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Government Form and Public Spending: Theory and Evidence from U.S. Municipalities*

Abstract

There are two main forms of government in U.S. cities: council-manager and mayor-council. This paper studies the effect of government form on public spending. It develops a theoretical model of spending decisions under the two forms of government. This model predicts that expected public spending will be lower under mayor-council. Support for this prediction is found in both a cross-sectional analysis and a panel analysis of changes in government form. The implications of the theory for the choice of government form are also developed.

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1 Introduction

There are two main forms of government in U.S. cities: council-manager and mayor-council. Under the mayor-council form, a mayor and city council are independently elected by voters and jointly develop policy. Under the council-manager form, policy-making power resides with the city council. The council appoints a manager to assist in the administration of city government functions, but this manager has no authority over policy development and can be replaced at any time by a vote of the council. While some council-manager cities retain the position of mayor, the role is largely ceremonial.

This paper explores how these two forms of government influence public spending. It begins by developing a simple theory of spending decisions under the two forms. This theory considers a city government charged with choosing among a set of potential projects or programs that could be undertaken. The key difference between the two forms is that the passage of projects under mayor-council requires the support of both the mayor and a majority of council-members, whereas under council-manager it requires the support of only the council. This difference, when combined with uncertainty in the policy preferences of candidates for city office, implies that expected spending levels will be lower under the mayor-council form. This result remains generally true even when sophisticated voters select candidates accounting for the different biases of the two systems.

The paper then tests this prediction of lower government spending under mayor-council form. It constructs a dataset that includes form of government and fiscal policy outcomes based on a large sample of cities covering the years 1982, 1987, 1992, 1997, and 2002. A cross-sectional analysis reveals that spending is significantly lower in mayor-council cities. A panel analysis of cities that changed their form of government, also shows that spending falls (rises) following switches to mayor-council (council-manager), relative to jurisdictions not changing their form of government. The theoretical prediction is therefore supported. The quantitative magnitudes are large: per-capita spending is 10 percent lower in mayor-council cities. This implies that if all cities in the U.S. switched to a mayor-council form, municipal spending as a fraction of GDP would decrease by 0.17 percent.

Finally, the paper examines the positive implications of the theory for the choice of government form. Which system will a majority of citizens prefer? Even though mayor-council leads to lower spending, it is not necessarily majority preferred. While mayor-council may eliminate some projects which the majority oppose, it may also remove projects which the majority support. Citizens choice of government form will appropriately balance these benefits and costs. In this way, the theory can explain the coexistence of both government forms in U.S. cities.

The paper proceeds as follows. Section 2 reviews the related literature. Section 3 outlines a theory of spending decisions under the two forms of government. Section 4 examines the empirical relationship between government form and public finances. Section 5 develops the normative implications of the theory for the choice of government form and Section 6 concludes.

2 Related literature

This paper is by no means the first to ask how fiscal policy differs in cities with council-manager and mayor-council governments. There is a literature on the topic dating back to the 1960s. The results of this literature have been mixed, with some studies finding that spending is higher under mayor-council form, some finding that spending is lower, and others concluding that there is no difference.

In one of the first studies to examine the issue, Sherbenou (1961) finds that council-manager cities in the Chicago suburbs have higher per capita spending than mayor-council cities. However, he also documents that cities with higher median home prices are more likely to be council-manager cities, raising the possibility that his finding just reflects a positive income effect. Lineberry and Fowler (1967) relate government form to public spending and taxes in a sample of 175 cities during 1960. They find that aggregate spending as a fraction of aggregate city income, which could be considered a proxy for the tax base, is higher in mayor-council cities (5.8 percent) than in council-manager cities (4.5 percent). Standard errors for these calculations are not provided, and thus the statistical significance of this difference cannot be gauged. Booms (1966) finds similar results in a sample of 73 cities from Ohio and Michigan in the early 1960s; in particular, mayor-council cities spend $16 less on a per-capita basis. While this result is statistically significant at conventional levels, the author does not provide sample averages for spending, and thus the economic significance of this result is difficult to assess. Clark (1968), which is based upon a sample of 51 communities, finds that spending is lower in cities with mayor-council form, and this result is statistically significant at conventional levels.

On the other hand, three later studies conclude that fiscal policy outcomes do not depend upon government form. Morgan and Pelissero (1980) examine 11 cities that changed their form of government between 1948 and 1973. After controlling for trends in spending during this period, they find that spending increases following a switch to council-manager form. This result, however, is statistically insignificant, and the authors also find that spending increased in a similar manner among a sample of matched control cities that did not change their government form.[1] Deno and Mehay (1987) estimate spending regressions derived from a median voter model using a nationwide sample of 191 cities in 1982. They also find that form of government has no impact. Hayes and Chang (1990) employ the same sample to test for the relative efficiency of government forms. Using frontier estimation, they find no efficiency differences between council-manager and mayor-council forms.

Taken together, these studies offer no clear picture of the empirical effects of government form on public spending. Reconciling their results is difficult since they examine different cities and time periods and use different sources of variation in spending and government form. Collectively, they also suffer from relatively small sample sizes, often lack tests for statistical significance, and, with the exception of Morgan and Pelissero (1980), rely on purely cross-sectional variation in government form.

The literature also lacks convincing theoretical arguments for why fiscal policy outcomes should differ across government forms. Early papers suggested that council-manager cities might have lower costs because managers were professionals with training in public administration. This neglects the fact that mayor-council cities are also perfectly capable of hiring administrators with such training. Another argument was that city managers were more detached from the political process and therefore would be more able to hold down costs.[2] However, as Deno and Mehay (1987) point out, council-members face political pressures and, since the manager is responsible to the council, these pressures should be effectively conveyed to the manager. Indeed, perhaps the most persuasive argument in the literature is that, in either form, the pressures of political competition should ensure that spending is in line with the level demanded by the median voter (Deno and Mehay (1987)).

[1] In particular, spending increased by $6 per-capita in treatment cities and $10 per-capita in the matched control cities. While this suggests that the switch to council-manager form reduced spending by $4 per-capita, the authors do not test for the statistical significance of this difference in coefficients.

[2] A number of papers have explored the effect of government form on municipal wage levels with mixed results. See, for example, Edwards and Edwards (1982), Ehrenberg (1973), and Ehrenberg and Goldstein (1975).

This paper advances the literature by starting with an explicit theory of spending decisions under the two government forms. The model departs from the median voter paradigm by incorporating realistic imperfections in the political process and delivers a clear prediction about the difference in size of government under the two forms. In addition, the empirical analysis uses a large, nationally-representative sample of cities and tracks fiscal policy outcomes and government form in these cities over two decades. This permits a within-city comparison of fiscal policy outcomes before and after changes in government form and thus better controls for city-level unobserved characteristics.

The paper also relates to a broader political science literature on presidential versus parliamentary forms of government at the national level (for an overview see Carey (2004)). Under the presidential form, the legislature and executive are independently elected, while under the parliamentary form, the executive is typically a member of the governing coalition in the legislature and is not independently elected by voters. At the local level, the mayor-council form is analogous to the presidential form, while the council-manager form is closer to the parliamentary form.

The bulk of the presidential versus parliamentary literature focuses on party-related issues such as the formation of governing coalitions, votes of confidence, etc. These are less relevant in the municipal context, where many elections are non-partisan (i.e., candidate party affiliations do not appear on the ballot) and where many cities are dominated by a single party. More relevant for this paper is the recent theoretical work that seeks to understand how fiscal policy differs under the two forms and which is better for citizen welfare. Persson, Roland and Tabellini (2000) examine these issues in the context of an infinite-horizon political agency model.[3] The government raises taxes in order to finance public goods, district-specific transfers, and political rents. Politicians are venal and care only about the consumption of political rents. Citizens are divided into districts and each district controls (imperfectly) its own legislator via the promise of re-election. In the basic model, which is intended to capture the behavior of a simple legislature, one legislator is selected to propose a policy, which is implemented if approved by a majority of the legislature. In the separation of powers model, intended to capture a presidential system, one legislator is selected to propose a level of taxes and another the composition of spending. The main result is that separation of powers leads to lower taxes, lower transfers, and lower political rents. Public good provision is weakly lower and citizen welfare is higher. Thus, separation of powers leads to

[3] Their work builds on Persson, Roland and Tabellini (1997).

smaller government.

While this paper's conclusion is similar to Persson, Roland and Tabellini's result, the underlying mechanism is very different. Our theoretical model is static and assumes that politicians have policy preferences that are not perfectly observed by voters. While voters have some influence over the policy preferences of their representatives through up-front elections, they have no influence on politician behavior through re-election incentives. The difficulty faced by voters is electing politicians whose policy preferences diverge from their own, rather than controlling politicians bent on expropriating political rents. In common with Persson, Roland and Tabellini, however, it is important that budgetary decisions require the consent of both the council and the mayor. Thus, so-called "checks and balances" are key to the argument. In essence, both arguments assume that the budgetary process incorporates checks and balances, but offer different accounts of the mechanism by which these lead to lower spending.

On the empirical front, Persson and Tabellini (2003) investigate how fiscal policies differ across countries with presidential and parliamentary forms of government. They find that the size of government is significantly smaller in nations with presidential forms. Their cross-sectional estimates suggest a large reduction of about 5% of GDP. Interestingly, these results are robust to instrumental variables methods, matching, and Heckman selection corrections. Given the stability of national constitutions, however, the authors cannot compare spending levels in specific countries before and after changes in form of government. One advantage of this study over their work is that one of our specifications identifies the effect of government form from cities that actually switched their form. While such switches are relatively rare, they occur sufficiently frequently in our large sample of cities to permit a statistical analysis. This helps to address a common criticism of Persson and Tabellini's results involving the endogeneity of political institutions (see, for example, Acemoglu (2005)).

More generally, this paper contributes to the growing literature that seeks to understand, theoretically and empirically, the impact of different political institutions on policy choices and citizen welfare. At the cross-national level, this literature includes efforts to understand the relative merits of different electoral systems (e.g., Lizzeri and Persico (2001), Milesi-Feretti, Perotti, and Rostagno (2002), and Myerson (1999)) and government structures (e.g., Oates (1972), Lockwood (2002), and Inman and Rubenfeld (1997)). At the local level, it includes analyses of the effects of the size of city councils on spending (Baqir (2002)), the desirability of citizens' initiatives (e.g., Matsusaka (2004) and Matsusaka and McCarty (2001)), term limits (e.g., Besley and Case (1995), Dick and Lott (1993), and Smart and Sturm (2006)), and campaign contribution limits (e.g., Ashworth (2006), Coate (2004), and Stratmann and Aparicio-Castillo (2006)). Reviews of this literature are provided by Persson and Tabellini (2003) who cover the cross-national work, and Besley and Case (2003) who cover the local material.

3 Theory

This section presents a theory of spending decisions under the two forms of city government. It first outlines the model and derives the results. It then identifies and defends the core assumptions driving the results.

3.1 The model

The job of the city government is to choose the projects or programs the city should undertake. There are p potential projects indexed by $i = 1, ..., p$. Each project i is characterized by a per capita tax cost C_i and an average per capita benefit B_i. Citizens differ in the extent to which they value public programs. There are three preference types: high valuers, moderate valuers, and low valuers, indexed by $k \in \{h, m, l\}$ respectively. If project i is undertaken a type k citizen receives a payoff of $\theta_k B_i - C_i$, where $\theta_h > \theta_m > \theta_l$. The fraction of citizens of type k is denoted μ_k.[4] Both μ_h and μ_l are less than 1/2 which implies that the median voter is a moderate valuer.

There are two different forms of city government: *council-manager* and *mayor-council*. In the council-manager form, project decisions are taken by an n seat city council. The council votes whether to adopt each project, with $q < n$ positive votes necessary for adoption. In the mayor-council form, project decisions are made by an $n - 1$ seat city council and a mayor. For a project to be undertaken, it must have $q - 1$ affirmative votes in the council and the mayor's approval. Notice that in both forms the number of politicians is constant at n and the minimum number of votes needed for a project to be approved is q. All that differs across the forms is that, under mayor-council, the politician who is the mayor has additional voting power.[5]

[4] The assumption that B_i is the *average* per capita benefit of project i implies that $\mu_l\theta_l + \mu_m\theta_m + \mu_c\theta_c = 1$.

