or how agencies view the importance

of money. Literally, my model contains a double integration across time and across the impact of policy actions. The point of combining these views is to show the trade-offs that agencies make when they choose policy regarding time, money, and policy.

## 1.3 Budgets as Endogenous Controls

The abdication thesis argues that Congress has shifted its formal power of lawmaking to the bureaucracy and has given up its own interest in policy outcomes (Lowi, 1979). This single argument has spawned an incredible amount of literature in the discipline, primarily oriented around showing the ways that Congress has an influence over the bureaucracy. The two major tools of Congressional control, lawmaking (to supersede rules and regulations) and appropriations, have been shown on the margins to impact how agencies behave. The null in these cases, while inspired by an abdication like thesis, is not abdication *per se*. Instead, the alternative is typically that a particularly conceived realization of Congress has an effect on the work agencies perform, and the null is an utter absence of control.

Few scholars would argue that bureaucracies are entirely beyond control, and that politicians have entirely forfeited their right to craft legislation. A description of abdication involves the creation of what is a second, lower level of government that performs the same functions as the national government, but for a specific issue area. The sub-government acts as legislator, executive, and judiciary, and works very closely with the firms and/or individuals that it regulates (Lowi 1979). The sense in which abdication seems to be important is not the fact that power has devolved from the national government to other actors. Instead, it is implied that this devolution in power brings with it ambivalence over outcomes. The national government, having granted authority to other actors, then regards all policy outcomes as being equivalent in the utility to the government itself. These two parts seem necessary: power is devolved, and the highest levels of authority are effectively removed from altering outcomes.

Abdication involves agencies setting the status quo policy, their discretion covers all possible policies. This is not to say that the abdication outcome was not desired by some set of principles at some time. Instead, I want to focus on what the counter argument that scholars make to their own models. Instead of abdication suggesting that there is no control, an abdication argument should argue for a context and time dependent arrangement having a lasting effect. The shadow of old coalitions loom over current politics.

### 1.3.1 Extant arguments

Studies of appropriations have focused on how agencies respond to partisan signals inherent in either total or changing dollar amounts of appropriations. Budgetary signals make it explicit that agencies perceive extra information inherent in the dollar amount. Previous scholarship had claimed that bureaucrats maximized their personal utility by maximizing budgets (Niskanen, 1971). Contrary to this position, political scientists have instead argued that bureaucrats are primarily concerned with what policy gets implemented, and that their utility is a function of the distance between their ideal policy and what they must implement (Miller and Moe, 1983; Bendor and Moe, 1985; Moe, 1985, 1984). Empirically, scholars have found mixed though marginally positive results regarding the budgetary signaling hypothesis (Wood and Waterman, 1991, 1993; Weingast and Moran, 1983; Carpenter, 1996). A common theme in these studies is that the null is an absence of control, even if the contrary argument is something akin to an abdication thesis.

A nicety of studying appropriations politics is the strictly defined domain. Appropriations must theoretically have an effect on policy outcomes. However, as one moves from this strictly defined setup into more general questions of agency responsiveness, Congressional organization, and appropriations politics the volume of literature explodes. There are two literatures which I think are relevant that I wish to highlight here. First, appropriations politics has become a testing ground for models of Congressional organization (Kiewiet and McCubbins, 1988, 1991; Shepsle et al., 2009; Aldrich, Gomez and Merolla,

2006; Adler, 2000; Schickler and Sides, 2000; Aldrich and Rohde, 2000; Levitt and Snyder Jr., 1995). Appropriations is interesting in this regard for two reasons. One reason is because appropriations has seen fairly radical and discrete shifts in organization in the last one hundred years. Specifically, party leadership in the House and Senate divested jurisdictional power from the appropriations committees, and then later returned it. This shift had consequences for Congressional organization (Schickler and Sides, 2000; Aldrich and Rohde, 2000; Bovitz, Carson and Collens, 2012). The second reason has to do with the relative stability of appropriations outside of these discrete shifts in power. As a result of this intergenerational stability in membership of the committees, appropriations seems to be an ideal testing grounds for general theories of Congressional organization (Aldrich, Gomez and Merolla, 2006). Less specific to Congressional organization, scholars have looked at appropriations for understanding inter-branch conflict (Wlezien and Soroka, 2003; Anderson and Harbridge, 2010; Dharmapala, 2003; Wlezien, 1993; Shepsle et al., 2009).

### 1.3.2 Budgetary Signals sent by Congress

The appropriations figure sent down by Congress is argued to serve as a signal of Congress's preferences over policy. I classify the sorts of models into two groups: strategic models, and dynamic models of budgetary signals. Strategic models are intended to imply an emphasis on contemporaneous strategic action by Congress and/or agencies. The general intuition is that more budget should imply more output, a model formalized by Bendor and Moe (1985). In the aggregate production model proposed by the authors, agencies work at the production possibility frontier for their public good. Since agencies are working as hard as they can to produce public goods, changes in the budget should directly lead to changes in output. The aggregate production theory was directly used in Wood and Waterman (1993); Wood and Anderson (1993). Carpenter (1996) argues that agencies are responsive to the history of changes, implying that more recent changes in the budget may have less impact than earlier changes. In general, this class of models have found that agencies respond

slower, and with less magnitude to changes in budgets than might otherwise be believed. To explain the lack of responsiveness, Carpenter (1996) goes beyond the strategic models to describe a policy environment where politicians are implored to do something to curtail offending agencies, and agencies are compelled to respond, but minimally, mostly to guarantee visible results for constituencies.

The second class of models are of "bounded rationality" (Baumgartner and Jones, 2002, 2009). In this class of models, the emphasis is on the dynamic limitations of agencies and Congress, at the expense of a more global rationality incorporating preferences over a very large set of possible outcomes. Actors are limited to a fairly small set of outcomes, given their current location in a policy space. Behavior is thought to be rational within a local policy space. Large shifts in policy are argued to be pressure from forces outside the local policy equilibrium which shift the entire location to a new policy equilibrium, leading to the terminology of "punctuated equilibrium" (Baumgartner and Jones, 2009). These shifts are thought to operate according to an alternate logic to the local rationality. The authors argue that agencies are rational within specific temporal equilibrium, but large shifts happen due to things that exist beyond the rational model. Compared to the failures of the strategic model, an opposite set of problems emerge. While changes appear unduly small in strategic models, to describe policy change outside the local equilibrium, authors must resort to a story which goes beyond the incrementalism of the small local changes.

The term "incrementalism" has been used by both camps to describe the root qualitative models that they claim to be building from, a term which has multiple origins (Wildavsky, 1984; Lindblom, 1979; Fenno, 1966). All three works describe, on some level, a process where the policy implemented (and the budgets granted) are the previous budget or policy, plus or minus some amount, perhaps describable to "error". These works, and the empirical literature that follows seeks to answer two questions: what information is contained in the budgetary signal from Congress? And second, are bureaucrats responsive to that signal? The answer depends on which camp work tends to fall in. In strategic models, Congress

sends a clear signal, and bureaucrats are minimally responsive, if at all. In models of bounded rationality, Congress and agencies play locally responsive games, with Congress sending clear signals and agencies responding in kind, but large shifts happen due to forces outside the scope of the local game.

Ultimately, the answer to both questions are empirical ones, but they should be jointly answered. Unless it is understood to what degree agencies are responsive, it is not clear how we can understand a budgetary signal, and vice-versa. I argue that the observed reality is a mixture of both types of responsiveness–agencies and Congress have preferences over outcomes in all policy spaces, but are largely constrained by their current behavior. In this essay, I show how both models of strategic signaling and bounded rationality are special cases of a more general model. The goal of the model I propose, however, is not to declare one strictly the winner, or to demonstrate a novel feature about these models which highlights the politics. The ultimate goal is to estimate the parameters of the model utilizing the structure derived in the model, in order to show to what degree the models are blended.

# 2

# Models of Optimal Policy Choice

## 2.1 Introduction

In this chapter, I outline a general model that is used in the following two empirical chapters. The general theory is set up to consider many agencies. In the chapter on antitrust enforcement, there is only one agency being considered. In the chapter where I consider many agencies, and explore questions about agency structure (i.e. independent versus executive), the structure allows for agency specific features to the data. However, the optimization problem that agencies face is restricted so that they all face the same problem. In other words, I treat the work of all the agencies as if they all were simply part of one really big agency.

This chapter also develops a two-sided optimization problem, and discusses problems of solving this model. The second "side" in this case is the decision making of the people who grant appropriations. It is not clear, nor do I attempt to clarify, whether this is exactly Congress, the president, or both. In practice, I refer to Congress as the appropriator. The most interesting finding in the second section is a two-sided model needs a sufficiently rich description of the utilities of the different actors, otherwise the strategies for the two sides reduces to unstable orbits, and there is not a fixed strategy. The necessary complication is an appealing one–both sides must have loss functions in the functional form of their utilities.

Both sides need to have utilities that are neither infinitely increasing nor decreasing in either policy or money.

## 2.2 A Structural Model of Policy Choice

The October 1st start of the fiscal year structures an otherwise fluid and dynamic environment of policy choice. The resources defined in the appropriations amount allow agency planners to meet policy goals. By utilizing assumptions about the rational motivations of agency planners and the dynamic path of appropriations, I develop a dynamic discrete choice model of policy choice. The model developed here is constructive in the sense that the derivations craft a strategy for recovering the primitive parameters of the model directly from observed data.

There are a couple of general intuitions from the model I wish to highlight. First, the overall intention of the model is to develop a method to deal with the endogenous nature of appropriations. I assume policy choice influences future appropriations and that it does so in a regular, structured way. I use the assumptions about structure to derive a method of weighting observed policy and appropriations data. Essentially, the weight is a shadow price and it describes the expected costs from making a policy choice. To calculate the shadow price, I describe a method of calculating the shadow price within a maximum likelihood estimator. Failure to include the shadow price[1] leads to an estimator where agencies place no weight on the future; such an estimator would produce inconsistent estimates of the relationship between policy and money.

### 2.2.1 Notation and Description of the Model

The start of each fiscal year, noted $t$, sets the appropriations to each agency, $\alpha$. Agencies make a choice to adjust policy by either doing more $(m)$, less $(l)$, or remaining with the

[1] By which I mean the sum total of future costs associated with making a policy decision.

status quo $(s)$, with their choice in any given year being noted $a_{\alpha ti}$. Agencies have a number of policy instruments at their disposal; the subscript $i$ refers to a given policy instrument.[2] Policy choice is consequential to the future value of the budget. When an agency makes a policy choice it has a stochastic impact on the next round. This means that, while agencies may influence the next round of funding, they cannot know with certainty the outcome of the next round of appropriations.

I discretized policy outputs to form policy choices. The observed data is typically counts of agency activities by year, for a number of policy instruments.[3] Let each policy choice from each year be defined as $a_{\alpha tj}$, with $j \in \{1, 2, \ldots, J_\alpha\}$. The total number of policy instruments an agency has at its disposal is written $J_\alpha$. The raw count of actions is noted $O_{tj}$. I calculate the yearly difference in the raw counts, $\Delta(O_{tj}) = O_{tj} - O_{t-1,j}$ and then calculate the standard deviation of this difference across all years. The standard deviation is written

$$\sigma^2 = \frac{\sum_t [\Delta(O_{tj}) - \overline{\Delta(0)}]^2}{t-1}$$

The action is defined as being

$$a_{\alpha tj} = \begin{cases} l & if \Delta(O_{tj}) < -2\sigma \\ s & if -2\sigma < \Delta(O_{tj}) < 2\sigma \\ m & if \Delta(O_{tj}) > 2\sigma \end{cases}$$

I assume the budget ranges from a value of zero to an endpoint, $X_t = 100$[4] Put less technically, the budget is defined as a value on a real number line, and this line contains

[2]The model development will proceed suppressing $i$ until later.

[3]For example, OSHA performs tens of thousands of workplace inspections in each year. The ADOJ has a fairly large number of different policy instruments at its disposal, including investigations of mergers and suspected criminal activity, criminal lawsuits, and civil lawsuits.

[4]In the interval, $x_t \in [0, X_t]$, $X$ is assumed to be a Banach space. This assumes that the sets contained in the interval $[0, X_t]$ are single dimensional, real number valued, and that the norm for the vector $\{0, x_1, x_2, x_3, \ldots, X_t\}$ has some arbitrary norm. In this case, I assume a uniform norm so that values between points in the vector space have a regular value.

regular grid points. The number of grid points, while arbitrary, is somewhat consequential for analysis.[5] Appropriations are standardized, by agency, by the standard deviation of annual change. With $\gamma_{\alpha t}$ as the observed amount appropriated agency $\alpha$ and $\Delta(\gamma_{\alpha t}) = \gamma_{\alpha t} - \gamma_{\alpha t-1}$,

$$x_t = \frac{\gamma_{\alpha t}}{\sigma_\alpha} \tag{2.1}$$

and

$$\sigma_\alpha^2 = \frac{\sum_t^{T_\alpha} [\Delta(\gamma_{\alpha t}) - \overline{\Delta(\gamma_{\alpha t})}]^2}{T_\alpha - 1}.^{6} \tag{2.2}$$

This implies that the grid points are the natural numbers $\{0, 1, \ldots, 100\}$, and for each agency the standardized values of the budget fall somewhere between 0 and 100.[7] For clarity, I describe the range falling between two grid points as "bins."

The policy choices agencies make feed back to them through future alterations of the budget. Their budget is fixed for each year, but the outcome of the next round of appropriations is unknown to the agency until the start of the next fiscal year. The agency only knows the likelihood of an impact of their policy choice, noted $p(x_t, a_t, \boldsymbol{\theta})$. The elements in $\boldsymbol{\theta}$ pertaining to the transition probability are written $\theta_p$. I assume that $p(x_t, a_t, \boldsymbol{\theta})$ is a ordinal logistic model with the outcome variable as the probability that the budget is reduced by at least one bin, remains within the same bin, or is increased by at least one bin. This probability is an approximation to the real transition probability which would be for a continuous variable. That this functions as an effective approximation is shown in Banach's Fixed Point Theorem (Rust, 1994). This set of probabilities is the agency's beliefs regarding the outcome of their policy choices on their future resources.

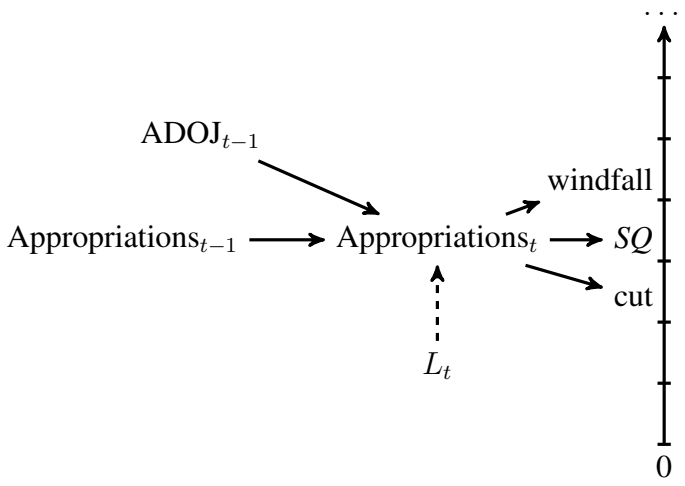
Agency beliefs can be summarized as the transition between different bins on a grid which describes the distribution of changes of appropriations to the agency. Figure 2.1 is a

[5] See Kasahara and Shimotsu (2009) for further discussion of this point.

[6] The number of years can vary by agency.

[7] This is true in the sample, but it is possible that the standardized value could fall outside of 100. If this were the case, the solution would be increase the value of the endpoint to some higher value, as the choice of $X_t$ is arbitrary.

Figure 2.1: Agency Beliefs




representation of the reduced form of their beliefs. When an agency acts, in the next time period Congress and the president decide upon the level of appropriations. They can either remain in the same area, or move up or down a bin.

Agencies receive utility from three things: their budget, their policy choice, and their private information about the quality of the decision ($Q_{\alpha t}(a)$).[8] The quality of the decision is private information held by the agency and is the utility they receive from making a particular policy choice from all things not regarding money. This can include the demand agencies perceive for a particular policy, or more mundane constraints such as sick days and weather. In addition, this private information is not observable by me, the researcher. The utility function includes a set of parameters, $\boldsymbol{\theta}$, which govern the relationship between the state variables, policy, and utility. This function is written

$$u_\alpha(x_t, a, Q_t, \boldsymbol{\theta}) = \begin{cases} 0 + Q_t(l), & a = l \\ \theta_s + b(x_t, s, \boldsymbol{\theta}) + Q_t(s), & a = s \\ \theta_m + b(x_t, m, \boldsymbol{\theta}) + Q_t(m), & a = m \end{cases} \tag{2.3}$$

In words, the utility to an agency is zero, plus their private information, if they choose to

[8]The quality of the decision is assumed to be distributed Type 1 Extreme Value.

do less.[9] If they choose to remain with the status quo or do more, they receive utility from the policy choice, $\theta_a$, and from the budget. The utility they receive from money varies by the policy choice. This function, $b(x_t, s, \boldsymbol{\theta})$ is written

$$b(x_t, s, \boldsymbol{\theta}) = \begin{cases} 0, & a = l \\ \theta_{s1} x_t + \theta_{s2} x_t^2, & a = s \\ \theta_{m1} x_t + \theta_{m2} x_t^2, & a = m \end{cases} \tag{2.4}$$

### 2.2.2 The Agency's Optimization Problem

The agencies optimization problem is to choose the set of policy changes that make themselves the best off. I assume that agencies face an infinite horizon optimal policy choice problem.[10] Future utility is discounted by $\beta$. Given the setup of the utility functions, state, and control variables, the agency's utility optimization problem is written

$$V_\theta(x_t, Q_t) = \sup_{\Pi} E \left\{ \sum_{j=t}^{\infty} \beta^{j-t} [u(x_j, f_j, \boldsymbol{\theta}) + Q_j(f_j)] | x_t, Q_t, \boldsymbol{\theta} \right\} \tag{2.5}$$

The term $\Pi$ is the set of all possible policy decisions across time. In words, the agency's optimization problem is to make a series of policy decisions. Those decisions need to be such that they cannot make themselves any better off. The problem is that the set of all policy decisions is infinitely large. This choice is tantamount to saying $a_t = more$, $a_{t+1} = status\ quo$, and so on, starting with $t = 1$ and running off to infinity. There are an infinite number of possible combinations of policies, and this problem is a technically complicated one. Applying the Bellman equation leads to a less complex description of

[9] This is a necessary standardization of the utility. This does not imply that choosing less is the worst choice, as utility from choosing other policies could be higher or lower than zero.

