The Price of Pork: The Seniority Trap in the U.S. House

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Abstract

Using data on federal outlays and U.S. House elections, I estimate the effect of the pork barrel on the quality of officeholders, taking into account the fact that seniority creates a dynamic linkage across periods. After estimating the parameters governing the influence of seniority on federal outlays and the parameters governing the distributions of candidate quality, I conduct several policy experiments to uncover the size of the welfare loss created by the seniority system. I find that the seniority system negatively impacts the quality of Representatives, but has little effect on the outcomes of elections. Furthermore, the most commonly proposed solution to the distortion, term limits, may have a significant, negative effect on the quality of sitting representatives. Instead of a quantity constraint (term limits), I change the relative price of seniority by way of a Pigouvian tax on seniority. Such a policy achieves the first-best outcome.

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From 1983 to 1995, J.J. Pickle served his eleventh to sixteenth terms in the United States House of Representatives. He was the third ranking Democrat on the House Committee on Ways and Means. Each term, Pickle directed over \$7,300 per capita in newly awarded, discretionary spending to the 10th district of Texas. By this measure, he was one of the most influential members of Congress; achieving a level of discretionary spending for his district that was over thirteen times the average.

Pickle's story is typical of the popular view of pork barrel politics; senior Congressmen, and Congressmen with seats on important committees greatly influence the geographical allocation of federal spending. Such a view has prompted policy groups and academics to worry over the inefficiencies that might result from such influence. Senior members of

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Congress can direct federal spending towards their district, but this funding comes at the expense of districts with junior representatives and the net transfer is zero. Given that voters care about spending in their district, they set lower standards on incumbents than on challengers because incumbents are better able to manipulate the pork barrel. However, slacker standards on incumbents leads to a welfare loss; the average quality of those in office goes down, but the net transfer of federal outlays is zero. Elhauge, Lott, and Manning (1997) call this the "seniority trap".

The objective of this paper is to estimate the effect of the seniority trap on the quality of representatives in the U.S. House. I develop a dynamic, structural model of the voters' decisions and estimate the parameters governing the unobservables through a maximum likelihood approach. A dynamic, structural model is necessary because seniority creates a dynamic linkage across periods and because candidate quality is unobserved by the econometrician. I use data from the Federal Assistance Awards Data System (FAADS) and data on House election outcomes to estimate the model. Such an approach also has the advantage of allowing me to conduct policy experiments, using the model to test counterfactuals. Following estimation I conduct several policy experiments: a reform of the seniority system, the institution of term limits on House seats, changes to the committee assignment process, and the institution of a tax on seniority.

A structural model allows one to capture the important dynamic effects at play in Congressional elections. For example, a reduced form analysis would not be able to account for the option value inherent in an incumbent. With forward looking voters, it is not just the intrinsic value of the candidate, but also this option value that matters for election decisions. Furthermore, selection effects are critical to understanding electoral outcomes. The use of elections with repeated challengers (see, for example, Levitt (1994)), have provided one way to control for selection bias in a reduced form model. However, the use of repeat challenger elections imposes strict limitations on the data. Moreover, if candidate quality varies over time, models with candidate fixed effects are inappropriate. By using a structural model, I am able to explicitly model the electoral process and thereby control for selection effects, even when candidate quality is not permanent.

Contrary to conventional wisdom, I find that the seniority system, by the most reason-

able estimates, has a small effect on the quality of candidates in office for two reasons. First, the returns to seniority in terms of federal outlays are small. I find that an additional term of tenure in the House increases federal outlays in a district by only about \$3 per capita and that an additional term of tenure on a prestigious committee increases federal outlays in a district by \$58 per capita. Second, the probability that a representative is re-elected does not increase significantly as he gains seniority. An incumbency advantage exists, but almost all of this advantage accrues during the Congressman's first term (Dawes and Bacot (1996)). Furthermore, the most common solution to the seniority trap, proposed by policy groups and academics, is term limits (see, for example, Elhauge, Lott, and Manning (1997) and Bernhardt, Dubey, and Hughson (2004)) which are found to have a relatively large, negative impact on the quality of representatives in office. Indeed, when I account for candidate quality, my results are in direct opposition to the proponents of term limits. I find that as the amount of pork increases, term limits become even more costly. Instead of term limits, I propose a Pigouvian tax on seniority. Such a system achieves the first-best outcome; eliminating the wedge between incumbents and challengers that results from the pork barrel and allowing high quality candidates to stay in office indefinitely.

The main contribution of this work is to quantify the costs of the seniority trap. Bernhardt, Dubey, and Hughson (2004) suggest that the ability of members of Congress to influence discretionary spending accounts for the difference in incumbent re-election rates between governors (\sim 70%) and Congressmen (over 90%). Levitt and Snyder (1997) find that an increase of \$100 per capita in federal pork increases a representative's vote share by 2%. Couple this with the influence on spending shown by J.J. Pickle or the returns to seniority estimated by Falk (2006) (over \$200 per capita per year) and one would likely infer that the seniority trap has a large effect on election outcomes and the quality of representatives in office. Furthermore, the Republicans' "Contract with America", and academic work such as Dick and Lott (1993), Elhauge, Lott, and Manning (1997), and Bernhardt, Dubey, and Hughson (2004) suggest that the costs of the seniority trap are large enough to warrant term limitations on Congressmen. The work that follows is the first to quantify the costs of the seniority trap as well as the costs and benefits associated with potential solutions to the trap such as term limits and a tax on seniority.

An additional contribution of this paper is to identify the relationship between seniority on prestigious committees and the ability to control discretionary spending. While many have controlled for the influence of committee membership or seniority in the House (Stein and Bickers (1994), Alvarez and Saving (1997a), Levitt and Poterba (1999), Falk (2006)), no one, to the best of my knowledge, has controlled for seniority on a committee. Roberts (1990) provides an analysis of the death of Senator "Scoop" Jackson and its effect on the prices of securities for firms in Jackson's state and in the state of his successor, Sam Nunn. Roberts (1990) does find a positive effect of committee seniority in this particular case, however, I have not found a study that uncovers such a relationship in a larger sample. Given the story that underlies the models of seniority, that seniority influences funds through its impact on committee assignments and leadership positions on committees, one should expect a relationship between committee seniority and discretionary spending. Like others in the literature, I find a statistically and economically small effect of seniority on federal spending. The relationship between seniority on a prestigious committee and federal outlays is much stronger and reflects the interaction between the seniority system and the committee structure in the House.

The remainder of the paper proceeds as follows. Section 1 introduces the models of voter choice. Section 2 discusses the data used and Section 3 outlines the estimation strategy. Section 4 presents the results of the estimation. Section 5 describes the policy experiments and Section 6 discusses some extensions to the model. Section 7 concludes.

1 Model

I consider two models of incumbency. I call the first the naïve model of seniority. In this model, federal outlays are a function of the number of terms a representative has spent in Congress, plus some stochastic term. The seniority-funds relationship in the naïve model is similar to the relationship between seniority and funds estimated by Stein and Bickers (1994), Alvarez and Saving (1997a), Levitt and Poterba (1999), and Falk (2006), among others. In the naïve model and in the models of those listed, it is seniority in the House that affects a member of Congress' ability to direct funds. The second model is a model of

committee seniority. In this model, federal outlays are a function of committee seats and seniority on committees. Many, including Alvarez and Saving (1997a), find that committee seats are an important determinant of the amount federal outlays a district receives. The literature on committee seniority and its relation to funds is not as well researched as the naïve model of seniority, but Roberts (1990) finds support for the influence of committee seniority in an event study of Senator "Scoop" Jackson's death. Additionally, the relationship between committee seniority and Congressional influence is well documented in such works as Cox and McCubbins (2007).

In both models, voters care only about the flow of federal outlays to their district and the quality of the candidate. Quality is specific to the match between the candidate and the district. The model is similar in spirit to the dynamic labor-search models with a jobspecific match component and returns to tenure (e.g. Adda, Dustmann, Meghir, and Robin (2002)). One can think of quality as the ability of the politician to represent the interests of the district in areas other than at the pork barrel. Bernhardt, Dubey, and Hughson (2004) and Elhauge, Lott, and Manning (1997) refer to this quality component as the ideological fit of the Congressman and that is certainly a component to the quality measure in this model, although I cannot identify the role of each factor that contributes to the quality measure. It is anything specific to the politician from which the voters derive utility, excluding his ability to direct federal funds to the district. Like Bernhardt, Dubey, and Hughson (2004), I ignore the aggregation of ideologies in the House, which is an issue beyond the scope of the paper.¹ Because the characteristics of the electorate may shift over time and because the ideological position and influence of an elected official may change, I allow the quality of a candidate to evolve over time, with a degree of persistence. In addition, I allow the distribution of candidate quality to differ between candidates from open elections and those who run in contested elections. It is often argued that the "scare-off" effect (where incumbents face candidates of lower quality than those running in open elections) has a large impact on the incumbent's electoral advantage (see, for example, Levitt and Wolfram

¹If the aggregation of ideologies in the House is at least partially a zero-sum game, then one can interpret my results as placing an upper bound on importance of quality. That is, I find the largest inefficiencies that the seniority trap might cause and the largest costs to policies that lower candidate quality.

(1997) and Gowrisankaran, Mitchell, and Moro (2008)).² Allowing these distributions to differ accounts for this source of in the incumbency advantage and plays a central role in determining the welfare effects of policy changes such as term limits.

The decision I model is that of the decisive voter.³ Each district's decisive voter chooses between an incumbent and a challenger (or between two new candidates in the case of an open election). At the time of the vote, the voters perfectly observe the quality of each candidate and have an expectation of the funds the candidate will be able to direct to the district based on the seniority and/or committee membership of the candidate. The modeling choices capture the mechanisms at work in the models of Dick and Lott (1993), Elhauge, Lott, and Manning (1997), Mao (2001), and Bernhardt, Dubey, and Hughson (2004), and the story of a costly seniority trap. Voters have perfect information about the candidates' quality at the time of the election.

The models I present are similar to the model in Gowrisankaran, Mitchell, and Moro (2008). Both Gowrisankaran, Mitchell, and Moro (2008) and I model elections as a dynamic, discrete choice by a decisive voter and we share a similar description of candidate quality. An important difference is their assumption of permanent quality, whereas my model allows quality to evolve over time.⁴

I present both models formally below; starting with the model of naïve seniority.

