A Really Simple Explanation of Policy Punctuations?
Interdependence, Complexity, and Policy Punctuations

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Keywords: Theory of Budgeting, Policy Punctuations, Agent based Modeling, Complexity, Non-Equilibrium Games.

Abstract: We know for a fact that changes in budgets follow a leptokurtic or power law distribution. We have solid evidence that the degree of leptokurtosis can be explained by factors such as special features of policy areas, information processing, decision costs, and differences in the institutional setting (Jones & Baumgartner, 2005a; 2005b, Breunig, 2007; Jones, Sulkin and Larsen, 2003; Breunig and Koski, 2006). However, we do not know why leptokurtosis is omnipresent. In this paper we conjecture that leptokurtosis can be explained by four simple observations which must be true of any budgeting process: (1) that several actors request and spend budgets, (2) several actors allocate funding, (3) that actors which do not receive sufficient funding will eventually close down, and (4) that available funding is limited and often smaller than requested funding. We first review the literature on policy punctuations and leptokurtosis, and identify the four simple observations. We then discuss how a simulation can be useful in investigating the implications of these four observations, and introduce a simulation of the interaction of beggars and philanthropists in a budget game. We show that the four observations can account for the omnipresence of leptokurtosis at the sub system level. They cannot, however, explain the magnitude of leptokurtosis found in empirical distributions of budget changes.

1 COMPLEX PATTERNS WITH A SIMPLE EXPLANATION IN THE THEORY OF POLICY PUNCTUATION

Public budgeting is, in a sense, very well understood. When Aaron Wildavsky and his colleagues almost 50 years ago began to use quantitative methods in the study of public budgeting, it became clear that public budgets are, compared to other phenomena within the realm of political science, extremely easy to predict. Budgets almost always develop ‘incrementally’, i.e. they tend to grow slowly and gradually year after year. If one knows the budget for one year of a country, a municipality, a public agency, or some other entity, it is fairly easy to predict next year’s budget. Just add a small fraction and you have, almost always, a very good estimate. This has been documented in several studies, in various ways and countries (see, for instance, Davis, Dempster & Wildavsky, 1966; Jones, Baumgartner & True, 1998).

However, this is only one side of the story. Although public budgets are indeed predictable and changes small most of the time, once in a while, often when least expected, changes of catastrophic nature occur (Padgett 1980; Jones, Baumgartner & True, 1998). Figure 1 shows the distribution of budget changes in U.S. budget outlays for almost 200 years. Compared to a normal distribution, it has a characteristic form. Small changes are very frequent, and much more frequent than in a normal distribution with similar mean and standard deviation would predict. However, the distribution has fat tails; extreme changes occur once in a while, and much more often than would be expected from a normal distribution. Budget changes follow a leptokurtic distribution, and the cumulative frequency of observations is related with a power function to the size of the change.

This does not only apply to U.S. budget outlays but is a very strong empirical result. A massive amount of empirical evidence confirms that budget

Prange F. and Serritzlew S..
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DOI: 10.5220/0004055300970102
In *Proceedings of the 2nd International Conference on Simulation and Modeling Methodologies, Technologies and Applications* (SIMULTECH-2012), pages 97-102
ISBN: 978-989-8565-20-4

changes follow this distribution, in different countries, states, municipalities. James True calls such budget changes avalanches (True 2000).

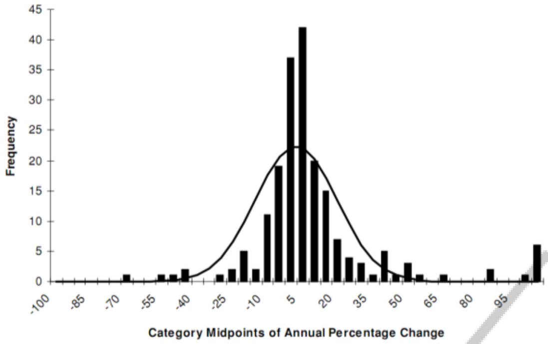

Figure 1: Real U.S. Budget Outlays, 1800-1994. Note: Copied from Jones, Sulkin & Larsen (2003: 164).

Sometimes the avalanches are small and affect only limited parts of the system, sometimes the avalanches gain momentum and cause dramatic changes. The tricky part is that it is impossible to predict when these avalanches occur, both in sand piles and in budgets. Studies of actual sand piles have revealed clear patterns of how often it happens, and of the frequency of avalanches of certain sizes, but it has proved extremely hard to predict exactly where and when it occurs (Bak, 1996: 59ff.). The same is true for public budgets. It is easy to predict how many avalanches appear within a reasonable period of time, but the timing usually comes as a surprise.