[10] The infinite horizon serves as an approximation for the finite game that agency planners face. Careers are finite, and instiutional memory, as a result. A question I want to resolve is to what degree agency planners look to the future. I allow planners to have the capacity to look to an infinite future, and then determine how far down the road they actually look.

the problem, which also has a more intuitive interpretation. As shown in Rust (1987), the solution to this optimization problem is given by a stationary decision rule

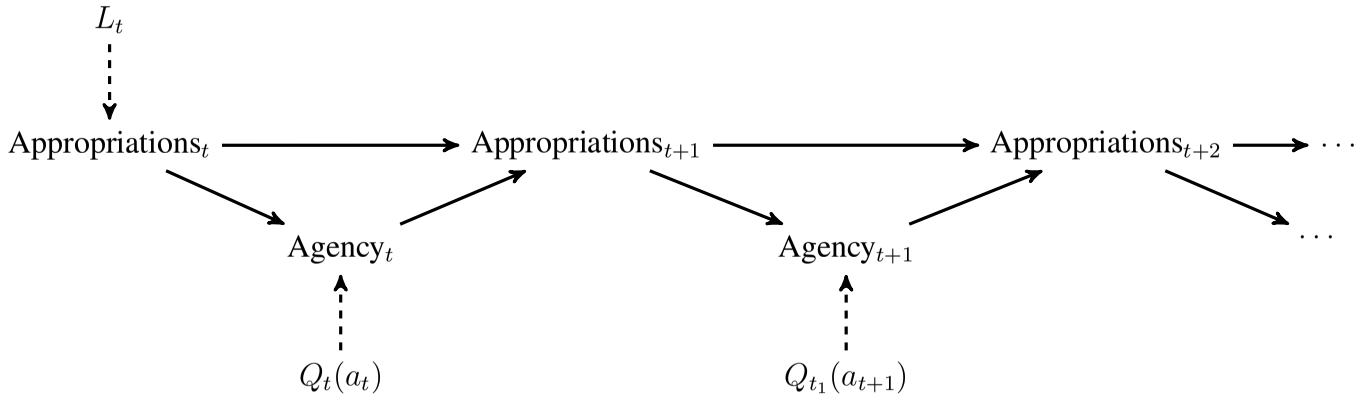
$$a_t = f(x_t, Q_t, \boldsymbol{\theta}) \tag{2.6}$$

which is the optimal decision the agency can make, given the state variables. Equation 2.5 can be rewritten, by applying the Bellman equation, to be equal to the decision rule, such that

$$f(x_t, Q_t, \boldsymbol{\theta}) \equiv \underset{a \in \{l,s,m\}}{\operatorname{argmax}} [u(x_t, a, \boldsymbol{\theta}) + Q_t(a) + \beta E V_\theta(x_t, Q_t, a)] = V_\theta(x_t, Q_t) \tag{2.7}$$

Equation 2.7 can be described as being of two terms. The first is the current term utility to choosing a particular policy. The second is the expected value from all future decisions. The second term is the shadow price of the policy choice.

Figure 2.2: Stochastic Control of Appropriations



The model described here is a stochastic control model of appropriations. Agencies attempt to control the appropriations process to their benefit. However, they are not able to do so perfectly, hence the stochastic form of control. Figure 2.2 is a graphic visualization of the model. Appropriations are fixed at time $t$, and agencies choose a policy based upon the budget, their policy preferences, and their private information. The policy choice controls, with some randomness, the next round of appropriations.

### 2.2.3 Fixed Point Solution and Parameter Recovery

Finding the stationary decision rule allows for a method for recovering the primitive parameters in the model. Solving for the decision rule requires a means to find the shadow price described in Equation 2.7 by the term $EV_\theta(x_t, Q_t, a)$. The equation

$$V_\theta(x_t, Q_t) = \underset{a \in \{l,s,m\}}{\text{argmax}}[u(x_t, a, \boldsymbol{\theta}) + \int_0^\infty V_\theta(x_{t+1}, a) p(x_{t+1}|x_t, a)] \tag{2.8}$$

is the functional equation used to solve for the decision rule. This equation is a contraction mapping.[11] This implies that the value is recursively used, and that the properties of the mapping can be used to derive a solution method. I use a series of successive approximations to solve Equation 2.8. I find the solution with an algorithm which begins with a set of arbitrary guesses for $V_\theta(x_t, Q_t)$, inserts them into the right hand side of Equation 2.8, solves for new values of $V_\theta(x_t, Q_t)$, and then repeats until the difference between the previous values and the new values converge to an arbitrary tolerance level. Starting with values of zero is equivalent to solving the model by back-wards induction (Rust, 1994).

Recovering the primitive parameters from the model requires embedding the fixed point solution algorithm with a maximum likelihood estimation routine. The model, as described, is a multinomial policy choice by agencies. The choice model framework defined by Train (2003) is actually a special case of this framework when $\beta = 0$. I describe the conditional

[11] This implies that the function crosses over itself at some point and that this fixed point describes the shadow cost of the optimal policy choice.

choice probability as

$$P(a|x,\boldsymbol{\theta}) = \frac{\exp[u(x,a,\boldsymbol{\theta}) + \beta EV_\theta(x,a)]}{\sum_{j\in\{l,s,m\}} \exp[u(x,j,\boldsymbol{\theta}) + \beta EV_\theta(x,j)]} \tag{2.9}$$

with $EV_\theta(x,a)$ as the unique solution to Equation 2.8. This equation is a single policy-agency-year's contribution to the likelihood of a policy choice. The entire algorithm for solving begins with with the MLE procedure generating a parameter vector. This vector is used to solve for the shadow price, which is then inserted into the mean function of the likelihood problem. The MLE routine solves for each observations contribution to the likelihood, and checks to see if convergence has been achieved. If it has not, a new parameter vector is generated, a new fixed point is found, and the procedure iterates until the MLE procedure converges. The point of the estimation procedure is to recover the primitive parameters from the utility function described earlier. What these parameters tell us are the preferences that agencies have regarding money and policy.

### 2.2.4 Hypotheses

The estimation procedure produces direct estimates of the parameters of an agency's budget-output function, such as that defined by Niskanen (1971). I assume that policy is endogenous to appropriations and craft a model to deal with the endogeneity. The estimates of the primitive parameters inform a number of things about bureaucratic strategies. The discount factor, $\beta$, describes the weight that agencies place on future rounds of appropriations and policy. A high value of $\beta$ implies that place a great deal of weight on the future. The relative values of the coefficients for policy signal agency preferences for money. For example, if I found $\theta_{1m} > \theta_{1s} > 0$, this would imply that agencies prefer to do more over remaining with the status quo or doing less, absent money concerns. An equivalent calculation can be done to recover agency preferences regarding money. In addition, the entire optimal policy choice function can be evaluated for varying levels of budget to determine varying levels

of responsiveness to budgetary signals.

This procedure leads to a couple of specific testable hypotheses. Primary among them is a test for the marginal impact of money on agency output. There are two ways of considering this margin. First, I look at the margins in the utility function by policy choice (i.e. $\frac{\partial u_a}{\partial x_t}$). Second, I look at the marginal impact of money in the conditional choice probabilities (i.e. $\frac{\partial P(a|x,\boldsymbol{\theta})}{\partial x_t}$). Both contain the same information, though the emphasis results in different interpretations. In the case of the first, the reader can distinguish the direction of the association between money and utility. The second reveals the size of the effect on the probabilities of a policy choice. In both cases the margins are conditional on the size of the budget. The hypotheses in these cases regards the marginal impact of money. What is the marginal association between money and policy output, and when is it statistically distinguishable from zero?

## 2.3 Model Outline

Congress has two explicit tools to control the policy implemented by agencies. First, Congress can pass legislation which supersedes any rules or regulations created by an agency. Second, Congress controls the "Power of the Purse." Every year, agencies submit themselves to examination by Congress, and are required to justify their budgets before Congressional committees. Appropriations, unlike other legislation, guarantees a yearly appraisal of the behavior of the agency, and serves as an important tool for controlling agencies. At the extreme, Congress can effectively kill a policy by zeroing out funding for an agency.

As required in the Constitution, Congress must pass law for federal agencies to withdraw funds from the Treasury. Historically, the process has been done yearly. Starting October 1st, Congress makes available through the Treasury a sum of money that agencies can withdraw. This amount is generally fixed, as Congress has to pass a second law to

make more money available. This lawmaking has been made systematic into a process referred to, by Congress, as *appropriations*. A fair portion budget has now passed out of the appropriations process. Over half the budget is spent according to a formula specified by Congress, and does not require yearly lawmaking. The rest is referred to as discretionary, and comes under the jurisdiction of appropriations. In the 2010 fiscal year, this figure comprised 40% of the budget, an amount equal to 1.368 trillion dollars, a reasonably large sum of money.[12]

This paper formulates a dynamic model of fiscal control, with private information, to describe how Congress uses the appropriations process to influence bureaucracies. The model developed here contains both strategic and bounded rationality models of fiscal control as special cases. Importantly, I attempt to bring observed private information into a logically consistent framework of fiscal control. Most empirical applications of models of control usually specify a model where $i$, an outcome, is decided to be a function of a variable used to control an agency, $x$, and under equilibrium conditions $i = f(x, \theta)$, with $\theta$ being a set of parameters. In empirical application, many studies instead implement $i = f(x, \theta) + \epsilon$ with $\epsilon$, private information or some other form of error, not considered under equilibrium conditions. I rectify this by introducing and extending a class of structural models based on Rust (1987) which explicitly include private information under equilibrium conditions, and control for the impact in observable studies. As a practical matter, the functional form of agency action in both empirical and formal models is described as a utility, with private information playing a deciding role.

In this essay, I first derive a complete information version of the model, in order to highlight concepts relevant to the game with private information. Expanding upon this basic model, I introduce two unobserved state variables, information available only to Congress and agencies. Based on this structure, I derive a double nested fixed point algorithm which is inserted into a maximum likelihood estimator.

[12]Office of Management and Budget. 2010. *Budget of the United States Government: Fiscal Year 2010. Washington, D.C.: GPO.*

### 2.3.1 Two-Sided Model Description

The model explored in the following sections of this chapter is a model of fiscal control of an agency, by appropriators (For the sake of clarity, I refer only to Congress). In every time period, Congress, $C$ chooses to give a budget, $b$, to an agency in order for that agency, $A$ to provide some public good. The actual practice of providing that public good results in a policy, $p$. The budget available to the agency is the amounted listed in the annual appropriations bill. This amount is available to the agency at the start of the fiscal year, and, with few exceptions, is the amount available to them for that entire fiscal year. Each year is noted $t$. All provision of policy must be done within the confines of the budget granted through appropriations. The aggregate count of each of agency actions is $p_{o,t}$, with the subscript $o$ referring to output type (as agency outputs are used to create public goods). I drop the subscript $o$ and deal with only pairs of budgets and outputs.

### 2.3.2 Short Summary

At the start of each time period, Congress reviews the policy implemented by an agency and decides whether to adjust the amount granted through appropriations. This process repeats itself, from the prospective of the appropriations subcommittee relevant to the agency, and the agency itself, infinitely. Congress sets a budget, agencies implement policy, and so on. When making a decision at any given point of time, both actors consider the future consequences of their behavior, and most of the math that follows regards the structure required to deal with that optimization problem.

In the following section, I first describe the structure of the game played between Congress and agencies, and apply Bellman's equation to the optimization problem, and derive conditional choice probabilities for the actions available to the actors. I then discuss solving the dual fixed point problem inherent in this formulation of a discrete choice game necessary for generating data. Following the discussion of the model and the data

generation process, I describe a method for recovering parameter estimates.

## 2.4 Fiscal Control of Policy

My goal is to describe how policy, $p_t$, maps onto appropriations, $b_t$, at $t$ and vice versa, from the prospective of Congress and agencies, respectively. The dynamic, stochastic process which generates $\{c_t, p_t, a_t, b_t\}$ is used to derive a likelihood function $l(p_1, b_1, \ldots, p_T, b_T; \boldsymbol{\theta})$ which follows from the solution of the model. I can systematically observe four pieces of information: the aggregate level of policy provision, appropriations, and the changes from one time period to the next. The changes in policy and funding are choices actively made by the two actors in the model, agencies and Congress. This information is used to recover the parameter vector $\boldsymbol{\theta} = \{\boldsymbol{\theta}_A, \boldsymbol{\theta}_C\}$. The state and control variables mirror each other. Agencies control policy, which is the state variable for Congress. Congress controls appropriations, the state variable for agencies.

Let $p_t$ be the aggregate level of funding provided through appropriations by Congress. The aggregate provision of policy is denoted $b_t$. Both of these state variables are aggregates from a single year. In the appropriations process, this is the dollar amount granted to the agency. For agencies, $b_t$ is the total number of agency actions over the year. For example, the Department of Justice's Antitrust division is charged with enforcing antitrust law; $b_t$ is the number of investigations started in a calendar year, one measure of their investigative behavior. An upper case $C$ and $A$ are used to denote Congress and an agency, while lower case $c$ and $a$ are used to indicate the actions of the same two actors, with the generic actor and action being noted by $I$ and $i$, with $-I$ being actor not $I$. Both actors have three actions available to them, $i \in \{l, s, m\}$, which correspond to doing less, the same, or more, as they had in the last time period. Each of these three actions corresponds to changes (or lack thereof) to $x_{I,t}$ in the real valued realization of this number. If $i = s$ then $x_{I,t} = x_{I,t-1}$, with the equality being replaced by less than and more than for $l$ and $m$. Agencies gain

utility from a function of their budget, $g(p_t, b_t, \boldsymbol{\theta})$. Other things exterior to the model may influence bureaucrats, but they are assumed to be orthogonal to the utility from budgets.[13] Congress receives utility as a function of policy, $h(p_t, b_t, \boldsymbol{\theta})$. Actor $I$ faces costs $c$ that they must consider.

Each year, Congress and agencies face choices over budgets and policy. The choices are defined as being discrete. Each can decide to remain with a status quo, or increase or decrease the other actor's state variable. The utility agencies earn is given by

$$u_A(p_t, b_t, a_t, \boldsymbol{\theta}) = \begin{cases} \theta_{A,l} + g(p_t, a_t, \boldsymbol{\theta}_{A,b}) & if\ a = l \\ \theta_{A,s} + g(p_t, a_t, \boldsymbol{\theta}_{A,b}) & if\ a = s \\ \theta_{A,m} + g(p_t, a_t, \boldsymbol{\theta}_{A,b}) & if\ a = m \end{cases} \tag{2.10}$$

with $\theta_{A,l}$ set to zero, as well as $\theta_{A,b,l}$. Both serve as a normalization of the utility. Replacing $b$ with $p$, $g$ with $h$, and the parameter vector with $\boldsymbol{\theta}_C$, gives the utility for Congress. In any given time period, the actors earn utility from their state variable, and from their choice.

Utility is broken into two parts. The first is an intercept, $\theta_{I,i}$ which varies according to choice. This should be viewed as the bonus that an agency receives for pursuing a preferred policy change. Alternately, one can view the intercept as evidence of shirking, or as an indicator of to whom an agency is actually responsive (Saltzstein, 1992). If the appropriations signal is followed slavishly, there is no utility in shirking, and $\theta_{A,l} = \theta_{A,s} = \theta_{A,m}$. It is possible to have an intercept shift for reaching a preferred policy but the policy as implemented, i.e. agents prefer some particular $b_t$ or $p_t$ and receive extra utility from not just the action taken. For clarity of exposition, I do not pursue that strategy here, as the notation is already becoming painful, and it follows as a special case of this more general model.

[13] This assumptions will be relaxed somewhat later in the paper.

### 2.4.1 Private Information

In this section I will describe how private information is used by both actors in this game. Naturally, agencies are assumed to posses information that Congress does not have. This assumption is a hallmark of the principal agent literature. In addition to that assumption, I assume that, from the prospective of the agency, Congress has private information regarding the appropriations process. Regarding policy implementation, agencies are considered to posses information that is observed neither by the researcher, nor by Congress. This information is considered to have a large impact on policy implementation decisions, and the information may vary over time.

Obviously, my characterization of Congress in this model is obtuse. I consider only one piece of information Congress may send, the appropriations figure, and disregard any heterogeneity in Congress, either in terms of actors or the legislative process. From the prospective of an agency, much of the legislative process that goes on may have an impact, but they are largely incapable of affecting these things, and the sum total of their impact is probably unknown. I assume that the trade-offs that generate appropriations numbers are largely unknown to any single agency, as well as being unknown to the researcher. Private information is assumed to be orthogonal to both the budget and policy outcomes, an assumption already in the literature (Huber and Shipan, 2002). Budgetary trade-offs that Congress faces have been argued to be largely driven by events exogenous to the domestic political environment (Berry and Lowery, 1990).

The two pieces of private information vary by the actions of the actor, and are known, by each actor, at each time point. Information at time $t + 1$ is unknown to the actors. I note the private information as $\epsilon_{I,t}$. I assume there is unique private information for each action, such that $\epsilon_{I,t}$ is a vector, of length equal to the number of choices in $C(x_{I,t})$, the set of actions available to $I$ for a value of the state variable. Private information enters into the

equation utility as a linear additive term in the utility, such that

$$u_I(\theta_{I,i} + c(x_{I,t}, i_t, \boldsymbol{\theta}_I)) + \epsilon_{I,t}(i_t) \tag{2.11}$$

The different information that actors consider vary by the action they might choose, and are observed only by the actor so choosing.

### 2.4.2 Problems of Optimization

While the utility from their state variable does not vary contemporaneously, the utility earned from their choice does. The two actors face a dynamic optimization problem, defined by

$$V_{I,\theta}(x_{i,t}) = \sup_{\Pi_I} E\left\{ \sum_{j=t}^{\infty} \beta^{j-t} u(x_{i,j}, f_{i,j}, \boldsymbol{\theta}_I) + \epsilon_{I,j}(f_{i,j}) \Big| x_{i,t}, x_{-i,t}, f_{-i,t}, \epsilon_{I,t}, \boldsymbol{\theta}_{-I} \right\} \tag{2.12}$$

Actors maximize their utility by finding a set of decision rules, $\Pi_I = \{f_{i,t}, f_{i,t+1}, \dots\}$, with each $f_{i,t}$ serving as actor $i$'s policy decision at time $t$ as a function of the entire history of the game prior to $t$. At each time period, agencies and Congress select the policy that nets the highest utility. They act knowing the other actor's last action, and they act not knowing the next action their opponent might take. Their beliefs about future outcomes weigh on their decision.

The transition of the state variables are a function of the choice the players make. When Congress chooses to provide less appropriations, $b_t < b_{t-1} | c_t = l$. This transition process is formally defined:

$$p(x_{i,t+1} | x_{i,t}, i_t, \boldsymbol{\theta}) \sim \begin{cases} \mathcal{U}(k_1, k_2) & if \ -i_t = l \\ \mathcal{U}(k_2, k_3) & if \ -i_t = s \\ \mathcal{U}(k_3, k_4) & if \ -i_t = m \end{cases} \tag{2.13}$$

The state variable transitions according to the choice of the other actor, vis-a-vie the state variable. If Congress chooses less, than the amounted appropriated is a realization of a draw from a uniform distribution, with $k_1 < b_{t+1} < k_2 < b_t$. For the same, the interval is over $k_2 < b_{t+1} <> b_t < k_3$. With more, $b_t < k_3 < b_t < k_4$. The intervals are restricted such that $k_{j+1} - k_j = \delta$, with $\delta$ being a positive constant. The functional form of the transition is somewhat arbitrary. What is essential is that the expectation of the three choices differ sufficiently. Equation 2.12 is the value function and is the unique solution to Bellman's equation given by

$$V_{I,\theta}(x_{i,t}) = \max_{i_t \in C_i(x_{i,t})} [u(x_{i,t}, i_t, \boldsymbol{\theta}) + \beta EV_\theta(x_{i,t}, i_t)] \tag{2.14}$$

where $C_i(x_{i,t}) = \{l, s, m\}$ and the function $EV_\theta(x_{i,t}, i_t)$ is defined by

$$EV_{I,\theta}(x_{i,t}, i_t, \epsilon_{I,t}) \equiv \int_y \int_\nu V_\theta(y, \nu) p(dy, d\nu | x_{i,t}, x_{-i,t}, i, \boldsymbol{\theta}) \tag{2.15}$$

The optimal behavior for $I$ is defined by the the function

$$f_I(x_{I,t}, \epsilon_{I,t}, \boldsymbol{\theta}) \equiv \underset{i \in C(x_{I,t}}{\text{argmax}} [u(x_{I,t}, i, \boldsymbol{\theta}) + \epsilon_{I,t}(i) + \beta EV_{I,\theta}(x_{I,t}, \epsilon_{I,t}, i)]. \tag{2.16}$$

Since each actor is not directly responding to the contemporaneous action of the other optimal behavior is a straightforward to calculate, given that it is possible to calculate $EV_{I,\theta}$. The structure of 2.16 can further be used to calculate a conditional choice probability.[14] The conditional choice probability for action $i$ is defined as

$$\Pr(i|x_{I,t}) = \frac{exp[u(x_{I,t}, i, \boldsymbol{\theta} + \epsilon_{I,t}(i) + \beta EV_{I,\theta}(x_{I,t}, \epsilon_{I,t}, i)}{\sum_j exp[u(x_{I,t}, j, \boldsymbol{\theta} + \epsilon_{I,t}(j) + \beta EV_{I,\theta}(x_{I,t}, \epsilon_{I,t}, j)} \tag{2.17}$$

I describe solving the fixed point problem in the next section, and describe how data sets of observables can be generated. Solving the fixed point requires recursively find-

[14] Non-dynamic discrete choice models are a special case (Train, 2003) of this model.

ing continuation values, and then replacing the transition probabilities in the continuation value ($EV_\theta$) based on an actors beliefs of their opponents choice probabilities, which are expressed as conditional choice probabilities.

