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GOVERNMENT FORM AND PUBLIC SPENDING: THEORY AND EVIDENCE FROM U.S. MUNICIPALITIES

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ABSTRACT

There are two main forms of government in U.S. cities: council-manager and mayor-council. This paper develops a theory of fiscal policy determination under these two forms. The theory predicts that expected public spending will be lower under mayor-council, but that either form of government could be favored by a majority of citizens. The latter prediction means that the theory is consistent with the co-existence of both government forms. Support for the former prediction is found in both a cross-sectional analysis and a panel analysis of changes in government form.

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1 Introduction

There are two main forms of government in U.S. cities: mayor-council and council-manager. 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.[1] While some council-manager cities retain the position of mayor, the role is typically largely ceremonial.[2]

This paper develops a theory of fiscal policy determination under these two forms of government. This theory considers a city government charged with choosing among a set of projects or programs that could be undertaken. It assumes 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. In addition, it assumes that voters have only partial information about the policy preferences of candidates for city-level offices. When voters choose candidates sincerely, these assumptions imply that expected spending will be lower under mayor-council than under council-manager. Moreover, this result generally remain true even when voters are sophisticated and choose candidates accounting for the different biases of the two systems.

The paper also uses the theory to provide a positive analysis of the choice of government form. It shows that either form of government could be chosen by citizens in a referendum.[3] Thus, 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

[1] The mayor-council form is the traditional form of municipal government in the U.S.. The council-manager form appeared first in 1908 in Staunton, VA and spread widely over the next half century as part of the municipal reform movement. See Knock (1982) for a historical analysis of the spread of the council-manager form.

[2] In the traditional council-manager form of government there is either no mayor or a council-member is selected to be mayor by the council. In recent decades, many council-manager cities have chosen to separately elect a mayor. However, in these cities the mayor typically serves on the council and has less power than his counter-part in a mayor-council city.

[3] While the process by which cities may change their form of government varies across the states, it is typically the case that a change must be approved by a majority of city residents in a referendum. Referenda can be initiated either by the city council or by petition of citizens.

in U.S. cities.

The paper then investigates the theory's 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: the panel analysis suggests that per-capita spending is about 9 percent lower in mayor-council cities. Assuming that this represents the causal effect of government form, municipal spending as a fraction of GDP would decrease by 0.16 percent if all cities in the U.S. switched to a mayor-council form.[4]

The paper proceeds as follows. Section 2 reviews the related literature. Section 3 outlines our theory of fiscal policy determination under the two forms of government and develops its implications for public spending. Section 4 takes up the theory's implications for the choice of government form. Section 5 examines the empirical relationship between government form and public spending, and Section 6 concludes.

2 Related literature

There is a large literature on the differences between council-manager and mayor-council cities, dating back at least to the 1960s. Not surprisingly, differences in public spending across the two forms have been a major focus. Early results were mixed, with some studies finding higher spending under mayor-council (e.g., Booms (1966) and Lineberry and Fowler (1967)) and some finding lower spending (e.g., Clark (1968) and Sherbenou (1961)). Later work tended to the view that there is no difference (e.g., Deno and Mehay (1987), Farnham (1990), Hayes and Chang (1990), and Morgan and Pelissero (1980)). This conclusion is reinforced by the recent work of MacDonald (2008), which

[4] In 2002, per-capita city government spending was about $1,000, or 2.78 percent of per-capita GDP (which was about $36,000) and around 60 percent of cities were council-manager. Thus, our estimate implies that average per-capita city government spending was 1037 in council-manager cities and 944 in mayor-council cities. It follows that if all council-manager cities switched to mayor-council, average per-capita city government spending would be 944 which is 2.62 percent of per capita GDP.

is the most sophisticated analysis to date.[5] She uses a large, nationally-representative sample of cities and tracks fiscal policy outcomes and political institutions over two decades. Although her main focus is on the effects of the size of the city council, she also investigates the effects of government form.[6] In both a cross-sectional analysis and in a fixed effects panel analysis that is identified by cities changing their form of government over time, she finds no significant differences in government spending between mayor-council and council-manager.

This work looking at spending differences has largely been atheoretical, offering few arguments for why fiscal policy outcomes might 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 can (and indeed do) hire administrators with such training or select mayors with managerial skills. Another argument was that city managers were more detached from the political process and therefore would be more able to hold down costs. 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 theoretical argument in the literature is that, in either form, political competition should ensure that spending is in line with the level demanded by the median voter (Deno and Mehay (1987)).

This paper advances the literature on spending differences under mayor-council and council-manager in two ways. First, it starts 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. Second, it reaches an empirical conclusion at odds with the conventional wisdom in the literature. This is in spite of the fact that we use a very similar data set to MacDonald. We defer discussion as to why we reach a different conclusion until after we have presented our results.

In finding empirical differences between the two forms of government, our paper complements three recent papers that identify policy differences in areas other than aggregate spending. Levin and Tadelis (2008) show that council-manager cities are more likely to privatize services than

[5] We developed our empirical analysis independently of MacDonald's paper and thank Razvan Vlaicu for bringing it to our attention.

[6] MacDonald finds no relationship between the size of the council and government spending, and her results thus challenge the findings of Baqir (2002) and others that larger city councils produce higher spending levels.

mayor-council cities. They suggest that this result may reflect the explicitly political motivations of mayors, relative to those of city managers. Levin and Tadelis also show that privatization reduces fiscal costs, so the fact that council-manager cities are more likely to privatize should lower their costs. This finding does not contradict ours if, as our theory suggests, council-manager cities undertake more projects in any given service area. Enikolopov (2007) compares the policies of council-manager and mayor-council cities with respect to public employment. He finds that the number of full-time public employees is significantly higher in mayor-council cities, while the number of part-time employees displays no difference.[7] He argues that this is because mayor-council governments are more likely to value patronage jobs than are council-manager governments. These findings are fully consistent with those of Levin and Tadelis because privatization will reduce full-time public employment. Vlaicu (2008) finds a relatively large and statistically significant electoral cycle in police office hiring in mayor-council cities, which is not present in council-manager cities. This difference in responsiveness is present both in a cross-sectional analysis and in an analysis of cities that switched their form of government. Vlaicu argues that his finding reflects the fact that mayors have more incentive to pander to voters than do city-managers.[8]

A further related strand of the council-manager versus mayor-council literature is that seeking to understand why cities adopt one or the other form. Various theories of why cities switched to council-manager and adopted other related reforms have been offered.[9] These theories typically focus on class or ethnic conflict. A number of papers have explored these theories empirically, and have found little support for any of them (e.g., Dye and MacManus (1976), Farnham and Bryant (1985), and Knoke (1982)). Rather, the main empirical finding has been the importance of regional factors: council-manager cities are most prevalent in the West and the South. Our theory offers an alternative account of why cities choose one or the other form.

Our paper also relates to a literature on presidential versus parliamentary forms of government at the national level.[10] Under a presidential form of government, the legislature and executive are

[7] A number of earlier papers 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).

[8] Vlaicu develops a two period political agency model which generates this prediction.

[9] Switches to council-manager were often accompanied by switches to at-large elections for council-members and non-partisan elections.

[10] Also worth mentioning is the literature on elected versus appointed public officials. This literature seeks to understand the differences in policy choices made by public officials who are directly elected by the voters and those who are appointed by other elected politicians (e.g., Alesina and Tabellini (2007), Besley and Coate (2003), and Maskin and Tirole (2004)). Since city-managers are appointed by the council and mayors are directly

independently elected, while under a 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. Some papers in this literature are concerned with how fiscal policy differs under the two forms.[11] Persson, Roland and Tabellini (2000) examine these issues theoretically in the context of an infinite-horizon political agency model.[12] 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. 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 smaller government.[13]

While this paper's theory produces a similar finding to Persson, Roland and Tabellini, 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

elected by the voters, it may seem that the comparison of the policies made by council-manager and mayor-council governments falls squarely within the purview of this literature. However, it should be emphasized that officially city-managers and mayors have very different roles in the policy-making process. In a mayor-council city, the mayor jointly develops policy along with the council. In a council-manager city, the manager is an administrator not a policy-maker. The theory of spending decisions presented in this paper reflects this official distinction by assuming that the manager has no impact on policy in a council-manager government and therefore plays a very different role from the mayor in a mayor-council government. This said, we acknowledge that managers may have *de facto* policy-making power and it may therefore be useful to apply the insights from the elected versus appointed literature to the council-manager versus mayor-council question. Theoretical efforts in this direction by Enikolopov (2007) and Vlaicu (2008) should therefore be regarded as complementary to the theory presented here.