[5] Our objective is to hold everything constant but the allocation of decision-making authority. Thus, we are implicitly holding the size of the city administration constant as well. In our conception, when a city switches from council-manager to mayor-council, the administrator who is the manager in the council-manager form becomes the mayor's chief administrator in the mayor-council form. An alternative approach would be to compare an n member council and an n member council with a mayor, under the assumption that the mayor undertakes the

Under both government forms, politicians are selected by the voters in elections. Politicians are citizens and thus will also be either high valuers, moderate valuers, or low valuers. Following the citizen-candidate approach, these preferences will govern their decision-making when in office. At the time of the elections, citizens cannot observe how much candidates value public programs. They do, however, observe a signal of each candidate's preferences $j \in \{\alpha, \beta\}$.[6] The probability that a candidate who emits signal $j \in \{\alpha, \beta\}$ has ex post preference type $k \in \{h, m, l\}$ is π_k^j. We assume that $\pi_l^\alpha = \pi_h^\beta = \underline{\pi}$ and that $\pi_h^\alpha = \pi_l^\beta = \overline{\pi}$ where $\underline{\pi}$ and $\overline{\pi}$ are positive numbers such that $\underline{\pi} < \overline{\pi} < 1 - \underline{\pi}$. Thus, *type α candidates* (i.e., those emitting signal α) are more likely to be high valuers and type β candidates are more likely to be low valuers. Moreover, the likelihood that a type α candidate is a high valuer equals the likelihood that a type β candidate is a low valuer and visa versa. For each seat in the council and mayor's office, there are two candidates, one with each type of signal. This electoral process is consistent with either district-based elections, in which council members represent geographic constituencies, or at-large elections, in which all council-members represent the entire city.[7]

When in office, a politician of preference type $k \in \{h, m, l\}$ will favor introducing project i if its benefit/cost ratio B_i/C_i exceeds $1/\theta_k$. Relabelling as necessary, we may assume that projects with lower index numbers have higher benefit/cost ratios; that is, $B_1/C_1 > B_2/C_2$, etc. In reality, there will be some programs that all three types of politicians will want to be introduced and some programs that no type will support. Since there is no point in including these projects in the analysis, we assume that $B_1/C_1 \in (1/\theta_m, 1/\theta_l)$ and $B_n/C_n \in (1/\theta_h, 1/\theta_m)$. This implies that high valuers would like to implement all the projects, low valuers would like to implement none of them, and moderate valuers would like to implement a subset. Let g denote the index of the

manager's adminstrative work. In this conception, when a city switches to mayor-council, the number of politicians is increased by one at the same time the number of adminstrators is reduced by one, so that the total number of city officials (politicians plus adminstrators) remains constant. It is unclear which of these two conceptions is the most empirically relevant. In our data, the average council size in mayor-council cities is 0.44 persons smaller than in council-manager cities, suggesting that some but not all mayor-council cities have smaller councils. When cities switch from council-manager to mayor-council, they tend to keep the council the same size and add a mayor. However, when they switch from mayor-council to council-manager, they tend to increase the council by one seat. Fortunately for our purposes, the general conclusions concerning expected spending levels are similar under either conception. The details are available from the authors upon request.

[6] This signal can be thought of as emerging during the campaign as a result of media coverage of candidates backgrounds, televised debates, campaign advertising, newspaper endorsements, etc.

[7] In our data, 65 percent of cities have at-large council elections, 15 percent have district-based council elections, and the remaining 20 percent have some district-based and some at-large seats. The procedure for at-large elections varies across municipalities, with some municipalities having council-members with staggered terms and others offering voters the chance to elect an entire slate of council-members at once. For an interesting analysis of the choice between at-large and district-based elections see Aghion, Alesina and Trebbi (2008).

marginal project for moderate valuers; that is, $g = \max\{i : B_i/C_i \geq 1/\theta_m\}$. Under either form of government, there are three possible policy outcomes: i) all the projects are funded; ii) projects 1 through g are funded; and iii) no projects are funded. These outcomes will depend upon the types of politicians who hold office but in a way that differs across the form of government.

3.2 Analysis

Under council-manager, projects 1 through g will be approved if and only if at least q of the n elected council-members are either high or moderate valuers and projects $g+1$ through p are undertaken if and only if at least q of the n elected council-members are high valuers. Let $\Pr(\#\frac{h+m}{n} \geq \frac{q}{n}\big| x)$ denote the probability that at least q of n elected council-members are high or moderate valuers when x members are type β candidates and $n-x$ are type α. Similarly, let $\Pr(\#\frac{h}{n} \geq \frac{q}{n}\big| x)$ denote the probability that at least q of n elected council-members are high valuers when x members are type β. Then, expected spending level under council-manager when x council-members are type β is given by

$$S_C(x) = \Pr(\#\frac{h+m}{n} \geq \frac{q}{n}\Big| x) \sum_{i=1}^{g} C_i + \Pr(\#\frac{h}{n} \geq \frac{q}{n}\Big| x) \sum_{i=g+1}^{p} C_i. \tag{1}$$

Under mayor-council, projects 1 through g will be approved if and only if at least $q-1$ of the $n-1$ council-members are either high or moderate valuers *and* the mayor is a high or moderate valuer. Similarly, projects $g+1$ through p will be funded if and only if at least $q-1$ of the $n-1$ elected council-members are high valuers *and* the mayor is a high valuer. Thus, the expected spending level under mayor-council when x council-members are type β and the mayor is type j is

$$S_M(x,j) = (1-\pi_l^j)\Pr(\#\frac{h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) \sum_{i=1}^{g} C_i + \pi_h^j \Pr(\#\frac{h}{n-1} \geq \frac{q-1}{n-1}\Big| x) \sum_{i=g+1}^{p} C_i. \tag{2}$$

The characteristics of elected officials and the resulting public spending levels will depend on how sophisticated citizens are in their voting behavior. A common assumption in the literature on legislative elections is that citizens vote "sincerely" for the candidate whose favored policies they most prefer.[8] Under this assumption, high valuers will vote for the type α candidate in

[8] In elections for a single office holder (e.g., president or mayor) sincere voting is equivalent to voting for the candidate whose election would produce the highest expected policy payoff. This is not the case in legislative

each race and low valuers for the type β candidate. Moderate valuers will vote for the type α candidate if the gain in surplus they get from projects 1 through g exceeds the loss of surplus they experience from projects $g+1$ through p. If citizens vote in this way, in each race, the candidate type preferred by moderate valuers will win and thus all the elected politicians will either be type α or type β. Thus, *either* $x = 0$ under council-manager and $(x, j) = (0, \alpha)$ under mayor-council, *or* $x = n$ under council-manager and $(x, j) = (n-1, \beta)$ under mayor-council. Importantly, citizens choice of candidates will be the same under both government forms. It is then easy to establish:

Proposition 1: *If voters vote sincerely, expected spending is lower under a mayor-council form of government than a council-manager form.*

Proof: We consider only the case in which moderates prefer type α candidates, so that $x = 0$ under council-manager and $(x, j) = (0, \alpha)$ under mayor-council. The argument for the case in which moderates prefer type β candidates is similar. Using (1) and (2), we can write the difference between expected spending under the two forms as:

$$\begin{aligned} S_C(0) - S_M(0,\alpha) = {} & [\Pr(\#\tfrac{h+m}{n} \geq \tfrac{q}{n} \big| 0) - (1-\pi_l^\alpha)\Pr(\#\tfrac{h+m}{n-1} \geq \tfrac{q-1}{n-1} \Big| 0)] \sum_{i=1}^{g} C_i \\ & + [\Pr(\#\tfrac{h}{n} \geq \tfrac{q}{n} \big| 0) - \pi_h^\alpha \Pr(\#\tfrac{h}{n-1} \geq \tfrac{q-1}{n-1} \Big| 0)] \sum_{i=g+1}^{p} C_i. \end{aligned} \tag{3}$$

Now observe that

$$\Pr(\#\frac{h+m}{n} \geq \frac{q}{n} \Big| 0) = (1-\pi_l^\alpha)\Pr(\#\frac{h+m}{n-1} \geq \frac{q-1}{n-1} \Big| 0) + \pi_l^\alpha \Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1} \Big| 0), \tag{4}$$

and that

$$\Pr(\#\frac{h}{n} \geq \frac{q}{n} \Big| 0) = \pi_h^\alpha \Pr(\#\frac{h}{n-1} \geq \frac{q-1}{n-1} \Big| 0) + (1-\pi_h^\alpha)\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1} \Big| 0). \tag{5}$$

Substituting (4) and (5) into (3), we obtain

$$S_C(0) - S_M(0,\alpha) = \pi_l^\alpha \Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1} \Big| 0) \sum_{i=1}^{g} C_i + (1-\pi_h^\alpha)\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1} \Big| 0) \sum_{i=g+1}^{p} C_i.$$

Both terms in this expression are positive since, by assumption, $\pi_k^\alpha > 0$ for all k. ■

elections. This leads to a distinction between sincere and "sophisticated voting" which anticipates how different slates of candidates will interact to generate policy. Both concepts are distinct from "strategic voting" whereby voters vote to maximize expected utility and thus take into account their potential pivotality. On the question of whether voters do in fact vote sincerely or in a sophisticated manner in legislative elections see inter alia Degan and Merlo (2008), Fiorina (1996), and Lacy and Paolino (1998).

To understand the result, recall that projects 1 through g will be implemented under council-manager if at least q of the n elected politicians are high or moderate valuers. Under mayor-council, this condition is necessary but not sufficient. If it is satisfied but the mayor happens to be a low valuer, projects 1 through g will not be implemented. Similarly, projects $g+1$ through p will be implemented under council-manager, if at least q of the n elected politicians are high valuers. Under mayor-council, this condition is necessary but not sufficient. If it is satisfied but the mayor is a low or moderate valuer, projects $g+1$ through p will not be implemented. The result then follows from the fact that under mayor-council, the probability that at least q of the n elected politicians are high or moderate valuers is exactly the same as under council-manager because voters elect the same type of candidates under the two systems.

The sincere voting underlying Proposition 1 is naive, because it does not take into account the political process determining spending levels. Sophisticated voters will anticipate the policy outcomes associated with each possible mix of candidate types and choose candidates accordingly. While high valuers will still prefer type α candidates and low valuers type β candidates, moderate valuers will sometimes prefer a mix of the two types to appropriately balance the council. Moreover, the precise mix they prefer will depend upon the form of government. The expected spending result of Proposition 1 might then be invalidated if voters select more type α candidates under mayor-council.

Given this, it is important to think through the implications of sophisticated voting. Before doing so, however, note that moderate valuers must coordinate on which candidates to support. For example, if there are three seats and the optimal number of type β candidates is two, moderates must decide in which two races they will back type β candidates. If moderates failed to anticipate correctly how other moderates were voting and one group backs the type β candidate in races 1 and 2, and another group backs the type β candidate in races 2 and 3 then they might end up with anywhere from one to three β candidates elected. The analysis that follows abstracts from this problem by assuming that moderate voters know (or correctly anticipate) who other moderates are voting for and so elect the optimal number of each type of politician.

Let G denote the surplus moderate valuers gain from projects 1 through g, and L be the surplus they lose from projects $g+1$ through p.[9] Under council-manager, a moderate valuer's

[9] That is, $G = \sum_{i=1}^{g}(\theta_m B_i - C_i)$ and $L = \sum_{i=g+1}^{p}(C_i - \theta_m B_i)$.

payoff with x type β council-members can be written as

$$U_C(x) = \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x)G - \Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x)L. \tag{6}$$

It follows that with sophisticated voting, moderates will choose x_C type β council-members, where

$$x_C = \arg\max\{U_C(x) : x \in \{0, 1, ..., n\}\}. \tag{7}$$

Under mayor-council, a moderate voter's payoff function with x type β council-members and a type j mayor is

$$U_M(x,j) = (1-\pi_l^j)\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x)G - \pi_h^j \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x)L. \tag{8}$$

Moderates will therefore choose x_M type β's in the council and a type j_M mayor, where

$$(x_M, j_M) = \arg\max\{U_M(x,j) : (x,j) \in \{0, 1, ..., n-1\} \times \{\alpha, \beta\}\}. \tag{9}$$

The task is now to compare spending levels under the two systems when voters select candidates optimally. In particular, we wish to understand whether Proposition 1 generalizes. Before presenting our findings, we briefly explain the logic of the moderates' choice. Consider first the problem of moderate voters under council-manager. The benefit of selecting an additional type β council-member is that, by making the council less likely to be dominated by high valuers, it reduces the probability of the loss L. The cost is that, by making the council more likely to be dominated by low valuers, it also reduces the probability of the gain G. From (6), we see that starting with x type β council-members, the benefit will exceed the cost (i.e., $U_C(x+1) > U_C(x)$) as long as

$$\frac{\Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x+1)}{\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x+1)} > \frac{G}{L}. \tag{10}$$

On the left hand side of this inequality, the numerator is the reduction in the probability that at least q of the n council-members are high valuers created by going from x to $x+1$ type β politicians. The denominator is the reduction in the probability that at least q of the n council-members are high or moderate valuers. Moderates will keep on raising the number of type β council-members as long as this inequality holds. Condition (10) can therefore be used to characterize x_C.

The problem of voters under mayor-council is more complicated because it involves the simultaneous selection of a mayor and a council. Nonetheless, for a given selection of the mayor's type, the problem of selecting the optimal number of council-members is similar to that under council-manager. From (8), we see that starting with x type β council-members and a type j mayor, it will be optimal to add an additional type β council-member (i.e., $U_M(x+1,j) > U_M(x,j)$) as long as

$$\frac{\pi_h^j[\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x+1)]}{(1-\pi_l^j)[\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x+1)]} > \frac{G}{L}. \tag{11}$$

Condition (11) can therefore be used to characterize x_M taking as given j_M. The incentives to vote in type β council-members across the two systems can be contrasted by comparing the left hand sides of (10) and (11).