This phenomenon calls for an explanation. Two explanations are available in the literature. According to the theory of punctuated equilibria (Baumgartner & Jones, 1993; Jones, Baumgartner & True, 1998), long periods of stability in political subsystems, where most decisions are made, will, once in a while, be broken or punctuated when a political issue is elevated unto the macro political level or becomes subject to intense media attention. This may produce dramatic changes. Consistent with this explanation, Jones, Baumgartner & True (1998) find that dramatic changes occur, and that they cannot be explained simply by exogenous shocks, and Danish and UK data show that leptokurtosis is more prevalent in some policy areas than in others. The authors suggest that explanations for this might be factors such as international conflict and party preferences (John and Margetts, 2003: 427).

Explanations based on the interplay between political subsystems and the macro political arena and on information processing are definitely relevant, and account for empirical variation in the amount of leptokurtosis. But one puzzle is still left. If the avalanches are caused by the differences in institutions, in policy areas, in media attention or due to friction or to over-emphasis on certain signals from the outside world, how come that avalanches seems to be omnipresent? The empirical studies show that budget changes nearly always follow a leptokurtic distribution. If these factors were the only possible causes of this phenomenon, should we not expect it not to occur in some instances?

In the following, we identify four simple characteristics, which must apply to any budgeting process. We argue that complex patterns of policy punctuations is a result of these four characteristics alone, and develop a simulation which show that this is indeed true. Specifically, we hypothesize that, even in a system with no outside intervention, with perfectly normally distributed input signals, with no overemphasis on certain signals, no institutions, and with no friction, leptokurtosis will, due to interaction among multiple agents, still prevail. This conjecture is based on the following four simple observations, which must be true of any budgeting process. Without someone requesting and allocating funding, there would be no budgeting activity at all (Schick, 1988: 63). Therefore, in any budgeting process:

(1) Several actors (beggars) request and spend budgets

(2) Several actors (philanthropists) allocate funding

Funding is requested partly because any organization or program needs some resources to survive; insufficient funding will, at some point, lead to closure or radical transformation. Programs, institutions, agencies, or other entities which depend on public money which do not receive sufficient funding will eventually close down. This means that:

(3) Beggars which do not receive sufficient funding will eventually close down

Budgeting is about allocating resources between several different purposes. This means that any budgeting process involves several different actors requesting funding, and there is always a possibility that new ideas or programs will appear. Finally, budgeting is only relevant if funding is limited and smaller than the sum of all requests for funding. If this were not the case, money could just be distributed, and budgeting would not be relevant at all. This completes the list of the four observations:

(4) Available funding is limited and often smaller than requested funding

Therefore, in budgeting, actors are interdependent. This is easy to see. Since funding is limited (4), some actors request funding (1) from a closed set of funding opportunities (2), and is required to do so in order to survive (3), the fate of one particular actor in the budgeting process depends on how successful others are. If there are many competitors, and if they receive a very large share of the available funding, it is harder to get sufficient funding. If competitors collapse or disappear, more resources will be available for others. The four simple observations therefore imply that budgeting takes place in a complex interdependent system. Interestingly, complex systems of interdependent parts tend to produce leptokurtic distributions. This happens when complex systems during prolonged periods of relative stability self-organize into a critical state. When in a critical state, the system is likely to experience a major change.

This brief account of budgeting and complexity does not, of course, substantiate the claim that the four simple observations on budgeting imply leptokurtosis. In order to do this, we simulate a simple budgeting game adhering to the four observations.

2 THE SIMULATION

In our simulation some actors, called beggars, are capable of applying for funding from several possible sources, which are called philanthropists. Beggars seek to optimize their appropriations. Beggars and philanthropists obey a set of simple and minimalist rules which are congruent with the four observations. All input into the simulation is drawn randomly from a normal distribution. The question is then whether the output is also normally distributed or leptokurtic.

In this section the simulation is described. We begin with a verbal explanation of the basic logic in the simulation, and how it can be interpreted. We then schematically present it in more detail.

Beggars and philanthropists interact as shown in Figure 2. First, beggars request funding (point 1 of the observations). They spend money and generate (or use) savings. Second, philanthropists allocate funding among applicants and send appropriations (point 2). If appropriations continue to fall short of spending, savings of the beggar will eventually be exhausted. The beggar then closes down and disappears (point 3). Philanthropists have limited possibilities to provide funding, and there is always a demand from beggars of funding (point 4).

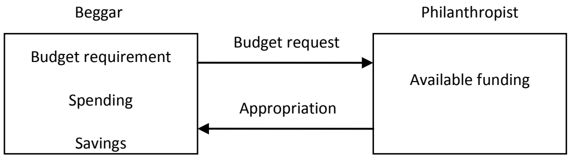

Figure 2: The relation between a beggar and a philanthropist.