[11] See Carey (2004) for a broader overview of the literature, the bulk of which 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 cities are often dominated by a single party.

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

[13] Persson, Roland and Tabellini also analyze a third model designed to capture aspects of policy-making in parliamentary systems that are not embodied in the basic model. To reflect the process of government formation, a minimum winning coalition of legislators is first randomly selected to form a government. One legislator from the coalition (the prime minister) then proposes a policy. This policy is implemented only if unanimously approved by the minimum winning coalition. The unanimity requirement reflects the idea that the prime minister must have the full support of his governing coalition, or a government crisis will follow. In the event of such a crisis, policy-making reverts to the rules of the basic model. Persson, Roland and Tabellini show that in this third model, taxes, public good provision and political rents are higher than in the separation of powers model. Citizen welfare could be higher or lower.

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) analyze 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 and these results are robust to instrumental variables methods, matching, and Heckman selection corrections. In a panel analysis, Persson and Tabellini (2006) study how becoming a democracy impacts countries' economic policies and growth. Interestingly, they find that government spending decreases in countries who adopt a presidential form of government, but increases in countries who adopt a parliamentary form. The difference between government spending across the two forms is remarkably similar to the 5% of GDP estimate from their cross-sectional analysis.

Persson and Tabellini's empirical results stand in sharp contrast to the conventional wisdom in the council-manager versus mayor-council literature that there is little difference in public spending across the two forms. While politics at the national level is certainly more complicated than at the local level, one might expect similar political institutions to have similar effects in both contexts. Our empirical analysis suggests that this may indeed be the case and therefore takes a step towards unifying the presidential versus parliamentary and council-manager versus mayor-council literatures.

3 Theory

This section presents our theory of fiscal policy determination under the two forms of city government. It outlines the theoretical model and derives the model's implications for spending decisions. It also identifies and defends the core assumptions of the model.

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 a benefit parameter B_i. Citizens differ in the extent to which they value public programs. There are three *preference types*: high, moderate, and low, indexed by $k \in \{h, m, l\}$ respectively. If project i is undertaken, a citizen of preference type k receives a payoff of $\theta_k B_i - C_i$, where $\theta_h > \theta_m > \theta_l$. The fraction of citizens of preference type k is denoted μ_k. Both μ_h and μ_l are less than 1/2, implying that the median voter is a moderate.

We compare 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.[14]

Under both government forms, politicians are selected by the citizens in elections. Politicians are citizens and thus will also be either high, moderate, or low preference types. 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 preference type $j \in \{\alpha, \beta\}$.[15] The

[14] 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 city's chief administrative officer in the mayor-council form. An alternative approach would be to compare an n member council with a manager and an n member council with a mayor, under the assumption that the mayor undertakes 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 implications are broadly similar under either conception. The details are available from the authors upon request.

[15] This signal should be thought of as emerging during the campaign as a result of media coverage of candidates' backgrounds, televised debates, campaign advertising, newspaper endorsements, etc. It should not be interpreted as a strategic choice - otherwise, candidates would simply choose to send the signal most likely to get them elected.

probability that a candidate of *signal type* $j \in \{\alpha, \beta\}$ has 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, candidates of signal type α are more likely to be high preference types and candidates of signal type β are more likely to be low preference types. Moreover, symmetry prevails in the sense that the likelihood that a candidate of signal type α is a high preference type equals the likelihood that a candidate of signal type β is a low preference type and visa versa. For each seat in the council and mayor's office, there are two candidates, one of each signal type. 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.[16]

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. Let p_k denote the identity of the marginal project for citizens of preference type k; that is, $p_k = \max\{i : B_i/C_i \geq 1/\theta_k\}$, and assume that $1 < p_l < p_m < p_h < p$. Under either form of government, projects 1 through p_l will be funded and projects $p_h + 1$ through p will not be funded. The uncertainty concerns projects $p_l + 1$ through p_h. There are three possible outcomes: i) none of these projects are funded; ii) projects $p_l + 1$ through p_m are funded; and iii) all of these 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 Implications for public spending

Under council-manager, projects $p_l + 1$ through p_m will be funded if and only if at least q of the n elected council-members are either high or moderate preference types and projects $p_m + 1$ through p_h will be undertaken if and only if at least q of the n elected council-members are high preference types. 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 preference types when x members are of signal type β and $n - x$ are of

[16] In our data, about two-thirds of cities have at-large council elections, and the remaining one-third have either single-member district council elections or mixed systems with both district-based and at-large seats. The procedure for at-large elections varies across municipalities. In some, if there are x seats up for election, each voter can vote for up to x candidates, and the x candidates with the most votes are elected. In others, seats are numerically labeled (i.e., Council Seat #1, Council Seat #2, etc) and candidates must choose which seat to compete for. See Dye and MacManus (2003) for more detail. For an interesting analysis of the choice between at-large and district-based elections see Aghion, Alesina and Trebbi (2008).

signal 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 preference types when x members are of signal type β. Then, we can write the expected spending level under council-manager when x council-members are of signal type β as

$$S_C(x) = \sum_{i=1}^{p_l} C_i + \Pr(\#\frac{h+m}{n} \geq \frac{q}{n}\bigg| x) \sum_{i=p_l+1}^{p_m} C_i + \Pr(\#\frac{h}{n} \geq \frac{q}{n}\bigg| x) \sum_{i=p_m+1}^{p_h} C_i. \tag{1}$$

Under mayor-council, projects $p_l + 1$ through p_m will be approved if and only if at least $q - 1$ of the $n - 1$ council-members are either high or moderate preference types *and* the mayor is a high or moderate preference type. Similarly, projects $p_m + 1$ through p_h will be funded if and only if at least $q - 1$ of the $n - 1$ elected council-members are high preference types *and* the mayor is a high preference type. Thus, we may write the expected spending level under mayor-council when x council-members are of signal type β and the mayor is of signal type j as

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

Citizens choose the signal types of the elected officials and this will determine the expected spending levels under the two forms. The signal types they choose will depend on how sophisticated they are in their voting behavior. We consider two polar cases. The first is that citizens simply vote sincerely for the candidate whose favored policies they most prefer. The second is that they vote in a sophisticated manner, anticipating the policy outcomes associated with each possible mix of candidate types.[17]

3.2.1 Sincere voting

If citizens vote sincerely, high preference types will vote for candidates of signal type α and low preference types for candidates of signal type β. Moderates will vote for candidates of signal type α if the gain in surplus they get from projects $p_l + 1$ through p_m, which we denote by G, exceeds

[17] In elections for a single office holder who will be uniquely responsible for policy, 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 elections and this leads to the 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).

the loss of surplus they experience from projects $p_m + 1$ through p_h, which we denote by L.[18] If citizens vote in this way, in each race, the candidate of the signal type preferred by moderates will win and thus all the elected politicians will either be of signal type α or of signal 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:[19]

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

To understand the result intuitively, recall that projects $p_l + 1$ through p_m will be implemented under council-manager if at least q of the n elected politicians are high or moderate preference types. Under mayor-council, this condition is necessary but not sufficient. If it is satisfied but the mayor happens to be a low preference type, projects $p_l + 1$ through p_m will not be implemented. Similarly, projects $p_m + 1$ through p_h will be implemented under council-manager, if at least q of the n elected politicians are high preference types. Under mayor-council, this condition is necessary but not sufficient. If it is satisfied but the mayor is a low or moderate preference type, projects $p_m + 1$ through p_h 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 preference types is exactly the same as under council-manager because voters elect candidates of the same signal type under the two systems.

3.2.2 Sophisticated voting

The sincere voting underlying Proposition 1 is naive, because it does not take into account the political process determining spending levels. Sophisticated voters will understand how policy outcomes vary with different combinations of candidate types and will choose candidates accordingly. While high preference voters will still prefer candidates of signal type α and low preference voters candidates of signal type β, moderates will sometimes prefer a mix of the two signal 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

[18] Formally, $G = \sum_{i=p_l+1}^{p_m} (\theta_m B_i - C_i)$ and $L = \sum_{i=p_m+1}^{p_h} (C_i - \theta_m B_i)$.

[19] The proofs of all the theoretical results can be found in the Appendix.

voters select more candidates of signal type α under mayor-council.

Before analyzing the mix of candidates moderates prefer, we should note that they must coordinate on which candidates to support. For example, if there are three seats and the optimal number of candidates of signal type β is two, moderates must decide in which two races they will back type β candidates. If moderates fail to anticipate correctly how other moderates are 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 politicians of each signal type.