### 2.4.3 Fixed Points

The model outlined in the previous section builds on an influential dynamic discrete choice model (Rust, 1987). Other treatments that look similar to an application to Congress, pricing models of oligopolies (Berry, Levinsohn and Pakes, 1995), focus on the action of the demand side and assume a structure for supply side characteristics. Prices impact the other actors in an oligopoly by action through demand side mechanisms. In my model, arguably a duopoly setup, actors can directly impact the state variable of the other actor deterministically. The action between members of a oligopoly is assumed to happen instantaneously, or with some specified lag due to market forces. Due to the relatively fixed nature of the fiscal year appropriations, happens in rounds. Typically, agencies are responding to Congress, and Congress review agencies in a turn based manner. This necessitates calculating two fixed points, as each side needs to consider the impact of their future decisions.

### 2.4.4 Solving for the Fixed Point

Both $b$ and $p$ are defined as being Banach spaces. This implies that they can be approximated by a grid of regular intervals and that functions that are evaluated at points along this grid serve as approximations for the values on the interior between grid points, and that as the number of grid points goes to infinity, the approximation converges on the real value of the function. The space for both $b$ and $p$ is defined as a compact set of numbers along a single dimension on the real line. In practice, I assumed 50 grid points for both budget and policy.

Solving for the fixed point is an exercise in contraction mapping. Let

$$EV_\theta = \Gamma(EV_\theta) \tag{2.18}$$

I'm suppressing the notation of the player temporarily to aid in understanding the algorithm used. The left hand side of 2.18 is the application of Bellman's equation integrated across the set of possible future states, described in equation 2.14. The distribution used for the expectation in calculating $EV_\theta$ is the conditional choice probabilities of their opponent. In the original Rust (1987) model, the transition probabilities are a function of a Markov transition process assumed to be independent of the private information of the agent. In the Rust example, the transition probability referred to how many extra miles a bus might put on in a month. The mileage probabilities referred to three bins, 0-5000 miles, 5000-10,000 miles, and 10,000+ miles a month. The observed transition determined whether the bus remained in the current bin, or moved to the next, or two or more bins beyond the current bin.

For any given $x_t$, the goal is to find a mapping of the value function back onto itself, which serves as the expectation of the value function for all future actions, which can be written $EV_\theta = \Gamma(EV_\theta)$. For a mild set of regularity conditions, this is assumed to be a fixed point (Rust, 1987). The realization of that value is the shadow price of all future actions.

The value of the fixed point is found through a numerical algorithm. Starting with an arbitrary guess for $EV^0$, this value is used to solve for $EV^1$. The value from this first iteration is used as the value for the third, and this is repeated until an arbitrary tolerance for the difference between values from one iteration to the next is achieved. Convergence is assured by the Banach fixed point theorem.

### 2.4.5 Two-Sided Convergence

To evaluate each players optimal behavior for a given value of the state variable, it is necessary to find two fixed points, simultaneously. The function $EV_{I,\theta}$ is the integration across possible future outcomes, which includes each players beliefs about the others behavior. Solving for $EV_{I,\theta}$ requires solving for $EV_{-I,\theta}$ because the expectation of the transition of the state variable for $I$ is in terms of the choice probabilities of $-I$. Convergence is guaranteed for the one sided case, if the assumptions of the Banach fixed point theorem are met. The structure of the game assures that this is the case. A useful result of the fixed point theorem is that there is a unique solution, given that one can be calculated. I leverage this result, along with the fact that a single optimal behavior rule can be calculated implies that a unique combination of shadow prices can be calculated, for a given $\{x_I, x_{-I}\}$ and $\{i, -i\}$.

The algorithm uses the one sided fixed point algorithms as subroutines, which I'll refer to as $M^I$. The first run of the algorithm for one side, $I$, will be $M_0^I$. Using a guess for $EV_{-I,\theta}$, I construct a probability transition matrix based on the conditional choice probabilities of $-I$. Following convergence for this one side (which is guaranteed), I update $EV_{I,\theta}$ and use these new values to construct a transition matrix for the second subroutine $M_0^{-I}$. I iterate this process until the sum of the two tolerances from the routines reaches an arbitrary tolerance threshold.

I do not currently have a proof regarding the convergence of this algorithm. I implemented a grid search for a large number of parameter values (¿10 million runs). Convergence to a pair of fixed points is dependent upon the function form of the utilities. If a polynomial form is not specified (i.e. there must be a squared term, or of a higher order, for the impact of the budget on utility), then, for many parameter values, the system does not settle onto a pair of values. Instead, the two points orbit each other. Oppositional pairs of utility (where the two actors have parameter values of opposite signs for their state

variables) lead to orbits.

### 2.4.6 Conclusions

A two-sided, dynamic discrete choice model has virtues beyond a decision theoretic model. By allowing for Congress to have strategic capacity, the overall realism of the model is much higher. Denying Congress strategic reasoning seems to defy credulity. However, allowing for this extra capacity also greatly increases the demands on the model, and increase the complexity. Utilities must take on a specific set of functional forms, and the solution concepts are more difficult to implement. Because appropriations happens in rounds each actor in a two-sided model picks a strategy in the expectation of their opponents behavior. This reduces to a set of beliefs; these beliefs can be written as a Markov transition process. Solving a two-sided model is simply solving two decision theoretic models.

In the following empirical chapters, I implement the one sided, dynamic policy choice model. The chapter on antitrust restricts the analysis to a single agency. The following the antitrust example, I examine the behavior of a larger set of agencies. In both cases, the restriction on the models is the same.

# 3

# Stochastic Control of Appropriations by Antitrust Enforcers

The ADOJ makes an ideal test case for theories of budgetary signaling. The budget for the ADOJ is mostly uncomplicated. The agency is funded by discretionary funds, and does not suffer from earmarks. The most notable rider to the appropriations bills for the agency was a ban on the establishment of permanent field offices, which was later removed (and the offices established). The public goods generated by the agency, protection from monopoly abuses, are diffuse and the agency does not directly distribute private goods.[1] While the agency does impose costs directly on select producers, these most frequently fall upon firms and not individuals. Furthermore, the agency has largely defied attempts at finding clear determinants of its enforcement activity (Lewis-Beck, 1979; Wood and Anderson, 1993; Siegfried, 1975; Gallo et al., 2000; Posner, 1970; Yandle, 1988).

Enforcement falls into two categories: violations of the per se rule and the "Rule of Reason." The first considers acts of collusion and price setting by erstwhile competitors, while the second deals with abuses by de facto monopolists. The agency opens investigations by following leads from a number of sources, some informal and some formal. The investigations may lead to either criminal cases or civil cases, or they can be used as a

[1] I highlight this point to differentiate this study from works that look at the distribution of private goods by the government. See Berry, Burden and Howell (2010) for a recent example.

threat. Bork (1978) argues that the agency works best by using investigations as an old west sheriff would use a judicious pistol whip, as a means to remind business who is the boss. The political orientation of lawyers and economists who fill the ranks of the agency significantly impacts policy, controlling for the level of funding (Eisner and Meier, 1990; Wood and Anderson, 1993).

Because of the nature of antitrust enforcement, the dynamic nature of appropriations is consequential. Antitrust cases can occasionally persist for decades. In some cases, the suits persist past the time of the initial conditions that brought about the case. Microsoft, for example, now finds itself on the side of the plaintiffs suing Google over possible antitrust violations concerning Internet searches. This case comes a few years after a nearly 15 year case against Microsoft over its business practices with Internet browsers. In addition, the antitrust case law is voluminous and, as many of the features of the cases can consider new technologies, complex. Given the duration and complexity of cases, it is necessary that the ADOJ not just react to Congress, but be proactive.

## 3.1 Empirics

The theoretic setup of the model is for discrete actions by the agency. I split the actions into three categories (more, status quo, and less). Using a discrete choice approach to choice has been used by other applications to public policy, such as actions by the Federal Reserve (Hu and Phillips, 2004*a*,*b*).[2] The dividing points for the three categories depend on the sample distribution of the actions. To get a sense of what a significant change in policy might be, I find the standard deviation of the change of policy from one year to the next. Anything that exceeds a two standard deviations in policy is considered a policy alteration, in either the high, or low direction corresponding to the sign of the change.[3]

[2]One can take the view that the practiced clumping of the data serves as an approximation of the underlying choice, and that with more information, one would be able to have a larger number of choices which more accurately reflects the decision making process (Rust, 1994).

[3]I estimated versions of the model with a one standard deviation change instead of two, and the results are very similar, but model fit was significantly worse.

The Department of Justice's Antitrust division keeps detailed records of a number of activities the agency engages in, including investigations, court cases, and the results of the cases tried. In this study, I examine 15 different policy instruments, in a pooled analysis.[4] Previous works (Lewis-Beck, 1979; Wood and Anderson, 1993; Siegfried, 1975; Gallo et al., 2000; Yandle, 1988) have looked at two or three policy instruments that the agency has available to them, with the exception of Posner (1970) which studies a large set of activities. Posner is unclear as to whether the agency treats different activities as being more important than others. Previous literature has been unclear on the merits of choosing particular policy instruments over others. Because of this, I have tried to be comprehensive in my data collection and use as many as possible. I do spend some effort splitting the analysis to see if the agency has different preferences across the types of policy instruments.

The different activities of the agency can be grouped into two areas: investigations and court cases. Both instruments can lead to a number of different outcomes. Investigations can lead to either civil or criminal cases under a couple of different laws. Cases have a fairly large number of possible outcomes ranging from jail time to fines of a number of types, along with court ordered dismemberment of companies, in the extreme cases. Table 3.1 lists summary statistics for the policy instruments.[5]

The actual policy as implemented has some kind of mapping to a more general public good that the agency is pursuing. The Antitrust division is described as pursuing a consumer-surplus maximizing public good, versus an alternative of an aggregate surplus maximization (Whinston, 2008). While in a few cases the mapping of the choice of the agency to the public good is theoretically clear (e.g., the ADOJ has a rule that horizontal mergers must not lead to a price increase), for most agency actions, the mapping of agency action to public good is less clear, beyond a vague ordinal statement. Higher agency ac-

[4]Later in the document, I disaggregate the analysis into different categories, to study the differential impact of policy instruments. A number of studies have argued for the merits of one instrument over another, with most focusing on either investigations, or court cases. I study the aggregate production of a large set of policy instruments, as well as the disaggregated production of the agency.

[5]All but two of the instruments span the entire time of the study. These two that do not follow from the Hart-Scott-Rodino act, which was passed in the mid-70's, and actively enforced from 1977 onwards.

Table 3.1: Agency Actions

| | Variable | Mean | Std. Dev. | N |
|---|---|---|---|---|
| Investigations | Restraint of Trade Investigations | 143.951 | 82.159 | 41 |
| | Monopoly Investigations | 13.39 | 12.136 | 41 |
| | Merger Investigations | 130.268 | 65.982 | 41 |
| | Business Reviews | 17.854 | 9.878 | 41 |
| | HSR Investigations | 86.939 | 43.706 | 33 |
| | Screenings of Bank Mergers | 26.463 | 15.06 | 41 |
| | Preliminary Inquiries | 233.683 | 89.308 | 41 |
| Court Cases | CID's Issued | 600.634 | 481.333 | 41 |
| | Grand Jury Investigations | 38.293 | 11.942 | 41 |
| | HSR Cases Filed | 6.727 | 4.882 | 33 |
| | Criminal Cases Filed | 52.854 | 25.153 | 41 |
| | Number of Individuals Fined | 36.171 | 17.821 | 41 |
| | Total Fines, Individuals | 2289.293 | 3100.844 | 41 |
| | Number of Corporations Fined | 54.707 | 35.36 | 41 |
| | Number of Indiviudals Sentenced | 149503.732 | 261373.111 | 41 |

tivity leads to more protection of consumers from antitrust abuses, and leads to consumer surplus maximization, while lower agency activity leads to less protection. For each policy instrument, I divide the action into three categories based on the sample properties. I find the year to year difference in output for each action. I define the status quo choice as being within two standard deviations[6] of the year to year difference, in absolute value. Doing more is defined as having increased output by two standard deviations in positive value. Let each policy choice from each year be defined as $a_{tj}$, with $j \in \{1, 2, \ldots, 15\}$. The raw count of actions is noted $O_{tj}$.[7] I calculate the yearly difference in the raw counts, $\Delta(O_{tj}) = O_{tj} - O_{t-1,j}$ and then calculate the standard deviation of this difference across

[6] I estimated the following results using one standard deviation of change instead of two, and the estimates were substantively the same. However, model fit was drastically improved by using two standard deviations instead of one.

[7] An alternate specification would be to replace the raw counts with the log of the raw counts. I estimated this model, and while model fit does improve, it is not a radical increase and the results are similar. As estimation of the log model makes interpretation more difficult, I chose to present results based on the raw counts, i.e. $O_{tj}$ and not $\log(O_{tj})$.

all years. The standard deviation is written

$$\sigma = \sqrt{\frac{\sum_t [\Delta(O_{tj}) - \overline{\Delta(0)}]}{t-1}]^2}$$

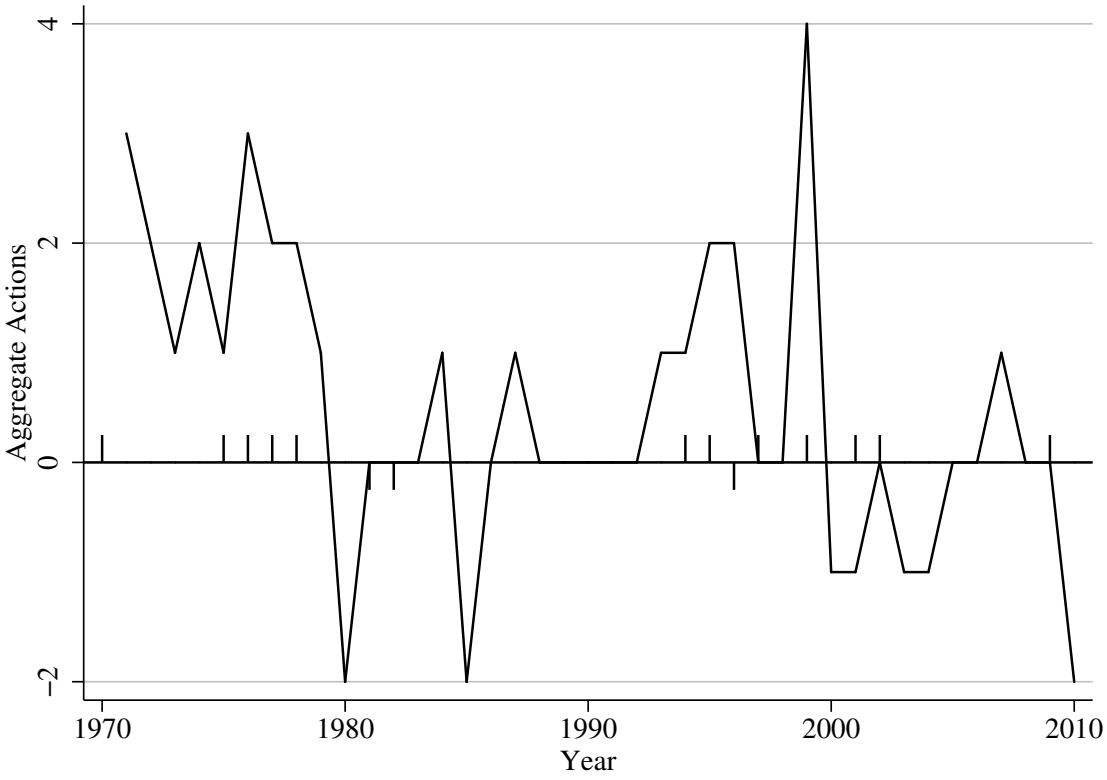
The action is defined as being

$$a_{tj} = \begin{cases} less & if \Delta(O_{tj}) < -2\sigma \\ sq & if -2\sigma < \Delta(O_{tj}) < 2\sigma \\ more & if \Delta(O_{tj}) > 2\sigma \end{cases}$$

The outputs are weighted equally regarding their impact on the utility of the agency. Each category of output is defined as independent from the others. Strictly speaking, there is no strategic trade-off from logrolling between policy instruments. In order to explore a possibility of such a trade-off, which may seem to exist in the real world, I later split the analysis examining groups of the instruments separate from each other. In particular I focus on the divide between investigations and court cases, which seem likely to have different costs associated with them, and different time horizons associated with success.

Each policy instrument is split into a set of discrete choices which serve as approximations to the real policy choice made by the ADOJ. Marginally, each policy is weighted equally, from the perspective of the agency. Figure 3.1 tracks the yearly summation of the agency's actions. Choices of doing more, staying with the *status quo*, and doing less are coded 1, 0, and -1, respectively. When the line moves above zero, this implies the agency changed to be more active than previously. The ticks on the graph indicate which direction appropriations changed that year, following the procedure described in the section below.

Figure 3.1: Aggregate Agency Outputs, With Appropriations Changes



### 3.1.1 Appropriations

In addition to specifying the actions taken by the agency, I find the distribution of the state variable, in order to numerically integrate across the values of the budget. Similar to the choice variable, I specify the grid points based upon the standard deviation of change in the budget, a value roughly equal to $5.5 million. In order to estimate $p(x_{t+1}|x_t, a_t)$, I fit an ordinal logistic model with the change in budget, grouped into three categories, as the dependent variable. The three outcomes correspond to the budget increasing by more than a standard deviation of change[8], remaining within a single standard deviation of change, or decreasing by more than a single standard deviation of change. The transition probabilities are used to create three different Markov transition matrices. The ends of the Markov chain are not assumed to be absorbing. [9] Another interpretation of the setup is that I have binned the state variable at 6.74 million dollar intervals. The transition probability is the probability that the chain moves up one bin, down one bin, or remains in the same bin.

Congress and the president appropriate funds directly for the running of the Antitrust division. A significant portion of the funding comes from fees from pre-merger notifications required by the Hart-Scott-Rodino act. In the 2012 fiscal year, that sum was estimated to be $108 million with another $54 million, approximately, coming from the general fund. If the fees exceed the estimate, the agency simply receives less from the general fund. If the agency runs a profit, the excess money returns to the general fund.[10]

From 2000-2004, and again in 2009, funding to the ADOJ was entirely drawn from

[8]There are no budget cuts larger than two standard deviations. Due to this, it isn't possible to redraft the dependent variable as being a bigger change since there would be no budget cuts. With an absence of budget cuts in the dependent variable in this construction, I couldn't estimate the probability of a cut.

[9]Though not in the paper, I estimated alternate models with absorbing chains at both the top and bottom of the state variables. The choice of an absorbing chain did not appear consequential for the analysis.

[10]The exact language from the 2012 FY appropriations bill: "For expenses necessary for the enforcement of anti- trust and kindred laws, $162,844,000, to remain available until expended: Provided, That notwithstanding any other provision of law, fees collected for pre-merger notification filings under the Hart-Scott-Rodino Antitrust Improvements Act of 1976 (15 U.S.C. 18a), regardless of the year of collection (and estimated to be $108,000,000 in fiscal year 2012), shall be retained and used for necessary expenses in this appropriation, and shall remain available until expended: Provided further, That the sum herein appropriated from the general fund shall be reduced as such offsetting collections are received during fiscal year 2012, so as to result in a final fiscal year 2012 appropriation from the general fund estimated at $54,844,000."

filing fees. The language in the appropriations bills for these years is nearly identical to that of the 2012 FY. The important point is that the total amount appropriated to the agency as reported by the agency itself is the total guaranteed amount in the appropriations bill. Any reference to funding through fees does not reduce the amount the agency is scheduled to have available. The language of the appropriations bills is deceptive, as the source of the funding does not affect the availability of the total appropriations to the agency.

