On the stability of U.S. politics: Post-sample forecasts and refinements of the Congleton-Shughart models of Social Security and Medicare benefit levels[1]

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Abstract: An important issue associated with empirical research is the extent to which statistical results continue to hold in the post-sample period. Although many tests of robustness within the period of a given study are routinely reported, relatively little attention is paid to model performance in the post-sample period. This paper examines the post-sample performance of the Congleton and Shughart (1990) estimates of three public choice models of Social Security benefit levels. The Social Security program is the single largest line item in the federal budget; so, examining the post-sample performance of the Congleton-Shughart estimates also sheds light on the long-run stability of political processes in the United States. In general, we find that the three public choice models perform well in the post-sample period, although there are several caveats to that conclusion. The results of our post-sample study also suggest that the political processes of the United States with respect to major fiscal policies are more stable and robust than news reports suggest.

JEL codes: H1, H55, D7

Key Words: Social Security, Fiscal Policy, Post-Sample Forecasts, Replication Study, Public Choice Models, Political Stability, U.S. Politics

1. Introduction

In 1975 Edgar Browning wrote a theoretical paper that showed how aging could produce stable support for a tax-funded public pension program. He argued that voters of median age and income secure above-average rates of return from tax-funded public pensions because they have only a decade or two of future tax payments to make in order to collect their pensions. Those tax payments together with uncertainty about longevity tend to moderate demands for future transfers. Older voters tend to prefer larger pensions and younger ones tend to prefer smaller ones insofar as they vote their economic interests. Thus, he argued that median voter outcomes could explain the existence of stable tax-financed pension programs in democracies without recourse to altruistic

[1] The authors thank William Shughart II and two anonymous referees for several unusually helpful questions and suggestions.

impulses or redistributive ideologies and, moreover, that changes in median age and income would affect average benefits and taxes.

Browning's theoretical argument went untested for a decade. Data sources were not digitized in those days, and one had to contact the Social Security Administration or consult its annual paper reports to collect data on Social Security benefits. Still other paper sources were necessary to estimate median voter age and income. In addition, relatively few scholars were engaged in public choice research at that time. While on sabbatical at George Mason University, Congleton asked Shughart about the feasibility of undertaking such estimates. Congleton developed three mathematical public choice models for tax-financed pension programs similar to those of the United States—with earmarked taxes and benefits linked to past labor income—and Shughart undertook the hard work of assembling a data set and estimating the models.

The result was a paper that compared a variation of Browning's median voter model with both interest group and combined models of public policy formation. They were surprised at how well the median voter model accounted for variations in average benefit levels in the period of their study, 1946–1982. The pure interest group model worked nearly as well, however, and their combined model—a model that included both electoral and interest group influences—worked a bit better than either pure model. See Congleton and Shughart (1990)—hereafter referred to as CS.

Their study justified its relatively simple models of the politics of what might be considered the pension or annuity portion of Social Security by the program's separate and relatively straightforward funding. Old Age, Survivors and Disability Insurance (OASDI) is financed by an earmarked payroll tax on wage and salary income that is proportional over the range of most voter's income. A similar funding method is used to finance Medicare parts A and B. The use of earmarked taxes to fund these programs allows those programs to be considered substantially independent of those funded from general revenues.[2]

The CS estimates demonstrated that relatively straightforward public choice models could account for the expenditure path of two of the largest programs of the U.S. government during the post-war period. The Social Security program was the second largest area of expenditure for much

[2] In the post-sample period of the present study, this independence is likely to disappear as more and more of the funding for both programs is likely to come from general revenues—unless another major package of reforms is legislated in the next few years.

of their period of study, after national defense. Medicare did not start until 1965, but had become the third largest area of expenditure by the end of their study.[3]

Few scholars have followed up on their study and the political economy of major welfare state programs has remained a relatively understudied area of research.[4] This paper explores the extent to which the CS results have stood the test of time. It also updates and refines their study in various ways, the most important of which is to take account of the Greenspan reforms of 1983, which effectively constitutionalized the path of tax-financed pension (OASI) benefits and taxes for the next several decades. Details about the tax-financed retirement programs and their reforms are provided in somewhat lengthy footnotes in order to keep the narrative focused on replication and post-sample analysis.

2. Data

In an ideal data environment, replication and post-sample forecasts would be trivial tasks. The data used in the original studies would be freely available and replication would involve simply repeating the estimation strategies undertaken. Data sets, however, are "updated" continuously as the data collectors change their minds about which numbers should be combined in what manner to produce

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[3] Informal use of the term Social Security refers to its pension or annuity benefits for retired persons. It is that usage that we apply throughout the present paper. However, when the Social Security program was enacted in 1935, it included a variety of social insurance provisions including unemployment insurance and aid to poor families with dependent children. Different parts of the program were implemented at different times. Unemployment insurance began well before retirement pensions were paid out. The pension portion of the program did not pay pensions until about 10 years later.

In general terms, the package and provisions of the Social Security program are determined by federal legislation and administered by various federal and state government agencies. Some of these programs are jointly funded and administered by states and the federal government, as with unemployment insurance and aid to families with dependent children. Tax-financed healthcare programs were established 30 years later. Medicare (for retired persons) was established in 1965 and Medicaid (for poor persons) in the same year. Medicaid is jointly funded and administered by individual states and the federal government. The two programs focused on in the CS study—the pension component of Social Security and Medicare—are both federally funded and administered.

[4] At the time of this writing, the Congleton-Shughart paper has been cited 88 times on Google Scholar, most of which deal with other aspects of the welfare state or with other public policies. Notable exceptions are Breyer (1994), Breyer and Craig (1997), Pecchenino and Utendorf (1999), Congleton and Bose (2010), Congleton, Batinti, and Kim (2011) and Bergh and Bjørnskov (2014). Congleton and Batinti (2018) undertakes a somewhat narrower study of interdependencies between healthcare R&D and tax-financed healthcare expenditures in OECD countries.

the "raw" data that economists use in most of their statistical studies. In addition, over time, econometric software packages evolve. The latter involves not only additions to the menu of estimation procedures included but also modifications in how older estimators are calculated. Matrix inversion methods have been refined and the number of digits used for arithmetical calculations has expanded during the past half century as computer processors increased in speed and data storage capacities became less costly. The more digits used, the smaller is the rounding error associated with computerized arithmetic. The latter can be significant when several thousand or millions of arithmetical calculations and logarithmic operations are necessary to estimate a numerical value.[5] Evidence of the statistical relevance of this effect is provided in our base replications.

Taken together, the vintage data and statistical package effects account for many of the difficulties researchers encounter in replication studies.[6] Those challenges are, of course, reinforced by data entry and other typographical errors, which would have been commonplace in the days when researchers had to "punch in" all of the numbers used in their statistical studies from printed material, which was also subject to typographical errors. Typographical errors tend to be reinforced by researcher priors about the correct signs and magnitudes of estimated parameters. When priors are disconfirmed, data and other errors are looked for assiduously, typos corrected and decisions made about the treatment of possible "outliers." When the observations are confirmed, the data and tabulated results are "naturally" presumed to be correct.

We were fortunate in that Congleton had held onto a typed copy of the data set used in the original Congleton-Shughart (henceforth CS) study, which allowed our replication efforts to begin with their data, although it is possible that some data entries differ from those entered into the statistical program used. We did not have access to their vintage 1986 estimation package. In order to rely on a consistent data set for appraising their estimates, we first replicated their results using contemporary data and two contemporary econometrics packages (Eviews and Stata). The new full

[5] To illustrate the rounding effect, consider a few simple calculations from Excel. Let $X = Y^A Y^A Y^A$ with exponent A being successively better approximations of 1/3, namely 0.3, 0.33., 0.333 and 0.3333. The Xs associated with those values of A are 5.762, 6.865, 6.986, and 6.998, respectively. As A approaches the true value of 1/3—that is, as the number of digits used for the exponent and its associated logarithmic operations increases, A approaches its true value of 7.000. The rounding problem increases with the number of arithmetic operations undertaken and falls with the number of digits used for those calculations. Arithmetic expressions that cannot be precisely digitized with a finite number of digits always generate such round-off errors.

[6] See Croushore and Stark (2003) for an overview of how the vintage of data can affect estimation results and replications.

sample period—the original period and the post-sample period—is approximately twice the length of the original study.

Table 1 lists the Congleton-Shughart data sources (those followed by CS in parentheses) and those used in the current study. Data sets for the entire period were not always available and thus some of our data series were spliced from different sources, as noted in Table 1. In addition, some variables such as the age of the median voter had to be estimated from available sources. People casting votes do not record their ages, although exit poll and other survey data provide information about the age distribution of voters. That information was used to estimate the median age of the median person casting votes in each national election.[7] The estimated median voter's age varied from 43 to 54 over the course of the full sample. The remaining work life of the median voter is that age less the full benefit retirement age.[8] The expected longevity of the median voter is the average longevity associated with a person of the median voter's age. Statistical properties of our data set are provided in Table 6 of the appendix.

