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A Dynamic Model of Political Party Equilibrium:
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Abstract

The effective number of political parties (*ENP*) in a first-past-the-post single member (*SMP*) electoral system is analyzed as a dynamic process whereby the tournament nature of the election contest induces excessive entry and sunk entry costs promote persistence even as Duverger-Demsetz type political competition works to winnow unsuccessful minor candidates and parties. The result is a fringe of ever changing marginal parties circulating in long run equilibrium. The factors hypothesized to affect the entry and exit of candidates and parties are analyzed first using an auto-regressive distributed lag (ARDL) model whose advantage is that it allows the separation of an evolving long run equilibrium from short run variations in response to transitory changes in conditioning variables and the process of converging back to the long run equilibrium. The possibility that the short run adjustment process is asymmetric either for parties or candidates is tested using panel estimation techniques. The results are consistent with an observed time path that incorporates slower adjustment to positive as opposed to negative shocks. Variations in the size and trend of both the long and short run are then examined for *ENP*'s ability to predict changes in the competitiveness of the Canadian federal electoral system.

JEL: D72, C41, C24.

Key words: Expected number of political parties, entry and exit, Duverger's Law, asymmetric adjustment, ARDL and NARDL modeling

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1. Introduction

Any analysis of the structure of political parties and their competitiveness in the electoral process must confront the fact that political parties differ widely in their ability to win electoral support and compete effectively. In Canada, for example, the majority of federally registered political parties receive relatively few votes and exit the electoral process quite quickly. A smaller number of parties have achieved intermediate success, with some lasting as long as twenty elections, while only two have succeeded in surviving for the full forty-two elections that comprise Canada's entire post-Confederation electoral history. Constituencies also differ in their ability to attract good candidates and so generate the level of competition that best promotes local interests and the constituency's perspective on policies of national interest. Considerations of size, location and longevity then force recognition that some parties and constituencies are more influential than others. How the support for different candidates and parties is distributed across the electorate will weigh heavily in the structure of political equilibrium and the nature of political competition.

In part for these reasons, political scientists tend to discuss the structure of political equilibrium in terms of the effective rather than actual number of political parties or candidates (hereafter *ENP)*.[2] Because an increase in *ENP* typically means more alternatives, an increase is often taken to signal an increase in the intensity of political competition (see Lijphart, 1984; Andrews and Money, 2009; Hinchliffe and Lee, 2016). In the particular case of Canada, political competition within a Westminster plurality electoral system has resulted in two distinct party types that have alternated times in power (see Ferris and Voia, 2016). Despite the persistence of this duality through time, however, *ENP* has not remained constant. This implies that any

[2] ENP weighs each party (candidate) by its vote share squared and is formally defined as one over a Herfindahl Index of vote shares. In what follows we use two *ENP* measures: the first, *ENP_Candidate*, uses the vote share received by each candidate at the constituency level (averaged across all constituencies); the second, *ENP_Party*, uses the vote shares of the 105 named parties in the election rolls plus one (for all other non-party participants, called 'other' (with three aberrant)). Canada presents a number of challenges in calculating this number, with the early elections featuring a number of acclamations (candidates elected but receiving no cast votes). In our analysis each candidate elected by acclamation was treated as having received a vote share of 1. For the national party measure, the party vote share received in each acclamation was weighted by the average number of non-acclaimed constituency votes. The correlation between the number of registered political parties and *ENP_Party* across 1870-2011 is small (-.094). Both *ENP* measures were interpolated between election years.

explanation for the variation in *ENP* must account for the variations in the number of and support for the evolving pattern of mid to marginally sized parties/candidates that re-appear in each election (Travits, 2007). To explain the variation in this fringe of smaller parties, we follow Forand and Maheshri (2015) who, agreeing with Chhibber and Kollman (1998), note that "[a]s important features of political environments evolve over time, changes in the number of parties over time should be expected; an issue that existing parties have difficulty capturing can become salient, giving a new party an opportunity for entry, or an existing party can be discredited by scandal, which can lead to the disbanding of this party or its replacement by a new alternative" (p.286). In this way the continual entry of new parties and candidates serves to promote new ideas and organizational change within the political process (Aldrich, 1995; Bruns, 2011). Whether the concomitant increase in *ENP* is a signal of greater electoral competition remains to be seen.

In what follows we argue that because the observed levels of *ENP* include in their measure the dynamic process of entry and exit, the actual level of *ENP* may be a biased measure of the long run structure of the political equilibrium. This is because the conditions governing the processes of entry and exit may vary across time and the factors that determine the rate of convergence back to equilibrium from random shocks may not be symmetric. To separate the adjustment process from the longer run evolution of our measures of *ENP* across time, we use auto-regressive distributed lag (ARDL) modelling. This allows estimation of separate long and short run effects arising from the benefits and costs of entering the political process (Cox, 1997; Lewis-Beck and Stegmaier, 2000) and the separation of both from the movements in the data that describe convergence back to the long run equilibrium. ARDL modelling is then applied to Canada over the long 1870 - 2011 time period.

Implicit in the use of ARDL modeling is the presumption that the short run changes in *ENP* in response to transitory and permanent variations in their conditioning variables and shocks are symmetric on either side of the long run equilibrium time path. However, the all-or-nothing nature of the political contest in a single member district, plurality rule political system (SMP) in the presence of sunk entry costs suggests that short run movements may respond differently to

positive versus negative shocks. To examine this possibility, we treat positive and negative changes as generating different states and use asymmetric ARDL panel data techniques (NARDL) to assess whether candidate and/or political party measures respond differently to positive versus negative changes and shocks, and if so, what effect that asymmetry has on the measure of the long run. To anticipate our later findings, short run adjustment appears to be symmetric about the measure of long run *ENP_Candidate* but asymmetric about the long run equilibrium of *ENP_Party*. Positive shocks generate more persistence and less rapid convergence back to the long run than do negative shocks.

Once the appropriate long run and short run fringes have been calculated, we are in position to ask whether it is the variation or trend in the long run that better signals a change in the competitiveness of the political system than does the variation in the short run fringe.

2. Duverger's Law and the Fringe of Marginal Political Parties

It is impossible to discuss *ENP* seriously without encountering Duverger's Law (1959)--the hypothesis that the expected number of parties in a SMP political system will tend towards 2.[3] As Grofman, Bowler and Blais (2009, p. 1) write, "this seemingly straightforward statement, made over 50 years ago, has become perhaps the most famous theoretical generalization in political science." As a positive statement about the equilibrium structure produced by competition among political parties, Duverger's Law is much more precise than anything offered in economics, where the number of firms producing private goods under competition is generally indeterminate.[4] This degree of precision makes for a seemingly straightforward test of the predicted structure of competitive equilibrium in a political party system and the long term stability of Canada's Westminster parliamentary system provides an excellent setting for its test against the data. When this has been done, however, the typical finding has been that Canada's two *ENP* measures are both greater than 2 and rising (Chhibber and Kollman, 2004;

[3] Two parties each receiving half of the vote would result in an ENP = 2. References that expand upon Duverger's classic work include: Riker (1976), Cox (1997), Taagepera (1999), Chhibber and Kollman (2004).

[4] In a perfectly competitive atomistic industry producing private goods under constant cost, the expected number of firms is indeterminate. The more general definition perfect competition--that under perfect competition price equals marginal cost—is equally precise but untestable since marginal cost is typically unobservable to the outsider.

Johnston and Cutler, 2009). This is illustrated in Figure 1 below, where our two *ENP* measures--a party-based measure of *ENP* (*ENP_Party*) and a candidate based measure (*ENP_Candidate*), both built up from the constituency level--are presented from 1867 onwards. As Duverger also predicted, and as is seen to be the case here, the candidate-based ENP measure is smaller than the party-based *ENP* measure. In both cases, however, *ENP* had risen above 2 by the 14th election (in 1921) and both have continued to rise until most recently. This apparent contradiction of Duverger's convergence prediction is often referred to as Canadian exceptionalism (Rae, 1971; Riker, 1976, p. 760; Gaines, 1999).

-- insert Figure 1 about here –

While the growing departure of *ENP* from 2 is often taken to be the most striking feature of Figure 1, what is also interesting is the pattern of similarity and difference in the two *ENP* time paths. In the first thirty years following Confederation in 1867, for example, *ENP_Party* fell rapidly towards 2 while the *ENP_Candidate* began below 2 in 1867 and rose rapidly to meet it. This early pattern of convergence on 2 has, of course, been noticed by political scientists and while the specific reasons given for consolidation within and between the two major political parties may differ (see, for example, Cox (1987) and Godbout and Hoyland (2013)), all concur that the early post-Confederation period for *ENP_Party* represented one of national party consolidation. The rise in *ENP_Candidate*, on the other hand, reflects the spread of electoral competition within constituencies as the large number acclamations arising in the early federal elections slowly fell with rising numbers of candidate rivals.[5] In the empirical work below, the trend in *ENP_Party* through 1897 (*CONVERGENCE_TREND*) is used to reflect this period of 'learning-by-doing' as Canada strove to convert older colonial governing structures into the nation-wide party structure needed for competition at the national level.

While the early period may be somewhat anomalous in reflecting the different formative stages of national party and constituency growth, the long period that follows 1900 is characterized

[5] Roughly 25 percent of the members of the first parliament were acclaimed (46 of 180 in 1867) and this had fallen to roughly 2 percent by 1896 (4 of 206). There was one anomalous election in 1917 (WW1) election when acclamations rose to 31 of 230 members. However there have been virtually no acclamations since, with the last acclamation arising in 1957.

more by the co-movement of the two *ENP* measures (their correlation equals .86). In large part this reflects the characteristic that party politics in Canada has been dominated by the interchange of governance between two evolving major political parties (called, for convenience, the Liberal and Conservative Parties).[6] An implication of the virtual monopoly on governance by these two parties is that the observed changes in *ENP* will then reflect to a large extent changes in the size or voting strength of the fringe parties and candidates that enter and exit the political area. One measure of the size of the fringe of minor parties can be seen from Figure 1 as the deviation between the two *ENP* measures. That is, while the two ENP measures have typically varied together in the time period following convergence, they have also moved ever further apart, a process that represents a growth in the effective number of parties relative to the effective number of candidates. In Canada, the departure in the two ENP measures has been called multipartism (Johnston and Cutler, 2009) and its growth is often attributed to the emergence and success of regional specific federal parties. Our interest in what follows is on variations in the size of this fringe of lesser major political parties/candidates and its meaning for the competitiveness of elections within SMP political systems. For us the important empirical feature of *ENP* that needs explanation is the presence of a time varying fringe of mid-to-minor political parties and its implications for the competitiveness of Canada's political system.

