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The Political Economy of the Vanishing Marginals: Tiebout Sorting and the American Political System

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Tiebout Sorting and the American Political System

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I. Introduction

In 1974, David Mayhew revealed a trend in congressional elections suggesting that the number of 'marginal districts' declined from the 1950s to the 1970s. That is, the number of districts won with between 50% and 60% of the vote had decreased, while the number of districts won with more than 60% of the vote had increased (Mayhew 1974a[1]). Although Mayhew did not provide evidence as to the causal mechanism of this phenomenon, he gave several conjectures. This paper explores one of Mayhew's possible causal mechanisms, examining the theory that candidates "have been profiting not from any exertions of their own but from changes in voter attitudes" (Mayhew 1974a[2]).

The scope of this paper entails investigating whether the impetus for the increase in vote margins is *Tiebout Sorting*. The traditional theory of Tiebout Sorting holds that "consumer-voters" will sort themselves in a fashion such that they are "picking that community which best satisfies [their] preference pattern for public goods" (Tiebout 1956[3]). Although the strong version of this model is not being considered, even a weak version suggests that over an extended period of time consumer-voters within a given area will become more homogeneous with regard to their view of government services as they sort themselves into and out of a given area. With this in mind, consumer-voters will vote together more and more often over time because of the growing similarity of their preferences. Thus, this results in higher vote margins because consumer-voters will

[1]Mayhew, David R. (1974a). "Congressional Elections: The Case of the Vanishing Marginals." *Polity*, 6:295-317.
[2]Mayhew, David R. (1974a). "Congressional Elections: The Case of the Vanishing Marginals.' *Polity*, 6:295-317.
[3]Tiebout, Charles M. (1956). "A Pure Theory of Local Expenditure." *The Journal of Political Economy*, 64:416-24.

vote in bloc for the candidate closest to their increasingly uniform attitudes towards government.

The way in which we explore this notion stands in stark contrast to the existing literature both of the Tiebout Sorting and the Vanishing Marginals. In regard to Tiebout Sorting, we argue that the commonly employed measurement for Tiebout Sorting, ascertaining whether or not there has been an increase in stratification for given public goods over time, is fundamentally flawed as it does not recognize the role of the political system as a body which mediates preferences between individuals and implemented government services. This fundamental flaw in the literature is alleviated through invoking vote margin as a measurement of Tiebout Sorting. Specifically, we do this through our first hypothesis:

> **Hypothesis 1:** *If the margin by which a candidate wins in a given district increases, then we will observe a corresponding increase in the homogeneity of preferences of consumer-voters within that specific district. The reverse will hold as well.*

That is, we would expect a U-shaped relationship (a quadratic relationship) between our measure of homogeneity and vote margin: when a district becomes increasingly homogeneous on either extreme of the U-shaped relationship, vote margin should rise; moreover, when a district becomes increasingly heterogeneous between these two homogeneous extremes, vote margin should fall. The use of exploring homogeneity through a U-shaped relationship is a novel approach in both the Tiebout Sorting and Vanishing Marginals literature.

Further, we call into question whether the way in which the traditional notion of Tiebout Sorting, consumer-voters "picking that community which best satisfies [their] preference pattern for public goods" (Tiebout 1956[4]), is an accurate portrayal of how real-world people act. Factors such as socioeconomic stratification and normative beliefs are important determinants of individual behavior; social strife affects sorting, and people are not merely heartless calculators searching for the highest gains from public goods. As such, we introduce two types of Tiebout Sorting: *traditional* Tiebout Sorting, referring to the notion of consumer-voters self-selecting into districts where the basket of goods provided most closely matches their preferences, and *expanded* Tiebout Sorting, referring to the sorting of public goods preferences that is a result of the spatial sorting through ideological and economic factors independent of public goods preferences. Explicitly stated:

> **Hypothesis 2:** *The pattern identified in the first hypothesis is driven by both traditional and expanded Tiebout Sorting.*

Note that we are using an expansive definition of a public good. For example, while one could trivially show that public schooling is neither non-rivalrous nor non-excludable, it is still considered a public good by our definition because of the government's role in public schools.

In regards to the increase in vote margins, the literature explaining this pattern commonly offers one-shot changes in the 1950 to 1970 time range to explain why vote margins have increased. These explanations, however, prove to be exceedingly deficient if this trend is not one from the 1950 to 1970 time range but rather one whose breadth encompasses the entire twentieth century. Thus, we will show that this trend of increasing vote margins spans the entire twentieth century and that a mechanism that is

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[4]Tiebout, Charles M. (1956). "A Pure Theory of Local Expenditure." *The Journal of Political Economy*, 64:416-24.

not one-shot, but rather fluid over time such as Tiebout Sorting, will more properly explain this pattern in vote margins. That is, we introduce our third hypothesis:

> **Hypothesis 3:** *The observation made by David Mayhew is a portion of a longer trend stationary pattern in an increase in vote margins.*

Thus, we apply the never before used methodology of expanding vote margins to the timeframe of the twentieth century and explore this data through the tools of time-series econometrics.

In pursuit of these assertions, this paper is divided into four further sections. The following two sections will provide a literature review for the Vanishing Marginals and Tiebout Sorting as well as the context in which this analysis fits. After these sections we will introduce and conduct our econometric analyses. Finally, the last section will summarize the results of the econometric analysis and provide a discussion of their meaning.

II. Vanishing Marginals

There are four general categories of explanations for the increase in vote margins. The first explains this trend through the process of gerrymandering (McAdams and Johannes 1988[5]; Tufte 1973[6]; Tufte 1974[7]). Although this is the common explanation put forth by the media, recent academic evidence has suggested this is not a major cause (Carson, Crespin, and Finocchiaro 2007[8]): "one need only look back at the last partisan

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[5] McAdams, John C., and John R. Johannes (1988). "Congressmen, Perquisites, and Elections." *Journal of Politics*, 50(2):412-39.
[6] Tufte, Edward R. (1973). "The Relationship between Seats and Votes in Two-Party Systems." *American Political Science Review*, 67(2):540-54.
[7] Tufte, Edward R. (1974). "Communication." *American Political Science Review*. 68(1):211-13.
[8] Carson, Jamie, Michael Crespin, and Charles Finocchiaro, and David Rohde (2007). "Redistricting and Party Polarization in the U.S. House of Representatives." *American Politics Research* 35(6): 878-904.

era, when redistricting was not a significant factor, or to the contemporary Senate, whose ideological and partisan patterns mirror those of the House, to realize that other, more powerful forces are at work" (Mann and Ornstein 2006[9]). A second argument claims that this change is due to changes in voter attitudes or behavior (Burnham 1974[10]; Cover 1977[11]; Ferejohn 1977[12]). The third category explains this trend by asserting that quality challengers have decreased (Jacobson 1978[13]; Mann 1978[14]; Mann and Wolfinger 1980[15]; Jacobson 1992[16]). However, this explanation can be partly tied into the previous two perspectives: "strategic challengers realize their chances of winning are greater following" a constituency preference change in their favor, gerrymandering or migration, and are thus "more likely to enter" a political contest (Cox and Katz 2002[17]; Carson, Engstrom, and Roberts 2006[18]). The last group of explanations suggests a change in the behavior of elected officials, notably through greater responsiveness to constituency needs, increased constituency services, and increased strategic position-taking (Mayhew

[9] Mann, T. E., & Ornstein, N. J. (2006). The Broken Branch: How Congress is Failing America and How To Get It Back on Track. New York: Oxford University Press.
[10] Burnham, Walter D. (1974). "Communications." *American Political Science Review*. 68(1): 207-11.
[11] Cover, Albert D. (1977). "One Good Term Deserves Another: The Advantage of Incumbency in Congressional Elections." *American Journal of Political Science* 21(3):523-41.
[12] Ferejohn, John A. (1977). "On the Decline of Competition in Congressional Elections." *American Political Science Review* 71(1):166-76.
[13] Jacobson, Gary C. (1978). "The Effects of Campaign Spending in Congressional Elections." *American Political Science Review* 72(2):469-91.
[14] Mann, Thomas E. (1978). Unsafe at Any Margin. Washington, DC: American Enterprise Institute.
[15] Mann, Thomas E. and Raymond Wolfinger (1980). "Candidates and Parties in Congressional Elections." *American Political Science Review* 74:617-634.
[16] Jacobson, Gary C. (1992). The Politics of Congressional Elections, 3rd edition. New York: Harper Collins Publishers.
[17] Cox, Gary W., and Jonathan N. Katz (2002) Elbridge Gerry's Salamander: The Electoral Consequences of the Reapportionment Revolution. Cambridge: Cambridge University Press.
[18] Carson, Jamie L., Erik J. Engstrom, and Jason M. Roberts (2006). "Redistricting, Candidate Entry, and the Politics of Nineteenth-Century U.S. House Elections." *Midwest Political Science Association* 50(2): 283-293.

1974a[19]; Cover and Mayhew 1977[20]; Fiorina 1977a[21]; Fiorina 1977b[22]; Cain, Ferejohn, and Fiorina 1987[23]; McAdams and Johannes 1988[24]; Jacobson 1992[25]).

It follows that there is a striking gap in this literature arising from a widespread focus on the 1950 to 1970 time period for finding a causal mechanism. It has been suggested that this trend has existed far longer than originally noted by Mayhew. In fact, there is evidence that the trend discovered by Mayhew is actually just a portion of one starting in 1896 (Gross and Garand 1984[26]). Thus, if the increase in vote margins is indeed a pattern with its origin in the beginning of the twentieth century, as will be later shown, a comprehensive approach to this question requires data and an answer, or answers, which explain the entire history of this trend rather than simply the 1950 to 1970 focused explanations common in the literature. As such, we introduce Tiebout Sorting as it serves as this comprehensive explanation.

III. Tiebout Sorting

The rationale behind traditional Tiebout Sorting can be intuitively understood through an example from Charles Tiebout:

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[19] Mayhew, David R. (1974a). "Congressional elections: The Case of the Vanishing Marginals." *Polity* 6:295-317.
[20] Cover, Albert, and David Mayhew (1977). "Congressional Dynamics and the Decline of Competitive Congressional Elections." In Congress Reconsidered, ed. Lawrence C. Dodd and Bruce I. Oppenheimer. New York: Praeger.
[21] Fiorina, Morris P. (1977a). "The Case of the Vanishing Marginals: The Bureaucracy Did It." *American Political Science Review*. 71(1):177-81.
[22] Fiorina, Morris P. (1977b). Congress: The Keystone of the Washington Establishment. New Haven: Yale University Press Publishers.
[23] Cain, Bruce, John Ferejohn, and Morris Fiorina (1987). The Personal Vote: Constituency Service and Electoral Independence. Cambridge: Harvard University Press Publishers.
[24] McAdams, John C., and John R. Johannes (1988). "Congressmen, Perquisites, and Elections." *Journal of Politics* 50(2):412 -39.
[25] Jacobson, Gary C. (1992). The Politics of Congressional Elections, 3rd edition. New York: Harper Collins Publishers.
[26] Gross, Donald A., and James C. Garand (1984). "The Vanishing Marginals, 1824 – 1980." *Journal of Politics* 46(1):224-37.

> Consider for a moment the case of the city resident about to move to the suburbs. What variables will influence his choice of a municipality? If he has children, a high level of expenditures on schools may be important. Another person may prefer a community with a municipal golf course. The availability and quality of such facilities and services as beaches, parks, police protection, roads, and parking facilities will enter into the decision-making process.
>
> (Tiebout 1956[27])

Empirical testing of Tiebout Sorting has been a strongly active research area focusing on (i) whether there is actually choice in public goods between communities, (ii) whether the implications of Tiebout Sorting can be observed, and (iii) whether Tiebout Sorting can be observed. The first question is generally settled in that there are observable differences between public goods offered by different communities (Fischel 1981[28]; Hamilton 1982[29]). The second topic area, testing the implications of Tiebout Sorting, has involved deriving locational equilibriums and testing if these equilibriums are consistent with real world data. This is strongly tied to the third area of study, observing Tiebout Sorting, which has been thoroughly studied, yet is still disputed. Empirical tests have searched for Tiebout Sorting through the examination of schools (Epple, Figlio, and Romano 2004[30]; Hoxby 1999[31]; Hoxby 2000[32]; Fernaindez and Rogerson 1998[33]; Nechyba 1999[34]; Nechyba 2000[35]), the number of jurisdictions

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27 Tiebout, Charles M. (1956). "A Pure Theory of Local Expenditure." *The Journal of Political Economy*, 64:416-24.

28 Fischel, William A (1975). "Fiscal and Environmental Considerations in the Location of Firms in Suburban Communities." In Fiscal Zoning and Land Use Controls, E. Mills and W. Oates, eds. Lexington, MA: Heath-Lexington Books.