We now present:

Proposition 2: *If voters vote in a sophisticated manner and if*

$$\frac{G}{L} \notin \left(\frac{\sum_{s=q-1}^{n-1} \binom{n-1}{s} \underline{\pi}^s (1-\underline{\pi})^{n-1-s}}{\sum_{s=q-1}^{n-1} \binom{n-1}{s} (1-\overline{\pi})^s \overline{\pi}^{n-1-s}}, \frac{\underline{\pi}^{q-1}(1-\underline{\pi})^{n-q}}{(1-\overline{\pi})^{q-1}\overline{\pi}^{n-q}} \right), \tag{12}$$

then expected spending is lower under a mayor-council form of government than a council-manager form.

Proof: See Appendix.

Proposition 2 provides a sufficient condition for the expected spending result to hold with sophisticated voting. The condition requires that the ratio G/L lies outside an interval determined by n, q, and the parameters $(\underline{\pi}, \overline{\pi})$. This turns out to be a very mild requirement. To see this, consider the case of $n = 3$ and $q = 2$. The condition in this case amounts to $\frac{G}{L} \notin \left(\frac{\underline{\pi}(2-\underline{\pi})}{1-\overline{\pi}^2}, \frac{\underline{\pi}(1-\underline{\pi})}{\overline{\pi}(1-\overline{\pi})} \right)$. Note first that, if $G > L$, then the condition will necessarily be satisfied since, by assumption, $\underline{\pi} < \overline{\pi}$ and $\underline{\pi} < 1 - \overline{\pi}$. If $G < L$, on the other hand, then there exist feasible combinations of $\underline{\pi}$ and $\overline{\pi}$ for which the condition will not be satisfied. Figure 1 depicts these feasible sets for G/L equal to 0.25, 0.50, and 0.75. Evidently, when compared with the set of all $\underline{\pi}$ and $\overline{\pi}$ satisfying the assumptions $\underline{\pi} < \overline{\pi}$ and $\underline{\pi} < 1 - \overline{\pi}$, these sets represent a small part of the parameter space. Moreover, for larger values of n, the set of parameter values violating the condition is even smaller.[10] Thus, Proposition 2 can be interpreted as implying that the expected spending result

[10] The most common council sizes in our dataset are 5 members and 7 members.

of Proposition 1 will typically hold even when voters vote in a sophisticated manner.

The proof of Proposition 2 consists of five distinct steps.

1. Establish that both the probabilities of approving projects 1 through g and projects $g+1$ through p are lower under mayor-council whenever the *total* number of type β politicians elected under mayor-council (i.e., including both council-members and the mayor) is greater than or equal to that elected under council-manager.

2. Show that if a type α mayor is optimal under mayor-council (i.e., $j_M = \alpha$), then the optimal number of type β council-members under mayor-council is the same as under council-manager (i.e., $x_M = x_C$) except in one case. This is when the entire council is type β under council-manager (i.e., $x_C = n$), in which case the entire council is also type β under mayor-council (i.e., $x_M = n-1$).

3. Show that if a type β mayor is optimal under mayor-council (i.e., $j_M = \beta$), then the optimal number of type β council-members under mayor-council is one less than under council-manager (i.e., $x_M = x_C - 1$) except in one case. This is when the entire council is type α under council-manager (i.e., $x_C = 0$), in which case the entire council is also type α under mayor-council (i.e., $x_M = 0$).

4. Combine the second and third steps to conclude that the only circumstance in which the total number of type β politicians under mayor-council is less than that under council-manager is when $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$.

5. Establish that a necessary and sufficient condition for $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$ is that G/L belong to the interval described in (12).

The most difficult part of the proof is establishing the second and third steps. Here the marginal conditions (10) and (11) are key. The second step is completed by showing that, with a type α mayor, the left hand side of (10) is exactly equal to (11) for all $x \in \{0, ..., n-2\}$.[11] Thus, the marginal incentives to add additional type β council-members are the same across the two forms with a type α mayor. The third step is established by showing that, with a type β mayor, the left hand side of (10) evaluated at $x - 1$ is exactly equal to (11) evaluated at

[11] The symmetry assumption that the likelihood that a type α is a liberal equals the likelihood that a type β is conservative and visa versa is key for this step.

$x \in \{0, ..., n-2\}$. Thus, the marginal incentives to add additional type β council-members are stronger under council-manager with a type β mayor, but are linked across the two forms in an easy way.

Proposition 2 naturally raises the question of whether the expected spending result will fail when (12) is not satisfied. The answer is not necessarily, but possibly. The Appendix develops an example with $n = 3$ and $q = 2$ in which the parameters $(G/L, \underline{\pi}, \overline{\pi})$ violate (12) and the probability of approving projects 1 through g and projects $g + 1$ through p is higher under mayor-council. Obviously, this implies that the expected spending level will be higher under mayor-council.

3.3 Discussion

Proposition 1 tells us that expected spending will be lower with a mayor-council form of government than with council-manager, under the following four assumptions.

- Candidates for public office have heterogeneous preferences over public programs which, while governing their behavior if elected, are not perfectly observed by voters.
- Voters vote sincerely, so that their choices between candidates with different expected policy preferences are the same under the two forms of government.
- Under council-manager, programs are approved if and only if they receive support from the required majority of the council.
- Under mayor-council, programs are approved if and only if they receive support from the required majority of the council *and* the mayor.

The first assumption implies that the policy preferences of elected politicians will be ex ante uncertain and the second implies that the nature of this uncertainty will be the same under either form of government. The third assumption implies that, under council-manager, if more than q elected politicians turn out to be high valuers then more programs will be funded than the median voter would like. On the other hand, if more than q turn out to be low valuers, less programs will be funded. The fourth assumption means that, under mayor-council, if more than q elected politicians (council-members and mayor) turn out to be high valuers excess programs will not necessarily be funded. This is because such programs will be blocked by the mayor if he is not a high valuer. However, if more than q turn out to be low valuers, it will continue to be the case that insufficient programs will be funded. This is because, even if the mayor is not a low valuer, the council will block projects.

Proposition 2 tells us that the second assumption (i.e., sincere voting) is not a necessary condition for the spending conclusion. It suggests that the spending result will typically continue to hold if voters vote in a more sophisticated way which anticipates the policy outcomes associated with any given slate of elected candidates. In principle, sophisticated voting could undermine the spending result if voters select candidates who are more likely to be low valuers under council-manager. However, the analysis suggests that this will not be the case. When given a choice between two types of candidates, sophisticated voters typically choose to elect the same number of each type of politician under the two forms. This reflects the fact that the marginal incentives created by the two systems to elect candidates who are more likely to be low valuers are similar. Admittedly, the model is restrictive in assuming that voters have only two types of candidates from which to choose. Moreover, it is clear that introducing multiple types of candidates would make the model very intractable. Nonetheless, Proposition 2 does provide some reassurance that the spending result is at least somewhat robust to relaxing the sincere voting assumption.

The remaining three assumptions, however, are necessary for the spending result and thus it is important to discuss how reasonable they are. The first assumption is necessary because it implies that elected politicians can disagree. If all politicians had the same preferences ex post, then the two forms of government would deliver exactly the same project choices. This assumption seems uncontroversial. Politicians, as citizens, clearly will have preferences over programs and these preferences will influence their choices when elected.[12] Moreover, voters will not perfectly know what these preferences are when they elect them. Voters often appear surprised by the revealed preferences of national leaders, let alone city politicians.

The third assumption also seems reasonable. Under council-manager, the preferences of the majority of the council seem likely to determine policy choices. It is true that the manager, with the cooperation of city administrators, typically prepares the budget for the council in council-manager cities. But the manager is appointed by the council and so will probably share the policy

[12] One possible criticism is that this ignores the role re-election incentives in disciplining politicians from following their policy preferences. While we agree that such incentives may partially constrain politicians, we do not think that they make their preferences irrelevant. Indeed, there is much empirical evidence to this effect (see, for example, Levitt (1996)). Re-election incentives work imperfectly because of discounting, last period problems, and the general difficulty voters have in assigning responsibility when policy decisions are determined collectively. We note here, however, that the relative effectiveness of re-election incentives under the two government forms in our model is an excellent topic for futher study.

preferences of the majority. Moreover, if he does not and indulges his preferences by omitting programs that are demanded by the majority or adding programs that do not have majority support, he will likely be fired.

The fourth assumption is key for the result because it creates an asymmetry between the blocking and passing of projects. In particular, while both the council and the mayor can unilaterally block projects, the approval of both executive and legislature is necessary to pass projects. If we had assumed, for example, that a project was implemented unless it was opposed by both a majority of the council and the mayor, the asymmetry would go in the other direction and the spending result would be reversed.[13]

Our motivation for the fourth assumption comes from studying the way in which budgeting works in mayor-council cities. A crude description of the process is that the mayor, with the cooperation of city administrators, prepares a budget which provides a detailed list of the programs that are to be financed. This is sent to the city council who make amendments to the budget and approve it. While practices vary across cities, in many mayor-council governments the council can only amend the mayor's budget by removing support for programs.[14] This process will result in only programs that have the support of both the mayor and the majority of council-members being approved, which is our assumption.

In reality, of course, things are more complicated than this simple description suggests, and rules vary considerably across cities. In some cities, at the budget preparation stage, the mayor may be required to obtain input from an executive committee, which can contain key members of the council. In other cases, the council may be able to add programs to the mayor's budget. At the budget approval stage, the mayor may be able to selectively veto the council's amendments

[13] An alternative assumption would build in a status quo bias by assuming that the addition of *new* projects could be blocked by either the mayor or the council, but the removal of *existing* projects could be blocked by either the mayor or the council. In the language of Tsebelis (1995), both the mayor and council would be "veto players" in the sense of being able to block change. In this case, expected spending would display more path dependence under mayor-council, but would not necessarily be lower.

[14] Unfortunately, there is no national database of city budgetary procedures, and our research was thus limited to case studies. Examples of large cities with this budgetary procedure include Cleveland, New York, Boston, and San Francisco. We found no cities in which the council could introduce new programs to the mayor's budget. See Rubin (1983) and Mullin et al (2004) for additional details. This budgetary process is also in place in at least one country with a presidential form of government. As explained in Carey (2004), the current Chilean constitution allows Congress to amend each spending item in the president's budget downwards only and disallows the transfer of funds across different programs. Baldez and Carey (1999) provide a theoretical and empirical analysis of the impact of this constitution on policy outcomes in Chile. In their theoretical work, they use a two player (congress and president) game theoretic model with two dimensions of spending to compare outcomes under the Chilean constitution with what would happen under two alternative stylized constitutional rules.

or veto the whole package. The council may then be able to override the mayor's vetoes with a super-majority vote.[15]

Despite the rich variation in the details of the budgetary process across cities, we feel that the most plausible modelling assumption to make is that only those projects that have the support of both the mayor and the majority of council-members will be implemented.[16] The fact that the mayor prepares the budget gives him/her the agenda-setting ability to focus resources on the projects and programs that he/she supports. The fact that the council has to approve the mayor's budget gives it the ability to strike out programs from the mayor's wish list. Even when the council can, in principle, add new programs, it seems natural to see its ability to do so as somewhat constrained. This reflects three realities. First, council-members will typically have little time to devote to crafting their own budgetary programs. Not only will the council have a limited time period in which to respond to the mayor's budget, but also council-members tend to be part time. Second, council-members will also have much less information than the executive about the costs of different budgetary options. Finally, mayors often have powers of impoundment, in which they can unilaterally withhold funds for projects that have been approved in the budget. While these powers are designed to be used only in emergency situations, such as midyear budget shortfalls, they have sometimes been used in order to block projects supported by the council but not the mayor.[17]

4 Evidence

This section tests the theoretical prediction of lower public spending under mayor-council. It begins by describing the data and then turns to the econometric analysis of the relationship between government form and public finances.

[15] While the use of such selective vetos does not seem to be important in practice, if it were then that our model would still be a valid description of policy outcomes under mayor-council. The $q-1$ would just change from a majority to a super-majority. However, the comparison between council-manager would change because the q used would be majoritarian. It seems likely that such a change would make it harder to approve projects under mayor-council and hence strengthen the result.

[16] The diversity of rules among municipalities make attempting to write down a detailed non-cooperative game theoretic model of the budgetary process under the two forms of government appear rather futile.

[17] For example, Mayor Guliani attempted to block spending on council priorities during a 1994 budget shortfall in New York City (New York Times, December 2, 1994).

4.1 Data

Our data on government spending are derived from the Census of Governments from fiscal years 1982, 1987, 1992, 1997, and 2002. Our measure of public spending is general expenditure per-capita, which excludes government spending on utilities, liquor stores, and insurance trusts. In order to make the measures comparable across time, we convert all spending to 2002 dollars by using the CPI deflator.

These data on fiscal outcomes are matched to data on political institutions from the Municipal Form of Government survey, which is conducted by the International City/County Management Association (ICMA) every five years. In particular, we have data from survey years 1981, 1986, 1991, 1996, and 2001. We assume that the government in place during 1981 was responsible for setting the budget for fiscal year 1982, the 1986 government was responsible for the 1987 budget, etc. In each year, surveys are sent to roughly 7,000-8,000 municipalities with response rates in any given year ranging from 50 to 70 percent. This incomplete response rate makes the panel unbalanced.

For the cross-sectional analysis, we rely on the survey question regarding the city's current form of government. In addition to mayor-council and council-manager forms, a smaller number of municipalities have either a commission, town meeting, or representative town meeting form.[18] Given that over 90 percent of municipalities have either council-manager or mayor-council forms, our analysis will ignore these other forms of government.