Table 1. Data sources used for the original CS estimates, our replication, post-sample forecasts, and full-sample recalibrations

Data series	Data Source
Average Real OASDI Benefit	The Social Security Bulletin

[7] The median voter's age was calculated by finding the median individual within the U.S. Census Bureau's age categories for each voting year, and then using linear interpolation based on the median individual's location within his or her age-range category to approximate the "expected" age of the median voter in years in which no national elections took place. In principle, median income should be calculated with the median voter's age in mind, but we used the approach used in the original study for the purpose of replication and re-estimation. This is still the most common one in studies based on median-voter models.

[8] The full-benefit retirement age was 65 for most of the period of study. However, minor changes in the full-benefit retirement age have been phased in accordance with the Greenspan reforms for persons born after 1938 and gradually reaches 67 for those born after 1959. The process is incremental rather than continuous. For example, for persons born between 1943 and 1954, the full-retirement age is 66. The earliest age one is eligible to receive retirement benefits, nonetheless, remains 62.

The most common age at which persons apply for benefits is 62, partly because many persons retire earlier than that. This causes the average age of retirement to be less than the full-retirement age. However, the median age of retirement—in the years where that age can be calculated—is approximately that required for full benefits. Benefits for those retiring at age 62 are reduced by approximately 25%, and the reduction diminishes to zero as one postpones retirement to the full benefit age—which is currently 66 for persons eligible for the full benefit. (The benefit continues to increase to the age of 70, after which persons still gainfully employed receive their retirement benefit, whether they retire or not.)

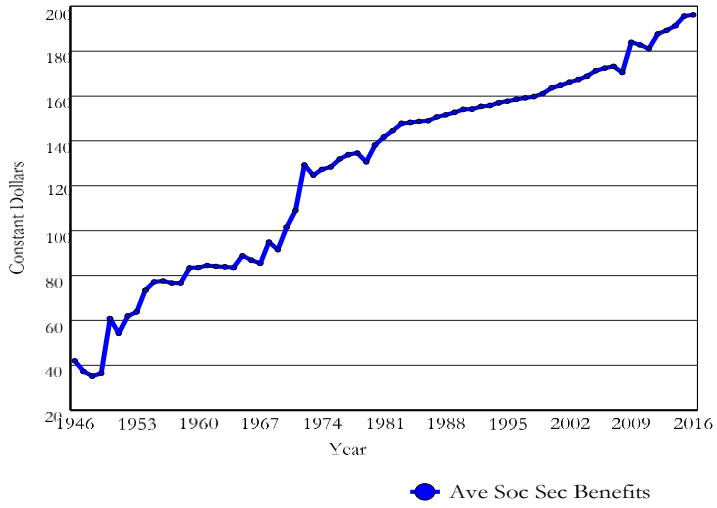
Average Real OASDI plus Medicare Average Real Medicare Benefit	Average Real Medicare Benefit was calculated by taking the difference between OASDI Benefit and OASDI plus Medicare as reported by the Bulletin.
Average Private Retirement Income	The Historical Statistics of the United States, Colonial Times to 1970 (CS) The Handbook of Pension Statistics (1986) (CS) The Historical Statistics of the United States, Colonial Times to 1970 The Handbook of Pension Statistics (1986) After 1985, the data from the Historical Tables of Private Pension Plan Bulletin, the Department of Labor.
Average life expectancy of the population data from 1939–1941 data from 1949–1970 except for the years, 1953, 1961, and 1970 Additional values	The Vital Statistics of the United States (CS) The Historical Statistics of the United States, Colonial times to 1970 (CS) The 1986 Statistical Abstract (CS) Linear interpolations used to fill in the gaps (CS) U.S. National Center for Health Statistics, U.S. Life Tables and Actuarial Tables, 1979–81; Vital Statistics of the United States, annual; and unpublished data U.S. National Center for Health Statistics, U.S. Life Tables and Actuarial Tables, 2005–2016; Vital Statistics of the United States, annual; and unpublished data
Total wages and salary	The Economic Report of the President U.S. Bureau of Economic Analysis (2007–2016)
Median voter's income	Proxied by the median annual earnings of workers (1940–1965) available for only five-year intervals. Annual figures are calculated using linear interpolation (CS) Proxied by median income data from the U.S. Census Bureau
Voter participation rates by six age groups (1946–1962) Data from 1964–1982	Estimated by using data from 1964 to 1984 (CS) Estimated by using data below from 1964 to 2004 Reported Voting and Registration by Race, Hispanic Origin, Sex and Age Groups: November 1964 to 2016 from the U.S. Census Bureau
All-item CPI	The Economic Report of the President (CS) The Economic Report of the President U.S. Bureau of Labor Statistics
Interest rate, the yield on AAA corporate bonds	The Economic Report of the President (CS) The Economic Report of the President Moody's Seasoned AAA Corporate Bond Yield
Growth rate of real GNP	The Economic Report of the President (CS) The Bureau of Economic Analysis, The Department of Commerce U.S. Bureau of Economic Analysis (2007–2016)
Number of OASI Recipients	The Social Security Bulletin
Number of workers reporting taxable earnings	The Social Security Bulletin
Administrative Expense	The Social Security Bulletin
Percentage overhead	The Social Security Bulletin (CS) The Historical Statistics of the United States, Colonial Times to 1970 The Social Security Bulletin

3. Replication

As a point of departure, Figure 1 plots average monthly benefits in 1967 dollars and is similar to Figure 1 of the CS study. Average real retirement benefits generally have increased through time, although not monotonically or at a constant rate. Average benefits frequently were adjusted legislatively in the period of the CS study. Before the Greenspan reforms were adopted in 1983; several periods are observed in which real average benefits fell. It is that relatively active period of legislation on which the CS study focused. After the Greenspan reforms of 1983, the path of benefits was quasi-constitutionalized, and the future course of benefits and taxes were largely left untouched until the financial crises of 2007–2009. Benefits were indexed to average wage rates,

which tended to reduce the variation in real benefit levels through time and produce a steady increase in real average retirement benefits. This constitutionalization is visible in the reduced variation in real average retirement benefits in the period after 1983. During the financial crisis, both Social Security benefits and taxes were used as Keynesian policy tools.[9]

Figure 1: Average Real Monthly Benefits



After the Greenspan reforms, Social Security became the so-called "third rail" of politics as subsequent efforts to reform the retirement system were disparaged in various ways and blocked by opponents. Other eligibility and coverage provisions were reformed modestly and the scope of the Social Security retirement programs was broadened. These reforms affected average pension benefit levels minimally. [10] Average healthcare benefits were not significantly affected by the Greenspan

[9] The "American Recovery and Reinvestment Act of 2009" provided a one-time payment of $250 for adults eligible for benefits from Social Security, Railroad Retirement, Veterans Disability, and the Supplemental Security Income programs. Social Security tax rates (for employees) were reduced by 2 percentage points in 2011 and 2012, from 6.2% to 4.2%. The employer's share remained at 6.2%, as it had been since 1990. (Medicare taxes remained at 1.45% for both employees and employers during this period, as they have since 1986.)

[10] For example, the ability to collect benefits without retiring was gradually liberalized over the course of the program. The age at which collecting Social Security retirement benefits without penalty while still working was set at 75 in 1950, at 72 in 1954, and at 70 in 1978. In 2000 reforms were adopted that allowed Social Security benefits to be obtained in one's mid-60s without formally retiring or facing punitive taxes. The 2000 reform was considered by the Social Security Administration itself to be "a historic change in the Social Security retirement program," because most persons retire in their 60s. In effect, the program became a tax-financed annuity program. A short history of the Social Security program and its major reforms can be found at:

reforms and have expanded greatly as new treatments were added to the list of procedures covered. The expanding menu of procedures available to Medicare recipients were joint consequences of innovation and policy decisions. Non-retirement aspects of the Social Security programs were revised more frequently, although those changes are beyond the scope of the CS models and this study. Disability payments, for example, increased in both size and scope during the past 35 years.

The CS study estimated relatively lean forms of median voter and interest group models, plus a new combined model that was, in effect, a weighted average of the two pure models. The median voter was presumed to maximize the lifetime utility of his or her retirement benefits in a manner that may take account of effects on older and younger taxpayer-recipients.[11] The reduced-form median voter model estimated by CS was of the form:

$$S_t = a + B_1Y_t + B_2A_t + B_3R_t + B_4D_t + B_5r_t + B_7T_t + B_6G_t + B_7t. \quad (1)$$

The B_i's are the coefficients to be estimated; Y_t is the median voter's income in period t; A_t is average real private pension benefits in period t; R_t is remaining work life in period t; D_t is the median voter's remaining life expectancy in year t; r_t is the real interest rate; T_t is the effective tax base per beneficiary in period t; G_t is the long-term growth rate in year t; and t is time, which accounts for any linear trends in real average Social Security benefits, S_t, that are not explained by the other variables.

