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Forecasting Brazilian presidential elections: Solving the *N* problem

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ABSTRACT

The use of election forecasting models is common practice in the US and other established democracies like France and the UK. However, not much work has been done in the area for more recent democracies. Forecasting election results in recently (re)democratized countries poses a serious challenge, given the very few observations of the dependent variable. Thus, we ask: is it possible to make valid election forecasts when the number of elections we have is very small? In this paper, we present recommendations on how to forecast elections under such circumstances. Our strongest recommendation is to evaluate forecasting models using subnational data. We illustrate our recommendations using Brazilian presidential elections since 1994 and data from the 27 states of the Union. Our findings indicate that forecasting elections in recent democracies is neither futile nor impossible, as some of the models presented here produce reasonably accurate forecasts.

1. Introduction

Election forecasting has a long tradition, especially in French and American presidential and midterm elections (Lewis-Beck, 2005), but not much has been done elsewhere, including, most notably, in the more recently democratized parts of the world, where elections have been few and far between. The most important constraint in forecasting election results in the newly democratized world is the limited number of observations on the dependent variable: that is, the small number of elections these countries have faced in the recent democratic period. Admittedly, most election forecast models today still deal with a small N (<20 in most cases), but even that is already three to four times more than are available for newly democratized countries. Thus, we ask: is it possible to make valid election forecasts when the number of elections is extremely low? A low N constitutes an important limitation when making election forecasts, but we believe that the task is neither futile nor impossible.

There are indeed some solutions to the small N problem. One possible strategy to increase the sample size is to move to a lower level of analysis (King, Keohane, & Verba, 1994). Electoral districts can be divided into smaller units where information about the dependent variable and (at least some of) the independent variables is available. Consider, for example, a nationally fought election (e.g., a presidential election) where the new unit of analysis could be regions, states, provinces, länder or cantons. Depending on the number of smaller units that can be used, this can improve the N problem.

Another (more obvious) recommendation would be to avoid specifying models with large numbers of determinants. The smaller the number of independent variables, the greater the number of degrees of freedom available for the estimation. In scenarios plagued by data limitations, parsimony is not a choice but a necessity.

Now, the move from one level of analysis to a lower one can certainly pose new challenges, such as that related to the availability of some measures. To be sure, most countries collect economic data at much lower levels of analysis than the national one, so moving to smaller units should not cause much of a problem for these kinds of data. On the other hand, public opinion

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data measuring more subjective economic and political determinants of the vote can be harder to find. This may affect the kinds of forecasting model one may be able to specify, which consequently influences forecast evaluations. Another potential challenge concerns the issue of unit heterogeneity, where the electoral dynamics are strongly related to regional differences. In this case, additional statistical care will have to be taken to achieve valid forecasts when moving from one level of analysis to a lower one.

In this paper, we illustrate our recommendations using Brazilian presidential elections. Brazil's recent (re)democratization in the 1980s has now produced six presidential elections (1989, 1994, 1998, 2002, 2006 and 2010). We test a model that attempts to explain the vote choice for the incumbent candidate from the 1994 elections onward. Because of the low N size at the national level, this model focuses on explaining election outcomes at the subnational level, more specifically at the state level in Brazil. Therefore, our modeled variable is election outcomes for the incumbent candidate in Presidential elections in each of the 27 states of the Union.

In the next section we discuss the basic models for election forecasting in older democracies. Next, we evaluate three forecasting models using data from Brazil's recent presidential elections. We conclude with a discussion of the value of each of these three models for predicting presidential election results in Brazil, a recently (re)democratized country.

2. Theory: the basic model

Election forecasting models tend to be quite simple, and usually follow this basic form:

$$\text{Vote} = f(\text{economy},\ \text{politics}),$$

where the vote (generally expressed as the vote for the incumbent party or candidate in the case of the US presidential election, or the total vote share received by the left-wing presidential candidates during the first round in France) is a function of some economic and political factors. Conventional economic determinants include objective measures of economic performance such as economic and income growth, inflation and unemployment (or job creation), or other kinds of economic indices (e.g., the US Leading Economic Indicator), as well as measures of government spending. Some models also include subjective economic measures such as those related to consumer sentiment, including voter perceptions about their retrospective and/or prospective personal finances, and perceptions about the positivity (or negativity) of economic news. The expectation is that good economic performances and positive voter perceptions of the economy and personal finances should benefit incumbents (or candidates running under the same party label as incumbents) who are seeking reelection.

Political determinants, for their part, are generally composed of public opinion measures of government popularity, vote intentions, and party identification. Some models also include the incumbent's number of terms in office. The expectation is that popular governments should be more successful in their reelection bids than unpopular ones, although long tenures should reduce the likelihood of reelection. Similarly, parties and candidates which generally do well in pre-election polls, and those that have large bases of partisans, also generally tend to do better in elections.