### 3.1.2 Belief Estimates

Appropriations to agencies is said to change incrementally, meaning that the current appropriation is the previous year's appropriation plus or minus some amount. The incremental aspect is the rate of change; the amount of the change an agency might experience in funding is fairly regular. I argue that agencies can impact the probability that their budget increases or decreases by altering policy. If the agency is unable to impact it's fiscal resources through it's policy choice there is no dynamic tension to their choice of policy.

The ADOJ has had few large changes in funding. A standard deviation of the change in appropriations is \$6.74 million, with the amount of the change rarely exceeding \$10 million in the 40 years of data. I define the distance between grid points as equal to a standard deviation of change, and also take an action to change the budget as needing to be greater, in absolute value this amount.[11] The mean amount of change is \$2.7 million a year, which is not statistically distinguishable from zero at any standard levels of significance. Appropriations to the ADOJ do not change much, and a shift of \$6.74 million or more constitutes a significant change in funding. Larger budget cuts or windfalls are rare.

The budget is assumed to move as a Markov process. Each year, Congress and the president either hold constant, decrease, or increase the budget. The grid points are used to make the appropriations changes by Congress discrete. If appropriations are held constant,

[11] I attempted a 2 standard deviation change model, but there are no negative changes of that size. The largest negative adjustment of the agency's budget was \$9.7 million in 1996. The ratio of the change to the standard deviation, in that case, is only $-1.455$, with the budget scaled to tens of millions.

this implies that the level of appropriations stays within the same bin as the previous year. The range defined from zero to $6.74 million is one bin. Increasing to a funding point beyond this is moving up a bin, and corresponds to an increase in the budget. If we treat the budget as having $k$ grid points, there are $k-1$ bins. The distribution of the transition of the state variable is described by a matrix of dimensions $(k-1)$ by $(k-1)$. The diagonal contains the probability of remaining in a bin, where the first superdiagonal is the probability of moving from the current bin to the next largest bin, and the first subdiagonal is the probability of moving down a bin. With no covariates, three parameters describe the entire set of probabilities of transition.[12] I utilize 45 grid points in the following analysis.

The actions of the agency create the strategic tension in the model, by leading to different transition probabilities. In other words, I assume that appropriations change in response to the policy that the agency chooses. The reaction, from the perspective of the agency, is not deterministic. Instead, their choice leads to different transition probabilities. This increases the number of parameters governing the transition probabilities to nine, and creates three different transition matrices. To find the transition probabilities, I estimate an ordinal logit model with the outcome as stayed in the current bin, moved up, or moved down, and dummies for two of the three lagged agency actions as the independent variables. I find that agency policy choice is strongly correlated with an increase in the probability of an increase in appropriations. Results from this analysis are listed on Table 3.2.[13]

These beliefs are used in the calculation of the fixed point $EV_\theta$. The probabilities calculated by evaluating the regression estimated on table 3.2 are the distribution used in the expectation for solving $EV_\theta$. It is useful, though not necessary, for policy to have a

[12] I do not assume there is an absorbing state. Certain agencies, for example, could run a profit and pay out to the Treasury every year.

[13] I am hesitant to apply a causal interpretation to this result. This is the estimation of the beliefs of the agency regarding the impact of their policy choices. As an estimate of policy-as-a-signal, this is a thin model. In the model specification, I assume that agencies can influence appropriations only through their policy choices; this means that the only meaningful regressor is the agency actions. Altering this specification requires a deeper alteration of the model, with the agency having alternate beliefs depending upon a set of factors, and beliefs about how those factors change. In effect, this would be to add a third state variable, which radically increases the complexity of the model.

Table 3.2: Ordinal Logistic Regression of Budget Changes

| | |
|---|---|
| Status Quo | 0.517 |
| | (0.527) |
| More | 1.886 |
| | (0.597) |
| 1st Cutpoint | -1.976 |
| | (0.528) |
| 2nd Cutpoint | 1.514 |
| | (0.523) |
| Log Likelihood | -505.2 |
| N | 615 |

Standard errors in parentheses

significant impact on this distribution. It is not necessary, because the model can still be solved in absence of this finding. It is useful because there is evidence that policy choice impacts the outcome of future appropriations cycles. Table 3.2 shows that when the ADOJ chooses to do more, an increase in the probability of a budget increase occurs (significant at a $p < .05$ level). Choosing to remain with the status quo does not lead to a statistically significant increase in the budget. This is primia facia evidence that the ADOJ does possess a strategic capacity to influence their budgetary future.

### 3.1.3 Utility Parameter Estimates

Estimation of the primitive parameters in the model, parameter vector $\boldsymbol{\theta}$, follows from the procedure described earlier. Policy choice is modeled as a dynamic discrete choice. This means that policy choice is estimated, by maximum likelihood, as a multinomial logistic model with an added function in the mean, namely, the shadow price $EV_\theta$. Estimation of the discount factor $\beta$ is fixed in any one run of the model. To find the optimal value of $\beta$ the model must be run multiple times across different values of $\beta$, which ranges between zero and one. The value of $\beta$ which maximizes the log likelihood of the model is the maximum likelihood estimate for the discount factor.

Table 4.3 has the estimates from a number of specifications of the model. In any given

run of the model, $\beta$ is fixed, treated as true, and not estimated. Varying $\beta$ has the effect of altering both model fit and the estimates of the parameters. On Table 4.3 I vary $\beta$ to show how model fit and the magnitude of parameters change. As the value of $\beta$ increases, the dynamic effect of policy and budgets increases in magnitude. This means that, at high values of $\beta$, the ADOJ has a long time horizon, implying that they look far into the future when planning policy. Figure 3.2 charts the value of the likelihood across a the range of $\beta$ by increments of a thousandth. I find that the model is slightly better fitting for higher values, though the difference between very low values, near zero, and those at the peak, in the neighborhood of .7895, is not significant. For values of $\beta > .96$, I find that model fit rapidly declines, to the point that likelihoods are flat and models fail to converge. Figure 3.3 narrows in the graph to the neighborhood of the maximum in terms of $\beta$. For the following analysis, I set the value of $\beta$ at .7895. Model Five on Table 4.3 lists the estimates for $\beta = .7895$, which is the estimate with the best model fit across values of $\beta$. This suggests that the ADOJ has a fairly long time horizon, when choosing policy.

Results on Table 4.3 are grouped into two equations which are based on the utility function defined earlier. The third equation in the utility function, the utility for choosing less, is set to zero by assumption. Defined in Equation 2.3, $u(x, a)$ contains six parameters. For the status quo and more policy choices there are policy utility constants. For the same two equations there are coefficients for the budget and budget squared terms. The coefficients listed on Table 4.3 are interpreted as the contemporaneous impact of the budget on policy choice. I calculate the optimal policy choices by adding the shadow price (which is calculated as a function of the utility parameters and the value of the budget) to the evaluation of the contemporaneous utility conditional on the size of the budget. In the immediate term, the ADOJ has a preference for doing more. This is figured by comparing the values of the three policy constants (with less as zero). The value for doing more, 6.477, is greater than the value to the agency for remaining with the status quo, 1.190, and both are greater than zero (these values come from the fifth model in Table 4.3). The numerical value of

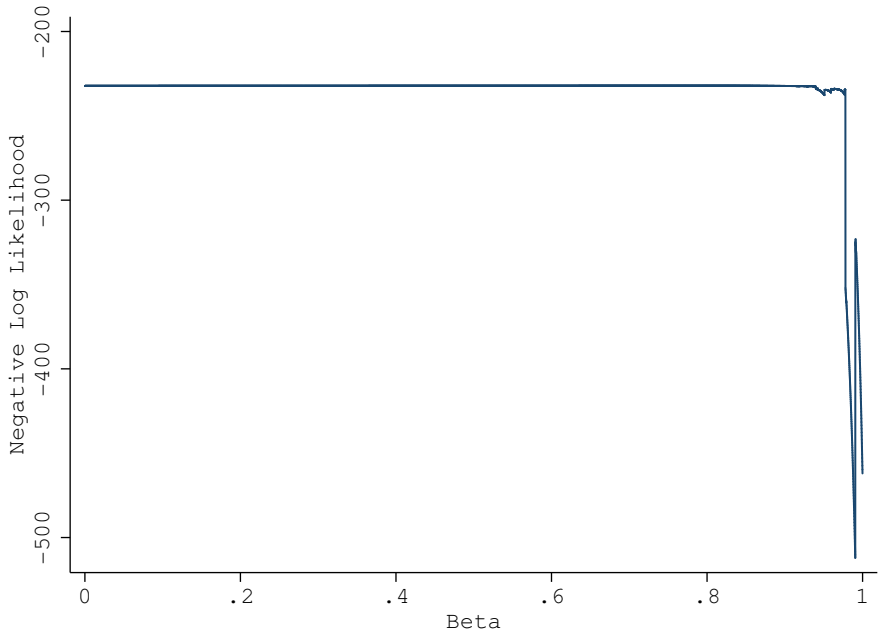
the constants allows me to conclude that, purely in terms of policy, the ADOJ prefers more to the status quo and both are preferred to doing less. However, when money is included this preference order changes. In order to interperate the total effect of money and policy, I evaluate the optimal policy choice function, Equation 2.8.

Table 3.3: Primitive Parameter Estimates

| | | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|---|
| | | $\beta = .05$ | $\beta = .25$ | $\beta = .5$ | $\beta = .75$ | $\beta = .7895$ | $\beta = .96$ |
| *SQ* | Budget | -0.277 | -0.218 | -0.145 | -0.0719 | -0.0604 | -0.0124 |
| | | (0.627) | (0.495) | (0.330) | (0.165) | (0.139) | (0.0365) |
| | Budget$^2$ | 0.00782 | 0.00619 | 0.00412 | 0.00202 | 0.00168 | 0.000403 |
| | | (0.0264) | (0.0209) | (0.0139) | (0.00697) | (0.00587) | (0.00160) |
| | Policy Utility | 5.383 | 4.235 | 2.814 | 1.410 | 1.190 | 0.278 |
| | | (3.533) | (2.790) | (1.860) | (0.931) | (0.785) | (0.200) |
| More | Budget | -1.579 | -1.521 | -1.450 | -1.376 | -1.364 | -0.882 |
| | | (0.723) | (0.615) | (0.497) | (0.412) | (0.403) | (0.348) |
| | Budget$^2$ | 0.0562 | 0.0546 | 0.0527 | 0.0505 | 0.0502 | 0.0307 |
| | | (0.0324) | (0.0282) | (0.0236) | (0.0206) | (0.0202) | (0.0178) |
| | Policy Utility | 10.66 | 9.516 | 8.104 | 6.698 | 6.477 | 3.176 |
| | | (3.874) | (3.228) | (2.497) | (1.944) | (1.883) | (1.573) |
| | Log Likelihood | -232.2 | -232.2 | -232.2 | -232.2 | -232.2 | -237.1 |

Standard errors in parentheses, $N = 615$

Figure 3.2: Likelihood Values at $\beta$




As the budget increases from the lowest observed values, the gap between doing more and the status quo increases. Graph 3.4 charts the optimal policy choice at varying levels of appropriations. This graph charts the evaluation of the agency's optimal decision rule (Equation 2.7). For the observed data range of appropriations, I find that the status quo choice always generates more utility for the agency than does doing more or less. In fact, that difference increases as the budget increases, with the status quo becoming increasingly attractive. This result is both intuitive and not. It is intuitive insofar as I expect that bureaucrats prefer to gather resources to themselves. The sense in which it is not intuitive is that, as the stakes increase and as the budget gets larger, agencies are increasingly less responsive. Marginally, the status quo is dropping in value relative to doing less as well, as the value of the budget is increasing. Marginally, the attractiveness to the agency of staying with the status quo, or even doing less, for an upwards change in budget is increasing. If we take responsiveness to budgetary signals to strictly follow an aggregate production model, than the ADOJ has become increasingly unresponsive over time, as the budget of the agency has been on an upward trend at least since the mid-1990's. For lower values of the budget,

Figure 3.3: Likelihood Values in the Neighborhood of the Maximum

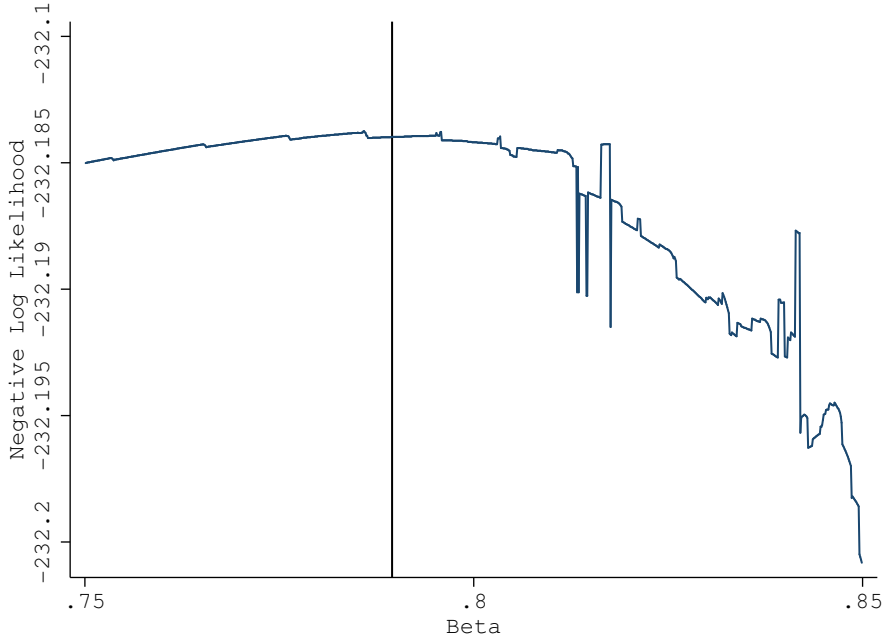



Figure 3.4: Optimal Policy Choice at Different Budget Levels, With MLE 95% C.I.s

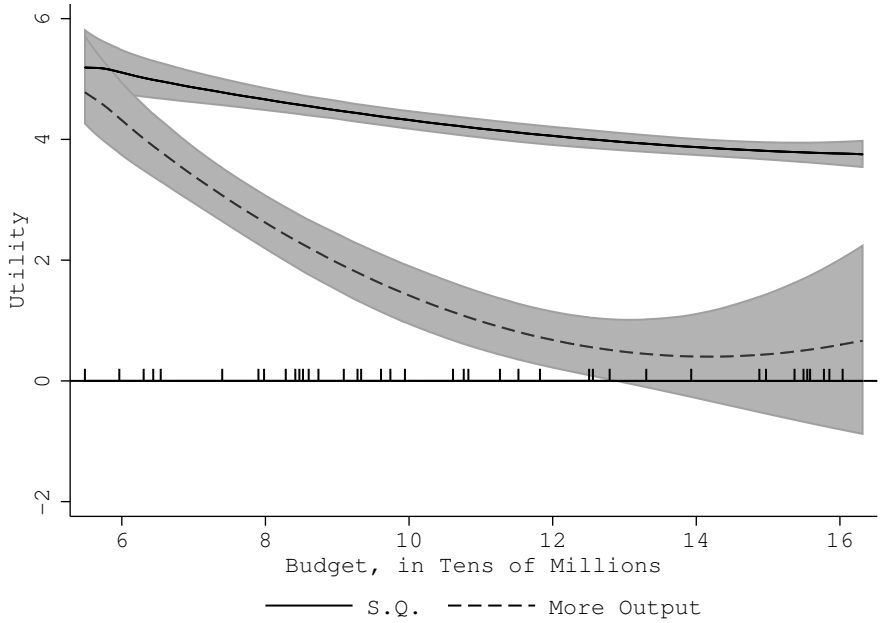
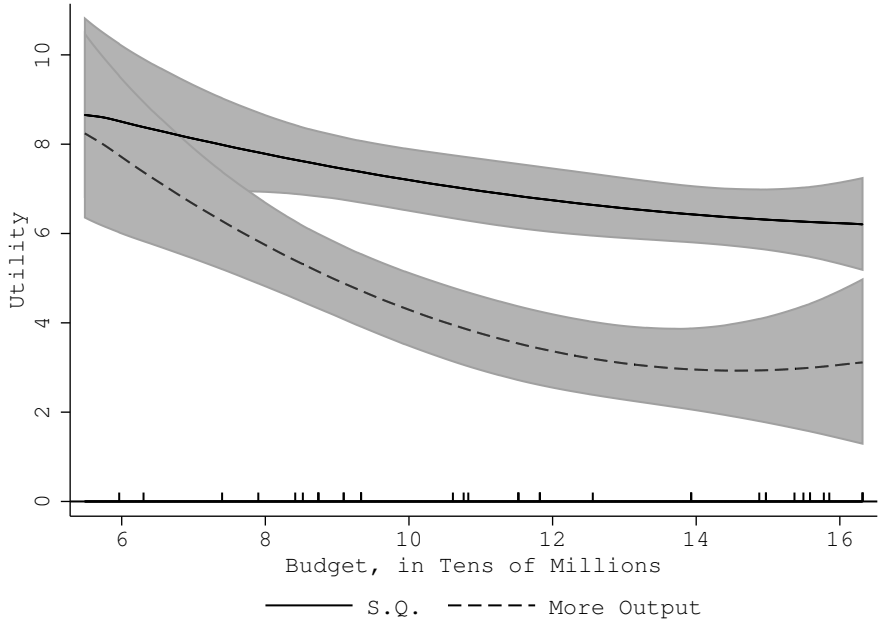


Figure 3.5: Optimal Policy Choice with $\beta = .0001$




the agency would appear to be more responsive, if not exactly so, and that responsiveness disappears when more than 130 million dollars are appropriated to the agency.

If the agency is assumed to be myopic, I do not find an area of unresponsiveness, though the agency preserves the status quo preference. Figure 3.5 is from a model estimated with $\beta = .0001$, an extremely myopic agency. For this model, it is assumed that the ADOJ places almost no weight on the future. In this case, the agency would appear to be weakly responsive across the entire range of appropriations. This graph demonstrates the bias present when the term $\beta EV_\theta$ is not included in an estimated model. While the results that created Figure 3.4 show a clear heterogeneity in appropriations (i.e., for low values the agency appears fairly responsive, and high values not at all), no such heterogeneity appears in Figure 3.5.

This result is central to understanding why agencies seem unresponsive to budgetary signals. As there is more money available to them, agencies are increasingly less likely to respond to the signal. The graph includes standard errors derived from the maximum likelihood estimates. It is worth reiterating that these estimates do not include the uncertainty

from estimating the beliefs of the agency. The point estimate is the evaluation of Equation (2.7). The standard errors are the standard error of the linear prediction (i.e., the estimate minus the term $\beta EV_\theta$) so it is assumed that both $\beta$ and $EV_\theta$ are calculated without error.

### 3.1.4 Controls and Robustness Checks

As a set of robustness checks, I estimate the model with a varying set of controls, including fixed effects of various types and a set of political controls. Within the framework of the research design, these controls would be considered additional structure on the private information of the agency. Including measures of the information could, if the variables are relevant, improve the accuracy of our estimation of the utility parameters of the agency.

One concern that I investigate is that the results might be driven by a diversity of types of goods that are present in the pooled dependent variable. In particular, some goods the agency could produce might be highly effective, but more costly, and the second set might be less effective but cheaper. The agency may have different tastes for different outputs.[14] I split the sample into two categories of outputs: inspections and court case outcomes. One would presume that the "higher quality" output would be observable in the cases and not the inspections. I find that the direction of the coefficients is the same, though there is a loss of significance in the case of the investigations. It is difficult to determine whether this results from a loss of data, or from truly different tastes in the two models. I ran models with fixed effects for both time and policy type, and find that the substantive interpretation is largely unchanged, though statistical significance is changed. I suspect that this is largely from the inclusion of a large number of parameters to the models, in both cases.