29 Hamilton, Bruce W. (1975). Zoning and Property Taxation in a System of Local Governments. *Urban Studies* 12: 205-11.

30 Epple, Dennis, David Figlio, and Richard Romano (2004). "Competition Between Private and Public Schools: Testing Stratification and Pricing Predictions." *Journal of Public Economics* 8(7-8):1215-1245.

31 Hoxby, Caroline (1999). "The Productivity of Schools and Other Local Public Goods Producers." *Journal of Public Economics* 74(1):1-30.

32 Hoxby, Caroline (2000). "Does Competition Among Public Schools Benefit Students and Taxpayers?" *American Economic Review* 90(5):1209-1238.

33 Fernaindez, Raquel and Richard Rogerson (1997). "Keeping People Out: Income Distribution, Zoning, and the Quality of Public Education." *International Economic Review* 38(1):23-42.

(Alesina, Baqir, and Hoxby 2000[36]), redistribution (Wooders 1999[37]), zoning (Glomm and Lagunoff 1999[38]), general public goods (Perroni and Scharf 2001[39]), environmental quality (Kahn 2000[40]; Banzhaf and Walsh 2008[41]), and more. However, much of these two subfields have a strong methodological breakdown because the most commonly used measurement has entailed determining the presence or absence of Tiebout sorting by ascertaining whether or not there has been an increase in stratification for given public goods over time (Oates 2005[42]). That is, through the commonly used criterion that an increase in stratification for given public goods over time is indicative of Tiebout Sorting there is an implicit assumption that consumer-voters will get together and implement their optimal choice for a given policy. This, however, is not the case. In the United States the policy preferences of a consumer-voter are mediated through elected officials. Thus, the voting booth does not give the option to fill in how much money to spend on a given program, or even a choice between two amounts for the vast majority of issues. Rather, the choice given tends to be restricted to Democrat or Republican, and occasionally a member of an independent party. Further, the policy goals of these elected

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[34] Nechyba, Thomas (1999). “School Finance Induced Migration and Stratification Patterns: The Impact of Private School Vouchers.” *Journal of Public Economic Theory* 1(1):5-50.
[35] Nechyba, Thomas (2000). “Mobility, Targeting, and Private-School Vouchers." *American Economic Review* 90(1): 130-46.
[36] Alesina, Alberto, Reza Baqir, and Caroline Hoxby (2000). “Political Jurisdictions in Heterogeneous Communities.” National Bureau of Economic Research Working Paper No. 7859.
[37] Wooders, Myrna (1999). “Multijurisdictional Economies, the Tiebout Hypothesis, and Sorting.” *Proceedings of the National Academy of Sciences* 96(19): 10585- 87.
[38] Glomm, Gerhard and Roger Lagunoff (1999). “A Dynamic Tiebout Theory of Voluntary vs. Involuntary Provision of Public Goods.” *Review of Economic Studies* 66(3):659-77.
[39] Perroni, Carlo and Kimberley Scharf (2001). “Tiebout with Politics: Capital Tax Competition and Constitutional Choices.” *Review of Economic Studies* 68(1):133-154.
[40] Kahn, Matthew E. (2000). “Smog Reduction's Impact on California County Growth.” *Journal of Regional Science* 40(3):565-582.
[41] Banzhaf, H. S. and Randall P. Walsh (2008). “Do People Vote with Their Feet? An Empirical Test of Tiebout's Mechanism.” *American Economic Review* 98(3):843-863
[42] Oates, Wallace E. (2005). “The Many Faces of the Tiebout Model.” In The Tiebout Model at Fifty: Essays in Public Economics in Honor of Wallace Oates, ed. William A. Fischel, 21-45. Cambridge, MA: Lincoln Institute of Land Policy.

officials may not match the preferences of a consumer-voter. A more accurate methodology would be to consider the mediation of preferences of consumer-voters through the goals of elected officials. For example, consider the goals of congressmen as posited by Richard Fenno:

> *Goal 1 - Satisfying Constituents*: It could be that constituency considerations come back ultimately to an interest in re-election. But one observes congressmen taking account of constituency reaction long before and much more frequently than they worry explicitly about gain or loss of votes in the next election.
>
> *Goal 2 - Intra-Washington Influence*: These include going along with one's party leadership, favor-trading among fellow legislators, and following the lead of the administration, particularly if the President is of the deciding legislator's party.
>
> *Goal 3 - Good Public Policy*: Most legislators have their conception of good public policy, and act partly to carry that conception into being.
>
> (Kingdon 1973[43]; Kingdon 1977[44])

Therefore, to look for a link between consumer-voter preferences and those policies that are actually implemented will be an inaccurate measure of Tiebout Sorting. Succinctly, the commonly employed measurement is not reliable; outcomes are in reality "a product of some unknown combination of constituency characteristics, members' personal preferences, the underlying agenda of votes, and party pressure" (Carson, Jenkins, and Schickler 2004[45]).

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[43] Kingdon, John W. (1973). Congressmen's Voting Decisions. New York: Harper & Row Publishers.
[44] Kingdon, John W. (1977). "Models of Legislative Voting." *Journal of Politics* 39(3):563-95.
[45] Carson, Jamie, Jeffery Jenkins, and Eric Schickler (2004). "Constituency Cleavages and Congressional Parties: Measuring Homogeneity and Polarization, 1857-1913." *Social Science History* 28(4):537-573.

Further, these tests tend to lack a focus on how individuals actually act; socioeconomic stratification and ideology as well as one's consideration of public goods provided influence spatial sorting with respect to demand for public goods. As such, we will augment Tiebout Sorting by considering it in both *traditional* and *expanded* versions. Traditional Tiebout Sorting refers to consumer-voters self-selecting into districts where the basket of goods provided most closely matches their preferences. On the other hand, expanded Tiebout Sorting refers to the sorting of public goods preferences that is a result of the spatial sorting by ideological and economic factors independent of public goods preferences. As an intuitive example, consider the following hypothetical: a group of low socioeconomic status will be restricted both in housing choices, due to the price of housing, as well as in availability of suitable jobs in a given location, due to the need to match demanded and supplied skill sets. Further, note that individuals within a group of low socioeconomic status will tend to have more homogeneous preferences for public goods than those not in that group.[46] As such, it follows that if there is spatial sorting due to housing choices and job availability there will consequently be the sorting of public goods preferences. Thus, while consideration of public goods does not drive the sorting, it is nonetheless a product of the spatial sorting resulting from housing and job concerns.

IV. Econometric Models

From these insights follows the mutually supporting relationship between the Vanishing Marginals and Tiebout Sorting. In particular, the relevance of Tiebout Sorting is best measured through the vote margins of consumer-voters for candidates, and Tiebout Sorting can serve as a causal explanation for the Vanishing Marginals. This is so because the Vanishing Marginals acknowledges the mediation required; voting for a

[46] General Social Survey: http://www.norc.uchicago.edu/GSS+Website/

candidate is a direct action by a consumer-voter, and voting homogeneously in bloc is a measurement of the effectiveness of Tiebout Sorting. The exact relationship will be made clear in this section as we introduce our three models to provide support for the position that traditional and expanded Tiebout Sorting account for an increase in vote margins over the twentieth century.

When investigating the increase in vote margins, there are three general sets of data used to investigate this issue. The first set encompasses data from elections and the creation of districts, notably for the explanations of gerrymandering and the decrease of quality challengers (Gross and Garand 1984[47]; Alford and Brady 1993[48]). The second use of data in this field analyzes evidence garnered directly from constituents in forms such as surveys, most common when investigating a change in voter attitudes (Cain, Ferejohn, and Fiorina 1987[49]). Finally, the third method used in gathering data entails collecting information directly from assistants of an elected official, a method generally used in looking at change in the behavior of elected officials (Johannes and McAdams 1981[50]; Cain, Ferejohn, and Fiorina 1987[51]). A less common approach involves obtaining and scrutinizing data collected directly from members of Congress (Herrera and Yawn 1999). For our first model we employ data from elections and the creation of

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[47] Gross, Donald A., and James C. Garand (1984). "The Vanishing Marginals, 1824 – 1980." *Journal of Politics* 46(1):224-37.
[48] Alford, John R., and David Brady (1993). "Personal Partisan Advantage in U.S. Congressional Elections, 1846-1990." In Congress Reconsidered, ed. Lawrence Dodd and Bruce Oppenheimer. New York: Praeger
[49] Cain, Bruce, John Ferejohn, and Morris Fiorina (1987). The Personal Vote: Constituency Service and Electoral Independence. Cambridge: Harvard University Press.
[50] McAdams, John C., and John R. Johannes (1981). "Does Casework Matter?: A Reply to Professor Fiorina." *American Journal of Political Science* 25(3):581-604.
[51] Cain, Bruce, John Ferejohn, and Morris Fiorina (1987). The Personal Vote: Constituency Service and Electoral Independence. Cambridge: Harvard University Press Publishers.

districts evidence. The second and third models use these data as well as information garnered directly from constituents in forms such as surveys. Specifically:

(A) Model I: This model will establish that the increase in vote margins is a trend stationary pattern that has spanned the twentieth century.

(B) Model II: Our second model will use a blunt measurement over a long span to establish that Tiebout Sorting (not distinguishing here between traditional and expanded sorting) is a force of long-term spatial homogenization in the United States.

(C) Model III: Finally, we will investigate the nuances of this mechanism such that it can be determined whether this homogenization mechanism is both parts of our augmented understanding of Tiebout Sorting.

(A_1) Econometric Analysis I

Of paramount importance to understanding this econometric analysis is knowledge of Mayhew's discovery regarding the Vanishing Marginals. As can be seen in Chart 1, while Mayhew looked at a time period spanning from the 1950s to the 1970s to find that the number of districts won with between 50% and 60% of the vote had decreased, while the number of districts won with more than 60% of the vote had increased, this observation holds true for the time period observed in this study, 1900 to 1992, and possibly longer. It follows that if a set of independent variables explains the change in vote margin over time they likewise explain why the vote margin has increased over time.

To fully understand the factors at work, we must determine whether, for this pattern in the data, there exists a unit root. Specifically, if there is a unit root then the pattern is difference stationary and an exogenous shock will result in a new level at which vote margin will continue to increase. On the other hand, if there is no unit root then this pattern will be trend stationary and an exogenous shock will cause vote margin to temporarily move away from the trend before returning to it. Intuitively, this considers whether a scandal, innovation, or other shock to the political system will have a permanent (difference stationary) or temporary (trend stationary) effect.

We test the existence of the unit root through, first, the weaker test on aggregated time-series data for vote margins by year and, second, by using a stronger panel data test.[52] For the weaker test, we utilize the commonly used Augmented Dickey-Fuller (ADF) and the Elliott-Rothenberg-Stock DF-GLS (ERS) test. The null hypothesis of both of these tests is that there exists a unit root. Further, to determine lag length we use both the Akaike Information Criterion (AIC) as well as the Schwarz Criterion (BIC) for the sake of robustness, though they both result in a lag length of zero.

Results Table 1 shows that, in this weaker test, we fail to reject that the pattern possesses a unit root and, consequently, are led to believe it is difference stationary. However, a closer examination of the results brings a large degree of ambiguity into what should be concluded from this result. Specifically, notice that the ADF test barely fails to reject that the pattern possesses a unit root at the 10% level, while the ERS test does reject that this pattern has a unit root at the 10% level. While traditionally for the existence of a unit root to be rejected it must be rejected at the 5% level, here there are circumstances that prevent us from drawing the hasty conclusion that we should view this

[52] The reasoning behind our methodology for choosing tests to determine if there exists a unit root and the optimal number of lags for those tests is explained in the appendix under sections III and IV.

pattern as having a unit root. Consider the following two explanations, both of which are possible from the results of the ADF and ERS tests.

Upon inspection of Chart 2, there appears to be a shock in this pattern from the early 1930s through the late 1950s. If we suppose this is trend stationary it would not at all be unexpected for us to fail to reject the existence of a unit root because the exogenous shock between the lines is such a large part of the dataset (Diebold and Senhadji 1996[53]). By contrast, this pattern may have a unit root, be difference stationary, and have had an exogenous shock in the early 1930s moving it to a new, permanent, and lower level as well as a second exogenous shock moving it back to the previous level.

To shed light on this ambiguity we move to our stronger and more comprehensive test by employing two commonplace panel unit root tests that do not require balanced panel data, the Fisher ADF and Fisher PP tests. Further, we use the Akaike Information Criterion to determine the number of lags used in each time-series section of the panel data.[54] We observe that the optimal lag fluctuates between 0 and 3 for each time-series section of the panel data and, consequently, we will use the maximum lag for the full panel test, as is generally practiced (Österholm 2004[55]). Displayed in Results Table 2 are the results for each of the Fisher ADF and Fisher PP tests for 0 through 3 lags. Each test delivers the same conclusion: we reject the null hypothesis that there exists a unit root. Thus, we are able to conclude that this pattern is trend stationary.