1.1 Naïve Seniority

The voter discounts future by β and his instantaneous utility is given by:

$$u(f(T_{i,t},\epsilon_{i,t}),\eta_{i,t}) = f(T_{i,t},\epsilon_{i,t}) + \eta_{i,t}$$
(1.1)

Where $T_{i,t}$ is the tenure of the incumbent in district *i* at time *t*. The function $f(\cdot, \cdot)$

 $^{^{2}}$ Not all researchers agree on the importance of this effect. Cox and Katz (1996) find only a small amount of the incumbency advantage can be attributed to a scare-off effect, with most of the advantage being driven by the quality of incumbents. One result of the estimation of the model presented here will be to provide and another estimate of the size of this effect.

³I do not take not stand on the distribution of voter preferences or candidate positioning. Thus whatever the model is (e.g. representative agent or median voter), I am abstracting from the process and choosing to model only the pivotal voter from the underlying model.

⁴The assumption of fixed quality is overly restrictive and does not account for, among other factors, changes in the make-up of the electorate over time.

represents the dollars of federal outlays per capita for district *i* in period *t*, which are a function of both the tenure of the incumbent and a stochastic term, $\epsilon_{i,t}$. The parameter $\eta_{i,t}$ is the quality of the incumbent, measured in dollars of federal outlays. At the time of the election, I assume that voters can perfectly observe the quality of the candidates. The quality of the incumbent is allowed to evolve over time following a mean reverting process. Specifically, the law of motion for the incumbents quality is:

$$\eta_{I,t} = (1-\rho)\mu_e + \rho\eta_{I,t-1} + u_{I,t} \tag{1.2}$$

Where e = c if the incumbent first won office in a contested election and e = o if the incumbent came to power by winning an open election. Thus, μ_c is the mean of the quality distribution for candidate who run in contested elections and μ_o is the mean of the quality distribution for candidates who run in open elections. The parameter ρ is the persistence parameter for the AR(1) process, and $u_{I,t} \sim N(0, \sigma_u^2)$. One can think of the quality of the incumbent as his ability to represent the district. Thus the evolution of this variable can be due to both changes to the Congressman's productivity and his ideological position and changes in the socioeconomic make-up of the district that shift the preferences of the electorate. The quality of challengers, η_C , is distributed $N(\mu_c, \sigma_c^2)$ in contested elections and $N(\mu_o, \sigma_o^2)$ in open elections. Denote the these distributions by $F_c(\eta)$ and $F_o(\eta)$, with densities $f_c(\eta)$ and $f_o(\eta)$.

I abstract from the decisions of Congressmen and parameterize the funds production function $f(\cdot, \cdot)$ as follows:

$$f(T_{i,t},\epsilon_{i,t}) = \alpha_1 + \alpha_2 T_{i,t} + \alpha_2 T_{i,t}^2 + \epsilon_{i,t}$$
(1.3)

The parameter α_1 is the mean federal outlays per capita for districts with freshman representatives and α_2 and α_3 describe the return to a term of seniority in the House, in terms of federal outlays. I assume that the effect of tenure on one's ability to manipulate the pork barrel is the same for all Congressmen with 15 or more terms. This bounds the problem and is a legitimate assumption given that the benefits from seniority are relative to the distribution of tenure and very few representatives have over 15 terms of tenure in any Congress. The stochastic portion of funds is distributed as $\epsilon_{i,t} \sim N(0, \sigma_{\epsilon}^2)$.

Voters are rational and forward looking. Every election cycle, they must make a choice between an incumbent and a challenger. Let the value of a vote in an election with an incumbent running be:

$$V^{E}(T,\eta_{I},\eta_{C},e) = max[V^{I}(T,\eta_{I},e),V^{C}(0,\eta_{C},c)]$$
(1.4)

Let the value of a vote in an open election be:

$$V^{OE}(0,\eta_C,\tilde{\eta}_C,o) = max[V^C(0,\eta_C,o),\tilde{V}^C(0,\tilde{\eta}_C,o)]$$
(1.5)

 $V^{I}(T, \eta_{I}, e)$ and $V^{C}(0, \eta_{C}, e)$ represent that value of electing an incumbent and challenger (given tenure, quality, and election type (open or contested)), respectively. Subscripts I and C on the quality variables indicate whether the variable is for the incumbent or challenger. The tilde over \tilde{V}^{C} and $\tilde{\eta}_{C}$ differentiates between the two challengers in an open election. Both candidates in such elections have zero tenure, but may differ in quality.

The Bellman equation for the value of electing an incumbent is written as:

$$V^{I}(T,\eta_{I},e) = E_{\epsilon}u(f(T,\epsilon),\eta_{I}) + \delta_{T}\beta E_{\eta_{C}^{'},\tilde{\eta}_{C}^{'}}V^{OE}(0,\eta_{C}^{'},\tilde{\eta}_{C}^{'},o) + (1-\delta_{T})\beta E_{\eta_{I}^{'},\eta_{C}^{'}}|_{\eta_{I},e}V^{E}(T+1,\eta_{C}^{'},\eta_{I}^{'},e)$$
(1.6)

The first term in Equation 1.6 is the expected utility flow from the next term if the voter elects an incumbent with T terms of tenure. Because the voter does not observe federal outlays before the election, he maximizes the expected utility of electing the incumbent. The second and third terms of Equation 1.6 describe the continuation value from electing an incumbent and are thus discounted by the time preference parameter β . One-period ahead values for parameters are denoted by a prime. Expectations are taken over the probability of retirement and candidate quality for future elections. If an incumbent retires, which occurs with probability δ_T , the next period election is open.⁵ With probability $1 - \delta_T$, the

⁵The parameter δ is truly the probability of non-electoral exit from office. This may be due to death, scandal, or voluntary exit. I use the term retirement throughout, although that is not the strict definition

incumbent runs in the following election.

The Bellman equation for the value of electing the challenger is written as:

$$V^{C}(0,\eta_{C},e) = E_{\epsilon}u(f(0,\epsilon),\eta_{C}) + \delta_{0}\beta E_{\eta_{C}^{'},\eta_{C}^{'}}V^{OE}(0,\eta_{C}^{'},\tilde{\eta}_{C}^{'},o) + (1-\delta_{0})\beta E_{\eta_{L}^{'},\eta_{C}^{'}|\eta_{C},e}V^{E}(1,\eta_{C}^{'},\eta_{I}^{'},e)$$
(1.7)

Equation 1.7 is the much the same as Equation 1.6 but the tenure of a challenger is always zero. Thus the first term in Equation 1.7, the expected utility flow from the next term if the voter elects a challenger, is the utility from having a freshman representative with quality η_C . The continuation value is similar to that in 1.6, the difference being the seniority of a challenger.

Equation 1.1 to Equation 1.7 completely describe the discrete choice dynamic programming problem (DPP) that the decisive voter solves in the naïve model of seniority. The solution to the DPP yields an election rule that depends on the state variables: the quality of the incumbent and challenger, the tenure of the incumbent, and the type of election in which the incumbent first won office. Denote this policy function by $r(T, \eta_I, \eta_c, e)$. If the incumbent is re-elected, then $r(T, \eta_I, \eta_c, e) = 1$. If the challenger wins, $r(T, \eta_I, \eta_c, e) = 0$. Because a higher quality Representative increases the utility of the voter monotonically, one can write this policy function in terms of a cutoff rule. Voters will elect a challenger only if his quality exceeds a threshold which depends upon the incumbent's quality, tenure, and the type of election from which the incumbent first one office (because the election type affects the expected future values of the candidates quality). Denote the cutoff value by $\bar{\eta}(T, \eta_I, e)$. The forward looking-ness of the voters means that the cutoff rule is not simply choosing the candidate with the best match quality or even the highest instantaneous utility.

Figure 1 displays the relationship between the per capita amount awarded to a district per term and the tenure of the district's representative. While more senior members tend to have higher outlays per capita, the relationship between tenure and funds is not strong. The unconditional correlation between tenure and federal outlays is 0.035 in the sample period. The tenuous relationship is consistent with much of the literature on the congressional pork of the parameter.



Figure 1: Returns to House Seniority

barrel, many of whom find a weak relationship between seniority and federal outlays (Stein and Bickers (2007), Alvarez and Saving (1997a), Levitt and Poterba (1999)).



Figure 2: Returns to Committee Seniority

Alvarez and Saving (1997a) find a more significant relationship between seats on select House committees and federal outlays. In particular, seats on the Committee on Ways and Means, the Committee on Appropriations, the Committee on Armed Services, the Committee on Natural Resources, and the Committee on Small Business are important determinants of a district's outlays. I find that members of these influential committees also enjoy an increasing ability to direct funds to their district as their tenure on the committee increases. Figure 2 shows the average per capita funds from new awards of high variation programs by committee tenure.⁶ A much stronger relationship is present with committee tenure than with overall tenure in the House. Such a relationship is consistent with the

⁶If a Congressman is serving on more than one of these committees I define his tenure to be the maximum tenure of the committees he sits on.

idea of seniority being important due to its role in the committee system. By using overall tenure in the House as a proxy, the relationship between seniority and the ability to control federal spending is attenuated since many Congressmen may not have obtained seats on powerful committees. By focusing on the role of seniority on these prestigious committees, the relationship between seniority and control of discretionary funds is much stronger. I now turn to a less stylized model where Congressman obtain committee seats and with an active seniority system within committees.

1.2 Committee Seniority

In the model of committee seniority, funds are a function of committee membership and seniority on powerful committees. Committee membership is given by a dummy variable indicating the Congressman sits on a powerful committee. Let the funds function $f(\cdot, \cdot, \cdot)$ be described as follows:

$$f(C_{i,t}, comm_{i,t}, \epsilon_{i,t}) = \alpha_1 + \alpha_2 C_{i,t} + \alpha_3 C_{i,t}^2 + \alpha_4 comm_{i,t} + \epsilon_{i,t}$$
(1.8)

In this case, it is the incumbent's seniority on a prestigious committee that matters for the distribution of federal funding. The variable $C_{i,t}$ denotes the tenure on a prestigious committee of the incumbent representing district *i* at time *t*. $comm_{i,t}$ is a dummy variable indicating membership on a prestigious committee and $\epsilon_{i,t}$ is the stochastic portion of federal outlays. The parameters α_1 is the mean federal outlays per capita to districts with representatives that do not have a seat on a prestigious committee. α_2 and α_3 measure the returns to a term on a prestigious committee and α_4 is the return to a seat on a prestigious committee. To bound the problem, and because seniority is relative, it is assumed that returns to tenure end after a 15 terms on the committee.

