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**MODELLING THE GROWTH
(AND DECLINE) OF
FEDERAL AGENCIES AND PROGRAMS***

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University of California
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FOREWORD

Through this series of working papers, the Institute of Governmental Studies, Berkeley, provides a channel through which scholars at work on problems of public organization may present their thoughts in a convenient form and without too much delay. We envision this series as a modest undertaking, but we hope that "Studies in Public Organization" will make some contributions toward an understanding of the properties that describe the variety of public organizational systems that exist throughout the world. We want also to note that no single formula will dominate; the series will contain papers that are theoretical, methodological, comparative, or historical. It is open to faculty and student contribution alike, not restricted to this campus, and its objective is to publish papers that engage important problems and present interesting ideas.

Committee on the Study of Public Organization
IGS, University of California, Berkeley
The Editors

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INTRODUCTION

This is an era of widespread concern over the scale of governmental activity. Intense debate centers upon the scope, and particularly the cost, of public policies and programs. As a consequence of these political concerns, a great deal of analytic effort, from political scientists and economists alike, has been expended in an attempt to explain the growth of government.

These proposed explanations range widely. One (termed "Wagner's Law") postulates governmental growth as an inevitable concomitant of industrialization. Rising social interdependencies and investment needs come to exceed the control and support capacities of markets, leading to a major expansion of the public sector (Berry and Lowery, 1982; Mann, 1980). Other explanations have centered upon international economic interdependencies and the rising need to buffer domestic economies from potential instabilities in employment and prices which such interdependencies can engender (Cameron, 1978; Lindbeck, 1976). Also cited are (1) lagging productivity increases in the public sector which are assumed to raise disproportionately the cost of public services vis-a-vis private ones (Baumol, 1967; Spann, 1977); (2) a "fiscal illusion" maintained in the taxation system of Western societies which fragments and disguises tax burdens, and dissociates taxation policies from expenditure decision-making (Goetz, 1977; Cameron, 1978); (3) electoral strategies requiring new public programs to knit together competitive political coalitions (Tuftes, 1978; Buchanan, 1977; Shefter, 1980; Peters and Rose, 1980). and, finally, (4) general social pressure for redressing the social effects of economic inequality by means of regulatory and redistributive policies—a pressure heightened by mass communications and the threat of social unrest (Piven and Cloward, 1971; Jennings, 1979).

Many of these explanations have been subject to considerable controversy, but few have been subject to systematic empirical test (Berry and Lowery, 1982). The question of why

government grows continues to sit on the front burners of research in both economics and political science, sparking a lively set of explanatory efforts.

In the midst of this concern over governmental growth, however, an important issue has been subject to significantly less attention. This issue concerns the actual process of growth—the developmental sequences or "trajectories" assumed by agencies and their programs as they enlarge. It might be said that while we have theorized extensively on the question of **why** government grows; the question of **how** it grows (the "efficient" as opposed to the first cause) has been subject to far less analytic attention.

It is in fact toward this latter question that this essay is directed. Our research has been focused on uncovering long-term patterns in the growth or decline of federal agencies and programs. We have sought to model different developmental trajectories of growth or decline which these agencies and programs have, in fact, assumed. We will argue that these growth patterns can signal a great deal about the nature of the political coalition which supports an agency. Distinctive developmental trajectories can also provide important information about political and administrative "niches" which a given public program may occupy.

PRIOR MODELS OF AGENCY AND PROGRAM DEVELOPMENT

It is astonishing to survey the current theoretical state-of-the-art in political science regarding the analysis of long-term policy change. Few models exist to cover the evolution of public agencies or their programs over time.

It is not only that we lack analytic frameworks which could generate predictive statements regarding probable evolutionary trends of major programs. Present analytical models in organizational theory and policy analysis cannot even track past growth patterns and account for why some programs differ in their developmental trajectories from others.

There are perhaps two prime candidates for the role of developmental model in application to the analysis of long-term policy change. One is the life-cycle model of organizational change, and the other is the incremental model of decision-making.

Formulated in the 1950's in application to regulatory agencies, the life-cycle model postu-

lates the developmental transformation of these agencies over time. The metamorphosis begins from a "genesis" stage, characterized by flexible internal procedures, employee esprit, widespread innovative and risk-taking dispositions, as well as a commitment to a specific vision of the public interest. It proceeds to a "mature" end-state, in which formal rules and procedures come to rigidify these organizations, they lose their organizational esprit and sense of mission and, as regulatory agencies, they risk "capture" by the very interests they are charged with regulating (Bernstein, 1955; Fainsod, 1940; Huntington, 1952).

In its more embellished forms, the life-cycle model details a shift in agency personnel from younger, ambitious "zealots" and "climbers" to older "conservers" more concerned with maintaining their status and preventing uncertainty from contaminating the organization (Downs, 1966; Dimock, 1959; Simon, Smithburg and Thompson, 1971).

While of enormous impact upon a number of policy studies, the life-cycle model is beset by important analytic difficulties. The intervening stages between extreme end-points of the "cycle" are only vaguely sketched, and indeed, would be quite difficult to describe explicitly. The model does not readily suggest how any of the presumed developmental stages through which an agency would pass could be identified on the basis of objectively measurable criteria.

The causal linkage between life-cycle changes and policy behavior is also a difficult issue. In regulatory policy in particular, it is frequently an analyst's presumption that a regulatory agency's policy outputs are wedded to the interests of a regulated constituency which leads to an assertion of capture and a subsequent inference that the agency must be in the end-stage of its life-cycle. This, in effect, amounts to a reverse causal sequence. It is very different from independently establishing a cycle stage as a causal variable in the production of subsequent policy effects. Such causal confusion is further aggravated by the failure of the life-cycle model to specify the likely duration of developmental stages or to elaborate factors which might influence the speed of transition from one phase to another.

Finally, it is in regulatory policy—the very area in which the life-cycle model has received its most vigorous application—that it has been subject to its most severe criticism. The model has been challenged for rendering a simplistic and frequently inaccurate account of regulatory

policy behavior (Weaver, 1978; Sabatier, 1975). Some regulatory agencies (such as the late AEC) seem "captured" at birth (if not from the moment of conception!). Still others (such as the FDA and FTC) have been subject to something of a regulatory "rebirth" later in life. To some critics, the emergence of a "new social regulation" in such agencies as EPA, EEOC, OSHA and the FDA invalidates the concept of maturation or "capture" because these agencies are suffused with the ideological zeal of a new regulatory class (Weaver, 1978).

The Incremental Model of Decision-Making. Aside from life-cycle conceptions, the remaining model of relevance to the analysis of long-term agency and program development is the incremental model of decision-making, particularly in its application to the budgetary process. Incremental theorists assert that, due largely to the great uncertainty and high information costs associated with political decision-making, organizations will generally move in small steps. Each step represents a limited search and a marginal refinement on policies and practices already in effect (Lindblom, 1959; Lindblom and Braybrooke, 1963).

In a classic work, Aaron Wildavsky (1964) described the Federal budgetary process as following closely the incremental strategy—with agencies, the Budget Bureau (OMB) and the Congress all relying heavily upon the previous year's appropriation as the "base" from which to launch marginal increases or decreases. In a later work Davis, Dempster and Wildavsky (1966) argued that simple incremental decision rules could account for budgetary allocations to a large number of federal agencies. The Bureau of the Budget, they contended, would allow an agency to request an increment above what it received the previous year, and the Congress would use the request as a guideline for marginal adjustments in its actual appropriations.

There are obvious implications of the incremental budgetary model for the growth and development of federal agencies and programs. Following incremental theory one would expect the growth of these agencies to be approximately linear over time, or at least to follow a curve defined by a more or less fixed percentage of yearly increases (Fenno, 1966; Crecine, 1969).

Yet the incremental model is beset by a number of problems insofar as the "tracking" of agency and program growth is concerned. Most importantly, the model does not really account

for long-term growth patterns over extended periods. Even Davis, Dempster and Wildavsky (1966) were forced to admit that, while their incremental decision equations produced good intra-year fits between agency request and Congressional appropriation, they do not offer good predictions for inter-year growth patterns, particularly over a multi-year time span. In later work, they added a number of additional "exogenous" variables to their prediction equations—variables representing political events and conditions external to the budgetary process such as economic recessions, armed force commitments overseas, presidential election years and party control over the Congress. These variables they suggested underlie the many discontinuities or "shift points" which disrupted incremental periods of budgetary change (Davis, Dempster and Wildavsky, 1974; Dempster and Wildavsky, 1979).

But this later work concedes the inability of pure incrementalism to account for budgetary changes over multi-year periods. Further, Davis, Dempster and Wildavsky admit that in their model "fits for the congressional side of the process are much better than those for the agencies" (1974, p.429). This means that the year-by-year marginal adjustment process depicted in incremental theory appears to apply more to the congressional disposition of executive branch requests than to the generation of those requests themselves. In this sense incrementalism can offer only a partial statement on the issue of how government grows.

The Davis, Dempster and Wildavsky research has additionally been attacked on methodological grounds.¹ One line of criticism centers upon the format of the incremental prediction equations. One analyst has demonstrated that these equations (with their generous error terms) would yield high correlations between even randomly fluctuating appropriations and requests (Wanat, 1974). Another suggests that the presence of close linear regression fits between requests and appropriations does not imply that incremental decision rules are actually at work in the production of these budgetary outcomes (Padgett, 1980).

Finally, two researchers have demonstrated that, however well the incremental model of budgeting might account for the appropriations to an overall agency, it fails in many cases to map the growth or decline patterns of individual programs within agencies (Natchez and Bupp,

¹ For a review and defense against these criticisms see Tucker (1982) and Dempster and Wildavsky (1979).

1973). Certainly, there is evidence that many individual programs develop and expand in ways unaccountable by incremental theory (Gist, 1973; Jones, 1974; Schulman, 1980).

We will consider the incremental model later, in more detail, but it should be evident from the discussion so far that both incremental and life-cycle theories have pretty severe deficiencies as guidelines for the analysis of long-term policy and organizational change. This is true despite the fact that both models have had a major impact upon a variety of public policy studies.

It is the very deficiencies of these prior approaches to the analysis of long-term policy change which prompt this study. We hope to offer an alternate theoretical route to the understanding of public agency and program development.

A NEW PERSPECTIVE ON POLICY CHANGE

It is a striking fact that processes of growth or development in nature are not generally incremental. The evolution of plant or animal species, the growth of populations, even the growth of social movements, towns and business organizations appears to proceed in shifting stages of acceleration and deceleration rather than in linear or incremental patterns. In species evolution, for example, the gradualist models of step-by-step adaptation have come under increasingly critical scrutiny by biologists and paleontologists who argue for "punctuational" evolution and "quantum speciation" (Stanley, 1981; Simpson, 1944). These models assert non-linear patterns in mutation and adaptation processes.