Most election forecasting models include only a limited number of these factors (two to three determinants on average). Most models use a combination of objective economic measures and subjective measures of public opinion (e.g., Abramowitz, 2004, 2008; Campbell, 2004, 2008; Lewis-Beck, Bélanger, & Fauvelle-Aymar, 2008; Lewis-Beck & Tien, 2004, 2008) while others only use measures of one kind, either all objective (e.g., Cuzán & Bundrick, 2008) or all subjective (e.g., Holbrook, 2004). Pure economic or political models are not very common, but see Norpoth (2004, 2008) for a pure political model.

The choice of variables to include in models is restricted by data availability. In the developed world, there are plenty of series to choose from, either of a political or economic nature. However, the same is not true in new democracies. This issue is important, because a forecast evaluation is contingent upon the specification of the models. If there are data limitations, then the quality of the models, and thus their predictive capacity, may suffer, posing yet another challenge for forecasting in young democracies.

3. Forecasting Brazilian presidential elections

We select Brazilian presidential elections as a good case for evaluating election forecasts when the number of observations is very low. In the 1980s, Brazil went through a period of re-democratization, first with gubernatorial elections in 1982, followed by the promulgation of a new constitution in 1988, and the first presidential elections in 1989 after more than 20 years of absence. Since then, Brazil has held six presidential contests (1989, 1994, 1998, 2002, 2006 and 2010), of which the first was won by Fernando Collor de Mello, from a small party that no longer exists, and the remaining elections were won twice by the Partido da Social Democracia Brasileira (PSDB) and three times (the last three elections) by the Partido dos Trabalhadores (PT).

Brazilian presidents elect themselves based on a majority of the popular vote, at times requiring a second round to have a winner. Only in the two elections won by the PSDB, in 1994 and 1998, was there no need for a second round, with Fernando Henrique Cardoso winning a majority of the popular vote in the first round. The Brazilian electorate is made up of over 100 million voters and participation is compulsory, albeit justified abstention and casting a null or a blank vote are allowed by law. Still, turnout is very high, with around 80% of the eligible population voting in each election. However, Brazil is not only populous, it also extends over a very large territory (larger than the continental US) and forms a federation. The territory is divided into five regions and 27 states. Thus, Brazil constitutes a good case for examining the question at hand, not only because it has held only a handful of presidential elections in recent times, but also because its territory is divided into smaller units.

In addition, there is plenty of evidence in Brazil that economic outcomes are a central determinant of vote choice at the individual level: voters are certainly aware of the state of the economy when making choices. Hence, forecasting based exclusively on aggregate level economic data, which presupposes to some extent that voters are aware of the economy, does not incur much risk of the ecological fallacy in Brazil (King, 1997). The literature on voting behavior in Brazil has indicated that voters rely extensively on socio-tropic economic voting as a central determinant of vote choice for President (Ames, Baker, & Renno, 2008; Camargos, 2001; Carreirão, 2007; Rennó, 2007). In Brazil, voters are aware of several different dimensions of incumbents' performances in office, and evaluate them based on the state of the national economy. Rennó and Spanakos (2006), for example, in explaining presidential vote intentions, show that in Brazil economic variables have the theoretically expected effect: inflation decreases the vote for the incumbent and GDP growth increases it. Therefore, it is highly probable that election forecasting models based on the state of the economy and evaluations of the incumbent will work very well in Brazil, as they do when applied to older democracies.

In all elections since 1994, except for 2002, one has seen a strong incumbent candidate taking full advantage of its highly visible position in the Brazilian political scenario. In 1994, Cardoso was the then Minister of Finance of the Itamar Franco administration. In 1998 he was reelected. The elections of 2002 were a water-shed moment in Brazilian history, with a left-wing candidate winning the presidential elections for the first time, in a setting of extremely low levels of popularity of the incumbent administration. It is the only case in contemporary history where the incumbent candidate was not elected. Lula da Silva's 2002 victory marked the beginning of a long reign of successful PT bids at the presidency, being reelected in 2006 and electing the government's candidate in 2010, Dilma Rousseff. Lula and Dilma have generated very positive economic outcomes in the country, boosted by a favorable international scenario, with booming commodities prices (Spanakos & Rennó, 2010). The result has been very high levels of popularity, which must be considered in forecasting models. Studies attribute Dilma's victory in 2010 directly to Lula's popularity and the incumbent administration's economic successes (Rennó & Cabello, 2010; Singer, 2009).