3. Political Competition, Tournaments and Political Party Equilibrium in SMP systems

While initially developed by Laakso and Taagerapera (1979) as a measure of political instability, *ENP* is often used in the political and economic literatures as a measure of the competitiveness of the political system (see Aidt and Eterovic, 2011; Drazen and Eslava, 2010; and Boulding and Brown, 2014 for recent examples). Analogous to the use of a Herfindahl index of output shares among firms in an industry to measure economic market power, a less concentrated political area of political parties (a larger *ENP*) is viewed as an indicator of greater party choice, greater electoral outcome uncertainty and hence evidence of greater competition in the political

[6] Third parties, such as the Bloc Québécois, the Reform and the New Democratic parties, have occasionally served as the official opposition but have never formed a government.

environment. But an electoral system is not a private goods market where multiple firms sell a single output to consumers at a constant price. Rather the right to govern an electorate is more analogous to a public good, where a single governing authority sets the policies and programs that are consumed concurrently by all voters. Given the efficiency of one governing coalition and voters' ability to replace incumbent governments in regularly recurring elections, then, as Demsetz (1968) has argued in another context, parties will compete for the right to govern by offering to provide alternative sets of policies and programs. Competition among political parties for the right to govern when combined with voters' ability to choose program offerings for the one that most closely approximates their preferred set of outcomes can then lead to a Lindahl efficient equilibrium solution.[7]

For party competition to enhance welfare, however, alternative parties must not only promise superior program alternatives, they must also be a credible alternative to the incumbent. The contending party must be seen as able to step in and perform should the level of performance promised by the incumbent not be forthcoming or the programs promised be reneged upon. Hence contestability in the sense developed by Baumol et. al. (1982) -- the ability to credibly replace the incumbent producer -- is necessary for the benefits of competition to be realized effectively by the community. Because the greater fragmentation signalled by a higher *ENP* means that each of the smaller contending parties is less likely to win a majority of seats, and because party coalitions are both difficult to arrange and maintain over time in SMP systems, the promises of these parties become less credible to voters and hence form less of a credible threat to the incumbent government. In the SMP system, then, the incentive not to waste one's vote by supporting a nonviable alternative implies that the greater is party fragmentation, the less effective will second or third placed parties be as meaningful constraints on the performance of the governing party. It is the inability to provide meaningful contestability in a SMP political system then that underlies the winnowing process highlighted by Duverger

[7] For a more extended development of this argument, called the Duverger-Demsetz hypothesis, see Ferris, Winer and Grofman (2016).

leading to convergence upon 2 as the number of effective political parties that will arise in a competitive equilibrium.

At the same time that the Duverger-Demsetz competitive process works to winnow the number of existing political parties, the tournament nature of a SMP election will itself work to generate a larger number of competitors. This is because the first-past-the-post voting system has all the characteristics of a winner-take-all tournament whose distinguishing feature, in the presence of open entry, is overcrowding.[8] That is, in contests where there is the possibility of winning a large prize, but only if the contest is won, the number of contestants typically attracted into the contest will be larger than the number (one) that can ultimately be successful.[9] In choosing to enter, each entrant weighs the expected benefit from winning relative to the cost of entry and depending upon the size of the perceived benefit, entry can continue to arise even if the probability of winning is very low. In the absence of significant political barriers to entry, new parties will continue to enter until the expected benefit of winning falls into line with the cost of entry. The result is a larger number of political parties participating in each election than can succeed in the longer run. They form a fringe of political parties that may ultimately find success in having their organization, advocacy of innovative policies or programs absorbed by the major parties before Duverger type competitive pressures lead to their disappearance over the longer run (Bruns, 2011).

For political parties the cost of entry consists relate primarily to party formation and gaining electoral status. They are often fixed in size and must be incurred prior to entry. Once a party has been formed and its electoral status won, these entry costs become sunk and hence are irrelevant when considering whether to continue or not. The situation is somewhat different for individual candidates because nomination filing deposits are often returned and campaign

[8] See, for example, Lizzeri and Persico (2005) and Fischbacher and Thoni (2008). Vandegrift, Yavas and Brown (2007) provide experimental evidence on how the degree of participant overcrowding is a function the way that the tournament prizes are proportioned (with winner-take-all tournaments generating the most overcrowding).
[9] A classic early application is by Harris and Todaro (1970) who used this equilibrium concept to explain why in many lesser developed countries employed farm workers voluntarily leave the farm to become part of a large pool of unemployed urban workers in the competition for the scarce but high paying jobs in the city. Other examples include the large number of unsuccessful artists and actors working as waiters in New York and Los Angeles.

expenses are largely publicly funded.[10] It follows that sunk entry costs create an asymmetry for the party's in its decision whether to stay relative to enter. This asymmetry implies that even as the Duverger-Demsetz process introduces greater realism into the perceived benefit of electoral participation, the lower cost of continuing as opposed to initial entry may allow even minimally successful parties the ability to stay in the electoral process longer than would otherwise be the case. Tenure in the party fringe persists somewhat longer than the observed lack of electoral success might indicate.[11]

In the absence of restrictions on entry, continuous change in the composition of the electorate and their ideological and policy preferences create ongoing opportunities for new parties and candidates that will perturb any long run equilibrium. In addition, negative shocks to the party equilibrium, such as those that induce party exit from political scandal, will be quickly offset by standby participants. This implies that with the continual arrival of new party hopefuls and the grudging exit of previous entrants, the Duverger-Demsetz tendency for party numbers to converge back towards 2 following a shock will be postponed. For *ENP_Part*y in particular, the short run transition process can result in an observed outcome in which the mean number of political parties will be larger than the number indicative of long run equilibrium. Sunk entry costs in combination with the tournament nature of the SMP political contest can then produce an asymmetry in which unsuccessful entrants typically outstay their welcome and the observed effective number of parties exceeds the effective number that can survive in a longer run equilibrium. We turn next to model the long run before seeing whether there is evidence of such an asymmetry in either *ENP* measure.

4. Modeling strategy and the factors affecting the *ENP_Candidate* and *ENP_Party*

[10] In Canada a candidate's $1000 nomination deposit is returned once the candidate complies with election return filings. Moreover all election and personal campaign expenses are paid up to a maximum of 60 percent of the ridings established expense limit provided the candidate receives at least 10 percent of the valid votes cast.

[11] The dynamic implication of this aspect of the entry/exit decision faced by political parties in plurality electoral systems has been modelled more formally by Forand and Maheshri (2015). Their focus is on how the fixed entry cost creates a 'barrier to exit' if there remains an expectation of electoral success in the future.

Cox (1997) provides the methodology most often used to explain the entry/exit decision of political parties and their candidates. Under this approach a potential candidate or party is viewed as weighing the expected benefits and cost of entry and choosing to enter the electoral arena as long as the benefits they expect to receive by winning sufficient electoral support for their proposed programs and policies exceeds the expected cost of entry. With multiple potential parties and candidates, entry will continue until for the marginal party entrant the net benefit falls to zero. Having achieved initial success, political parties and candidates will continue to participate only if their revised expectation of the benefit of continuing exceeds the ongoing cost of maintaining support in upcoming elections.

While the two decision rules seem intuitively plausible, the hypotheses become testable only if we can identify a set of factors that represent changes in the probability of initial and continuing electoral success, the expected benefit of continued participation, setup and continuation costs. What makes this more difficult is that the benefits of electoral participation as perceived by candidates and parties are typically unobservable. This implies that operationalizing the theory for Canada requires the finding of a set of variables that both span our entire time period and can capture changes in the other three components (ideally, with unchanged perceptions of the benefit of participating).

To implement a test of this hypothesis we follow the established literature in assuming that the expected number of political parties competing in an election, *ENP_Party*, and the expected number of candidates, *ENP_Candidate*, are a function of the different demographic, institutional and organizational features of the Canadian political environment. In particular,

EXP_X = f(Electoral space, voter heterogeneity, incumbency success, pecuniary rewards and costs of participation, institutional characteristics of the electoral voting system), (1)

where *X* = *Candidate, Party*.

We begin to operationalize this hypothesis by choosing first three variables often used to describe the electoral space available to parties wishing to participate in the political arena: the relative size of the voting franchise (*REGISTERE*D), the voter turnout rate (*TURNOU*T); and the

relative voting size of the average constituency (*CONSTITUENCY SIZE*).[12] An increase in the proportion of the population eligible to vote and the proportion of those eligible who chose to vote will both increase electoral participation which in turn increases the range of programs and policies that a more diversified electorate will consider of value. Greater participation is then expected to increase the likelihood of new party/candidate success and provide increased potential support to existing fringe parties. Both work to increase *ENP* (Berrington, 1985). In a similar way the larger the number of proportion voters in each constituency, the larger will be the expected number of parties/candidates that can be supported (Clark and Golder, 2006). Larger constituency sizes allow heterogeneity to achieve a scale sufficient to support more candidates and parties, "to allow social divisions to be mobilized and expressed electorally" (Singer and Stephenson, 2009, p. 480). Note that in relative terms, the greater heterogeneity likely in a larger sized constituency increases the value of candidate characteristics relative to the party. With party participation needing to establish policy on a national basis, a candidate that can appeal to distinct local or regional as opposed to national concerns may find success. This implies that independent or minor party candidates may be more successful in larger the sized constituencies.

For any given level of electoral participation and district size, greater voter heterogeneity would also be expected to support a larger number of candidates and/or political parties (Singer and Stephenson, 2009). Here we use the degree of religious diversity in the country (RELIGION) as one distinct dimension of heterogeneity.[13] To the extent that a broader range of religious groupings reflects a broader range of political ideologies and policy aspirations, increases in this expected number would be expected to create greater space for participation and hence increase *ENP*. A second metric that has sometimes been used as an index of heterogeneity is the proportion of the population that are recent immigrants (Ordeshook and Shvetsova,

[12] In Canada the voting franchise grew from 8.3% of the population in 1867 to 76.7% by 2011, with the biggest jump coming in the extension of the franchise to women (beginning in 1917). Greater detail on the specific definition and data source of each variable is given in the Data Appendix at the end of the paper.

[13] Religious diversity is measured as one over a Herfindahl index of population shares within six religious denominational categories (Protestant, Catholic, Jewish, Mormon, other religions, and unknown), interpolated between censuses.