The interest group model is simpler and focuses on retired persons and employees of the Social Security Administration. Both are presumed to have an interest in larger benefits and to lobby and vote for increased benefits. Insofar as their lobbing efforts are effective or votes affect electoral outcomes, benefit levels will reflect their lobbying and/or voting efforts. The interests of the administration's employees are aligned with those of retired persons partly because larger expenditures on Social Security tend to be associated with additional discretionary resources for the

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https://www.ssa.gov/history/briefhistory3.html. We find evidence that the reform did affect the electoral politics of Social Security benefit levels, although those results are not reported herein.

[11] The CS median voter model is a generalization of the Browning model that accounts for the possibility of interdependent utility functions and intergeneration transfers among three generations (young, median, old). A Social Security program confers immediate benefits on the old and future benefits on the median and young generations at the cost of tax obligations on the median young generations until retirement. The implicit function theorem was used to specify the median voter's demand for social security as a function of the model's exogenous variables. A linear specification of that function was estimated. See Congleton and Shughart (1990) for a more complete discussion of the assumptions and mathematics of their median voter model.

Social Security Administration and because many agency employees have internalized their agency's mission(s).

$$S_t = a + C_1N_t+C_2A_t+C_3E_t \quad (2)$$

The C_is are the coefficients to be estimated, N_t is the number of retired persons in year t, A_t is their average private pension income, and E_t is the net administrative expenses of the Social Security Administration from which any lobbying undertaken by its employees are assumed to be funded.[12]

The combined model includes all the explanatory variables of the two models, where the coefficients of the variables in common are weighted sums of the coefficients of the two pure models. In the combined model, public policy will be somewhere between the median voter and interest group ideals.[13] The linear forms of the models estimated were adopted—somewhat arbitrarily—because of econometric conventions. The models did not assume nor necessarily imply linearity.

We begin our study with a simple replication of the CS results for average real Social Security (pension) benefits using contemporary data and estimation software (Eviews and Stata). Replications of the original Congleton-Shughart estimates for the overall package of tax-financed retirement benefits—average Social Security plus average Medicare benefits—are reported in Table 7 of the appendix. The results are presented in Table 2. Columns 1, 3, and 5 are taken directly from the 1991 paper. Columns 2 and 6 are replications of the median voter and combined model results with contemporary data and software. Column 4 simply re-estimates the interest group model using the original data with a contemporary econometrics package.[14] It should be kept in mind throughout the

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[12] Lobbying takes several forms. The simplest involves the production and dissemination of persuasive arguments for the adoption of general types of legislation. A more direct form of lobbying occurs when specific descriptive language and/or budgets are suggested by a bureaucracy or organized interest group and subsequently adopted by the Congress as legislation. Similar suggested language or principles may also be adopted by a government agency for use as guidelines or rules for implementing legislation that grants significant discretion to its implementing agencies.

[13] A few years later, Grossman and Helpman (1994) would use a similar combined model to analyze trade policy, although rather than using the median voter to represent an ideal electoral outcome, they used a "devoted utilitarian" ruler, for example, a policy maker that maximizes a social welfare function.

[14] The tables report unadjusted R-square numbers, rather than adjusted R-squares. Unadjusted R-square numbers can be regarded as non-parametric goodness of fit statistics. It is simply the unadjusted ratio of unexplained variation to total variation in the dependent variables without any assumptions about the statistical properties of the residuals. The unadjusted R-Square numbers are not used for statistical inference in the paper, but as a direct indicator of the goodness of fit.

paper that our aim is not to redo the CS study with modern methods, but to replicate and modestly extend their results using the models and methodologies applied in their paper.

Column 4 allows us to distinguish vintage data effects from vintage software effects because the data were unchanged. Note that the coefficient estimates reported in column 4 differ unsystematically from those in column 3, as one would expect from reductions in rounding errors. Rounding errors tend to be randomly (uniformly) distributed. Generally, the t-statistics differ somewhat, reflecting differences in both calculated coefficients and, in this case, a larger standard error. Those effects were large enough to undermine the statistical significance of the coefficient for net administrative expenses (the discretionary budget), which no longer is statistically significant. The results from the other two replications combine vintage data and vintage estimation effects. Coefficient estimates change, although generally remain of the same signs and order of magnitude. Their associated t-statistics rise and fall as a consequence. In the median voter model, the last two variables, the effective tax base per retired person and time, which were distinguishable from zero at the 10% significance level in the CS study, are not statistically distinguishable from zero using contemporary data and statistical packages for the original 1946–1982 period.

The results have a pattern similar to other replication studies, although our estimates also shed some light on the estimation-package effect, which is non-trivial. The latter evidently accounts for about half the difficulty of replicating early studies. The model estimates associated with the revised data and estimation packages track the 1946–1982 real Social Security average benefit levels somewhat less well than did the original estimates. The goodness of fit statistics fell for all three model estimates although the F-statistics remained statistically significant at the .001 level.

Table 2. Average monthly OASI benefits for the period 1946–1982 (CS estimates and replicated data estimates)

Model	Median Voter (CS)	Median Voter (CKM)	Special Interest (CS)	Special Interest (CKM)	Combined (CS)	Combined (CKM)
Estimation	OLS	OLS	OLS	OLS	OLS	OLS
Intercept	-238.781	-56.785	69.001	36.775	188.669	-45.237
		(-1.58)		(2.80)**		(-1.068)
Real Median	0.082	0.034			0.074	0.029
Earnings	(7.56)***	(3.86)***			(6.69)***	(2.502)*
Average Real	-0.084	-0.0004	-0.016	.0025	-0.08	-0.002
Private Pension	(4.29)***	(-0.051)	(1.15)	(.219)	(4.14)***	(-0.174)

Adjusted R-Square and F-statistics, in contrast, are parametric in that they are useful if the error distribution is normal. It is this assumption that allows them to be used for statistical inference.

Remaining Work Life of Median Voter	-11.473 (2.43)*	-18.131 (-4.71)***			-12.573 (2.61)*	-17.467 (-4.107)***
Median Life Expectancy	14.791 (4.17)***	17.178 (5.16)***			14.619 (4.04)***	16.534 (4.264)***
Real Interest Rate	0.821 (1.57)	0.667 (0.701)			0.873 (1.73)	1.009 (0.93)
Long-Term Growth Rate	-3.037 (5.052)***	-2.146 (-2.59)*			-2.772 (4.60)***	-2.016 (-2.301)*
Effective Tax Base per Beneficiary	0.0001 (1.88)*	-0.000041 -0.685			0.0001 (1.64)	-0.00002 (-0.308)
Time	-1.19 (2.22)*	-1.435 (-1.64)			-2.324 (2.446)*	-0.915 (-0.337)
Number of Retired Workers			4.21E-06 (5.78)***	4.10E-06 (3.90)***	1.93E-06 (1.28)	-1.02E-06 (-0.291)
Net Administrative Expenses			0.0192 (2.42)*	0.0312 (1.48)	0.001 (0.96)	0.025 (0.79)
AR(1)			1.081	.653 (2.92)**		
AR(2)			-.315	.077 (.35)		
R^2	0.988	0.976	0. 981	0.968	0.99	0.976
Durbin-Watson	1.85	1.58	2.14	1.92	1.8	1.58
F Statistic	297.13***	140.98***	297.98***	152.06***	251.52***	107.31***
Standard Error	3.96	5.67	4.57	6.28	3.86	5.81

Note: t-statistics are reported in parentheses. Those followed by *** are statistically significant at the .001 level, ** at the .01 and * at the .05 level.
(CS) indicates estimation outputs from Congleton & Shughart (1990); (CKM) indicates estimates with contemporary software and data as available in 2019.

4. Post-sample performance

Our main interest in this study is not whether the original CS results can be replicated, but the extent to which CS model estimates explain the course of tax-financed retirement benefits in the post-sample period. If they do so well, such a finding would imply that relatively simple public choice models can account for the trajectory of major U.S. government spending programs, which in turn would imply that U.S. political-economic processes were stable during the post-war period. If they do not, then why they fail to do so is of interest.

We initially ignore the medical portion of tax-financed retirement benefits, in part, because significant changes to the pension program were undertaken just beyond the end of the original CS data set—the so called Greenspan reforms. Those reforms are likely to undermine the post-sample performance of the CS estimates of Social Security benefits by fundamentally changing the politics of tax-financed pensions in the post-sample period for reasons discussed below. The medical

component of tax-financed retirement benefits were not reformed in a similar manner and so remained subject to what might be called ordinary or day-to-day political influences.