Under council-manager, a moderate's expected payoff with x council-members of signal type β can be written as

$$U_C(x) = \sum_{i=1}^{p_l}(\theta_m B_i - C_i) + \Pr(\frac{\#h+m}{n} \geq \frac{q}{n}\bigg| x)G - \Pr(\frac{\#h}{n} \geq \frac{q}{n}\bigg| x)L. \tag{3}$$

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

$$x_C = \arg\max\{U_C(x) : x \in \{0, 1, ..., n\}\}. \tag{4}$$

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

$$U_M(x,j) = \sum_{i=1}^{p_l}(\theta_m B_i - C_i) + (1-\pi_l^j)\Pr(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\bigg| x)G - \pi_h^j \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\bigg| x)L. \tag{5}$$

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

$$(x_M, j_M) = \arg\max\{U_M(x,j) : (x,j) \in \{0, 1, ..., n-1\} \times \{\alpha, \beta\}\}. \tag{6}$$

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 preference types, it reduces the probability of the loss L. The cost is that, by making the council more likely to be dominated by low preference types, it also reduces the probability of the gain G. From (3), 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

$$\frac{\Pr(\frac{\#h}{n} \geq \frac{q}{n} \Big| x) - \Pr(\frac{\#h}{n} \geq \frac{q}{n} \Big| x+1)}{\Pr(\frac{\#h+m}{n} \geq \frac{q}{n} \Big| x) - \Pr(\frac{\#h+m}{n} \geq \frac{q}{n} \Big| x+1)} > \frac{G}{L}. \tag{7}$$

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 preference types 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 preference types. Moderate voters will keep on raising the number of type β council-members as long as this inequality holds. Condition (7) can therefore be used to characterize x_C.

The problem of moderates 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 (5), 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

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

Condition (8) 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 (7) and (8).

We now present:

Proposition 2: *If voters are sophisticated and if*

$$\frac{G}{L} \notin \left(\frac{\sum_{s=q-1}^{n-1} \binom{n-1}{s} \underline{\pi}^s (1-\underline{\pi})^{n-1-s}}{\sum_{s=q-1}^{n-1} \binom{n-1}{s} (1-\overline{\pi})^s \overline{\pi}^{n-1-s}}, \frac{\underline{\pi}^{q-1}(1-\underline{\pi})^{n-q}}{(1-\overline{\pi})^{q-1}\overline{\pi}^{n-q}} \right), \tag{9}$$

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

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, 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.[20] Thus, Proposition 2 can be interpreted as implying that the expected spending result of Proposition 1 will typically hold even with sophisticated voters.

The proof of Proposition 2 consists of five distinct steps. The first establishes that both the probabilities of approving projects $p_l + 1$ through p_m and projects $p_m + 1$ through p_h are lower under mayor-council whenever the *total* number of politicians of signal type β elected under mayor-council (i.e., including both council-members and the mayor) is greater than or equal to that elected under council-manager. The second shows that if a mayor of signal type α 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., $x_M = n-1$). The third step shows that if a mayor of signal type β 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., $x_M = 0$). The fourth step combines 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 $(x_M, j_M) = (n-1, \alpha)$. The fifth and final step establishes 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 (9).

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

The most difficult part of the proof is establishing the second and third steps. Here the marginal conditions (7) and (8) are key. The second step is completed by showing that, with a type α mayor, the left hand side of (7) is exactly equal to (8) for all $x \in \{0, ..., n-2\}$.[21] 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 (7) evaluated at $x-1$ is exactly equal to (8) evaluated at $x \in \{0, ..., n-2\}$. 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 (9) is not satisfied. The answer is not necessarily, but possibly. The Appendix presents an example with $n = 3$ and $q = 2$ in which the parameters $(G/L, \underline{\pi}, \overline{\pi})$ violate (9) and the probability of approving projects $p_l + 1$ through p_m and projects $p_m + 1$ through p_h is higher under mayor-council. Obviously, this implies that the expected spending level will be higher under mayor-council.

To sum up, in principle, sophisticated voting could undermine the spending difference between the two forms of government if voters select candidates who are more likely to be low preference types 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 preference types are similar. Admittedly, the model is restrictive in assuming that voters have only two signal types of candidates from which to choose. Moreover, it is clear that introducing multiple types of candidates would make the model very intractable. Nonetheless, the analysis demonstrates that the spending result is at least somewhat robust to relaxing the sincere voting assumption.

3.3 Discussion of the model

Our theory of fiscal policy determination under mayor-council and council-manager forms of government makes three key assumptions. First, that candidates for public office have heterogeneous

[21] The symmetry assumption that the likelihood that a candidate of signal type α is a high preference type equals the likelihood that a candidate of signal type β is a low preference type and visa versa is key for this step.

preferences over public programs which, while governing their behavior if elected, are not perfectly observed by voters. Second, that under council-manager, programs are approved if and only if they receive support from the required majority of the council. Third, that under mayor-council, programs are approved if and only if they receive support from the required majority of the council *and* the mayor. We now discuss and defend these assumptions.

The first assumption is necessary to generate a difference between the two forms. If all politicians had the same preferences or, alternatively, if voters could perfectly observe politicians' preferences and elect only those who shared the majority preference, then the two forms of government would deliver exactly the same project choices.[22] In our view, it seems indisputable that politicians, as citizens, will have heterogeneous preferences over programs. Moreover, it seems hard to believe that voters will perfectly know these preferences when they elect them. Voters often appear surprised by the revealed preferences of national leaders, let alone city politicians.

Perhaps the best line of attack against the first assumption would be to argue that politicians, while having different policy preferences, will not indulge these when in office because of the fear of not being re-elected. Suppose, for example, that if voters observed anything other than projects 1 through p_m being implemented, they would remove all incumbents at the next election. Then, if the rewards from holding office are sufficiently large, politicians would only approve projects 1 through p_m under either form of government and there would be no spending difference. We have three responses to this argument.[23] First, as a matter of fact, the rewards to holding office at the city level are not large. It is not a job which comes with glamorous perks, high salary, or significant social prestige. As reported by Ross and Levine (2006), many seats are uncontested and, even though it is relatively easy for incumbents to get re-elected, many city council-members serve only one term. Second, even if the rewards of office were large, the argument overstates the power of re-election incentives. In reality, voters will not know perfectly which projects would be supported by the different preference types. This is because the benefits of many projects will be stochastic, so that even a project which would not be supported ex ante by a voter might turn out to yield net benefits ex post. Moreover, if candidates differ in their initial reputations (or some

[22] This conclusion would be in line with Deno and Mehay (1987) and the median voter approach to local politics more generally.

[23] See also Dye and MacManus (2003) who argue that "electoral accountability" has little direct influence over city council-members. Consistent with our model, they argue that any congruence between the views of citizens and council-members comes from "belief sharing" (p.381).

other characteristic such as charisma), voters will not be indifferent over candidates at the time of re-election. Such heterogeneity will dampen re-election incentives because voters know that policy decisions are determined collectively and will be unlikely to know each individual's voting decision. This will protect politicians with good initial reputations because they can always blame others for the introduction of unsuccessful projects.[24] Third, there is much empirical evidence to the effect that politicians follow their policy preferences even when holding offices that are highly prestigious (see, for example, Levitt (1996) on U.S. senators).

The main content of the second assumption is that the city manager has no independent influence on policy choices under council-manager. This is so even though the manager, with the cooperation of city administrators, typically prepares the budget for the council in council-manager cities. We see three possible justifications for this assumption. The first is that the council is able to appoint a manager who shares the policy preferences of the majority of its members. The second is that the threat of being fired by the council is sufficient to deter the manager from indulging his preferences by omitting programs that are demanded by the majority or adding programs that do not have majority support.[25] The third is that the manager views his professional role as implementing the policy choices of the council, rather than pursuing his own policy preferences. Note that either of the first two justifications create an asymmetry in the relationship between council-members and the manager on the one hand, and voters and council-members on the other. After all, we have assumed that voters can neither perfectly observe politicians' policy preferences nor control them ex post via the threat of re-election. However, this asymmetry is natural because the council will be much better informed about its manager than voters will be about their politicians.[26]

The third assumption is key for the spending result because it creates an asymmetry between the blocking and passing of projects. In particular, while both the council and the mayor can

[24] The relative effectiveness of re-election incentives under the two government forms in a model in which candidates have heterogeneous reputations and projects have stochastic payoffs is an interesting (but challenging) topic for futher study. Intuitively, the strength of the re-election incentive will be determined by how much voters update positively or negatively after observing policy outcomes. One might conjecture that the mayor will have stronger re-election incentives than will council-members in a council-manager system because voters know that if a project is introduced then the mayor must have approved it. However, one must bear in mind that, if a project is not introduced, then voters do not know whether this reflects the mayor or the council's decision.