Non-linear change characterizes the overall growth of plant and animal populations as well as alteration of their physical characteristics. Living organisms occupy an ecological "niche" defined by environmental supports and threats, as well as by their own reproductive (or "carrying") capacities (Cohen, 1978). As a number of formal ecological models suggest, the growth or decline of many plant and animal populations is determined by distinct predator-prey relationships into which they are locked within their niches. Non-linear, oscillatory models have been successfully constructed to track species growth over extended periods of time within

these predator-prey systems (Gilpin, 1972; May, 1972).

A more general theory of the importance of non-linear change processes to the evolution of complex systems has been formalized by Prigogine and others (Prigogine, 1978; Jantsch, 1975). This theory -- termed "non-equilibrium thermodynamics" -- stresses the importance of "order through fluctuation"; that is, the requirement of systems for alternating rates of change if they are to offset processes of entropy and attain new levels of complexity and integration.

It is this general perspective which influences our approach to the analysis of agency and program development. We seek models of program growth which need not rest upon linear assumptions. Such models would not be forced to dismiss departures from a straight-line trend as essentially "random" or externally induced perturbations outside their analytical coverage. They would be able to account for both periods of incremental change, but also for periods of more rapid, accelerated change.

This is precisely what models depicting oscillation are able to do. They are able to track repetitive patterns which include widely varying characteristics of behavior and performance. Consider the motion of a pendulum, for example, as a simple illustration. The pendulum's swing defines an oscillatory motion with slow movement at either end and rapid motion in the middle. In analyzing pendulum behavior we are not forced to model only end motion and attribute center activity to randomized or otherwise unpredictable factors. Yet, it is revealing to note that this is exactly what we would be likely to do if we were wedded only to essentially linear models such as incrementalism.

The Concept of Oscillating Systems. Let us investigate the idea of oscillation in a bit more detail. As we have suggested oscillations abound in nature (the vibrations of atomic nuclei, fluctuations in the population of competing species, and the pulsing of stars are but a few).

Oscillating systems are characterized by the presence of a **reference state** (usually called a state of **stable equilibrium**), **momentum** (the persistence of uniform change in the absence of external force) and an external **restoring force** (which opposes displacements from the reference state but vanishes when the system is in the reference state). Thus, when an oscillating

system is displaced the restoring force returns it to the reference state, and momentum carries it through.

An important feature of oscillating systems is the set of parameters by which they can be described. We can assess the **amplitude** of the oscillation, and its increase or decrease over time; the **reference state** with respect to some positional variable (and its change over time); and finally, the **frequency** of the oscillation -- the number of displacement/restoration cycles which occur over a given unit of time.

We will examine each of these parameters later in more detail, but for now they suggest an important feature of oscillating systems. Such systems frequently signal more about themselves, in terms of their internal workings, than do systems whose behavior can be described by a simple linear function. We can infer a set of internal characteristics of a system based upon its oscillatory variables, whereas we are more likely to have to place an analytic "black box" around systems whose behavior produces only a set of steady or linear outputs.

Thus, for example, if system oscillations are decreasing in amplitude (or "dampening out") we might suspect a dissipation of energy or an increasing detachment of a system from external sources of displacement. Increasing amplitudes may imply the importation of external energy. A fast frequency may signal strong restorative forces or capabilities within a system.

It is not that oscillatory variables provide definitive insights into the character of a system. But they can suggest hypotheses concerning its operation, while simultaneously allowing fuller comparisons between different systems, or between the same system at different times as a means of testing these hypotheses. Such hypothesizing and comparison may be much more limited in connection with systems of only linear behavior and output.

Oscillations and System Memory. An important internal quality of all oscillating systems is **memory**. This is the degree to which present behavior is influenced by past states of the system. Because oscillatory systems are engaged in behavioral cycles we can assert that past system states are important determinants of current behavior.

Upon this question of memory hinges an important distinction between incremental and oscillatory models of agency growth. The incremental model asserts what is essentially a one-year institutional memory in the budgetary system. Present requests are heavily determined by the previous year's appropriation. This year's appropriations are primarily founded upon this year's requests.

An oscillatory model would assert a longer-term institutional memory in the budgetary system. Any non-random appropriations "cycle" must mean a memory of more than one year's duration. The system is, in effect, acting out an extended set of responses to an original equilibrium displacement. If oscillatory patterns can be demonstrated in the budgetary data associated with agencies and programs, it would be strong evidence that longer-term political forces and strategies are operating than those assumed in the incremental model. This, in turn, (as we shall see) could have great implications for our conception of the calculation and decision-making functions associated with the budgetary process. It could also have a bearing on our understanding of the lobbying strategies directed toward influencing these budgetary outcomes.

Oscillations and the Policy-Making Process

It is one thing to detail the characteristics of oscillating systems. It is quite another to suggest plausible reasons for oscillatory behavior in the growth of federal agencies and programs. We cannot, after all, simply assert that federal agencies are analogs of pendulums! Yet we believe there are persuasive reasons to hypothesize that oscillatory patterns should come to characterize the growth and development of federal agencies and their programs.

Policies and Administrative "Niches". The first argument concerns the competitive nature of policy-making arenas. Public agencies and programs are frequently locked into competition with one another for scarce budgetary resources and political attentions (Rourke, 1976; Lowi, 1968). While the distributive nature of budgetary decisions in specialized appropriations subcommittees may moderate much direct "zero-sum" program competition, most agencies must face at least fractional competitors, and must carve out distinct niches for themselves if they are to survive and grow (Downs, 1967; Long, 1978). Programs in turn must locate administrative niches

within agencies -- departmental or divisional sponsors, institutional slack not already committed to prior programs, etc. -- as well as political niches outside of agencies based upon OMB, constituency and legislative support.

Within any given niche there are likely to be a variety of resource, functional and jurisdictional competitors. One way to manage this niche competition across agencies or between programs is by a serial mode of allocation increases. If each program were allowed a growth period in alternation with its rivals, competitive stresses as well as "zero-sum" choices could be minimized. The result of such a conflict-management strategy would be that each program within the niche would have alternate periods of high and low growth -- an oscillatory pattern which would vary in frequency depending upon the size of the niche and in amplitude depending upon its competitive intensity.

Niche competition can result in oscillatory growth even if no explicit conflict-management strategy is in effect. One program may simply gain a short-term competitive advantage over others, only to have it eroded by "catch-up" responses among its competitors. In a related argument, a recent study of the growth patterns of small, private firms in highly competitive markets reported that expansion did not occur incrementally, but that instead "dynamic, job creating establishments appear to oscillate, or pulsate, constantly" (Birch, 1981). Perhaps for both public as well as private organizations oscillatory growth patterns may hint at the competitive character of the niche they occupy.

Growth and Consolidation Cycles. Another factor likely to contribute to oscillations in the growth patterns of federal agencies is the likelihood of tension between pressures for expansion and forces acting to maintain administrative certainty and routine. Agencies as policy instruments seek growth as an outlet for institutional vitality -- to improve policy performance, implement new plans, and solidify or extend political ties to legislators and constituents. Yet at the same time, agencies as bureaucratic organizations seek stable and predictable task environments.

Some economic analysts have treated growth as an essentially no-cost organizational "good" to administrative agencies (Niskanen, 1971). Yet such assumptions really present a naive picture of bureaucratic organizations and the motives of their participants. Growth can disrupt established work routines, cloud demarcations of responsibility and authority, and increase the personal risk associated with employee decision-making. Growth can even threaten to resurrect a wide-ranging set of past organizational conflicts which lay dormant under previous accommodations (now subject suddenly to renegotiation).

These institutional cross-pressures can be moderated by a lapse into growth/consolidation budgetary cycles. Periods of accelerated growth can be followed by an organizational "sorting-out" -- a low-growth period during which distributions of power and responsibility are clarified and readjusted, and a stable set of reciprocal expectations can reassert itself. To be sure, disparate organizational personnel would resent departures from continuous states of either routine or rapid change, but a pattern of cyclical fluctuation between these two states may be a natural compromise linking such divergent institutional interests.

Oscillation and Lobbying Strategy. A third reason to expect some degree of cyclicity in the growth trends of agencies and their policy undertakings lies in important strategic requirements associated with the lobbying process. We know that political "alliances" surround most public policy undertakings (Rourke, 1976; Freeman, 1958). The participants in these alliances -- agency and other executive branch officials, congressional committee members and interest group leaders -- attempt to establish interactions which maximize their own individual benefits, within the limits of their shared interests.

Such alliances obviously can offer broad support for a public policy undertaking, and can protect it from many hostile or competitive political intrusions. However, alliances at the same time can **bind** a policy within set limits of budgetary and institutional growth. Imagine, for example, the efforts of a lobbying organization to increase policy benefits for its members. Let us assume that each year benefit amounts increase incrementally. While there has been program growth, the leaders of the organization are likely to have some important strategic questions.

Do incremental gains really represent the limits of their lobbying power? How much further growth in the amount and variety of benefits might have been possible during the period when only incremental gains were realized? Alternately, how much in the way of superfluous lobbying resources and effort are being routinely brought to bear? Agency officials might have similar unanswered questions concerning their potential influences on the Congress and OMB.

The possibility in fact exists that long-term incremental increases may actually "lock-in" a given program to limited growth by institutionalizing expectations around low-level, marginal changes.² The application of intense lobbying pressure at periodic intervals may actually be a better strategy to affect major, substantive program enlargements. While such expansions may trigger political and institutional resistances which restrict growth sharply in follow-on years, the net effect may be a maximization of benefit increases in the long run. In this way, oscillations in agency or program growth -- reflecting a legislative strategy of alternating pressure -- may represent a more rational allocation of lobbying effort.

To summarize: a non-linear growth pattern would be an indication of a lobbying strategy which fully tests and stretches the elasticities possible within a policy alliance. The participants would have evolved more rational interactive strategies -- conserving arguments and political resources efficiently during some periods while expending them in concentrated fashion the next.

"System" Oscillations and Program Growth. The arguments detailed above all depict oscillations as the outcome of rational strategies pursued by conscious political actors. These strategies, moreover, would each be somewhat more global and longer-term in outlook than those depicted in the incremental model of budgeting and policy-making.

In addition to these strategic causes, however, we must recognize that larger social or economic forces might also be at work in the production of oscillatory patterns in agency and program growth. Broadly based economic trends such as business cycles could certainly

² For an argument concerning such a "lock-in" in connection with war-on-poverty programs see Joseph Kershaw, *Government Against Poverty* (1970).

influence the ebb and flow of available public resources as well as the demand for public policy benefits. Long-term demographic cycles -- such as the post-war "baby boom" and its subsequent "ripple effects" -- can produce waves of pressure upon social security and other entitlement programs.

Further, **policy development cycles** may exist and impart oscillation onto patterns of agency and program growth. In weapons procurement, for example, large start-up costs may be required at the outset of a weapons system, followed by declining costs as deployment concludes. Base-line maintenance costs may dominate for a time followed by renewed heavy investment requirements for modernization or replacement of the weapon by its next-generation substitutes (Kaldor, 1981; Ostrom, 1978).

This class of systemic cyclic forces should in general be distinguishable from strategic factors by the cycle times they cover. They should introduce "long cycles" -- perhaps extending over a decade or more. It would be very surprising if political strategies could extend over comparable periods. Turnover among Congressmen as well as political executives within the agencies; the "disruptive" effects of political fads and movements; and electoral instabilities should act to shorten the cycle-length of any oscillations which would reflect the purposive strategy of political agents.