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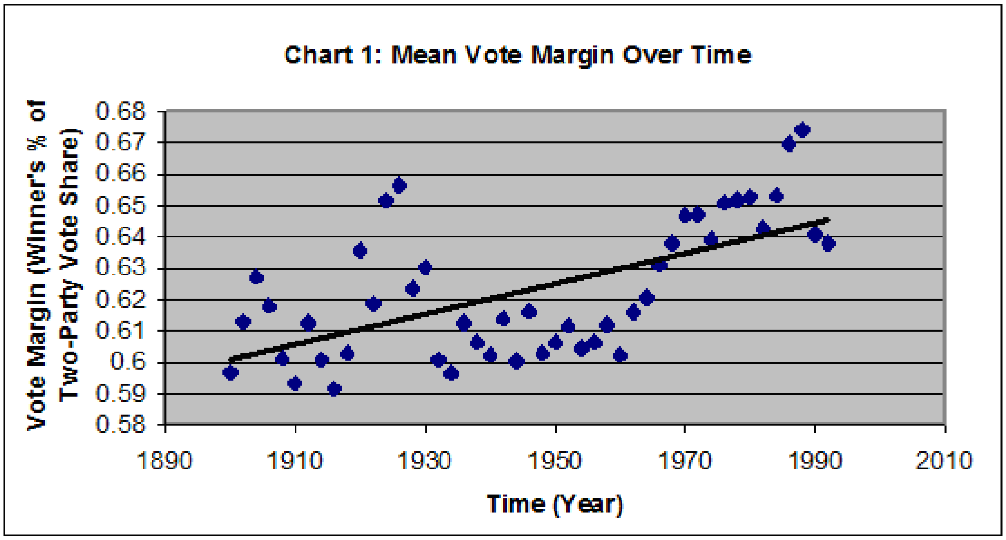
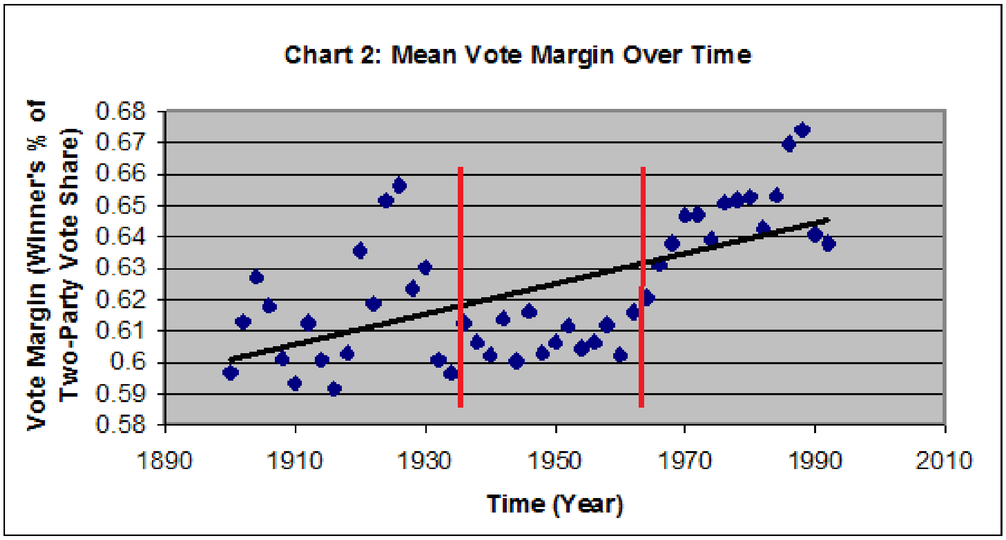
[53] Diebold, Francis X. and Abdelhak S. Senhadji (1996). "The Uncertain Unit Root in Real GNP: Comment." *The American Economic Review* 86(5):1291-1298.
[54] Like our previous tests for the existence of a unit root and criterion for determining optimal lag length, an explanation of our methodology can be found in sections III and IV of the appendix.
[55] Österholm, P. (2004), "Killing Four Unit Root Birds in the US Economy with Three Panel Unit Root Test Stones." *Applied Economics Letters* 11(4), 213-216.

Year	Mean
1900	0.596
1902	0.612
1904	0.627
1906	0.617
1908	0.601
1912	.612
1914	0.600
1916	0.591
1910	0.593
1918	0.602
1920	0.635
1922	0.618
1924	0.651
1926	0.656
1928	0.623
1930	0.630
1932	0.600
1934	0.596
1936	0.612
1938	0.606
1940	0.602
1942	0.613
1944	0.600
1946	0.616
1948	0.602
1950	0.606
1952	0.611
1954	0.604
1956	0.606
1958	0.611
1960	0.602
1962	0.615
1964	0.620
1966	0.631
1968	0.637
1970	0.646
1972	0.647
1974	0.639
1976	0.650
1978	0.651
1980	0.652
1982	0.642
1984	0.653
1986	0.669
1988	0.674
1990	0.640
1992	0.637



Note: This aggregated vote margin data by year is used in our first test for the existence of a unit root. The elections combined to create this aggregation are the data that are defined as competitive (races with major-party opposition where there is no incumbent or where there is an incumbent that faced major-party opposition in both a given election and the previous election).

The aggregated data by year can be seen to the left, the graph of the aggregated data can be seen above, and the location of the exogenous shock can be seen below.



Results Table 1		
ADF Test, AIC and BIC suggest 0 lags necessary		
Lags: 0		t-Statistic
1% level		-4.1706
5% level		-3.5107
10% level		-3.1855
ADF Test Statistic		-3.0059
ERS Test, AIC and BIC suggest 0 lags necessary		
Lags: 0		t-Statistic
1% level		-3.77
5% level		-3.19
10% level		-2.89
ERS Test Statistic		-3.0713

Results Table 1 contains the results of the ADF and ERS tests for the aggregated vote margin data. Both the ADF and ERS tests can be interpreted as follows: if the magnitude of the (negative) test statistic is larger than the t-Statistic at the 1%, 5%, or 10% level for its corresponding test then the null hypothesis that there is no unit root is rejected at that level.

For the ADF test, we note that -3.1855 (10% level t-Statistic) is larger in magnitude than -3.0059 (ADF Test Statistic) so we fail to reject the null hypothesis at the 10% level.

For the ERS test, notice that -3.0713 (ERS Test Statistic) is larger in magnitude than -2.89 (10% level t-Statistic) but smaller in magnitude than -3.19 (5% level t-Statistic). Consequently, we fail to reject the null hypothesis at the 5% level, but we do reject the null hypothesis at the 10% level.

Results Table 2 contains the results of the Fisher ADF and Fisher PP tests for the entire panel dataset repeated for 0 through 3 lags. The null hypothesis is that there exists a unit root for both the Fisher ADF and PP tests. Consequently, a Prob > Chi^2 value of 0.000 for each of the tests at every choice of lag length rejects the null hypothesis at the 1% level.

Results Table 2

Test	**# of Lags**	**Chi^2**	**Prob > Chi^2**	**Conclusion**
Fisher ADF	0	4517.2793	0.000	No Unit Root
Fisher ADF	1	4545.7366	0.000	No Unit Root
Fisher ADF	2	4771.4298	0.000	No Unit Root
Fisher ADF	3	4849.882	0.000	No Unit Root
Fisher PP	0	4517.2793	0.000	No Unit Root
Fisher PP	1	1986.9359	0.000	No Unit Root
Fisher PP	2	1554.0046	0.000	No Unit Root
Fisher PP	3	1257.7595	0.000	No Unit Root

(A_2) *Nature of the Exogenous Shock*

While the exogenous shock is originally viewed as a weakness of the data set – it adds ambiguity to our first, weaker set of unit root tests – there is also a resulting strength: it provides us the opportunity to explore the nuances of this trend stationary pattern. This period from the early 1930s to the late 1950s coincides exactly with the realignment of the Democratic and Republican parties. In particular, there was a distinct decline in the level of partisanship as well as a pattern of political moderation in both the Democratic and Republican parties; consequently, "the parties became more diverse internally, creating considerable ambiguity about the extent to which the parties differed" (Stonecash 2006[56]). Further, this creates a knowledge problem as it has been shown that voters are more knowledgeable of party differences than individual candidate differences (Popkin 1994[57]). It follows that during this period we would see a relatively less efficient transmission of voter preferences from individuals to elected officials. Thus, one would expect an indiscriminate drop in vote margins as well as a more reserved slope in the realignment period relative to the pre- and post-realignment period. As can be observed in Chart 3 through Chart 6, this is in fact exactly what happens; the slope of a line fit to the 1900 to 1930 period (pre-realignment) is 0.0011 and one fit to the 1962 to 1992 period (post-realignment) is 0.0009 whereas in the 1932 to 1960 timeframe (realignment) the slope of such a line is much smaller at 0.0001.

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[56] Stonecash, Jeffrey M. (2006). Political Parties Matter: Realignment and the Return of Partisan Voting. Boulder: Lynne Rienner Publishers, Inc.
[57] Popkin, Samuel L. (1994). The Reasoning Voter: Communication and Persusasion in Presidential Elections. Chicago: University of Chicago Press.

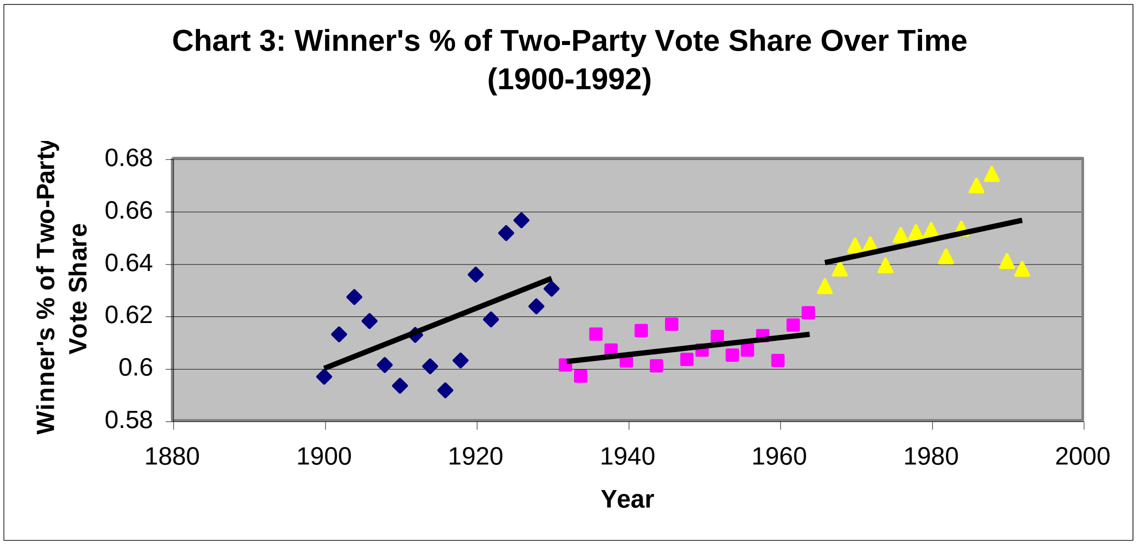
Chart 3: Winner's % of Two-Party Vote Share Over Time (1900-1992)
Winner's % of Two-Party Vote Share
0.68
0.66
0.64
0.62
0.6
0.58
1880
1900
1920
1940
1960
1980
2000
Year

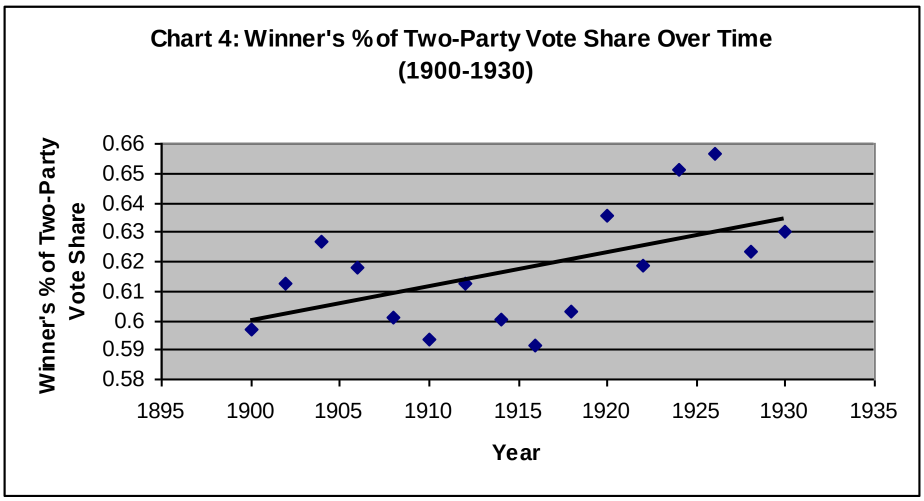
Chart 4: Winner's % of Two-Party Vote Share Over Time (1900-1930)
Winner's % of Two-Party Vote Share
0.66
0.65
0.64
0.63
0.62
0.61
0.6
0.59
0.58
1895
1900
1905
1910
1915
1920
1925
1930
1935
Year