Additionally, I estimated a version of the model where I include a dummy for Republican control of the House, Senate, and the presidency, as well as a dummy for the Reagan administration. I find that Republican control of the executive and the legislature signifi-

[14] I argue that, by the construction of the dependent variable, this problem is somewhat alleviated. The discrete choice made by the agency is distributed according to the sample properties, so that shifts in choice are roughly equivalent across different outputs.

Table 3.4: Models of Policy Choice with Controls

| | | (1) Invest. | (2) Court Cases | (3) Output F.E. | (4) Year F.E. | (5) Pol. Vars. |
|---|---|---|---|---|---|---|
| *SQ* | Budget | -0.00485 | -0.741 | -0 | -0.000806 | 0.136 |
| | | (0.163) | (1.096) | (0.473) | (0.0613) | (0.183) |
| | $Budget^2$ | 0.000323 | 0.0257 | 0 | -3.60e-05 | -0.00824 |
| | | (0.00706) | (0.0399) | (0.0168) | (0.00399) | (0.00763) |
| | Rep. Admin. | | | | | 0.641 |
| | | | | | | (0.155) |
| | Reagan Admin. | | | | | -0.568 |
| | | | | | | (0.204) |
| | Rep. House | | | | | 0.0406 |
| | | | | | | (0.206) |
| | Rep. Senate | | | | | 0.613 |
| | | | | | | (0.180) |
| | Constant | 0.746 | 5.818 | 1 | 0.983 | -0.197 |
| | | (0.892) | (7.402) | (3.340) | (0) | (1.063) |
| More | Budget | -1.340 | -1.806 | -0 | -0.00451 | -1.945 |
| | | (0.546) | (1.234) | (0.530) | (0.926) | (0.612) |
| | $Budget^2$ | 0.0472 | 0.0691 | 0 | -0.000931 | 0.0653 |
| | | (0.0284) | (0.0492) | (0.0222) | (0.0529) | (0.0287) |
| | Rep. Admin. | | | | | -1.632 |
| | | | | | | (0.664) |
| | Reagan Admin. | | | | | -1.636 |
| | | | | | | (1.100) |
| | Rep. House | | | | | -1.024 |
| | | | | | | (1.372) |
| | Rep. Senate | | | | | 2.391 |
| | | | | | | (1.260) |
| | Constant | 6.564 | 9.116 | -1 | -0.962 | 11.39 |
| | | (2.471) | (7.818) | (3.454) | (3.584) | (3.309) |
| | ll | -155.7 | -71.49 | -267.3 | -248.9 | -217.2 |
| | N | 410 | 205 | 615 | 615 | 615 |

Standard errors in parentheses

Table 3.5: Transition Probability Estimates with Controls

| | |
|---|---|
| Status Quo | 1.307 |
| | (0.637) |
| More | 2.877 |
| | (0.710) |
| Rep. Admin. | -1.705 |
| | (0.227) |
| Reagan Admin. | -0.533 |
| | (0.364) |
| Rep. House | 3.128 |
| | (0.393) |
| Rep. Senate | -3.779 |
| | (0.389) |
| 1st Cutpoint | -4.328 |
| | (0.694) |
| 2nd Cutpoint | 1.082 |
| | (0.638) |
| | |
| ll | -369.2 |
| N | 615 |

Standard errors in parentheses

cantly affects policy choices. Inclusion of the political controls increases model fit, though not at the expense of the base findings of the canonical model. In fact, the results are largely strengthened, with the status quo choice now showing significant and positive utility in money. I interpret the result to imply when agencies have more information about the politicians in charge, they make more accurate policy choices. Agency policy choices reveal a policy flexibility, but a inflexibility regarding money. More money while preserving the status quo is better.

Another concern regards the role of the president as a confounder. Since the president acts in both setting policy and working with the budget, the president could apply pressure to both the transition of the budget and the actions of the agency. More technically, the president could induce correlation between $p(x_{t+1})$ and $Q_t$, which would lead to inconsistent estimates of the primitives in the model. Column 5 in Table 3.4 includes estimates from the model Republican administrations do have a significant downward affect on pol-

icy. In this specification, the effects of money seem pronounced, which seems to imply that the results regarding money hold. The ADOJ acts more conservatively when the president is a Republican, a result which confirms a number of other studies in this area (Wood and Anderson 1993; Eisner and Meier 1990). Problematically, the president does significantly affect both the policy choice, and the probability that the agency sees a budget cut. Table 3.6 show the parameter estimates for the primitives when the sample is split by administrations. The agency beliefs are also estimated with a split sample, though the size of the bins for both agency actions and appropriations are estimated using the full sample. Across the two types of administrations results differ dramatically. Democratic administrations have null results, while under Republican administrations the results from the whole sample are largely replicated. It is difficult to consider the mapping of the split sample results to the whole sample, as the original Markov process is disrupted. Likely there are two different choices about policy actions for the different administrations. The analysis suggests that the response to money is largely the same, however. Figures 3.6 and 3.7 chart the optimal policy choices under Democratic and Republican administrations. For both, the rank ordering of policies mostly remains $SQ >$more$\geq$less.

## 3.2 Conclusions

I find that the ADOJ behaves in status quo preserving ways, and that this behavior is reinforced as budgets get larger. The inclusion of a control function as a means to include expectations of future resources and outcomes leads to the conclusion that a substantively significant portion of the agencies utility is carried in future plans, though, largely, it is a concern about policy, not future resources. The Antitrust division influences its own future resource availability, and can significantly increase the probability that its budget is increased in the future. This leads to the central strategic tension the agency faces: when does the agency do more, in order to get more? When the ADOJ chooses to increase output

Table 3.6: Parameter Estimates by Administration

| | | (1) Dem. Admin. | (2) Rep. Admin. |
|---|---|---|---|
| *SQ* | Budget | 0.0939 | 0.0558 |
| | | (0.860) | (0.229) |
| | Budget$^2$ | -0.00405 | -0.00305 |
| | | (0.0313) | (0.0100) |
| | Constant | 0.143 | 0.571 |
| | | (5.762) | (1.196) |
| More | Budget | 2.524 | -2.902 |
| | | (4.348) | (0.566) |
| | Budget$^2$ | -0.115 | 0.118 |
| | | (0.185) | (0.0271) |
| | Constant | -15.10 | 13.52 |
| | | (25.31) | (2.653) |
| | ll | -87.39 | -128.0 |
| | N | 195 | 420 |

Standard errors in parentheses

Figure 3.6: Optimal Policy Choice under Democratic Administrations

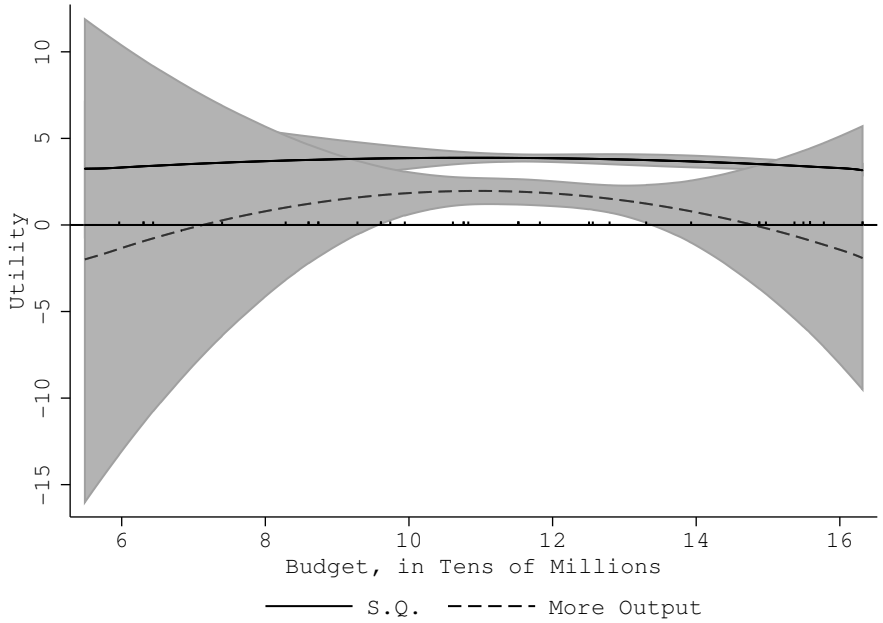
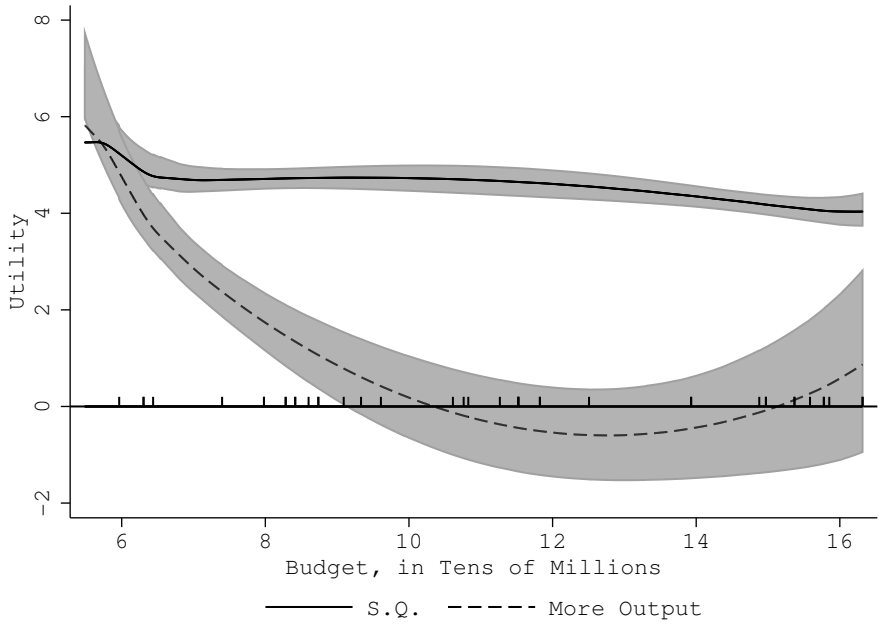


Figure 3.7: Optimal Policy Choice Under Republican Administrations




it is with the intention of getting more money. The likely strategy is to recoup the losses from the initial output from years of a new policy status quo. Agencies lead regarding funding. They act knowing that their choice to do more is likely to lead to an increase in funding. When the agency does receive more money, however, they are loath to do more because they want to take advantage of the money to deal with current projects. More money does not always lead the agency to choose to do more.

Money, contemporaneously, makes remaining with the status quo more attractive to an agency than increasing output. In one way, this should not be surprising. I presume from Niskanen (1971) that agencies are single minded budget maximizers. What my work concludes is that this view is simplistic. In the short run, having more money is less appealing than achieving policy goals, and increases in output are done proactively as a means to protect status quo policies. Instead of being global budget maximizers, agencies prefer to receive more money to do the same job they had previously been doing. Agencies are local budget maximizers instead of global. They just want to get paid more to do the same job they've always done. I replace the claim of budget maximization with a more nuanced

position; agencies (the ADOJ at least) are status quo preservers, preferring to use money in ways other than increasing policy output.

I do not explicitly outline a principal-agent (PA) model in this paper, though the project has been written with an eye to that idea. The idea of the decision theoretic model outlined here is that this is the best response function, regarding money, for an agency to a larger, more complicated, non-cooperative PA model. The evidence presented here implies as much–while there is a strong story for the impact of money, the partisanship of both the president and Congress still impact the agencies above and beyond appropriations. Following the call from Moe (1984), scholars have focused on "contractual perspectives" and "hierarchical control." These terms imply a strict PA relationship where agencies are given a task, and the only questions are, "what task?" and "did they do that task?" The reality, for better or worse, is that the deep, and somewhat messy, world of bureaucratic politics frequently defies these strict and harsh views of the relationship between Congress and bureaucracies. I break the hierarchical control model from the title of this essay onwards by suggesting that agencies work to control appropriations. The implication is that Congress is the agent of agencies regarding funding, even if the actors might not themselves put it in those terms. The more difficult reality is that neither the president nor Congress may know exactly what it wants the agency to do, and the agency is on a more equal footing than might be otherwise thought regarding the directives from these actors.

The model developed in this paper is a novel application to a political science problem. While formally derived choice models are not new (Signorino, 1999; Morton, 1999) the dynamic structure from this paper represents an methodological innovation. In typical economics applications of this class of model, the discrete choice usually has a deterministic effect on the value of the state variable. For example, works in this area have focused on the choice to replace capital (Rust 1987), or to enter or exit a market (Aguirregabiria and Mira, 2002). The question of stochastic control, however, has been less frequently used. Because of the uncertainties in politics, many political science problems are apt to have

an extra element of randomness. The application of dynamic discrete choice models has a reasonably long history in economics, but the framework has not been applied to political science questions until now.

# 4

# Appropriations and Agency Policy Strategy

In this chapter, I examine the behavior of 14 agencies. The agencies, listed on Table 4.1, cover a wide variety of policy areas. While the majority of them can be considered agencies concerned with the area of the U.S. economy, others are engaged in social welfare work, such as the Black Lung Disability Trust Fund and the Pension and Welfare Benefits Administration. Only two of the agencies are organized as independent agencies: OSHA and the Pension Benefit Guaranty Corporation.

The agencies were chosen because they list workload statistics in the appendix to the *Budget of the United States Government*. The budget itself contains relatively little hard data about agency funding. However, the appendix contains an account by account listing of budget requests along with funding for previous years. For any given fiscal year, the budget appendix typically reports three pieces of information for each agency. First, the proposed budget for the fiscal year of the budget is included. Second, the budget of the agency for the year the budget is written is included.[1] Finally, the actual budget granted to the agency for two years prior to the fiscal year of the budget (i.e. the year before the budget is written) is included for comparison.

Every agency listed in the appendix has, at a minimum, a short description of the ac-

[1] Or, during years of continuing resolutions, the expectations for funding needs for the rest of the year is included.

Table 4.1: The Agencies

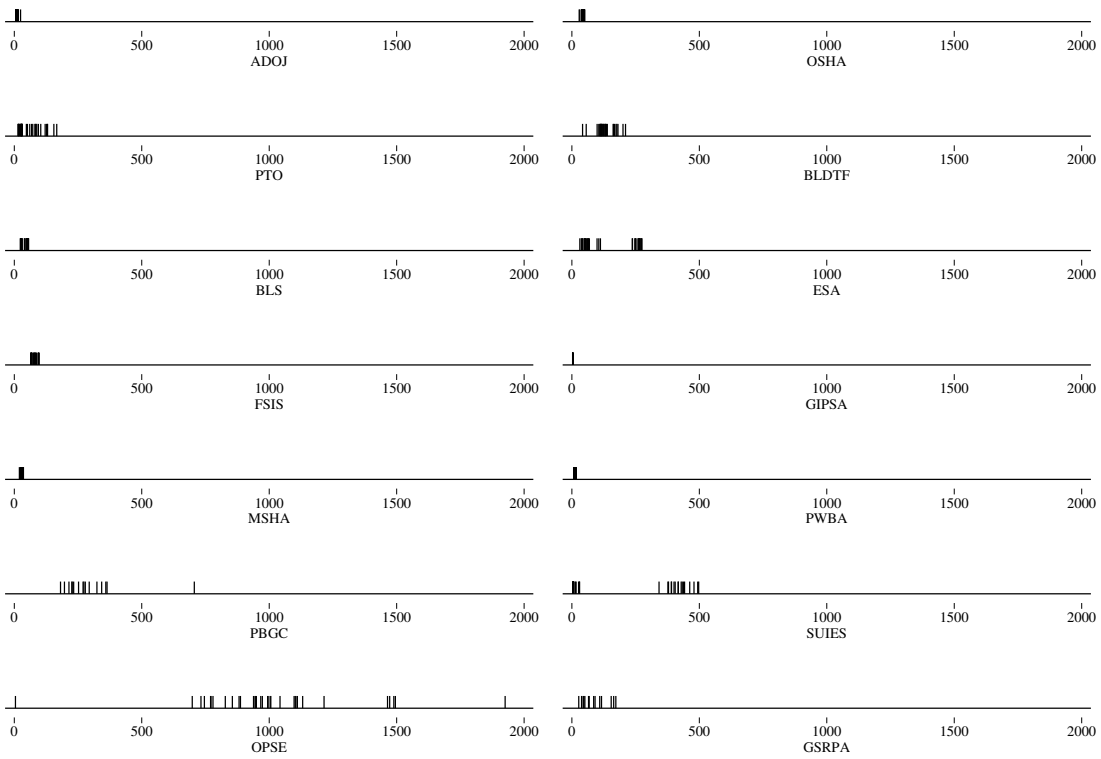
| Agency Name | Abreviation |
|---|---|
| Antitrust Division, Dept. of Justice | ADOJ |
| Occupational Safety and Health Administration | OSHA |
| Patents and Trademarks Office | PTO |
| Black Lung Disability Trust Fund | BLDTF |
| Bureau of Labor Statistics | BLS |
| Employment Standards Administration | ESA |
| Food and Safety Inspection Service | FSIS |
| Grain Inspection, Packers, and Stockyards Administration | GIPSA |
| Mine Safety and Health Administration | MSHA |
| Pension and Welfare Benefits Administration | PWBA |
| Pension Benefit Guaranty Corporation | PBGC |
| State Unemployment Insurance and Employment Service | SUIES |
| General and Special Risk Program | GSRPA |
| Office of Post-Secondary Education | OPSE |

tivities of the agency. For a select group, workload statistics of the agency are included as well. The workload statistics mirror those of the funding information. Two years prior to the fiscal year of the budget, the actual workload statistics for that year are included. For the fiscal year when the budget is written, there is an expectation for the workload for the rest of that year, and a workload projection for the year of the the budget. For both the appropriations and the workload statistics, I use the numbers reported for two years prior to the fiscal year of the budget (e.g. for the FY1980 budget, I coded the numbers that were listed from 1978.).

### 4.0.1 Appropriations by Agency

In this model, agencies earn utility from the absolute value of the budget. Unless the value of the budget is standardized by some manner, estimation would need to proceed on an agency by agency basis. Figure 4.1 is a rug plot of the distribution of each agency's real appropriations (fixed to 2006 real dollars). The agencies in this study have a wide variety of distributions of appropriations. OSHA, for example, has a budget that is in the hundreds of millions of dollars; the Grain Inspection, Packers, and Stockyard Administration (GIPSA)

Figure 4.1: Raw Appropriations by Agency

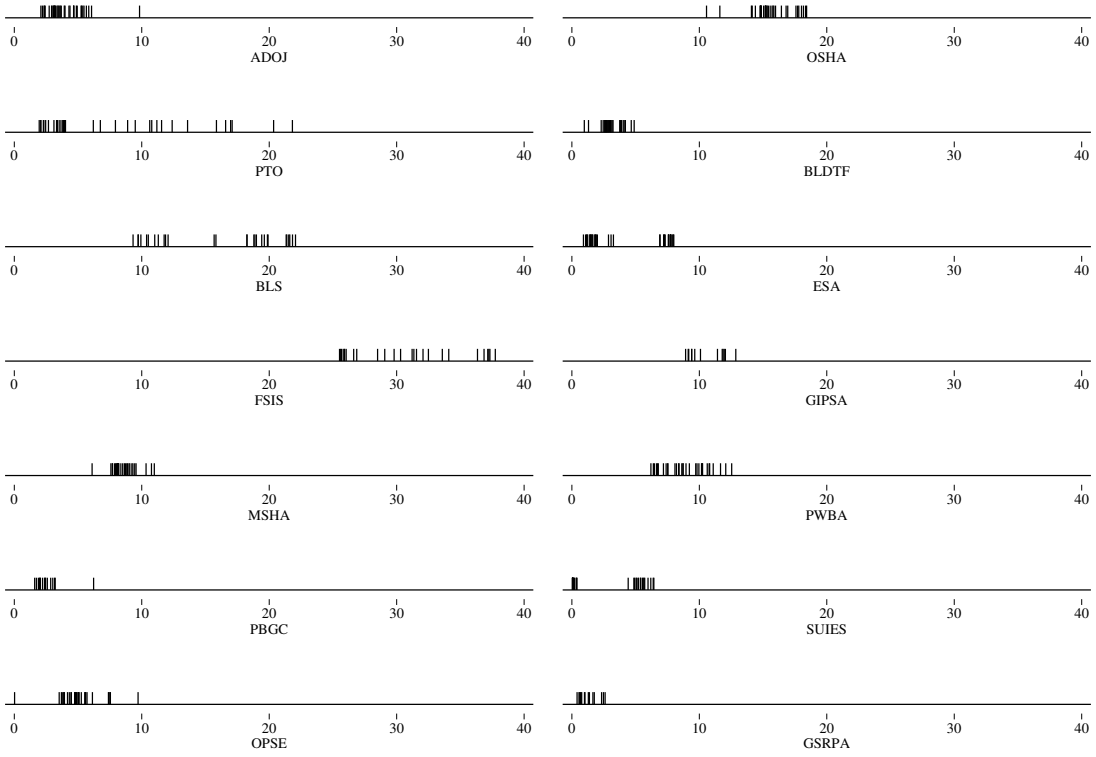



has a budget in the millions. A budget windfall of $10 million would be less than a 1% to OSHA, while it would be more than a 100% increase for the GIPSA.