Let the value of a vote in an election with an incumbent be:

$$V^{E}(T, C, \eta_{I}, \eta_{C}, e) = max[V^{I}(T, C, \eta_{I}, e), V^{C}(0, 0, \eta_{C}, c)]$$
(1.9)

Table 1: The Committee Assignment Process

	$comm_{t+1} = 0$	$comm_{t+1} = 1$
$comm_t = 0$	$1 - \pi_c(T)$	$\pi_c(T)$
$comm_t = 1$	$ 1 - \pi_{cc}(C)$	$\pi_{cc}(C)$

Let the value of a vote in an open election be:

$$V^{OE}(0, 0, \eta_C, \tilde{\eta}_C, o) = max[V^C(0, 0, \eta_C, o), \tilde{V}^C(0, 0, \tilde{\eta}_C, o)]$$
(1.10)

The Bellman equation for the value of electing an incumbent can be written as:

$$V^{I}(T, C, \eta_{I}, e) = E_{\epsilon} E_{C'|C} u(T, C', \eta_{I}, \epsilon) + \delta_{T} \beta E_{\eta'_{C}, \tilde{\eta}'_{C}} V^{OE}(0, 0, \eta_{C}, \tilde{\eta}_{C}, o)$$

$$+ (1 - \delta_{T}) \beta E_{\eta'_{I}, \eta'_{C}, C''|\eta_{I}, e, C'} V^{E}(T + 1, C'', \eta'_{C}, \eta'_{I}, e)$$

$$(1.11)$$

Expectations are taken over candidate quality, federal outlays, retirement, and committee membership. Committee assignments are not revealed until after the election. I assume the assignments follow a first order Markov process that is conditional on seniority in the House and seniority on a prestigious committee. The Markov process is summarized in Table 1, where $\pi_c(T)$ is the probability of obtaining a seat on a prestigious committee conditional on T terms of tenure in the House and $\pi_{cc}(C)$ is the probability of retaining seat on a prestigious committee given C terms of tenure on a prestigious committee. The first term in Equation 1.11 is the expected flow of utility for the next term when the incumbent remains in office. The last two terms are the expected present value of future elections, conditional on electing the incumbent in the current period.

The Bellman equation for the value of electing a challenger has the same structure and can be written as:

$$V^{C}(0, 0, \eta_{C}, e) = E_{\epsilon} E_{C|0} u(0, C', \eta_{C}, \epsilon) +$$

$$\delta_{0} \beta E_{\eta_{C}', \tilde{\eta}_{C}'} V^{OE}(0, 0, \eta_{C}, \tilde{\eta}_{C}, o)$$
(1.12)

$$+ (1 - \delta_{0}) \beta E_{\eta_{I}', \eta_{C}', C''|\eta_{C}, e, C'} V^{E}(1, C'', \eta_{C}', \eta_{I}', e)$$

Equation 1.1 and Equations 1.8 to 1.12 completely describe the dynamic programming

problem that the decisive voter solves in the committee seniority model. As with the naïve model, the solution to the DPP in the committee model can be represented in a cutoff rule; $\bar{\eta}(T, C, \eta_I, e)$. A challenger with $\eta_C > \bar{\eta}(T, C, \eta_I, e)$ is elected.

2 Data

Estimation of the model requires data on election outcomes, Congressional tenure, and federal spending by district. District population data are also required, as the decisions are those of an individual voter and thus it is easier to speak of funding in per capita terms. My data come from four main sources. I briefly discuss the data-sets from which election outcomes, congressional tenure, and district population are gathered. The federal funding data necessitates a longer discussion.

The Census Bureau provides district level population data, which allows one to put the federal outlays in per capita terms. Data on election outcomes and political action committee (PAC) contributions come from the Federal Election Commission's (FEC) Campaign Summaries files. Vote share of the winning candidate is used to proxy for effort due to electoral vulnerability when estimating the role of tenure in determining federal outlays. The regression analysis controls for PAC contributions in order to account for the influence of special interests on federal outlays. The FEC's data are available from 1982-2006.

The United States Congressional Biographical Data Series from the ICPSR includes information on the time served in office, pre and post congressional careers, and other biographical information. The data span almost the entire history of the US government, from 1789-1996. For the years 1996-2006, I use the Congressional committee membership data-sets of Charles Nelson and Charles Stewart (Nelson (1994), Stewart and Woon (2007)). Both Stewart's and the ICPSR's data-series have information about electoral success and allow me to construct a tenure variable. These data-sets contain information on committee membership, leadership positions held, and tenure in these positions. In all of these datasets, as in the model, tenure is defined as consecutive terms in office. Such a definition is consistent with the method the House and Senate use to determine seniority.

Data on federal money allocated to each district are obtained from the Federal Assistance

Awards Data System (FAADS). FAADS data records, at the transaction level, awards of federal aid to all recipients. Each transaction is identified by type (e.g. grant, loan, direct payment), the domestic assistance program it was for, and other attributes. Most importantly, it identifies the recipient at the county and district level. The Census Bureau provides FAADS data for the years 1983-2006.⁷

The federal awards in the FAADS data-set account for approximately 55% of the federal budget. Awards included in FAADS are all federal grants and other direct and indirect financial assistance to individuals, firms, and governments. Payments of wages to federal employees and procurement contracts are excluded from FAADS. The advantages of the FAADS data over the Consolidated Federal Funds Report (CFFR), which includes almost the entire federal budget, are threefold. First, the FAADS data better identifies recipient districts; CFFR data is only available at the state level. Second, FAADS awards represent true transfers, not payments for products or services. This means that we can identify the true beneficiary and the size of the benefits are clear. For example, it would be incorrect to credit Pascagoula, Mississippi with the dollar value of a purchase of a battleship that was built there. Clearly Pascagoula is not the sole beneficiary from the services of the ship nor were the citizens of Pascagoula able to provide their labor at no cost. The federal assistance programs from FAADS are more pure transfers and represent public goods that are more local in nature. Third, many of the programs in the FAADS data-set are highly variable over time and across districts. Hundreds of new aid awards are realized for each district in each Congress (Stein and Bickers (2007))

Still, many programs in FAADS are not under the direct control of legislators. Programs not under the direct control of representatives include Medicare, Social Security, the Railroad Workers Pension Program, and veterans benefits programs. Programs such as these

⁷For some programs, for which there are many recipients, the awards are aggregated at the county level. Most of the programs that are aggregated at the county level are non-discretionary programs that make awards to individuals according to formula, such as Social Security Retirement Insurance. Bickers and Steinand (2004) provide a version of FAADS that succeeds in allocating every transfer in FAADS to a congressional district. Through a population-based algorithm, they are able to divide the county-level aggregates into Congressional district-level aggregates. While many studies have used the data of Bickers and Steinand (2004) (Stein and Bickers (2007), Levitt and Snyder (1995), Levitt and Snyder (1997), Alvarez and Saving (1997b)), I use the Census data because the Stein and Bickers data is not correct after 1996. Since almost all of the programs that are aggregated at the county level are non-discretionary in nature, I do not believe that I suffer from using the data provided by the Census Bureau.

distribute aid according to a legislated formula. While Congressmen can exert influence when legislating the formula (see for example, Levitt and Snyder (1995)), once made these formula greatly limit the ability of Congressmen to direct funds to their district. A true measure of political pork must exclude such awards that Congressmen cannot directly control, thus I drop such programs from my measure of federal dollars allocated to districts. I identify such non-pork programs in the same way as Levitt and Snyder (1995) and Levitt and Snyder (1997). That is, I divide programs into high variation and low variation programs based on the coefficient of variation of each program. The coefficient of variation is taken to be the variance in mean awards by program (defined by the Catalog for Federal Domestic Assistance (CFDA) program codes) across congressional districts. The grouping puts 28 programs into the low variation group.⁸ Table 2 lists the five largest programs in the low variation group and the mean in per capita spending for each program over the sample period.⁹ Low variation programs are predominately large entitlement programs and are excluded from my analysis, since these are not pork barrel programs. They are not the type of funds under the control of the legislator and thus not the funds voters consider in their evaluation of the candidate. Apparent from Table 2 is the difficulty in identifying pork barrel programs. While the low variation programs are determined by formula, the largest high variation program, food stamps, is also a program that is largely determined by a districts' socioeconomic characteristics and not its representative's influence. This is a shortcoming, but the low/high variation division adopted by Levitt and Snyder remains the best method of identifying those programs that allow for the most political manipulation and credit claiming.

The majority of dollars in aid handed out by the federal government in each year are payments for grants and assistance awards that originated in previous years, which presents a problem when attempting to identify the outlays a politician can claim credit for. The results in this study use only new payments (and not continuing payments) for high variation

⁸The cutoff for the low variation programs was set to include all programs identified by Levitt and Snyder (1995) as low-variation programs into the low-variation group in my sample. The coefficient of variation that I use as a cutoff is 1.283, as opposed to 0.67 from Levitt and Snyder (1995). They include 16 programs in their low-CV-group, I include 28 in mine. A full list of the programs in the low variation group is provided in the appendix Table A.1. Moving this cutoff around does not change the results in any significant way.

⁹Dollar values here and throughout are all in constant 2006 dollars.

CFDA Code	Program Name	Mean Per Capita Outlays
10.551	Food Stamp Program	\$1,534.615
20.205	Highway Planning and Construction	\$1,374.487
84.01	Title I Grants to Local Educational Agencies	\$482.3613
13.667	Social Services Block Grant	\$353.0026
93.784	Federal Reimbursement of Emergency Health Services	\$252.0816

 Table 2: Largest High Variation Programs by CFDA Number

programs.

After restricting my funds data to new, high variation programs reported in FAADS, I am left with approximately 5.5% of the federal budget or about \$60 billion per year. The average amount of federal spending per capita, per term using my definition of newly awarded discretionary funds is \$552.53 and varies greatly across districts over the sample. The lowest spending in a district is \$0.06 per capita in Florida's 22nd district during the 107th Congress, and the district with the most discretionary spending is New York's 21st district, with \$24,286.33 per capita during the 108th Congress. The standard deviation in per capita spending on high variation programs in \$1,676.09.

3 Estimation Strategy

Estimation takes place in two stages. I estimate the relationship between seniority and the ability to direct funds, the relationship between seniority and non-electoral exit from office, and the relationship between seniority and committee assignments in a first stage, outside the structural model. With these estimates and a value for the time preference parameter, I then estimate the final five parameters of the model, those governing the stochastic processes for candidate quality, using the structural model and a maximum likelihood approach.