[25] By all acounts, turnover among city managers is frequent and the time spent in any given city is brief. In a sample of 120 larger council-manager cities, Ammons and Bosse (2005) found that the median completed tenure of departing city managers was just five years.

[26] We would also note that if it is the case that the manager can influence policy choices in a council-manager system, than so presumably can a city's chief administrative officer in a mayor-council city.

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.[27]

Our motivation for the third 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.[28] 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 procedures vary considerably across mayor-council cities. In some cases, 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 or veto the whole package. The council may then be able to override the mayor's vetoes with a super-majority vote.[29]

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[27] 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.

[28] 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 (1990) and Mullin et al (2004) for additional details. This budgetary process is also in place in a number of countries with presidential form of governments (see Shugart and Haggard (2001)). For example, 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.

[29] While the use of such selective vetos does not seem to be important in practice, if it were then 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.

Despite the rich variation in the details of the budgetary process across mayor-council 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.[30] The mayor's role in the budget preparation process 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 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.[31] 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, in the vast majority of cities, service on the council is a part-time job (see, for example, Ross and Levine (2006)). Second, council-members will also have much less information than the executive about the costs of different budgetary options and such information that they do have will typically be provided by the executive. 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.[32]

4 The choice of government form

We now turn to the question of which system of government citizens would choose if they had a referendum before city elections are held. We both derive the implications of our theory and discuss what they imply for our empirical work. Our analysis will presume that citizens understand the forces underlying the trade off highlighted by our theory. We recognize that this may be a heroic assumption given that the existing academic literature on U.S. cities does not offer a coherent

[30] The diversity of procedures 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.

[31] In the words of Dye and MacManus (2003): "Council members do *not* usually serve as either general policy innovators or general policy leaders. The role of the council is largely passive, granting or withholding approval in the name of the community when presented with proposals from a leadership outside of itself." (p. 380 italics in the original).

[32] 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).

message on the spending difference between the two forms. However, it is widely understood that the mayor-council form embodies more "checks and balances" and our theory can be interpreted as capturing the benefits and costs of these additional checks and balances.

4.1 Implications of the theory

We begin with the case in which citizens vote sincerely in city elections. Recall that both the probabilities of approving projects $p_l + 1$ through p_m and projects $p_m + 1$ through p_h are lower under mayor-council than under council-manager. Thus, high preference types will always favor council-manager and low preference types mayor-council. Moderates 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.

Recall that the median voter is a moderate so that which ever system preferred by moderates will be majority preferred. To quantify the moderates' trade off, suppose first that $G > L$ so that candidates of signal type α will be elected under both government forms. A moderate's expected payoff under council-manager will therefore be $U_C(0)$ and under mayor-council will be $U_M(0, \alpha)$. If $G < L$ so that candidates of signal type β 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 $U_M(n-1, \beta)$. Differencing these payoffs, we obtain:

Proposition 3: *Suppose that voters vote sincerely in candidate elections. Then, if $G > L$ a majority of voters prefer council-manager to mayor-council if and only if*

$$\underline{\pi}\,\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\bigg|\, 0)G > (1-\overline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\bigg|\, 0)L, \tag{10}$$

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

$$\overline{\pi}\,\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\bigg|\, n-1)G > (1-\underline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\bigg|\, n-1)L. \tag{11}$$

To understand this result intuitively, consider the case in which $G > L$. The term multiplying G on the left hand side of inequality (10) is the probability that under mayor-council, more than q of the $n-1$ council-members will be high or moderate preference types but the mayor will be a low preference type. This is precisely the circumstance under which projects $p_l + 1$ through p_m will be rejected under mayor-council but would not have been under council-manager. Similarly, the term multiplying L on the right hand side of inequality (10) is the probability that under mayor-council, more than q of the $n-1$ council-members will be high preference types and the mayor will not be a high preference type. This is the probability that projects p_m+1 through p_h 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 theory can explain the fact that both government forms co-exist, which is obviously essential given the data. It is clear from (10) and (11) that council-manager will be more likely to be favored by voters when the surplus from projects that low preference types would remove (i.e., G) is high relative to the loss from projects that high preference types would add (i.e., L). It is also clear that, when $G > L$ and there is only a very small chance that candidates of signal type α are low preference types (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 candidates of signal type β are high preference types (i.e., $\overline{\pi} \approx 0$) 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.

Note that Proposition 3 assumes that moderate voters understand the difference in spending between mayor-council and council-manager when choosing the form of government but nonetheless vote 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 above, with sophisticated voting, except possibly in a very small part of the parameter space, both the probabilities of approving projects p_l+1 through p_m and projects p_m+1 through p_h, 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).

4.2 Implications for the empirical analysis

Our empirical analysis not only investigates the theoretical prediction that *ceteris paribus* mayor-council cities will have lower expected spending than council-manager cities, but also seeks to shed light on the quantitative magnitude of any such spending differences across government forms. We do this by comparing public spending in mayor-council and council-manager cities. If there are unobserved characteristics of cities which affect both their choice of government form and their spending levels, then this analysis will yield biased estimates.[33] However, we will show here that, if our theory correctly captures the forces leading cities to choose one or the other form, the bias associated with the endogenous choice could go in either direction. What this means is that, if our theory is correct, there is no a priori reason to believe that our estimate of the quantitative magnitude of the impact of government form is biased in one or the other direction.

To see this, consider what types of changes could induce a city to switch its form of government and the implications of such changes for spending levels. From Proposition 3, we see that an increase in the ratio G/L could induce a switch from mayor-council to council-manager.[34] To understand what changes in the underlying environment could cause an increase in G/L, it is useful to refer to Figure 2. The vertical axis measures project benefits and costs and the horizontal axis indexes projects. To facilitate a graphical analysis, we have assumed that there are a continuum of projects and that the cost of each project is constant at C. The three downward lines represent the project benefits $\theta_k B_i$ of the three preference types and the horizontal line the constant project cost. The intersection of the benefit and cost lines determine each group's marginal project p_k. The area G is the gain in surplus moderates get from projects p_l through p_m and the area L is the loss they experience from projects p_m through p_h.

An increase in G/L could arise from a shift up in the moderates' preference parameter θ_m. This would shift the line $\theta_m B_i$ to the right, increasing p_m. The increase in p_m would, in turn, increase G and reduce L. Alternatively, an increase in G/L could arise from a shift down in either

[33] See Sass (1991) for an explicit demonstration of this in a context in which a municipality is choosing between representative and direct democracy.

[34] From Proposition 3, we also see that the parameters $\underline{\pi}$ and $\overline{\pi}$ play a role in determining which form of government citizens prefer. However, deriving the comparative static implications of changes in these parameters is difficult because the probabilities in inequalities (10) and (11) are complex functions of $\underline{\pi}$ and $\overline{\pi}$. For example, when $G > L$, as we increase $\underline{\pi}$ we simultaneously increase the probability of electing a mayor who is a low preference type but reduce the probability that q or more of the $n-1$ council-members are high or moderate preference types. Accordingly, we illustrate our argument with changes in the ratio G/L.

the low or high type's preference parameters θ_l and θ_h. A shift down in θ_l would shift the line $\theta_l B_i$ to the left and reduce p_l. The reduction in p_l would increase G and have no effect on L. Notice that while both these changes increase G/L, they have opposite effects on expected spending. Holding constant the form of government, a hike in θ_m will increase expected spending. This is because it will increase the number of projects moderate politicians will implement should they be decisive. A fall in θ_l, on the other hand, will reduce expected spending because it will decrease the number of projects low preference type politicians will implement should they be decisive.

It follows that changes that could induce a city to switch its form of government from mayor-council to council-manager could either increase or decrease expected spending, holding constant government form. Thus, if the theory correctly describes citizens' choice of government form, then the bias arising from endogeneity could go in either direction. If the forces that lead cities to adopt a council-manager form correspond primarily to decreases in θ_l and θ_h, then the actual increase in the city's expected spending will be less than implied by a random switch to council-manager. On the other hand, if the forces that lead cities to adopt a council-manager form correspond primarily to increases in θ_m, then the actual increase in the city's expected spending will be more than implied by a random switch to council-manager.

5 Evidence

This section investigates the theoretical prediction that *ceteris paribus* public spending will be lower under mayor-council than council-manager. It begins by describing the data and then turns to the econometric analysis of the relationship between government form and public finances. It also compares the results with those obtained by MacDonald (2008).