The chances of getting funding depends the familiarity of a beggar to a philanthropist. This is modeled spatially. The beggars and philanthropists are located in a grid of, say, the size 10 x 10. This gives 100 possible locations. The various locations of the philanthropists in space can be interpreted as their association with a certain sector, with certain types of projects, or a certain policy area. If a beggar is close to a philanthropist, it means that the proposal of the beggar seems relevant and familiar from the perspective of the philanthropist. The distance from a beggar to a philanthropist represents familiarity. For instance, an interpretation of a beggar being located next to a philanthropist would be that the beggar provides a service, which is well known to and highly prioritized by the philanthropist. Conversely, a beggar located far away from any philanthropist is trying to get funding for a really arcane project or purpose, which no philanthropist is likely to prefer to support.

A beggar can only apply for funding from one philanthropist. Beggars move in order to be close to an attractive philanthropist, but movement is penalized. Moving is tantamount to redefining or reformulating the funding proposal in order to accommodate a new philanthropist. The distance moved to be located next to a philanthropist therefore affects the opportunity to get funding. If a beggar does not have to move, it is well known by the philanthropist and is therefore likely to get funding. If a beggar must move a long distance, it is less likely to get funding. If a beggar has moved a long distance, the philanthropist will be more likely to consider cutting the budget request. This happens when the beggar is selected for review. If the beggar has moved the maximum possible distance, the beggar will always be selected. If the beggar has not moved since the last iteration, the risk of review is equal to the base risk at 50%. As we return to below, this, and other central values can be varied. We systematically vary these parameters in our analysis to check the robustness of the results.

If a beggar received all requested funding in last iteration, the beggar stays with the philanthropist. If not, the beggar seeks for a more attractive philanthropist. The beggars find the most attractive philanthropist, move if necessary, and receive funding. If funding is insufficient, savings are reduced, and if saving fall below zero, the beggar disappears. If funding is sufficient, the beggar starts over in the next iteration. The philanthropists receive applications, and allocate appropriations.

In the first three stages, the simulation is initialized. The action takes place in the remaining six stages, which are repeated in a large number of iterations. In the first stage of the simulation the n × n grid is created. The size of the grid is determined by a parameter called [Size]. In the second and third stage, several beggars and philanthropists are created. For each beggar, a budget to be requested is determined; for each philanthropist, funding to allocate is determined, both random numbers drawn from a normal distribution with a specific mean and standard deviation (both are parameters). The exact number of beggars and philanthropists are set as parameters. Their location in the grid is determined randomly. This completes the initialization in the first three stages.

The action takes place in the remaining six stages. These stages are iterated a large number of times. In stage four, budget needs are determined for each beggar. This is the amount the beggar will spend. Budget needs is a fraction of the budget requirements, calculated as a random number from a normal distribution with mean 0.98 times the budget requirement. Beggars then select a philanthropist. If a beggar in the previous iteration got full finding, it will stick to the same philanthropist as in last iteration. If not, it will locate visible philanthropists, and choose the most attractive one, based on a calculation of the expected payoff for each visible philanthropist.

In stage five, funding is allocated. The philanthropists collect the budget requests, and determine whether the available funding is sufficient. If it is, the beggars get what they request. If the sum of requests for funding exceeds the amount available, the philanthropist will select beggars for review. The likelihood of being selected is base risk (a parameter) at 50% + a movement penalty. If no beggars were selected, the procedure is repeated. In stage six, the beggars spend money according to the budget needs. The surplus (or deficit) of a beggar is added to its savings. In stage seven, the state of the world is printed to a file. Beggars with negative savings are eliminated. In stage eight, new beggars are generated if the sum of available resources exceeds the sum of requested funding. In stage nine, the positions of the beggars are updated, and the budget requests of each beggar changes by a random number drawn from a normal distribution. The beggars and philanthropists then start over at stage four in the next iteration.

3 THE DISTRIBUTION OF BUDGET CHANGES

We now analyze the distribution of changes in appropriations in subsets of different sizes. The smallest subset consists of 9% of the grid. On average, such an area encompasses 4-5 philanthropists and 18-20 beggars. The beggars, of course, may have options outside of the area, and are able to move in and out. For the 9%-subset, Figure 3 shows a histogram for changes in appropriations for the default parameters in a simulation with 10,000 iterations with a superimposed normal distribution with same mean and standard deviation as the distribution of changes in appropriations. A visual inspection reveals that the distribution is non-normal. Changes in appropriations tend to have a higher peak, and more dramatic changes occur than would be expected from a normal distribution. Similar simulations have been carried out for 959 other configurations of parameters.