The panel analysis uses information on changes in government form for specific cities over time. There are two possible measures of such changes in the ICMA data. One measure compares the form of government reported in the current survey to that in the previous survey. The other relies on separate survey questions in which respondents are asked whether or not their city changed its form of government in the past five years.[19] For several reasons, we choose the latter measure over the former. First, the panel is unbalanced due to an incomplete response rate, and we thus cannot compare the current form of government to the prior form of government for many observations in the data. Second, according to our contacts at ICMA, the former measure overstates the true degree of switching in government form over the past twenty years; this overstatement may be

[18] The latter two forms are found disproportionately in New England towns.

[19] If so, they are also asked to report the previous and current form of government.

due to measurement error associated with different survey respondents in different years having different interpretations of the city's form of government.[20] The latter measure, by contrast, provides a more realistic account of the recent degree of switching in government form.

Given that we are using different measures of government form in the cross-sectional and panel analyses, we delete observations in which these two measures are inconsistent with one another. In particular, for those cities included in the prior survey, we delete those observations in which the respondent reported that the city changed their form of government, say, from x to y in the previous five years, but whose form of government did not change from x in the prior survey to y in the current survey. Likewise, we also delete observations in which the form of government changed from x in the prior survey to y in the current survey but in which the respondent did not report a change in the form of government over the prior five years. For purposes of clarification, note that we cannot check for internal inconsistency if the city was not included in the prior survey, and we thus include these cities in the analysis. Also, since we cannot check the prior survey for the first year of the sample, 1982, we exclude these observations from our analysis. This process removes 4,037 observations from 1982 plus 1,090 post-1982 observations, which represents about 7 percent of the original post-1982 dataset.

After deleting these internally inconsistent observations, we use this new sample of cities for both the cross-sectional and panel analysis. Based upon this sample, Table 1 provides a breakdown of government form for the different years of our sample. As shown, the fraction of mayor-council cities in the data fell from about 47 percent in 1987 to about 39 percent in 2002. As shown in Table 2, however, switching between government form by specific cities is relatively rare, suggesting that the trend in Table 1 is largely due to changes in the composition of the sample. In particular, we have 85 city-year observations, or less than one percent of the sample, switching from mayor-council to council-manager, and only 37 city-year observations switching from council-manager to mayor-council.

As shown in Table 3, mayor-council cities in our dataset do indeed spend about 15 percent less on a per-capita basis than do council-manager cities, providing preliminary cross-sectional support for the theoretical prediction. Regarding population, mayor-council cities average about 24,000 residents and are somewhat smaller than council-manager cities, which average almost

[20] As noted in the introduction, some council-manager governments retain the position of a mayor for ceremonial purposes.

28,000 residents. As will be described below, in addition to focusing on the size of government, we also analyze the growth of government. As shown, over a 5-year period, per-capita government spending increases roughly 12 percent (at a real rate) on average; this translates into an annual increase of 2.5 percent. We detect no differences in these growth rates in the summary statistics between council-manager and mayor-council cities.

4.2 Empirical analysis

For the cross-sectional analysis, we estimate the parameters of the following regression model:

$$\ln(S_m/N_m) = \alpha_1 \ln(N_m) + \alpha_2 \mathrm{MC}_m + \alpha_s + e_m. \tag{13}$$

Here S_m represents government spending in municipality m, N_m represents municipal population, and MC_m indicates the presence of mayor-council form relative to council-manager form. We also include a series of state fixed effects (α_s) in order to capture both regional patterns in form of government as well as the responsibilities of municipal governments relative to other localities. Finally, e_m represents unobserved determinants of municipal spending. We measure the spending variable in logs in order to reduce the influence of outliers and to provide a percentage change measure of the effects of government form.

Table 4 reports the results from the cross-sectional analysis separately by year. As shown, mayor-council is associated with lower government spending per-capita and this result is statistically significant at the 99-percent level in each year. This result is of large magnitude from an economic perspective, with mayor-council being associated with a reduction in government spending of between 7 and 14 percent. Given the summary statistics in Table 3, this represents a reduction in government spending of between \$70 and \$140 per-capita on an annual basis.

The main concern with the cross-sectional evidence in Table 4 is the role of unobserved factors that might influence both fiscal policy outcomes as well as the choice of government form. For example, if, as in Sherbenou's (1961) study, cities with high per capita income also tend to adopt the council-manager form, then any positive correlation between council manager form and spending outcomes may simply reflect a positive income effect. One solution to this problem would be to control for as many demographic variables as possible. Unfortunately, standard demographic variables are collected at the city level only every 10 years (1980, 1990, and 2000) and the timing thus does not overlap well with the spending data used here, which, as noted above, were collected in 1987, 1992, 1997, and 2002. In addition, there may be important unobservable demographics at play here. We instead address this issue by conducting a panel analysis which focuses on changes in government form within cities over time. This analysis controls for all characteristics, both observed and unobserved, that are fixed over the sample period. In particular, we take first differences of the key variables in equation (13) above and estimate the following regression specification:

$$\Delta \ln(S_{mt}/N_{mt}) = \alpha_1 \Delta \ln(N_{mt}) + \alpha_2 \Delta \mathrm{MC}_{mt} + \alpha_s + \alpha_t + e_{mt}, \tag{14}$$

where t indexes time and α_t is a series of survey year dummies. As reported in the first column of Table 5, we find that switches to mayor-council (council-manager) form are associated with a reduction (increase) in spending of about 10 percent, relative to jurisdictions with no change in government form in that year. Again, these effects are statistically significant at conventional levels and are large in magnitude.

The regression model in equation (14) implicitly assumes that switches from council-manager to mayor-council ($\Delta \mathrm{MC}_{mt} = 1$) have equal and opposite effects of switches from mayor-council to council-manager ($\Delta \mathrm{MC}_{mt} = -1$), relative to jurisdictions experiencing no change in government form ($\Delta \mathrm{MC}_{mt} = 0$). We next relax this symmetry assumption by estimating the following panel-data regression model:

$$\Delta \ln(S_{mt}/N_{mt}) = \alpha_1 \Delta \ln(N_{mt}) + \alpha_3 I[\Delta \mathrm{MC}_{mt} = 1] + \alpha_4 I[\Delta \mathrm{MC}_{mt} = -1] + \alpha_s + \alpha_t + e_{mt}. \tag{15}$$

As shown in the second column of Table 5, we find that, as hypothesized, switches to mayor-council are associated with lower government spending and that switches to council-manager are associated with higher government spending. Again, both of these results should be considered relative to jurisdictions with no changes in government form in that year ($\Delta \mathrm{MC}_{mt} = 0$). Both of these coefficients are of the hypothesized sign and are statistically different from zero at the 90 percent level. Also, we can strongly reject the null hypothesis that spending changes in similar ways following switches to and from mayor-council form (i.e., that $\alpha_3 = \alpha_4$). We fail to reject, however, the symmetry assumption implicitly imposed in equation (14) (i.e., that $\alpha_3 = -\alpha_4$) at conventional significance levels.

Finally, we examine the relationship between growth in government spending and the current government form in cities. Although the theoretical model is static, we can use it to make predictions regarding the growth in spending. In particular, we would expect public spending to grow more slowly under mayor-council form if the number of potential projects increases over time. This is because more of the new projects will be blocked under mayor-council form, and thus spending will increase less than it would have under council-manager form.

To implement this test, we estimate the following regression model:

$$\Delta \ln(S_{mt}/N_{mt}) = \alpha_0 + \alpha_1 \ln(N_{mt}) + \alpha_2 \text{MC}_{mt} + \alpha_s + e_{mt}. \tag{16}$$

As shown in the third column of Table 5, the rate of growth in spending is about 1 percent lower under mayor-council form, relative to what it would have been under council-manager form, although this coefficient is not statistically significant at conventional levels. Finally, the fourth column presents results from a fixed effects regression model, which implicitly compares growth rates in public spending before and after switches in government form. As shown, these results have the expected negative sign and are statistically significant. The magnitude of this effect on spending is large as it accounts for over one-half of the average 5-year growth rate in spending.

4.3 Robustness

As a robustness check on these results regarding the relationship between government form and spending, we next examine the relationship between government form and revenues, an alternative measure of the size of government. This measure excludes revenues from utilities, liquor stores, and insurance trusts. In order to capture the revenue sources under the direct authority of the municipal government, we also exclude funds received from other governments, such as the federal and state governments.

As shown in Table 6, the cross-sectional results are similar with respect to revenues, with a statistically significant reduction of between 12 and 18 percent under mayor-council form. These effects are somewhat stronger in magnitude than the spending results, presumably reflecting the fact that own-source general revenues tend to be lower than own-source general expenditures given that municipal operations are also funded by grants from both state and federal governments. A reduction in government spending and taxes that is equivalent in dollar terms will thus lead to a larger percentage reduction in own-source revenues than in government expenditures.

Table 7 presents the panel results using the revenues measure. As shown, in the first two columns, revenues also tend to fall following switches to mayor-council and rise following switches to council-manager, relative to municipalities with no change in form of government. Finally, as shown in columns 3 and 4, revenues grow more slowly under mayor-council form, although neither of these coefficients are statistically significant at conventional levels.

As an additional robustness check, we develop an alternative measure of switching between government form. Recall that our baseline measure excludes internally inconsistent observations but includes cities that were not included in the previous survey. As an alternative, and more conservative, measure, we include only observations that are internally consistent. In particular, in addition to deleting internally inconsistent observations, as defined above, we also delete cities that were not included in the previous survey. Said differently, we only include the following two sets of cities: 1) those cities reported to have changed from, say, form x to form y in the prior five years and also reported form x in the previous survey and form y in the current survey, and 2) those cities not reporting a change in government in the prior five years and also reporting the same form of government in the current and previous survey. This sample of internally consistent observations includes 9,278 observations, relative to 13,075 in the baseline sample, and only 50 city-year observations in which a switch occurred.

As shown in Table 8, the results using only internally consistent cities are similar to the baseline results. In column 1, which implicitly assume symmetry between switches, per-capita spending falls (rises) percent following switches to mayor-council (council-manager) form. In column 2, we again find that switches to and from mayor-council form have the hypothesized effects on government spending, relative to jurisdictions not switching their form of government. The changes to mayor-council form, however, are statistically insignificant, reflecting the diminished sample sizes in this case. Finally, columns 3 and 4 show that the results are similar when using revenues as a measure of the size of government. Taken together, these results demonstrate that the baseline results are robust to using a more conservative sample of only internally consistent observations.

4.4 Summary

To summarize, both the cross-sectional and panel analysis suggest that mayor-council leads to lower public spending. According to our preferred estimates, which are based on the panel analysis, public spending is roughly 10 percent lower under mayor-council form. This is a large effect. In 2002, per-capita city government spending was about \$1,000, or 2.8 percent of per-capita GDP (which was about \$36,000). Thus, since around 60 percent of cities were council-manager, if all council-manager cities had switched to mayor-council, per capita municipal public spending as a fraction of per capita GDP would have decreased by 0.17 percent.[21] We also provide weaker evidence that the growth in public spending is lower under mayor-council form. These results provide support for the theoretical predictions developed above and suggest that providing effective veto power to both the legislative and executive of government leads to fewer projects being approved in the budgetary process.

5 The choice of government form

As noted in Section 4, communities sometimes switch between council-manager and mayor-council government forms. In addition, when a city if founded, its population must choose its form of government. In this section, we develop the implications of our theory for the choice of government form. We ask which system of government would a majority of citizens prefer if they had to choose in a referendum before city elections are held?[22]

We begin with the case in which citizens vote sincerely in city elections. Recall from Section 3.2, that both the probabilities of approving projects 1 through g and projects $g+1$ through p are lower under mayor-council than under council-manager. Thus, high valuers will always favor council-manager and low valuers mayor-council. Moderate valuers must trade off the benefit of a higher probability of obtaining the projects they like with the cost of a higher probability of obtaining the projects they do not. To quantify this trade off, suppose first that $G > L$ so that

[21] Letting z denote average per-capita city government spending in council-manager cities, we have that $(0.6)z + (0.4)(0.9)z = 1000$. This implies that average per-capita city government spending is 1042 in council-manager cities and 938 in mayor-council cities. Thus, if all council-manager cities switched to mayor-council, average per-capita city government spending would be 938 which is 2.53 percent of per capita GDP.