5.1 Data

Our empirical analysis uses information on political institutions, government finances, and city demographics. These three pieces of information are derived from three separate data sources. Our data on political institutions come 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. 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. While ICMA mails surveys to all cities with population greater than 2,500, they only send surveys to a select set of cities with population below 2,500. Given that this set may not be representative of all small cities, we focus only on those cities with population in excess of 2,500.

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.[35] 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.[36] 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 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 due to measurement error associated with survey respondents in different years having disparate interpretations of the city's form of government.[37] 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.

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

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

[37] In the 2001 ICMA survey respondents are asked to indicate their city's current form of government as defined by its charter, ordinance, or state law, and are given five different choices: mayor-council, council-manager, commission, town meeting, and representative town meeting. Mayor-council is described as "Elected council or board serves as the legislative body. The chief elected official is head of government, with significant administrative authority, generally elected separately from the council." Council-manager is described as "Elected council or board and chief elected official (e.g., mayor) are responsible for making policy. A professional administrator appointed by the board or council has full responsibility for the day-to-day operations of the government." While these definitions are certainly correct, the fact that many council-manager cities now separately elect a mayor does create the possibility for confusion. Direct evidence of confusion on the part of respondents comes from the large number of cases in which cities switch form in one survey year and then switch back in the following survey year. In particular, we found over 200 cases in the ICMA data of such double switching, and we suspect that this is evidence of confusion rather than instances in which the city actually changed their government form twice in 10 years.

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.[38] Also, since we cannot check the prior survey for the first year of the sample, 1982, we exclude these observations from our cross-sectional analysis.[39] This process removes roughly 4,000 observations from 1982 plus about 1,000 post-1982 observations, which represents about 7 percent of the original post-1982 dataset.

Our data on government finances come from the Census of Governments for fiscal years 1982, 1987, 1992, 1997, and 2002. 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. Our measure of public spending is general expenditure per-capita, which excludes government spending on utilities, liquor stores, and insurance trusts.[40] In order to make the measures comparable across time, we convert all spending to 2002 dollars by using the CPI deflator.

Finally, city demographics, which are used as control variables, come from the decennial Census. In particular, we employ three measures of citizen preferences for public spending: per-capita income, fraction of residents with a high school degree, and fraction over age 65. To construct city-level measures of these variables, we use GeoLytics CDs. We match the 1980 Census demographics with the 1981 political institutions, the 1990 Census demographics with the 1991 political institutions, and the 2000 Census demographics with the 2001 political institutions.[41] For the 1986 political institutions, we average the Census demographics from 1980 and 1990, and we use an analogous procedure for computing demographics to match with the 1996 political institutions.

[38] As a robustness check, we also undertook the analysis with a more conservative measure of switching which excludes such cities. This yields very similar results.

[39] This choice does not substantively affect our cross-sectional results. In particular, the 1982 results are qualitatively similar to those in the other years of our analysis. Note also that the 1982 observations are implicitly included in our panel analysis, since the first set of observations is based upon changes between 1982 and 1987.

[40] In addition to spending measures, we have also analyzed revenue measures at the city level and find broadly similar results. This suggests that any spending differences between mayor-council form and council-manager form are not driven by differences in budget deficits.

[41] Similarly to the government spending measures, we convert all income to 2002 dollars using the CPI deflator.

Tables 1, 2, and 3 provide summary statistics for our data set. 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 49 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 decline in the prevalence of mayor-council form documented in Table 1 is largely due to changes in the composition of the sample.[42] In particular, we have 71 city-year observations, or less than one percent of the sample, switching from mayor-council to council-manager, and only 32 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 support for the theoretical prediction. Regarding population, mayor-council cities average about 24,000 residents and are smaller than council-manager cities, which average almost 29,000 residents. In terms of demographics, citizens in mayor-council cities are on average older, poorer, and less educated than their counterparts in council-manager cities.

5.2 Cross-sectional analysis

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

$$\ln(S_m/N_m) = \alpha_1 \ln(N_m) + \alpha_2 \mathrm{MC}_m + \boldsymbol{\alpha}_3 \mathbf{X}_m + \alpha_s + e_m. \tag{12}$$

Here S_m represents government spending in municipality m, N_m represents municipal population, MC_m indicates the presence of mayor-council form relative to council-manager form, $\mathbf{X}_m$ represents a vector of municipality demographics, and α_s represents a series of state fixed effects, which are included to capture both regional patterns in form of government as well as the responsibilities of municipal governments relative to other localities.[43] Finally, e_m represents unobserved determinants of municipal spending. We measure the per-capita 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.

[42] Indeed, when restricting the sample to those municipalities included in the sample in all of the survey years, we see only a very small trend in the direction of council-manager form. One explanation for the trend in Table 1 away from council-manager form is that newly incorporated cities are more likely to be council-manager form.

[43] As noted in Section 2.1, it is well established that there are significant regional differences in the adoption of the council-manager form.

Table 4 reports the results from the cross-sectional analysis separately by year. As shown, mayor-council form 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 difference in government spending of between 8 and 16 percent. Given the summary statistics in Table 3, this represents a difference in government spending of roughly \$80 to \$160 per-capita on an annual basis. Regarding other city characteristics, per-capita spending is increasing in population and in the fraction of the population over age 65. The elasticity of public spending with respect to income is measured at between 0.26 and 0.34 across the four years. Somewhat surprisingly, the results suggest that per-capita spending is declining in educational attainment. This result is due to a strong correlation (about 0.75) of educational attainment with per-capita income. When we drop income from the regression, the coefficient on fraction of high-school graduates becomes strongly positive in each of the four years, and the coefficient on mayor-council form is largely unchanged.

Interestingly, the measured differences in government spending are stronger in magnitude in the early years of the analysis, 1987 and 1992, relative to the final year of the analysis, 2002. One possible explanation for this trend in the coefficients is a convergence in forms of government over time. As noted earlier, council-manager cities have increasingly chosen to separately elect a mayor. According to some sources, the power allocated to these mayors have also increased.[44] Thus, the distinctions between mayor-council and council-manager form may have become less sharp over time, and this could explain the smaller estimated difference between mayor-council cities and council-manager cities in the latter years of our analysis.

5.3 Panel analysis

We next conduct a panel analysis which focuses on changes in government form within cities over time. The source of variation is different from the cross-sectional analysis, and thus we view these two analyses as complementary. Our panel analysis is based upon taking first differences of the key variables in equation (12) above and estimating the following regression specification:

$$\Delta \ln(S_{mt}/N_{mt}) = \alpha_1 \Delta \ln(N_{mt}) + \alpha_2 \Delta \mathrm{MC}_{mt} + \boldsymbol{\alpha}_3 \Delta \mathbf{X}_{mt} + \alpha_s + \alpha_t + \Delta e_{mt}, \tag{13}$$

[44] See DeSantis and Renner (2002) and Frederickson, Johnson, and Wood (2004).

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 just over 9 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. In contrast to the cross-sectional results above, we find that increases in population are associated with declines in per-capita spending. We again find a positive coefficient on per-capita income but find no statistically significant effects associated with changes in the fraction of the population with high school degrees or the fraction over age 65.

The regression model in equation (13) implicitly assumes that switches from council-manager to mayor-council ($\Delta\text{MC}_{mt} = 1$) have equal and opposite effects of switches from mayor-council to council-manager ($\Delta\text{MC}_{mt} = -1$), relative to jurisdictions experiencing no change in government form ($\Delta\text{MC}_{mt} = 0$). We next relax this symmetry assumption by estimating the following panel-data regression model:

$$\Delta \ln(S_{mt}/N_{mt}) = \alpha_1 \Delta \ln(N_{mt}) + \alpha_3 I[\Delta\text{MC}_{mt} = 1] + \alpha_4 I[\Delta\text{MC}_{mt} = -1] + \boldsymbol{\alpha}_5 \Delta\mathbf{X}_{mt} + \alpha_s + \alpha_t + \Delta e_{mt}. \tag{14}$$

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; the latter coefficient, however, is not statistically different from zero at conventional levels. Again, both of these results should be considered relative to jurisdictions with no changes in government form in that year ($\Delta\text{MC}_{mt} = 0$). Also, we can reject the null hypothesis that spending changes in similar ways following switches to and from mayor-council form (i.e., that $\alpha_3 = \alpha_4$) at conventional significance levels. We fail to reject, however, the symmetry assumption implicitly imposed in equation (13) (i.e., that $\alpha_3 = -\alpha_4$) at conventional significance levels.