3.1 Stage 1

In the first stage, I estimate $\alpha_1, \alpha_2, \alpha_3, \sigma_{\epsilon}$, the parameters of the function describing the relationship between seniority and federal discretionary spending and the probabilities of non-electoral exit from office, δ_T . For the committee model, I also estimate α_4 , the coefficient on the committee indicator variable; $\pi_c(T)$, the probabilities of obtaining a seat on a powerful committee, and $\pi_{cc}(C)$, the probabilities of retaining a seat on a prestigious committee. As discussed previously, T represents tenure in the House and C tenure on a prestigious committee.

Regression analysis identifies $\alpha_2, \alpha_3, \alpha_4$, and σ_{ϵ} . Equation 3.1 describes the model of the seniority-funds relationship estimated for the naïve model and Equation 3.2 describes the committee model's seniority-funds relationship. Again, $T_{i,t}$ is tenure in the House in the naïve model and $C_{i,t}$ is tenure on a prestigious committee in the committee model.

$$f_{i,t} = d_i + \alpha_2 T_{i,t} + \alpha_3 T_{i,t}^2 + \gamma_1' P_{i,t} + sc_{i,t} + \epsilon_{i,t}$$
(3.1)

$$f_{i,t} = d_i + \alpha_2 C_{i,t} + \alpha_3 C_{i,t}^2 + \alpha_4 comm_{i,t} + \gamma_1' P_{i,t} + sc_{i,t} + \epsilon_{i,t}$$
(3.2)

The parameter α_2 is the coefficient on a representative's tenure (or committee tenure) from a regression of tenure and other controls on per capita federal outlays and α_3 is the coefficient on the square of tenure. The parameter α_4 is the coefficient on the committee membership dummy variable in the committee model. Each model includes a district specific fixed effect, d_i a set of political controls, $P_{i,t}$ and dummy variables for the interaction of the state and congressional term, $s_{c_{i,t}}$. The political control variables include the fraction of the vote with which the Representative won the last election (a proxy for the security of the incumbent's seat), the money received from PACs during the last election cycle, and the political party affiliation of the representative. In the naïve model, the political controls also include dummy variables indicating membership on standing committees. District fixed effects account for heterogeneity across districts, which affect the amount of spending that is directed towards the district. Including the state-congress interaction accounts for transitory, statewide increases in spending. The stochastic portion of funds, σ_{ϵ} is the unexplained variation in per capita funds from the regressions. The intercept on the funds production function, α_1 , I estimate as the average per capita funds of districts with freshman Representatives or as the average funds of a district with a Representative who does not sit on a prestigious committee, depending upon the model.

The time preference parameter, β , is set to 0.9 which, since a model period is a two-year

term in the House, corresponds to an annual risk free interest rate of about 5%. I set this parameter because it is difficult to identify the rate of time preference in a dynamic discrete choice model (see, for example, Rust (1987)). I estimate the δ_T 's using the empirical probability of retirement conditional on tenure from the sample. The assumption of exogenous probabilities of non-electoral exit is consistent with the evidence of Ansolabehere and Snyder (2004) who find no evidence that candidates for statewide office retire strategically. Gowrisankaran, Mitchell, and Moro (2008) also propose that Congressmen's retirement probabilities are non-strategic. Similarly, I estimate the transition matrix for committee seats conditional on seniority in the House (for the probability a representative attains a seat) or conditional on seniority on a committee (for the probability a representative retains a seat) using the empirical probabilities of such transitions from the data.

3.2 Stage 2

3.2.1 Overview

After the first stage estimation, the parameters governing the distributions of incumbent and challenger quality $(\rho, \mu_o, \mu_c, \sigma_o, \sigma_c \text{ and } \sigma_u)$ must be estimated. Given values for each of these six parameters, and the results of the first stage of the estimation procedure, the model can be solved and the decision rules of voters generated. Using the decision rules, it is possible to create a probability distribution over a sequence of electoral outcomes. Although quality is not directly observable by the econometrician, one can uncover the parameters of the quality distributions by choosing the model parameters that maximize the probability of observing the sequences of electoral outcomes found in the data.

Because the data contain information on the number of elections a Congressman won and how that Congressman came to office, I am able to separately identify the distributions of challenger quality in open versus contested elections. However, one cannot identify μ_o and μ_c because the voter has no outside option and because the decision rules are the same under any affine transformation of the utility function. There must be *some* representative in office and therefore one cannot identify the mean of the distribution of candidate quality, but only the differences between different types of candidates. I set $\mu_c = 0$ as a normalization. Measures of candidate quality are interpreted as differences in quality between the candidate elected and the best challenger. The scale of these quality distributions is pinned down by the estimates of the returns to seniority in terms of federal funds. These estimates, coupled with the assumption that voters place a non-zero value on federal outlays in their district allows me to identify the quality parameters through the observed electoral outcomes. For example, if the seniority-funds relationship is found to be strong, and higher tenure allows a Congressman to bring home many more dollars to his district, then the observation that a senior member is beaten in an election gives the econometrician information about both the evolution of incumbent quality and the spread of the distribution of challenger quality.

The remaining five parameters $(\rho, \mu_o, \sigma_o, \sigma_c \text{ and } \sigma_u)$ are estimated via an indirect inference approach using the method of maximum likelihood in the second stage. Table 3 summarizes these parameters.

 Table 3: Parameters Estimated via MLE

Parameter	Definition
ρ	persistence of candidate quality
σ_u	std dev of shock to incumbent quality
μ_o	mean of new candidate quality, open elections
σ_o	std dev of new candidate quality, open elections
σ_c	std dev of new candidate quality, contested elections

3.2.2 Sequences of Electoral Outcomes

The maximum likelihood estimation (MLE) procedure used to estimate the parameter vector $\Theta = (\rho, \mu_o, \sigma_o, \sigma_c, \sigma_u)$ is similar to that in Gowrisankaran, Mitchell, and Moro (2008). Using the data on election results, I construct histories of election which start with an open seat election and end with a non-electoral exit from office such as death or retirement. Following Gowrisankaran, Mitchell, and Moro (2008), let each of these histories be known as a chain. A chain is a vector of ones and zeros with a length equal to the number of elections between the open seat election and the exit from office. That is, the first element of the vector is one if the Representative who won the open election also won his first bid for re-election and the second element is zero if he loses his second bid for re-election. The chain continues in the same fashion until its' end when there is a non-electoral exit from the House seat. In addition to an exit from office, there chains may end for two other reasons. First, a chain may cutoff by the end of the sample period. Second, chains may end if district boundaries are redrawn and a state either loses or gains a district. In both of these cases, I am still able to extract information from the chains and thus keep them in the sample, with the exception of elections where more than one incumbent is running. I discuss these cases further below.

The construction of such chains is more complicated for the House than the Senate because Congressional districts are reapportioned every 10 years. Such reapportionment can make it unclear who the incumbent is and over what seat a chain is defined. In order to be consistent with traditional arguments pertaining to the incumbency advantage, such as selection effects, benefits to seniority, institutional knowledge, and fund raising ability, I define an incumbent as any candidate who has served at least one term.¹⁰ A chain will continue through a redistricting, consistent with the definition of an incumbent. That is, a "seat" will follow the incumbent and not the geographical boundaries through a redistricting.¹¹ Open seat elections are those following the death or retirement of a Representative or those for a newly created district in which no incumbent is running. Elections where the incumbent loses in a primary are not considered open elections. That is, primary and general elections are treated as a single election with two candidates.

The data contain 514 chains with 2656 elections. Of these 514 chains , 47 contain no information on candidate quality because the chain ends in the period following an open election. At most, a chain contains four Representatives. The longest chain is made up of 13 elections. Four Representatives won an open election in 1982 and every election thereafter until the end of the sample in $2006.^{12}$

 $^{^{10}}$ Such a definition corresponds to the Federal Election Commissions classification of candidates and with Congressional rules regarding seniority. Given this definition, it is possible that two (or more) incumbents may face each other in an election. Indeed, 40 out to the 5800 elections (0.6%) from 1982 to 2006 involved more than one incumbent. I drop these elections and end the chain at the last election with a single incumbent.

¹¹Admittedly, match quality may change more when district boundaries are redrawn than in other years because the constituency is likely to change more when district boundaries change. To keep the model and estimation parsimonious, I do not specifically account for these shock to quality, thus biasing upwards to some degree the parameter σ_u .

¹²The four are all still in office: Sander Levin, Howard Burman, Solomon Ortiz, and Danny Burton.

3.2.3 The Likelihood Function

Let d be a chain with dimension N and let $h_n \equiv \langle d_1, ..., d_{n-1} \rangle$ denote the history of wins and losses prior to the n^{th} election in the chain. One can then write the posterior density of incumbent quality after history h_n as $g(\cdot|h_n)$. Let the tenure of the incumbent after history h_n be given by T_{h_n} . Also, let w_n be a random variable that takes on a value of one if the incumbent wins election n and a value of zero in the incumbent loses election n. The likelihood of observing chain d is thus:

$$L(d|\Theta) = \prod_{n=1}^{N} Pr(w_n = d_n | h_n)$$

$$= \prod_{n=1}^{N} \int_x \{ d_n \cdot F_c(\bar{\eta}(T_{h_n}, x, e)) + (1 - d_n) \cdot [1 - F_c(\bar{\eta}(T_{h_n}, x, e))] \} dg(x|h_n) dx$$
(3.3)

The likelihood function depends upon the policy function $\bar{\eta}$ which in turn depends upon the parameters Θ .¹³ The likelihood also depends upon the posterior density of incumbent quality at the start of period n, $g(x|h_n)$. Letting p denote the period n prior density of incumbent quality and separating the history h_n into the outcome of the last election, d_{n-1} and the previous history, h_{n-1} , one can use Bayes' Law to write the posterior density of incumbent quality at the beginning of period n:

$$g(\eta_n | \langle d_n, h_n \rangle) = \int_H \frac{p(\eta_{n-1} | h_{n-1}) \cdot Pr(d_{n-1} | \langle \eta_{n-1}, h_{n-1} \rangle)}{Pr(d_{n-1} | h_{n-1})} Q(\eta_n | \eta_{n-1}, h_{n-1}) d\eta_{n-1}$$
(3.4)

Here, $Pr(d_{n-1}|\langle \eta_{n-1}, h_{n-1} \rangle)$ is the conditional probability of observing the outcome d_{n-1} given quality η_{n-1} . The function $Pr(d_{n-1}|h_{n-1})$ is the conditional probability of observing the election outcome d_{n-1} . The function $Q(\eta_n|\eta_{n-1}, h_{n-1})$ is the conditional probability of the incumbent-district match moving from quality η_{n-1} to quality η_n between period n-1and period n, conditional on history h_{n-1} .¹⁴ This function depends upon the AR(1) process

¹³The likelihood function for the committee model is analogous, with $\bar{\eta}(T_{h_n}, x, e)$ being replaced by $\bar{\eta}(T_{h_n}, C_{h_n}, x, e)$.