The discussion above has focused upon a set of theoretical arguments for expecting some degree of oscillation in the growth trends of federal agencies and programs. It is by no means an exhaustive set of explanatory possibilities. Nor are the proposals themselves mutually exclusive.

What we hope to do is to demonstrate that statistically significant oscillations do, in fact, widely characterize the growth trends of federal agencies and programs. Further, we will attempt to show that such oscillations are in addition **politically** significant -- that they should make a difference in the way we conceive of the calculation and decision functions which underlie the federal budgetary process. Finally, we will attempt to deduce what a particular pattern of oscillation associated with a given agency may imply about those strategic or systemic

forces which might have produced it.

Obviously, a huge set of variables contribute to the growth of public agencies and their programs. We do not suggest that a simplified set of theoretical propositions can integrate all of these variables, nor that a single oscillatory model can account for all growth trajectories displayed by federal agencies (or even by the same agency over different periods of time). Instead we are endeavoring simply to marshal evidence to support the development of additional explanatory models of how programs grow -- models constructed from a new analytical point of view.

THE SEARCH FOR CYCLES IN BUDGETARY DATA

To search for oscillations in program development requires first a technique for the identification of cyclical behavior in time series data; then a measurement of key oscillatory variables associated with identified cycles; and finally, a validation of the oscillatory patterns uncovered relative to the probability of a set of randomly-generated data points duplicating the observed pattern.

Identifying and Describing Oscillations

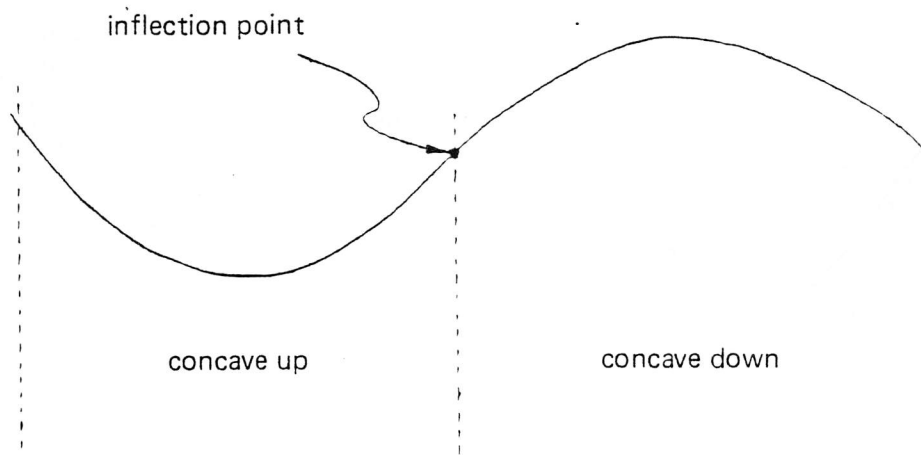
As we have noted, three fundamental parameters describing an oscillation are: the position of the reference state, the amplitude and the cycle length. The amplitude is the maximum displacement of a system from its equilibrium or reference state. The length of a cycle is the amount of time it takes the system to describe the pattern of change whose repetitions form the oscillation. Note that a cycle may include one or more swings through the reference state before the exact pattern to be repeated is established.

Uniform and Non-Uniform Oscillations. It is important to distinguish between **uniform** and **non-uniform** oscillations. In a uniform oscillation the values of the fundamental parameters remain constant. In a non-uniform oscillation one or more of these parameters may change from one cycle to the next, or even during the course of a single cycle. Moreover, in non-uniform oscillation, the amplitude of displacements in one direction from the reference state

may differ from that of displacements in other directions. The degree of uniformity of the oscillation is measured by the the regularity of change of the fundamental parameters. (It is, of course, important to distinguish between oscillations and the irregular pattern of change resulting from the action of random forces haphazardly opposing each other; more will be said on this topic in the section on validation.)

In order to identify and describe oscillations, it is necessary to understand the behavior of a system changing under the action of a force. For simplicity, let us suppose that the state of a system is being described by a single number. The system may be complex, but the number reflects a single aspect of its state: in our case, the system will be either a broad policy area, a federal agency, or a program within an agency and that number will be its level of annual expenditures or personnel. Further, for the purpose of visualization, let us suppose that this number varies continuously with time. In the absence of external force, the system will experience uniform change. A graph of the describing number versus time would be a straight line: the slope of that line represents the rate of change of the state. A force, in contrast, will cause the graph of the state to curve. The direction of that curvature, that is, whether the curve is **concave up** or **concave down**, indicates the direction of the force (see fig. 1).

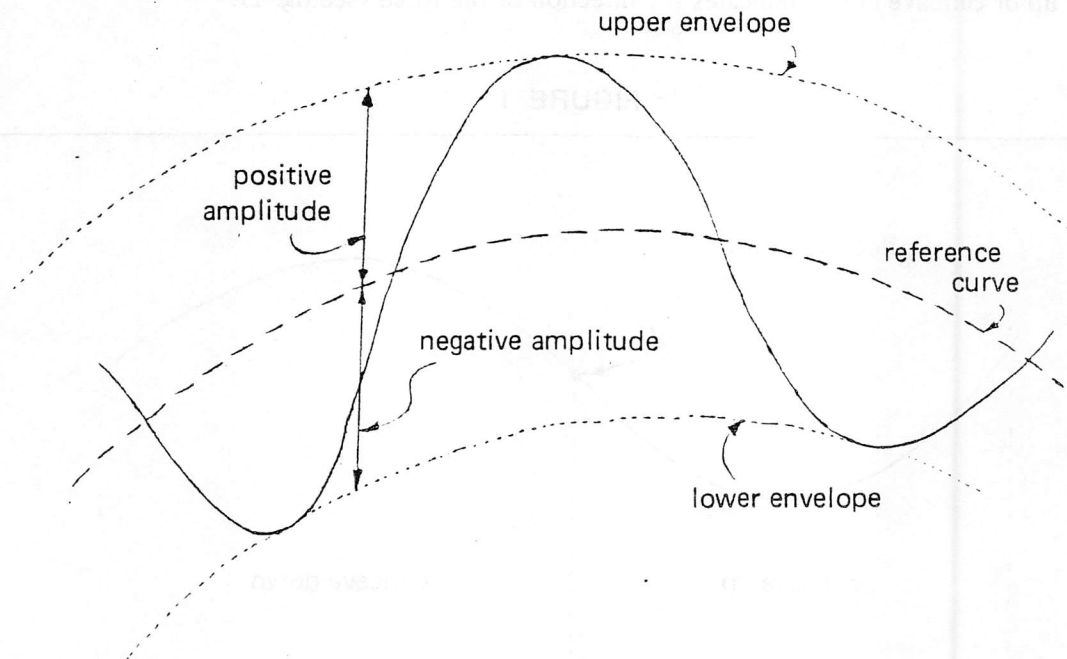
FIGURE 1



Thus a force acting to diminish the number describing the state will cause the graph to rise more slowly or fall faster; a force in the opposite direction will cause the graph to rise more quickly or fall more slowly. Note that the direction of concavity does not depend on whether the graph is rising or falling.

Concavity and the Reference Curve. Putting together the ingredients of oscillation and the behavior of systems under the action of forces yields the observation that the position of the reference state is exhibited by the points at which the concavity changes direction; such points are called **inflection points** (see fig. 1). The **reference curve**, displaying the location of the reference state as a function of time, is a curve passing through the inflection points. For a uniform oscillation the reference curve would be a horizontal straight line. The amplitude may be visualized by drawing an **envelope** -- a pair of curves, one touching the points of maximum displacement above the reference curve, the other touching the points of maximum displacement below the reference curve (see fig. 2).

FIGURE 2



The amplitude at a particular time is then the vertical distance between the reference curve and the envelope curves. For a uniform oscillation the envelope would be a pair of horizontal straight lines equidistant from the reference curve. Since a non-uniform oscillation may not place the reference curve exactly halfway between the upper and lower curves of the envelope, there may be two different amplitudes, the distance to the upper envelope curve yielding an **upper amplitude**, and the distance to the lower curve of the envelope yielding a **lower amplitude**.

The Problem of Discrete Data. Now we must adapt the ideas explained above to the case in which the state of the system can only be defined or measured at discrete times. For this it is necessary to extend the notion of concavity. For convenience, assume that the number describing the state of the system has one value each year, which is the case with expenditure data. Then the graph of the state of the system consists of a sequence of data points, one for each year, rather than a continuous curve. Consider a sequence of values for three consecutive years. Call the change in value from the first to the second year the first change and that from the second to the third year the second change. These changes may be positive, negative, or zero. Applying the notions described above, we can say that:

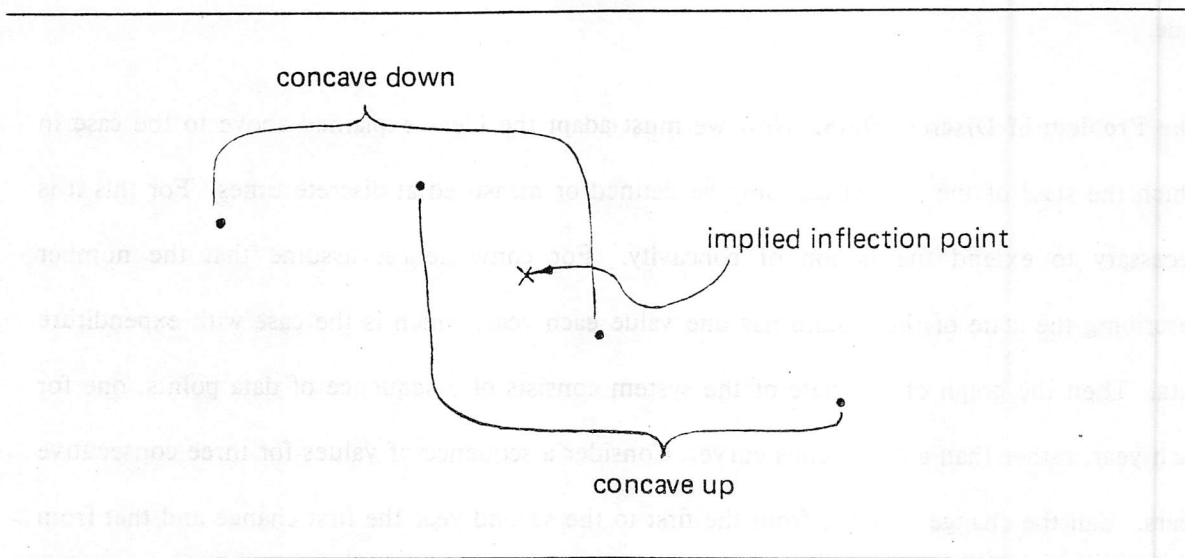
- (1) if the first change is positive (data points rising) and the second change is either negative (falling) or less positive (rising more slowly) or the first change is negative (falling) and the second is more negative (falling faster) then the concavity is downward;
- (2) if the first change equals the second change (points on a straight line) then there is no concavity;
- (3) if the first change is negative (falling) and the second change is either positive (rising) or less negative (falling more slowly) or the first change is positive (rising) and the second is more positive (rising faster) then the concavity is upward.