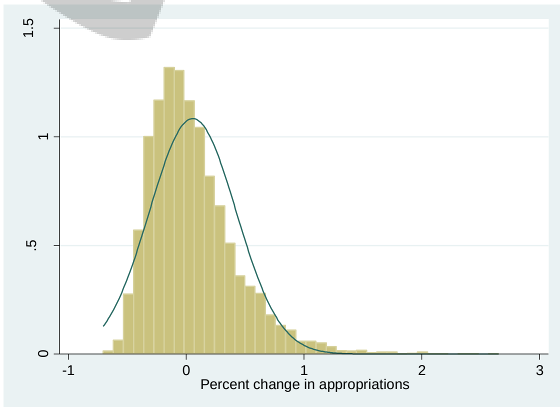

Figure 3: Histogram for changes in appropriation for 9%-subset. Standard parameters.

On average, the l-kurtosis value for these 960 distributions is 0.203. This is clearly higher than the l-kurtosis score for the normal distribution. Hence, in the smallest subset, the typical distribution is leptokurtic. However, it is not always the case. Of the 960 simulations, 1% has distributions below 0.112, and 5% below 0.124. Although it is quite rare, and although l-kurtosis values are typically above 0.1226 (the value for a normal distribution), some of the simulations end up with normal or even almost uniform distributions.

Figure 4 shows average l-kurtosis scores for different subsets. It is clear the l-kurtosis score is negatively related to the size of the subset. The figure shows the average l-kurtosis scores (0.203 for the 9% subset) along with the scores for the 25th and 75th percentiles. The horizontal line shows the l-kurtosis scores for a normal distribution. As the subset becomes larger, the l-kurtosis scores drop. They are always, also at the system level where 100% of the grid is analyzed) on average above the score of a normal distribution, but when the subset is larger than 50%, only slightly so. The percentile spikes indicate that it becomes increasingly common that some of the simulations, even though the average is above 0.1226, fall below the score of the normal distribution.

Hence, the simulations show that leptokurtosis is quite common in analyses of subsets of the system, and that the l-kurtosis scores are quite low compared to empirical distributions of budget changes. Furthermore, the tendency to leptokurtosis becomes smaller when for larger subsets, and almost disappears at the system level. We infer from this that leptokurtosis at the subsystem level is almost always a consequence of the four simple observations that we argue must be true of any budgeting process. We also infer that the four observations cannot account for the much larger l-kurtosis scores typically observed in empirical distributions. Hence, the four simple observations can account for why leptokurtosis is omnipresent, but they cannot account for the magnitude of leptokurtosis.

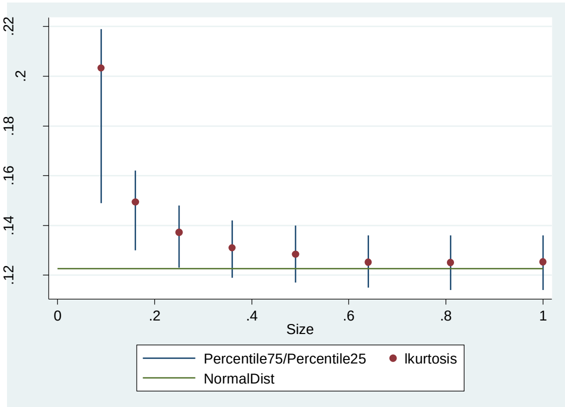

Figure 4: L-kurtosis scores for different subsets. 960 simulations with varying parameters.

This is consistent with the empirical findings that leptokurtosis is an fact systematically related to factors such as different features of policy areas, characteristics of information processing, differences in decision costs, and variations in the institutional setting (Jones & Baumgartner, 2005a; 2005b; Breunig, 2007; Jones, Sulkin and Larsen, 2003; Breunig and Koski, 2006). All of these factors are held constant in this simulation. What are not held constant are the parameters. The analyses are based on 960 simulations with different configuration of parameters.

4 CONCLUSIONS

We know quite a lot on how public budgets change. They tend, most of the time, to be remarkably stable. This is the classical instrumentalist insight. However, an equally important part of budgeting is that, once in a while, very large changes occur. Changes in budgets follow a leptokurtic distribution.

This seems to be an omnipresent phenomenon. In this paper we conjecture that leptokurtosis is a very fundamental feature of public budgeting. We argue that four simple observations, that should be true of any budgeting process, are enough to account for leptokurtosis. We investigate the implications of the four observations by designing a simple simulation of a budgeting game between beggars and philanthropists adhering to the observations. It turns out that the four observations do in fact imply leptokurtosis at the subsystem level. However, the observations and the simulation do not predict as large l-kurtosis scores as is typically found in empirical distributions of changes in budgets. Ockham's razor seems, in this case, to be too blunt an instrument. This leads us to conclude that leptokurtosis is in fact a very fundamental feature of public budgeting, and that this is likely to be part of the explanation of why leptokurtosis is omnipresent. However, it is only part of the explanation. To understand differences in leptokurtosis and the magnitude of leptokurtosis, other explanations are necessary. Fortunately, these explanations are available in the empirically based literature on policy punctuations and budgeting.

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