5.4 Interpretation

Although the sources of variation are different, the cross-sectional and panel results both demonstrate that, conditional on observed characteristics, spending is lower under mayor-council form, relative to council-manager form. However, interpreting these results as supportive of the theoretical prediction that *ceteris paribus* mayor-council leads to lower spending requires additional assumptions. In particular, in order to interpret the cross-sectional results as causal, the key identifying assumption is that unobserved determinants of public spending (e_m) are independent of government form; that is, $\mathrm{E}(e_m|\mathrm{MC}_m = 1) = \mathrm{E}(e_m|\mathrm{MC}_m = 0)$. In the panel analysis, the key assumption is that changes in unobserved determinants of public spending (Δe_{mt}) are independent of changes in government form over time; that is, $\mathrm{E}(\Delta e_{mt}|\Delta\mathrm{MC}_m = 1) = \mathrm{E}(\Delta e_{mt}|\Delta\mathrm{MC}_m = 0) = \mathrm{E}(\Delta e_{mt}|\Delta MC_m = -1)$. Note that these identifying assumptions are different so that, even though the interpretation of the coefficient on government form is common, the two analyses are distinct.

If these identifying assumptions are satisfied, the results clearly provide strong support for the theoretical prediction. However, we would be remiss in not acknowledging that these assumptions may be violated due to the endogenous choice of government form. It could be, for example, that a random switch from council-manager to mayor-council form would have no effect on a city's spending and the econometric results just reflect the fact that cities that either have, or have switched to council-manager governments, possess unobserved characteristics which generate higher spending. While we think this is unlikely given the set of controls that we employ, we cannot definitively rule this out.

This duly acknowledged, we do feel the evidence suggests that the difference in decision-making highlighted by our theory is relevant. Given this, the next question involves the quantitative significance of this difference. After all, it would be perfectly consistent with the theory for there to be only a very small difference in expected spending levels across forms. The size of the coefficients in our regressions suggest otherwise, but again the issue of endogeniety bias must be raised. Here, however, the discussion from Section 4.2 provides some reassurance. If our theory also correctly captures the forces underlying the choice of government form, then there is no *a priori* reason to believe that our estimates of the effect of a random switch to council-manager are biased in either direction. As shown in the previous section, if the forces that lead a city to adopt a council-manager form correspond primarily to changes in the preferences of non-centrist groups, then the actual increase in the city's expected spending will be less than implied by a random switch to council-manager. On the other hand, if the forces that lead a city to adopt a council-manager form correspond primarily to changes in the median voter's preferences, then the actual increase in the city's expected spending will be more than implied by a random switch to council-manager. Thus, assuming that our theory is correct, we have no reason to believe that the quantitative magnitudes of our estimates are misleading.

5.5 Comparison with MacDonald's findings

As noted in Section 2, MacDonald (2008) uses a very similar data set and set of techniques, but reaches the conclusion that there are no significant differences in public spending across the two forms government. We now try to shed light on why the empirical results of the two papers differ.

There are three important differences between our cross-sectional analysis and that of MacDonald. The first is that she has an expanded set of control variables, including other Census variables, and given her more general focus on city political institutions, other political variables from the ICMA data. The second is that she does not include state fixed effects. The third is that she focuses on cities with population above 10,000, whereas we use a lower population threshold of 2,500.

In the first row of Table 6, we present results from a specification similar to MacDonald's baseline analysis. In addition to excluding state fixed effects and using the higher population threshold, this specification includes an expanded set of control variables that includes many, although not all, of the measures used by MacDonald.[45] To simplify the presentation of the results, we only display the coefficient on mayor-council form.[46] As shown, our specification yields results that are qualitatively similar to those of MacDonald, and mayor-council form is associated with a reduction in government spending only in the 1987 sample.

To isolate which of these three differences in our specifications is driving the differences in results, we next present results from three specifications in which we begin with our baseline model and then modify it to reflect each of the differences between our specification and MacDonald's. As shown in the second row, when we use the expanded set of controls but include state fixed effects and use our lower population threshold, we find effects on government spending that are similar to our baseline results. Thus, the set of controls does not seem to be driving the differences in results. As shown in the third row, when we exclude state fixed effects but use the baseline set of controls and our lower population threshold, we again find effects that are similar to our

[45] In addition to our set of controls, MacDonald controlled for the size of the city council, racial heterogeneity on the council, racial heterogeneity in the population, income inequality, fraction of council seats elected from districts, citizen initiative / referendum, retail sales, and percent of public spending by local governments. Our expanded set of controls includes council size, fraction black, income inequality, fraction of council seats elected from districts, and citizen initiative / referendum. Note that MacDonald's measure of the percent of public spending by local governments varies only at the state-level and will thus be captured by state fixed effects.

[46] The full set of results is available from the authors.

baseline results. Finally, as shown in the fourth row, we do find weaker effects of government form on spending when using MacDonald's population threshold but our baseline set of controls and state fixed effects. With the exception of the 1992 analysis, the results are similar to those in the first row, and mayor-council form is associated with a reduction in government spending in only two out of the four years. Note that this statistical insignificance reflects not only the smaller coefficients but also the reduction in power associated with focusing on this subsample of the dataset.

Our panel analysis also differs from that of MacDonald in three ways. In addition to differences in the set of control variables and the population threshold, she uses a measure of switching that is based upon comparisons of reported government form across survey years. As noted above, we use a more conservative measure based upon whether or not cities explicitly reported a change in form of government.[47] In the first row of Table 7, we present results from a panel specification similar to MacDonald's baseline panel analysis. Again, to simplify the presentation of the results, we only display the coefficient on mayor-council form.[48] As shown, we too find no effects of government form on public spending when running a fixed effects panel data regression similar to MacDonald.

To isolate which of these three differences in specification is driving the difference in results between our panel analyses, we again present three specifications in which we begin with our baseline model and then modify it to reflect each of the differences between our specification and MacDonald. As shown in the second row, when we use her measure of switching but our baseline set of controls and our lower population threshold, we find that mayor-council form is associated with a statistically significant reduction in government spending. But the magnitude is much smaller than in our baseline panel analysis, which suggested a larger reduction of around 9 percent. As shown in the third row, using her expanded set of control variables only serves to strengthen our panel results. Similarly, as shown in the fourth row, running our specification with her higher population threshold also serves to strengthen the panel results.[49]

[47] Note that her panel analysis includes municipality fixed effects and thus state fixed effects are implicitly included. We should also note that she presents an alternative specification with no population threshhold. This is different from our analysis, which uses a 2,500 population threshhold.

[48] The full set of results is available from the author.

[49] This final finding is consistent with MacDonald's analysis, where she finds somewhat stronger effects of council-manager form when using the 10,000 population threshold, relative to a specification with no population threshold, although neither of these coefficients are statistically significant in her analysis.

In summary, the differences in the cross-sectional results between the two papers seem to be driven largely by differences in the population threshold. This suggests that the effect of form of government is larger in smaller cities. However, in the panel analysis, our results are strengthened by focusing on the set of larger population cities, casting doubt on this conclusion. While we do not have any definitive explanation for these population-related differences between the cross-sectional and panel analyses, it is nonetheless reassuring that our results are not entirely driven by these small cities. Relative to MacDonald, the differences in the panel results seem to be largely driven by differences in the switching measure. Her reported switching rates are much higher than ours, and, as argued above, our measure more accurately reflects the recent degree of switching in government form. Moreover, any measurement error associated with this measure of switching may bias her estimated effects of government form towards zero.

6 Conclusion

This paper has made two contributions. The first is to offer a theory of fiscal policy determination 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. It implies that expected public spending will be lower under mayor-council. It also implies that either system could be chosen by voters in a referendum. This means that the theory is consistent with the co-existence of both government forms.

The second contribution of the paper is to empirically investigate the prediction of the theory as regards spending. Our findings support the theory. This is a major departure from prior work, which has come to the conclusion that there is no difference in size of government under the two forms. Independently of the forces that might be generating this result, the finding suggests an important revision to the conventional wisdom about urban public finance in the U.S.. It is also notable that the finding is consonant with the difference between size of government across countries with presidential and parliamentary forms of government.