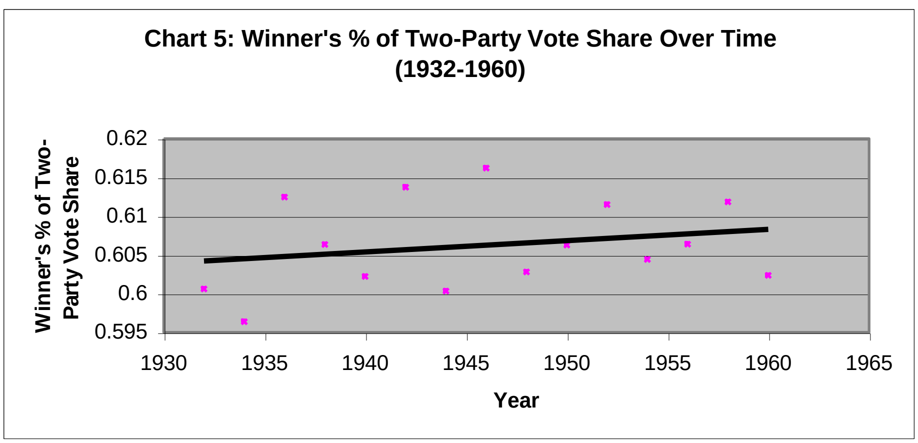
Chart 5: Winner's % of Two-Party Vote Share Over Time (1932-1960)
Winner's % of Two-Party Vote Share
0.62
0.615
0.61
0.605
0.6
0.595
1930
1935
1940
1945
1950
1955
1960
1965
Year

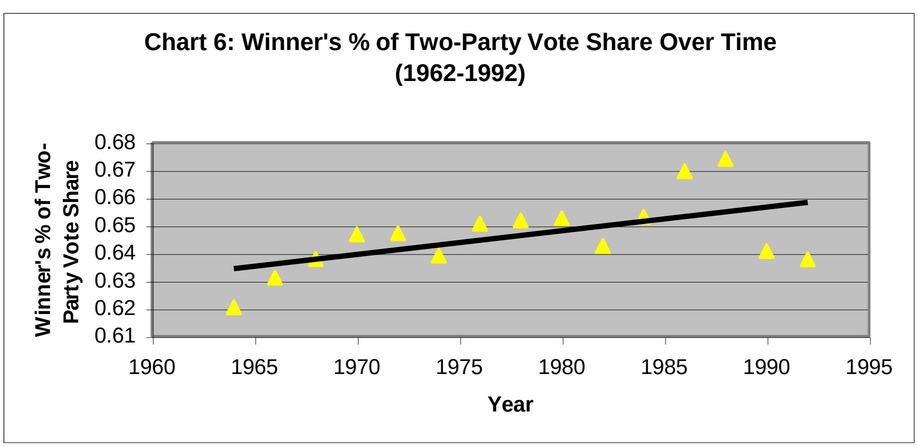
Chart 6: Winner's % of Two-Party Vote Share Over Time (1962-1992)
Winner's % of Two-Party Vote Share
0.68
0.67
0.66
0.65
0.64
0.63
0.62
0.61
1960
1965
1970
1975
1980
1985
1990
1995
Year

(B) Econometric Analysis II

The second econometric analysis considered establishes that Tiebout Sorting (not distinguishing here between traditional and expanded sorting) is a long-term spatially homogenizing force in the United States. There are two datasets that will be used for this econometric analysis. The first dataset comes from E. Scott Adler's *Congressional District Dataset*, which "includes a wide range of economic, social, and geographic information for every U.S. congressional district" from the 78th Congress through 103rd Congress.[58] Data from every other year will be used, as data are provided at each biennial election for the United States House of Representatives.

This test explores the expected U-shaped relationship (a quadratic relationship) between our measure of homogeneity and vote margin. That is, if there exists such a U-shaped relationship then it would imply that as a district becomes increasingly homogeneous on either extreme of a measurement of homogeneity, then vote margin should rise. Moreover, when a district becomes increasingly heterogeneous between these two homogeneous extremes, vote margin should fall. We will use the percent urban population in a district as a broad yet extremely effective measurement of heterogeneity.

Consider the strengths of this measurement in testing for a U-shaped relationship. In regards to income and occupation, evidence shows that there is a "wage gap between urban and rural workers occurs across societies and time periods" (Glaeser and Mare 1994[59]), and while the urban wage premium has fallen over time, the earnings gap between those who work in a large city and those who work outside it is still larger than the earnings gap between the races or between union and non-union members" (Freeman

[58] Congressional District Dataset: http://socsci.colorado.edu/~esadler/Congressional_District_Data.html
[59] Glaeser, Edward L. and David C. Mare (1994). "Cities and Skills." *Journal of Labor Economics* 19(2):316-342.

1984[60]). This can be explained partially through the positive externalities provided by cities as posited by the tradition of Marshall. There are three reasons, this literature claims, for the localization of similar occupations:

> First, the concentration of several firms in a single location offers a pooled market for workers with industry-specific skills, ensuring both a lower probability of unemployment and a lower probability of labor shortage. Second, localized industries can support the production of nontradable specialized inputs. Third, informational spillovers can give clustered firms a better production function than isolated producers.
> (Krugman 1991[61]; Marshall 1890[62])

That is, it is an efficient result for workers possessing a given industry-specific skill set to group together spatially. This theory has been shown to be supported by real world observation, notably in the classic example of the American Manufacturing Belt; "[t]he steady movement of the geographical center of manufacturing toward the West and South did not involve any decline in manufacturing or lessening of its density in the New England or Eastern states. It was accompanied, indeed by a growing concentration of certain branches of industry in those regions" (Clark 1929[63]). However, this trend is not restricted to manufacturing and regional sorting. It can be observed in the agricultural, manufacturing, and service sectors of the economy beyond regional sorting throughout the United States (Kim 1995[64]). While the explanations and predictions about future impact of this geographic concentration of industry-specific skill sets are disputed, the

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60 Freeman, R. (1984). "Longitudinal Analyses of the Effects of Trade Unions," *Journal of Labor Economics* 2:1-26.

61 Krugman, Paul (1991). "Increasing Returns and Economic Geography." *Quarterly Journal of Economics*. 108: 551-576.

62 Marshall, Alfred (1890). Principles of Economics. London: Macmillian.

63 Charles, Camille Z. (2003). "The Dynamics of Racial Residential Segregation." *Annual Review of Sociology* 29:167-207.

64 Kim, Sukkoo (1998). "Economic Integration and Convergence: U.S. Regions, 1840-1987." *The Journal of Economic History* 58(3):659-683.

existence of this trend is not. The scope of urban-rural differences is more apparent with the consideration of a wider range of socioeconomic variables beyond income and occupation:

> In the 1950s rural poverty was far more severe than urban poverty, with over a third of rural residents in poverty compared to 15% in urban areas and 18% in central cities. The combination of national economic growth and substantial outmigration from depressed areas brought a precipitous drop in rural poverty, and by the late 1960s rural poverty had fallen to 18% (compared to 13% in central cities). During the mid-1970s the poverty rate in rural areas continued to decline to a low of 14% in 1978, but hard economic times in the late 1970s and early 1980s brought new increases in rural poverty, until the rate reached 18% in the mid-1980s. The 1980s saw a significant increase in all poverty rates. By the decade's end the 17% poverty rate in rural America nearly equaled the 19% rate in the central cities. Although there are compositional differences between the rural and urban poor (the rural poor are more likely to be white, elderly, or in two-parent households with at least one worker), those who are most vulnerable in the central cities-blacks, children, and those in female-headed households-are even more likely to be poor if they live in rural area.
>
> (Tickamyer and Cynthia M. Duncan 1990[65])

That is, the use of this measurement further invokes data on age, class, gender, and race differences seen on a rural-urban comparison (Tickamyer and Duncan 1990[66]; Charles 2003[67]; Strait 2001[68]). Finally, age, class, gender, income, occupation, and race have been shown by the General Social Survey to influence preferences for political affiliation and public goods.[69]

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[65] Tickamyer, Ann R. and Cynthia M. Duncan (1990). “Poverty and Opportunity Structure in Rural America.” *Annual Review of Sociology* 16:67-86.
[66] Tickamyer, Ann R. and Cynthia M. Duncan (1990). “Poverty and Opportunity Structure in Rural America.” *Annual Review of Sociology* 16:67-86.
[67] Charles, Camille Z. (2003). “The Dynamics of Racial Residential Segregation.” *Annual Review of Sociology* 29:167-207.
[68] Strait, John B. (2001). “The Disparate Impact of Metropolitan Economic Change: The Growth of Extreme Poverty Neighborhoods, 1970-1990.” *Economic Geography* 77(3): 272-305.
[69] General Social Survey: http://www.norc.uchicago.edu/GSS+Website/

The second source of data will be Gary King's *Elections to the United States House of Representatives, 1898-1992 Dataset* containing the number of votes for Democratic and Republican candidates for each biennial House election grouped by congressional district. Only data from 1942 to 1992, the elections of the 77th through 103rd House of Representatives, will be used such that it corresponds to the *Congressional District Dataset*. Also included is information stating whether there was an incumbent running and, if so, their party affiliation.[70] From this dataset the variable *VoteMargin* will be calculated as the winner's percentage of the two-party vote share. This will be used as the dependent variable.

It is important to note that while public goods are generally provided by local and state government, *VoteMargin* is being calculated through congressional election results, a federal government election. This is because there is a distinct advantage to using House election data over local and state election data. In particular, whereas the average federal election garners participation by roughly half of the voting age population (higher in presidential election years and lower in midterm elections), (Verba, Schlozman, and Brady1995[71]; Lijphart 1997[72]; Bennett and Resnick 1990[73]) local and state elections commonly elicit the participation of a mere one-fourth of the voting age population (Alford and Lee 1968[74]; Morlan 1984[75]; Bridges 1997[76]). This advantage comes from the

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[70]Elections to the United States House of Representatives, 1898-1992 Dataset: http://dvn.iq.harvard.edu/dvn/dv/king/faces/study/StudyPage.xhtml?globalId=hdl:1902.1/TQDSSPRDDZ&studyListingIndex=1_d7657df4f6008b7fc80aaaf4688d

[71] Verba, S., K. L. Schlozman, and H. E. Brady (1995). Voice and equality: Civic voluntarism in American politics. Cambridge, MA: Harvard Univ. Press.

[72] Lijphart, A. (1997). "Unequal participation: Democracy's unresolved dilemma." *American Political Science Review* 91:1-14.

[73] Bennett, S. E., and D. Resnick (1990). "The implications of nonvoting for democracy in the United States." *American Journal of Political Science* 34:771-802.

[74] Alford, R. R., and E. C. Lee (1968). "Voting turnout in American cities." *American Political Science Review* 62:796-813.

idea that a large sampling of the preferences of individuals within a given area will deliver more accurate results. Moreover, the varying local and state institutional arrangements would have a confounding, as well as less studied and understood, effect on the transmission of consumer-voter preferences, whereas House elections are relatively more standardized (Hanjal and Lewis 2003[77]). One possible drawback is that local elections may offer a stronger indicator of consumer-voter preferences, as public goods are not generally provided at the federal level. However, House elections do possess a strong local component, and local and state elections are also influenced by a national component (Brady, David W., Robert D'Onofrio, and Morris P. Fiorina 2000[78]). Therefore, while there is a tradeoff between using House election results rather than local and state election results for calculating vote margin, House election results provide the stronger measure out of these two possibilities.

In order for these data to give meaningful information regarding the hypotheses, it is necessary to control for a number of factors. Recall the categories of explanations for the Vanishing Marginals in the literature. Thus, we must control for the incumbency effect, candidate quality, whether or not an election is competitive, and the effect of gerrymandering. The final category, a change in voter attitude or behavior, is invoked in the form of Tiebout Sorting. To control both for candidate quality and whether or not an election is competitive, only races with major-party opposition where there is no

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[75] Morlan, R. L (1984). "Municipal versus national election voter turnout: Europe and the United States." *Political Science Quarterly* 99:457-70.
[76] Bridges, A (1997). Morning glories: Municipal reform in the southwest. Princeton, NJ: Princeton Univ. Press.
[77] Hanjal, Zolton L., and Paul G. Lewis (2003). "Municipal Institutions and Voter Turnout in Local Elections." *Urban Affairs Review* 38(5):645-668.
[78] Brady, David W., Robert D'Onofrio, and Morris P. Fiorina (2000). "The Nationalization of Electoral Forces Revisited." In Continuity and Changes in House Elections, 20th edition, ed. David W. Brady, John F. Cogan, and Morris P. Fiorina. Stanford, CA: Stanford University Press.

incumbent or where there is an incumbent that faced major-party opposition in both a given election and the previous election will be used. Further, in the remaining races a dummy variable will be used denoting whether or not an incumbent is running. To control for the influence of gerrymandering, a dummy variable will be constructed for when districts have been altered. Finally, as changes in voter turnout often result from the competitiveness of a race and the quality of the candidates, it will be controlled for as well (Caldeira, Patterson and Markko 1985[79]; Cox, Munger 1989[80]; Huckfeldt et al. 2007[81]).