Figure 2 plots the predicted values and actual values of real average Social Security pension benefits from 1946 to 2000 using the coefficient values from Table 2. The six within-sample estimates are sufficiently accurate that they all fall within the line width of the actual average benefits data plot. In the post-sample period, the prediction errors increase in magnitude and rise more or less in accordance with the theoretical properties of forecast errors. The errors are no longer trivial relative to the size of average benefits, although they are a relatively small fraction of the actual benefit levels. It is noteworthy that the forecasts generated by the original estimates predict future benefits essentially as well as the updated ones. It is also noteworthy that the models generally forecast larger average real-benefit levels than actually received by retirees.

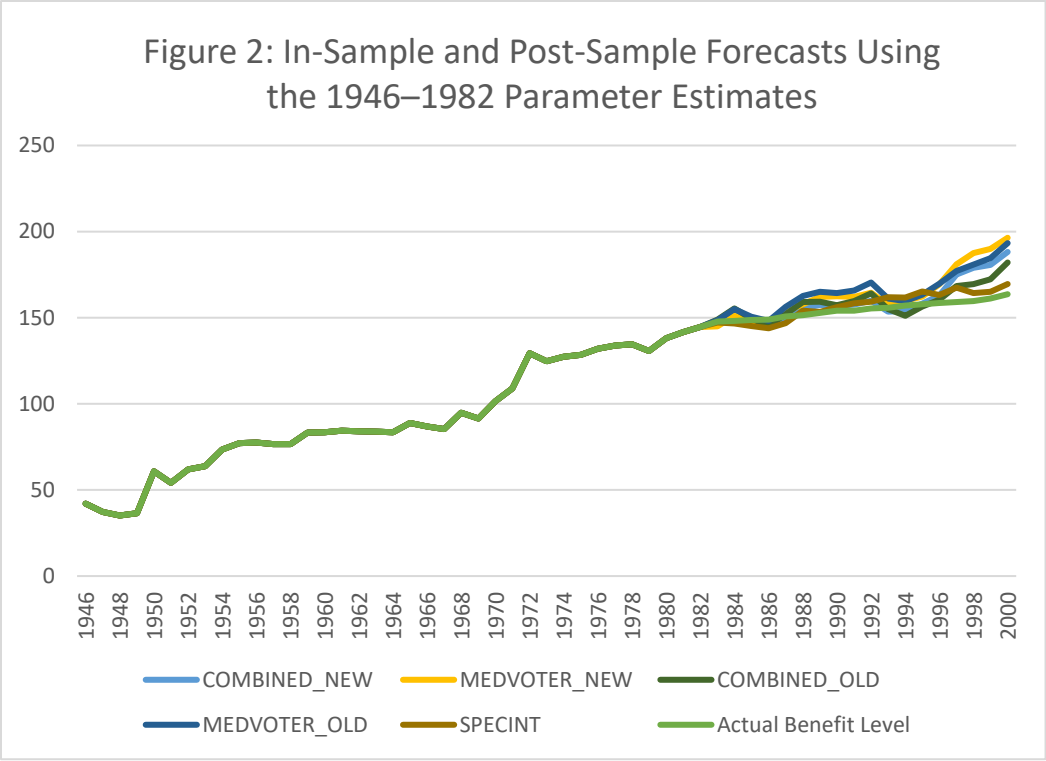

Table 3 provides root mean squared prediction errors of the post-sample forecasts for 10, 20 and 30 years. As evident in Figure 2 and implied by statistical theory, the prediction errors increase through time. The average prediction errors are small relative to the average value of benefit levels, although they are—with four exceptions—large relative to the variance of those benefits. In the post-sample period, the interest group model does a significantly better job of tracking the course of

average Social Security benefits than the two other models. F-statistics for the differences between the estimation errors of the special interest and combined models are reported in the last column of the table. The difference in prediction errors between the special interest and combined models is not significantly different from zero during the first 10 years but is significantly smaller for the special interest model during the next 20 years. The same is true for the interest group and median voter forecast errors. (To place the interest group model on an equal footing with the median voter and combined models, it was re-estimated without its auto regressive terms. Those results were used in both the post sample plots above and the RMSE calculations.)

Table 3. Root mean squared errors of OASI benefit forecasts from the replicated 1946–1982 estimates

Forecast Period	Average Benefit	Benefit Variance	Median Voter Model	Special Interest Model	Combined Model	F Statistics Int. Grp vs Combined
1983–1992	146.79	16.199	5.828608	3.164672	3.270625	1.07
1983–2002	152.21	58.346	16.92346	4.845681	12.24365	6.38***
1983–2012	158.98	215.713	42.55641	9.713578	37.01741	14.52***

The post-sample errors differ from within-sample estimates in two ways. First, the root-mean prediction errors are all somewhat larger than the standard errors of the original estimates, although those of the interest group model are not markedly larger. Second, in contrast to in-sample estimates, where adding additional explanatory variables usually reduces standard errors and improves other goodness-of-fit measures, that is not the case for post-sample estimates. Post-sample studies reveal what might be referred to as "over fitting" errors in estimation strategies. In the case here, adding explanatory variables from the median voter model to the special interest model reduced the ability of the interest group model to predict the path of real average retirement benefits, because of the more error-prone predictions of the median voter model in the post-sample period. For the 20- and 30-year periods, the increase in prediction errors was statistically significant.

At first blush, one might think that the interest group model "cheats" because it is based largely on the number of retired persons. However, the dependent variable is average benefit levels rather than total benefits paid out, and no reason exists for believing that real average benefits would rise with the number of retired persons other than those implied by the interest group model—that is, through their support for lobbying organizations and for candidates that favor larger benefit levels. Indeed, according to the median voter model, average benefits should fall as the number of

retired persons increases—other things being equal—because the tax price of tax-financed retirement programs increases with the number of beneficiaries.

5. A regime shift?

The post-sample forecasts imply that the interest group politics of Social Security were relatively stable during the in-sample and post-sample periods, whereas the median-voter model either broke down in the post-sample period or was affected by a regime shift in the electoral politics of Social Security. Such a regime shift in the politics of Social Security is likely to have been associated with the adoption of the so-called Greenspan reforms of 1983. The reforms adopted were largely those recommended by a two-year study by a bipartisan committee of legislators, economists, and experts in finance chaired by Alan Greenspan. The Greenspan Commission recommended a "constitutionalization" of the path of Social Security benefits, retirement ages, and taxes through 2027. If adhered to, the Greenspan reforms would tend to change the politics of reform fundamentally by limiting their scope. Indeed, they would effectively remove the tax-financed pension portion of Social Security from politics.

As noted above, this constitutionalization of Social Security policy is visible to the eye in Figure 1. Prior to 1983, significant variation in real average benefits is evident. This was the period focused on in the CS models and estimates. Average real retirement benefits generally increased in the period before the Greenspan reform, but they did so erratically as majorities in Congress shifted. It is because of such increases—often passed without sufficient new taxes to pay for them, that the reserve—the Social Security Trust Fund—was predicted to run out in 1983.[15] It was in response to such predictions that President Reagan organized the National Commission on Social Security in 1981 chaired by Alan Greenspan, and that Congress subsequently adopted significant reforms in 1983. After 1983 the expansion of Social Security retirement benefits continued but became noticeably less erratic.

The time path of benefits after 1983 suggests that the Social Security Reform Act of 1983 (signed into law on April 20, 1983) altered the subsequent politics of Social Security benefit levels as intended. Those reforms may have done so because the Greenspan commission anticipated the demands of future median voters and interest groups. If they did so perfectly, there would be no

[15] A very short history of the Greenspan Commission that mentions the anticipated 1983 exhaustion of the OASDI trust fund appears at https://www.ssa.gov/history/greenspn.html.

reason to adjust future program benefits and taxes. That source of policy stability would be reinforced by the increase in the frequency of legislative deadlocks that emerged in the last part of the twentieth century as party-line voting strengthened in both chambers of Congress.[16]

However, the post-sample forecasts depicted in Figure 2 suggest that median voter demands were generally higher in the post-sample period than actually delivered by Congress. This suggests that the reforms actually reduced program benefit and tax levels relative to what they would have been without the reforms, again as intended. This is not to say that no Social Security reforms were implemented after 1983 but that subsequent retirement program reforms were minor.[17] For the most part, the long-term path of benefits, retirement ages, and tax rates specified in the 1983 reforms remain in place today.[18]

If we posit a quasi-constitutional status for the Greenspan reforms, each of the three models estimated by Congleton and Shughart would be affected by the reduction in the scope for year-to-year changes in real average retirement benefits in the post-sample period. Benefits might still be altered in minor ways by changing indexing or eligibility rules, but major reforms would be politically

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[16] Party-line voting has increased from 40% to 60% in the 1950s to 70%-90% in the past decade. For a scatter plot of party-line voting rates, see https://towardsdatascience.com/political-partisanship-a-look-at-the-data-e71946199586. One consequence of the recent rise in party-line voting has been an increase in funding by the device of passing continuing budget resolutions, which tend to reduce the variation in spending across years and expenditure categories simply by continuing previous spending or authorizing more or less across-the-board increases in spending. Congleton and Sweetser (1992) suggested that the more frequent use of continuing resolutions might be caused partly by changes in information technologies that allow district-level benefits to be more quickly and accurately estimated.