[22] Of course, our analysis will presume that citizens understand the forces underlying the trade off highlighted by our model. We certainly recognize that this may be a heroic assumption given that the existing academic literature on U.S. cities does not offer a coherent message on the spending difference between the two forms. Moreover, as far as we know, popular discussions of the advantages and disadvantages of the two forms do not focus on spending.

type α candidates will be elected in both government forms. A moderate valuers expected payoff under council-manager will therefore be $U_C(0)$ and under mayor-council will be $U_M(0,\alpha)$. From (6) and (8) and using (4) and (5), we obtain:

$$U_C(0) - U_M(0,\alpha) = \pi_l^\alpha \Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\Big| 0)G - (1-\pi_h^\alpha)\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\Big| 0)L.$$

If $G < L$ so that type β candidates will be elected in both government forms, a moderate valuer's expected payoff under council-manager will be $U_C(n)$ and under mayor-council will be $U_M(n-1,\beta)$. In this case, we obtain:

$$U_C(n) - U_M(n-1,\beta) = \pi_l^\beta \Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\Big| n-1)G - (1-\pi_h^\beta)\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\Big| n-1)L.$$

Since the median voter is a moderate, the foregoing analysis implies:

Proposition 3: *If $G > L$ a majority of voters prefer council-manager to mayor-council if and only if*

$$\underline{\pi}\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\Big| 0)G > (1-\overline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\Big| 0)L.$$

If $G < L$ a majority of voters prefer council-manager to mayor-council if and only if

$$\overline{\pi}\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\Big| n-1)G > (1-\underline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\Big| n-1)L.$$

To understand this result intuitively, consider the case in which $G > L$. The term $\underline{\pi}\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\Big| 0)$ is the probability that under mayor-council, more than q of the $n-1$ council-members will be high or moderate valuers but the mayor will be a low valuer. This is the precisely the circumstance under which projects 1 through g will be rejected under mayor-council but would not have been under council-manager. Similarly, the term $(1-\overline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\Big| 0)$ is the probability that under mayor-council, more than q of the $n-1$ council-members will be high valuers and the mayor will not be a high valuer. This is the probability that projects $g+1$ through p will be rejected under mayor-council but would not be under council-manager. Essentially, therefore, the median voter's choice between council-manager and mayor-council involves trading off an expected benefit and an expected cost. The benefit is that mayor-council will eliminate projects that would be implemented under council-manager that the median voter does not want. The cost is that mayor-council will eliminate projects that would be implemented under council-manager that the median voter wants.

The most important point to note from this proposition is that, even though mayor-council produces lower expected spending levels, it is not necessarily preferred by a majority of voters. Thus, the model can explain the fact that both government forms coexist. This is obviously an essential feature given the data. It is clear that council-manager will be more likely to be favored by voters when the surplus from projects that low valuers would axe (i.e., G) exceeds the loss from projects that high valuers would add (i.e., L). It is also clear that, when $G > L$ and there is only a very small chance that type α candidates are low valuers (i.e., $\underline{\pi} \approx 0$) then mayor-council dominates. For in this case there is little chance that desirable projects will be rejected under either form of government and hence the median voter just wants to maximize the chance that undesirable projects are rejected. Similarly, when $G < L$ and there is only a very small chance that type β politicians are high valuers (i.e., $\underline{\pi} \approx 0$) then there is no chance that undesirable projects will be approved and the median voter just wants to maximize the chance that desirable projects are approved. Council-manager therefore dominates. Saying anything more than this is difficult because the probabilities in question are complex functions of $\underline{\pi}$ and $\overline{\pi}$ respectively. For example, when $G > L$, as we increase $\underline{\pi}$ we simultaneously increase the probability of electing a low valuer mayor but reduce the probability that q or more of the $n-1$ council-members are high or moderate valuers.

Note that Proposition 3 assumes that the median voter understands the difference in spending between mayor-council and council-manager when choosing the form of government but nonetheless votes sincerely in candidate elections. For the purposes of this exercise, therefore, it may be more logically consistent to assume sophisticated voting in candidate elections. However, as shown in Section 3.2, with sophisticated voting, except possibly in a very small part of the parameter space, both the probabilities of approving projects 1 through g and projects $g+1$ through p, are lower under a mayor-council form of government. Thus, in choosing between the two forms, moderate voters must again trade off the same expected benefit and cost. All that differs is that the expectations are more complex because they depend upon voters' endogenous choices x_C and (x_M, j_M).

While Proposition 3 falls a long way short of providing testable implications, it does suggest an intuition that seems quite reasonable. If a community experiences an increase in preferences for spending, which could be captured, for example, by an increase in θ_m and a corresponding increase in G and a decrease in L, then we might expect that community to switch to a council-manager system. Similarly, if a community experiences a decrease in preferences for spending, then we might expect that community to switch to a mayor-council system. Given that these changes in preferences would also lead to changes in spending, holding government form constant, our empirical analysis would provide an upper-bound estimate on the effects of government form. Of course, this argument assumes that the median voter chooses government form based upon the conditions in Proposition 3. If cities choose government form for reasons unrelated to preferences for government spending, then our empirical analysis will provide an unbiased estimate of the effects of government form on spending.

6 Conclusion

This paper has made three contributions. The first is to offer a theory of spending under the two main forms of government found in U.S. cities: mayor-council and council-manager. This theory offers a simple vision of how government form matters and explains clearly why, if this vision is correct, public spending will be lower under mayor-council. Moreover, the theory also suggests that this difference will generally hold even if voters choose politicians accounting for the spending biases of the two forms.

The second contribution of the paper is to show that the main prediction of the theory is bourne out in the data: public spending is significantly lower under the mayor-council form. This finding goes against the prior literature which has come to no firm conclusion on the difference in size of government under the two forms. Independently of the forces that might be generating this result, the finding establishes an important empirical fact about urban public finance in the U.S.. It is also notable that the finding matches that on the difference between size of government across countries with presidential and parliamentary forms of government.

The final contribution of the paper is to offer a positive analysis of the choice between the two government forms. This is useful because newly forming cities must necessarily confront this choice. Essentially, from the median voter's perspective, the decision to switch from council-manager to mayor-council involves trading off an expected benefit and an expected cost. The benefit is that the additional checks and balances under mayor-council will eliminate projects that the median voter does not want that would be implemented under council-manager. The cost is that the additional checks and balances will create a form of gridlock that blocks projects that the median voter would like that would be implemented under council-manager. The existence of this trade-off mean that the theory is consistent with the prevalence of both government forms in U.S. cities.

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7 Appendix

7.1 Proof of Proposition 2

As discussed in the text, the proof consists of five distinct steps.

7.1.1 Step 1: Comparing probabilities

We claim that mayor-council generates lower probabilities of approving projects 1 through g and projects $g+1$ through p, whenever the total number of type β politicians is at least as big as under council-manager. To establish this, it is enough to show two things. First, for all $x \in \{0, ..., n-1\}$

$$(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\bigg| x) < \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\bigg| x)$$

and

$$\pi_h^\alpha \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x) < \Pr(\frac{\#h}{n} \geq \frac{q}{n}\bigg| x).$$

This would show the result for the case in which, under council-manager, there are x type β council-members under council-manager and, under mayor-council, there is a type α mayor and x type β council-members. Second, for all $x \in \{1, ..., n\}$

$$(1-\pi_l^\beta)\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\bigg| x-1) < \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\bigg| x)$$

and

$$\pi_h^\beta \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x-1) < \Pr(\frac{\#h}{n} \geq \frac{q}{n}\bigg| x).$$

This would show the result for the case in which, under council-manager, there are x type β council-members and, under mayor-council, there is a type β mayor and $x-1$ type β council-members.

Both results are immediate. For the first, note that

$$\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\bigg| x) = (1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\bigg| x) + \pi_l^\alpha \Pr(\frac{\#h+m}{n-1} \geq \frac{q}{n-1}\bigg| x)$$

and that

$$\Pr(\frac{\#l}{n} \geq \frac{q}{n}\bigg| x) = \pi_h^\alpha \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x) + (1-\pi_h^\alpha)\Pr(\frac{\#h}{n-1} \geq \frac{q}{n-1}\bigg| x).$$

For the second, note that

$$\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\bigg| x) = (1-\pi_l^\beta)\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\bigg| x-1) + \pi_l^\beta \Pr(\frac{\#h+m}{n-1} \geq \frac{q}{n-1}\bigg| x-1)$$

and that

$$\Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x) = \pi_h^{\beta} \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x-1) + (1-\pi_h^{\beta}) \Pr(\frac{\#h}{n-1} \geq \frac{q}{n-1}\Big| x-1).$$

7.1.2 Step 2

We show that with a type α mayor, $x_M = x_C$ except in the case $x_C = n$, in which case $x_M = n-1$. We begin by characterizing the optimal number of type β council-members under council-manager and mayor-council with a type α mayor. We then explore the relationship between the optimal number of type β council-members under the two systems.

Optimal number of type β council-members under council-manager From (10), starting with $x \in \{0, 1, ..., n-1\}$ type β council-members, the benefit of adding an additional type β council-member under council-manager will exceed the cost as long as

$$\frac{\Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x+1)}{\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x+1)} > \frac{G}{L}.$$

We now establish:

Claim 1: For all $x \in \{0, 1, ..., n-1\}$

$$\frac{\Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x+1)}{\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x+1)} = \frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| x)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| x)}.$$

Proof of Claim 1: Observe that

$$\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x) = (1-\pi_l^{\alpha}) \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) + \pi_l^{\alpha} \Pr(\frac{\#h+m}{n-1} \geq \frac{q}{n-1}\Big| x)$$

and that

$$\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x+1) = (1-\pi_l^{\beta}) \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) + \pi_l^{\beta} \Pr(\frac{\#h+m}{n-1} \geq \frac{q}{n-1}\Big| x).$$

Thus, we may write

$$\begin{aligned}\Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\Big| x+1) &= (\pi_l^{\beta} - \pi_l^{\alpha}) \left[\begin{array}{c} \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \\ \Pr(\frac{\#h+m}{n-1} \geq \frac{q}{n-1}\Big| x) \end{array} \right] \\ &= (\pi_l^{\beta} - \pi_l^{\alpha}) \Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| x).\end{aligned}$$

Similarly, we have that

$$\Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x) = \pi_h^\alpha \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x) + (1-\pi_h^\alpha)\Pr(\frac{\#h}{n-1} \geq \frac{q}{n-1}\Big| x)$$

and that

$$\Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x+1) = \pi_h^\beta \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x) + (1-\pi_h^\beta)\Pr(\frac{\#h}{n-1} \geq \frac{q}{n-1}\Big| x).$$

So that

$$\begin{aligned}\Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x) - \Pr(\frac{\#h}{n} \geq \frac{q}{n}\Big| x+1) &= (\pi_h^\alpha - \pi_h^\beta)\begin{bmatrix}\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \\ \Pr(\frac{\#h}{n-1} \geq \frac{q}{n-1}\Big| x)\end{bmatrix} \\ &= (\pi_h^\alpha - \pi_h^\beta)\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| x).\end{aligned}$$

To complete the proof, observe that both $\pi_l^\beta - \pi_l^\alpha$ and $\pi_h^\alpha - \pi_h^\beta$ equal $\overline{\pi} - \underline{\pi}$. ■

Next we show:

Claim 2: For all $x \in \{0, 1, ..., n-1\}$

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| x)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| x)} = \frac{\overline{\pi}^{q-x-1}(1-\overline{\pi})^{n-q-x}}{(1-\underline{\pi})^{q-x-1}\underline{\pi}^{n-q-x}}.$$

Proof of Claim 2: We begin with $x = 0$. We have that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 0)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 0)} = \frac{\binom{n-1}{q-1}\pi_h^{\alpha q-1}(1-\pi_h^\alpha)^{n-q}}{\binom{n-1}{q-1}(1-\pi_l^\alpha)^{q-1}\pi_l^{\alpha n-q}}.$$

Since $\pi_h^\alpha = \overline{\pi}$ and $\pi_l^\alpha = \underline{\pi}$, it follows that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 0)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 0)} = \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}},$$

as required. At the other extreme, consider $x = n-1$. In that case,

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| n-1)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| n-1)} = \frac{\binom{n-1}{q-1}\pi_h^{\beta q-1}(1-\pi_h^\beta)^{n-q}}{\binom{n-1}{q-1}(1-\pi_l^\beta)^{q-1}\pi_l^{\beta n-q}}.$$

Since $\pi_h^\beta = \underline{\pi}$ and $\pi_l^\beta = \overline{\pi}$, it follows that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| n-1)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| n-1)} = \frac{\underline{\pi}(1-\underline{\pi})^{n-q}}{(1-\overline{\pi})^{q-1}\overline{\pi}^{n-q}} = \frac{\overline{\pi}^{q-n}(1-\overline{\pi})^{1-q}}{(1-\underline{\pi})^{q-n}\underline{\pi}^{1-q}},$$

as required. Thus, the result is true at both ends of the spectrum.