1994).[14] Under their hypothesis a larger inflow of immigration in the period leading into an election (IMRATIO) diversifies the interests of the electorate, opening more policy space for the participation of additional parties or the expansion of previously marginal political parties (Carty, 2002). A counter hypothesis, suggested by Ferris and Voia (2016) argues that recent immigrants are more conservative in their political choices than the general population and can often be targeted more easily by the major contending parties. In such a case *ENP* will fall with *IMRATIO* rather than rise. A third demographic feature that may reflect heterogeneity and hence influence the expected number of candidates or parties is the proportion of the population in urban as opposed to rural areas (*URBANIZATION*). While there is a long literature linking urbanization and political democratization (Anthony, 2014), we have no prior on whether Canada's growing urbanization has resulted in more or less voter homogeneity and hence on whether relationship between urbanization and the expected number of candidates or parties is positive or negative.

One organizational or institutional feature of the electoral system that makes the entry of new candidates and parties and their continued participation more difficult is the competition of candidates who have already been elected as members of parliament. As is well known (for Canada, see Kendall and Rekkas, 2012), an incumbency advantage exists which decreases the likelihood that non-incumbents can achieve electoral success if they run against an incumbent member of the House. It follows that the larger is the proportion of incumbent members running again for office, *AVG_INCUMBENTS*, the lower will be the entry of new members and larger exit rate of existing candidates. Both work to make *ENP* smaller than would otherwise be expected.[15] A organizational convention of Canadian election practice has been the suspension or relaxation of electoral competition between the two main political parties during the two world wars (Berrington, 1985, p.447). In general, the relaxation of regular party completion during a war and the introduction of new issues and concerns arising during the world wars

[14] The acquisition of Canadian citizenship takes three consecutive years of residence and confers voting rights at the municipal, provincial and federal level.

[15] We recognize that incumbency will be codetermined with ENP in the general political equilibrium. This underscores the point that the empirical relationship found in this paper should not be interpreted as causal in the direction implied by their order in the test but rather as part of the cointegrating relationship among the variables to form a long run equilibrium time path.

would be expected to give more opportunities for new party entry. However, Canada's WW1 experience was somewhat different, characterized by its extended period of coalition government and the legislative passage of the Wartimes Election and Military Voters Acts that successfully skewed the 1917 vote towards the 'Government' and away from its 'Opposition' and potential new parties. We test for the presence of these different wartime period effects by including separate dummy variables (1 versus 0) for time periods involving *WW1* and *WW2*.

The benefits received by candidates, political parties and their supporters for participating in the political process and achieving electoral success are primarily nonpecuniary and typically unobservable. This inability to quantify means that changes in their value will appear in the empirical work below as shocks impacting our system of equations. On the other hand, successful candidates and their parties benefit directly in pecuniary ways and the expectation of winning these benefits can influence the decision to participation. We use two measures of the pecuniary benefits received by candidates who win their election in Canada: the wage received by members of parliament relative to outside alternatives, *RELATIVE_MP_WAGE*, and the pension that can be received upon retirement or electoral loss. For the latter we use an index of financial accruals relative to contribution rates, *PENSION_ PARAMETERS*, to measure the generosity of parliamentary pensions. Ceteris paribus, the greater is the financial reward from (lower the cost of) participating in the political process, the greater is the likelihood that a marginal candidate will participate and the lower is the cost to the political party of recruiting a set of competent representatives. Both measures are expected to increase *ENP*.

Finally, in 1974 the public funding of political parties (*FUNDING1974)* was introduced in Canada (eliminating corporate and union contributions and substituting a per-vote subsidy to parties, subsidization electoral expenses and allowing tax credits to individual contributors).[16] Providing candidates and parties funds for election activities would be expected to encourage electoral participation, expand the number of political parties and candidates and thus increase both *ENP*

[16] Public funding in 1974 introduced two key types of electoral support: for individuals, a political contribution tax credit for up to 75% for small contributions then falling; and for parties and their candidates, parties that spent at least 10% of their spending limit could get 22% refunded and candidates who got at least 15% of the vote could get 50% back. The percentages and forms of support have varied through time. See Jensen and Young, 2011.

measures. However, to qualify for public support a political party must be registered and must have received at least 2% of the valid votes in the preceding general election or 5% of the valid votes in the electoral districts in which it had a candidate. In addition, only political parties (rather than independent candidates) receive research and staffing support in parliament and only if they maintain party status, i.e., hold a minimum of 12 seats in the House of Commons. It follows that while all parties tend to receive benefits, major parties will benefit more than both parties that are small and receive relatively few votes and potential entrants that receive no support at all. By supporting established parties and their candidates, public funding also disadvantages the candidates of small parties and particularly independent candidates.[17]

The long run equilibrium relationship expected from this analysis, written in linear form, is:

$$ENP\_X = c_0 + c_1\ RELATIVE\_MP\_WAGE + c_2\ PENSION\_PARAMETERS + c_3\ REGISTERED + c_4\ TURNOUT$$
$$+ c_5\ CONSTITUENCY\ SIZE + c_6\ AVG\_INCUMBENT + c_7\ RELIGION + c_8\ IMRATIO + c_9\ URBAN\_PROPORTION$$
$$+ c_{10}\ WW1 + c_{11}\ WW2 + c_{12}\ CONVERGENCE\_TREND + c_{13}\ FUNDING1974, \qquad (2)$$

where the expected coefficient signs are c_1, c_2, c_3, c_4, c_5, c_7, c_{11}, and both c_{12} and c_{13} (for parties) > 0; c_6, c_{10} and c_{13} (for candidates) < 0; and c_8 and c_9 are ambiguous in sign ex ante.

5. ARDL tests and Symmetric results

The time series processes that describe *ENP_Candidate* and *ENP_Party* and the political and election variables considered as their determinants are both stationary, I(0), and nonstationary, I(1), in nature.[18] To handle the time series issues raised by such a combination of variables, the autoregressive distributed lag approach (hereafter ARDL) of Pesaran, Shin and Smith (2001) has

[17] FUNDING1974 = 1 for the years 1974 – 2011, 0 otherwise.

[18] Much of the empirical work on new party entry and party longevity has been cross country (Hamel and Robertson, 1985; Hug, 2001; Travits, 2007; Nishikawa; 2010) where varying institutional detail—differences in electoral rules, threshold petition requirements, other entry conditions and registration costs/subsidies—provide the observables to explain why entry occurs more often in one country than others. Here we follow authors like Happy (1989) and Lucardie (2007) and apply the analysis to a single country where the institutional framework for elections and governance has been largely unchanged. In such cases the econometric issues become ones of cointegration and convergence among time series.

proven to be particularly useful.[19] The advantage of the ARDL method is that it is designed to assess whether or not a cointegration (long run equilibrium) relationship exists among a group of variables when the orders of integration are ambiguous and when the sample size is small. If cointegration is found (as indicated by the bounds test), the ARDL method generates not only the long run equilibrium path but also the short run convergent process that surrounds the long run equilibrium. In describing the dynamic processes that generate this outcome, the method also allows for lags of differing length to capture the varying degrees of persistence exercised by each of the interrelated variables. For our purposes the ARDL approach and its nonlinear NARDL extension by Shin, Yu and Greenwood-Nimmo (2014) are particularly relevant, the latter because we suspect that the observed evolution of ENP may reflect the confluence of a long run equilibrium process and a short run convergence process is asymmetric in responding to the disturbances that shock the political system and induce entry and exit. The conceptual ability to separate these influences is critical for assessing whether or not a long run equilibrium relationship exists and, if so, how its time path differs from what is actually observed. As part of this process, the analysis also allows us to determine which variables are associated with long run size and whether or not these variables are significant only in the short run.

A dynamic ARDL model of symmetric ENP adjustment can then be written as:

$$ENP_t = \alpha + \sum_{i=1}^{i=4} \gamma_i ENP_{t-j} + \sum_{j=1}^{k} \sum_{i=0}^{4} \beta_{j,i} Z_{j,t-i} + \epsilon_t, \qquad (3)$$

where the Z_j are the k explanatory variables shown in equation (2) and where each variable can have up to four lagged terms. ϵ_t is a white noise random variable. Before estimation was initiated, the Adjusted Dickey Fuller test statistics of each variable were first calculated to ensure that no variable was I(2). After finding that all variables were either I(0) or I(1), the set of autoregressive distributed lagged equations were re-estimated allowing for a maximum of 4 lags for each variable. The Akaike criterion was then used to select the optimal combination of

[19] In the political science literature, de Boeuf and Keele (2008) propose a similar method for modelling dynamic political (stationary) processes. The advantage of the ARDL/NARDL framework is that there exists a set of formal tests to establish the presence and stability of the long run and dynamic processes, often packaged as part of a statistical time series program. The time series packages used here are Eviews 10 for ARDL and Stata 15 for panel ARDL.

lags for the test. The final ARDL equations estimated for *ENP_Candidate* and *ENP_Party* are presented as Tables 1 and 2 along with the implied long run cointegrating equation and short run transition effects. The equations were subjected to two stability tests: the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares (CUSUM of Squares). In each case the recursive sums remain within the 5 percent bounds.[20] The values found in the associated Bounds test, presented as the bottom line in each table, are consistent with the existence of a long run cointegrating relationship among the I(1) variables and thus provide evidence of the existence of an equilibrium time path on which departures from equilibrium will converge.[21] In forming this separation of the long run from the short run adjustment process the ARDL model assumes that convergence will be symmetric on either side of the long run equilibrium.

-- Insert Tables 1 and 2 about here –

The two sets of individual long run results presented in Tables 1 and 2 are interesting for both their similarities and differences. In both *ENP* cases the set of variables perform well as a test of the explanatory power of our representation of the general Cox hypothesis. The adjusted R^2s tell us that the ARDL equations can explain virtually all of the observed variation in the candidate and party-based measures over our time period. Similarly, the bounds test indicates that both ARDL models incorporate a longer run cointegrating relationship among the I(1) variables. The data is then consistent with the existence of an equilibrium time path that is surrounded by a short run process that incorporates convergence back to the equilibrium path. The long run coefficient estimates of *ENP_Candidate* conform in sign to the predictions of the earlier analysis and most are significantly different from zero at 10 percent or less. Hence larger values of *ENP_Candidate* are associated with larger proportions of the population registered to vote, higher voter turnout, larger constituency sizes, fewer incumbents, and

[20] To economize on space the ADF statistics and recursive residual diagrams are not included but are available upon request.

[21] Note also that the error correction terms, in the bottom of right hand corner of both tables, are both negative and significantly different from zero. This signifies the stability of the longer run cointegrating relationship as shocks producing departures converge back to long run equilibrium. The small size of the error correction term in the party-measure indicates the persistence of any shock through a long period of readjustment.