[17] A variety of small eligibility reforms were implemented, for example. The most significant occurred in 2000, when it became possible for working persons in their mid-60s to receive Social Security payments without retiring. The "Senior Citizens' Freedom to Work Act of 2000" was signed into law on April 7, 2000. It eliminated the Retirement Earnings Test for beneficiaries at or above the normal retirement age (then 65, now 66, and scheduled to reach 67 for persons born after 1960, as per the Greenspan reforms).

[18] The extent of tax base for OASDI and the taxability of Social Security's retirement benefits have been modestly adjusted through time. The Greenspan reforms made a portion of Social Security benefits subject to the income tax for the first time. For a short history of the taxation of Social Security benefits see https://www.ssa.gov/history/taxationofbenefits.html. The Greenspan reforms also indexed the maximum labor income subject to the tax to wages, which has remained more or less constant since the mid-1980s. That cap had initially fallen from the time of inception until the mid-1960s after which it rose (in real terms and relative to average wages) until the mid-1980s. An overview of the history of the tax cap can be found at: https://www.ssa.gov/policy/docs/policybriefs/pb2011-02.html.

impossible—as the expression the "third rail of American politics" is meant to capture. Changes in benefits would be formulaic and reflect political pressures only to the extent to which the Greenspan Commission explicitly or implicitly took them into account when working out their constitutionalization of the OASI program.

To determine whether statistical support can be found for the constitutionalization hypothesis, we first re-estimate the original models on our full data set (1946–2016) and then use the regression discontinuity method to account for the regime shift that might have been introduced by the Greenspan reforms. New explanatory variables include a binary Greenspan (GS) variable (fixed effect) that is zero before 1983 and 1 thereafter, and a truncated series of the other explanatory variables formed by multiplying each series by the GS vector. If the reform reduces the responsiveness of Social Security's tax-financed pension benefits, the coefficients of the variables that characterize the median voter's ideal and the influence of relevant interest groups would be diminished, although not necessarily eliminated by the reforms of 1983. If so, the reforms would create a "kink" in the trajectory of OASI benefits rather than the usual type of "jump" discontinuity looked for in most regression discontinuity estimates. Such a kink is one possible explanation for the post sample results of Table 3. Table 4 reports the results of OLS estimates of the original models for the 1946–2016 period and their 1983 regime-shift counterparts.

Table 4. Recalibration and extensions of the CS models of real average monthly OASI benefits for the 1946–2016 period

	Median Voter Model	Median Voter w/ GS Modification	Special Interest Model	Special Interest w/ GS Modification	Combined Model	Combined w/ GS Modification
Period	1946–2016	1946–2016	1946–2016	1946–2016	1946–2016	1946–2016
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS
Intercept	5.388	-56.785	45.785	36.821	11.458	-45.237
	(0.22)	(-2.07)*	(5.46)***	(4.84)***	(0.48)	(-1.41)
Real Median Earnings	0.000317	0.034			-0.001	0.029
	(.06)	(5.04)***			(-0.21)	(3.30)***
x GS Dummy		-0.010				-0.020
		(-0.65)				(-0.91)
Average Real Private Pension	-0.002193	-0.0004	0.0007	0.002	-0.003	-0.002
	(-0.35)	(-0.07)	(0.13)	(0.37)	(-0.57)	(-0.23)
x GS Dummy		0.002		-0.004		0.001
		(0.22)		(-0.20)		(.09)
	2.135605	-18.131			0.836	-17.467

Remaining Work Life of Median Voter	(-1.74)	(-6.14)***			(0.72)	(-5.42)***
x GS Dummy		16.778 (5.38)***				16.952 (4.89)***
Median Life Expectancy	0.895531 (.70)	17.178 (6.73)***			1.156 (0.90)	16.534 (5.63)***
x GS Dummy		-15.539 (-5.59)***				-15.981 (-4.89)***
Real Interest Rate	0.408724 (0.65)	0.667 (0.91)			1.127 (2.06)*	1.009 (1.23)
x GS Dummy		0.146 (0.11)				-0.744 (-0.53)
Long-Term Growth Rate	-1.798648 (-2.13)*	-2.146 (-3.38)**			-0.878 (-1.18)	-2.016 (-3.04)**
x GS Dummy		2.137 (1.59)				1.813 (1.31)
Effective Tax Base per Beneficiary	-0.000104 (-2.43)*	-0.00004 (-0.89)			-1.34E-05 (-0.33)	0.0001 (-0.41)
x GS Dummy		-0.003 (-2.79)**				-0.001 (-0.34)
Time	1.970658 (5.40)***	-1.435 (-2.14)*			1.353 (1.48)	-0.915 (-0.44)
x GS Dummy		2.129 (2.54)*				1.157 (.50)
Greenspan Effect		152.974 (3.55)***		50.63 (0.78)		126.872 (2.64)*
Number of Retired Workers			3.48E-06 (9.35)***	4.12E-06 (6.79)***	6.99E-07 (0.53)	-1.02E-06 (-0.38)
x GS Dummy				-1.49E-06 (-0.66)		2.64E-06 (0.76)
Net Administrative Expenses			0.028 (2.65)**	0.031 (2.45)*	0.044 (3.18)**	0.025 (1.04)
x GS Dummy				-0.022 (-0.38)		-0.008 (-0.24)
AR(1)			0.703 (5.37)***	0.613 (4.34)***		
AR(2)			0.156 (1.13)	0.112 (0.81)		
R^2	0.977	0.993	0.990	0.991	0.984	0.993
Durbin Watson	0.88	1.61	1.91	1.94	0.93	1.66
F-statistic	330.3	438.8	1014.9	641.0	372.1	346.4
Standard Error	7.24	4.35	4.80	4.68	6.12	4.40

The results reported in Table 4 are generally consistent with the constitutionalization hypothesis. Regime-shift variables are significant in the median voter and combined models. The net

magnitudes of the explanatory variables were all reduced (in absolute value terms) by the Greenspan reforms. As might be expected given the post-sample forecasts, the median voter model benefited the most from including the regime-shift variables. Although the fit of the original median voter model is good over the full sample, very few of the median voter variables are statistically different from zero in those estimates.

However, when the 1983 reforms are taken into account, the coefficients of what might be regarded as the core coefficients of electoral politics are statistically significant and of the same order of magnitude as they were in the 1946–1982 period. Moreover, the regime-shift variables for median income, remaining work life, expected longevity, and tax base per retired person are all statistically distinguishable from zero. The overall median voter model's standard error falls significantly when the regime-shift variables are included ($F = (7.24/4.35)^2 = 2.77^{**}$). Nonetheless, the net post regime-shift coefficients indicate that the median voter had little overall effect on Social Security benefit levels after the Greenspan reforms were adopted.

Similar results and evidence of a regime shift are evident for the combined model, although the reduction in standard error is smaller than for the median voter model's estimates. The autoregressive terms of the interest group model capture the regime shift and so the GS variables are not significant in that model.[19] That result is consistent with the post-sample forecast evidence, which indicated that the interest group model performed quite well in the period after 1983. The standard errors of both the full-sample estimate and the regime-shift forms of the combined model are both somewhat smaller than either of the corresponding pure models, as was the case in the original CS study. The reduction in standard errors generated by including the regime-shift variables is smaller than that in the median voter model but larger than that in the interest group model. The standard error of the latter falls from 6.12 to 4.40, which is statistically significant at the 5% level ($F = 1.93^{*}$).

[19] We estimated the interest group model without the autoregressive terms to see how much they contributed to the fit of the special interest model; surprisingly, they did relatively little to diminish the standard error or increase the F-statistics. Without the autoregressive terms, the standard error of the interest group model estimates falls from 7.64 to 6.21 and several of the coefficients for the GS interaction terms are statistically significant. However, the improvement in fit generated by the GS interaction terms is not statistically significant given our sample size and associated degrees of freedom ($F = 1.51$). The autoregressive terms of the special interest group model did, however, bring the Durban Watson (DW) statistics into the reject the null hypothesis of autocorrelation range.