For example, if an agency's budget increases by a smaller amount than it did the year before, the graph of its budget would be concave down, indicating a force in the negative direction. Or, if an agency's budget increases by a larger amount than the year before, the graph of

its budget would be concave up, indicating a positive force. Identical increases in consecutive years results in no concavity and indicates a budget that is coasting under momentum only (i.e., political routines).

The presence of an inflection point is indicated if, in a sequence of four data points, the direction of concavity of the first three of the four differs from that of the last three of the four (see fig. 3).

FIGURE 3

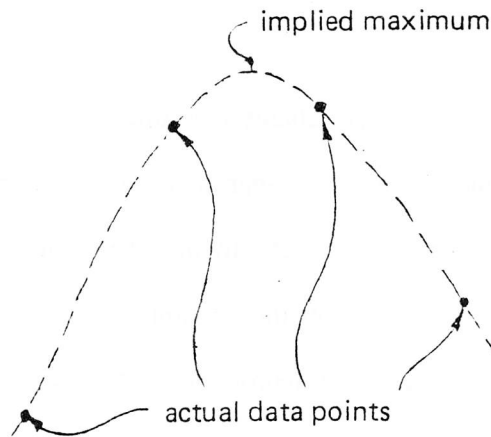


It is important to note that inflection points may technically fall in mid-year. We accept this because political forces conditioning agency budgets are not suspended between the beginning and ending date of each fiscal year. (The APPENDIX contains a description of how the location of these mid-year points may be estimated by comparing the amount of concavity of the first three and last three of the four data points to determine when the concavity changed direction.) To construct reference values for years between the inflection points, a smooth reference curve³ may be passed through the inflection points.

Construction of the envelope, and subsequent determination of the amplitudes, in the case of discrete time is less straightforward. The problem is that the discrete data may imply a maximum displacement value in mid-year (see fig. 4).

³ The simplest method for the computation of such a curve is that of "cubic splines". See, for example, Dahlquist and Bjork (1974).

FIGURE 4



But, again, we assume that political forces and strategies influencing agency growth are not suspended between budget periods. Thus we infer the point of maximum displacement by passing a smooth curve through the data points.

Finally, the cycle length is the most difficult to define for non-uniform oscillation, especially in the discrete case, since it is difficult to identify repeated patterns and pinpoint when they begin and end. Although we attempted to determine cycle lengths we could only do so imprecisely. The validation test described in the next section indicated that this imprecision undermined the reliability of our cycle-length measurements.

Application of the Method

We applied the methods described above to annual budgetary data for 17 broad policy areas, such as health care or transportation, 37 federal departments and agencies and 15 programs within agencies. Specifically, we analyzed expenditures and personnel levels for each fiscal year running from 1945 to 1981 -- roughly a "modern era" of public program development.

It is possible to question our use of expenditure data as opposed to appropriations as a primary budgetary variable. But there seem to be significant advantages to the use of actual outlays as a program measure rather than appropriations and obligational authority. First,

expenditures tap more closely into actual program outputs than do appropriations. They index the most direct link between a public program and its ultimate beneficiaries and political constituents.

Secondly, appropriations can be an unreliable measure of the actual growth of a program in relation to its primary constituents. At times appropriations can be more a procedural artifact than an actual index of program size or impact. In the 1954 Foreign Aid appropriation, for example, severe reductions were imposed over the previous year simply because of a backlog of obligated but unexpended funds. The use of appropriations data would give a distorted view of the actual size of the foreign aid program during this period, particularly in terms of its overseas impacts.

Finally, the use of expenditure data avoids the additional difficulties of keeping track of supplemental appropriations, differentiating two or multi-year appropriations and, most importantly, the problem of programs, such as entitlements, whose outlays are not dependent upon the appropriations process. This latter class of so-called "uncontrollable" programs raises interesting problems for the incremental theory of budgeting. Because they do not require an explicit appropriation such programs effectively by-pass the year-by-year decision strategies depicted by the incrementalists. Yet these uncontrollable expenditures have come to account for upwards of 70 per cent of federal outlays (Ippolito, 1978). Thus the dominant portion of the federal budget and the influences governing it now lie **outside the scope of incremental theory.**

By taking a longer-term perspective, directed at expenditures, we are not forced to omit these programs from our analytic coverage. To be sure, we cannot assume them to be identical to appropriations-controlled programs, but, at the same time, they are not really uncontrollable from the standpoint of their long-term growth. Take social security as an illustration. Its growth has certainly been influenced by long-term demographic trends, as well as by changes in the economy and the labor force. But its growth has also been strongly influenced by changes in its scope, eligibility and taxation-support. These are the result of legislative enactments, enactments which reflect policy alliances and their strategies. The analysis of potential growth cycles

may allow us to distinguish the relative influences of these demographic and strategic factors, and to assess the character of each. **Additional Data Issues.** Because we are analyzing long-term growth, and not intra-year relationships between appropriations and requests, the question of data comparability arises. We felt the need to compensate for inflation in order that the expenditure dimensions of a given program or agency could really be measured in constant units over time. Thus the expenditure data we employed is adjusted annually by the Wholesale Price Index for that year. Finally, we also analyzed personnel totals associated with given agencies (and with specific programs where available) as an additional measure of overall expansion or decline.

Validation

It is important to recognize that those methods described above could be applied to any sequence of values, even randomly varying ones, to yield a reference curve and an envelope and amplitudes. Having computed these parameters, the question remains: are we really seeing an oscillation? Irregularity in the reference curve or the amplitudes reveals a system buffeted by random forces rather than one experiencing an oscillation as delineated above. However, even random forces can occasionally produce patterns which resemble oscillation. Hence, we test the hypothesis that random variation could produce a pattern as uniform as the one we see.

Our fundamental goal was to test for the existence of oscillations, patterns which necessarily encompass several years. As we have seen, current budgetary models do not identify patterns relating successive yearly budget increments (i.e., change between one pair of years relative to that of another). They specify only one-year memory, and the absence of extended memory would be reflected in the absence of a pattern relating successive increments. Thus incremental theory provides no better a determination for each year's increment than a random selection from a given distribution of increments. Indeed Wanat (1974) has demonstrated that those budgetary patterns uncovered by incrementalists could be duplicated in precisely this way.

To validate our observations, we tested them against simulated data based on random number generation.⁴ The simulated data was created to retain the real data's year to year pat-

⁴ Technically, computer generated random sequences are called **pseudo-random**.

tern but not necessarily its longer term characteristics; that is, its multi-year sequences of increments. Specifically, we simulated data with yearly percent changes chosen randomly from the distribution of yearly percent changes of the real data. The uniformity of the oscillations found in our total number of real data cases was compared with that of 100 comparable samples generated from random data. The disparity between the uniformity of the oscillation in the real and random samples allows us to compute a level of confidence against the hypothesis that the real data could have resulted from random variation.

We studied the reference curve and the amplitudes in the following way. Since we expect periods of transition separating quite uniform oscillations with different parameters, we looked for **streaks**, consecutive years during which year to year changes in a specified measurement were no larger than a given **tolerance**. For the reference curve we examined changes in slope with a tolerance of 2% of the reference value. (Although a tolerance of 1% gave validation results as strong as those for 2%, it was too strict and eliminated what we would intuitively pick out as oscillations, while a tolerance of 3% was too weak and yielded too many unreasonably long streaks.) For upper and lower amplitudes, we used a tolerance of 1% of the reference value. We measured the uniformity of the oscillation of an agency, program, policy area, or random case by computing the mean length of its streaks for each parameter. (Note that a single change larger than the tolerance yields a streak of length zero.)

The real data was so much more uniform than the random data that the confidence level against random variation duplicating the uniformity of the real exceeds 99%. Details of the statistical test appear in the APPENDIX, but the following results are typical. For example, a mean streak length of at least 3.5 years for the slope of the reference curve appeared in 24% of the real agencies, programs, and policy areas but in only 4% of the random cases. While 27% of the real cases possessed a mean streak length of at least 3.5 years for the upper amplitude, again only 4% of the random cases did. And although a mean streak length of at least 3.5 years was obtained in 22% of the real cases, only 5% of the random matched that degree of uniformity. Given results like these we can assert that (again, with a 99% confidence level) we are indeed seeing non-random multi-year patterns in budgetary behavior.

RESULTS, IMPLICATIONS AND SPECULATIONS

Through the application of oscillatory modelling we have been able to demonstrate that, in an aggregate sense, we find statistically significant cyclical patterns in general budgetary data for federal policies, agencies and programs. But such a general finding, while encouraging, does not constitute a sufficient basis for analysis. We must probe further and investigate a series of follow-up questions. What differences in oscillation appear across major policy-making categories -- broad functional areas, such as health or transportation; specific agencies; programs within agencies; and, finally, so-called "uncontrollable" programs such as social security, veterans benefits or unemployment compensation? What specific characteristics of oscillation do we see for particular agencies and programs, and what might these traits tell us about the political forces, coalitions and strategies associated with them?

Oscillatory Variables in a Policy Context

To begin investigating the questions raised above it is important to attempt a translation of the oscillatory variables we are measuring into the language of policy-making -- to attempt to infer an organizational and political meaning in them. These inferred meanings must stand the test of logical plausibility in their own right, and must provide interpretive results of power and consistency.

Reference Slope and Niche Stability. One important oscillatory measurement is the slope of the reference curve. The reference curve it will be remembered, is determined from connecting inflection points -- those points which mark a change in the direction of curvature, and thus a change in the direction of forces applied to a system. In essence the reference curve represents the "center-of-gravity" of a system; a balance point between those opposing forces acting upon it. The slope of this reference curve depicts the overall direction of motion for this equilibrium state.

For an agency or program inflection points can be said to mark a balance point struck between competing forces pushing for and restraining growth. The slope of the reference curve at any particular juncture would then indicate the net effect or resultant of these pressures in

terms of overall growth or decline. Under this conception the reference curve really is an indication of the balance of an agency or program within its particular administrative and political niche -- those political interests and organizational elements which exert direct behavioral influences. The slope of the reference curve depicts overall budgetary motion through this thicket of contrasting supports and restraints.

Obviously slope can be zero -- indicating a stasis within a niche -- it can be positive -- indicating a net growth in an upward-moving equilibrium within a niche -- or it can be negative -- indicating a downward-moving niche equilibrium heading an agency or program into decline. In addition, the slope of the reference curve can be stable -- meaning that an overall direction of budgetary motion persists over a number of years -- or unstable -- meaning that the overall direction of motion itself changes even as oscillations occur around it.