WW2. The special circumstances associated with WW1 and the introduction of public funding are associated with significant decreases in *ENP_Candidate* as expected. It is only with respect to the pecuniary returns to candidates--through salaries and/or pensions—that we find no significant effect on *ENP_Candidate* (using conventional standards of significance).[22] The two hypotheses on which we have no strong priors—the effects of higher immigration rates and the proportion of the population in urban as opposed to rural areas— are both found to be inversely related to *ENP_Candidate*.

In relative terms, the *ENP_Party* convergence process is indicated as being more protracted, that is the error correction term is somewhat smaller that of *ENP_Candidate* and the size of the lagged ENP values and their first differences are both larger, telling us that there will be more persistence in the response to the shocks that hit the *ENP_Party* equilibrium. Many of the long run coefficient estimates are of similar sign to those found for *ENP_Candidate* but differ in their significance. For example, religious diversity is much more significantly related to *ENP_Party* than *ENP_Candidate* while *IMRATIO* has had a more significant effect on *ENP_Candidate* than *ENP_Party*. Moreover, while the general pattern of coefficient findings follows that set out in the candidate case, there is much less agreement between the estimated and predicted sign (and significance) of the long run coefficient estimates in the *ENP_Party* case. For example, while it is not surprising that the introduction of public funding of established political parties will have increased *ENP_Party* and lowered *ENP_Candidate*, it is more surprising that increases in constituency size are found to be associated with decreases in *ENP_Party* and increases in the average number of incumbents in an election is associated with increases rather than decreases in *ENP_Party*.[23]

-- Figures 2 and 3 about here --

The time paths associated with the ARDL model estimates and their equilibrium time paths are shown in Figures 2 and 3. The tight convergence of the actual *ENP* values and their *ARDL* model

[22] This may imply that formal pecuniary considerations are not high on the priority list of candidates running for office.

[23] Neither of these effects is significant, however. See also how the results change when asymmetric short run adjustment is considered.

forecasts reflects the strong explanatory power of these models in being able to explain virtually all of the variation in *ENP* over our time period. The long run 'equilibrium' time paths implied by the models' cointegrating equations appear as the dashed line with circles on the two diagrams and seem to show a somewhat different pattern of covariation. In Figure 2, for example, the long run variation in *ENP_Candidate* appears to be fairly smooth with changes that typically moderate the larger variations in the actual and forecasted values. On the other hand, following the convergence period running through the turn of the century in Figure 3, the variations in long run *ENP_Party* appear to be both sharper and less synchronized with both *ENP_Party* and *ENP_Party Forecast* than is *ENP_Candidate_Long Run* with its forecasted and actual values. The difference in the two short runs, defined as the difference between the forecasted and long run values, is shown in Figure 4 and illustrates the point quite dramatically. While not dissimilar in the timing of their variation, the short run variations in *ENP_Party* are considerably larger than their *ENP_Candidate* counterpart.[24]

-- Insert Figure 4 about here --

An important cautioning note with respect to these findings is suggested by our earlier discussion of the all-or-nothing nature of the election contest in combination with sunk entry costs. Together they suggest that the short run adjustment process may be asymmetric. Particularly for political parties, positive shocks or transitory changes that encourage party entry may have larger and more persistent effects on *ENP_Party* than similar sized negative shocks. This in turn implies that if an asymmetry is present, not only will the ARDL's short run symmetric coefficient estimates and their standard errors be biased, but because the long and short runs are estimated simultaneously, bias may also appear in the long run coefficients and their standard errors. In the following Section we explore this possibility.

6. Nonlinear ARDL (NARDL) Estimation and Results

[24] The coefficient of variation in short run movements in ENP_Party is over 100 times larger than the coefficient of variation in short run ENP_Candidate (969.8 to 5.28).

Although the previous results already imply the existence of a cointegrating relationship for both ENP measures, our estimates of the long run equilibrium time path and corresponding short run can be improved upon if an asymmetry in the adjustment process is present and incorporated into our analysis. A test for asymmetry in the adjustment/convergence process can be undertaken by using an asymmetric variant of the ARDL model (NARDL). Here we follow the methodology of Shin, Yu and Greenwood-Nimmo (2014) by first breaking all the covariates into positive and negative partial sums to allow for possibly different adjustment to positive and negative changes. We then apply their nonlinear panel estimating method by treating the positive and negative partial sums as two separate states and using the pooled mean group (PMG) estimator. This estimator generates separate short run coefficients and error variances for positive and negative changes while constraining the long run coefficients to be equal across states. The PMG estimator also generates separate error correction terms for the positive and negative change states. Should a Hausman test not reject the hypothesis that the short run coefficients generated by the PMG estimator are systematically different from the short average generated by the mean group (MG) estimating procedure, we can use the PMG estimates of the error correction and short run coefficients as the more efficient representation of the two states. In this case, we reject the common ARDL estimates relative to the set of two separate short run estimates generated by the PMG procedure. On the other hand, if the Hausman test does allow rejection of the hypothesis that the short run coefficient estimates are systematically different, then the separate short run coefficients and error correction terms generated by the PMG approach are inconsistent and can easily be biased. In this case, we reject the hypothesis of short run asymmetry and fall back on the symmetric results presented in the previous section.

The NARDL model used in the estimations below can be written as

$$ENP_t = \sum_{i=1}^{i=4} \gamma_i^+ ENP_{t-i}^+ + \sum_{i=1}^{i=4} \gamma_i^- ENP_{t-i}^- + \sum_{j=1}^{k} \sum_{i=0}^{4} \beta_{j,i}^+ Z_{j,t-i}^+ + \sum_{j=1}^{k} \sum_{i=0}^{4} \beta_{j,i}^- Z_{j,t-i}^- + \epsilon_t, \quad (4)$$

where the variables are defined as before and where ENP_t and $Z_{j,t}$ are decomposed as $X_t = X_{t-1} + X_t^+ + X_t^-$ where X_t^+ and X_t^- are partial sum processes of positive and negative changes in $X_t = ENP_t$ and $Z_{j,t}$ and the γ's and $\beta's$ are the corresponding coefficients.

After running the NARDL model for both *ENP_Candidate* and *ENP_Party* and applying the Hausman tests, it was found that only in the case of *ENP_Party* does the model generate coefficient estimates consistent with separate short run state averages, allowing in the party case for the short run coefficients and error correction terms to indicate the asymmetry arising in the short run arising about the common long run cointegration time path.[25] The NARDL results for *ENP_Party* are shown in Table 3. However before proceeding to discuss the new findings, it is important to note that the rejection of asymmetry in the case of *ENP_Candidate* supports the relevance of the symmetric results found earlier. This increases our confidence that the cointegrating equation estimated for *ENP_Candidate* (the results in Table 1 in Section 5) is a meaningful representation of an equilibrium long run time path. The rejection of asymmetry for *ENP_Candidate* and the provisional acceptance of asymmetry for *ENP_Party* is consistent with implied by our earlier discussion and inspection of Figures 2, 3, and 4. There the smaller smooth response of the long run to both temporary and permanent changes in *ENP_Candidate* stood in dramatic contrast to the more dramatic stochastic changes in the long run equilibrium path implied by imposing symmetry on *ENP_Party*.

-- insert Table 3 about here --

A quick scan of the long run coefficient estimates in Table 3 indicates that virtually all of the models' covariates exhibit coefficient signs consistent with that predicted by the underlying theory and with many of those coefficients significantly different from zero at the ten percent significance level or beyond.[26] While the results are similar to those indicated in the symmetric case of Table 2, the asymmetric results do produce three significant differences. First, the effects of constituency size and incumbency that were perverse in sign in the symmetric case now have their predicted sign. As expected, larger constituency sizes are now found to be positively associated with *ENP_Party* while larger numbers of incumbent candidates are associated with reductions in ENP. The contractionary effect of more incumbents is found to be

[25] For the ENP_Candidate PMG and MG estimates, the Hausman test for no systematic difference in the set of short run coefficients generates a chi2(9) = 12.8 with a Prob > Chi2 = 0.002. This allows us to reject the hypothesis that the two sets are not systematically different.

[26] The Im, Pesaran and Shin (2003) test for unit roots in heterogeneous panels with cross section dependence rejects the hypothesis of unit roots in the state residuals.

significant in the long run while constituency size has a significant effect only in the short run. Second, the effects of the proportion of voters who are registered and the size of voter turnout which were significant in the symmetric case are now both found to be insignificant in the long run while the short run gives evidence of cyclical adjustment to short run variations in *REGISTERED.*[27] Thirdly, the effect of the introduction of public funding that was found to be insignificantly positive in the symmetric case is now negative (but significantly different from zero at the 17 percent significance level). That is, the data is weakly consistent with the hypothesis that the introduction of public funding for established political parties reduces the importance of both individual candidates and minor political parties relative to established parties. Finally, the asymmetric results concur with those suggested earlier in that the pecuniary rewards received by elected party candidates have no significant effect on party participation as measured by *ENP.*

When we turn to the short run, two things are immediately noticeable. First, the multiplicity of sign reversals in the lagged changes and the intermittent significant findings imply a short run that is both complex and specific to the incidence of shocks. Second, and from our perspective more interesting, is the finding that short run adjustment is quite different depending upon whether the shocks and/or variable changes experienced are positive versus negative. This is indicated by the error correction terms for positive and negative shocks being significantly different in size (-0.077 and- 0.127 with the probability that the two coefficient estimates are equal at less than one percent). The smaller absolute size of the error correction term on positive departures indicates that the correction of positive departures from the equilibrium time path will be significantly slower than the correction of negative departures. And while neither convergence process is particularly fast, convergence will be more than fifty percent faster for negative departures than for positive ones. Similarly, positive changes to *ENP_Party* (for whatever reason) will be followed by both larger and more persistence changes to *ENP_Party* than will negative shocks. The lagged first difference coefficients (0.725 and 0.420)

[27] Both TURNOUT and PENSION_PARAMETERS were found to be insignificant in all forms of the NARDL tests and were so omitted from the final equations.

span the coefficient estimate of the symmetric case (0.469) and imply a convergence path that takes longer to adjust to longer run equilibrium from positive changes than negative ones.