To fill in the gaps, consider $x = 1$. We have that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 1)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 1)} = \frac{\pi_h^\beta \binom{n-2}{q-2}\pi_h^{\alpha q-2}(1-\pi_h^\alpha)^{n-q} + (1-\pi_h^\beta)\binom{n-2}{q-1}\pi_h^{\alpha q-1}(1-\pi_h^\alpha)^{n-q-1}}{(1-\pi_l^\beta)\binom{n-2}{q-2}(1-\pi_l^\alpha)^{q-2}\pi_l^{\alpha n-q} + \pi_l^\beta\binom{n-2}{q-1}(1-\pi_l^\alpha)^{q-1}\pi_l^{\alpha n-q-1}}$$

or, equivalently, that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 1)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 1)} = \frac{\pi_h^{\alpha q-2}(1-\pi_h^\alpha)^{n-q-1}[\pi_h^\beta\binom{n-2}{q-2}(1-\pi_h^\alpha) + (1-\pi_h^\beta)\binom{n-2}{q-1}\pi_h^\alpha]}{(1-\pi_l^\alpha)^{q-2}\pi_l^{\alpha n-q-1}[(1-\pi_l^\beta)\binom{n-2}{q-2}\pi_l^\alpha + \pi_l^\beta\binom{n-2}{q-1}(1-\pi_l^\alpha)]}.$$

Since $\pi_l^\alpha = \pi_h^\beta = \underline{\pi}$ and $\pi_h^\alpha = \pi_l^\beta = \overline{\pi}$, it follows that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 1)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 1)} = \frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}},$$

as required. Next consider $x = 2$. We have that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 2)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 2)} = \frac{\begin{array}{c}\pi_h^\beta\binom{n-3}{q-3}\pi_h^{\alpha q-3}(1-\pi_h^\alpha)^{n-q} + 2\pi_h^\beta(1-\pi_h^\beta)\binom{n-3}{q-2}\pi_h^{\alpha q-2}(1-\pi_h^\alpha)^{n-q-1}\\ +(1-\pi_h^\beta)^2\binom{n-3}{q-1}\pi_h^{\alpha q-1}(1-\pi_h^\alpha)^{n-q-2}\end{array}}{\begin{array}{c}(1-\pi_l^\beta)^2\binom{n-3}{q-3}(1-\pi_l^\alpha)^{q-3}\pi_l^{\alpha n-q} + 2\pi_l^\beta(1-\pi_l^\beta)\binom{n-3}{q-2}(1-\pi_l^\alpha)^{q-2}\pi_l^{\alpha n-q-1}\\ +\pi_l^{\beta 2}\binom{n-3}{q-1}(1-\pi_l^\alpha)^{q-1}\pi_l^{\alpha n-q-2}\end{array}}$$

or, equivalently,

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 2)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 2)} = \frac{\pi_h^{\alpha q-3}(1-\pi_h^\alpha)^{n-q-2}\left[\begin{array}{c}\pi_h^{\beta 2}\binom{n-3}{q-3}(1-\pi_h^\alpha)^2 + 2\pi_h^\beta(1-\pi_h^\beta)\binom{n-3}{q-2}\pi_h^\alpha(1-\pi_h^\alpha)\\ +(1-\pi_h^\beta)^2\binom{n-3}{q-1}\pi_h^{\alpha 2}\end{array}\right]}{(1-\pi_l^\alpha)^{q-3}\pi_l^{\alpha n-q-2}\left[\begin{array}{c}(1-\pi_l^\beta)^2\binom{n-3}{q-3}\pi_l^{\alpha 2} + 2\pi_l^\beta(1-\pi_l^\beta)\binom{n-3}{q-2}(1-\pi_l^\alpha)\pi_l^\alpha\\ +\pi_l^{\beta 2}\binom{n-3}{q-1}(1-\pi_l^\alpha)^2\end{array}\right]}$$

Since $\pi_l^\alpha = \pi_h^\beta = \underline{\pi}$ and $\pi_h^\alpha = \pi_l^\beta = \overline{\pi}$, it follows that

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1}\Big| 2)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1}\Big| 2)} = \frac{\overline{\pi}^{q-3}(1-\overline{\pi})^{n-q-2}}{(1-\underline{\pi})^{q-3}\underline{\pi}^{n-q-2}},$$

as required. The remaining cases are dealt with analogously. ■

Finally, we show:

Claim 3: For all $x \in \{0, 1, ..., n-1\}$

$$\frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1} \Big| x)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1} \Big| x)} > \frac{\Pr(\frac{\#h}{n-1} = \frac{q-1}{n-1} \Big| x+1)}{\Pr(\frac{\#h+m}{n-1} = \frac{q-1}{n-1} \Big| x+1)}.$$

Proof: By Claim 2, this inequality is equivalent to

$$\frac{\overline{\pi}^{q-x-1}(1-\overline{\pi})^{n-q-x}}{(1-\underline{\pi})^{q-x-1}\underline{\pi}^{n-q-x}} > \frac{\overline{\pi}^{q-x-2}(1-\overline{\pi})^{n-q-x-1}}{(1-\underline{\pi})^{q-x-2}\underline{\pi}^{n-q-x-1}},$$

which boils down to

$$\frac{\overline{\pi}(1-\overline{\pi})}{(1-\underline{\pi})\underline{\pi}} > 1.$$

This in turn is equivalent to

$$\overline{\pi} - \underline{\pi} > (\overline{\pi} - \underline{\pi})(\overline{\pi} + \underline{\pi}),$$

which follows from the assumption that $\overline{\pi} < 1 - \underline{\pi}$. ■

Combining Claims 1, 2 and 3, we may conclude that:

$$x_C = \begin{cases} 0 & \text{if } \frac{G}{L} \geq \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}} \\ 1 & \text{if } \frac{G}{L} \in [\frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}}, \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}}) \\ 2 & \text{if } \frac{G}{L} \in [\frac{\overline{\pi}^{q-3}(1-\overline{\pi})^{n-q-2}}{(1-\underline{\pi})^{q-3}\underline{\pi}^{n-q-2}}, \frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}}) \\ . & . \\ n & \text{if } \frac{G}{L} < \frac{(1-\overline{\pi})^{1-q}\overline{\pi}^{q-n}}{\underline{\pi}^{1-q}(1-\underline{\pi})^{q-n}} \end{cases}.$$

Optimal number of type β council-members under mayor-council with a type α mayor

From (11), starting with $x \in \{0, 1, ..., n-2\}$ type β council-members, the benefit of adding an additional type β council-member under mayor-council with a type α mayor will exceed the cost as long as

$$\frac{\pi_h^\alpha[\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]}{(1-\pi_l^\alpha)[\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]} > \frac{G}{L}.$$

We now establish:

Claim 4: For all $x \in \{0, 1, ..., n-2\}$

$$\frac{\pi_h^\alpha[\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]}{(1-\pi_l^\alpha)[\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]} = \frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{(1-\pi_l^\alpha) \Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)}.$$

Proof of Claim 4: We have that

$$\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x+1) = (1-\pi_l^{\beta})\Pr(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\Big| x) + \pi_l^{\beta}\Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x),$$

so that

$$(1-\pi_l^{\alpha})\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x+1) = \begin{array}{c} (1-\pi_l^{\alpha})(1-\pi_l^{\beta})\Pr(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\Big| x) + \\ (1-\pi_l^{\alpha})\pi_l^{\beta}\Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x). \end{array} \tag{17}$$

Using the fact that

$$\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) = (1-\pi_l^{\alpha})\Pr(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\Big| x) + \pi_l^{\alpha}\Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x),$$

we also have that

$$(1-\pi_l^{\alpha})\Pr(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\Big| x) = \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \pi_l^{\alpha}\Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x). \tag{18}$$

Substituting (18) into (17), we obtain

$$(1-\pi_l^{\alpha})\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x+1) = (1-\pi_l^{\beta})\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) + (\pi_l^{\beta}-\pi_l^{\alpha})\Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x).$$

Thus, we may write

$$\begin{aligned} &(1-\pi_l^{\alpha})[\Pr(\tfrac{\#h+m}{n-1} \geq \tfrac{q-1}{n-1}\Big| x) - \Pr(\tfrac{\#h+m}{n-1} \geq \tfrac{q-1}{n-1}\Big| x+1)] \\ &= (\pi_l^{\beta}-\pi_l^{\alpha})[\Pr(\tfrac{\#h+m}{n-1} \geq \tfrac{q-1}{n-1}\Big| x) - \Pr(\tfrac{\#h+m}{n-2} \geq \tfrac{q-1}{n-2}\Big| x)] \end{aligned} \tag{19}$$

Next note that

$$\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) = \pi_l^{\alpha}\Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x) + (1-\pi_l^{\alpha})\Pr(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\Big| x),$$

implying that

$$\begin{aligned} \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x) &= (1-\pi_l^{\alpha})\left[\begin{array}{c} \Pr(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\Big| x) - \\ \Pr(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\Big| x) \end{array}\right] \\ &= (1-\pi_l^{\alpha})\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| x). \end{aligned}$$

Thus, from (19), we have that

$$(1-\pi_l^\alpha)[\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\bigg| x) - \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\bigg| x+1)] = (1-\pi_l^\alpha)(\pi_l^\beta - \pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\bigg| x). \tag{20}$$

Turning attention to the numerator of the expression in Claim 4, we have that

$$\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x+1) = \pi_h^\beta \Pr(\frac{\#h}{n-2} \geq \frac{q-2}{n-2}\bigg| x) + (1-\pi_h^\beta)\Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x),$$

so that

$$\pi_h^\alpha \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x+1) = \pi_h^\beta \pi_h^\alpha \Pr(\frac{\#h}{n-2} \geq \frac{q-2}{n-2}\bigg| x) + (1-\pi_h^\beta)\pi_h^\alpha \Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x). \tag{21}$$

Using the fact that

$$\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x) = \pi_h^\alpha \Pr(\frac{\#h}{n-2} \geq \frac{q-2}{n-2}\bigg| x) + (1-\pi_h^\alpha)\Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x),$$

we have that

$$\pi_h^\alpha \Pr(\frac{\#h}{n-2} \geq \frac{q-2}{n-2}\bigg| x) = \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x) - (1-\pi_h^\alpha)\Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x). \tag{22}$$

Substituting (22) into (21), we obtain

$$\pi_h^\alpha \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x+1) = \pi_h^\beta \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x) + (\pi_h^\alpha - \pi_h^\beta)\Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x).$$

Thus, we may write

$$\pi_h^\alpha[\Pr(\tfrac{\#h}{n-1} \geq \tfrac{q-1}{n-1}\big| x) - \Pr(\tfrac{\#h}{n-1} \geq \tfrac{q-1}{n-1}\big| x+1)] = (\pi_h^\alpha - \pi_h^\beta)[\Pr(\tfrac{\#h}{n-1} \geq \tfrac{q-1}{n-1}\big| x) - \Pr(\tfrac{\#h}{n-2} \geq \tfrac{q-1}{n-2}\big| x)]. \tag{23}$$

Next note that

$$\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x) = (1-\pi_h^\alpha)\Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x) + \pi_h^\alpha \Pr(\frac{\#h}{n-2} \geq \frac{q-2}{n-2}\bigg| x),$$

implying that

$$\begin{aligned}\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x) - \Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x) &= \pi_h^\alpha[\Pr(\frac{\#h}{n-2} \geq \frac{q-2}{n-2}\bigg| x) - \Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\bigg| x)] \\ &= \pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\bigg| x).\end{aligned}$$

Thus, from (23), we have that

$$\pi_h^\alpha[\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x+1)] = \pi_h^\alpha(\pi_h^\alpha - \pi_h^\beta)\Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| x). \tag{24}$$

Combining (20) and (24) and using the fact that $\pi_l^\beta - \pi_l^\alpha = \pi_h^\alpha - \pi_h^\beta$, yields the result. ■

Next we show:

Claim 5: For all $x \in \{0, 1, ..., n-2\}$

$$\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| x)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| x)} = \frac{\overline{\pi}^{q-x-1}(1-\overline{\pi})^{n-q-x}}{(1-\underline{\pi})^{q-x-1}\underline{\pi}^{n-q-x}}.$$

Proof of Claim 5: We begin with $x = 0$. We have that

$$\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| 0)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| 0)} = \frac{\pi_h^\alpha\binom{n-2}{q-2}\pi_h^{\alpha q-2}(1-\pi_h^\alpha)^{n-q}}{(1-\pi_l^\alpha)\binom{n-2}{q-2}(1-\pi_l^\alpha)^{q-2}\pi_l^{\alpha n-q}}.$$

Since $\pi_h^\alpha = \overline{\pi}$ and $\pi_l^\alpha = \underline{\pi}$, it follows that

$$\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| 0)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| 0)} = \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}}.$$

At the other extreme is $x = n-2$. We have that

$$\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| n-2)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| n-2)} = \frac{\pi_h^\alpha\binom{n-2}{q-2}\pi_h^\beta(1-\pi_h^\beta)^{n-q}}{(1-\pi_l^\alpha)\binom{n-2}{q-2}(1-\pi_l^\beta)^{q-2}\pi_l^{\beta n-q}}.$$

Since $\pi_h^\beta = \underline{\pi}$ and $\pi_l^\beta = \overline{\pi}$, it follows that

$$\begin{aligned}\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| n-2)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| n-2)} &= \frac{\underline{\pi}^{q-2}(1-\underline{\pi})^{n-q-1}}{(1-\overline{\pi})^{q-2}\overline{\pi}^{n-q-1}} \\ &= \frac{\overline{\pi}^{q+1-n}(1-\overline{\pi})^{2-q}}{(1-\underline{\pi})^{q+1-n}\underline{\pi}^{2-q}},\end{aligned}$$

as required. These represent the two ends of the spectrum.