The stability of reference slope can give important clues as to the status of an agency and its programs within a given niche. An unstable slope may signal that an agency has failed to locate a balance or equilibrium within its niche. It has failed to achieve a balance, or even a moving equilibrium, between its supporters and opponents. A rapidly rising slope, for example, could indicate an agency or program for which political support drastically outweighs any organized or stable opposition. This indeed was the case in the NASA budget during the 1961 to 1966 period. A plunging slope, on the other hand, indicates hardening opposition confronting a dissolving line of political support. This too can be illustrated in the NASA budget during the 1967 to 1973 period. In the case of fluctuating positive and negative reference slopes, we might conclude that an agency or program is, in effect, in drift -- directionless in its budgetary trajectory, with no control over its overall growth or development.

Amplitude Variables and Policy Traits. Important political implications can also be deduced for both the upper and lower displacements (amplitudes) which mark the range of cyclical fluctuations. The upper displacement of a budgetary fluctuation begins with a stage of accelerated agency or program growth. This growth encounters an administrative drag or triggers political resistances which eventually overcome forces for expansion and push to restore

the agency to its original budgetary position or rate of growth. These forces, depending upon their strength, may or may not be able to accomplish a complete restoration. (It is possible, for example, that the original point of political equilibrium may have moved as a result of the upward displacement.)

The downward displacement (or negative amplitude) is initiated by a period of budgetary decline (sometimes this is a decline in previously attained budgetary growth rates). This decline then confronts arresting forces pushing to recover lost ground. As in the case of upward displacement, restoring forces may fail to attain a previous point of political equilibrium (which may have shifted downward as a result of the displacement) or they may be powerful enough to rebound an agency to an even higher equilibrium around which future displacements will occur.

There is an additional way to think about upper and lower displacements or amplitudes. The upper displacement defines, in effect, a political ceiling on budgetary expansion while the lower displacement defines a political floor placed under budgetary decline.

Clearly one significant comparative variable is the relative size of oscillatory displacements or swings around the reference curve. In a program context, oscillations can reflect progressive "waves" of policy-making opportunity. The upper displacement signals new or enlarged programmatic undertakings, and the lower displacement the fulfillment or saturation of those opportunities. A large amplitude, under this conception, could reflect an agency with significant program innovation and flexibility -- probably dominated by ambitious program officers (much like Downs' "climbers"). Small displacements, on the other hand, could signal an agency whose programs are locked into relatively rigid routines, dominated by large amounts of administrative overhead.

In a larger political context, large amplitudes could be a sign of a wide range of disagreement between the major constituents of an agency's niche -- disagreement which precludes much compromise on intermediate expenditure proposals and instead fosters big winners and big losers in fierce legislative and political competitions. Small amplitudes, by contrast, might be indicators of a stable consensus surrounding the functions of an agency, and probably, a small number of attentive elements in its political and administrative niche.

Asymmetrical Displacements. Because the oscillations we are dealing with are non-uniform, it is decidedly possible that the upper and lower displacements will not be symmetrical in either magnitude or stability. Indeed, such asymmetries are important clues as to the relative effectiveness, attentiveness and persistence of supporters and opponents of given agencies or programs. A large upward relative to downward displacement could mean, for example, that forces resisting program expansion are less closely attentive or require longer time for organization and activation than those interests pushing for expansion and resisting subsequent decline in attained amounts or rates of growth.

Observing relative magnitudes of upward and downward displacement in relation to the slope of the reference curve might give us additional clues as to the dynamics underlying a program's overall growth or decline. A downward slope with small positive amplitudes would seem to imply a program in serious if not moribund decline. Few expansion opportunities have been available to the program -- either a close "cap" has been placed upon it by its rivals and political opponents, or it is a program with little intrinsic vitality; that is it is characterized by administrative inflexibility and few chances for programmatic innovation.

Alternately, a downward slope with large or unstable positive displacements could indicate a program whose decline was not yet irretrievable -- either because its enemies are not fully organized or attentive, or because there is still flexibility for programmatic innovation to unbalance its rivals and attract new support. As we shall see, we can find just this pattern characterizing the decline and partial recoveries of the post-war foreign aid program of the United States. Perhaps the analysis of decline-cycle trends among public programs will some day allow us to distinguish on a quantifiable basis between those with optimistic as opposed to limited prospects for long-term survival.

Amplitude Stability. A final variable of importance to our budgetary "diagnostic" of agencies and programs is the stability of the upward and downward displacements (i.e. the consistency of their magnitude). If the magnitude of displacements can reflect the relative effectiveness or power of program supports and restraints, the stability of these magnitudes (i.e. their repetition

over time) is a likely measure of the attention and **persistence** of policy opponents and clientele.

It is unlikely that the simple distribution of intrinsic policy opportunities or administrative drags would result in identical displacement magnitudes over significant periods of time. It seems instead probable that when substantial regularity is displayed in these magnitudes it reflects purposeful strategies as well as political tolerances which are stable over time. Thus comparing the relative stabilities of upper and lower displacements for a given agency or program can allow us to compare the relative persistence of its supporting and opposing coalitions. As we will see, some programs grow primarily due to the constant attentiveness of supporting coalitions which place an effective floor under periods of decline. Others grow primarily due to the inconsistency of opponents who are unable to place a ceiling over periods of accelerated advance. Still others probably grow irrespective of their supporters or opponents. They expand due to their fixed coupling to a social problem or demand which is escalating inexorably in intensity. Analyzing the stability of displacements will help us to distinguish these three disparate cases.

Analyzing Oscillations in Budgetary Data

Using the foregoing discussion as a point of departure, we can now examine our findings in more detail and subject them to a politically-focused analysis. To begin we offer the following summary table of comparative cycle data, covering functional policy areas (Fn. Area), agency expenditures (Ag. Exp.), agency personnel (Ag. Per.), programs within agencies (Prog.), and "uncontrollable" programs not subject to direct year-by-year Congressional appropriations (Uncon.).

	Fn. Area	Ag. Exp.	Ag. Per.	Prog.	Uncon.
	Mean Streak Length (Years)				
slope (2% tol.)	1.15	1.84	5.01	1.78	5.80
+ amplitude (1% tol.)	1.71	1.98	5.97	5.15	4.26
- amplitude (1% tol.)	.73	2.08	4.70	2.17	8.73
	Mean Relative Amplitude				
+ amplitude	.08	.12	.03	.04	.06
- amplitude	.10	.13	.04	.04	.06

The table displays mean streak lengths in years for the reference slope, the positive amplitude (displacement) and the negative amplitude across all policy-making categories. In addition, it displays the mean magnitude of both upward and downward displacements (relative to the value of the current reference or equilibrium point).

Some interesting contrasts are quickly evident here. Clearly the least stable policy category, from a cyclical point of view are overall expenditures in broad functional areas. This is not surprising since these expenditures are simply aggregate totals cutting across numerous agencies and programs. The potential influences of political "niches" and the strategies adopted within them are "washed out" in such sweeping aggregations. On the other hand, the longest lasting cyclical periods -- in both slope and overall amplitude stability -- are to be found in uncontrollable programs. Agency personnel, program expenditures and finally overall agency expenditures lie between these extremes in descending order of cyclical stability.

Let us consider uncontrollable programs from this stability perspective. The stable slope of their oscillations is a likely result of the legislative enactments which bind these programs to relatively long-running social demand factors (such as unemployment or pension requirements). These programs in their overall growth trajectories are likely to follow major economic or demographic trends and to display a developmental regularity (at least relative to budgetary time frames) because of them.

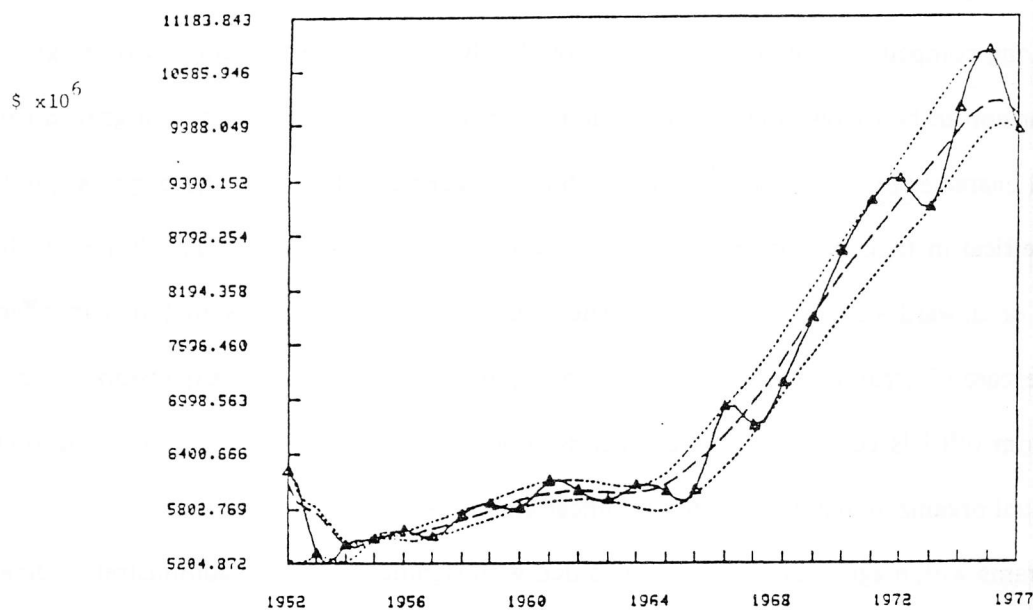
The amplitude or displacement values for uncontrollable programs, on the other hand, gives a real clue as to the political dynamics underlying their growth. Note the unusually stable downward displacements associated with these programs. The mean streak regularity for these displacements extends over eight years. They are more than twice as stable as upward displacements. This means that in the downward part of their development cycles these programs frequently encounter a stable floor below which they cannot drop. At the same time, the limits placed upon their upward swings are nowhere near as regular or stable.

It is likely that outlays for uncontrollable programs begin their growth as a result of "natural" demand increases. Eventually this growth saturates this natural demand among exist-

ing constituents, and the upside of the growth cycle is ended. As the growth rate falls as a consequence of saturation the program soon meets a floor which in effect levels out the downside of growth. This floor amounts to a political activation resulting in legislative enactments enlarging program benefits or coverage. Such enactments trigger a new up-cycle in which outlays again expand to saturation, and the resulting down-cycle again meets a stable political floor triggering a new round of increases, and so on. One might think of these highly stable downside displacement limits as "resting points" prior to new growth "excursions" for this set of uncontrollable programs.

The above argument is one which seems deducible from the asymmetrical stability of upward and downward displacements. If uncontrollable programs were simply oscillating wholly in sympathy with economic conditions or demographic trends, their lower displacement endpoints should hardly be more regular than the upward displacements to which they are reacting. Instead, it seems justifiable to suspect political interventions lying behind such unusual stabilization. (Indeed downside stabilization is probably exactly what such interventions are designed to achieve.) An illustration of regular downside floors can be seen in the following graph which displays the long-term oscillatory growth pattern in veterans benefits from 1952 to 1977.

FIGURE 5
Veterans Benefits



Appropriated vs. Uncontrollable Programs. The findings discussed above are certainly consistent with recent arguments regarding the political causes of general governmental growth (Borcherding, 1977). But, surprisingly, a different pattern characterizes the behavior of appropriated programs under the control of specific administrative agencies. Here it is the **upward** displacement which is more than twice as regular as the downward. One cannot escape the conclusion that a different political pattern is at work here.