The asymmetric pattern of adjustment implied by these estimates is then consistent with our earlier theoretical discussion. The first-past-the-post electoral format induces overly optimistic entry in response to positive changes in the likelihood of electoral success while sunk party setup costs work to retain an excessively large number of parties by delaying exit. The result is an asymmetry under which the observed time path will differ from its longer run equilibrium more often on the up side which implies that the long run equilibrium will likely lie below the actual level of *ENP_Party* observed in the data. Just such a result can be seen in Figure 5 where the asymmetric long run equilibrium time path estimated for *ENP_Party* (derived from the long run coefficient estimates of Table 3) is plotted as the dashed line relative to relative to the solid line that plots *ENP_Party*.[28] Following the early period of convergence when party structure was in the process of adapting to a new national based federal environment (through 1900), long run *ENP_Party* adjusted for asymmetry has generally been below the level *ENP_Party* actual. While the gap between these two measures has varied across time, the long run has remained below actual for almost the entire 1900 – 2011 time period. The fringe, representing as it does the variation in support for the set of mid to small sized parties, is shown in Figure 6 for the post 1900 time period. Its removal from *ENP_Party* moves the long run value much closer to the 2 expected by Duverger while also removing some of the overall upward trend observed in its actual level.

--Figures 5 and 6 about here—

7. Does long run *ENP* or its fringe signal anything about political competition?

The separation of observed *ENP* into a long run equilibrium time path and a fringe of entry/exit activity allows us to ask whether the fringe and/or the long run can tell us anything meaningful about the electoral competitiveness of the candidates and/or parties in the Canadian political

[28] Long run NARDL *ENP_Party* excludes WW1 and WW2 but incorporates CONVERGENCE_TREND and FUNDING1974.

system? In particular does the greater fragmentation indicated by rising long run *ENP* signal greater competitiveness among more parties and candidates offering a larger range of policies, programs and personalities or does greater fragmentation signal a reduction in the likelihood that any challenging candidate/party can win an election and thus provide less effective competition for incumbents. Alternatively, is it the variation in the fringe of short run adjustment activity that provides more insight into the competitiveness of the political system? Finally, do the two *ENP* measures offer similar signals with respect to changes in political competition?

One way of approaching these questions is to look at how the long run estimates of *ENP*'s size and their fringe correlate with other less controversial measures of political competitiveness. Here we choose three measures of political competitiveness used in the literature that can be regressed against the two dimensions of *ENP* variation: i) the Przeworski/Sprague measures of constituency competitiveness, competitiveness among candidates, *PS_current_Candidate*, and competitiveness amongst parties, *PS_current_Party*; ii) the proportion of contested seats in national elections that are electorally marginal, adjusted for any asymmetry in the distribution of marginal constituencies among the major political parties, *Adj_marg_constituencies*; and iii) the proportion of seats won by the governing political party, *SEATS*.[29] Increases in the former two measures are treated as meters of electoral competitiveness while decreases in the latter are viewed as indicating greater competition for the governing party in the House. In testing for the presence of a relationship by regressing these variables we note that the long run measures of *ENP* are both nonstationary or I(1), whereas the three competition variables are all stationary or I(0).[30] Hence to assess the relationship between the long run ENP values and political competition (as measured by our three political competition alternatives) we use the first differences and so test whether changes in long run ENP are positively or negatively

[29] See Ferris and Winer (2017) for greater detail on these measures. Election outcomes are viewed as offering point estimates of an evolving political environment so that the annual observations on the competition measures represent interpolations between election years.

[30] The adjusted Dickey Fuller statistics for *ENP_Party_LR* and *ENP_Candidate_LR* are, respectively, -1.43 and -1.19 (for level with a constant) and -8.56, -10.84 (for first differences). The MacKinnon 10% critical value is -2.58. The corresponding ADF's for *PS_current_Candidate, PS_current_Party , Adj_marg_constituencies* and *Seats* are, respectively, -4.38, -4.81, -3.73 and -4.39 (level, constant).

related to our metrics of political competition. Because both *ENP_Fringe* measures are stationary we can test directly for their association with the political competition measures. The results of these tests are presented in Table 4.

--insert Table 4 about here—

An examination of the equations in Table 4 indicates that of the two different sets of *ENP* measures it is the long run *NARDL_ENP_Party* equation that best provides evidence of a relationship arising between *ENP* and political competition. None of the competition variables in the short run/fringe equations are significant at the five percent significance level and the explanatory power of the estimated equations comes almost entirely from the strong element of persistence that follows departures from the underlying long run. To the extent that the results can be taken as somewhat suggestive of a role for the fringe, the sign pattern found in these regressions is consistent across the two equations and suggests that increases in the fringe are potential signals of greater political competition. That is, a larger size fringe is associated with greater competition among the candidates and parties within constituencies, more seats that are marginal and symmetrically distributed and a smaller sized seat majority held by the governing party.[31] More reasonably, the results suggest non-responsiveness of the fringe to political competition which would works to diminish the meaning of observed changes in *ENP* by embodying into the long run the random shocks and convergence characteristics of the adjustment process.

Turning to look at the long run equilibrium time paths, we first note that fully five of the six competition coefficient estimates and the two significant ones all are consistent in sign with the hypothesis that an increase in long run ENP signals a reduction rather than an increase in political competition.[32] In this sense the greater fragmentation signalled by a rising long run is more consistent with a reduction in competition coming from the reduced credibility of party

[31] The exception in signage is for marginal seats adjusted for asymmetry.
[32] The exception is again the insignificant positive sign on marginal seats adjusted for asymmetry in long run *ENP_Party*

alternatives to the governing party than the hypothesis that greater fragmentation implies greater policy choice and hence a more competitive environment for voters.

In terms of the two long run *ENP* equations, however, while the sets of signs are generally consistent across equation estimates, only the NARDL estimate of long run *ENP_Party* presents significant evidence of an association with our measures of political competition. For *ENP_Party* the data indicate that increases in the constituency competitiveness of political parties are significantly associated with decreases in long run *ENP_Party* (at the 1 percent significance level) while increases in the size of the seat majority held by the governing party and decreased in the competitiveness of the House of Commons are significantly associated with long run *ENP_Party* (at the 10 percent significance level).

Overall, then, the data is consistent with the hypothesis that long run *ENP_Party* is inversely associated with political competition as measured by changes in *PS_current_Party* and *SEATS* and is not inconsistent with the same relationship holding for *ENP_Candidate*. The data sheds little light on the relationship of the fringe with political competition at best suggesting that increases in the fringe may be positively related to political competition and hence inversely related to that implied by variations in long run *ENP*.

8. Conclusion

In this paper we have examined the structure of political party equilibrium in Canada with a view to answering the questions whether there has been a true upward trend in *ENP* away from Duverger's 2 in Canada and if so whether an increase would signal more or less electoral competition. We begin by arguing that the actual measures of candidate and party *ENP* are likely biased measures of equilibrium structure and use symmetric ARDL and asymmetric NARDL modeling to separate empirically the long run equilibrium to which candidate and party selection processes would evolve from the shorter run and convergence processes that we argue are likely to be asymmetric. Doing so reveals a cointegrated long run equilibrium path for both *ENP* measures but a short run that is asymmetric only in the case of *ENP_Party*. This we argue represents an ever-changing set of optimistic minor parties that are less successful competing in first-past-the-post tournament elections. Having overcome relatively large setup

costs that are sunk following initial entry, these parties persist under election returns which if known would have prevented their entry. This produces an observed outcome in which actual participants consistently outnumber the number of parties that can feasibly survive in long run equilibrium.

Our findings with respect to the long run size of the two *ENP* measures confirm a number of hypotheses advanced in the literature for party structure generally and particularly for Canada. For example, increases in district size, the voting franchise, voter turnout, and religious diversity are all associated with higher *ENP* candidate and party levels. Similarly increases in the proportion of candidate and party incumbents running for re-election are both associated with lower *ENP* values. On the other hand, there is relatively little evidence in the data that MP salaries and/or pension benefits are successful incentives attracting electoral candidates or additional parties. The public funding of political parties initiated in 1974, however, appears to have had the effect of reducing the expected participation of independent candidates running and the finding that party based ENP has fallen suggests that public funding has helped consolidating the position of the major parties relative to minor parties. Finally the particular political measures introduced during WW1 in Canada to reduce competition through special legislation and a coalition government party is reflected in the data as a fall in both *ENP* measures while the effect of agreeing to lessen party competition during WW2 without legislative reinforcement led to the rapid entry of new parties immediately following and an upward jump in *ENP*.

We conclude by examining the correlations between our separated *ENP* measures—long run size and fringe—with three traditional measures of competitiveness in the election process and legislature. In neither long run case do we find evidence consistent with the hypothesis that larger *ENP* values signal greater political competition. Rather in the case of *ENP_Party* in particular, the evidence is consistent with the hypothesis that increases in ENP signal decreases in the competitiveness of the political system.

DATA APPENDIX

a. Description and sources

AGRIC = percentage of the labour force in agriculture 1870-1925 M.C. Urquhart (1993) Gross National Product, Derivation of Estimates, p.24; 1926-1975 Cansim D31251/D31252; 1975-2011 Cansim II v2710106/v2710104; AVERAGE_AGRICULTURE = average size over the previous governing period.
GNP = gross national product in current dollars. 1870-1926: Urquhart (1993: 24-25) (in millions); 1927-1938: Leacy et al. (1983: 130); 19391960 Canadian Economic Observer (Table 1.4), CANSIM D11073 = GNP at market prices. 1961-2011 CANSIM I D16466 = CANSIM II V499724 (aggregated from quarterly).
GOV = total federal government expenditure net of interest payments.1870-1989: Gillespie (1991: 284-286); 1990-1996: Public Accounts of Canada 1996-97: 1997-2000: Federal Government Public Accounts, Table 3 Budgetary Revenues Department of Finance web site, September 2001. To this we add the return on government investment (ROI) originally subtracted by Gillespie for his own purposes. Expenditure is net of interest paid to the private sector. Data on ROI: 1870 to 1915: Public Accounts (1917: 64); 1915-1967: Dominion Government Revenue and Expenditure: Details of Adjustments 1915-1967 Table W-1; 1916-17 to 1966-67: Securing Economic Renewal - The Fiscal Plan, Feb 10, 1988, Table XI; 1987-88 to 1996-97: Public Accounts 1996, Table 2.2. Interest on the Debt (ID) was subtracted out (with adjustment for interest paid to the Bank of Canada (BCI) ultimately returned to the government). Data on ID: 1870-1926: Leacy et al. (1983: Series H19-34): Federal Government budgetary expenditures, classified by function, 1867-1975; 1926-1995: Cansim D11166. 1996-2000: Cansim D18445. Finally, data for BCI: copied by hand from the Annual Reports of The Bank of Canada, Statement of Income and Expense, Annually, 1935-2000. Net Income paid to the Receiver General (for the Consolidated Revenue Acct). Note: all government data are converted from fiscal to calendar years, and allows for a change in the definition of the fiscal year in 1906/07, as described in Gillespie (1991: Appendix C). GSIZE = non-interest federal government, direct public expenditure, calculated as: GOV/GNP; LNGSIZE = Log(GSIZE); AVEGROWTH_GOV = average of LNGSIZE – LNGSIZE(-1) over the previous governing interval.
POP = the population size of Canada, 1870 – 1926: M.C. Urquhart (1993), Gross National Product of Canada 1870-1926, The Derivation of Estimates p. 24-25 (in thousands); 1927 – 1955: CANSIM data label D31248; 1996-2011 CANSIM Table 051-0005: Estimates of population, Canada, provinces and territories; Canada D1 Average of quarters.
IMMIGRATION: 1870 1953 O.J. Firestone Canada's Economic Development 1867-1953 Table 83, Population, Families, Births, Deaths (in thousands); 1954-1995; Cansim D27; 1996-2011 Cansim II v16.
IMRATIO = Immigration/POP where POP = Canadian population size. AVE_IMMIGRATION_RATE = average value of Imratio over the previous governing interval.
RELIGION = 1/{Herfindahl index of religious denominations}, interpolated between Censuses.
RGNPPC = (GNP)/(P*POP); LNGNPPC = Log(RGNPPC); PCGrowth = LNRGNPPC – LNRGNPPC(-1).
AVEGROWTH_PC = average of PCGROWTH over the previous governing interval.
P = GDP deflator: 1870-1926: Urquhart, (1993), 24-25; 1929-1960 (1986=100), Cansim data label D14476; 1961-2011, Cansim II V1997756. All indexes converted to 1986 = 100 basis.
INFLATION = LNP – LNP(-1); AVEINFLATION = average of INFLATION over the previous governing interval.
REGISTERED = fraction of the population registered to vote. Source: Elections Canada web site, www.elections.ca/past elections/A History of the Vote in Canada: Appendix
TURNOUT = fraction of registered voters who voted. Source: Elections Canada web site, www.elections.ca/past elections/A History of the Vote in Canada: Appendix
MINORITY = 1 when election resulted in a minority government.
WW1 = 1 for 1914 – 1917, 0 otherwise; WW2 = 1 for 1940-1945, otherwise 0.