¹⁴What is important in this history is the record of how the incumbent came to office. The distribution of quality differs depending on whether the incumbent came to office in an open election or a contested election

described in Equation 1.2 and thus on the parameters ρ , σ_u , μ_o , and μ_c . The prior is given by f_o if the incumbent won an open election in the previous period and f_c if the incumbent won against a previous incumbent in the proceeding election. If the incumbent has won more than one election, the prior is given by $g(\cdot|h_{n-1})$. The Appendix section A-1 details the computation of the posterior for several different cases.

The maximum likelihood estimation procedure has the following algorithm. Given the results of the first stage estimation and a vector Θ , the dynamic programming problem (DPP) of the voters is solved. The solution to the DPP is a policy function determining the voters' optimal choice of candidate given the match qualities of the incumbent and challenger and the seniority of the incumbent. The policy function is then used to evaluate the likelihood of a particular chain, using equations 3.3 and 3.4. The estimate, $\hat{\Theta}$, is the vector of parameters that maximizes the sum of the log likelihood of each chain.¹⁵

4 Results

I now present and discuss the results from both stages of estimation. The following subsection includes the results from the first-stage estimation, for both the naïve and committee seniority models. I then discuss the results from the structural estimation of each of the models.

4.1 First Stage Estimation Results

The exogenous probabilities of retirement from office are summarized in the first row of Table 4. The values range from 0.043 to 0.207, taking on the lowest value in the first term, but not monotonically increasing in tenure.¹⁶ It does appear that tenure is a slightly better proxy for retirement decisions than is age. The correlation between retirement and tenure is 0.13 and the correlation between retirement and age is 0.10. One might expect tenure to have a higher correlation with retirement decisions and for the retirement probabilities to be non-monotonic because the House is often a platform from which higher office is sought.

¹⁵For further details regarding the solution to the model and the estimation procedure, please see Appendix section A-2.

¹⁶Retirement probabilities for each level of seniority are reported in Table A.2 in the appendix.

That is, representatives leave the House after gaining some amount of political experience, not when they wish to end their careers. Merlo, Diermeier, and Keane (2005) provide a model and evidence supporting such career decisions from Congressmen.

Parameter	Definition	Value
δ_T	prob. of retirement	0.043-0.207
$\pi_c(T)$	prob of obtaining a committee seat	0.032 - 0.418
$\pi_{cc}(C)$	prob of retaining a committee seat	0.835 - 1.000

 Table 4: Parameters

Rows 2 and 3 of Table 4 summarize the exogenous committee assignment process. The probabilities indicate the likelihood (conditional on tenure in the House and tenure on a committee) that a Representative is assigned to one of the five committees identified as having a strong influence on discretionary spending: Ways and Means, Armed Services, Appropriations, Small Business, Natural Resources. As with the retirement probabilities, these probabilities are not monotonic in seniority. In fact, the probability of attaining a seat on a prestigious committee is highest in a representative's freshman term.¹⁷

Table 5 presents the estimates of α_2 , α_3 , and α_4 the returns to seniority at the pork barrel. The first column is the naïve seniority model and the second column is the model of committee seniority. In both cases I report only the coefficients on a subset of the political control variables.¹⁸ For the naïve seniority regression model, I include indicator variables for specific committee assignments. In both models, I include district fixed effects and include dummy variables for each state and congress interaction. The specification for the naïve seniority regression model similar to the specification in Alvarez and Saving (1997a) who perform the analysis on the 101st Congress. As in Alvarez and Saving (1997a), I find a similarly small effect of seniority in the House on outlays with an estimate of just over \$3 per capita as the marginal impact of another term of tenure on federal outlays and a tstatistic that is not significant at any reasonable level. Seniority on a prestigious committee does have an economically and statistically significant coefficient. The average return to a term on one of these committees is \$58.33 per capita. The estimate of α_4 , the coefficient

¹⁷The complete set of probabilities of obtaining and retaining seats on the prestigious committees are reported in Table A.3 and Table A.4.

 $^{^{18}\}mathrm{For}$ the results reported in full, please see Table A.5 and Table A.6 in the Appendix.

on the indicator of committee membership on a powerful committee, is negative, but is not statistically significant.¹⁹

Dependent Variable:	New Outlays, High Variation Programs	
Model:	Naïve	Committee
Tenure	3.069	
	(14.671)	
$Tenure^2$	0.041	
	(1.034)	
Power Comm Tenure		58.332***
		(19.446)
$PowerCommTenure^2$		-3.789**
		(1.505)
Power Comm Member		-56.186
		(48.409)
Gen Elec Pct	0.542	-0.537
	(1.019)	(1.001)
PAC Contrib	0.001^{***}	0.001^{***}
	(0.000)	(0.000)
Democrat	39.462	40.018
	(50.301)	(49.319)
Controlling Party	9.029	10.479
	(32.199)	(31.863)
District Fixed Effects	Yes	Yes
State*Congress Controls	Yes	Yes
R-Squared	0.903	0.903
Observations	5216	5216

Table 5: Outlays/Tenure Regressions

In the naïve model, the parameter α_1 is set to the mean funds for a district with a freshman Representative. In the committee model, α_1 is equal to the mean funds for a district whose Representative does not sit on a prestigious committee. The point estimate of α_1 is \$350.02 in the naïve model and \$371.92 in the committee model. The unexplained variation in per capita outlays from the regressions in Table 5 is σ_{ϵ} and equals \$483.95 in the naïve model and \$484.16 in the committee model.

I also estimate a model that is most favorable to the story of a costly seniority trap. The estimates of the returns to tenure of Falk (2006) are the largest in the literature. These estimates should result in the largest inefficiencies resulting from the seniority system. I calibrate the funds production function of the naïve seniority model to the returns to tenure

¹⁹I have tried including a dummy for committee chairmanships, but the coefficient is insignificant and negative in any reasonable specification. This is not an intuitive result and could be the result of the limited sample period and the long periods of time these chairmanships are held for. As a result, I have excluded chairmanship positions from the model.

documented by Falk. That is, I set α_1 to \$17,875.13, α_2 to \$802.75, and α_3 to 0. The parameter σ_{ϵ} is not available in Falk's paper, but is set to \$483.95, the same as in the naïve model. Although this value is not given by Falk, and may differ for his models, the value has no effect on the results given the risk neutrality of the voters.

Falk's numbers differ substantially from mine and those of others for two reasons. First, Falk uses a broader definition of pork barrel spending, which includes almost the entire federal budget. This means that spending on military equipment and salaries of federal employees are included in the expenditures he considers. Both of these categories of federal spending are occasionally mentioned in regard to pork barrel spending. Second, Falk uses a regression discontinuity approach to find exogenous variation in seniority in order to find an unbiased measure of the effect of seniority on federal outlays.²⁰

Falk applies a regression discontinuity approach, using exogenous variation in tenure that is provided by redistricting. The exogenous variation provides Falk with an unbiased estimate of the returns to tenure in terms of federal outlays. He also includes spending not in FAADS such as wages of federal employees and government procurement contracts. The drawback to Falk's analysis is that tenure is measured at the state level. This makes interpretation of the returns to tenure difficult since most states have more than one representative. I thus take Falk's estimate for the returns to tenure for a representative from a state-wide district, which is \$802.747 per capita for an additional term of tenure. This estimate is much larger than mine and most others' estimates for the econometric reasons cited and because Falk uses a much larger measure of funds; almost the entire federal budget compared to my use of 5.5% of the federal budget. I use Falk's estimates as a kind of

²⁰Falk argues that the measured returns to seniority found by others are biased downward for two reasons. As found by Tufte (1975) and Erikson (1990), incumbent re-election rates are sensitive to the state of the economy. Because some spending programs are determined by formula, these programs may increase in size during times of economics distress. As Falk points out, these are precisely the times when one is more likely to see an incumbent Representative fail to win re-election and a freshman take office. Such an interaction leads to a downward bias on the measured effect of seniority on funds because spending has increased when a freshman take office, for reasons unrelated to his ability to procure funds. This argument motivates Levitt and Snyder (1995) to distinguish high and low variation programs and Stein and Bickers (2007) to separate discretionary from non-discretionary spending. In addition, Falk argues that senior incumbents may put forth little effort to direct spending towards their district because they are secure in their seats. Omitting the effort level of politicians from the regressions leads to a downward bias on the returns to seniority. To control for this omitted variable bias, I include the incumbent's vote share for the election from which he last won office. This variable is a proxy for the security of the Representative's seat and should be correlated with his effort level.

robustness check. If I find that the costs of the seniority trap to be small, it may be due to my estimates of the returns to seniority. To give the seniority trap story the best possible chance, I use Falk's estimates of the returns to tenure.

Table 6 summarizes the parameters used in the funds production function in all models, using both my estimates and the values estimated by Falk (2006).

Parameter	Naïve Model	Committee Model	Falk Calibration
α_1	350.617	371.918	17875.131
α_2	3.069	58.332	802.747
α_3	0.041	-3.789	0.000
α_4	N/A	-56.186	N/A
σ_{ϵ}	483.951	484.156	483.951

Table 6: Parameters of the Funds Production Function

For each the naïve model, the committee model, and the model calibrated to Falk (2006), I now present the parameter estimates for in the vector Θ and measures of the goodness of fit of the model. I begin with the naïve seniority model.

4.2 Stage 2

4.2.1 Estimation Results

Table 7 presents the estimates for the parameters describing the distributions of candidate quality in the three models. Standard errors are reported in parentheses under the parameter estimates. All parameters are well identified, as evidenced by the small standard errors. Of the three models, the committee model achieves the highest log likelihood, suggesting that the least stylized model fits the data best.

With the exception of μ_o , it is difficult to interpret the parameter estimates and their implications for the quality of representatives in office at this point. The value of μ_o can be interpreted as the amount of federal outlays per capita a voter would give up to have in office a candidate of mean quality from an open election instead of a candidate of average quality from a contested election. In the naïve model, this difference is very small; two-tenths of one cent. The difference is found to be much larger in the committee model and the model with Falk's returns to tenure. In these cases, the scare-off effect is economically significant, with candidates from contested elections being, on average, of much lower quality than candidates from open elections.