Instead of the balance of stabilizing forces falling on the downward side of growth cycles, it falls on the upward side. It is the resistances to growth that are more consistently applied than the stimulants. This is not to say that these programs do not grow -- remember that the amplitude of an oscillation is different from its overall reference slope. But it is to say that even during their growth more regular limits are applied to upward displacements than to downward ones. Because, again, it is unlikely that intrinsic policy or "natural" forces could produce such disparities in upward and downward displacement regularity, it seems reasonable to suspect that purposive forces or strategies are at work. It appears that more consistent political attentiveness characterizes the up side of program cycles than their downside.

This proposition is closely consistent with our earlier arguments regarding conflict-management strategies and their role in the production of oscillatory budgetary effects. As we suggested, if agency officials, hoping to minimize zero-sum trade-offs, were to allow serial growth among competing programs, or if they could only tolerate a certain amount of programmatic expansion to be followed by a stage of administrative consolidation, a cyclical growth pattern would characterize individual programs within the agencies. Moreover, these cycles should be asymmetrical in their displacement regularity, with more regular displacement limits on the expansion or upward side of their cycles. The greater persistence of upward limits in effect reflects the careful scrutiny which would descend upon any program in its expansion phase -- scrutiny from officials connected with competing programs as well as from officials concerned with potential organizational disruptions and uncertainties associated with growth.

Programs within agencies are thus confronted with significant internal administrative drags or resistances where growth is concerned. We believe the character of their budgetary cycles

offers evidence to this effect. Moreover, this is a direct contradiction to those theorists of government growth who have assumed that maximizing organizational growth is a rational and uniform motivation among all bureaucrats. The fact is that there are real costs to bureaucrats in program expansion -- costs in uncertainty and in intensified internal competition. Apparently these are costs to which bureaucrats are persistently attentive, and at least some of them are party to strategies of growth which would act to minimize these costs. This, at least, is what we believe the program cycle patterns strongly suggest.

Agency-Cycle Characteristics. Agency budgetary cycles were analyzed in both expenditures and personnel. As can be seen in the comparative table the agency cycles offer some significant contrasts from the pattern seen in program cycles. Indeed, agency expenditures are only slightly more regular than are overall functional expenditures in their oscillation. Perhaps while functional categories cut across agencies and thus wash out niche characteristics, agency-wide expenditure data cuts across programs and may wash out some strategy factors which act to regularize oscillations among these programs. It is likely, in other words, that budgetary actors are far more concerned in their political behaviors and decision strategies with expenditures linked to particular programs than with aggregate agency expenditures overall.

This argument, it should be noted, is precisely the case which has been made by Natchez and Bupp (1973) in their attack upon the use by incrementalists of agency-wide as opposed to program data in the analysis of budgetary change. They assert that important programmatic fluctuations are hidden by the aggregation of appropriations data across programs. Our findings of major differences in expenditure oscillations between agencies and programs would seem to offer strong support for their contention.

By way of contrast to agency-wide expenditure patterns it is interesting to note some of the oscillatory regularities in agency personnel. The long reference slope streaks (the average length being 5 years) are a good indication of how stable the political niches are which agencies occupy. Their overall trajectories of personnel growth reflect the maintenance of stable equilibria between competing political forces. At the same time, their stable upward and downward

displacements indicate a tight control over internal instabilities to which agencies might be subject as they pursue their changing functional objectives. The somewhat more stable upward displacement limits in agency personnel suggest that here too, as in appropriated programs, the balance of attention is skewed on the growth-restraining side. It is probable that persistent restraints are applied to personnel growth, if not by agency officials themselves, than by OMB, as an arbiter among the growth demands of rival agencies.

Applying Oscillatory Analysis to Specific Cases

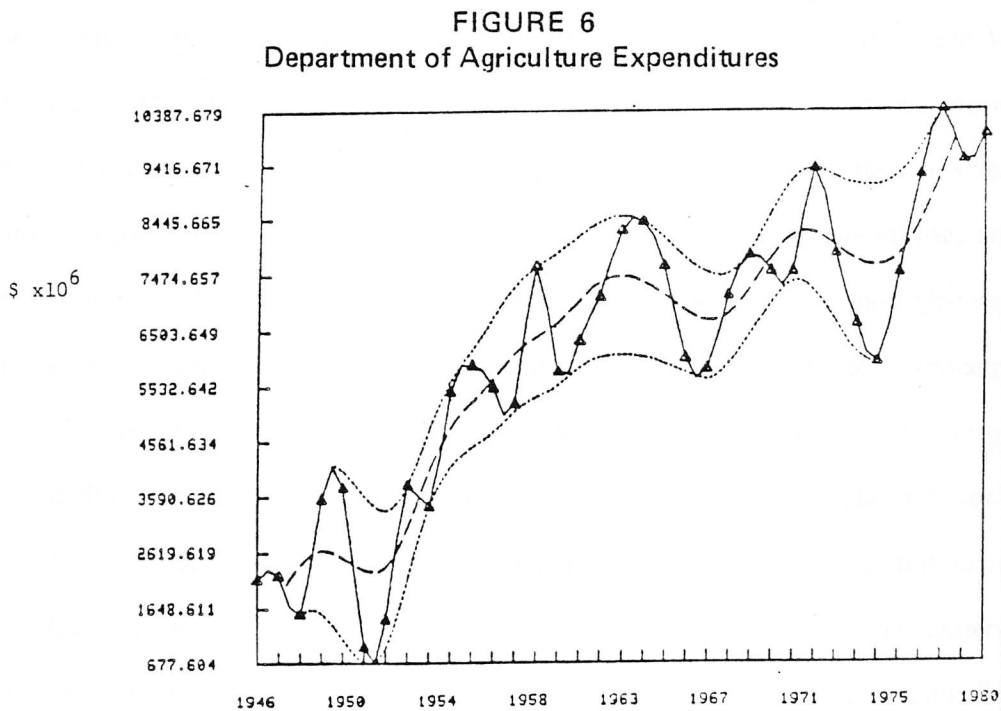
The discussion above has been founded upon the analysis of aggregate characteristics of oscillation within major policy-making categories. Reviewing these aggregate traits raises strongly the probability that purposive strategies -- strategies amounting to more than simply year-by-year incremental adjustments -- are at work in the budgetary process. These strategies appear to have a real impact upon actual budgetary outcomes. Moreover, aggregate characteristics compared across major policy-making categories suggest that somewhat different political strategies underlie the growth of programs within agencies as opposed to the agencies themselves, and that these are in turn different from those factors which drive the growth of so-called "uncontrollable" programs.

As interesting as these findings may be, we believe that oscillatory analysis has more potential to aid in the scrutiny of individual programs or agencies and the specialized political and administrative niches which they may occupy. What this will require is extensive program-by-program explication, looking for associations between known political features and observed oscillatory characteristics. With enough intensive program or agency analysis, combined with inter-agency or program comparisons, it might be possible in effect to "calibrate" oscillatory measures -- to fine tune them so that we could make reliable political diagnoses on the basis of oscillatory variables. Each agency or program may come to have its own harmonic "signature" -- a distinctive cyclic pattern which signals to the trained observer important political and administrative traits reflected in its budgetary history. We might eventually even be able to make predictive statements regarding the probable future of a given program or agency based upon its

oscillatory past. Is it vulnerable to major budgetary reductions or reorganizations; is it likely to continue along a trajectory of strong growth; or, if in decline, is this decline likely to be short-term, or do dim political prospects appear irremediable?

Admittedly, we cannot be sure of such future analytic capabilities. But it seems decided; worthwhile to explore the potential of oscillatory analysis. Toward this end we offer here brief applications of the technique in the explication of three cases -- two agencies and an appropriated program -- during distinct historical periods.

The Department of Agriculture, 1946 to 1980. We look first at the expenditures of the Department of Agriculture. Their historical oscillations are depicted in the following figure:



It is immediately evident that these oscillations are characterized by irregular reference line slope and rather large amplitudes. Indeed the mean ratio of positive amplitude to reference value is .20 and for negative amplitude it is .23. This spread is about twice the mean for all agencies, and it is four times the mean for agency personnel and for programs within agencies. Not only are the displacements back and forth large for Agriculture, but they are highly

unstable in their turn-around points as well. The mean positive amplitude limit lasts less than from one year to the next (.63) and the same is true of the negative limit as well (.70). Clearly the Department has been subject to wide and unstable swings around its reference line or political center-of-gravity.

Yet that center-of-gravity has itself been highly irregular. The mean duration of reference line slopes during this 35 year period is .77. That means that the overall direction of agency motion has been so unstable that on average it has been unable to maintain a consistent trajectory from one year to the next. The Department of Agriculture, in its pattern of expenditures, attains only one-half the slope stability and less than one-third the amplitude stability that characterizes our overall sample of Federal agencies.

All of this gives a deductive indication of an agency which has failed to establish a political equilibrium among its supporters and its enemies. It would suggest also a failure to attain regularity or administrative stability in internal policy ebbs and flows. Can this deduced pattern really be the case for such an old and seemingly well-established administrative organization?

An investigation of the political history of the Department of Agriculture confirms many of our suspicions. The largest program in the Department's yearly expenditure total is that of price supports conducted within the Commodity Credit Corporation. While this is a public corporation, not dependent upon annual appropriation, its outlays are strongly influenced by annual agricultural legislation covering crop eligibility and parity levels. Indeed, these legislative enactments have closely tied the expenditures of the CCC to ongoing political battles among conflicting agricultural policy coalitions and interests. As it turns out, there has been little agreement among these coalitions, and the Department in its price-support program has had a turbulent ride in the midst of intense political conflict.

One review of two decades of U.S. agricultural policy concludes that "a consensus could never be found for a thoroughgoing and permanent policy -- either of a free-market or a sharply managed farm economy." (Congressional Quarterly, 1965, p. 665). The opposing policy blocs consisted of those favoring high degrees of government support for farmers, through price sup-

ports, government purchase of agricultural surpluses, as well as production control through acreage allotments, on the one hand, and those favoring little income support for farmers and a maximum impact of free-market forces upon agriculture. Committed to the first policy was a Congressional voting bloc consisting primarily of Southern and Western Democrats and farm district and lake state Republicans. Favoring the latter position was a coalition consisting of Northern urban and suburban Democrats as well as rural West and Mid-West Republicans. The antagonism between these blocs has created a turbulent political niche for the Department of Agriculture. This turbulence is well revealed in the slope instability by which its expenditures are characterized. The department has been unable to attain a balance between these competing forces which would allow it to attain a consistent trajectory of program growth and development.