Number of political parties collected by election from Elections Canada to determine time of entry, exit and duration. Online at: http://www.parl.gc.ca/About/Parliament/FederalRidingsHistory/HFER.aspsee
ENP_Local = (1/Herfindahl index of vote shares by candidate across constituencies) = 1/national mean of $\sum(1/\sum v_{ij}^2)$, where v_{ij} is the vote share of candidate i in constituency j. ENP_106 uses 105 different parties plus other whereas *ENP_Candidate* uses candidates independent of party affiliation (where 13 is the maximum number of candidates running in any constituency). Candidates acclaimed were given a vote share of 1 while parties that were acclaimed were given the average consistency vote as part of a recalculation of national party vote shares.
ENP_CONVERGENCE = linear trend of ENP_106 from 1870 through 1898 (party formation period).
INCUMBENTS = proportion of incumbents running for election, interpolated across elections
AVE_ELECTORS = average number of electors across constituencies, interpolated across elections
RELATIVE_MP_WAGE = REAL_Adj_MP_Salary/RGDPPC (MP salaries are adjusted for allowances).
PENSION_PARAMETERS = MP accrual rate/MP contribution rate (beginning in 1952).
PUBLIC FUNDING 1974 = 0 from 1870 – 1993; 1 from 1974 onward.

Political Competition Variables:
AMCons = Asymmetric adjusted marginal constituencies = 1 - $\psi_t\phi_t$, where ψ_t is the proportion of safe constituencies in the previous election and ϕ_t is a Euclidean distance measure of asymmetry across the shares of safe seats. Safeness is defined using a three-year moving measure of volatility and a 1 standard deviation test. Lower values of $\psi_t\phi_t$ indicate either that more constituencies have become marginal or that the distribution of marginal constituencies across parties has become more symmetrical. In either case the election outcome has become less predictable ex ante. See also the Data Appendix in Ferris, Winer and Grofman (2016).
Adj_marg_constituencies AMCons adjusted for constituency redistributions. Because redistricting and the addition of new constituencies were frequent in Canada's electoral history, large numbers of constituencies will have no past history and hence no clear basis for assigning safeness. However, since some new constituencies will be formed out of constituencies that were previously safe, we defined the safeness of new constituencies (at the aggregate level) as the proportion of all current constituencies that would otherwise have been treated as safe. That is rather than simply treating all redistributed seats as marginal or as equivalent in safeness to the proportion of safe seats in the ongoing constituencies that did have incumbents, the set of redistributed constituencies were treated as being between these two extremes.
PS_current_Party = the Przeworski and Sprague measure of competitiveness at the constituency level and is the sum of a weighted measure of the volatility adjusted vote margin that each party must overcome at the constituency level relative to the incumbent winning party. To avoid the loss of data arising from acclamations and redistricting, the following conventions were adopted. Party candidates winning by acclamation were given a vote-share of 1 and were awarded the national constituency average number of votes to weigh their significance relative to other constituencies. This resulted in a larger adjusted national vote as the new base for the calculation of adjusted constituency vote shares. Redistributions were handled by creating pseudo-predecessor constituencies using the average vote shares of those parties of the constituencies (within the same super-constituency) that had been lost due to the redistricting. If the constituency was entirely new (no old constituencies were lost), the previous super-constituency average was used and if the super-constituency itself was new (as in the case of

Newfoundland), the national average was used. The PS index runs between and 1 with higher values indicating a more competitive constituency. The PS version used in the text uses current party outcomes.
Volatility. Because the size of a winning vote margin is meaningful only in relation to the volatility of the constituency's vote margin, we needed a measure of vote volatility over time. Then to avoid the loss of information when new constituencies were added or reformed (and hence have no past), we constructed a number of regional super-constituencies - 80 in total - based on geographic regions that persist throughout Canada's election history for measures that required past election outcomes. These established regional specific vote volatilities for use in periods when a new constituency was created or an old one reshaped. To give one example, the area around Ottawa was used as the base for one of 29 Ontario super-constituencies. Electorally it consisted of one 1 riding in 1867 and had risen to include 7 ridings by 2011. A super-constituency volatility for each area and election was then computed as follows. First the average vote shares by party over the constituencies within a superconstituency were computed. Next the absolute value of the changes in these (party-specific) average vote shares across adjacent elections was computed, summed and divided by 2. Each of these super-constituency specific differences in vote shares were weighted by the relative number of constituencies inside each superconstituency and summed to derive an aggregate volatility number for each election. This volatility measure was then applied to vote margins whether a constituency was new or not.
SEATS = the proportion of seats won by the governing party.

Figure 1
Candidate versus Party (with acclamations) Measures of ENP
Canada 1870 - 2011