One can see that the quality of incumbents exhibits a great deal of persistence, but it's difficult to determine the effect of the parameter values on the quality of officeholders. The estimated standard deviations get larger as the returns to seniority increase. The driving force for the increases in the spreads of quality are the flat relationship between re-election probabilities and tenure. While incumbents win at high rates, more senior incumbents do not win at much higher rates than do junior incumbents. Therefore, selection effects have to dominate the returns to tenure given by the seniority-funds relationship.

Parameter	Nave	Committee	Falk
ρ	0.999	0.918	0.900
	(0.000)	(0.004)	(0.000)
σ_u	19.662	20.175	$1,\!497.938$
	(0.719)	(0.126)	(1.508)
μ_o	0.002	113.485	199.676
	(0.136)	(0.537)	(3.159)
σ_o	106.827	250.029	407,362.889
	(1.452)	(8.361)	(15, 813.077)
σ_c	51.933	92.600	999.472
	(2.110)	(3.647)	(76.997)
ln(L)	-380.942	-360.459	-415.364

 Table 7: Structural Estimation: Parameter Estimates

4.2.2 Goodness of Fit Tests

To see how well the model fits the data, I now present several measures of the goodness of fit of the model. One way to test the fit is to calculate the important characteristics of congressional elections (for example, the incumbency re-election rate) and to compare the data values to the results from model simulations. I present these results in Table 8 below for moments describing the re-election probabilities of incumbents, the distribution of tenure (its mean and a measure of its skewness), and the committee assignment process (committee tenure and fraction serving on a committee). The three models all do well in matching the moments. In particular, the models generate incumbency re-election rates and tenure distributions very close to those found in the data. Of the three models, the committee model is found to match the moments particularly well. Also, note that the models are able to closely replicate the moments from the data, despite the parameters not being specifically chosen to match these moments.

Moment	Data	Nave	Committee	Falk
Mean Tenure	4.872	5.142	4.758	5.556
Mean/Median Tenure	1.218	1.285	1.190	1.389
Inc Reelect Rate	0.956	0.947	0.927	0.954
Comm Reelect Rate	0.961	0.948	0.956	0.965
Frac on Comm	0.497	0.527	0.508	0.536
Mean Comm Tenure	2.200	2.730	2.410	2.986

 Table 8: Data Versus Model Moments

Another series of moments to use for comparison come from the conditional re-election rates. Table 9 compares the re-election rates by tenure in the model to those found in the data. The first column contains the re-election rates found in the data. A notable feature of these re-election rates is the low correlation between an incumbent winning re-election and the tenure of the incumbent. In fact, incumbency re-election rates only vary between 93% and 98% over all levels of tenure. The second column displays the difference in the reelection rates between the naïve model and the data. The third and fourth columns present the differences between the committee model and the data and the Falk calibration and the data, respectively. The models are able to generate re-election probabilities that closely match the data, especially for incumbents with a tenure of less than ten terms, which make up the bulk of the data. The models are able to capture the non-monotonic re-election rates through the retirement probabilities (which are non-monotonic) and the persistent, but not permanent, nature of quality. The standard deviations of the distributions of candidate quality in open and contested elections are able to generate the flat relationship between reelection rates and seniority found in the data, while selection effects still create incumbency re-election rates averaging over 90%.

5 Policy Experiments

Using the estimated models, I conduct four policy experiments: reform of the seniority system, term limitations on House seats, term limits on committee seats, and a tax on seniority. For each model, I calculate the average quality of officeholders under the baseline case and for each of the policy changes.

Tenure	Data	Nave	Committee	Falk
1	0.934	-0.024	-0.067	-0.140
2	0.967	-0.028	-0.068	-0.026
3	0.951	-0.004	-0.032	0.023
4	0.971	-0.024	-0.013	0.020
5	0.942	-0.009	0.012	0.050
6	0.962	0.007	0.000	0.029
7	0.960	0.003	-0.017	0.039
8	0.962	-0.004	0.007	0.035
9	0.957	0.015	0.008	0.042
10	0.961	0.012	0.005	0.037
11	0.983	-0.012	-0.025	0.016
12	0.978	-0.009	-0.045	0.021
13	0.949	0.010	-0.008	0.051
14	0.982	-0.012	-0.063	0.018
15 +	0.949	0.014	0.016	0.051
All(N=)	0.956	-0.009	-0.029	-0.002

Table 9: Re-election Rates by Tenure- Data Values and Model Differences

Two important points must be made here. Under the assumptions of the model (quality and funds are perfect substitutes, voters are risk neutral, and the size of the pork barrel is fixed) and with a social welfare function that is utilitarian over the utility of the decisive voters, one can interpret changes in office holder quality as changes in voter welfare.²¹ Second, the mean of the quality distribution cannot be identified and is normalized to zero. This means that candidate quality, as I measure it, is to be interpreted as an equivalent variation measure. It is the value, in dollars of discretionary spending, that the decisive voter would pay in order to have the winner in office instead of the next best challenger.

Keeping the two caveats above in mind, I proceed with the policy experiments, interpreting changes in quality as changes in welfare. I begin with a reformation of the seniority system.

5.1 Seniority System Reform

The seniority system in the U.S. Congress is not the result of legislation, but is a *de facto* rule followed by its members.²² Furthermore, not all of the benefits of seniority come from

 $^{^{21}}$ The idea of using only the utility of the decisive voters in the social welfare calculation, as opposed to the welfare of all voters or all citizens, is done for two reasons. First, it is difficult to measure the welfare of all voters given the methods I used to uncover voter preferences. My methods rely on the voter casting the pivotal vote. Second, such a welfare function is, in a sense, implicit in the social choice function laid out in the U.S. Constitution.

 $^{^{22}}$ See McKelvey and Riezman (1992) for a model where a seniority system is endogenous and self-sustaining.

the seniority system; undoubtedly learning occurs that increases a Congressman's ability at the pork barrel as he gains experience. Thus, it might be very difficult to legislate away the seniority trap. Still, I implement a policy of seniority system reform that takes away all of the advantages in obtaining federal outlays that are due to seniority. More formally, I set $\alpha_2 = \alpha_3 = 0$ in all the models. While such a policy might not be realistic, it illustrates the largest possible costs of the seniority trap.

Table 10 summarizes the results of seniority system reform. The second column presents candidate quality before reform, the third column presents candidate quality after reform, and the fourth column is the difference between the reform and the baseline case. Rows of the table represents the different models: The results from the naïve model are first row, the results from the committee model are second, and the results from the Falk calibration are last row. Standard errors from 500 Monte Carlo simulations of the model are reported in parentheses under the estimates of quality. The Monte Carlo simulations account for uncertainty in the draws of candidate quality and for uncertainty about the parameter estimates. Before reform of the seniority system, the decisive voters in the naïve model would give up \$96.48 in federal outlays, on average, to have in office those candidates who won election as opposed to the next best challenger. Under the reform, this measure of quality increases by about \$0.50 in the naïve model. That is, the average decisive voter would give up about \$0.50 per term in discretionary spending to reform the seniority system. The reform increases the average quality of an officeholder in the other two models also. Both experience larger gains than the naïve model because they have larger returns to tenure in terms of federal outlays. The maximum gain from reforming the seniority system is \$591.65, from the Falk calibration. The Falk calibration also has the largest standard errors on mean quality, however one can reject the hypothesis that mean quality is the same in any two of the models at the 5% significance level.

Such a reform must have a positive effect on quality since the returns to tenure are greater than zero and voters gain utility from federal outlays. However, the returns to tenure are quite small in comparison to the differences in candidate quality. Despite the large returns to seniority measured by Falk, if one wishes to construct a model that matches the characteristics of Congressional elections, (and, in particular, the small change in the

Model	Baseline	No Seniority Effects	Difference
Naïve	\$96.484	\$96.983	+\$0.499
	(5.910)	(5.504)	(2.497)
Committee	\$168.715	\$171.315	+\$2.599
	(10.288)	(10.159)	(6.637)
Falk	\$1,735.388	\$2,327.038	+\$591.650
	(309.469)	(250.042)	(106.927)

Table 10: Seniority System Reform

re-election rates of incumbents as their seniority increases) then the quality of candidates must become much larger. The models display a positive correlation between outlays and the probability of re-election, but such a correlation is largely due to a positive selection bias, even with the tenure effects found by Falk. More senior representatives are, on average, of higher quality than more junior representatives due to selection effects, and thus are more likely to win re-election. A positive correlation between funds and winning is largely due to the fact that both funds and quality increase with tenure.

5.2 Term Limits

Term limits are the most commonly cited solution to the seniority trap. Academics who analyze the role of term limits in this context include Dick and Lott (1993), Elhauge, Lott, and Manning (1997), Mao (2001), and Bernhardt, Dubey, and Hughson (2004). Term limits were also a major part of the Republicans' "Contract with America" and Congressional term limits were passed by referenda in several states before being struck down by the Supreme Court in U.S. Term Limits, Inc. v. Thornton. While House Joint Resolution 38, a part of the "Contract", failed to leave the House, using the model in this paper I calculate what might have happened to the quality of office holders had it been implemented. H. J. Res 38 proposed a six-term term limit on representatives, the length of which I follow in my policy experiment.

Term limits can affect voters' choices between incumbents and challengers in two ways. By forcing out more senior members, the voters face a smaller tradeoff between electing a challenger as opposed to an incumbent. That is, even if the returns to seniority are the same, the incentive to re-elect an incumbent is smaller because he is forced out of office after a specified period of time. Term limits will also affect the decisions of voters by changing the returns to seniority. A change in the distribution of tenure, caused by term limits, will affect the allocation of power with give by the seniority system. I present the upper bound on the benefits that term limits might confer. That is, term limits in this experiment completely reform the seniority system, making the incentive to re-elect incumbents as low as possible. Notice that term limits can only be a net loss if no seniority trap exists. They may have a positive benefit in as much as they reduce the wedge between incumbents and challengers that results from pork barrel politics.

Table 11 follows the format of the previous section and presents the results of the institution of term limits, with Monte Carlo standard errors reported in parentheses. In all cases, term limits have a negative effect on office holder quality. In the naïve model, the drop in the quality of officeholders is dramatic, from \$98.48 to \$75.78.²³ When the scare-off effect is more important, term limits are not as costly. Although term limits force out high quality candidates, they also produce more open elections. If these elections have higher than average quality candidates, then term limits can be beneficial in creating more open elections and not just through reducing the distortions of the seniority system. For example, the welfare loss in the committee model is only \$7.62 as compared to a loss of \$20.70 in the naïve model. The Falk calibration presents the strongest case for term limits because of the large amount of pork senior members can direct to their district. As a result, it also has the largest gains realized from term limits of the three models due to the returns to tenure at the pork barrel. The Falk calibration also sees lower costs to term limits because of the high quality of candidates from open elections. Offsetting the decrease in average quality due to incumbents being forced from office, are the increase in the number of open elections which on average feature higher quality candidates. Term limits may be able to improve voter welfare, as Bernhardt, Dubey, and Hughson (2004) and others argue, but empirically term limits are harmful to voter welfare, unless the seniority-system is sufficiently distortionary.