As referenced in Equation (2.1), the appropriations to each agency is standardized by the average yearly change in appropriations. This standardization is desirable for two reasons. First, it preserves the absolute level of the budget on a yearly basis. This standardization only alters the ratio between the natural numbers. Further on this point, the natural numbers serve as both a reference point (meaning that recovering the impact of a budget change for any given agency is straightforward) as well as grid points for the numerical integration that occurs in the solution for the fixed point problem. Second, the ranges and distributions of the agencies becomes roughly comparable, without needing to standardize many more features of the distribution.[2] Figure 4.2 lists the standardized appropriations

[2]For example, a stronger standardization assumption might involve a mean standardization as well, which would fix the distance of the budget from some value to zero, and restrict them to be the same for all agencies.

Figure 4.2: Standardized Appropriations by Agency



for each agency. The scale, in both Figures 4.1 and 4.2 are fixed to be the same for all of the agencies in their respective graphs. From appearances, the distribution of the appropriations to the agencies are now roughly comparable, though the Food Safety and Inspection Service appears to be a bit of an outlier, regarding the distance between zero and the minimum of their budget.

### 4.0.2 Policy Actions

This model is predicated upon agencies making discrete policy choices. Of course, the output of agencies rarely meets this exact structure. Instead, most agency activities, in the aggregate, are yearly counts of behaviors. For example, OSHA performs tens of thousands of annual workplace inspections annualy. In contrast to OSHA, the ADOJ typically has less than a thousand investigations of all types running in any given year. The variability of the distribution of policy instruments is not only across agencies, however. In addition to workplace inspections, OSHA creates strategic partnerships with business around the country. Annually, these partnerships number in the dozens.

The drastic contrast in distributions represents a challenge to both inter and intra-agency comparisons of policy instruments and their relationship to appropriations. Discretizing policy choices makes the policies roughly comparable, as the move to do more or less is then measured in terms of the impact of the utility, and not directly in the production function to the agency for that specific policy. Put more plainly, discretizing the policy instruments allows me to pool the policies into one model, and makes them comparable. Previous scholars have dealt with this problem by running separate models on the various policy instruments.[3] Implicitly, I assume that all policies have equal weight in the decision making of agencies. In the area of monetary policy, the discrete choice approach has

The method I have chosen here also makes the restriction of a single set of parameters for all agencies regarding money less applicable, which would imply that this restriction would lead to a poor fit to the model. The data appears to suggest that a single set of parameters a sufficient reduction of the problem.

[3] In the area of antitrust, see Lewis-Beck (1979); Wood and Anderson (1993); Siegfried (1975); Gallo et al. (2000); Yandle (1988).

been taken to describe the behavior of the Federal Reserve (Hu and Phillips, 2004*a*,*b*). The justification rests on two arguments. First, the act of policy adjustment, though counted with precision, is difficult to adjust exactly. With the Fed, for example, the act of adjusting the interest rate cannot be done exactly, as the market intervenes and introduces uncertainty following the actions of the agency. More generally, the act of exactly controlling the number of activities is difficult, as changes in policy are brought about by changing rules and regulations, which leads to a diffrent number of countable actions by the agency. The second argument is more theoretic; because of the uncertainty in changing policy, the choices the agency face can be thought to reflect an unobserved distribution of utility for the agency.[4]

The graph in Figure 4.3 captures the aggregate activity of the agencies in the sample. Each action is mapped to a numerical value (i.e. $less = -1$, $sq = 0$, $more = 1$). This graph contains three pieces of information. The solid line is the sum of the actions for each time period. The dashed line is the total appropriations to the agency, in billions. Finally, the underlying bar graph is the total number of agencies in the study in any time period. In general, the government has increased in activity, as the sum activity never drops below zero in any given year. The rate of growth of the government slowed in the '80s and then rebounded post-Reagan.

### 4.0.3 Estimation of Beliefs

In order to solve the fixed point problem, it is necessary to estimate the agency's beliefs about how their actions impact the appropriations process. Their beliefs are structured such that agencies perceive the budget as doing one of three things: the budget can move up in value, down in value, or stay with a range. Similar to the choice variable, the grid points for the budget are inductively defined from sample properties. To find the beliefs of the agency, I estimate an ordinal logistic model of the change in the budget. The outcome variable is

[4]This assumption is utilized in any number of choice models. See Train (2003).

Figure 4.3: Aggregate Activity, Appropriations, and Number of Agencies

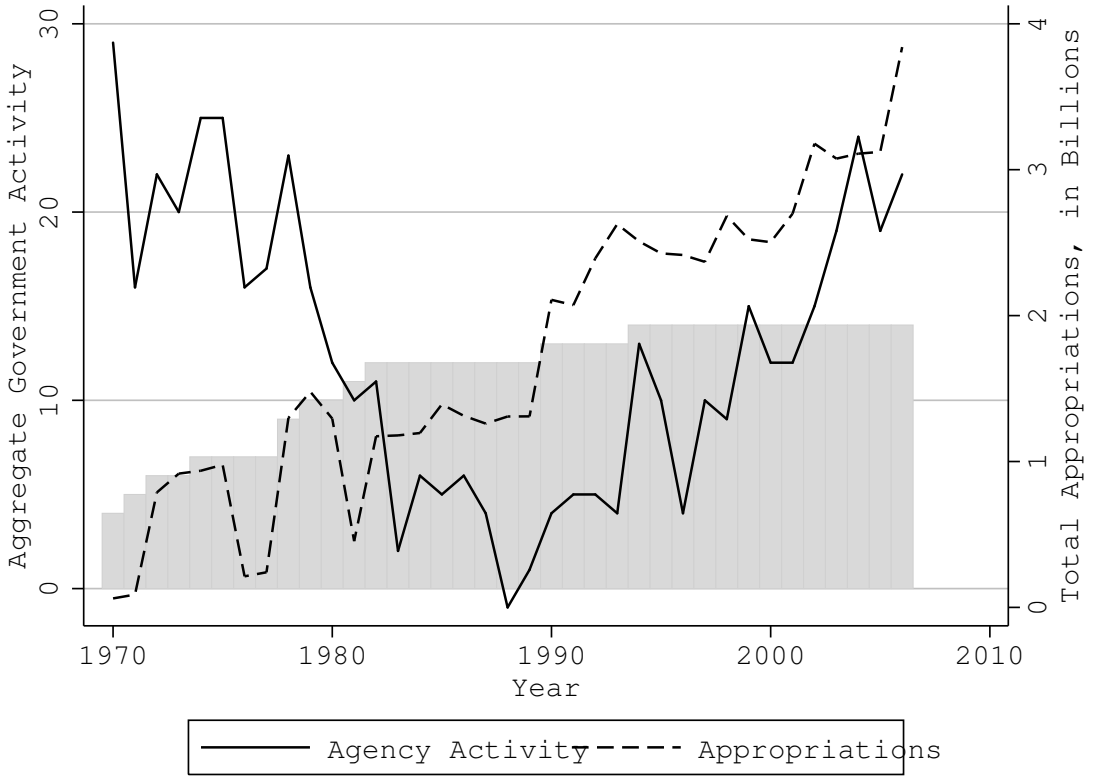


Table 4.2: Ordinal Logistic Estimates of Budgetary Change

| | |
|---|---|
| Status Quo | -0.129 |
| | (0.359) |
| More | 1.444 |
| | (0.366) |
| 1st Cutpoint | -3.072 |
| | (0.364) |
| 2nd Cutpoint | 1.832 |
| | (0.354) |
| | |
| ll | -1413 |
| N | 2354 |

Standard errors in parentheses

whether the budget remained in the same bin (as defined by grid points) at time $t + 1$, or moved upwards in value outside of the bin, or likewise downward. The regressor in this model is the policy choice at time $t$. The agency's beliefs are their perceived effect from making a policy choice on the future distribution of the budget.

Table 4.2 are the estimates from the beliefs model. I find that policy choice does have a significant impact on the distribution of the future budget. When agencies choose to remain with status quo policies, budgets tend to remain fixed (i.e. there is no significant impact from the status quo on a change in the budget). However, when agencies choose to increase output, this leads to a significant increase in the probability that the agency's budget rises. This, by itself, presents *prima facia* evidence that the model is appropriate in this context. Allowing agencies the ability to influence future appropriations in the model fails to be evidence in itself. These results suggest that agencies are utilizing this capacity. Further, this evidence suggests that the actors are involved in the appropriations process. Previous scholars have found that the relationship between political actors (i.e. the president and Congress) exist in an embedded, endogenous policy framework (Krause, 1999). This further lends evidence to the idea that agencies influence the policy preferences of politicians.

### 4.0.4 Utility Parameter Recovery

The estimation of the primitive parameters in the utility function, $\boldsymbol{\theta}$, follows from the procedure described above. The outcome variable for the following equations is the policy choices made by the agencies in the study. Agencies earn utility from their policy choice, and from the size of the budget. The primitive parameters of the utility function are the mean function in a multinomial choice model, with the mean weighted by an additive, recursive function of the utility parameters, namely $\beta EV_{\theta}$.

Any single run of the model is conditional on the value of $\beta$. Table 4.3 lists estimation results of the utility parameter for varying levels of $\beta$. Varying the discount parameter affects both the value of the primitive parameters (with the utility becoming shifted to future returns), and the fit of the model. The optimal value of $\beta$ is found through its effect on model fit. The highest value of the log likelihood serves as the MLE for $\beta$.

Agencies place a significant weight on future rounds of appropriations. The optimal fit of the model is found, approximately, at $\beta = .9739$. Likelihood ratio tests show that the value of $\beta$ is significantly different than both zero and one at a p value of less than $.05$. The sixth column of results in Table 4.3 lists the results for $\beta = .9739$, the point of optimal model fit.[5]

[5] Additionally, all the following graphs, unless otherwise noted, assume that $\beta = .9739$.

Table 4.3: Utility Parameters from Policy Choices

| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|---|
| | | $\beta = .05$ | $\beta = .25$ | $\beta = .5$ | $\beta = .75$ | $\beta = .95$ | $\beta = .9739$ | $\beta = .9999$ |
| SQ Budget | -0.0435 | -0.0360 | -0.0283 | -0.0213 | -0.0107 | -0.00772 | -0.00499 | |
| | | (0.105) | (0.0831) | (0.0559) | (0.0287) | (0.00641) | (0.00357) | (0.00159) |
| | Budget$^2$ | 0.000271 | 0.000335 | 0.000495 | 0.000691 | 0.000501 | 0.000359 | 0.000214 |
| | | (0.00792) | (0.00626) | (0.00420) | (0.00214) | (0.000465) | (0.000257) | (0.000115) |
| | Budget$^3$ | 7.25e-06 | 3.57e-06 | -2.39e-06 | -8.79e-06 | -7.52e-06 | -5.20e-06 | -2.73e-06 |
| | | (0.000157) | (0.000124) | (8.30e-05) | (4.21e-05) | (9.01e-06) | (4.97e-06) | (2.25e-06) |
| | Constant | 3.643 | 2.879 | 1.935 | 0.999 | 0.236 | 0.139 | 0.0720 |
| | | (0.376) | (0.298) | (0.201) | (0.104) | (0.0242) | (0.0136) | (0.00607) |
| More | Budget | -0.0415 | -0.0340 | -0.0261 | -0.0188 | -0.00868 | -0.00607 | -0.00326 |
| | | (0.112) | (0.0922) | (0.0702) | (0.0534) | (0.0474) | (0.0474) | (0.0475) |
| | Budget$^2$ | 0.00233 | 0.00239 | 0.00254 | 0.00272 | 0.00257 | 0.00247 | 0.00231 |
| | | (0.00848) | (0.00703) | (0.00539) | (0.00416) | (0.00374) | (0.00374) | (0.00375) |
| | Budget$^3$ | -7.91e-05 | -8.26e-05 | -8.82e-05 | -9.44e-05 | -9.43e-05 | -9.29e-05 | -9.01e-05 |
| | | (0.000169) | (0.000141) | (0.000109) | (8.51e-05) | (7.73e-05) | (7.72e-05) | (7.73e-05) |
| | Constant | 2.253 | 1.489 | 0.544 | -0.393 | -1.154 | -1.250 | -1.318 |
| | | (0.394) | (0.323) | (0.242) | (0.178) | (0.152) | (0.152) | (0.152) |
| | ll | -1382 | -1382 | -1381 | -1381 | -1380 | -1380 | -1380 |

Standard errors in parentheses

In general, the results suggest that agencies have a strong preference for the status quo. The utility parameters for policy show that agencies (holding money constant) prefer both the status quo and doing more to doing less. Additionally, choosing the status quo is the preferable outcome, in all cases. The value of the policy utility for choosing the status quo is greater than the equivalent parameter for choosing to do more, with a Wald test of $\theta_s \neq \theta_m$ having a p value less than $.05$.

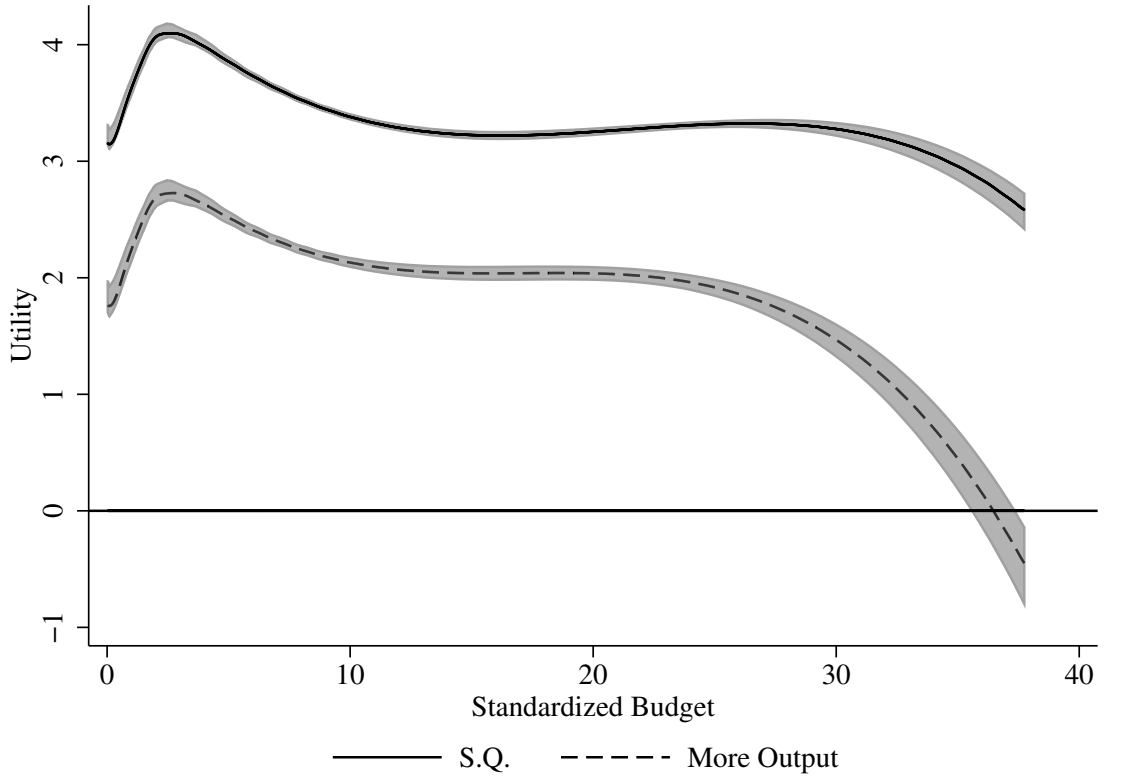
### 4.0.5 Evaluation of Optimal Policy Choice

While agencies exhibit a policy preference for the status quo, this itself doesn't constitute evidence of budgetary non-response, or even a preference for the status quo, considering the utility the agencies have in money. Indeed, the finding that agencies have a preference for the status quo, in policy alone, is not particularly surprising (unless the idea that bureaucrats don't like change is, itself, surprising). To include the effect of money on optimal policy choice, I evaluate the optimal policy choice function, equation 2.7. The full evaluation of the Bellman equation describes the preference ordering of policy choices, conditional on the current size of the budget. Below, I describe the marginal effect of money on making a policy choice, in the probabilities of selecting a particular action.

Figure 4.4 is the utility an agency gets from making any given policy choice.[6] The y axis of the graph is the utility an agency earns for a policy choice. The utility for choosing less is zero by assumption, and is visualized by the solid horizontal line at zero. If an agency chooses to remain with the status quo they earn the utility visualized by the solid line, or the dashed line, if they choose to do more. For all values of the observed budget, agencies prefer to remain with the status quo over choosing to do either more, or less. For the highest observed values of budget, doing more nets an agency less utility than choosing to less. In other words, with enough money, agencies would rather not continue to increase

[6] A smoothing function has been applied to the raw utility. Specifically, I fit a lowess curve to the utility function. Substantively, the results are the same. The raw data, however, has the appearance of a step function, to varying degrees.

Figure 4.4: Optimal Policy Choice



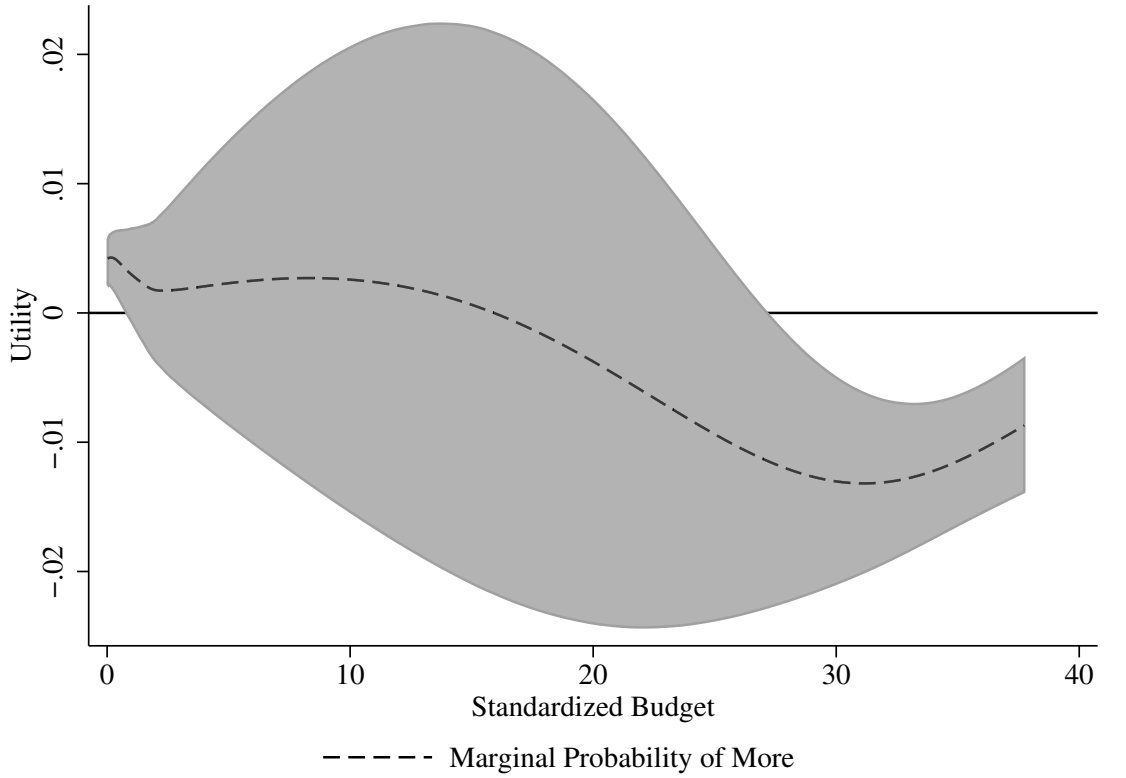

output.