Econometric Equation 1:

$$VoteMargin_{it} = \beta_0 + \beta_1 UrbnahetHet_{it} + \beta_2 \mathrm{UrbanHet}_{it}^{2} + \beta_3 Redist_{it} + \beta_4 Turnout_{it} + \beta_5 Inc_{it} + \alpha_i + \delta t + \varepsilon_{it}$$

Differenced Equation:

$$\Delta \mathrm{VoteMargin}_{it} = \Delta\beta_1 UrbnahetHet_{it} + \Delta\beta_2 \mathrm{UrbanHet}_{it}^{2} + \Delta\beta_3 Redist_{it} + \Delta\beta_4 Turnout_{it} + \Delta\beta_5 Inc_{it} + \delta + \varepsilon_{it} - \varepsilon_{it-1}$$

This model provides information as to whether the mechanism explaining the change in vote margin over time is Tiebout Sorting without differentiating between the traditional and expanded varieties. Specifically, if the margin by which a candidate wins in a given district increases, then there will be a corresponding increase in the homogeneity of preferences of consumer-voters within that specific district; further, the reverse will hold as well. An examination of Results Table 3 provides evidence in support of this hypothesis. Further, observe the shape of the line formed between the relationship of vote margin and urban heterogeneity; specifically, notice that as a district

[79] Caldeira, Gregory A., Samuel C. Patterson, and Gregory A. Markko (1985). "The Mobilization of Voters in Congressional Elections." *Journal of Politics* 47:490-509.
[80] Cox, Gary W. and Michael C. Munger (1989). "Closeness, Expenditures, and Turnout in the 1982 U.S. House Elections." *American Political Science Review* 83:217-31.
[81] Huckfeldt, Robert, Edward G. Carmines, Jeffrey J. Mondak, and Eric Zeemering (2007). "Information, Activation, and Electoral Competition in the 2002 Congressional Elections" *Journal of Politics* 69:798-812.

becomes increasingly urban there will be an increase in vote margin and when a district becomes increasingly not urban there is also an increase in vote margin. Further, when the district becomes increasingly heterogeneous between these two homogeneous extremes vote margin will fall. That is, our expected U-shaped relationship holds.

First, as a check of the integrity of these results, observe that our dummy variables for the incumbency effect (Incumbency), for when district lines have been redrawn (Redistricting), and for voter turnout (Turnout) are each statistically significant. While the influence each of these three variables has may differ depending on the context, it is expected both intuitively and after an examination of the relevant literature that these variables should be statistically significant. That is, each should have a genuine effect on the winner's percentage of the two-party vote margin.

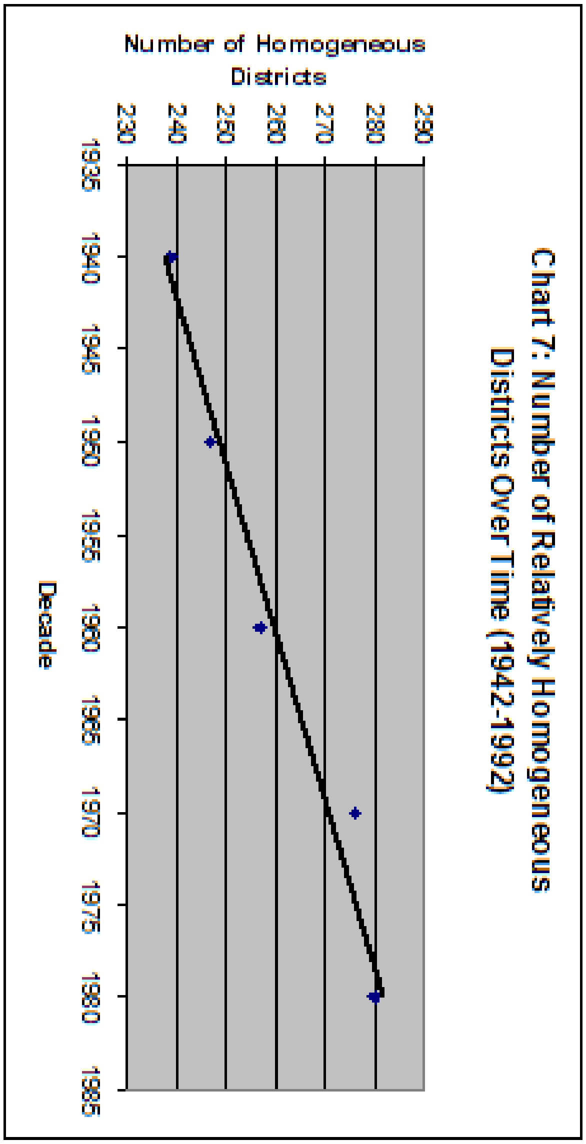
Note the marginal effects: a –0.1397 value change in urban homogeneity (Urban Homogeneity), a 0.9787 value increase in urban homogeneity squared (Urban Homogeneity^2), a 0.0552 value increase in incumbency (Incumbency), a 0.0385 value increase in redistricting (Redistricting), or a –0.0935 value change in the value for voter turnout (Turnout) while holding all other variables constant will correspond to a one-percent increase in the winner's percentage share of the two party vote. From these results we are led to the conclusion that this constitutes evidence in favor of Tiebout Sorting. Over time, vote margins have been increasing, and increasing vote margins are correlated with an increase of homogeneity in districts. While this is a blunt measurement by nature, it does invoke information regarding age, class, gender, income, occupation and race differences seen over time on a rural-urban comparison. Preferences for public goods can be measured by an individual's vote because preferences must be mediated through the political system. This, however, leads us back to the use of vote margins; consumer-voters will vote together more and more often over time because of the growing similarity of their preferences. Thus, the observed higher vote margins provide evidence that constituents within districts have increasingly homogeneous attitudes towards public goods.

It is important to note that this model for determining the relevance of Tiebout Sorting does not ascertain the specific underlying public good preferences – it merely demonstrates that they exist. Further, it cannot be determined from this model whether this phenomenon is an instance of traditional Tiebout Sorting (sorting based on public goods provided) or expanded Tiebout Sorting (spatial sorting by ideological and economic factors).

Chart Table 1	
Decade	Number of Relatively Homogeneous Districts
1940s	239
1950s	247
1960s	257
1970s	276
1980s	280

Calculation

The number of relatively homogeneous districts was calculated by finding how many districts were at least ten percentage points greater or less than the mean urban homogeneity with respect to districts in a given decade.



Results Table 3

	Coefficient	Std. Error
Urban Homogeneity	-0.1267613***	0.0281148
Urban Homogeneity^2	0.1124207***	0.0216749
Incumbency	0.0396652***	0.0024948
Redistricting	0.0113529***	0.000603
Turnout	-0.1643307***	0.0092834
Constant	0.6576452***	0.0090761

*** Statistically significant at 1% level.
** Statistically significant at 5% level
* Statistically significant at 10% level

Dependent Variable: Vote Margin

Quadratic Relationships

Quadratic relationships are of the form $f(x) = ax^2 + bx + c$ such that a and b are numbers not equal to zero. These functions create U-shaped curves (parabolas) where the U is either right side up ($f(x) = ax^2 - bx + c$) or upside down ($f(x) = ax^2 + bx + c$). In our case we turn urban homogeneity into a U-shaped relationship (quadratic relationship) by using both the variables Urban Homogeneity and Urban Homogenity^2. Thus, since the sign on Urban Homogeneity is negative and is also positive on Urban Homogenity^2, and both of these variables are statistically significant, we can conclude we have a right side up U-shaped relationship (quadratic relationship) between Vote Margin and Urban Homogeneity.

Marginal Effects Table 1

	ey/ex	Std. Error
Urban Homogeneity	-0.1397996***	0.03101
Urban Homogeneity^2	0.978777***	0.01887
Incumbency	0.0552964***	0.00348
Redistricting	0.0385291***	0.00205
Turnout	-0.0935401***	0.00529

*** Statistically significant at 1% level.
** Statistically significant at 5% level
* Statistically significant at 10% level

Dependent Variable: Vote Margin

Chart 8

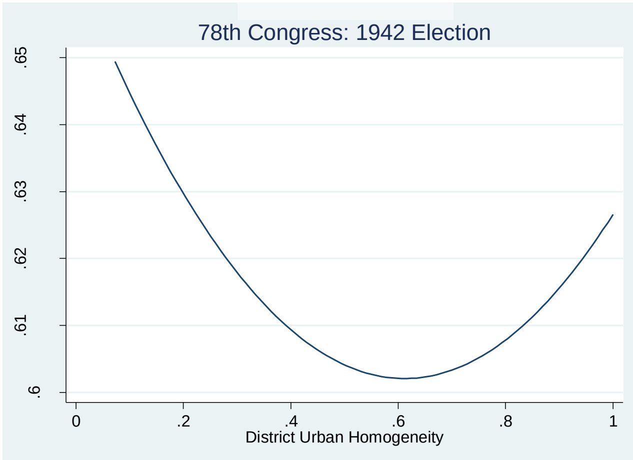


Chart 9

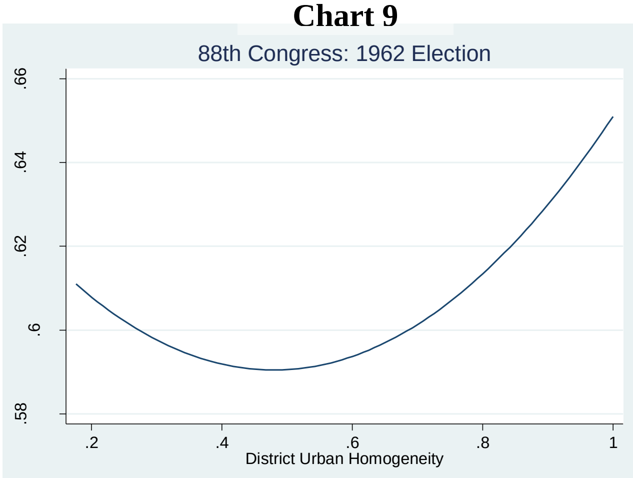
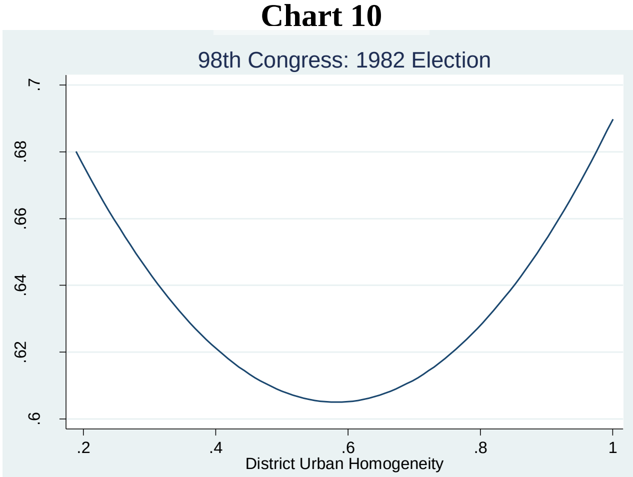


Chart 10



Model 2 Cross-Sections

By observing cross-sections of our data for the winner's percentage of the two-party vote share and district urban homogeneity we can observe how this pattern changes over time. Specifically, note that this pattern does appear to be consistent across cross-sections of the data and it appears to become more pronounced over time.

This persistence of the pattern as well as the strengthening of its role would be expected if Tiebout Sorting was indeed at work.