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7 Appendix

7.1 Proof of Proposition 1

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

$$\begin{aligned} S_C(0) - S_M(0,\alpha) = {} & [\Pr(\#\tfrac{h+m}{n} \geq \tfrac{q}{n}\big|\, 0) - (1-\pi_l^\alpha)\Pr(\#\tfrac{h+m}{n-1} \geq \tfrac{q-1}{n-1}\Big|\, 0)] \sum_{i=p_l+1}^{p_m} C_i \\ & +[\Pr(\#\tfrac{h}{n} \geq \tfrac{q}{n}\big|\, 0) - \pi_h^\alpha \Pr(\#\tfrac{h}{n-1} \geq \tfrac{q-1}{n-1}\Big|\, 0)] \sum_{i=p_m+1}^{p_h} C_i. \end{aligned} \tag{15}$$

Now observe that

$$\Pr(\#\frac{h+m}{n} \geq \frac{q}{n}\Big|\, 0) = (1-\pi_l^\alpha)\Pr(\#\frac{h+m}{n-1} \geq \frac{q-1}{n-1}\Big|\, 0) + \pi_l^\alpha \Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\Big|\, 0), \tag{16}$$

and that

$$\Pr(\#\frac{h}{n} \geq \frac{q}{n}\Big|\, 0) = \pi_h^\alpha \Pr(\#\frac{h}{n-1} \geq \frac{q-1}{n-1}\Big|\, 0) + (1-\pi_h^\alpha)\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\Big|\, 0). \tag{17}$$

Substituting (16) and (17) into (15) and using the assumptions that $\pi_l^\alpha = \underline{\pi}$ and that $\pi_h^\alpha = \overline{\pi}$, we obtain

$$S_C(0) - S_M(0,\alpha) = \underline{\pi}\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\Big|\, 0) \sum_{i=p_l+1}^{p_m} C_i + (1-\overline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\Big|\, 0) \sum_{i=p_m+1}^{p_h} C_i.$$

Both terms in this expression are positive since, by assumption, $\underline{\pi}$ and $1-\overline{\pi}$ are positive numbers. ■

7.2 Proof of Proposition 2

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

7.2.1 Step 1: Comparing probabilities

We claim that mayor-council generates lower probabilities of approving projects $p_l + 1$ through p_m and projects $p_m + 1$ through p_h, 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 $x \in \{0, ..., n-1\}$

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

and

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

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 $x \in \{1, ..., n\}$

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

and

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

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

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

and that

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

For the second, note that

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

and that

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

7.2.2 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 (7), 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

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

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 (8), 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

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

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

$$(1-\pi_l^\alpha)\Pr\left(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\middle| x\right) = \Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| x\right) - \pi_l^\alpha \Pr\left(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\middle| x\right). \tag{19}$$

Substituting (19) into (18), we obtain

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

Thus, we may write

$$\begin{aligned}&(1-\pi_l^\alpha)[\Pr(\tfrac{\#h+m}{n-1} \geq \tfrac{q-1}{n-1}\big| x) - \Pr(\tfrac{\#h+m}{n-1} \geq \tfrac{q-1}{n-1}\big| x+1)]\\ &= (\pi_l^\beta-\pi_l^\alpha)[\Pr(\tfrac{\#h+m}{n-1} \geq \tfrac{q-1}{n-1}\big| x) - \Pr(\tfrac{\#h+m}{n-2} \geq \tfrac{q-1}{n-2}\big| x)]\end{aligned} \tag{20}$$

Next note that

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

implying that

$$\begin{aligned}\Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| x\right) - \Pr\left(\frac{\#h+m}{n-2} \geq \frac{q-1}{n-2}\middle| x\right) &= (1-\pi_l^\alpha)\begin{bmatrix}\Pr(\tfrac{\#h+m}{n-2} \geq \tfrac{q-2}{n-2}\big| x)- \\ \Pr(\tfrac{\#h+m}{n-2} \geq \tfrac{q-1}{n-2}\big| x)\end{bmatrix}\\ &= (1-\pi_l^\alpha)\Pr\left(\frac{\#h+m}{n-2} = \frac{q-2}{n-2}\middle| x\right).\end{aligned}$$

Thus, from (20), we have that

$$(1-\pi_l^\alpha)[\Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| x\right) - \Pr\left(\frac{\#h+m}{n-1} \geq \frac{q-1}{n-1}\middle| x+1\right)] = (1-\pi_l^\alpha)(\pi_l^\beta-\pi_l^\alpha)\Pr\left(\frac{\#h+m}{n-2} \geq \frac{q-2}{n-2}\middle| x\right). \tag{21}$$

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

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

so that

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

Using the fact that

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

we have that

$$\pi_h^\alpha \Pr(\frac{\#h}{n-2} \geq \frac{q-2}{n-2}\Big| x) = \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x) - (1-\pi_h^\alpha)\Pr(\frac{\#h}{n-2} \geq \frac{q-1}{n-2}\Big| x). \tag{23}$$

Substituting (23) into (22), we obtain

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

Thus, we may write

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

Next note that

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

implying that

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

Thus, from (24), we have that

$$\pi_h^\alpha[\Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x) - \Pr(\frac{\#h}{n-1} \geq \frac{q-1}{n-1}\Big| x+1)] = \pi_h^\alpha(\pi_h^\alpha - \pi_h^\beta)\Pr(\frac{\#h}{n-2} = \frac{q-2}{n-2}\Big| x). \tag{25}$$

Combining (21) and (25) 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

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

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

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

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

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

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

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

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

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

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

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

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

Next consider $x = 2$. We have that

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

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

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

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:

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

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

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

This completes Step 2 of the proof.

7.2.3 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.

7.2.4 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 p_l+1 through p_m and projects p_m+1 through p_h than council-manager, except when $x_C = n$ and $(x_M, j_M) = (n-1, \alpha)$. ■

7.2.5 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

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

and that

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

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

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

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 (9) in Proposition 2 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 $p_l + 1$ through p_m and projects $p_m + 1$ through p_h than council-manager and, accordingly, lower expected spending levels. ■

7.3 Example

Suppose that $n = 3$ and $q = 2$. Then, as shown in the proof of Proposition 2, 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 $p_l + 1$ through p_m are approved under council-manager is

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

and the probability that projects $p_m + 1$ through p_h are approved is

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

Under mayor-council, the two probabilities are respectively

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

and

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

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 $p_l + 1$ through p_m 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 $p_m + 1$ through p_h 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 $p_l + 1$ through p_m and projects $p_m + 1$ through p_h are approved are significantly *higher* under mayor-council.

7.4 Proof of Proposition 3

From (3) and (5) and using (16) and (17), we obtain

$$U_C(0) - U_M(0,\alpha) = \underline{\pi}\,\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\bigg|\, 0)G - (1-\overline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\bigg|\, 0)L,$$

and

$$U_C(n) - U_M(n-1,\beta) = \overline{\pi}\,\Pr(\#\frac{h+m}{n-1} \geq \frac{q}{n-1}\bigg|\, n-1)G - (1-\underline{\pi})\Pr(\#\frac{h}{n-1} \geq \frac{q}{n-1}\bigg|\, n-1)L.$$

The Proposition then follows from the discussion in the text. ∎

TABLE 1: PREVALENCE OF GOVERNMENT FORM OVER TIME

	Fraction mayor-council form
1987	48.75%
1992	48.67%
1997	43.10%
2002	39.29%

TABLE 2: SWITCHES BETWEEN GOVERNMENT FORM

Mayor-council to council-manager	0.58% (n=71)
No change	99.16% (n=12,135)
Council-manager to mayor-council	0.26% (n=32)

TABLE 3: SAMPLE AVERAGES

	Mayor-council observations	Council-manager observations
Government spending per-capita	$867.42	$1,030.81
Population	24,001	28,714
Percent HS grad	74.74%	76.98%
log of per-capita income	9.70	9.79
fraction over age 65	14.39%	13.77%

TABLE 4: CROSS-SECTIONAL ANALYSIS

year	1987	1992	1997	2002
mayor council form	-0.1544***	-0.1558***	-0.1340***	-0.0833***
	(0.0223)	(0.0229)	(0.0223)	(0.0249)
log population	0.1640***	0.1523***	0.1312***	0.1030***
	(0.0090)	(0.0092)	(0.0092)	(0.0095)
fraction HS grad	-0.2425*	-0.4684***	-0.5530***	-0.4256***
	(0.1342)	(0.1401)	(0.1450)	(0.1566)
log income	0.2555***	0.3224***	0.3402***	0.3047***
	(0.0483)	(0.0441)	(0.0435)	(0.0435)
fraction over 65	2.0672***	1.4459***	1.9624***	1.3805***
	(0.1903)	(0.1874)	(0.1853)	(0.1860)
N	3405	3450	3016	2563
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: PANEL ANALYSIS

change in mayor council form	-0.0922**	
	(0.0395)	
change to mayor council form		-0.1236*
		(0.0711)
change to council-manager form		0.0780
		(0.0477)
change in log population	-0.3189***	-0.3191***
	(0.0304)	(0.0304)
change in fraction HS grad	-0.0127	-0.0125
	(0.1733)	(0.1733)
change in log income	0.6206***	0.6208***
	(0.0597)	(0.0597)
change in fraction over 65	0.2206	0.2175
	(0.2866)	(0.2867)
N	12238	12238
state indicators	Y	Y
year indicators	Y	Y