²³More strict term limits decrease welfare further in the naïve model. A two term term limit results in officeholder quality that is \$37 below the baseline case in the naïve model. However, with a two-term term limit, welfare in the committee model is only \$2.69 lower than in the baseline case (as opposed to a loss of \$7.62 with a six term limit). The reason for this is the larger estimate of μ_o in the committee model. Because open elections feature candidates of much higher quality, the benefit of more open elections outweighs more of the costs of forcing out high quality incumbents. The Falk calibration results in lower welfare under a two term limit than a six term limit. The increase in the number of open elections is not enough to offset the costs of forcing high quality candidates out of office.

Model	Baseline	Term Limits	Difference
Naïve	\$96.484	\$75.775	-\$20.709
	(5.910)	(4.289)	(3.049)
Committee	\$168.715	\$161.090	-\$7.625
	(10.288)	(8.829)	(5.553)
Falk	\$1,735.388	\$2,212.402	+\$477.014
	(309.469)	(167.828)	(104.137)

Table 11: Welfare Under Term Limits

5.3 Changes to the Committee Assignment Process

Another reform in the "Contract with America" is the term limitation of committee seats. Given the returns to seniority on committees, such term limits provide an alternative to term limits on House seats. Committee term limits allow high quality members to stay in Congress, but limit membership on committees, where I find the largest returns to seniority. Instituting term limits on committee membership in the committee model results in an average level of office-holder quality that is between the baseline case and the case of complete reform of the seniority system. The extent to which the result approaches the value found under reform of the seniority system depends upon how committee term limits affect the seniority system within committees and thus the returns to committee seniority. The welfare calculations below are for a three term limit on committee seats (the same length that the Speaker of the House placed on committee chairmanships in 1995) and assume that the term limit results in a complete deterioration of the committee seniorityfunds relationship.²⁴ The results show term limits on committee seats are an efficient tool if the returns to the pork barrel come from committee tenure. Such a policy allows quality candidates to stay in office (one of the costs of term limits on House seats), but reduces the distortion caused by the pork barrel. To be sure, Table 12 presents the largest possible gains from term limits on committee seats. The realized benefits will fall somewhere between the baseline and the first-best, depending upon the effect of committee term limits on the relationship between committee seniority and federal outlays. However, one can say that term limits on committee seats provide a solution with more potential than term limits on House seats. Term limits on committee seats can provide the potential benefits of reducing

 $^{^{24}}$ As in the case of the House term limits experiment, the true change in welfare will fall somewhere between the baseline case and the upper bound presented here.

the distortions caused by the seniority system, without the cost of forcing high quality candidates from office.

To further get an idea of the benefits from a committee seat and the distortions caused by such benefit, I also present the results of a policy experiment where committee seats are randomly assigned. I assume an i.i.d. process, where the probability of a committee assignment is independent of House tenure and committee tenure. In addition, I assume that the seniority-funds relationship stays in tact. Table 12 displays the resulting welfare change, which is less than that from committee term limits. With the committee seniority-funds relationship still in place, voters have an incentive to re-elect an incumbent over an equally qualified challenger because the incumbent may win a second term on a committee, with the corresponding increase in expected federal outlays.²⁵ If random committee assignments also weakened the seniority-funds relationship, the welfare gains from such a policy would be larger. For example, the first best solution would be achieved if, due to the randomized committee assignments, committee seats and committee tenure were orthogonal to expected funds.

Policy Change	Baseline	After Policy Change	Difference
Committee Term Limits	\$168.715	\$171.315	+\$2.599
	(10.288)	(10.925)	(5.776)
Randomized Comm Assign	\$168.715	\$169.783	+\$1.068
	(10.288)	(10.881)	(5.884)

Table 12: Welfare After Changes to the Committee Assignment Process

5.4 Seniority Tax

While the quantity constraint that is term limitation has been popular, a policy change that affects the relative prices is more efficient, if not politically viable. If one were serious about reducing the costs of the seniority trap identified in section 5.1, a tax can be used to eliminate the wedge between incumbents and challengers that results from the pork barrel. A tax has the advantage of reducing the distortion while allowing high quality and low quality Representatives to stay in office.

 $^{^{25}{\}rm Of}$ course, this incentive is stronger if both House tenure and committee tenure matter for the distribution of federal funds.

To achieve the first-best solution, I institute a seniority tax.²⁶ The size of the tax is a function of the incumbent's tenure. A district is taxed, in federal outlays, for electing an incumbent. Formally:

$$u(f(T_{i,t},\epsilon_{i,t}),\eta_{i,t}) = f(T_{i,t},\epsilon_{i,t}) - \tau(T_{i,t}) + \eta_{i,t}$$
(5.1)

Where $\tau(T_{i,t})$ is the seniority tax and is optimally set when $\tau(T_{i,t}) = \alpha_2 * T_{i,t} + \alpha_3 * T_{i,t}^2$. Such a tax can completely eliminate the wedge between incumbents and challengers and does not have the costs of term limits since it allows quality incumbents to remain in office. Table 13 presents the results of the seniority tax experiment, with Monte Carlo standard errors in parentheses below the estimate of the average quality of office holders. These results are equivalent to the reform of the seniority system; an optimally set seniority tax achieves the first-best outcome.

Table 13: Welfare Under Seniority Tax

Model	Baseline	Tax	Difference
Naïve	\$96.484	\$96.983	+\$0.499
	(5.910)	(5.776)	(2.926)
Committee	\$168.715	\$171.315	+\$2.599
	(10.288)	(10.374)	(6.161)
Falk	\$1,735.388	\$2,327.038	+\$591.650
	(309.469)	(227.512)	(125.511)

An important caveat is worth mentioning regarding the seniority tax. That is, there may be some avoidance behavior resulting from the implementation of this policy. Taxes on seniority could lead to an alternative rule allocating power in the House. If the new rule used to allocate power is identifiable by voters, it may lead to distortions similar to those resulting from the seniority system. In this case, the benefits of a seniority tax would not be fully realized.²⁷

²⁶While the specifics of how such a tax might be implemented are beyond the scope of this paper, one can think of such a tax as a "negative earmark".

²⁷On the other hand, one might also propose taxing the new externality causing behavior.

6 Discussion

After presenting the results from the policy experiments it is useful to discuss how alternative assumptions and extensions to the model would affect the results. Although the model presented is true to the models of those who have argued that the seniority trap is economically significant, it is important to discuss how changes to the model might affect the conclusions I reach.

Notably, I model the exit decisions of Congressmen as an exogenous process. The effect of this assumption depends on the relationship between candidate quality and exit decisions. Both Merlo, Diermeier, and Keane (2005) and Keane and Merlo (2007) model the career decisions of politicians. Keane and Merlo (2007) consider the effects on the entry and exit decisions of Congressmen that result from changes in the institutional structure of Congress. The authors find that legislative "achievers" and "skilled" politicians are differentially affected by term limits and other changes to institutional structure.

Achievers are defined as those who seek legislative accomplishment, while the skilled are those who have high ability to win elections. Keane and Merlo (2007) find that term limits have similar effects on achievers and non-achievers. The result is that there is no change in the distribution of achievers and non-achievers. If one believes that being an achiever corresponds to my measure of quality, an implication of Keane and Merlo (2007) is that my measures of quality changes due to the imposition of term limits are not biased in any particular direction. However, Keane and Merlo (2007) find several policy experiments that differentially impact the distribution of achievers and non-achievers. Eliminating seniority as a determinant to committee assignments increases the number of achievers. Reducing the seniority advantage in elections and restricting private sector employment after Congress is also found to increase the number of achievers. In the experiments where the committee assignment process is altered (either through term limits or randomized committee seats), I am understating the benefits to such proposals because of the assumption of exogenous exit probabilities. In addition, the seniority reform and seniority tax experiments lower the incumbency advantage and would therefore increase the number of achievers. Thus a model with endogenous exit would find even larger welfare gains from these policy experiments, than do I.

To be sure, quality as defined in this model does not map perfectly into the achiever/nonachiever definition. The definition of quality used here is more general and not only includes legislative ability and ambition, but skill in winning elections (e.g. from a charismatic politician). Keane and Merlo (2007) find a differential impact on skilled and unskilled politicians from their experiments with term limits, with the imposition of term limits resulting in more lower skilled politicians. Considering the effects term limits have on skilled politicians means that the bias from the exogenous exit assumption is to understate the benefits of term limits if one interprets political skill as a dimension of quality (because term limits do not affect the achiever type, but lower fraction of the skilled type).

A further exogeneity assumption I make is the assumption that the distributions of candidate quality are assumed to be exogenous. Merlo, Diermeier, and Keane (2005) find that term limits lower the value of a seat in the House. To the extent that ability in the legislature and ability in the private sector are correlated, the lower value of a House seat means that more high ability candidates will seek employment elsewhere. Omitting the candidate selection process from my model will then result in an underestimate of the costs of term limits. Also, because term limits result in more open elections, they may lower the average quality of candidates in these elections if the number of potential candidates is finite and small. Accounting for such effects would mean that the benefits of term limits are overstated in the model.

As discussed with the result of the policy experiments, one expects changes in the seniority-funds relationship after the policy experiment. In order to keep the structural model parsimonious, this relationship was estimated in a reduced form model. Because the model is not policy-invariant, the relationship is not robust to the institutional changes proposed in the policy experiments. Because of this, I assume that in the case of term limitations the seniority-funds relationship disappears completely. The result of such an assumption is to bias upwards the welfare changes from the policy experiments. In fact, because the seniority-funds relationship is the cause of all the distortions in the models, the assumption results in an upper bound on the welfare effects of the policy changes.

Beyond the effects on the quality of challengers, term limits have effects on how well

incumbents serve their constituents. My model does not account for these political agency problems. Term limits create lame ducks and, as Smart and Sturm (2004) show, term limits may lower the value of incumbents when agency problems exist. Ignoring lame duck issues results in my overestimating the benefits of term limits.