(C) Econometric Analysis III

The third econometric analysis undertaken will distinguish between the role of traditional and expanded Tiebout Sorting in the United States through a more extensive cross-section analysis and much shorter time-series analysis relative to the previous investigation. To perform this analysis we will employ two datasets. The first dataset comes from the *National Annenberg Election Survey*, a survey that "examines a wide range of political attitudes about candidates, issues and the traits Americans want in a president" during the 2000 and 2004 United States presidential election cycles during which over 100,000 interviews were conducted in each of the two years.[82] The following data have been gathered for use:

i. Household Income
ii. Adults Per Household
iii. Children Per Household
iv. Scale of Conservative to Liberal Self-Identification
v. Race
vi. Education
vii. Occupation

These data are being used to distinguish between traditional and expanded Tiebout Sorting. We can separate these into three categories: economic sorting, ideological sorting, and public goods sorting. Consider the common measures of socioeconomic status:

> The most commonly used measures of [socioeconomic status are] income, education, and occupational status, or some combination of the three…[and] the use of multiple measures of SES and the search for alternative SES measures is an important direction for future work. Although income is the most widely used SES measure of available

[82] National Annenberg Election Survey: http://www.annenbergpublicpolicycenter.org/ProjectDetails.aspx?myId=1

> economic resources, it may not be the most appropriate. A measure of total household income is a useful but limited indicator of all the economic resources available to a selected respondent in a given household. This suggests, at a minimum, that researchers would do well to use a per capita income measure…[however], years of formal education is probably the most practical and convenient indicator.
>
> (Williams, Lavizzo-Mourey, and Warren 1994[83])

Thus, a commonly employed measure of socioeconomic sorting is being implemented through the use of occupation, education, and household income (which has been made per capita through controlling for adults and children in a household). We must further control for race, as socioeconomic status "is transformed by racism" and consequently "occupation, education, and household income are not equivalent across race" (Williams, Lavizzo-Mourey, and Warren 1994[84]). These variables will comprise the economic sorting category. Ideological sorting will be measured through the scale of conservative to liberal self-identification. Finally, public goods sorting will be studied through children per household, as traditional Tiebout Sorting for parents seeking a good education for their children is a recognized phenomenon (Epple, Figlio, and Romano 2004[85]; Caroline Hoxby 2000[86]; Fernaindez and Rogerson 1998[87]; Hoxby 1999[88]; Nechyba 1999[89]; Nechyba 2000[90]).

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[83] : Williams, David R. Risa Lavizzo-Mourey, and Rueben C. Warren (1994). "The Concept of Race and Health Status in America." *Public Health Reports* 109(1):26-41.
[84] : Williams, David R. Risa Lavizzo-Mourey, and Rueben C. Warren (1994). "The Concept of Race and Health Status in America." *Public Health Reports* 109(1):26-41.
[85] Epple, Dennis, David Figlio, and Richard Romano (2004). "Competition Between Private and Public Schools: Testing Stratification and Pricing Predictions." *Journal of Public Economics* 8(7-8):1215-1245.
[86] Hoxby, Caroline (2000). "Does Competition Among Public Schools Benefit Students and Taxpayers?" *American Economic Review* 90(5):1209-1238.
[87] Fernaindez, Raquel and Richard Rogerson (1997). "Keeping People Out: Income Distribution, Zoning, and the Quality of Public Education." *International Economic Review* 38(1):23-42.
[88] Hoxby, Caroline (1999). "The Productivity of Schools and Other Local Public Goods Producers." *Journal of Public Economics* 74(1):1-30.
[89] Nechyba, Thomas (1999). "School Finance Induced Migration and Stratification Patterns: The Impact of Private School Vouchers." *Journal of Public Economic Theory* 1(1):5-50.

Further, so that these data provide additional evidence of our posited U-shaped relationship, the standard deviation amongst individuals within a given district will be calculated. Consider that a decrease in standard deviation denotes increasing homogeneity (at either extreme) because it signifies that a larger share of the data more closely approaches the average of that district, and an increase in standard deviation means the district is more heterogeneous as there is relatively more data dispersed more distantly from the average. It follows that if there exists a negative linear relationship between the standard deviation of a given trait and vote margin, this will represent evidence in favor of a U-shaped relationship between the two.

The second source of data will be the *Polidata Presidential Results by Congressional District 1992-2008* that contains the “collection of election results by congressional district [which] provides a variety of presidential and congressional election results by congressional district for the 103rd (1992 districts) to the 109th (2004 Districts) Congress.” The congressional election data from 2000 and 2004 by district will be used such that it corresponds with the *National Annenberg Election Survey* data. Like the previous dataset, this dataset contains whether there was an incumbent running and, if so, their party affiliation.[91] Further, through the same reasoning as in the previous model, the dependent variable *VoteMargin* will be calculated as the winner’s percentage of the two-party vote share, and the same controls for the incumbency effect, candidate quality, whether or not an election is competitive, and the effect of gerrymandering will be invoked.

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[90] Nechyba, Thomas (2000). “Mobility, Targeting, and Private-School Vouchers." *American Economic Review* 90(1): 130-46.
[91] Polidata Presidential Results by Congressional District 1992-2008: http://library.duke.edu/data/collections/polidata.html

Econometric Equation 2:

$$VoteMargin_{it} = \beta_0 + \beta_1 sdHHI_{it} + \beta_2 sdAPH_{it} + \beta_3 sdKPH_{it} + \beta_4 sdCONLIB_{it} + \beta_5 sdRACE_{it} + \beta_6 sdEDU_{it} + \beta_7 sdOCC_{it} + \beta_8 sdTurnout_{it} + \beta_9 sdInc_{it} + \beta_{10} sdRedist_{it} + \alpha_i + \delta t + \varepsilon_{it}$$

Differenced Equation:

$$\Delta \mathrm{VoteMargin}_{it} = \Delta\beta_1 sdHHI_{it} + \Delta\beta_2 sdAPH_{it} + \Delta\beta_3 sdKPH_{it} + \Delta\beta_4 sdCONLIB_{it} + \Delta\beta_5 sdRACE_{it} + \Delta\beta_6 sdEDU_{it} + \Delta\beta_7 sdOCC_{it} + \Delta\beta_8 sdTurnout_{it} + \Delta\beta_9 sdInc_{it} + \Delta\beta_{10} sdRedist_{it} + \delta + \varepsilon_{it} - \varepsilon_{it-1}$$

We have chosen variables such that a decrease in standard deviation correlating to an increase in vote margin will provide evidence of a U-shaped relationship between a given trait and vote margin. As can be seen in Results Table 4, this model offers interesting results. Notice that we have mixed results with regard to expanded Tiebout Sorting. The ideological portion of spatial sorting, measured through homogeneity along a 5-point conservative to liberal scale within a district (Con Lib, SD), is statistically insignificant. Further, two of our three variables for socioeconomic capital have been shown to be statistically insignificant: Spatial sorting due to occupation through the homogeneity of occupation type in a district (Occupation, SD) and household income (Household Income, SD) are both statistically insignificant with relation to the vote margin within a district. This model was repeated in regards to occupation with standard deviation from professional worker (lawyer, doctor, scientist, etc), skilled tradesperson (printer, baker, tailor, etc), clerical or office worker (typist, secretary, etc), service worker (police officer, fire fighter, etc), laborer (plumber's helper, construction worker, etc), manager (store manager, sales manager, etc), semi-skilled worker (machine operator, assembly, etc), salesperson, and business owner, and each time it was not statistically significantly related to the vote margin within a district. However, we can see that as a district becomes increasingly homogeneous in terms of its education level (Education, SD), the vote margin within this district correspondingly increases. This, as noted earlier, is considered the most practical and accurate single measure of socioeconomic capital.

Moreover, our measure of traditional Tiebout Sorting, homogeneity of households with children (Children In Household, SD), provides evidence of the occurrence of traditional Tiebout Sorting. That is, as a district becomes increasingly homogeneous in terms of having households with or without children there is a corresponding increase in vote margins within this district.

The variable for racial sorting is statistically significant but does not appear to speak to the presence of Tiebout Sorting. In regards to race (Race, SD), the model was repeated with models looking at standard deviation from individuals who identify themselves as “White”, “Black”, “Asian”, “American Indian”, and “Other”, as well as a combination thereof. However, the only one of these which was statistically significant was that with an emphasis on individuals self-identifying in the “Black” category. However, the relationship offered in this case was a decrease in the homogeneity of black or non-black within a district correlated to higher vote margins. This can be explained through the unique history of African-Americans in the United States; that is, there has been a practice of congressional districts being created to attempt to garner more fair African-American participation in government, both through policies of majority-minority districts and drawing lines in such a way that enough African-Americans are present in a district to such a degree that their views are supported (though not necessarily through a majority-minority district) (Cameron, Epstein, and O’Halloran

1996[92]; Lublin 1999[93]; Epstein and O'Halloran 1999[94]; Hutchings, McClerking, and Charles 2004[95]).

Finally, as in our last model, we have included a check of the integrity of our results through controlling for the incumbency effect (Incumbency), for when district lines have been redrawn (Redistricting), and for voter turnout (Turnout). The results indicate that each of these is statistically significant in this model also, as would be expected through intuition and an examination of the relevant literature.

---

[92] Charles Cameron, David Epstein, and Sharyn O'Halloran (1996). "Do Majority-Minority Districts Maximize Substantive Representation in Congress?" *American Political Science Review* 90(4):794-812.
[93] Lublin, David (1999). "Racial Redistricting and African-American Representation: A Critique of 'Do Majority-Minority Districts Maximize Substantive Representation in Congress?'" *American Political Science Review* 93(1):183-186.
[94] Epstein, David and Sharyn O'Halloran (1999). "A Social Science Approach to Race, Redistricting, and Representation." *American Political Science Review* 93(1):187-191.
[95] Vincent L. Hutchings, Harwood K. McClerking and Guy-Uriel Charles (2004). "Congressional Representation of Black Interests: Recognizing the Importance of Stability." *Journal of Politics* 66:450-468.

Results Table 4		
	Coefficient	**Std. Error**
Household Income, SD (UT)	0.0001345	0.0001824
Occupation, SD (UT)	0.0002161	0.0003829
Education, SD (UT)	-0.0004465**	0.0002017
ConLib, SD (UT)	0.0003464	0.0003604
Children in Household, SD (CT)	-0.0001417*	0.000086
Race, SD (C)	0.0007702*	0.0004197
Adults in Household, SD (C)	0.0000412**	0.0000196
Turnout (C)	-0.000000596***	0.0000000612
Incumbency (C)	0.0258713***	0.0093603
Redistricting (C)	-0.0001443***	0.0000527
Constant	80.22245***	1.850583

*** Statistically significant at 1% level.
** Statistically significant at 5% level
* Statistically significant at 10% level.

(UT) denotes Expanded Tiebout Sorting
(CT) denotes Traditional Tiebout Sorting
(C) denotes control variable

Dependent Variable: Vote Margin
SD denotes that these variables have been transformed such that the standard deviation has been calculated as a meaningful measurement of homogeneity in the given area.

Marginal Effects Table 2		
	ey/ex	**Std. Error**
Household Income, SD (UT)	0.000362	0.00049
Occupation, SD (UT)	0.0000664	0.00012
Education, SD (UT)	-0.001401**	0.00063
ConLib, SD (UT)	0.0004728	0.00049
Children in Household, SD (CT)	-0.000239*	0.00014
Race, SD (C)	0.0002461*	0.00013
Adults in Household, SD (C)	0.0000833**	0.00004
Turnout (C)	-0.235515***	0.02416
Incumbency (C)	0.0350385***	0.01268
Redistricting (C)	-0.000111***	0.00004

*** Statistically significant at 1% level.
** Statistically significant at 5% level
* Statistically significant at 10% level.

(UT) denotes Expanded Tiebout Sorting
(CT) denotes Traditional Tiebout Sorting
(C) denotes control variable

Dependent Variable: Vote Margin
SD denotes that these variables have been transformed such that the standard deviation has been calculated as a meaningful measurement of homogeneity in the given area.

Standard Deviations

A standard deviation is a measurement of how closely a set of data is spread out relative to the average of the dataset. Specifically, it is calculated by taking each data point in the dataset, subtracting the average of the dataset from it, squaring the result of this, and then dividing the sum all of these by one less than the total number of data points.

Thus, if there is a smaller standard deviation it implies the data is more clustered together (more homogeneous relative to the mean) and if there is a larger standard deviation the data is relatively less clustered together (more heterogeneous relative to the mean). Thus, standard deviation can be used as a meaningful measure of homogeneity.

V. Summary and Discussion

An overview of our methodology and results suggests that there does exist a trend stationary pattern of increasing vote margins driven by traditional and expanded Tiebout Sorting. First, we have found a long-term trend stationary pattern of increasing vote margins. This was followed by the discovery that within a subset of the trend, 1942 to 1992, a blunt measurement of Tiebout Sorting through the application of urban-rural differences, soliciting information regarding age, class, gender, income, occupation, and race while measuring preferences for public goods through an individual's vote, was statistically significant. Finally, we identified evidence of Tiebout Sorting of both the traditional variety (sorting based on public goods provided) and the economic, but not ideological, portion of the expanded variety (spatial sorting by ideological and economic factors). Succinctly, each of our three hypotheses is supported:

> **Hypothesis 1:** *If the margin by which a candidate wins in a given district increases, then we will observe a corresponding increase in the homogeneity of preferences of consumer-voters within that specific district. The reverse will hold as well.*
>
> **Hypothesis 2:** *The pattern identified in the first hypothesis is driven by both traditional and expanded Tiebout Sorting.*
>
> **Hypothesis 3:** *The observation made by David Mayhew is a portion of a longer trend stationary pattern in an increase in vote margins.*

These findings raise an important question: How robust is the literature on Tiebout Sorting and the Vanishing Marginals? Through the use of a different methodology we show that Tiebout Sorting can be observed when we recognize the role of the political system as a body that mediates preferences between individuals and services provided by government; this is something previous studies on Tiebout Sorting have not done.