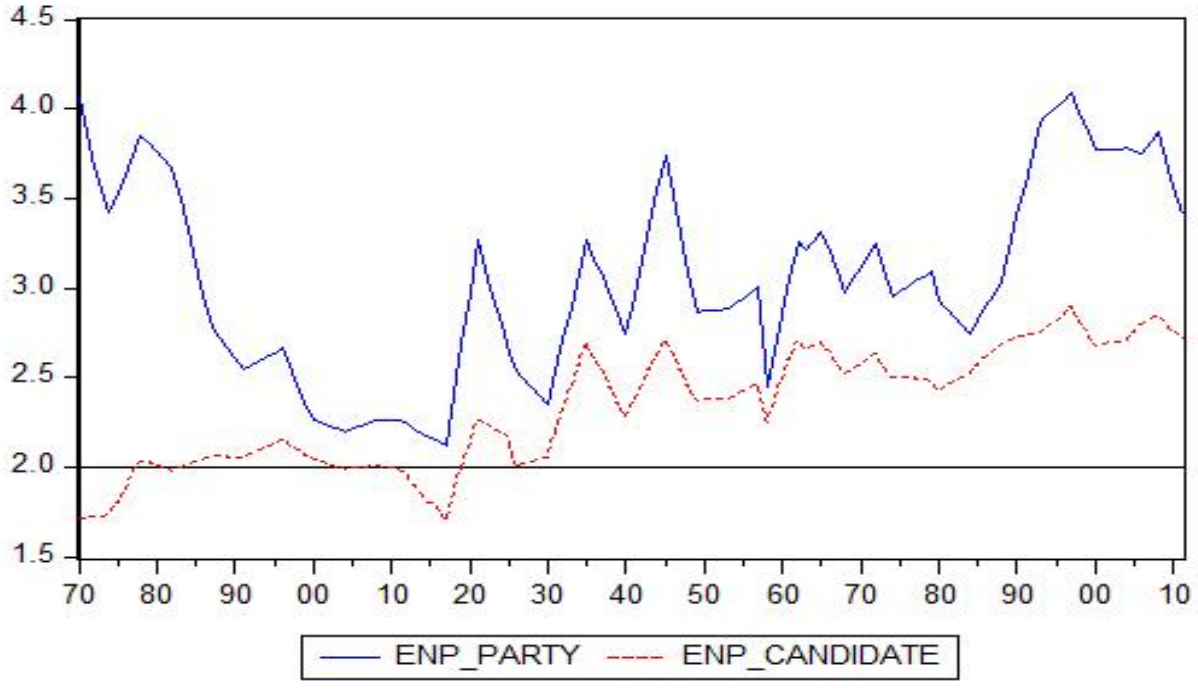

Figure 2
ARDL Model of ENP_Candidate
Canada 1870 - 2011

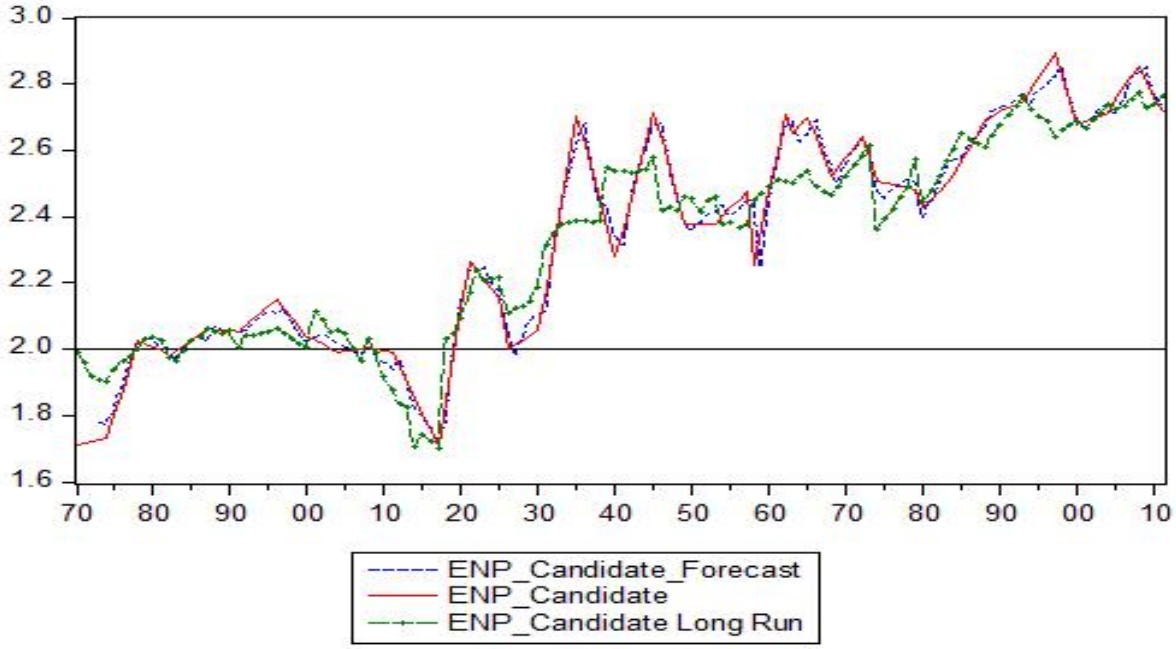

Figure 3
ARDL Modeling of ENP_Party
Canada 1870 - 2011

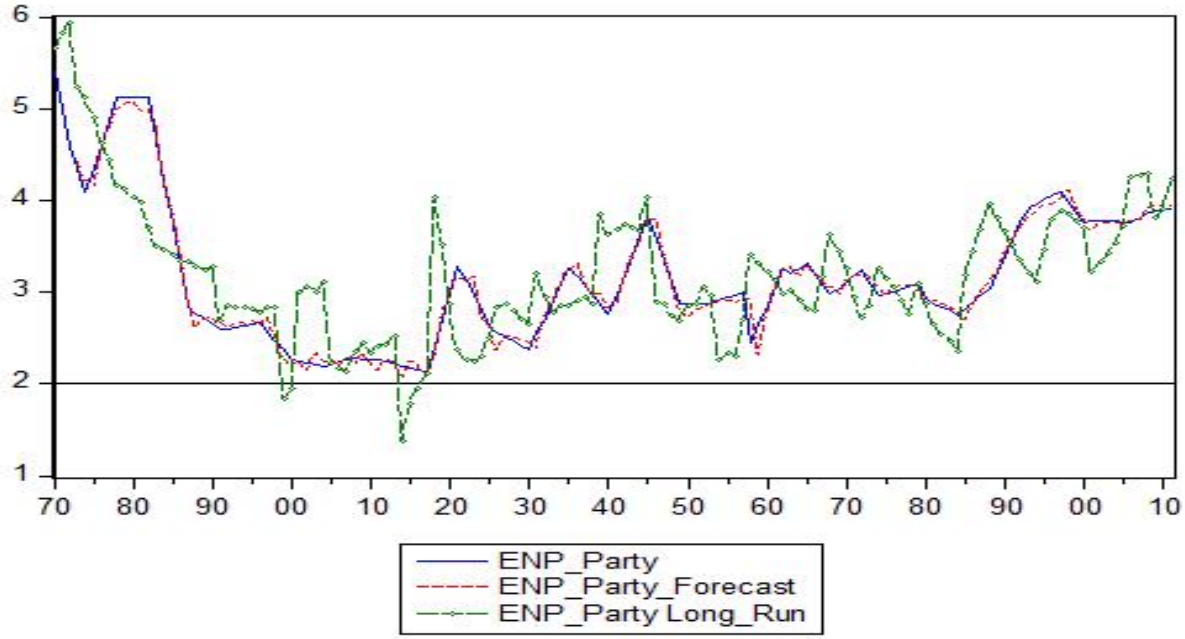

Figure 4
Short Run Adjustment Processes implied by ARDL Modeling
Canada: 1870 - 2011

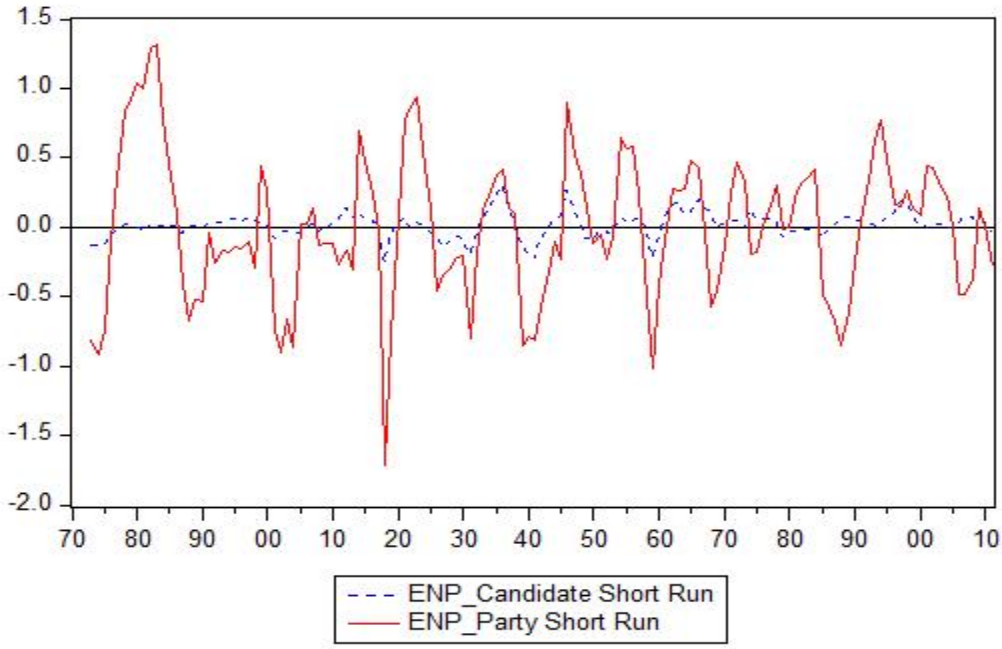

Figure 5
Actual and NARDL Long Run of ENP_Party

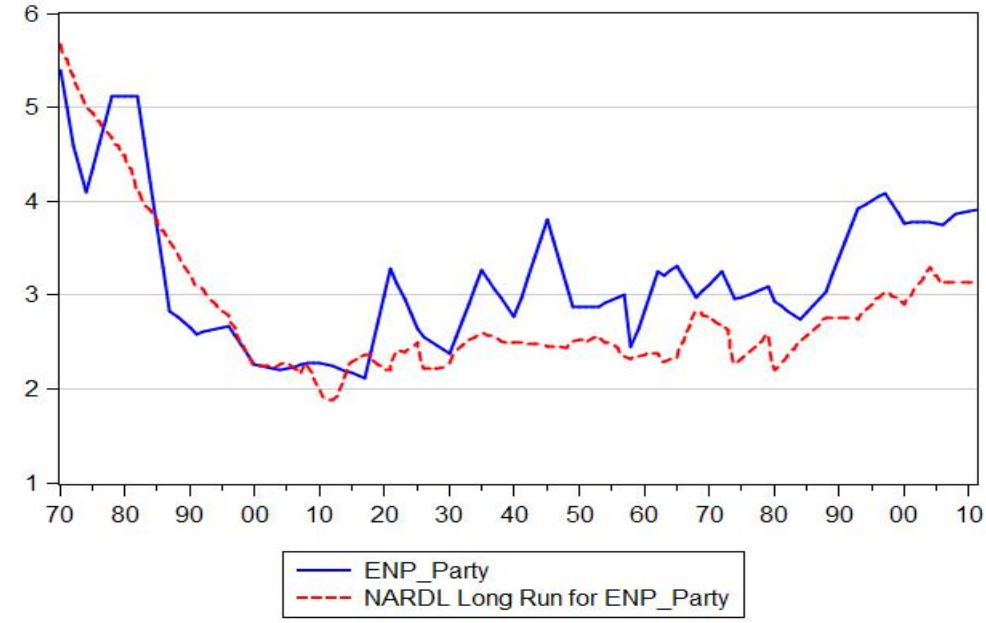

Figure 6
Party Fringe = ENP_Party - ENP_Party Long Run

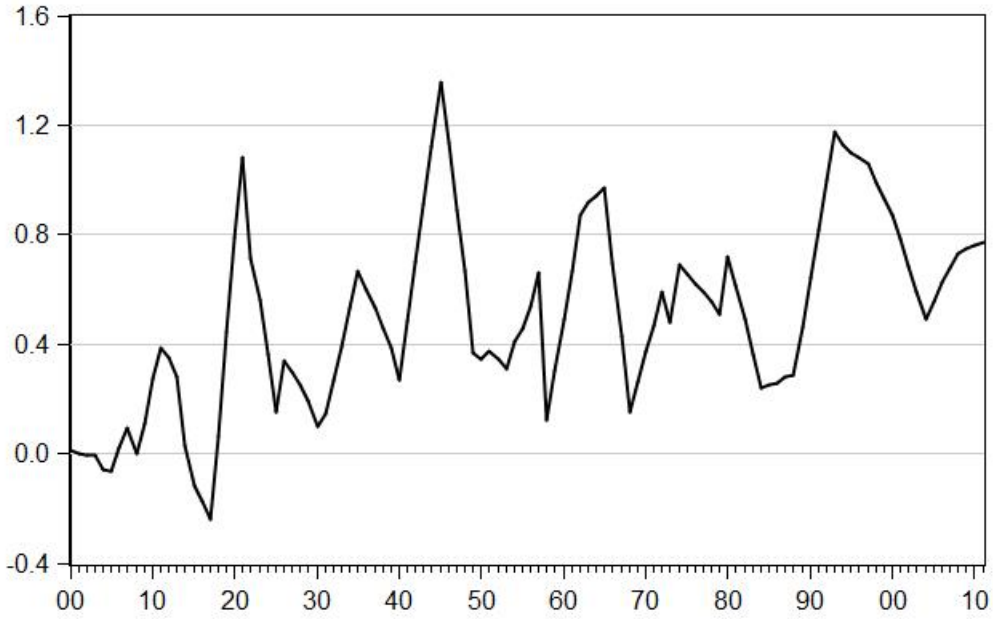

Table 1

ARDL (3,0,0,1,1,1,1,0, 0,0,0) Model of ENP_CANDIDATES: Canada: 1870 – 2011

(absolute value of t statistics in brackets)