The regression discontinuity approach is a more statistically demanding one than it might appear at first because it assumes that the regime shift occurs at the instant that the reforms were adopted and does not affect the error distribution. Linearity is also generally assumed in the estimation strategies and even relatively small nonlinearities can affect relationships among the coefficients. The shift variables also tend to be somewhat correlated with one another because of their common zero periods. An alternative less demanding approach to demonstrate that the politics of social security was changed by the Greenspan reforms is to simply re-estimate the CS models for the post-sample period and compare the coefficients and standard errors to those of the original CS estimates. The results of such estimates are reported in columns 1, 3, and 5 of Table 8 in the appendix. Those results show that the path of average benefit levels induced by the Greenspan reforms were consistent with median voter interests and that constitutionalization, as predicted, reduced the standard errors of all three model estimates of Social Security benefit levels in the post-sample period.

Overall, it should be acknowledged the results provide support for what may be termed the constitutionalization hypothesis. Coefficients for the Greenspan shift variables were significantly different from zero in two of the three models. Those variables provided a statistically significant improvement in the fit of the original CS models for two of the three cases, and standard errors fell for all three models. The former, together with the significance of other coefficient estimates, made two of the three estimates more consistent with the original results. (In the full-sample estimates without the Greenspan effects, errors in functional form or multicolinearity among the explanatory variables may account for the lack of statistical significance of many of the CS model coefficients in the median voter and combined models.) [20]

[20] One referee speculated that in the kinked functional form used to test for a Greenspan effect, the average of the net coefficients in the Greenspan period and the coefficient in the pre-Greenspan period should approximately equal the coefficient of the full-sample estimates without the Greenspan effect. Table 9 in the appendix illustrates some of the sensitivities of regression discontinuity estimation to assumptions about functional form and estimation strategies. The A and B estimate series show the classic case in which linearity assumptions hold. The C and D estimate series show how minor mistakes concerning functional forms can affect results. The A run estimates (row 2) are most similar to those undertaken above, and they do not exhibit the property that the average of the kinked (net) slopes (of row 2) equals the unkinked slope estimate (row 1). The B runs, in contrast, do exhibit this property (see rows 1 and 3). This property is also absent from the C runs.

6. Politics and the change in the composition of retirement benefits

The original CS models were developed and estimated for a period in which OASDI provided most of a retired person's tax-financed retirement benefits. The Medicare program was started in 1965, about two-thirds of the way through the CS sample period. Although Medicare expenditures grew rapidly, it was still a relatively small part of the overall package of tax-financed retirement benefits at the end of their sample period. During the post-sample period, the average benefits from Medicare continued growing at a rapid rate and presently make up about half of the tax-financed benefits received by retired persons. Thus, another possible explanation for the poor performance of the median voter model of Social Security benefit levels in the post-sample period is that Browning's characterization of tax-financed retirement benefits was too narrow. It might have been adequate at the time his paper was published and for the period of the original study but inadequate for the post-sample period.

To the extent that electoral pressures influenced the overall package of tax-financed retirement benefits, voters of approximately median age may well have favored retirement benefits that combined an annuity (pension), as provided by the OASDI program, with health insurance, as provided by Medicare and some parts of Medicaid. Evidence that OASDI and Medicare are connected in the minds of voters and legislators is evident in their legislative histories. Medicare initially was administered by the Social Security Administration, and legislation that addressed the tax-financed pension parts of OASDI often addressed issues associated with various aspects of Medicare. For example, the Greenspan reforms addressed hospital reimbursement rates and their timing. It also allowed borrowing and repayment across the OASDI and the Medicare Part A trust funds.[21]

If the two programs are connected in the minds of voters and government officials, the upward bias in prediction errors revealed by the post-sample forecasts may actually have been a measurement error, rather than a problem with the original models. The median voter may have attempted to maximize the net present value of tax-financed retirement benefits overall rather than independently through completely separate pension and medical programs.

Congleton and Shughart (1990) include an extension of their statistical approach to the overall package of tax-financed retirement benefits. Their estimates of the sum of average Medicare and Social Security benefits were similar to those of their Social Security estimates. Replications of

[21] Svahn and Ross (1983) provide a thorough overview of the 1983 reforms.

the CS extended models are provided in Table 7 in the appendix. The results are broadly similar to those reported above for Social Security, with replications exhibiting somewhat higher standard errors but with coefficient estimates of the same signs and order of magnitude as in the original study.

Table 5 reports estimates of the sum of average real Medicare and OASI benefits similar to those undertaken in Table 4. The purpose of these estimates is partly to test whether the original models track the overall path of total tax-financed retirement benefits better than they do the pension portion. The medical component of tax-financed retirement benefits was not "constitutionalized" and so would continue to be subject to political pressures in the post-sample period. It is possible that the constitutionalization of the pension portion anticipated interest group and electoral pressures and that the politics of tax-financed retirement benefits would tend to focus for the most part on healthcare benefits for retired persons in the post-Greenspan period. The estimates are also of interest because Medicare and Social Security expenditures are now the two largest areas of U.S. government expenditures, accounting for more than 40% of total federal government outlays—about $1.6 trillion. Being able to account for the expenditure paths of these two very large programs would be a significant achievement for the core models of public choice.

In general, the results reported in Table 5 are somewhat more supportive of the CS models than those of Table 4. All three base models have very good fits in the post-sample period. The coefficient estimates of the original CS models are closer to those found in the original study than those of Table 4 and more of the coefficient estimates are statistically significant. For example, remaining work life, longevity, and tax base per recipient all affect the median voter's package of retirement benefits in the manner predicted by the CS median voter model—which was not the case for the Table 4 estimates. The interest group model also fits the data very well and its coefficients have the predicted signs and significances.[22] The combined model fits the data slightly better than the two pure models. It has the smallest standard error. Its negative coefficient for the number of retired workers suggests that the associated cost effect on the median voter more than offset the lobbying/block-voting effect associated with interest group politics for the overall package of benefits.

[22] The autoregressive terms of the special interest group model again bring the DW statistics into the reject the null hypothesis of autocorrelation range.
The auto correlation evident in the other models is consistent with the constitutionalization hypothesis and with the existence of lags in reforms of the Medicare program.

As in Table 4, we find evidence of a regime shift in the overall package of tax-financed retirement benefits associated with the Greenspan reforms. Those effects have the expected signs and, as anticipated, reduce the net effects of changes in the explanatory variables in the period after 1983. The impact of the Greenspan reforms suggests that changes in the overall package of tax-financed benefit levels were not independent of those reforms, which is to say that voters and interest groups would have opted for a somewhat larger package of retirement benefits in the absence of those reforms.

Table 5. Recalibration and extensions of the CS models of real average monthly OASI plus Medicare benefits for the 1946–2016 period

	Median Voter Model	Median Voter w/ GS Regime-shift	Special Interest Model	Special Interest w/ GS Regime-shift	Combined Model	Combined w/ GS Regime-shift
Intercept	-7.676 (-0.24)	-135.96 (-2.89)**	31.946 (0.72)	22.869 (0.56)	23.924 (0.70)	-62.523 (-1.60)
Greenspan Intercept Effect (GS)		97.409 (1.33)		29.251 (0.36		66.970 (1.13)
Real Median Earnings	-0.008 (-1.19)	0.038 (3.22)**			-0.019 (-2.31)*	0.013 (1.23)
x GS		-0.055 (-2.14)*				0.043 (1.60)
Average Real Private Pension	5.92E-05 (0.01)	0.006 (0.52)	0.003 (0.61)	0.004 (0.70)	0.004 (.61)	-0.007 (-0.77)
x GS		-0.005 (-0.37)		-0.004 (-0.32)		0.023 (2.07)*
Remaining Work Life of Median Voter	-5.065 (-3.31)**	--26.123 (-5.51)***			-3.34 (-1.96)	-17.817 (-4.46)***
x GS		23.227 (4.63)***				14.196 (3.31)**
Median Life Expectancy	6.301 (4.24)***	15.315 (6.42)***			4.20 (2.37)*	16.819 (4.51)***
x GS		-21.379 (-4.786)***				-10.048 (-2.44)*
Real Interest Rate	-0.204 (-0.28)	0.120 (0.10)			-0.37 (-0.50)	1.717 (1.72)
x GS		1.344 (0.65)				1.626 (0.95)