Further, we call into question the completeness of a traditional view of Tiebout Sorting; we introduce and show the significance of the sorting of public goods preferences through economic factors (expanded Tiebout Sorting) independent of sorting due to public goods preferences (traditional Tiebout Sorting). Finally, by showing that the pattern of increasing vote margins spans the entire twentieth century and providing a causal mechanism that explains the change throughout its entire course, we find the use a one-shot explanation, many of the explanations commonly used in the Vanishing Marginals literature, is insufficient.

While this study critiques the existing literatures regarding Tiebout Sorting and the Vanishing Marginals, it also fits well into each of their structures. The fact that the observation of the actual act and implications of Tiebout Sorting is disputed would be expected through the use of the currently common and flawed methodology. That is, the result of ascertaining whether or not there has been an increase in stratification for given public goods over time is dependent on how local political institutions mediate preferences between individuals and actual implemented policy; consequently, we would expect to find evidence, or lack thereof, in some local contexts and not in others even if this phenomenon were happening in all of them. Thus, it logically follows that the use of the currently common methodology would lead to a contentious and disputed literature. Further, our study supports the influence of the one-shot trends common in the Vanishing Marginal literature; we have used them as control variables and found them to be statistically significant. Therefore, while our frame is one of trends in political economy as opposed to narrow one-shot explanations, we do find, as the literature would suggest, many of these one-shot explanations influencing vote margins.

We have come to this conclusion through the implementation of three models, each with its own strength supporting part of the overall picture. However, there is an important assumption being made: the mechanisms of Tiebout Sorting have remained consistent over time. This assumption is made in that our observed trend in increasing vote margins occurs from 1900 to 1992; however, our data bluntly measuring Tiebout Sorting covers only the time period of 1942 to 1992. Further, it can be seen through our assumption that the dynamics in our in-depth study of change in vote margins between 2000 and 2004 are applicable both to our blunt measurement and to the trend generally. We should note, however, that this assumption is not a radically strong one; the literature explaining the increase in vote margins does not offer a mechanism for an observed trend encompassing the vast majority of the twentieth century. It offers mainly one-shot changes in the 1950 to 1970 time range. Furthermore, since we have found that this pattern is trend stationary, it is unlikely that the increase in vote margins is a result of one or several one-shot shocks.

Appendix

I. Model Specification – Regression I

This section will provide the raw results and econometric considerations for model specification of the first regression (Model II). One of the major benefits of panel data is the ability to deal with unobserved heterogeneity, a problem nearly always present in cross-section data. That is, we are able to control for heterogeneity that is constant over time and is correlated to the independent variables. However, if the individual specific effect is not correlated to the independent variables, the Random Effects model is more efficient. Thus, we must test to find the best model specification. We will proceed as follows. First, we will provide the simple pooled OLS results as a benchmark and test it against the Random Effects model to determine which is the better model specification. Second, we will obtain the results from the Fixed Effects model and test this against the Random Effects model. Note that we do not need to test the Fixed Effects model against the simple pooled OLS model if the Random Effects model is demonstrated to be a better model specification than the simple pooled OLS model.

The results of a simple pooled OLS are as follows:

Source	SS	df	MS
Model	11.3496533	5	2.26993066
Residual	55.2454463	8405	.006572926
Total	66.5950996	8410	.007918561

Number of obs	= 8411
F(5, 8405)	= 345.35
Prob > F	= 0.0000
R-squared	= 0.1704
Adj R-squared	= 0.1699
Root MSE	= .08107

votemargin	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
urbanhet	-.1840295	.0212756	-8.65	0.000	-.2257348	-.1423241
urbanhet2	.1823471	.0159597	11.43	0.000	.1510622	.2136319
inc	.0393929	.0027228	14.47	0.000	.0340554	.0447304
redist	.0091416	.0006109	14.96	0.000	.007944	.0103391
turnout	-.2191702	.0087311	-25.10	0.000	-.2362853	-.2020551
_cons	.6837669	.0069614	98.22	0.000	.6701209	.6974129

The results of a Random Effects Model are as follows:

```
Random-effects GLS regression                   Number of obs      =      8411
Group variable (i): panelid                     Number of groups   =       497

R-sq:  within  = 0.1234                         Obs per group: min =         1
       between = 0.1913                                        avg =      16.9
       overall = 0.1653                                        max =        26

Random effects u_i ~ Gaussian                   Wald chi2(5)       =   1254.69
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
  votemargin |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    urbanhet |  -.1461165   .0256274    -5.70   0.000    -.1963453   -.0958876
   urbanhet2 |   .1365964   .0195797     6.98   0.000     .0982209    .1749718
         inc |   .0396144   .0024743    16.01   0.000     .0347648     .044464
      redist |   .0105958   .0005823    18.20   0.000     .0094546     .011737
     turnout |  -.1791789   .0089441   -20.03   0.000    -.1967089   -.1616489
       _cons |   .6675336   .0083774    79.68   0.000     .6511142     .683953
-------------+----------------------------------------------------------------
     sigma_u |  .04010497
     sigma_e |  .07174466
         rho |  .23808161   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Next, we will test for whether the simple pooled OLS model or the Random Effects model is more appropriate for this specification:

```
Breusch and Pagan Lagrangian multiplier test for random effects:

        votemargin[panelid,t] = Xb + u[panelid] + e[panelid,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                votemar~n |   .0079186       .0889863
                        e |   .0051473       .0717447
                        u |   .0016084        .040105

        Test:   Var(u) = 0
                             chi2(1) =  3042.32
                         Prob > chi2 =    0.0000
```

H_0: var(u) = 0 and there are no random effects: use pooled OLS.

H_A: var(u) is not equal to 0: pooled OLS is not appropriate to use.

Since the result of the Breusch-Pagan Test is Prob > chi^2 = 0.0000, we reject the null hypothesis and find that the Random Effects model is more appropriate to use than the pooled OLS model. We can now compare the Random Effects model to the Fixed Effects model, where we do not have to assume E(**x**'**c**)=0.

The results of a first differences Fixed Effects model are as follow:

```
Fixed-effects (within) regression               Number of obs      =      8411
Group variable (i): panelid                     Number of groups   =       497

R-sq:  within  = 0.1241                         Obs per group: min =         1
       between = 0.1707                                        avg =      16.9
       overall = 0.1571                                        max =        26

                                                F(5,7909)          =    224.16
corr(u_i, Xb)  = 0.1152                         Prob > F           =    0.0000

------------------------------------------------------------------------------
  votemargin |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    urbanhet |  -.1267613   .0281148    -4.51   0.000    -.1818737   -.0716489
   urbanhet2 |   .1124207   .0216749     5.19   0.000     .0699323    .1549091
         inc |   .0396652   .0024948    15.90   0.000     .0347748    .0445556
      redist |   .0113529    .000603    18.83   0.000     .0101708     .012535
     turnout |  -.1643307   .0092834   -17.70   0.000    -.1825287   -.1461328
       _cons |   .6576425   .0090761    72.46   0.000      .639851    .6754341
-------------+----------------------------------------------------------------
     sigma_u |  .05163867
     sigma_e |  .07174466
         rho |  .34125982   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(496, 7909) =     5.69            Prob > F = 0.0000
```

We now use a Hausman Test to decide whether the Fixed Effects model or the Random Effects model is a more appropriate model specification:

```
                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      bfe          bre         Difference          S.E.
-------------+----------------------------------------------------------------
    urbanhet |   -.1267613    -.1461165        .0193552        .0115618
   urbanhet2 |    .1124207     .1365964       -.0241757        .0092971
         inc |    .0396652     .0396144        .0000508        .0003187
      redist |    .0113529     .0105958        .0007571        .0001568
     turnout |   -.1643307    -.1791789        .0148482        .0024871
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       63.50
                Prob>chi2 =      0.0000
```

H_0: Difference in coefficients not systematic: use Random Effects model

H_A: Difference in coefficients systematic: use Fixed Effects model

Since we have a statistically significant result, Prob > chi^2 = 0.0000, we reject the null hypothesis and should use the Fixed Effects model.

The marginal effects are as follow:

Elasticities after xtreg
y = Xb (predict)
= .63135514

variable	ey/ex	Std. Err.	z	P>|z|	[95% C.I.]		X
urbanhet	-.1397996	.03101	-4.51	0.000	-.200572	-.079027	.696294
urbanh~2	.0978777	.01887	5.19	0.000	.060891	.134865	.549682
inc	.0552964	.00348	15.90	0.000	.048478	.062114	.880157
redist	.0385291	.00205	18.82	0.000	.034517	.042541	2.14267
turnout	-.0935401	.00529	-17.70	0.000	-.1039	-.083181	.359379

II. Model Specification – Regression II

As this second regression (Model III) also employs panel data, we follow the same procedure as *Regression I*.

The results of a simple pooled OLS are as follows:

Source	SS	df	MS
Model	10770.2141	10	1077.02141
Residual	37078.7159	733	50.5848784
Total	47848.9299	743	64.3996365

Number of obs =	744
F(10, 733) =	21.29
Prob > F =	0.0000
R-squared =	0.2251
Adj R-squared =	0.2145
Root MSE =	7.1123

votemargin	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
sdhhi	.01422	.0123609	1.15	0.250	-.0100469	.038487
sdaph	-.0006079	.001546	-0.39	0.694	-.0036431	.0024273
sdkph	-.0099851	.0064219	-1.55	0.120	-.0225926	.0026225
sdconlib	.0111808	.0235173	0.48	0.635	-.0349885	.0573501
sdrace2	.0974889	.0191769	5.08	0.000	.0598407	.1351371
sdedu	-.0373491	.011913	-3.14	0.002	-.0607368	-.0139614
sdocc10	-.0409122	.0293526	-1.39	0.164	-.0985374	.0167129
totalvote	-4.32e-07	5.05e-08	-8.56	0.000	-5.31e-07	-3.33e-07
inc	.0706813	.0089907	7.86	0.000	.0530308	.0883318
redist	.0019201	.0053849	0.36	0.722	-.0086516	.0124917
_cons	75.92465	2.235571	33.96	0.000	71.53576	80.31353

The results of a Random Effects Model are as follows:

```
R-sq:  within  = 0.2756                         Obs per group: min =         1
       between = 0.1613                                        avg =       1.9
       overall = 0.1676                                        max =         2

Random effects u_i ~ Gaussian                   Wald chi2(10)      =    202.84
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
  votemargin |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       sdhhi |   .0001415   .0001868     0.76   0.449    -.0002246    .0005077
       sdaph |   .0000401   .0000201     2.00   0.046     7.75e-07    .0000794
       sdkph |  -.0001317   .0000881    -1.49   0.135    -.0003043     .000041
    sdconlib |   .0004018   .0003687     1.09   0.276    -.0003208    .0011245
     sdrace2 |   .0007793   .0004293     1.82   0.069    -.0000621    .0016207
       sdedu |  -.0004463   .0002066    -2.16   0.031    -.0008511   -.0000415
     sdocc10 |   .0002496   .0003924     0.64   0.525    -.0005196    .0010187
   totalvote |  -5.51e-07   4.61e-08   -11.96   0.000    -6.41e-07   -4.61e-07
         inc |   .0410995   .0076525     5.37   0.000     .0261008    .0560982
      redist |  -.0001337    .000053    -2.52   0.012    -.0002376   -.0000298
       _cons |   77.63652   1.451485    53.49   0.000     74.79166    80.48138
-------------+----------------------------------------------------------------
     sigma_u |  7.1313321
     sigma_e |   .0643286
         rho |  .99991864   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Next, we will test for whether the pooled OLS model or the Random Effects model is more appropriate for this specification:

```
Breusch and Pagan Lagrangian multiplier test for random effects:

        votemargin[id,t] = Xb + u[id] + e[id,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                votemar~n|   64.39964       8.024938
                        e|   .0041382       .0643286
                        u|    50.8559       7.131332

        Test:   Var(u) = 0
                             chi2(1) =   312.05
                         Prob > chi2 =     0.0000
```

H_0: var(u) = 0 and there are no random effects: use pooled OLS.

H_A: var(u) is not equal to 0: pooled OLS is not appropriate to use.

Since the result of the Breusch-Pagan Test is Prob > chi^2 = 0.0000, we reject the null hypothesis and find that the Random Effects model is more appropriate to use than the pooled OLS model. We can now compare the Random Effects model to the Fixed Effects model, where we do not have to assume E(**x**'**c**)=0.