The wide displacements characterizing Agriculture expenditures must, of course reflect some of the uncertainties implicit in policies devoted to the support of prices in an area such as agricultural production. Factors such as bad weather or overseas crop failures are certain to introduce turbulence in the outlays of a price support program. But the width and instability of these displacements would seem to reflect more than simply the shifting fortunes native to agriculture. Note that many of the displacement upswings and downswings occur over multi-year periods. A given expansion or contraction period may extend over two, three or even four years. While it is easy to imagine that an unusually good harvest may spark major increases in governmental expenditures over a one or two-year period in order to maintain a parity-related price, it is difficult to conceive of this harvest fluctuations alone supporting continuing growth in these outlays over a three or even four-year period.⁵ Something more than meteorological chance is likely to be involved in these multi-year trends of expenditure increase or decrease. The agriculture policy system is being driven by forces of more than one or two year's duration.

One possible explanation is that supporting coalitions find opportunities to add new crops to the subsidy program or to gain a favorable readjustment of parity levels. This leads to an

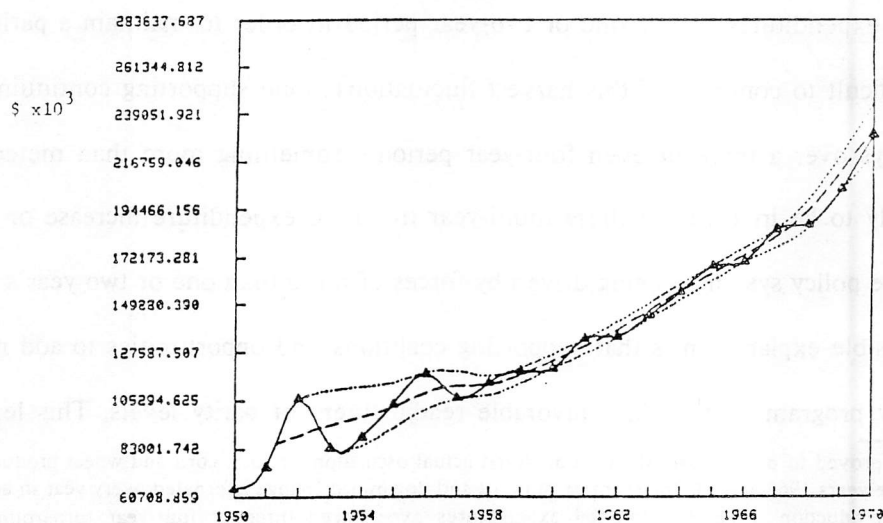
⁵ Indeed, this proved to be the case when we analyzed actual oscillations in U.S. corn and wheat production. Between the years 1962 and 74, for example, upward and downward change alternated every year in actual agricultural production while departmental expenditures experienced three or four-year turnaround periods.

escalating set of new outlays as farmers adjust their production strategies to these programmatic changes. Then these expenditure increases trigger a response from opponents of the agricultural subsidy program. They may gain renewed political cohesion and resolve as a reaction to the previous years' growth. Their mobilization results in legislative victories which delete some crops from subsidy coverage, reduce parity levels, or alter acreage allotments. A multi-year downturn then follows in Agriculture outlays. This downturn then mobilizes agricultural supporters and the cycle is renewed.

The size and instability of the upward and downward swings thus testifies as much to the uncompromising nature of these competing agricultural policy coalitions as it does to the uncertainties in agricultural production itself. Could these opposing political forces find a middle policy ground on which to agree, it is likely that expenditure swings for the Department would be less severe and more regular in their boundary points. Perhaps the ideological conflict between the two agricultural policy camps is aggravated by the difficulty in finding middle ground on issues such as whether a particular crop is or is not to be included in a price support program. The yes-or-no nature of questions such as these may be a factor in maintaining a legislative polarization between opposing policy coalitions.

The Federal Bureau of Investigation, 1950-70. A sharply contrasting oscillatory pattern is presented in FBI expenditures.

FIGURE 7
FBI Expenditures



In the period depicted (1950-70) the displacement swings are on average only 5% of the reference value. In addition, the displacement boundaries are very consistent -- with upper end-points remaining stable for an average of 5.6 years, and the lower end points stable for an average of 5.1 years. (This includes a ten year stable upper displacement boundary between 1958-67, and a nine year stable downward boundary between 1958-88.) Finally, the overall growth trajectory is much more steady than was the case in Agriculture, with a mean stable reference slope length of 4 years (and an eight year slope streak between 1959-66).

This pattern of oscillation is what one would expect to see associated with an agency which occupied a stable and homogeneous political niche, and whose programs were subject to little controversy and were administratively regularizable. The oscillations suggest an agency with both a stable (and strongly supportive) political niche and a strong administrative control over the development of its programs.

Of course, the FBI has throughout most of its history been an agency with just these characteristics. Indeed, Francis Rourke has described the FBI as a "self-directing" agency. In contrast to "constituency" agencies which become "governmental outposts" for private interests, self-directing agencies:

are organizations that have succeeded in establishing a position of autonomous self-determination within the executive branch. They are controlled neither by the public nor by any network of outside constituencies. They are dominated instead by career officials who steer the agency and set the course (Rourke, 1979, p. 538).

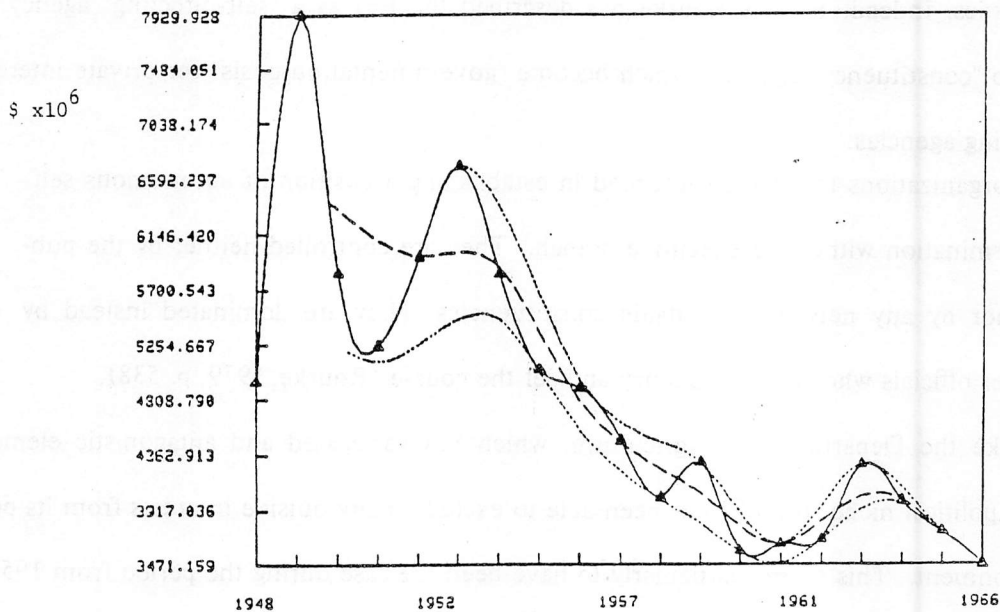
Unlike the Department of Agriculture, which has variegated and antagonistic elements within its political niche, the FBI has been able to exclude many outside interests from its political environment. This seems particularly to have been the case during the period from 1958 to 66. It is interesting to note that wider and less stable oscillations characterized the period from 1950 to 56. The slope of the oscillatory center line is also less regular during this period. This instability may reflect the expanded role thrust upon the agency during the McCarthy era -- a time in which external pressures were applied to the agency and new political elements entered its niche. These wider oscillations dampen out toward the late fifties and the FBI then settles

into a stable, self-directed period for nearly a decade.

From 1967 to 1970 the slope of the oscillatory equilibrium turns abruptly upward. The equilibrium point within its niche has moved in support of a higher overall growth. This is probably a result of the increased domestic political disturbances and violence associated with the Vietnam era. Yet, interestingly, the displacements remain relatively stable. Apparently, the agency during this period was able to retain a close administrative control and regularity in its programmatic expansion. This may be because the FBI itself was the dominant political element in its own expansion, rather than an object of political pressure by interests outside of the agency and its immediate supporters.

Foreign Aid Expenditures, 1948-66. Our last budgetary case focuses upon the decline of the nation's foreign aid program during the period from 1948 to 66.

FIGURE 8
Foreign Aid Expenditures



Here the graph depicts a dramatic dampening-out of oscillations, and a general downward plunge of the reference line around which these oscillations occur. While the overall impression gained from viewing such a graph is one of ominous future prospects for the program in question, there are some particulars which bear closer inspection.

First, the slope during the period depicted is highly unstable. The mean slope streak length is .8, meaning that the direction of the reference curve is generally unstable from one year to the next. The displacements are also unstable, but there is a revealing asymmetry between them: the positive amplitudes are extremely volatile, with a mean streak length of .18, whereas the negative amplitude is 1.3, significantly more stable (although hardly regular). There is, however, a four-year negative amplitude streak between 1957 and 1960.

We have previously suggested that a downward slope in combination with dampening oscillations is a sign of a program with a decidedly pessimistic prognosis. The balances of forces within its political niche is shifting downward, and it suffers in addition from declining programmatic vitality -- expansion opportunities are increasingly foreclosed by either heavily antagonistic forces or by dominant administrative restrictions or routines. While foreign aid expenditures in the period depicted are certainly declining, there are two important departures to note from the conditions outlined above. First, the slope has not been consistently downward -- it has been subject to periodic levelling off, such as in 1952-53, or even an upswing, such as during 1961-63. The overall instability of slope may be an additional sign that an intractable downward balance of political forces has not yet descended upon the program.

Apart from its slope, there is another significant oscillatory characteristic of foreign aid to consider. While the displacements are indeed dampening out in the 1948-53 period **they do not decline thereafter**. Instead they fluctuate while avoiding a pattern of further dampening. This may signal a program which is still confronted with expansion opportunities -- not completely caught in a downward administrative and political "sink". Finally, the more stable negative displacements may be a sign that the supporters of foreign aid, weak though they may be during this period, are somewhat more organized than its enemies. All of this might suggest caution in writing a political obituary based upon a simply reading of foreign aid expenditure trends.

A brief look at actual political and administrative events during this period confirms some of our suspicions. In the post-war era European economic recovery aid was a major source of expenditure increases. Expenditures dropped after recovery demands lessened. They rose shar-

ply again in the form of military assistance during the Korean war. After the Korean conflict, aid requirements dropped significantly, to be followed later by cold-war-related increases during the early sixties. Throughout the long decline from the Korean war to its brief resurgence in 1962-63, the supporters of foreign aid proved resourceful in attempting programmatic innovations in order to keep the policy alive. After military assistance needs diminished with the end of the Korean war, foreign aid was redirected toward foodstuffs, and sold politically as a farm surplus disposal program. Later, as support still declined, foreign aid programs were again redirected, this time toward development loans (as opposed to aid "gifts") and foreign currency purchases (with the currency then loaned back to the recipient nation for development). These adroit programmatic maneuvers did not prevent declines in the overall trajectory of the foreign aid program, but they did keep it alive politically against strong opposition.