Long-Term Growth Rate	-1.781	-3.287			-1.69	-2.476
	(-1.77)	(-3.20)**			(-1.69)	(-3.11)**
x GS		1.452				1.765
		(0.67)				(1.06)
Effective Tax Base per Beneficiary	0.0001	7.23E-05			0.0001	0.0002
	(2.80)**	(0.98)			(2.50)*	(3.70)***
x GS		0.0002				-0.011
		(0.13)				(-3.59)***
Time	4.229	-1.526			6.82	11.210
	(9.90)***	(-1.41)			(5.31)***	(3.57)***
x GS		6.670				-1.746
		(4.93)***				(-0.52)
Medicare Dummy Variable	12.623	20.176	3.57	8.29	10.530	6.421
	(2.58)*	(2.96)**	(0.17)	(0.41)	(1.69)	(0.95)
Number of Retired Workers			7.72E-06	6.42E-06	-3.89E-07	-1.76E-05
			(4.58)***	(2.40)*	(-2.13)*	(-4.46)***
x GS				1.50E-06		6.33E-06
				(0.42)		(1.32)
Net Administrative Expenses			0.039	0.087	0.029	0.076
			(2.34)*	(2.88)**	(1.24)	(2.57)*
x GS				-0.092		-0.043
				(-2.31)*		(-1.05)
AR(1)			1.059	1.103		
			(9.15)***	(9.85)***		
AR(2)			-0.113	-0.166		
			(-0.91)	(-1.31)		
R^2	0.995	0.997	0.997	0.997	0.995	0.998
Durbin Watson	0.81	1.48	2.01	2.01	.81	1.66
F-statistic	1334.7***	974.1***	2568.0 ***	1712.0***	1140.824***	1392.4***
Standard Error	8.42	6.98	6.89	6.73	8.24	5.28

We also simply re-estimated the CS models of Medicare plus pension benefits for the post-Greenspan period. The results of those estimates are reported in columns 2, 4, and 6 of Table 8 in the appendix. Those results show that the path of average pension and healthcare benefit levels after the Greenspan reforms were consistent with median voter interests. The combined model, however, provided a better overall explanation for the course of benefits in that period, with the smallest standard error of the three models.[23]

[23] We also examined post-sample forecasts of the replications of the original study reported in the appendix table 7. The median voter model tracked the post-sample path of total average tax-financed retirement benefits somewhat better than either the combined or interest group models. The interest group model systematically underestimated those benefits.

As true of the table 4 results, assessing the relative merits of the regression discontinuity and original CS-type estimates are not entirely unambiguous. Although the signs and magnitudes of the Greenspan effect coefficients are as predicted and imply that the overall package of retirement benefits has been constitutionalized, the fit of those estimates is not statistically better than those that ignore the effects. The standard errors of the regime shift estimates are all lower, but the F-statistics are also somewhat lower in two of the three model estimates. Moreover, in this case, the CS-type estimates of columns 1,3, and 5 had statistically significant coefficients, although fewer such coefficients than in the regime shift estimates. Because of the latter and their lower standard errors, we tend to favor the regime-shift results in table 4 and 5 over the original CS model estimates, but this is not a clean kill statistically.

7. Conclusions

Our post-sample analysis of the Congleton-Shughart (1990) analysis of tax-financed retirement benefits is broadly supportive of the original study. The full-sample estimates of their baseline models account for most of the path of tax-financed average benefit levels during both the 1946–1982 and the 1946–2016 periods. The coefficients in the full sample generally had the same signs and were of the same magnitudes as in the original study. These results might be regarded as indicating that American politics with respect to tax-financed retirement benefits have been relatively stable in the second half of the twentieth century—in spite of all the turmoil reported on the front pages of its newspapers during that period. The period studied included riots in cities, mass protest demonstrations in the capital city, assassination attempts (one of them successful), the great inflation, two series of impeachment hearings (one of them ending in a president's resignation), and several economic recessions, including the recent "Great" one. It also includes several major shifts in defense spending and international commitments. From that perspective, the ability of relatively simply public choice models to track a very important area of government spending is remarkable.

Nonetheless, the study also revealed weaknesses in the median voter and combined models that were not evident in the original study. First, the coefficient estimates in the full sample baseline model estimates of Table 4 often had the correct signs and were of the anticipated magnitudes but were not statistically distinguishable from zero. The results of the full package of tax-financed retirement benefits were, nonetheless, very consistent with the original estimates. Second, the post-sample predictions of the median voter and combined models with respect to the OASI benefits were generally poor. Although the CS-model estimates predicted the magnitude of average real tax-financed pension benefits reasonably well during in the first post-sample decade, the median voter

and combined models did far less well in the second and third post-sample decades. The special interest model, in contrast, tracked average real benefit levels quite well for the entire post-sample period. That result is a bit surprising because the interest group model fit the original 1946-1982 data somewhat less well than did the other two models. In other words, the worst fitting of the three CS public choice models of average tax-financed retirement benefits performed the best in the post-sample period with respect to OASI benefits, rather than the best fitting. In the post-sample period, the special interest group model had a far smaller root mean prediction error and it did so with a far shorter list of explanatory variables than the other two models.

Proponents of special interest group models might conclude that the post-sample results clearly demonstrate the superiority of that model of Social Security benefit levels. Its somewhat worse performance in the original study may have reflected the unusual political circumstances of those times. A more nuanced interpretation of the post-sample predictions of the three models would conclude that interest group politics were more stable in the second half of the twentieth century than electoral politics—at least with respect to tax-financed retirement benefits. Changes in electoral and legislative politics or the nature of the OASI program evidently altered the responsiveness of the federal government to the median-voter types of policy pressures without changing those associated with the lobbying efforts and block voting of retired persons.

In support of that possible explanation for the relatively poor post-sample forecasts of the median voter and combined models, we found historical and statistical evidence that durable changes in the retirement program were adopted and influenced the program's responsiveness to political factors. The Greenspan reforms of 1983 committed the government to a long-term path of Social Security benefit and tax increases and a modest increase in the age of eligibility for "full" benefits. Those policy paths have been largely followed ever since. The tax rates, full retirement benefits, and retirement ages today are exactly those specified by that legislation nearly 40 years ago. Such a "constitutionalization" of the retirement component of the Social Security program would naturally make programmatic benefits less responsive to electoral pressures in a manner that would undermine the predictive ability of the original CS median voter and combined model estimates. Although the CS models did not predict the regime shift in Social Security that took place, after that shift is accounted for, statistical results similar to those of the original study are found for real average Social Security benefits, albeit with electoral pressures having much less (effectively zero) effect on average pension benefit levels after the Greenspan reforms were implemented.

Partly because of the Greenspan effect, the three models provided a better explanation for the overall package of tax-financed retirement benefits than they did for the pension benefit in the post-sample period. The overall package of average real benefits (Medicare plus OASI) was less constrained by the Greenspan reforms and it quite possible that voters were more interested in medical benefits than additional pension benefits in the post-1983 period. The estimates of all three models of Medicare plus Social Security Pension Benefits, with and without accounting for the Greenspan reforms, track average real retirement benefits very well in the full-sample period. Moreover, the rank order of explanatory power was similar to that of the original estimates with the combined model's estimates providing a somewhat better fit than either pure model. The effect of the number of retired persons was negative in the combined model of overall average benefits, suggesting that the price effects of the number of retired persons dominated their interest group effects.

Overall, our analysis of the post-sample performance of the CS models suggests that the politics of retirement benefits have been remarkably stable and robust over the past 70 years and that straightforward public choice models can account for most of the path of what are now the two largest areas of federal expenditure.

Both the durability of these programs and the regime-shift results of the present study imply that democratic governments can credibly commit to long-term policies that advance the interests of median voters and/or interest groups. In the case of tax-financed retirement benefits in the United States, a durable commitment was produced by three pieces of "ordinary" legislation, rather than formal constitutionalization. Those commitments were consistent with political pressures, although also reduced their day-to-day impact. The legislative commitments created two very popular programs, social security and Medicare, and subsequently constrained the path of one of those programs for more than a half century.