The results of a first differences Fixed Effects model are as follow:

```
Fixed-effects (within) regression               Number of obs      =       744
Group variable (i): id                          Number of groups   =       391

R-sq:  within  = 0.2821                         Obs per group: min =         1
       between = 0.1457                                        avg =       1.9
       overall = 0.1507                                        max =         2

                                                F(10,343)          =     13.48
corr(u_i, Xb)  = -0.0266                        Prob > F           =    0.0000
```

votemargin	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
sdhhi	.0001345	.0001824	0.74	0.461	-.0002243	.0004932
sdaph	.0000412	.0000196	2.11	0.036	2.72e-06	.0000798
sdkph	-.0001417	.000086	-1.65	0.100	-.0003108	.0000275
sdconlib	.0003464	.0003604	0.96	0.337	-.0003625	.0010554
sdrace2	.0007702	.0004197	1.84	0.067	-.0000552	.0015957
sdedu	-.0004465	.0002017	-2.21	0.027	-.0008431	-.0000498
sdocc10	.0002161	.0003829	0.56	0.573	-.000537	.0009692
totalvote	-5.96e-07	6.12e-08	-9.75	0.000	-7.17e-07	-4.76e-07
inc	.0258713	.0093603	2.76	0.006	.0074604	.0442822
redist	-.0001443	.0000527	-2.74	0.007	-.000248	-.0000406
_cons	80.22245	1.850583	43.35	0.000	76.58253	83.86237
sigma_u	7.5171729					
sigma_e	.0643286					
rho	.99992677	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(390, 343) = 22973.93            Prob > F = 0.0000
```

We now use a Hausman Test to decide whether the Fixed Effects model or the Random Effects model is a more appropriate model specification; note, however, that there is a complication:

```
Note: the rank of the differenced variance matrix (9) does not equal the number of coefficients being tested (10); be
        sure this is what you expect, or there may be problems computing the test.  Examine the output of your estimators
        for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar
        scale.
```

	(b) bfe	(B) bre	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	Coefficients			
sdhhi	.0001345	.000153	-.0000186	.
sdaph	.0000412	.0000407	5.26e-07	.
sdkph	-.0001417	-.000131	-.0000107	.
sdconlib	.0003464	.0004257	-.0000793	.
sdrace2	.0007702	.0008007	-.0000305	.
sdedu	-.0004465	-.0004372	-9.25e-06	.
sdocc10	.0002161	.0002547	-.0000387	.
totalvote	-5.96e-07	-5.32e-07	-6.43e-08	4.01e-08
inc	.0258713	.0408523	-.014981	.0053257
redist	-.0001443	-.0001284	-.000016	.

```
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       20.05
                Prob>chi2 =      0.0176
                (V_b-V_B is not positive definite)
```

H_0: Difference in coefficients not systematic: use Random Effects model

H_A: Difference in coefficients systematic: use Fixed Effects model

Thus, we report the Hausman Test with both the sigamore and sigmaless options:

Sigmamore:

	(b) bfe	(B) bre	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	Coefficients			
sdhhi	.0001345	.000153	-.0000186	9.32e-06
sdaph	.0000412	.0000407	5.26e-07	9.16e-07
sdkph	-.0001417	-.000131	-.0000107	4.61e-06
sdconlib	.0003464	.0004257	-.0000793	.0000254
sdrace2	.0007702	.0008007	-.0000305	.0000308
sdedu	-.0004465	-.0004372	-9.25e-06	.0000102
sdocc10	.0002161	.0002547	-.0000387	.000015
totalvote	-5.96e-07	-5.32e-07	-6.43e-08	4.20e-08
inc	.0258713	.0408523	-.014981	.005672
redist	-.0001443	-.0001284	-.000016	.0000106

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 31.54
Prob>chi2 = 0.0001

Sigmaless:

	(b) bfe	(B) bre	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
	Coefficients			
sdhhi	.0001345	.000153	-.0000186	9.12e-06
sdaph	.0000412	.0000407	5.26e-07	8.96e-07
sdkph	-.0001417	-.000131	-.0000107	4.51e-06
sdconlib	.0003464	.0004257	-.0000793	.0000249
sdrace2	.0007702	.0008007	-.0000305	.0000301
sdedu	-.0004465	-.0004372	-9.25e-06	9.99e-06
sdocc10	.0002161	.0002547	-.0000387	.0000147
totalvote	-5.96e-07	-5.32e-07	-6.43e-08	4.12e-08
inc	.0258713	.0408523	-.014981	.0055526
redist	-.0001443	-.0001284	-.000016	.0000104

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 32.92
Prob>chi2 = 0.0001

Since, for both sigmamore and sigmaless, we have a statistically significant result at the one-percent level, Prob > chi^2 = 0.0001, we reject the null hypothesis and conclude that we should employ the Fixed Effects model.

The marginal effects are as follow:

Elasticities after xtreg
y = Xb (predict)
= 66.796569

variable	ey/ex	Std. Err.	z	P>|z|	[95% C.I.	]	X
sdhhi	.000362	.00049	0.74	0.461	-.0006	.001324	179.8
sdaph	.0000833	.00004	2.11	0.035	5.8e-06	.000161	134.865
sdkph	-.0002388	.00014	-1.65	0.099	-.000523	.000045	112.592
sdconlib	.0004728	.00049	0.96	0.336	-.000491	.001437	91.1691
sdrace2	.0002461	.00013	1.84	0.066	-.000017	.000509	21.3464
sdedu	-.0014008	.00063	-2.21	0.027	-.002641	-.000161	209.572
sdocc10	.0000664	.00012	0.56	0.573	-.000164	.000297	20.5387
totalv~e	-.2355152	.02416	-9.75	0.000	-.282872	-.188158	2.6e+07
inc	.0350385	.01268	2.76	0.006	.010192	.059885	90.4652
redist	-.0001109	.00004	-2.74	0.006	-.00019	-.000031	51.3441

III. Time-Series Analysis of Mean Vote Margins

There are a variety of tests available to ascertain whether there exists a unit root within a pattern. Further, there are also a number of tests to determine how many lags should be used in these unit root tests. Typically one would choose both the unit root test and criterion to determine the number of lags that is common in the literature in which one is conducting research. However, no one has previously written on either of these in regards to the Vanishing Marginals literature. As such, for the sake of robustness, we choose two of the most prominently used unit root tests, the Augmented Dicker-Fuller (ADF) and the Dickey-Fuller GLS (ERS) tests, as well as two commonly used methods to determine number of lags, the Akaike information criterion (AIC) and the Schwarz information criterion (BIC). We will proceed as follows. First, we will conduct the Augmented Dicker-Fuller test for a unit root using the AIC and then the BIC to determine the optimal lag length. Second, we will employ the Dickey-Fuller GLS test, once again invoking the AIC and then the BIC to derive the optimal lag length. The results will be provided in raw form such that one can interpret the conclusions drawn by this study.

(1) AIC, Augmented Dickey-Fuller → Null Not Rejected at 5% Level (Unit Root; Difference Stationary)

Null Hypothesis: MeanVoteMargin has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on AIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.005906	0.1417
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MeanVoteMargin)
Method: Least Squares
Sample (adjusted): 1990 1992
Included observations: 46 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
MeanVoteMargin(-1)	-0.348857	0.116057	-3.005906	0.0044
C	0.210743	0.069673	3.024756	0.0042
@TREND(1947)	0.000313	0.000190	1.649237	0.1064

R-squared	0.174403	Mean dependent var	0.000894
Adjusted R-squared	0.136004	S.D. dependent var	0.014604
S.E. of regression	0.013575	Akaike info criterion	-5.698194
Sum squared resid	0.007924	Schwarz criterion	-5.578935
Log likelihood	134.0585	Hannan-Quinn criter.	-5.653519
F-statistic	4.541775	Durbin-Watson stat	1.994336
Prob(F-statistic)	0.016237		

(2) BIC, Augmented Dickey-Fuller → Null Not Rejected at 5% Level (Unit Root; Difference Stationary)

Null Hypothesis: MeanVoteMargin has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.005906	0.1417
Test critical values:	1% level	-4.170583	
	5% level	-3.510740	
	10% level	-3.185512	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MeanVoteMargin)
Method: Least Squares
Sample (adjusted): 1900 1992
Included observations: 46 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
MeanVoteMargin(-1)	-0.348857	0.116057	-3.005906	0.0044
C	0.210743	0.069673	3.024756	0.0042
@TREND(1947)	0.000313	0.000190	1.649237	0.1064

R-squared	0.174403	Mean dependent var	0.000894
Adjusted R-squared	0.136004	S.D. dependent var	0.014604
S.E. of regression	0.013575	Akaike info criterion	-5.698194
Sum squared resid	0.007924	Schwarz criterion	-5.578935
Log likelihood	134.0585	Hannan-Quinn criter.	-5.653519
F-statistic	4.541775	Durbin-Watson stat	1.994336
Prob(F-statistic)	0.016237		

(3) AIC, Dickey-Fuller GLS (ERS) → Null Not Rejected at 5% Level (Unit Root; Difference Stationary)

Null Hypothesis: MeanVoteMargin has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on AIC, MAXLAG=9)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-3.071336
Test critical values:	1% level	-3.770000
	5% level	-3.190000
	10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
Warning: Test critical values calculated for 50 observations and may not be accurate for a sample size of 46

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Sample (adjusted): 1900 1992
Included observations: 46 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.348040	0.113319	-3.071336	0.0036

R-squared	0.173265	Mean dependent var	-8.97E-05
Adjusted R-squared	0.173265	S.D. dependent var	0.014604
S.E. of regression	0.013279	Akaike info criterion	-5.783773
Sum squared resid	0.007935	Schwarz criterion	-5.744020
Log likelihood	134.0268	Hannan-Quinn criter.	-5.768881
Durbin-Watson stat	1.993394		

BIC, Dickey-Fuller GLS (ERS) → Null Not Rejected at 5% Level (Unit Root; Difference Stationary)

Null Hypothesis: MeanVoteMargin has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-3.071336
Test critical values:	1% level	-3.770000
	5% level	-3.190000
	10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
Warning: Test critical values calculated for 50 observations
and may not be accurate for a sample size of 46

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Sample (adjusted): 1900 1992
Included observations: 46 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.348040	0.113319	-3.071336	0.0036

R-squared	0.173265	Mean dependent var	-8.97E-05
Adjusted R-squared	0.173265	S.D. dependent var	0.014604
S.E. of regression	0.013279	Akaike info criterion	-5.783773
Sum squared resid	0.007935	Schwarz criterion	-5.744020
Log likelihood	134.0268	Hannan-Quinn criter.	-5.768881
Durbin-Watson stat	1.993394		

IV. Panel Analysis of Mean Vote Margins

With ambiguous results, we turn to the panel unit root tests, as they are more powerful tests. However, like the above *Time-Series Analysis of Mean Vote Margins*, there is no precedence as to which unit root tests and optimal lag criterion should be employed within the Vanishing Marginals literature. As such, we choose to use the Fisher ADF and Fisher PP for two reasons. First, panel unit root tests of the Fisher variety do not require balanced panel data. Second, using both the Fisher ADF and Fisher PP tests will provide a check for robustness. Further, we choose to use the AIC for determining the number of lags used in each time-series section of the panel data. While using this criterion we find that the optimal lag fluctuates between 0 and 3 for each time-series section of the panel data. Thus, we will use the maximum optimal lag found of all time-series sections for testing the entirety of the panel data as has been commonly practiced in econometrics (Österholm 2004[96]). Below is provided the Fisher ADF and Fisher PP for 0 through 3 lags, each delivering the same conclusion. Like the previous sections of the appendix, the results are provided in raw form such that this study's interpretation of the results can be more fully understood.

[96] Österholm, P. (2004), "Killing Four Unit Root Birds in the US Economy with Three Panel Unit Root Test Stones." *Applied Economics Letters* 11(4), 213-216.

H_0: There is a unit root.

H_A: There is not a unit root.

Fisher Test for panel unit root using Phillips-Perron test (0 lags) Ho: unit root chi2(1018) = 4517.2793 Prob > chi2 = 0.0000	Fisher Test for panel unit root using an augmented Dickey-Fuller test (0 lags) Ho: unit root chi2(1018) = 4517.2793 Prob > chi2 = 0.0000
Fisher Test for panel unit root using Phillips-Perron test (1 lags) Ho: unit root chi2(1018) = 4545.7366 Prob > chi2 = 0.0000	Fisher Test for panel unit root using an augmented Dickey-Fuller test (1 lags) Ho: unit root chi2(986) = 1986.9359 Prob > chi2 = 0.0000
Fisher Test for panel unit root using Phillips-Perron test (2 lags) Ho: unit root chi2(1018) = 4771.4298 Prob > chi2 = 0.0000	Fisher Test for panel unit root using an augmented Dickey-Fuller test (2 lags) Ho: unit root chi2(950) = 1554.0046 Prob > chi2 = 0.0000
Fisher Test for panel unit root using Phillips-Perron test (3 lags) Ho: unit root chi2(1018) = 4849.8820 Prob > chi2 = 0.0000	Fisher Test for panel unit root using an augmented Dickey-Fuller test (3 lags) Ho: unit root chi2(906) = 1257.7595 Prob > chi2 = 0.0000

Since for the maximum optimal number lag for any of the time-series sections of the panel data the null hypothesis that there exists a unit root, both for the Fisher ADF and Fisher PP tests, is rejected, we have shown that this data does not contain a unit root.