The analyses undertaken here are not meant to suggest that oscillatory patterns can provide definitive accounts of the history of public agencies or programs. Still less are they meant to suggest that we could with great reliability predict the future of an agency or program through scrutiny of its budgetary oscillations. Instead, we hope to raise the possibility that the budgetary characteristics of agencies may tell us more about their different political and administrative circumstances than the incremental model of budgeting would lead us to believe. Cognitive limitations do not render the budgetary process a simple reactive response to a previous year's expenditure level. Non-linear fluctuations are not simply a "break-point" from overwhelming decision-making routines caused by essentially randomized "exogenous" variables. Budgetary outcomes we contend reflect a rich set of purposive strategies -- strategies which are far more complex than simply adding a marginal increment to the previous year's base. Oscillatory variables are themselves capable of expressing more behavioral richness than linear ones, and an oscillatory analysis has the potential therefore to suggest these budgetary strategies to us -- in their complexity and diversity.

It is as a signpost of these underlying strategies -- as a clue to their diversity and complexity -- that we have attempted to add oscillatory analysis to the budgetary research agenda. We conclude with a brief consideration of possible directions for this future research.

CONCLUSIONS

It has been our intention in this essay to offer the following general arguments:

- a) the study of how agencies and programs expand or contract over time has been seriously neglected, and this neglect has been obscured in recent debates over the general question of **why** government grows;
- b) existing analytic models which apply to agency growth or decline fail to account for complex strategic requirements -- in political information-gathering, administrative consolidation and conflict-management -- which are likely to be closely associated with growth or decline as developmental processes;
- c) the pursuit of such strategies should produce patterns of expenditure growth and decline which more closely resemble oscillatory motion than a linear, incremental trend;
- d) the budgetary oscillations which we have uncovered do indeed defy basic assumptions in incremental theory regarding the primacy of a single year precedent (or base) in the determination of budgetary decisions. They suggest factors of far greater complexity and longer time-frame at work in budgetary decision-making;
- e) and finally, we assert that oscillatory analysis can offer promising clues to guide researchers in analyzing those specific political and administrative niches which surround and influence the growth of individual agencies and programs.

These arguments suggest, we hope, that new issues should find their way onto the budgetary research agenda. Perhaps the starting point should be a reintegration of budgetary research with public policy and organizational studies. In recent years the literature on budgeting has become increasingly detached from its theoretical grounding in political science -- isolated instead in rarefied mathematics which few mainstream political theorists have been able to follow. As a consequence budgetary studies have had a decreasing impact upon our general understanding of organizational behavior and the policy-making process.

Yet we believe that renewed analysis of budgetary behavior among agencies and programs could have important implications regarding our understanding of coalition behavior, lobbying

strategy and influence, organizational processes of change and growth, as well as the character of public policy decision-making. All of these are long-standing issues at the heart of political science. The notion that budgeting rests primarily upon organizational routine, that it reflects processes which have been stripped of significant cognitive complexity, that it is simply one year's institutional momentum imposing itself upon another has no doubt been a major influence in the detachment of recent budgetary research from major concerns in political theory.

But we suggest that budgetary outcomes do not reflect processes of such routine or simplicity. Instead, they are strongly influenced by more complex forces and strategies -- multi-year in scope, and varied across diverse political and administrative niches. Let us consider some of the implications of this assertion for larger theoretical perspectives in political science.

Budgetary Oscillations and Coalition Theory. A great deal of coalition theory has been directed toward the issues of coalition formation and voting strategy among political blocs (Riker, 1962). While major insights have been derived from the formal theory of coalitions, the diversity of budgetary oscillations which we see across agencies and programs raises the possibility that coalition behaviors and strategies may well be far more varied than is presently accountable in formal deductive models. For example, it may well be that there are important differences between "defensive" coalitions, which mobilize only periodically to limit the downside of growth cycles, and "offensive" coalitions, which are out to effect major changes in program coverage or scope. Based on the oscillations we see there may also be "negative" coalitions within many policy environments which apply repetitive pressures to limit the expansion of particular programs.

Analyzing the oscillatory patterns attendant upon a specific agency or program may someday provide clues about the nature of those political coalitions which offer its primary opposition and support. As we have also suggested, the information needs required to maintain policy-making alliances extending outside agencies to legislative members and interest group leaders may be more extensive than the formal theory of coalitions would lead us to expect. It

may be that fluctuating pressures are an important part of coalition strategy, as a means of renewing, verifying and expanding the mutual "definitions of reality" upon which these alliances must rest.

Budgets and the Lobbying Process. One possibility raised in the oscillatory patterns characterizing so many agency and program expenditures is that lobbying strategies are frequently cyclical in nature or are subject to cycles in their influence and effectiveness. The latter case may imply the need for an addendum to our present conceptions of pluralism. The ability of an interest to organize and affect agencies and their program outputs may vary significantly depending upon where these agencies may be in their expenditure cycles. Outside interests, in particular, may find that many programs are locked into multi-year "pre-programmed" cycles of expenditure development. In particular phases (such as just after a shift into an upturn or downturn) these cycles may resist interruption by elements previously unincorporated into those political alliances under which they were given birth.

This argument, of course, reaffirms a long-standing notion concerning the importance of timing for successful legislative influence. But it suggests further, that points of maximal lobbying opportunity appear repetitively within the life of agencies and public programs, as do points of maximum resistance. These fluctuating periods may eventually help us to expand our understanding of the agenda-building process, by which some public demands are subject to political filtering while others receive rather direct policy-making and administrative attention (Cobb and Elder, 1983).

Budgeting and Decision Theory. Perhaps the most important implications of budgetary oscillations occur in our efforts to model the decision-making process. The incremental model of budgeting, it will be recalled, was formulated expressly upon the incremental theory of decision-making, and incremental budgetary changes were offered as strong evidence that the cognitive assumptions underlying incremental decision theory were correct. The fact that we have been able to demonstrate that longer-term oscillatory expenditure patterns are in fact the

case raises important challenges to this previous line of argumentation. The later work of Davis, Dempster and Wildavsky appears to recognize the incompleteness of incremental theory. They admit that a simple incremental model cannot account as well for budgetary patterns as a non-linear, or as they put it, "explosively linear," model (Davis, Dempster and Wildavsky, 1974). But they conceive of this revised model as one of interrupted incrementalism, with the numerous "break points" the result of exogenous variables **outside** of the budgetary process.

But this attempt to limit its connection to budgetary outcomes cannot, we believe, rescue incremental theory. The periodic behavior of expenditures need not be interpreted as "lapses" from "normal" budgetary decision-making caused by external "shocks". Rather, it can be thought of as an intrinsic part of that normal decision-making, a decision-making which is simply more cognitively complex than previously realized by the incrementalists. We believe that at least this prospect raises the need for major reinvestigation of the budgetary process. This should entail careful interviewing of budgetary participants, much as Aaron Wildavsky conducted in his original landmark research (Wildavsky, 1964), but with a careful scrutiny of the time horizons and political perspectives under which these actors operate.

The Theory of Organizational Growth. Lastly, we conclude that there is much to learn concerning how administrative organizations expand. Certainly, the purely economic arguments applied by Niskanen and others concerning the unrelenting motive of bureaucrats to expand their agencies seem far too simplistic in light of the complex behavior involved in their actual growth and in the growth of their programs. Growth/consolidation cycles may instead reflect the **shifting motives** of bureaucratic officials -- alternating frequently between income and security, prestige in the job and autonomy from the job, job variety and job mastery, and the like.

Organizational growth may signal a great deal about the characteristics of organizational environments, and the diversity of growth trajectories among government agencies may well mean that no single global theory can account for why government grows in modern social systems. Indeed, recognizing the need for the development of multiple models of organizational growth may be the first step toward actually answering this increasingly debated question.

In the meantime, we need to recognize that analyzing expenditure patterns alone tells us nothing about the substantive policy and organizational changes associated with growth. These issues also need to be addressed in the analysis of how government organizations expand. Further, additional research needs to be done comparing oscillatory expenditure patterns across theoretically interesting clusters of agencies or programs -- i.e., comparing trends between growing and declining agencies, or contrasting technology-intensive programs with human-service ones, etc. Finally, future research must be sensitive to the use of new aggregate budgeting procedures, such as budgetary "targets" and particularly the budget reconciliation process, which may strongly distort future patterns of individual agency growth and development (Schick, 1983).

APPENDIX

This appendix contains the details of (1) the method of estimating the location of inflection points in the case of discrete data and (2) the statistical test used in the validation section.

To investigate inflection points, we must first define the **degree of concavity** of a sequence of three data points, analogous to the curvature of a smooth curve. In the case of a smooth curve, the curvature is computed by means of the second derivative; in the discrete case, the degree of concavity is the **second difference**. The **first differences** of a sequence of values are the differences between successive pairs of values; they form a new sequence, one term shorter than the original, which gives the slopes between successive pairs of data points. The second differences are the differences between successive pairs of first differences; they form a new sequence which is one term shorter still and shows the way the slopes are changing to create concavity. The following table illustrates these ideas.

Department of Labor (constant dollars in millions)				
year	1959	1960	1961	1962
budget value	1178	586	887	660
first differences	-592	301	-227	
second differences		893	-528	

The two second differences in the table give the degrees of concavity of the data points for the years 1959-1961, centered around 1960, and 1960-1962, centered around 1961, respectively. The positive value indicates upward concavity, the negative indicates downward; hence we deduce the existence of an inflection point between the data points for 1960 and 1961.

The location of an inflection point may be estimated by using the simplifying assumption that the concavity changes at a constant rate between two successive values. (The same result would be obtained by computing the inflection point of a cubic curve passed through the four data points.) In the example above, the change in concavity from 893 in 1960 to -528 in 1961 is -1421; since it started at 893 at 1960, it takes $893 / 1421 = 0.628$ of that year to reach concavity zero, the crossover point between the two directions of concavity. Hence we estimate the time of the inflection point as 1960.628. To estimate the dollar value of the data point at time

1960.628 we may pass a smooth curve through the data points and use its value at 1960.628.

The statistical test used to validate our results is based on the Kolmogorov-Smirnov statistic (Knuth, 1981) for testing how likely it is that a given sample has been taken from a specified distribution. In our case, the question is: with what probability could the real data for the agencies, programs, and policy areas have appeared as a sample from the same distribution that generated the random data?

The method as it applies to the mean streak lengths is as follows. For each possible mean streak length, compute the fraction of cases with mean streak length less than or equal to that value. The maximum difference found between that fraction and the corresponding fraction for the specified distribution, multiplied by the square root of the number of cases, is the Kolmogorov-Smirnov statistic. We treat the "specified distribution" as unknown, but compute the lowest possible Kolmogorov-Smirnov statistics that any distribution could give when compared with the distribution of mean streak lengths for the real and random cases. Then, using the distribution for the Kolmogorov-Smirnov statistic itself, we compute the probability of obtaining those two values: since we get, for our data, a probability of less than 1%, the confidence level exceeds 99%.

A final point should be noted with respect to the generation of the random data. It could be argued that the random data could be biased toward irregularity since it is generated from a mixture of expenditures and personnel for agencies, functional areas, and programs and that each group of data has very different characteristics. However, when we generate random data separately for each type of real data, we actually get stronger validation results.

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