To fill in the gaps, consider $x = 1$. We have that

$$\begin{aligned}
&\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| 1)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| 1)} \\
&= \frac{\pi_h^\alpha[\pi_h^\beta\binom{n-3}{q-3}\pi_h^{\alpha q-3}(1-\pi_h^\alpha)^{n-q} + (1-\pi_h^\beta)\binom{n-3}{q-2}\pi_h^{\alpha q-2}(1-\pi_h^\alpha)^{n-q-1}]}{(1-\pi_l^\alpha)[(1-\pi_l^\beta)\binom{n-3}{q-3}(1-\pi_l^\alpha)^{q-3}\pi_l^{\alpha n-q} + \pi_l^\beta\binom{n-3}{q-2}(1-\pi_l^\alpha)^{q-2}\pi_l^{\alpha n-q-1}]} \\
&= \frac{\pi_h^{\alpha q-2}(1-\pi_h^\alpha)^{n-q-1}[\pi_h^\beta\binom{n-3}{q-3}(1-\pi_h^\alpha) + (1-\pi_h^\beta)\binom{n-3}{q-2}\pi_h^\alpha]}{(1-\pi_l^\alpha)^{q-2}\pi_l^{\alpha n-q-1}[(1-\pi_l^\beta)\binom{n-3}{q-3}\pi_l^\alpha + \pi_l^\beta\binom{n-3}{q-2}(1-\pi_l^\alpha)]}.
\end{aligned}$$

Since $\pi_l^\alpha = \pi_h^\beta = \underline{\pi}$ and $\pi_h^\alpha = \pi_l^\beta = \overline{\pi}$, it follows that

$$\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| 1)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| 1)} = \frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}}.$$

Next consider $x = 2$. We have that

$$\begin{aligned}
&\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| 2)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| 2)} \\
&= \frac{\pi_h^\alpha\left[\begin{array}{c}\pi_h^\beta\binom{n-4}{q-4}\pi_h^{\alpha q-4}(1-\pi_h^\alpha)^{n-q} + 2\pi_h^\beta(1-\pi_h^\beta)\binom{n-4}{q-3}\pi_h^{\alpha q-3}(1-\pi_h^\alpha)^{n-q-1} \\ +(1-\pi_h^\beta)^2\binom{n-4}{q-2}\pi_h^{\alpha q-2}(1-\pi_h^\alpha)^{n-q-2}\end{array}\right]}{(1-\pi_l^\alpha)\left[\begin{array}{c}(1-\pi_l^\beta)^2\binom{n-4}{q-4}(1-\pi_l^\alpha)^{q-4}\pi_l^{\alpha n-q} + 2(1-\pi_l^\beta)\pi_l^\beta\binom{n-4}{q-3}(1-\pi_l^\alpha)^{q-3}\pi_l^{\alpha n-q-1} \\ +\pi_l^{\beta 2}\binom{n-4}{q-2}(1-\pi_l^\alpha)^{q-2}\pi_l^{\alpha n-q-2}\end{array}\right]} \\
&= \frac{\pi_h^{\alpha q-3}(1-\pi_h^\alpha)^{n-q-2}\left[\begin{array}{c}\pi_h^\beta\binom{n-4}{q-4}(1-\pi_h^\alpha)^2 + 2\pi_h^\beta(1-\pi_h^\beta)\binom{n-4}{q-3}\pi_h^\alpha(1-\pi_h^\alpha) \\ +(1-\pi_h^\beta)^2\binom{n-4}{q-2}\pi_h^{\alpha 2}\end{array}\right]}{(1-\pi_l^\alpha)^{q-3}\pi_l^{\alpha n-q-2}\left[\begin{array}{c}(1-\pi_l^\beta)^2\binom{n-4}{q-4}\pi_l^{\alpha 2} + 2(1-\pi_l^\beta)\pi_l^\beta\binom{n-4}{q-3}(1-\pi_l^\alpha)\pi_l^\alpha \\ +\pi_l^{\beta 2}\binom{n-4}{q-2}(1-\pi_l^\alpha)^2\end{array}\right]}
\end{aligned}$$

Since $\pi_l^\alpha = \pi_h^\beta = \underline{\pi}$ and $\pi_h^\alpha = \pi_l^\beta = \overline{\pi}$, it follows that

$$\frac{\pi_h^\alpha \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| 2)}{(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\Big| 2)} = \frac{\overline{\pi}^{q-3}(1-\overline{\pi})^{n-q-2}}{(1-\underline{\pi})^{q-3}\underline{\pi}^{n-q-2}},$$

as required. The remaining cases are dealt with analogously. ■

Finally, we show:

Claim 6: For all $x \in \{0, 1, ..., n-2\}$

$$\frac{\pi_h^\alpha \Pr\left(\frac{\#h}{n-2} = \frac{q-2}{n-2} \middle| x\right)}{(1-\pi_l^\alpha)\Pr\left(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \middle| x\right)} > \frac{\pi_h^\alpha \Pr\left(\frac{\#h}{n-2} = \frac{q-2}{n-2} \middle| x+1\right)}{(1-\pi_l^\alpha)\Pr\left(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \middle| x+1\right)}$$

Proof: By Claim 5, this inequality is equivalent to

$$\frac{\overline{\pi}^{q-x-1}(1-\overline{\pi})^{n-q-x}}{(1-\underline{\pi})^{q-x-1}\underline{\pi}^{n-q-x}} > \frac{\overline{\pi}^{q-x-2}(1-\overline{\pi})^{n-q-x-1}}{(1-\underline{\pi})^{q-x-2}\underline{\pi}^{n-q-x-1}},$$

which we already established in the proof of Claim 3. ■

Combining Claims 4, 5 and 6, we conclude that when $j_M = \alpha$, it is the case that:

$$x_M = \begin{cases} 0 & \text{if } \frac{G}{L} \geq \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}} \\ 1 & \text{if } \frac{G}{L} \in \left[\frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}}, \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}}\right) \\ 2 & \text{if } \frac{G}{L} \in \left[\frac{\overline{\pi}^{q-3}(1-\overline{\pi})^{n-q-2}}{(1-\underline{\pi})^{q-3}\underline{\pi}^{n-q-2}}, \frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}}\right) \\ . & . \\ n-1 & \text{if } \frac{G}{L} < \frac{(1-\overline{\pi})^{1-q}\overline{\pi}^{q-n}}{\underline{\pi}^{1-q}(1-\underline{\pi})^{q-n}} \end{cases}.$$

Comparison Comparing the expressions for x_C and x_M, we see that

$$x_M = x_C \quad \text{if} \quad \frac{G}{L} \geq \frac{\underline{\pi}^{q-1}(1-\underline{\pi})^{n-q}}{(1-\overline{\pi})^{q-1}\overline{\pi}^{n-q}}$$

and

$$(x_C, x_M) = (n, n-1) \quad \text{if} \quad \frac{G}{L} < \frac{\underline{\pi}^{q-1}(1-\underline{\pi})^{n-q}}{(1-\overline{\pi})^{q-1}\overline{\pi}^{n-q}}.$$

This completes Step 2 of the proof.

7.1.3 Step 3

We now show that with a type β mayor, $x_M = x_C - 1$ except in the case $x_C = 0$, in which case $x_M = 0$. We begin by characterizing the optimal number of type β council-members under mayor-council with a type β mayor. We then explore the relationship between the optimal number of type β council-members under council-manager and mayor-council with a type β mayor.

Optimal number of type β council-members under mayor-council with a type β mayor
As noted in the text, starting with $x \in \{0, 1, ..., n-2\}$ type β council-members, the benefit of adding an additional type β council-member under mayor-council with a type β mayor will exceed the cost as long as

$$\frac{\pi_h^\beta [\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]}{(1-\pi_l^\beta)[\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]} > \frac{G}{L}.$$

We now establish:

Claim 7: For all $x \in \{0, 1, ..., n-2\}$

$$\frac{\pi_h^\beta [\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]}{(1-\pi_l^\beta)[\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)]} = \frac{\pi_h^\beta \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{(1-\pi_l^\beta) \Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)}.$$

Proof of Claim 7: Claim 4 implies that

$$\frac{\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)}{\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x) - \Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1} \Big| x+1)} = \frac{\Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)}.$$

Multiplying both sides through by $\pi_h^\beta/(1-\pi_l^\beta)$ yields the result. ■

Next we show:

Claim 8: For all $x \in \{0, 1, ..., n-2\}$

$$\frac{\pi_h^\beta \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{(1-\pi_l^\beta) \Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)} = \frac{\overline{\pi}^{q-x-2}(1-\overline{\pi})^{n-q-x-1}}{(1-\underline{\pi})^{q-x-2}\underline{\pi}^{n-q-x-1}}.$$

Proof of Claim 8: From Claim 5, we know that

$$\frac{\Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{\Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)} = \frac{(1-\pi_l^\alpha)\overline{\pi}^{q-x-1}(1-\overline{\pi})^{n-q-x}}{\pi_h^\alpha(1-\underline{\pi})^{q-x-1}\underline{\pi}^{n-q-x}}.$$

It follows that

$$\frac{\pi_h^\beta \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{(1-\pi_l^\beta) \Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)} = \frac{\pi_h^\beta(1-\pi_l^\alpha)\overline{\pi}^{q-x-1}(1-\overline{\pi})^{n-q-x}}{(1-\pi_l^\beta)\pi_h^\alpha(1-\underline{\pi})^{q-x-1}\underline{\pi}^{n-q-x}}.$$

Since $\pi_l^\alpha = \pi_h^\beta = \underline{\pi}$ and $\pi_h^\alpha = \pi_l^\beta = \overline{\pi}$, it follows that

$$\frac{\pi_h^\beta \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{(1-\pi_l^\beta) \Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)} = \frac{\overline{\pi}^{q-x-2}(1-\overline{\pi})^{n-q-x-1}}{(1-\underline{\pi})^{q-x-2}\underline{\pi}^{n-q-x-1}},$$

as required. ■

Claim 9: For all $x \in \{0, 1, ..., n-2\}$

$$\frac{\pi_h^\beta \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x)}{(1-\pi_l^\beta) \Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x)} > \frac{\pi_h^\beta \Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2} \Big| x+1)}{(1-\pi_l^\beta) \Pr(\frac{\#h+m}{n-2} = \frac{q-2}{n-2} \Big| x+1)}$$

Proof of Claim 9: By Claim 8, this inequality is equivalent to

$$\frac{\overline{\pi}^{q-x-2}(1-\overline{\pi})^{n-q-x-1}}{(1-\underline{\pi})^{q-x-2}\underline{\pi}^{n-q-x-1}} > \frac{\overline{\pi}^{q-x-3}(1-\overline{\pi})^{n-q-x-2}}{(1-\underline{\pi})^{q-x-3}\underline{\pi}^{n-q-x-3}},$$

which boils down to

$$\frac{\overline{\pi}(1-\overline{\pi})}{(1-\underline{\pi})\underline{\pi}} > 1.$$

This was already established in the proof of Claim 3. ■

Combining Claims 7, 8 and 9, we conclude that when $j_M = \beta$, it is the case that:

$$x_M = \begin{cases} 0 & \text{if } \frac{G}{L} \geq \frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}} \\ 1 & \text{if } \frac{G}{L} \in [\frac{\overline{\pi}^{q-3}(1-\overline{\pi})^{n-q-2}}{(1-\underline{\pi})^{q-3}\underline{\pi}^{n-q-2}}, \frac{\overline{\pi}^{q-2}(1-\overline{\pi})^{n-q-1}}{(1-\underline{\pi})^{q-2}\underline{\pi}^{n-q-1}}) \\ 2 & \text{if } \frac{G}{L} \in [\frac{\overline{\pi}^{q-4}(1-\overline{\pi})^{n-q-3}}{(1-\underline{\pi})^{q-4}\underline{\pi}^{n-q-3}}, \frac{\overline{\pi}^{q-3}(1-\overline{\pi})^{n-q-2}}{(1-\underline{\pi})^{q-3}\underline{\pi}^{n-q-2}}) \\ . & . \\ n-1 & \text{if } \frac{G}{L} < \frac{\overline{\pi}^{q-n}(1-\overline{\pi})^{1-q}}{(1-\underline{\pi})^{q-n}\underline{\pi}^{1-q}} \end{cases}.$$

Comparison Comparing the expressions for x_C and x_M, we see that

$$x_M = x_C - 1 \quad \text{if} \quad \frac{G}{L} < \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}},$$

and

$$(x_C, x_M) = (0,0) \quad \text{if} \quad \frac{G}{L} \geq \frac{\overline{\pi}^{q-1}(1-\overline{\pi})^{n-q}}{(1-\underline{\pi})^{q-1}\underline{\pi}^{n-q}}.$$

This proves Step 3.