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Appendix

Table 6: Summary Statistics of the Social Security Data Set

Variable	Mean	Std. Dev.	Min	Max
Real Average Monthly OASI	128.3569	45.42336	35.16	196.15
Real Average Monthly OASI + Medicare	206.9983	111.8916	35.16	385.56
Real Average Monthly Medicare	78.64167	68.33141	0	193.02
Real Median Earnings	3573.992	538.9722	2540.62	4425.74
Average Real Private Pension	1576.032	408.9589	699.04	2411.38
Remaining Work Life of Median Voter	17.92958	1.937231	11.4	20.83
Median Life Expectancy	26.93306	3.369091	18.2	32.1
Real Interest Rate	2.711944	2.443541	-4.41	8.88
Long-Term Growth Rate	3.050278	1.354747	-1.8	5.86
Effective Tax Base per Beneficiary	44722.5	41721.98	26079.67	265237.8
Number of Retired Workers	1.96E+07	1.14E+07	702000	4.12E+07
Net Administrative Expense	393.6626	157.5513	68.38	597.77

Table 7. Average monthly OASI benefits plus Medicare for the period 1946–1982 (CS estimates and replicated estimates)

Model	Median Voter (CS)	Median Voter (CKM)	Special Interest (CS)	Special Interest (CKM)	Combined (CS)	Combined (CKM)
Estimation	OLS	OLS	OLS	OLS	OLS	OLS
Intercept	-350.259	-135.9587 (-2.68)	57.571	20.990 (.95)	-252.116	-62.523 (-1.47)
Real Median Earnings	0.094 (8.16)***	0.038 (3.00)**			0.08 (6.94)***	0.0133 (1.13)
Average Real Private Pension	-0.097 (4.63)***	0.0057 (.479)	-0.012 (.80)	0.0050 (.69)	-0.092 (4.83)***	-0.0068 (-.71)
Remaining Work Life of Median Voter	-7.383 (1.37)	-26.122 (-5.12)***			-13.625 (2.52)*	-17.817 (-4.09)***
Median Life Expectancy	14.755 (3.74)***	26.314 (5.97)***			17.511 (4.61)***	16.819 (4.264)***
Real Interest Rate	1.262 (1.42)	0.120 (.093)			1.488 (1.81)	1.717 (1.58)
Long-Term Growth Rate	-3.535 (5.53)***	-3.287 (-2.98)**			-5.042 (5.04)***	-2.476 (-2.85)**
Effective Tax Base per Beneficiary	0.0002 (2.50)*	7.23E-05 (.91)			0.0001 (2.37)*	-0.0002 (3.40**
Time	-.895 (1.46)*	-1.53 (-1.31)			-2.783 (2.48)*	11.210 (3.27)**
Medicare Dummy Variable	34.478 (9.06)***	20.18 (2.75)**	41.642 (7.85)***	9.57 (.83)	40.937 (9.83)***	6.421 (.87)
Number of Retired Workers			5.14E-06 (5.06)***	5.64E-06 (3.15)**	2.40E-06 (1.28)	-1.76E-05 (-4.10)***
Net Administrative Expenses			0.0214 (2.70)*	0.087 (2.62)*	0.022 (2.18)	0.076 (2.36)*
AR(1)			1.206	0.922 (5.93)***		
AR(2)			-.18	-.039 (-.22)		
R^2	0.996	0.987	0.992	0.987	0.990	0.992
Durbin-Watson	2.03	1.62	2.11	1.98	1.80	1.65
F Statistic	644.76***	219.24***	610.68***	310.08***	251.52***	307.00***
Standard Error	4.15	7.51	4.91	7.05	3.86	5.76

Note: t-statistics are reported in parentheses. Those followed by *** are statistically significant at the .001 level, ** at the .01 and * at the .05 level.
(CS) indicates estimation outputs from Congleton & Shughart (1990); (CKM) indicates estimates with up-to-date software and data as available in 2019.

Table 8: Post-Greenspan model estimates of real average monthly OASI (O) and OASI + Medicare (O+M) benefits in the period 1983–2016

Model	Median Voter (O)	Median Voter (O+M)	Special Interest (O)	Special Interest (O+M)	Combined (O)	Combined (O+M)
Estimation	OLS	OLS	OLS	OLS	OLS	OLS
Intercept	96.189	-18.373	87.346	71.298	81.635	10.868
	(6.24)***	(-0.38)	(17.69)***	(1.31)	(5.73)***	(0.28)
Real Median	0.024	-0.017			0.009	0.057
Earnings	(3.68)**	(-0.81)			(1.06)	(2.56)*
Average Real	0.001	0.001	-0.003	0.001	-0.001	0.016
Private Pension	(0.61)	(0.12)	(-0.87)	(0.06)	(-0.37)	(2.65)*
Remaining Work Life of Median Voter	-1.353	-2.895			-0.515	-3.621
	(-2.87)**	(-1.95)			(-1.00)	(-2.62)*
Median Life	1.638	4.936			0.553	6.771
Expectancy	(3.19)**	(3.05)**			(0.96)	(4.38)***
Real Interest	0.813	1.463			0.264	3.343
Rate	(1.67)	(0.96)			(0.57)	(2.71)*
Long-Term Growth Rate	-0.010	-1.835			-0.203	-0.711
	(-0.02)	(-1.06)			(-0.42)	(-0.55)
Effective Tax Base	-0.003	0.0003			-0.001	-0.011
per Beneficiary	(-6.09)***	(0.18)			(-0.86)	(-3.94)***
Time	0.694	5.144			0.242	9.464
	(2.96)**	(6.96)***			(0.59)	(8.57)***
Number of Retired			2.69E-06	7.82E-06	1.62E-06	-1.13E-05
Workers			(14.37)***	(4.77)***	(1.81)	(-4.71)***
Net Administrative			0.012	-0.006	0.017	0.033
Expenses			(1.10)	(-0.22)	(1.72)	(1.25)
AR(1)			-0.068	1.251		
			(-0.38)	(5.27)***		
AR(2)			0.087	-0.330		
			(0.59)	(-1.34)		
R^2	0.986	0.990	0. 987	0.989	0.990	0.995
Durbin-Watson	1.81	1.25	2.02	2.00	2.67	1.67
F Statistic	214.9***	302.5***	341.1***	390.1***	227.2***	442.2***
Standard Error	2.02	6.36	1.85	6.47	1.76	4.72

Note: t-statistics are reported in parentheses. Those followed by *** are statistically significant at the .001 level, ** at the .01 and * at the .05 level. (O) indicates OASI benefits as the dependent variable; (O+M) indicates "OASI plus Medicare" as the dependent variable.

Table 9: Small Sample Simulations of the Effects of Functional Form and Estimation Strategy on Regression Discontinuity Estimates

A Runs: Data Generated from Y = 0 + .2X (for X = 0 to 5) and Y=X for X greater than 5, with D = 0 for the 0 through 5 range and D = 1 for the X>5 range, with X=1,2…10. Estimates of Y=C+bX, Y=C +bX +b'DX, and Y = C +bX +D +b'DX for 10 observations.

Constant term (T)	X Coefficient (T)	D Coefficient (T)	D*X Coefficient (T)	F-Statistic (with10 obs)
-2.666 (-2.857)**	1.267 (8.421)***			70.911***
1.12 E-15 (0.472)	0.200 (2.75 E^{14})		0.800 (1.58 E^{15})	0.24 E^{31}***
1.12E-15 (0.250)	0.200 (1.48 E^{14}) ***	-2.34 E-14 (-1.97)*	.800 (4.18 E^{14})***	2.68 E^{30} ***

B Runs: Data Generated from Y = 0 + .2X (for X = 0 to 5) and Y=-10+2X for X greater than 5, with D = 0 for the 0 through 5 range and D = 1 for the X>5 range, with X=1,2…10. Estimates of Y=C+bX, Y=C +bX +b'DX, and Y = C +bX +D +b'DX for 10 observations.

-2.666 (-2.74)**	1.0848 (6.92)***			47.929***
-1.42 (-1.080)	0.589 (1.457)		0.371 (1.31)	27.034***
3.93E-15 (0.505)	0.200 (8.54 E^{13}) ***	-10.000 (-4.86 E^{14})***	1.800 (5.43 E^{14})***	6.88 E^{29} ***

C Runs: Data Generated from Y = log(X) for 0<X ≤5 and Y = 3log(X) for X>5, with D = 0 for the 0 through 5 range and D = 1 for the >5 range, with X=1,2…10. Estimates of Y=C+bX, Y=C +bX +b'DX, and Y = C +bX +D +b'DX for 10 observations.

-1.302 (-2.084)*	0.886 (8.803)***			77.496***
0.263 (0.574)	0.261 (1.863)*		0.469 (4.816)**	157.833***
-0.216 (-1.651)	0.391 (9.915)***	3.351 (9.679)***	-0.0093 (-0.167)	1529.548***

D Runs: Data Generated from Y = log(X), with D = 0 for the 0 through 5 range and D = 1 for the >5 range, with X=1,2…10. Estimates of Y=C+bX, Y=C +bX +b'DX, and Y = C +bX +D +b'DX for 10 observations.

0.243 (1.491)	0.230 (8.764)***			76.800***
-0.036 (-0.181)	0.342 (5.630)***		-0.084 (-1.979)*	54.351***
-0.216 (-1.72)	0.391 (10.332)***	-0.264 (-4.928)**	1.261 (3.795)**	110.43***

Note that the A and B runs show that the results of regression discontinuity estimates are excellent when the linearity assumption holds. The C runs demonstrate that true regime shifts may be poorly estimated if the linearity assumption is not true and the D runs that spurious results are also possible. Note also that even very small data sets of "excellent" data (here with no stochastic component) yield convincing t-statistics and F-statistics.