### 4.0.6 Marginal Probability of Policy Change

The evaluation of the optimal policy choice indicates the general strategy an agency may take for a given level of budget. However, this information is different than the marginal effect of increasing money on policy choice. Given the structure of the choice model, the marginal impact of a change in budget is conditional on the rates of increase or decrease in utility for all of the choices. This marginal rate of change is the response rate to changes in appropriations, or, more directly put, how responsive agencies are to budgetary signals.

Figures 4.5, 4.6, and 4.7, are visualizations of the marginal probability of an agency choosing a particular action, calculated as a numerical derivative. I calculate the derivative

Figure 4.5: Marginal Probability of Choosing More



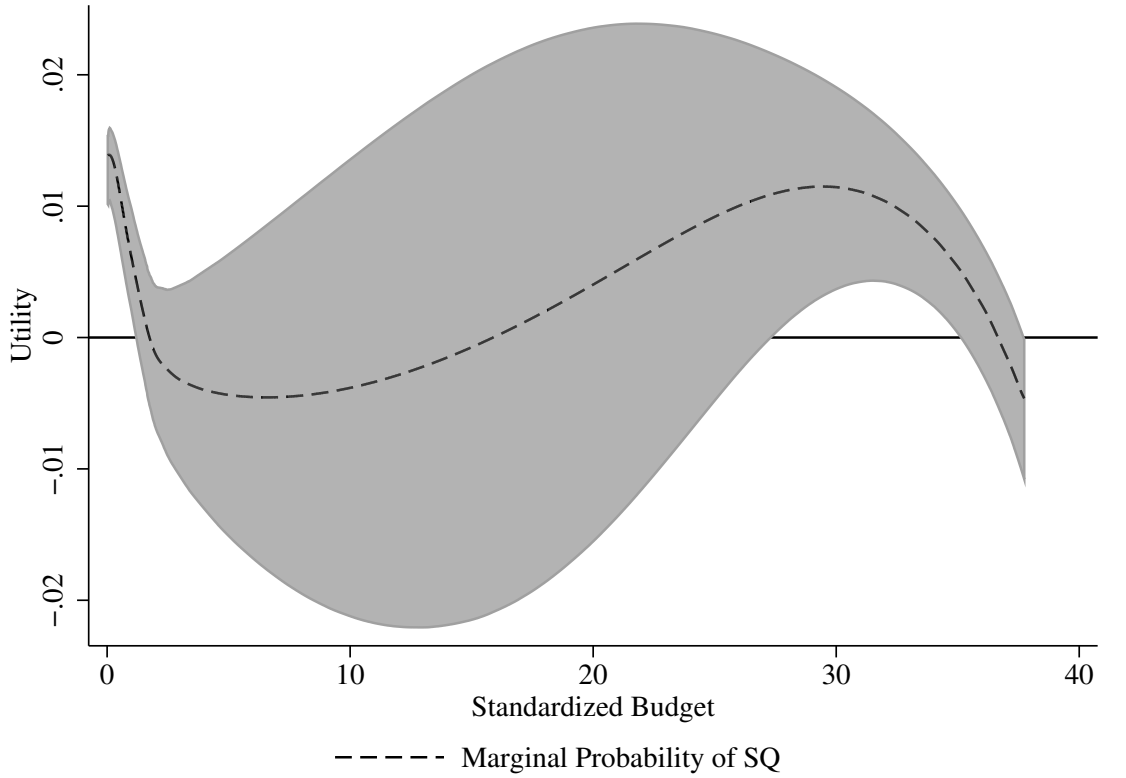

according to the function

$$P(a, x + t) - P(a, x) = \frac{\partial P(a, x)}{\partial x}$$

such that any point on the line in the following figures represents a one unit change in the absolute value of the budget from the current value. The standard errors are calculated in a manner similar to that provided by Clarify. I draw values from a normal distribution with means based upon $\boldsymbol{\theta}$ and a variance-covariance matrix $Var(\boldsymbol{\theta})$. I calculate the derivative at 5000 points between zero and 40, with 2000 draws of the parameters, and calculate the standard deviation of the distribution of evaluations of the derivative at each point.

At the lowest observed levels of budget, increases in appropriations lead to a marginal increase in the likelihood of doing more, as shown in Figure 4.5. However, agencies quickly loose this positive responsiveness to budgetary increases, and for most of the observed

Figure 4.6: Marginal Probability of Choosing Status Quo



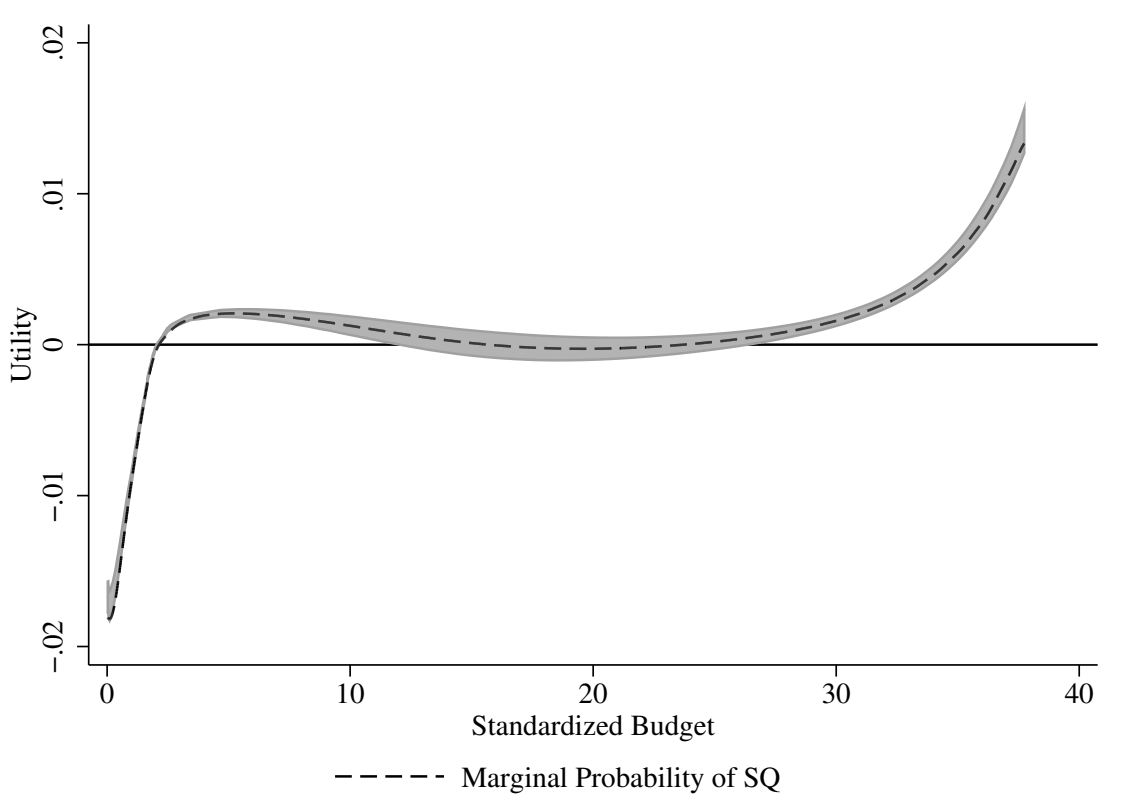

range of data, increased budgets do not statistically increase the likelihood of increasing output. At the highest observed values of appropriations, agencies are actually less likely to increase output.

The marginal likelihood of remaining with the status quo shows a similar pattern to that as the margin for $\Pr(a = m|x)$. Figure 4.6 shows that agencies are increasingly likely to remain with the status quo, until the budget increases enter the middle region of the support for observed budgets. At the higher end, agencies again are marginally likely to remain with the status quo. This support drops off at the tail end of the observed support for appropriations.

Figure 4.7 shows the marginal probability of an agency choosing to do less.[7] At the highest and lowest observed values of budget, agencies appear to be marginally more likely

[7]The standard errors appear substantively smaller in Figure 4.7 due to the lack of covariance (resulting from the choice model assumption) between choosing less and the other two policy choices.

Figure 4.7: Marginal Probability of Choosing Less



to choose less, for an increase in budget. Interestingly, all three policy choices exhibit a region of marginal nonresponse to money and these areas overlap. Between roughly 20 and 30 units of budget agencies changes are unlikely to respond to any changes in appropriations at all. In other words, for a moderate sized budget, agencies appear to be altering policy without any regard to budgetary signals. This result frames the findings in Carpenter (1996) in a new light. Carpenter finds that the FTC and FDA have an unusual rate of response to changes in appropriations. This work suggests a sample dependent property to the finding. Agencies, for some portion of the sample, appear responsive, and will increase output for marginal increases. As funding moves to the dead space of responsiveness, agencies are driven by forces other than the budget.

### 4.0.7 Robustness Checks and Controls

In the framework of this dynamic choice model, controls take on a different meaning. Including more variables into the dynamic framework is complicated, and suffers from problems related to the "curse of dimensionality" Rust (1994). Adding extra controls to the mean function of the choice model is not only simple, but has a natural interpretation. In this framework, control variables are extra information that otherwise would be contained in the private information for the agencies (i.e. $Q_t$). Other forms of robustness checks serve as restriction to the model. Splitting the sample implies a heterogeneity in the parameters dependent upon some information outside the scope of the model.

Introducing political controls to the utility function of the agency substantially leaves the findings regarding money and policy intact, though these variables are, themselves, predictors of agency behavior. The presence of a Republican president leads to an increased likelihood of an agency choosing a status quo policy, as does a Republican-controlled House. The Senate, unsurprisingly, seems to have a strong negative effect on policy, with a negative effect across both the status quo and more equations, leading to an overall downward push on government activity. While political actors do influence agency activity, even

above and beyond the means of political control inherent in budgets, introducing controls for this influence seems to have little impact on the estimates of budgetary responsiveness. The utility parameters regarding money maintain the same orders of magnitude and direction, with statistical significance basically unchanged for all six parameters. The policy utility parameters are likewise the same in magnitude and direction, with statistical significance unchanged. The total sum of the results implies that political control, above and beyond the budget, while extant, seems to operate in a way orthogonal to the temporal and strategic optimization problem agencies face.

### 4.0.8 Independent versus Executive Organized Agencies

Splitting the sample into independent versus executive organized agencies suggests that the two types of agencies have similar beliefs and preferences.[8] However, the estimation of the utility parameters for independent agencies is hampered by the data demands of the model, and these estimates seem unlikely, and the model fit is poor. Given this, comparison of the utility parameters between agencies are tenuous, at best.

The numerical results for agency beliefs and utility parameter estimates across the agency types reinforce the view that the two types of agencies largely behave similiarly. Table 4.5 are estimates of agency beliefs, conditional on the type of agency. Across the two agencies, the results are largely the same, with both types of agencies finding that an increase in output in one time period increases the likelihood that their budget will be increased in the next round. Estimates of the utility parameters, shown in Table 4.4 for executive organized agencies is largely unchanged from the estimates that do not omit independent agencies. The estimates for independent agencies, as previously mentioned, are poorly done. It is difficult to tell whether the unclear result is due to the model performing

[8]Coding independent agencies was done in a fairly lo-fi manner. I went to the websites of all fourteen agencies, and if any described their organization structure as being independently organized, I coded them as such. The absence of any mention of independence their website was then coded as being executive organized.

Table 4.4: Utility Parameter Estimates for Data Subsamples and with Controls

| | | (1) | (2) | (3) | (4) |
|---|---|---|---|---|---|
| | | Ref. Model | Pol. Vars. | Ind. | Executive Organized |
| SQ | Budget | -0.00499 | -0.00715 | -5.227 | -0.00664 |
| | | (0.00159) | (0.00163) | (8.993) | (0.00357) |
| | $Budget^2$ | 0.000214 | 0.000336 | 0.335 | 0.000278 |
| | | (0.000115) | (0.000117) | (0.567) | (0.000260) |
| | $Budget^3$ | -2.73e-06 | -5.05e-06 | -0.00706 | -3.69e-06 |
| | | (2.25e-06) | (2.28e-06) | (0.0119) | (5.12e-06) |
| | Rep. Admin. | | 0.0347 | | |
| | | | (0.00379) | | |
| | Rep. House | | 0.0552 | | |
| | | | (0.00479) | | |
| | Rep. Senate | | -0.0372 | | |
| | | | (0.00423) | | |
| | Policy Utility | 0.0720 | 0.0532 | 26.85 | 0.134 |
| | | (0.00607) | (0.00703) | (47.37) | (0.0136) |
| More | Budget | -0.00326 | -0.0153 | -3.168 | -0.0459 |
| | | (0.0475) | (0.0491) | (8.944) | (0.0486) |
| | $Budget^2$ | 0.00231 | 0.00310 | 0.143 | 0.00631 |
| | | (0.00375) | (0.00381) | (0.562) | (0.00391) |
| | $Budget^3$ | -9.01e-05 | -0.000104 | -0.00199 | -0.000176 |
| | | (7.73e-05) | (7.84e-05) | (0.0117) | (8.18e-05) |
| | Rep. Admin. | | -0.0197 | | |
| | | | (0.113) | | |
| | Rep. House | | 0.332 | | |
| | | | (0.158) | | |
| | Rep. Senate | | -0.395 | | |
| | | | (0.153) | | |
| | Policy Utility | -1.318 | -1.227 | 20.97 | -1.158 |
| | | (0.152) | (0.183) | (47.27) | (0.156) |
| | Observations | 2,257 | 2,257 | 336 | 1,921 |
| | ll | -1380 | -1376 | -195.7 | -1175 |

Standard errors in parentheses

Table 4.5: Beliefs Estimates of Budgetary Change

| | Independent | Executive Org. |
|---|---|---|
| Status Quo | -0.0334 | -0.171 |
| | (0.792) | (0.409) |
| More | 1.366 | 1.457 |
| | (0.809) | (0.416) |
| 1st Cutpoint | -2.397 | -3.275 |
| | (0.797) | (0.416) |
| 2nd Cutpoint | 1.299 | 1.955 |
| | (0.784) | (0.403) |
| ll | -310.6 | -1082 |
| N | 396 | 1958 |

Standard errors in parentheses

poorly, or a relatively low number of observations.[9]

Figures 4.8, 4.9, 4.10, and 4.11 replicate the earlier visualizations of the preference ordering of agencies, as well as the marginal rate of responsiveness in the probabilities of policy choices, only excluding independent agencies. These graphics reinforce the notion that the estimates for independent agencies, while odd, are not the result of the agencies being outliers. The effect on the substantive implications of the model are nearly identical to those where the independent agencies are not omitted.

## 4.1 Conclusions

I find that the agencies in this study choose a policy strategy that helps them preserve status quo policies. Both the policy orientation of agencies as well as the policy preferences regarding money induce a preference for the status quo. While I grant agencies the ability to make tradeoffs between money and policy, in a sense, they are making no such tradeoff; agencies simply prefer to sit on their hands and resist change. Agencies, if anything, ap-

[9]Strictly speaking, there does not appear to be a good guide as to what seems an appropriate number of observations. Asymptotics in this class of model are increasing in both the number of units (in this case, agency-policies) and the time of observation ($t$, in this formulation) (Kasahara and Shimotsu, 2009). In practice, it seems that fewer than 400-500 observations tends to lead to poor estimates of the parameters in the utility function. This is one of the reasons I formulated the model in terms of a "meta" styled set of agency preferences.

Figure 4.8: Optimal Policy Choice, Excluding Independent Agencies

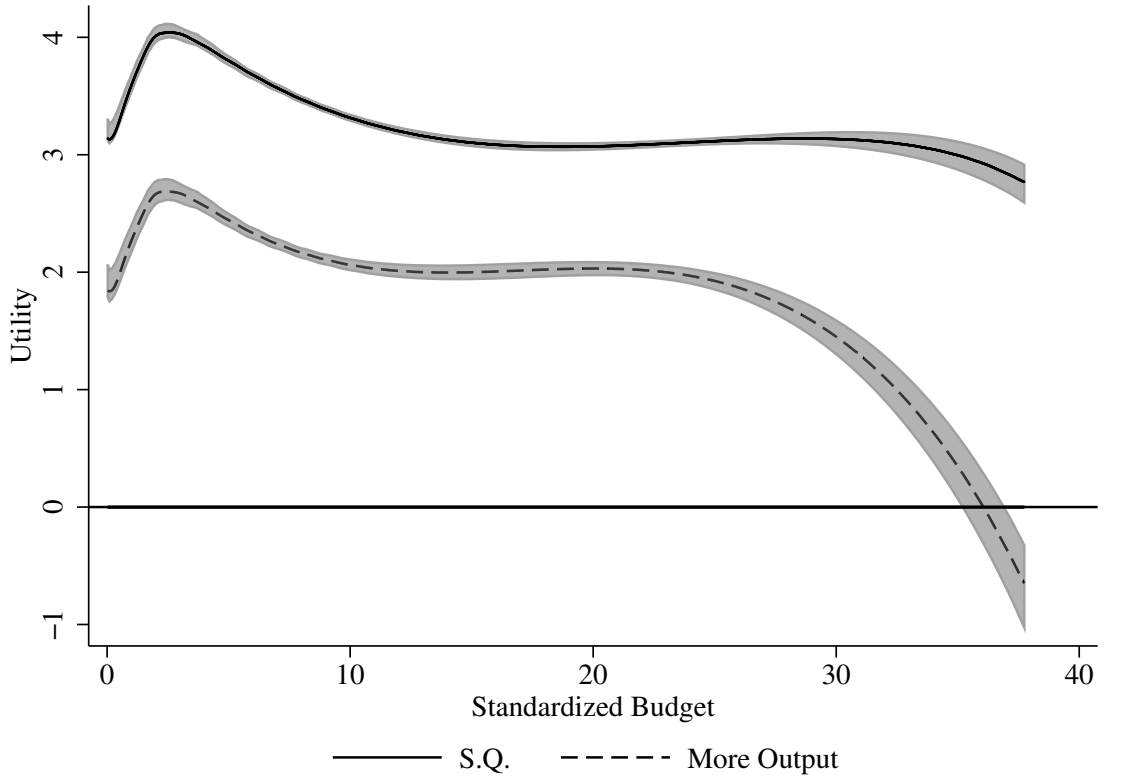


Figure 4.9: Marginal Probability of Choosing More, Excluding Independent Agencies