Level **Predicted Sign (+/-)**	**ARDL Model** Schwartz criterion used for Lag selection ENP_Candidate Measure	**Long Run Model** ENP_Candidate	**Short Run Model** D(ENP_Candidate)	
ENP_Candidate(-1)	1.085*** (13.60)		D(ENP_Candidate(-1))	0.413*** (6.31)
ENP_Candidate(-2)	-0.212* (1.81)		D(ENP_Candidate(-2))	0.189*** (2.79)
ENP_Candidate(-3)	-0.190 (2.56)**			
RELATIVE_MP_WAGE (+)	0.0029 (0.955)	0.009 (0.961)	D(RELATIVE_MP WAGE)	-0.001 (0.200)
PENSION_PARAMETERS(+)	0.0165 (0.638)	0.052 (0.632)	D(PENSION_ PARAMETERS)	-0.017 (0.371)
REGISTERED (+)	-0.004** (2.50)	0.005* (1.95)	D(REGISTERED)	-0.004*** (3.18)
REGISTERED(-1)	0.006*** (4.04)			
TURNOUT (+)	0.00008 (0.051)	0.008** (2.25)	D(TURNOUT)	0.00006 (0.040)
TURNOUT(-1)	0.003 (1.60)			
RELIGION (+)	0.055 (0.992)	0.173 (0.972)	D(RELIGION)	0.060 (0.249)
CONSTITUENCY SIZE (+)	0.00002** (2.40)	0.00002*** (2.80)	D(CONSTITUENCY_SIZE)	0.00002*** (3.89)
CONSTITUENCY SIZE(-1)	-0.00001 (1.54)			
AVG_INCUMBENTS (-)	-0.276*** (4.95)	-0.267** (2.33)	D(AVG_INCUMBENTS)	-0.286*** (5.43)
AVG_INCUMBENTS(-1)	0.192*** (3.56)			
IMRATIO (?)	-0.010** (2.10)	-0.032** (2.02)	D(IMRATIO)	-0.013* (1.79)
URBAN_PROPORTION (?)	-0.960** (2.49)	-3.03*** (2.71)	D(URBAN_PROPORTION)	-1.31 (1.54)
FUNDING1974 (-)	-0.071** (2.37)	-0.226*** (2.71)	D(FUNDING1974)	-0.045 (1.11)
WW1 (-)	-0.072*** (2.75)	-0.229*** (2.63)	D(WW1)	-0.094*** (3.08)
WW2 (+)	0.051*** (2.73)	0.160*** (2.63)	D(WW2)	0.042 (1.49)
CONSTANT	0.546** (2.35)	1.726*** (2.64)	Error correction Term	-0.319*** (8.19)
Adj R^2 Bounds Test: 1% I(1) 1% upper bound 3.68	.984 6.90***		No. of Observations Log Likelihood	139 261.4

***,(**),[*] significantly different from zero at 1%, (5%),[10%];

Table 2
ARDL (4,0,1,2,1,1,1,2,1) Model of ENP_Party (with Acclamations)
Canada: 1870 – 2011
(absolute value of t-statistics in brackets)

	ARDL Model Schwartz criterion used for Lag selection ENP_Party Measure	**Long Run Model** ENP_Party	**Short Run Model** D(ENP_Party)	
ENP_Party(-1)	1.214*** (10.03)		D(ENP_Party(-1))	0.469*** (7.31)
ENP_Party(-2)	-0.263* (1.85)		D(ENP_Party(-2))	0.205*** (2.82)
ENP_Party(-3)	-0.060 (0.981)		D(ENP_Party(-3)	0.145** (2.07)
ENP_Party(-4)	-0.146** (2.58)			
RELATIVE_MP_WAGE (+)	-0.011 (1.48)	-0.041 (1.54)		
REGISTERED (+)	-0.009*** (3.06)	0.018*** (2.91)	D(REGISTERED)	-0.009*** (2.69)
REGISTERED(-1)	0.013*** (4.46)			
TURNOUT (+)	0.003 (0.712)	0.039*** (2.98)	D(TURNOUT)	-0.003 (0.950)
TURNOUT(-1)	-0.0003 (0.050)		D(TURNOUT(-1))	-0.007** (2.09)
TURNOUT(-2)	0.007* (1.68)			
RELIGION	-2.387 (1.64)	2,259*** (5.80)	D(RELIGION)	-2.387** (2.27)
RELIGION(-1)	2.962* (1.96)			
CONSTITUENCY SIZE (+)	-0.00003 (1.131)	-0.00005** (2.19)	D(CONSTITUENCY SIZE)	0.00005** (2.40)
CONSTITUENCY SIZE(-1)	-0.00004* (1.72)			
AVG_INCUMBENTS (-)	-0.474** (1.96)	0.077 (0.279)	D(INCUMBENTS)	-0.474*** (3.77)
AVG_INCUMBENTS(-1)	0.493** (2.23)			
IMRATIO (?)	-0.003 (0.011)	-0.060 (1.33)	D(IMRATIO)	-0.0003 (0.018)
IMRATIO(-1)	-0.053 (1.04)		D(IMRATIO(-1))	-0.038** (2.26)
IMRATIO(-2)	0.038 (1.30)			
URBAN_PROPORTION (?)	-2.473 (0.849)	7.667* (1.91)	D(URBAN_PROPORTION)	-2.473 (1.192)
URBAN_PROPORTION(-1)	4.423 (1.55)			

WW1 (-)	-0.163*** (2.81)	-1.63** (2.23)		
WW2 (+)	0.119*** (2.98)	0.119*** (2.76)		
CONVERGENCE TREND (+)	0.028*** (4.87)	0.028*** (537)		
FUNDING1974	0.024 (0.515)	0.024 (0.398)		
CONSTANT	-1.786*** (3.868)	-18.55*** (3.80)	Error Correction Term	-0.254*** (8.73)
Adj R^2 Bounds Test: F-statistic (I1 1% upper bound 3.77)	.982 7.04***		No. of Observations Log Likelihood	138 144.4

***,(**),[*] significantly different from zero at 1%, (5%),[10%].

Table 3

NARDL (2,3,3,0,3,3,3,3) Model of ENP_Party

Canada 1870-2011

(absolute value of standard errors in brackets below coefficient estimates)

Levels **Predicted sign (+/-)**	**Long Run**	**Differences (D)**	**Short Run Positive**	**Short Run Negative**
		D(ENP_PARTY(-1))	0.725*** (13.03)	0.420*** (6.60)
RELATIVE_MP_WAGE (+)	0.007 (0.23)	D(RELATIVE_MP_WAGE)	0.001 (0.16)	-0.001 (0.05)
		D(RELATIVE_MP_WAGE(-1))	0.016** (2.19)	-0.013 (0.59)
		D(RELATIVE_MP_WAGE(-2))	-0.003 (0.38)	0.030 (1.35)
REGISTERED (+)	0.007 (1.06)	D(REGISTERED)	-0.007*** (3.59)	-0.008 (1.28)
		D(REGISTERED(-1)	0.002 (0.67)	0.017*** (2.75)
		D(REGISTERED(-2))	0.001 (0.36)	-0.013** (2.10)
RELIGION (+)	0.871*** (2.87)	D(RELIGION)	0.002 (0.001)	5.13 (0.40)
		D(RELIGION(-1))	-2.58 (1.37)	-54.08*** (3.28)
		D(RELIGION(-2))	1.78 (1.32)	-4.666 (0.39)
IMRATIO (?)	-0.050 (0.99)			
CONSTITUENCY SIZE (+)	0.00005 (0.20)	D(CONSTITUENCY SIZE)	0.0002** (2.07)	-0.0001 (1.43)
		D(CONSTITUENCY SIZE(-1))	-0.00004 (0.59)	0.00001 (0.04)
		D(CONSTITUENCY SIZE(-2)	-0.00001 (0.77)	0.00002 (0.06)
AVG_INCUMBENTS (-)	-0.703** (2.02)	D(AVG_INCUMBENTS)	-0.0001 (1.42)	-0.146 (0.61)
		D(AVG_INCUMBENTS(-1))	0.0001 (0.97)	0.224 (0.77)
		D(AVG_INCUMBENTS(-2))	-0.00003 (0.714)	0.012 (0.05)
URBAN_PROPORTION (?)	1.802 (0.43)	D(URBAN_PROPORTION)	0.178 (0.14)	17.35 (0.95)
		D(URBAN_PROPORTION(-1))	0.166 (0.10)	4.542 (0.27)
		D(URBAN_PROPORTION(-2))	-1.92 (1.33)	-1.986 (0.15)
WW1 (-)	-0.434* (1.65)	CONSTANT	0.007 (0.08)	0.013 (0.08)
WW2 (+)	0.659*** (3.54)			

CONVERGENCE TREND	0.112*** (10.43)	ERROR CORRECTION TERM	-0.077*** (6.16)	-0.127*** (6.42)
FUNDING1974 (-)	-0.309 (1.37)	Number of Observations Log Likelihood	278 423.3	

*, (**), [***] significantly different from zero at 10%, (5%), [1%]

-- Test of error correction term (state1) = error correction term (state 2) = 0; chi2(2) = 71.7; Prob > chi2 = 0.00.

-- Hausman test of the hypothesis that the short run coefficients estimated under the assumption that the long run coefficients are constant across states are not systematically different from their average generates a chi2(10) = 0.00.

Table 4

ENP_Measures as Indicators of Political Competitiveness: 1900 – 2011

(absolute value of Newey-West t-statics in brackets below coefficient estimates)

Competition Variable	D(ENP_Candidate Long Run) **ARDL**	ENP_Candidate **ARDL** Fringe	D(ENP_Party Long Run) **NARDL**	ENP_Party **NARDL** Fringe
Przeworski and Sprague Constituency based, Candidate measure	-0.010 (0.165)	0.047 (0.724)		
Przeworski and Sprague Constituency based, Party measure			-0.358*** (4.83)	0.142 (1.08)
Asymmetry adjusted marginal seats	-0.012 (0.263)	0.017 (0.050)	0.057 (1.14)	-0.018 (0.176)
SEATS	0.088 (1.42)	-0.106 (1.53)	0.121* (1.65)	-0.0001 (0.094)
Constant	-0.028 (0.574)	-0.026 (0.472)	0.136** (2.51)	0.002 (0.019)
Lagged Dependent variable		0.946*** (10.16)		1.272*** (14.13)
Twice lagged Dependent variable		-0.342*** (3.75)		-0.423*** (4.69)
Statistics: Observations AdjR^2 DW (3, 112: 1.603)	 112 0.00 2.08	 112 0.574 2.06	 112 0.161 1.62	 112 0.842 2.04

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