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

TABLE 6: CROSS-SECTIONAL RECONCILIATION

controls	state FE	pop threshhold	1987	1992	1997	2002
expanded	no	10,000	-0.0539*	-0.0461	0.0110	0.0319
			(0.0308)	(0.0327)	(0.0292)	(0.0307)
expanded	yes	2,500	-0.1440***	-0.1442***	-0.1212***	-0.0740***
			(0.0250)	(0.0248)	(0.0227)	(0.0261)
baseline	no	2,500	-0.1439***	-0.1258***	-0.1110***	-0.0359*
			(0.0204)	(0.0210)	(0.0206)	(0.0218)
baseline	yes	10,000	-0.0562*	-0.0729**	-0.0394	-0.0331
			(0.0291)	(0.0303)	(0.0302)	(0.0328)

notes: each cell represents the coefficient on mayor-council form from a different regression.
std errors in parentheses, dependent variable in logs, *** denotes significance at 99-percent level, ** at 95-percent, * at 90-percent

TABLE 7: PANEL RECONCILIATION

switching measure	controls	pop threshhold	coefficient
comparison across years	expanded	10,000	-0.0306
			(0.0216)
comparison across years	baseline	2,500	-0.0364***
			(0.0134)
reported change	expanded	2,500	-0.1546**
			(0.0633)
reported change	baseline	10,000	-0.1399***
			(0.0479)

notes: each cell represents the coefficient on mayor-council form from a different regression.
std errors in parentheses, dependent variable in logs, *** denotes significance at 99-percent level, ** at 95-percent, * at 90-percent

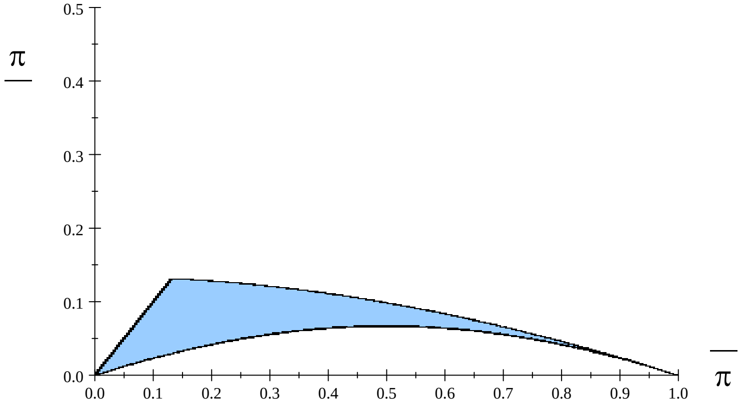

Figure 1a: G/L = 0.25

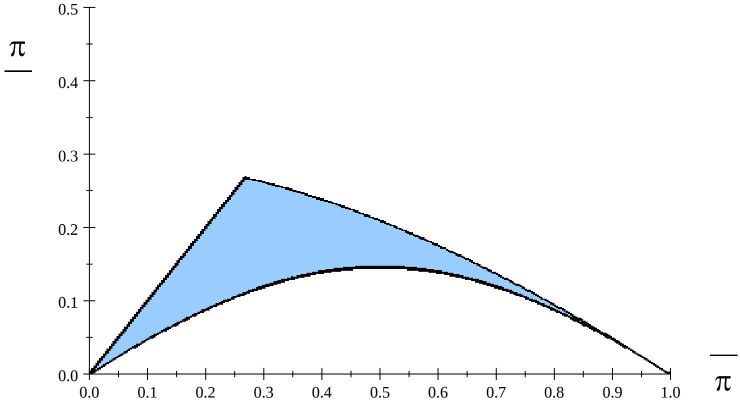

Figure 1b: G/L = 0.50

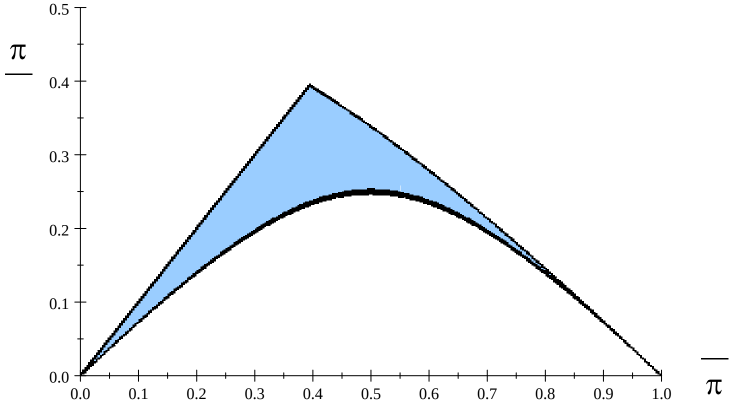

Figure 1c: G/L = 0.75

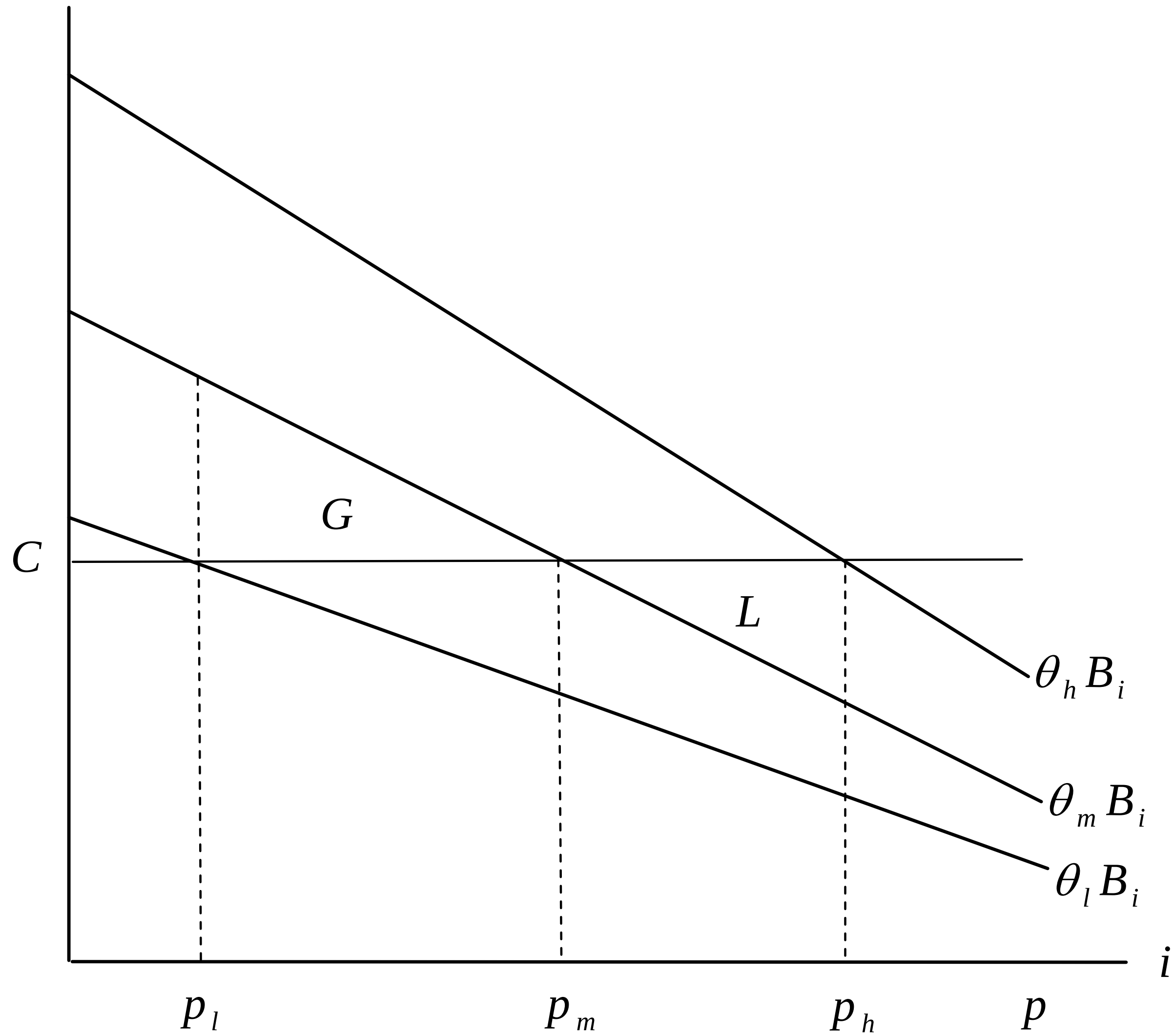

Figure 2