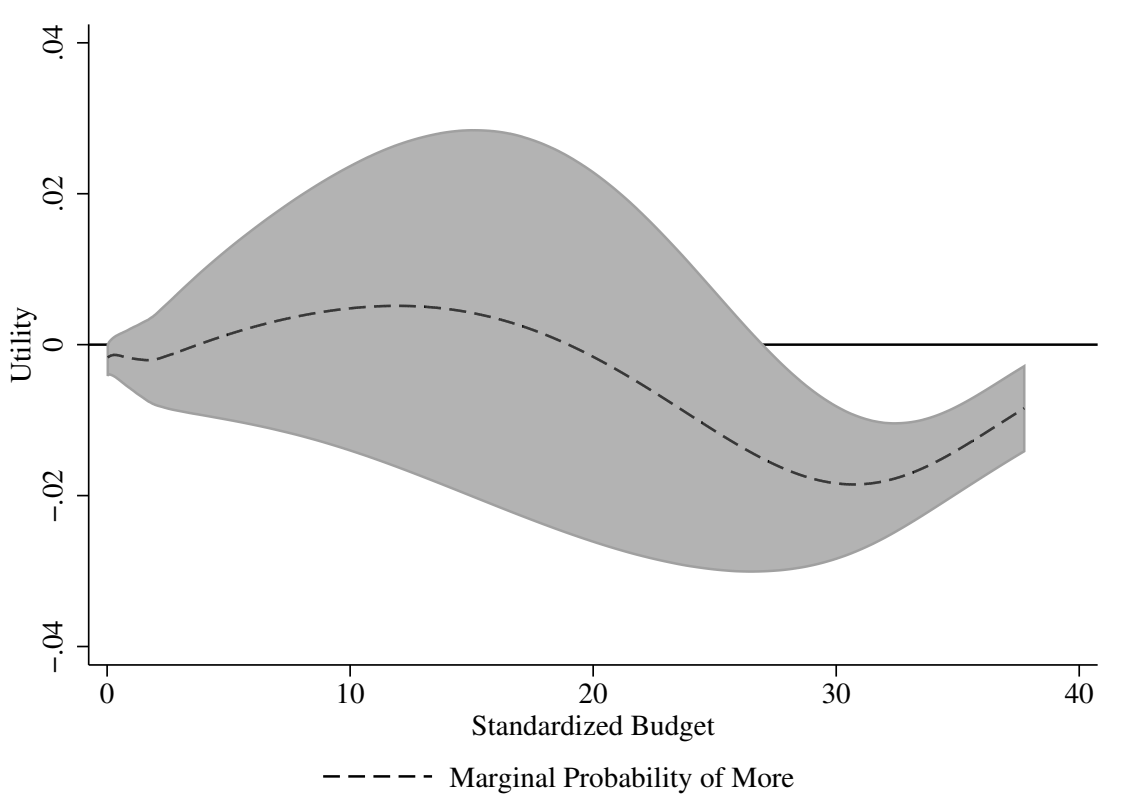


Figure 4.10: Marginal Probability of Choosing Status Quo, Excluding Independent Agencies

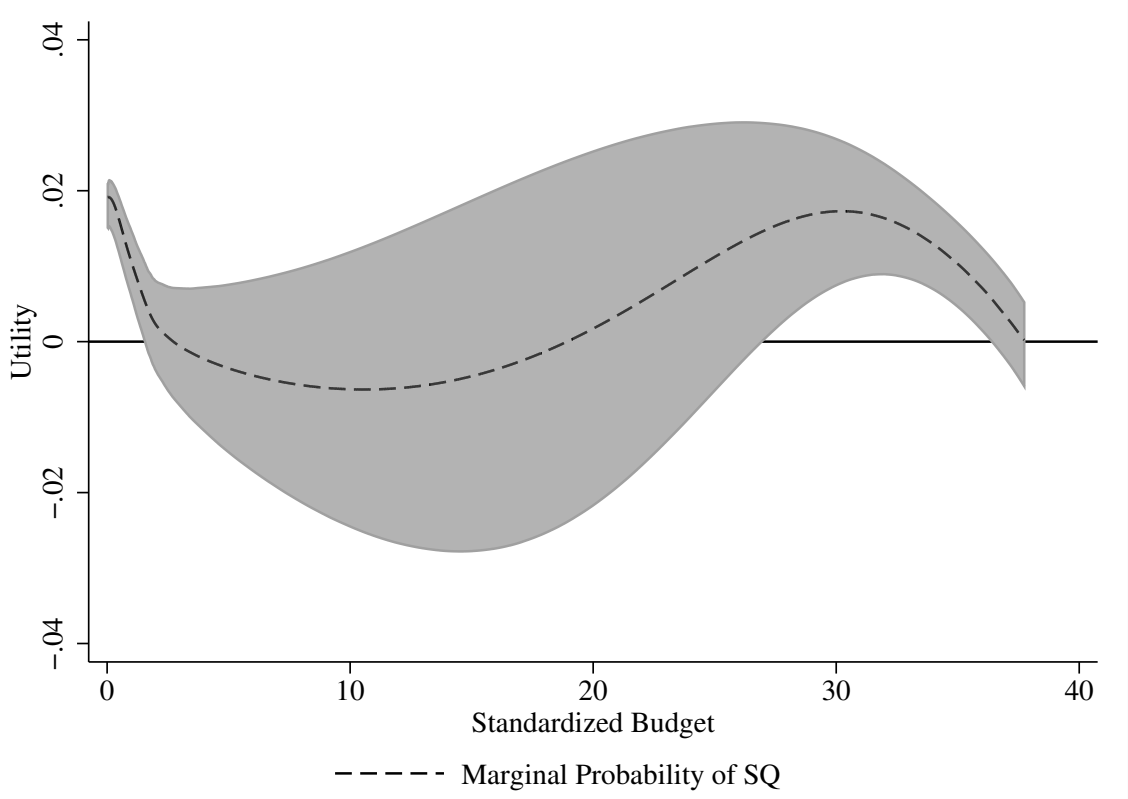
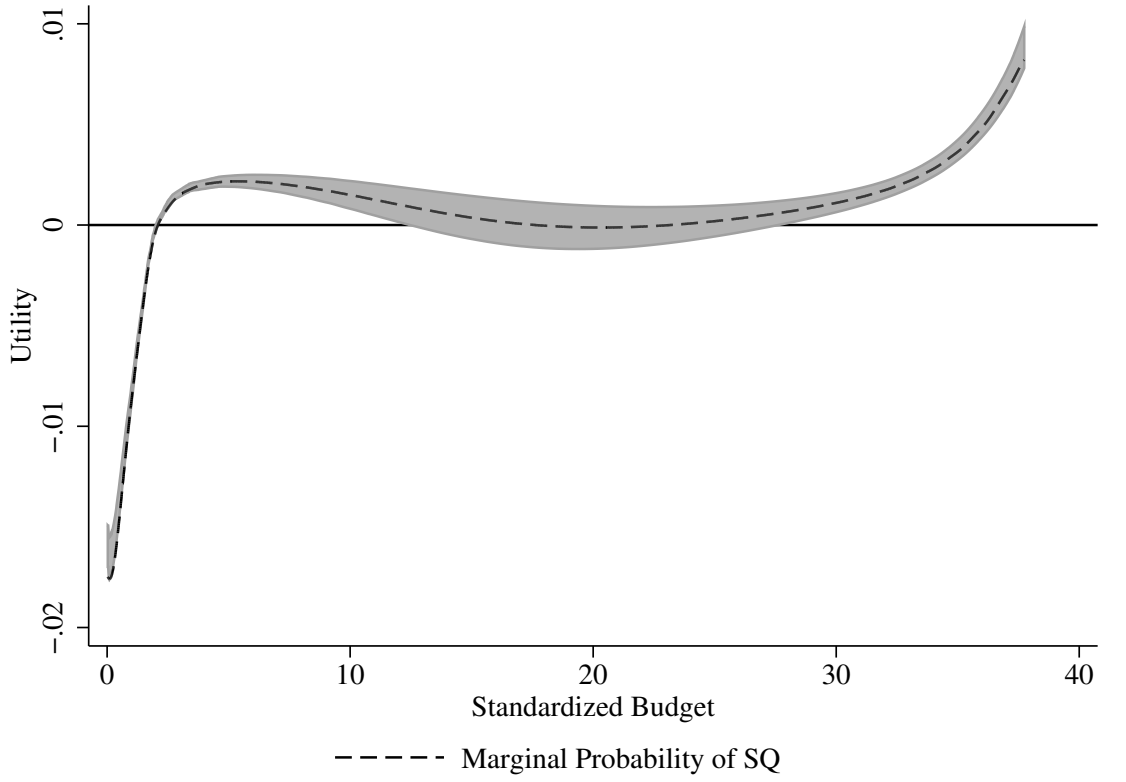


Figure 4.11: Marginal Probability of Choosing Less



pear to take the lead regarding changes in funding. It is the belief of agencies that if they choose to increase funding, unilaterally, the appropriations process will respond to meet their increased need for funding.

The responsiveness of the appropriations process defies the straightforward heirarchical control model posited by Moe (1984) and elsewhere (Moe, 1985; McCubbins and Schwartz, 1984; Bendor and Moe, 1985). After examining the behavior of the agencies, I am left with the vision of planets hurdling through space, each pulling on each other, influencing the others path, and moving together–to a largely unknown location. The interesting thing is less about the internal rules that govern the behavior of the objects. Instead the rules that govern their interaction as the move along, influencing each other are of primary concern, because these rules, ultimately, govern what policy is in place. The strict principal-agent control model, on the other hand, denies the system of co-evolution, and leads to an overly simplistic understanding of how agencies behave.

# 5

# Directions For Future Research

> "I'm so insulted when people say that lawmaking is like sausage making," said Stanley A. Feder, president of Simply Sausage, whose plant here turns out 60,000 pounds of links a year.
>
> "With legislation, you can have hundreds of cooks–members of Congress, lobbyists, federal agency officials, state officials," Mr. Feder said. "In sausage making, you generally have one person, the wurstmeister, who runs the business and makes the decisions."
>
> –Pear (2010)

> Trying to make a movie in Hollywood is like trying to grill a steak by having a succession of people coming into a room and breathing on it.
>
> –Douglas Adams, author, *Hitchhiker's Guide to the Galaxy*

## 5.1 Conclusions

Substantial reform of a Federal bureaucracy, resulting from legislative action, is a rare event in U.S. politics (Mayhew, 2005). By substantial, I mean reform that shifts the aggregate work of a bureaucracy in a direct and measurable way. The old saw about lawmaking and the sausage factory, in this case, really is a cliche with no truth to it. At the end of a round of

making sausage, there is at least a product that people might want to consume. Lawmaking is much more like movie making, in this regard. The end result of a long and tortured process is usually something not fit for consumption, and is thrown out on the trash-heap at the end of the day. The endless list of individuals who see fit to interject themselves in the lawmaking process guarantee that any policy created is going to be a long way from any individuals vision, and creating a useful product by the end of the process is unlikely.

This basic story of how the lawmaking process itself is an obstacle to bureaucratic reform is what I want to tell about how agencies appear to operate in a way that appears to be without limits on their discretion. The major formal tools of bureaucratic oversight–appropriations and re-writing rules and regulations–are used in ways that on the surface appear marginally important but are practically toothless. Appropriations happens almost according to formula, and budgets move incrementally, yielding changes slowly and through time (Davis, Dempster and Wildavsky, 1966; Wildavsky, 1964; Anderson and Harbridge, 2010). A browsing of THOMAS will inform the reader that changes in statutory law that affect bureaucracies a are fairly small expansion or contractions of the powers of agencies, or tweaks on existing regulations.

Bureaucrats tend to operate according to the principles that are laid out in the law that authorizes the agency, sometimes making minor tweaks to their operating procedures. Politicians make only small tweaks on the original formula that created the agency, preferring that an agency merely exist and do *something* (almost anything, really) rather than attempt to change how the agency is behaving. Members of Congress know that the likely outcome of trying to change the status quo will most frequently result in an outcome that is favorable to no one. The end result is that agencies appear to operate as if there are no bounds to their discretion, because, as a practical matter, there are none. Bureaucrats know that following policy fairly closely to how it was originally intended, and only making minor tweaks forestalls the creation of an outside force the can induce Congress to radically reform a bureaucracy.

In this essay, I describe an endogenous, dynamic model of political control over the bureaucracy. The endogenous and dynamic features of the model allow for bureaucrats and politicians to make marginal tweaks on an otherwise difficult to manage system. The sense is which the model is endogenous is such that bureaucracies serve as an important information gathering tool for Congress. Bureaucrats are more likely to know when significant changes in policy are likely to be necessary, and, inform Congress members. The dynamic element further allows for both actors to make incremental and substantively minor shifts that, through time, accumulate to more significant changes in the structure of the principle-agent relationship.

From allowing these extra dimensions of action by agencies, what I find is that agencies are far-sighted protectors of *status quo* policies. Agencies choose policy strategically in order to help protect their mode of business. When agencies operate under severe budget constraints they will increase output when budgets rise. Outside of severe budget constraints, agencies do not appear to follow budgetary signals.

I split the utility from choosing an action into two parts: utility from the choice itself, and from having a budget of a particular size. When I consider only the utility from the choice itself, the ADOJ prefers to do more. However, when I consider their total utility from a policy choice (both from the choice and from having a budget) the ADOJ prefers the *status quo*. A less formal way of putting it: everyone would like a raise without having to do more extra work.

In the rest of this chapter I discuss future directions for research. In practice, agencies operate under a *de facto* abdication system. Given enough funds, agencies operate as they please. This raises questions about how discretion fits into the modeling I've done previously, among other questions.

## 5.2 A Discussion of Discretion

Discretion, as it is commonly considered, is a range along an ideological spectrum that agencies are free to operate within (Huber and Shipan, 2002; Epstein and O'Halloran, 1999, 1994; Gailmard, 2009). Inside of this range they are free from interference, and outside of this range, they will be punished in some manner for their action. Let $a_t$ be an action by an agency in a given fiscal year. For the sake of discussion, let's refer to this as a mapping of some aggregation of an output ($O_t$), say workplace inspections by OSHA, to an ideological dimension where $a(O) \in \mathbb{R}$. A discretionary range granted to an agency is a compact set of values on the real number line. I'll call this set $D = [d_l, d_u];\ D \in \mathbb{R}$, and, without loss of generality, I'll assume $d_u \geq d_l$. An agency acts according to the discretion granted to them if they chose an action that falls within that range, i.e. $a_t \in D$.[1] There are two actors in this game: a coalition of principles ($P$), and an agency ($A$). Principles, in a game that is assumed to operate outside of the scope of this model, resolve a single preference point for policy among themselves. The difficulty of thinking about this connects back to the language problem I mentioned in a footnote earlier in Chapter 1. In general, I want to clarify and explore the difference between the authorization an agency has, the rules it promulgates, and how it turns those rules into actions.

Scholars assume that if an agency chooses an action that does not fall within their allowed range of discretion (i.e. $a_t$ is not an element of $D$), some form of punishment will

[1] Now, implicitly I've assumed that agencies work on one policy. This is false. The assumption (leaned on by Ting (2001) and Calvert, McCubbins and Weingast (1989)) is a common one, and is uncontroversial. I want to make it more controversial. Even if agencies have a single policy, even that is usually considered in a multi-dimensional way. Take the Patents Office. Regarding patents, the agency is usually judged on not just how many patents it ratified each year, but how big the backlog is, and the manner in which they ratify them. For example, computerizing the process has been a major concern over the last ten years. The growth of new industries challenges the existing patent system. How the Patent Office deals with patents from genetics and software industries, in and of themselves, can be thought of as distinct policies. From the perspective of Congress, it is easy to think that each of these dimensions constitutes a "policy" even if the authority granted to them is really one dimension. Of course, this is in addition to the fact that the Patents Office also grants corporate trademarks. Even how an agency performs their job, generally, can be thought of as a policy (Chun and Rainey, 2005). As a problem of theory, this is not easily dealt with because of the multidimensional calculations that are necessary to solve.

occur. The nature of the punishment varies by the study. In some cases, scholars assume that Congress and the president will write new legislation and overwrite the agencies own rules and regulations (Shipan, 2004). In other cases, the punishment will be in the form of redistribution. Congress will either slash the budget of the agency, or dis-appropriate funds from an agency (Ting, 2001). In all cases concerning discretionary authority, it is assumed that the same actor is making decision year in and year out. Or, whoever the decision makers may be, that they behave consistently across years. The result of this specification choice is that agencies have a choice about policy, and if they choose to act outside of their range of discretion they will pay a cost.[2]

The choice of punishment mechanism is consequential for a number of reasons. If the assumption is that budgets are altered as punishment, then this implies that ranges of discretion need not change. If no new legislation is passed, but budgets are slashed instead, policy itself may not need to change. Additionally, this implies that bureaucrats value money as a thing holding value separate from policy. Possessing the means of producing policy must be valuable to bureaucrats, else the threat of fiscal punishment would have no impact. If I assume that new legislation is passed that alters policy (as punishment), a host of questions about what quality the new legislation can take on need to be answered. What will the new status quo policy be? How much discretion will there be on the new act?

Moving forward, I will specify all and any punishments as a cost laid on bureaucrats. Costs can come of two forms. The first is a one period cost, $c$. This is intended to be something like a direct intervention by a politician, or a redistribution of appropriations that occurs for one term. The other cost is the creation of a new law which affects the bureaucracy in some way, $l$. The difference between the two is a shock versus a shift in costs to an agency. $c$ is a shock, and $l$ is a shift in costs. A shock is a one time cost applied to the agency (i.e. an impoundment of funds). New legislation shifts the entire cost curve

[2]There is a whole host of other things that can be thought of as violating the discretion granted to agencies, namely fraud and malfeasance, that I will not consider in detail. Ultimately, the punishment (arrest and removal from office) occurs for reasons orthogonal to the political implications. In other words, you can commit fraud and be punished for it, but still be producing a policy that falls within a discretionary range.

for an agency, for all future time periods.

## 5.3 Comparisons Across Models

The point of departure for this study concerns the nature of the discretionary range. Implicitly, it has been assumed that discretion does not change over time. Discretion is granted in something that can be thought of as the inverse of what is stated in a law (Huber and Shipan, 2002). The length and specificity of a law tends to decrease the discretion granted to an agency. The more sparse the instruction for an agency, the more discretion tends to be granted. The creation of the law defines the discretion range in a forward way. From the day of the authorization, the agency is seemingly bound by this same discretionary range. Unless a "menu law" is enacted, where agency action is context dependent and defined by a menu of options, agents have discretion over their actions, whether very clearly defined (as in minimum and maximum sentences for the courts) or loosely defined (Gailmard, 2009).

Even this minimal sketch of discretion, and the study thereof, starts to hit at how these questions push the model I've presented here. First, while I allow for something that might be thought of as a punishment mechanism (the feedback of policy through the budget), it does not necessarily punish the bureaucrat. While the budget itself can be thought of as a punishment mechanism,[3] I never impose a cost directly on the agency for taking the "wrong" action, i.e. acting outside the bounds of discretion. Moreover, even going so far as to define what is a right or wrong action is not specified here. As it is, agencies may be punished for choosing policy in some particular range only through the mechanism of appropriations. Regardless of an actual punishment regime, it is difficult to know the actual bounds of appropriations, and this is problematic. Knowing the actual bounds of discretion would be really useful for this class of model, if I continue to want to stay in the realm of models that translate directly into choice problems.

[3]This is a point that Ting (2001) makes in his work. The punishment effect of the budget becomes more important in a dynamic framework. The costs paid from having a cut budget–because of their affects across time–have a bigger impact than a one time cost laid on an agency through a punishment.

A reason that the models I develop in Chapter 2 work poorly as models of discretion has less to do with a weakness of a model, and more to do with our current understanding of discretion. Outside of the cases where there is a cut and dried (and easily counted) range of options available to the agent, discretionary ranges would appear to be soft in nature, and variable over time. My intuition is that this covers a very large number of agencies. Little work has been done towards understanding how discretion to agencies varies over time. Work that might be argued to do so (c.f. Shipan (2004)), presents discretion as a series of static games. Each year, politicians and agencies act according to the current arrangement of preferences of the actors, and they are memory-less[4].

[4]By this I mean that actors, in their consideration of the payoffs from making some action make no consideration in their utility from future rounds of interactions. Each game is a unique instance of strategic interaction, from the perspective of the actors.

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