District preferences for pork may vary. Because I measure quality in terms of the value of pork, and because I assume that pork is valued similarly across districts, the effect of ignoring heterogeneity in the preference for pork is to overestimate the quality of candidates in districts with a below average preference for pork and to underestimate the quality of candidates in districts with an above average preference for pork. Given the risk neutrality of voters in the model, the effects cancel out, and I have an unbiased measure of the average quality of candidates.

Adding risk aversion to the model has a number of effects. Holding constant the parameters governing the distributions of candidate quality, increases in the risk aversion of voters increase the re-election rates of incumbents. The increase in re-election rates is due to the increase in the option value of an incumbent. To match the moments from the data, and the incumbency re-election rates in particular, the estimates of the quality of candidates in office would decrease. The result, on the measures of voter welfare, would be a lower cost of the seniority trap and a lower cost to instituting term limits.

7 Conclusion

Worry over the seniority trap appears largely exaggerated. I have constructed a model that provides an environment where the effects of seniority and pork barrel politics would have their largest impact. I have also used the largest estimate of the returns to seniority found in the literature. Only when the returns to seniority are extremely large, does one find an economically significant change in representative quality due to the incentive to re-elect incumbents in order to direct funds to the district. In two of the three cases considered, the oft-cited cure is worse than the disease; term limits have a negative net impact on candidate quality. Moreover, the results likely represent an upper-bound on the benefits of term limits. For those that continue to believe the seniority trap carries large costs, their solution must not ignore the benefits to keeping quality candidates in office.

My results suggest three policies that dominate term limits on House representatives. The first is to not place term limits on House membership, but on committee membership. Committee assignments drive the relationship between seniority and spending. By limiting the time a representative can sit on a committee, one reduces the distortion of pork barrel politics while allowing quality candidates to remain in office. Such a policy, in addition to term limits on terms in the House, was a part of the "Contract with America". Neither measure was passed into law. Randomized committee assignments are a second policy that reduces the cost of the seniority trap. A more unique solution is the seniority tax proposed in Section 5.3. Such a tax, set optimally, would completely eliminate the wedge between incumbents and challengers that results from pork barrel politics and allow candidates to remain in office indefinitely.

Several avenues for future research present themselves. Endogenizing the choices of politicians is an obvious path. Daniel and Lott (1997) find that term limits have indirect effects on campaign outcomes through campaign finance and candidate reputation. Besley and Case (1995) find important effects on policy due to lame duck politicians, which are ignored in my analysis. Levitt and Wolfram (1997) cites the importance of endogenous challenger selection to the outcomes of Congressional elections. Merlo, Diermeier, and Keane (2005) and Keane and Merlo (2007) find that the career decisions of politicians are important for and depend upon different measures of quality. Such sources, among others, point to the importance of modeling the decisions of members of Congress.

A second line of research is to conduct a more thorough analysis of the relationship between committee seniority and the ability to direct federal spending. From the results of this paper, such a relationship appears strong, but the political science and economics literatures contain little corroborating evidence.

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Appendix

A-1 Calculating the Posterior Density

For an incumbent is in his first term (having just won an open election), the prior density is f_o and the probability of having won the election conditional on having quality η is given by $F_o(\eta)$. The posterior density for incumbent quality at the next election (Equation 3.4) can be written as:

$$g(\eta_n|h_0) = \int_H \frac{f_o(\eta_{n-1}) \cdot F_o(\eta_{n-1})}{\int_H f_o(x) \cdot F_o(x) dx} Q(\eta_n|\eta_{n-1}, h_0) d\eta_{n-1}$$
(A.1.1)

If the incumbent has tenure of more than one term and won in the previous election, the prior density is the previous posterior density, $g(\eta_{n-1}|h_{n-1})$, and the conditional probability of winning is given by $F_c(\bar{\eta}(T_{h_{n-1}}, \eta_{n-1}, e_{h_{n-1}}))$. The posterior density for incumbent quality at the next election is given by:

$$g(\eta_n | \langle d_n, h_n \rangle) = \int_H \frac{g(\eta_{n-1} | h_{n-1}) \cdot F_c(\bar{\eta}(T_{h_{n-1}}, \eta_{n-1}, e_{h_{n-1}})}{\int_H g(x | h_{n-1}) \cdot F_c(\bar{\eta}(T_{h_{n-1}}, x, e_{h_{n-1}}) dx} Q(\eta_n | \eta_{n-1}, h_{n-1}) d\eta_{n-1}$$
(A.1.2)

If an incumbent lost the previous election, the prior density for the new incumbent is f_c . The conditional probability of winning is determined by the posterior density of previous incumbent quality and the decision rule of the voter $(\bar{\eta}(T_{h_{t-1}}, z, e_{h_{n-1}}))$. The posterior density for incumbent quality at the next election thus given by:

$$g(\eta_n | \langle d_n, h_n \rangle) = \int_H \frac{f_c(\eta_{n-1}) \cdot \int_{z:\bar{\eta}(T_{h_{n-1}}, z, e_{h_{n-1}}) < \eta_{n-1}} g(z|h_{n-1}) dz}{\int_H f_c(x) \cdot \int_{z:\bar{\eta}(T_{h_{t-1}}, z, e_{h_{n-1}}) < x} g(z|h_{t-1}) dz dx} Q(\eta_n | \eta_{n-1}, h_{n-1}) d\eta_{n-1}$$
(A.1.3)

A-2 Details of Model Solution and Estimation

Given Θ , I approximate the AR(1) process for incumbent quality using the method of Tauchen (1986). The parameter vector, Θ , is updated using the derivative based approach of Lagarias, Reeds, Wright, and Wright (1998). To test the robustness of the maximization routine, a number of starting values were used. Results of estimation proved sensitive to starting values, so I conducted a search of the parameter space using both a brute-force approach and a simulated annealing algorithm (Goffe and Rogers (1994)). Once these methods narrowed down the space of parameters, I ran the estimation using the methods of Lagarias, Reeds, Wright, and Wright (1998) to find the minimum.

A-3 Full Tables of Results Not Reported in Text

CFDA Code(s)	Program Name
13.714, 93.778	Medical Assistance Program
13.773, 93.773	Medicare-Hospital Insurance
13.774, 93.774	Health Insurance for the Aged-Supplementary Medical Insurance
13.802, 93.802, 96.001	Social Security-Disability Insurance
13.803, 93.803, 96.002	Social Security-Retirement Insurance
13.805, 93.805, 96.004	Social Security-Survivors Insurance
13.807, 93.807, 96.006	Supplemental Security Income
14.156, 14.856	Lower-Income Housing Assistance Program
57.001	Social Insurance for Railroad Workers
64.101	Burial Expenses Allowance for Veterans
64.102	Compensation for Service-Connected Deaths for Veterans' Dependents
64.104	Pension for Nonservice-Connected Disability for Veterans
64.105	Pension to Veterans Surviving Spouses, and Children
64.109	Veterans Compensation for Service-Connected Disability
64.110	Veterans Dependency and Indemnity Compensation for Service-Connected Death
64.120	Post-Vietnam Era Veterans' Educational Assistance
64.104	Veterans Disability Pension
93.558	Temporary Assistance for Needy Families
93.600, 13.600	Child Development- Head Start
84.063	Pell Grant
$93.020, \ 93.560$	Family Support Payments to State Assistance Programs
93.563, 93.023, 13.783, 13.679	Child Support Enforcement
16.710	Public Safety and Community Policy Grants
84.04, 13.4782	Specials Services for Disadvantage Students
72.002, 94.002	Retired Senior Volunteers
21.3	State and Local Government Revenue Sharing
84.047	Upward Bound
13.808, 13.761, 13.780	Public Assistance-Maintenance Assistance (State Aid)

Table A.1: Low Variation Programs, 1983-2006

Tenure	Prob. Retire
1	0.043
2	0.051
3	0.096
4	0.080
5	0.106
6	0.166
7	0.107
8	0.119
9	0.122
10	0.174
11	0.085
12	0.175
13	0.093
14	0.154
15	0.207

Table A.2: Probability of Non-electoral Exit From Office by Tenure

Table A.3: Probability of Obtaining a Seat on a Powerful Committee by Tenure

Tenure	Prob. Obtain Comm Seat
1	0.418
2	0.188
3	0.198
4	0.152
5	0.125
6	0.119
7	0.103
8	0.104
9	0.093
10	0.066
11	0.083
12	0.100
13	0.122
14	0.032
15	0.093

 Table A.4: Probability of Retaining a Seat on a Powerful Committee by Tenure on a Powerful Committee

Tenure	Prob. Obtain
1	0.835
2	0.922
3	0.979
4	0.949
5	0.965
6	0.966
7	0.972
8	0.989
9	0.968
10	1.000
11	0.976
12	0.944
13	0.963
14	1.000
15	1.000

Dependent Variable:	New Outlays Per Capita, High Variation Programs
Tenure	3.069
	(14.671)
Tenure^2	0.041
	(1.034)
Gen Elec %	-0.542
	(1.019)
PAC Contrib. (\$'s)	0.001***
	(0.000)
Democrat	39.432
	(50.300)
Controlling Party Member	9.029
	(32.199)
Comm. on Appropriations Member	173.5446***
	(66.068)
Comm. on the Budget Member	6.598
0	(44.044)
Comm. on Rules Member	52.354
	(104.386)
Comm. on Ways and Means Member	48.488
	(74.969)
Committee on Agriculture Member	-17.394
	(67.419)
Comm. on Armed Service Member	64.190
	(67.480)
Comm. on Natural Resources Member	-22.670
	(62.982)
Comm. on Merchant Marine and Fisheries	9.737
	(77.476)
Comm. on Transportation and Infrastructure Member	53.975
	(49.316)
Comm. on Science and Technology Member	-34.964
	(50.333)
Comm. on Small Business Member	-56.223
	(50.895)
Comm. on Veteran's Affairs Member	13.319
	(62.78616)
District Fixed Effects	Yes
Congress*State Controls	Yes
R-Squared	0.903
Observations	5216

Table A.5: Outlays and Tenure Regression: Full Results for Naïve Model

Dependent Variable:	New Outlays Per Capita, High Variation Programs
Power Comm. Member	-56.186
	(48.410)
Power Comm. Tenure	58.332***
	(19.44633)
Power Comm. Tenure ²	-3.789**
	(1.505)
Gen Elect $\%$	-0.537
	(1.001)
PAC Contrib (\$'s)	0.001***
	(0.000)
Democrat	40.018
	(49.319)
Controlling Party Member	10.479
	(31.863)
District Fixed Effects	Yes
Congress*State Controls	Yes
R-Squared	0.903
Observations	5216

 Table A.6: Outlays and Tenure Regression: Full Results for Committee Model