7.1.4 Step 4

From Steps 2 and 3 we may conclude that, whether a type α or β mayor is optimal under mayor-council, the total number of type β politicians under mayor-council is greater than or equal to that under council-manager except when $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$. It therefore follows from

Step 1 that mayor-council generates lower probabilities of approving projects 1 through g and projects $g+1$ through p than council-manager, except when $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$. ■

7.1.5 Step 5

It remains to obtain the conditions for $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$. From the expression for x_C derived in Step 2, we see that

$$x_C = n \quad \text{if } \frac{G}{L} < \frac{(1-\overline{\pi})^{1-q}\overline{\pi}^{q-n}}{\underline{\pi}^{1-q}(1-\underline{\pi})^{q-n}} = \frac{\underline{\pi}^{q-1}(1-\underline{\pi})^{n-q}}{(1-\overline{\pi})^{q-1}\overline{\pi}^{n-q}}.$$

Moreover, under this condition, with either type of mayor the analysis in Steps 2 and 3 tells us that $x_M = n-1$. It follows that, under this condition, $j_M = \alpha$ if $U_M(n-1,\alpha) > U_M(n-1,\beta)$. Recall that

$$U_M(n-1,\beta) = (1-\pi_l^\beta)\Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)G - \pi_h^\beta \Pr\left(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)L$$

and that

$$U_M(n-1,\alpha) = (1-\pi_l^\alpha)\Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)G - \pi_h^\alpha \Pr\left(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)L.$$

Thus, $U_M(n-1,\alpha) > U_M(n-1,\beta)$ if and only if

$$(\pi_l^\beta - \pi_l^\alpha)\Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)G > (\pi_h^\alpha - \pi_h^\beta)\Pr\left(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)L.$$

Since $\pi_l^\beta - \pi_l^\alpha = \pi_h^\alpha - \pi_h^\beta$, this reduces to

$$\frac{G}{L} > \frac{\Pr\left(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)}{\Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right)}.$$

Note that

$$\begin{aligned}\Pr\left(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right) &= \sum_{s=q-1}^{n-1}\binom{n-1}{s}\pi_h^{\beta s}(1-\pi_h^\beta)^{n-1-s} \\ &= \sum_{s=q-1}^{n-1}\binom{n-1}{s}\underline{\pi}^s(1-\underline{\pi})^{n-1-s}\end{aligned}$$

and that

$$\begin{aligned}\Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| n-1\right) &= \sum_{s=q-1}^{n-1}\binom{n-1}{s}(1-\pi_l^\beta)^s\pi_l^{\beta n-1-s} \\ &= \sum_{s=q-1}^{n-1}\binom{n-1}{s}(1-\overline{\pi})^s\overline{\pi}^{n-1-s}.\end{aligned}$$

Thus, we conclude that $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$ if and only if

$$\frac{\underline{\pi}^{q-1}(1-\underline{\pi})^{n-q}}{(1-\overline{\pi})^{q-1}\overline{\pi}^{n-q}} > \frac{G}{L} > \frac{\sum_{s=q-1}^{n-1}\binom{n-1}{s}\underline{\pi}^{s}(1-\underline{\pi})^{n-1-s}}{\sum_{s=q-1}^{n-1}\binom{n-1}{s}(1-\overline{\pi})^{s}\overline{\pi}^{n-1-s}}.$$

Thus, if condition (12) in Proposition 3 is satisfied, then it cannot be the case that $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$. It follows therefore that mayor-council generates lower probabilities of approving projects 1 through g and projects $g+1$ through p than council-manager and, accordingly, lower expected spending levels. ■

7.2 Example

Suppose that $n = 3$ and $q = 2$. Then, as shown in the proof of Proposition 3, if

$$\frac{G}{L} \in \left(\frac{\underline{\pi}(2-\underline{\pi})}{1-\overline{\pi}^2}, \frac{\underline{\pi}(1-\underline{\pi})}{(1-\overline{\pi})\overline{\pi}}\right)$$

then $x_C = 3$ and $(x_M, j_M) = (2, \alpha)$. The probability that projects 1 through g are approved under council-manager is

$$\Pr(\frac{\#l+m}{3} \geq \frac{2}{3}\Big| 3) = (1-\overline{\pi})^3 + 3(1-\overline{\pi})^2\overline{\pi}$$

and the probability that projects $g+1$ through p are approved is

$$\Pr(\frac{\#l}{3} \geq \frac{2}{3}\Big| 3) = \underline{\pi}^3 + 3\underline{\pi}^2(1-\underline{\pi}).$$

Under mayor-council, the two probabilities are respectively

$$(1-\pi_l^{\alpha})\Pr(\frac{\#l+m}{2} \geq \frac{1}{2}\Big| 2) = (1-\underline{\pi})[(1-\overline{\pi})^2 + 2(1-\overline{\pi})\overline{\pi}]$$

and

$$\pi_h^{\alpha}\Pr(\frac{\#l}{2} \geq \frac{1}{2}\Big| 2) = \overline{\pi}[\underline{\pi}^2 + 2\underline{\pi}(1-\underline{\pi})].$$

Let $\overline{\pi} = 0.25$, $\underline{\pi} = 0.05$, so that

$$\frac{\underline{\pi}(1-\underline{\pi})}{\overline{\pi}(1-\overline{\pi})} = \frac{(0.05)(0.95)}{(0.25)(0.75)} = 0.253,$$

and

$$\frac{\underline{\pi}(2-\underline{\pi})}{1-\overline{\pi}^2} = \frac{(0.05)(2-0.05)}{1-(0.25)^2} = 0.104.$$

The probability that projects 1 through g are approved under council-manager is

$$\Pr(\frac{\#h+m}{3} \geq \frac{2}{3}\bigg| 3) = (0.75)^3 + 3(0.75)^2(0.25) = 0.844,$$

and the probability that projects $g+1$ through p are approved under council-manager is

$$\Pr(\frac{\#h}{3} \geq \frac{2}{3}\bigg| 3) = (0.05)^3 + 3(0.05)^2(0.95) = 0.007.$$

Under mayor-council, the two probabilities are respectively

$$(1-\pi_l^\alpha)\Pr(\frac{\#h+m}{2} \geq \frac{1}{2}\bigg| 2) = (0.95)((0.75)^2 + 2(0.75)(0.25)) = 0.891,$$

and

$$\pi_h^\alpha \Pr(\frac{\#h}{2} \geq \frac{1}{2}\bigg| 2) = (0.25)((0.05)^2 + 2(0.05)(0.95)) = 0.024.$$

Observe that both the probabilities that projects 1 through g are approved and that projects $g+1$ through p are approved are significantly *higher* under mayor-council.

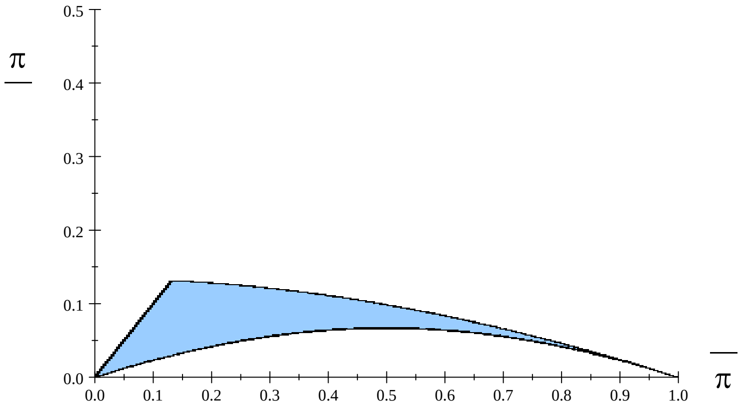

Figure 1a: G/L = 0.25

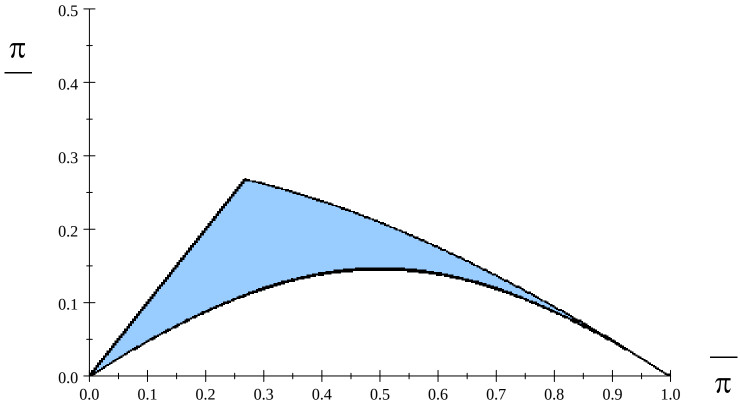

Figure 1b: G/L = 0.50

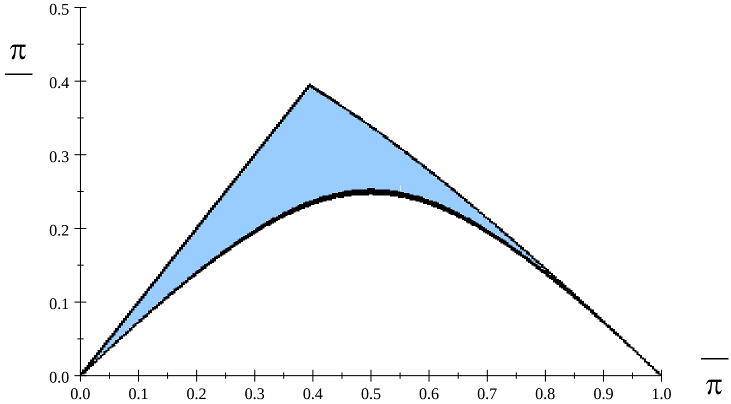

Figure 1c: G/L = 0.75

TABLE 1: PREVALENCE OF GOVERNMENT FORM OVER TIME

	Fraction mayor council form
1987	47.33%
1992	46.90%
1997	41.16%
2002	39.41%

TABLE 2: SWITCHES BETWEEN GOVERNMENT FORM

Mayor-council to council-manager	0.61% (n=85)
No change	99.13% (n=13,869)
Council-manager to mayor-council	0.26% (n=37)

TABLE 3: SAMPLE AVERAGES

	Mayor-council observations	Council-manager observations
Government spending per-capita	$880.35	$1,033.47
Population	24,069	27,561
Growth in government spending per-capita	11.81%	11.91%

TABLE 4: GOVERNMENT SPENDING AND MAYOR-COUNCIL FORM: CROSS-SECTIONAL EVIDENCE

year	1987	1992	1997	2002
mayor council form	-0.1316***	-0.1448***	-0.1182***	-0.0701***
	(0.0219)	(0.0220)	(0.0222)	(0.0245)
log population	0.1391***	0.1310***	0.1044***	0.0808***
	(0.0088)	(0.0088)	(0.0088)	(0.0091)
N	3590	3686	3229	2757
state indicators	Y	Y	Y	Y

notes: std errors in parentheses, dependent variable in logs, *** denotes significance at 99-percent level, ** at 95-percent, * at 90-percent

TABLE 5: GOVERNMENT SPENDING AND MAYOR-COUNCIL FORM: PANEL EVIDENCE

specification	changes	changes	changes	changes
dependent variable	spending	spending	spending	spending
change in mayor council form	-0.1021***			
	(0.0375)			
log population	-0.2649***	-0.2650***		
	(0.0283)	(0.0283)		
change to mayor council form		-0.1374**		
		(0.0661)		
change to council-manager form		0.0851*		
		(0.0458)		
mayor council form			-0.0102	-0.0774**
			(0.0088)	(0.0337)
log population			-0.0114***	-0.3732***
			(0.0035)	(0.0401)
N	13075	13075	13075	13075
state indicators	Y	Y	Y	Y
year indicators	Y	Y	Y	Y
municipality effects			random	fixed

notes: std errors in parentheses, dependent variable in logs, *** denotes significance at 99-percent level, ** at 95-percent, * at 90-percent

TABLE 6: GOVERNMENT REVENUES AND MAYOR-COUNCIL FORM: CROSS-SECTIONAL EVIDENCE

year	1987	1992	1997	2002
mayor council form	-0.1829***	-0.1652***	-0.1352***	-0.1185***
	(0.0238)	(0.0230)	(0.0237)	(0.0257)
log population	0.1551***	0.1312***	0.1099***	0.0828***
	(0.0096)	(0.0092)	(0.0095)	(0.0096)
N	3589	3686	3228	2757
state indicators	Y	Y	Y	Y

notes: std errors in parentheses, dependent variable in logs, *** denotes significance at 99-percent level, ** at 95-percent, * at 90-percent

TABLE 7: GOVERNMENT REVENUES AND MAYOR-COUNCIL FORM: PANEL EVIDENCE

specification	changes	changes	changes	changes
dependent variable	own revenue	own revenue	own revenue	own revenue
change in mayor council form	-0.1004***			
	(0.0358)			
log population	-0.2914***	-0.2914***		
	(0.0271)	(0.0271)		
change to mayor council form		-0.0742		
		(0.0631)		
change to council-manager form		0.1130***		
		(0.0437)		
mayor council form			-0.0064	-0.0412
			(0.0084)	(0.0314)
log population			-0.0136***	-0.3813***
			(0.0033)	(0.0373)
N	13071	13071	13071	13071
state indicators	Y	Y	Y	Y
year indicators	Y	Y	Y	Y
municipality effects			random	fixed

notes: std errors in parentheses, dependent variable in logs, *** denotes significance at 99-percent level, ** at 95-percent, * at 90-percent

TABLE 8: ROBUSTNESS CHECK WITH ONLY INTERNALLY CONSISTENT OBSERVATIONS

specification	changes	changes	changes	changes
dependent variable	spending	spending	own revenue	own revenue
change in mayor council form	-0.1390**		-0.1059**	
	(0.0555)		(0.0523)	
log population	-0.2719***	-0.2718***	-0.3504***	-0.3503***
	(0.0332)	(0.0332)	(0.0313)	(0.0313)
change to mayor council form		-0.1291		-0.0826
		(0.1171)		(0.1103)
change to council-manager form		0.1419**		0.1126*
		(0.0631)		(0.0595)
N	9278	9278	9276	9276
state indicators	Y	Y	Y	Y
year indicators	Y	Y	Y	Y

notes: std errors in parentheses, dependent variable in logs, *** denotes significance at 99-percent level, ** at 95-percent, * at 90-percent