Besides being an extreme case of multiple parties, Brazilian presidential elections have consistently been focused on two opposing forces: Fernando Henrique Cardoso and Jose Serra's PSDB and Lula da Silva's PT. These two parties form the core of the coalitions that have dominated national politics since 1994. Third place contestants have obtained up to 19% of the national vote, but have never really threatened the PT/PSDB dominance. The two-party nature of Brazilian presidential elections makes the Brazilian case similar to that of developed countries, where forecasting models based on the state of the economy and the incumbent's popularity have been used widely.

Therefore, there is no need to endogeneize the model to the Brazilian case, with the inclusion of other variables beyond those traditionally used in the forecasting models of older democracies. One could think that problems of crime and violence, unemployment and low income, as well as inequality and poverty, would be more pressing in Brazil and could affect the vote for president. These are plausible hypotheses. However, including such variables in a forecasting model would generate problems in finding indicators of expectations for the values of such variables in the year or quarter of future elections. Therefore, the lack of data prohibits the inclusion of more variables in a forecasting model of Brazilian elections. Finding projections for the traditionally used economic variables, such as GDP, has proven to be a challenge in itself, as will be discussed in the next section. In addition, as will also be seen later, a more parsimonious model fares well in our estimations.

3.1. Data

To be fair, Brazil is data-rich compared to other developing countries of the world. However, that being said, the lack of data does still pose challenges and limitations for the specification of the models we use, as will become clear later. Governments, governmental and non-governmental research institutes, interest groups and the media have all contributed a great deal to the collection of data about Brazil's economic, social and political spheres. The election data are readily available at various levels of analysis from Brazil's Superior Electoral Court (Tribunal Superior Eleitoral).[1] The main economic sources are the Instituto Brasileiro de Geografia *e* Estatística (IBGE) and the Instituto de Pesquisa Econômica Aplicada (IPEA), which offer a great range of series.[2] However, public opinion data are more scarce. Several institutes and agencies have been measuring presidential approval, vote intentions and other political issues since the mid 1990s[3]; the main challenge with these data being that they are generally not available at the subnational level. Such data are more readily available for more recent elections than for earlier ones, and the quality of data collection has also improved.

We use data from the 1994, 1998, 2002 and 2006 elections, for which some political and economic data are available at the state level. We exclude the 1989 presidential election for several reasons. First, it was not concurrent with legislative elections, which differentiates it from all presidential elections since. Hence, the dynamics of electoral competition in the 1989 election are completely distinct from those of the subsequent elections, and its results may simply distort predictions for future elections. It was

[1] The TSE website is http://www.tse.gov.br/internet/index.html.

[2] The IBGE website is www.ibge.gov.br/english/ and the IPEA datasets are available at http://www.ipeadata.gov.br/.

[3] Institutes who have been collecting public opinion data consistently include Datafolha, Sensus, Ibope and Vox Populi. These institutes generally work in partnership with other non-governmental agencies like the Confederação Nacional da Indústria (CNI) and the Confederação Nacional dos Transportes (CNT), or have media partners like TV Globo, *O* Estado de São Paulo, Folha de São Paulo, or Rádio *e* Televisão Bandeirantes Ltda.

also an election based on a different set of party system rules, with an inflated number of parties competing for the vote and a great fragmentation of vote choices. Therefore, the outcome of the 1989 election had much lower levels of voting for different candidates, which could influence the results of our model unduly. A final reason for its exclusion, based on the political characteristics of the election, is that it was not based on the logic of having an incumbent candidate: nobody wanted the very unpopular Jose Sarney's endorsement. Therefore, none of the candidates was considered responsible for the state of the economy, which should artificially reduce the goodness-of-fit of the model. Finally, the 1989 election also took place in a period with extremely high levels of inflation, which were not present in the elections from 1994 on. Hence, the 1989 election is clearly not comparable to the succeeding races. Therefore, we chose to exclude the first presidential election because of its unique character. The recent 2010 election is not included in the analysis either, because state-level data were not yet available at the time of writing.[4]

3.2. Models

We present here three models that can be used to forecast presidential elections in Brazil, with slight modifications. They are based on existing models for predicting US and French presidential elections. The choice of these three models is not random. First, they are models of presidential election forecasts. Second, they are parsimonious. Third, and more importantly, they make use of data that are available in the Brazilian context. The scarcity of public opinion data in Brazil limits the use of subjective measures of the economy and/or of politics, which are common in many other forecast models. Fourth, they have been around for a long time and have proven to be quite good overall. Fifth, and finally, as the above discussion demonstrates, the dynamics of Brazilian presidential elections are similar to those found in more established democracies. Thus, we feel confident that the three models presented below will also be quite useful in forecasting Brazilian presidential elections.

Table 1 presents the details of the models. Specifically, the table presents information about the authors of the forecast models considered here, the list of predictors included in their forecast equation, the predictors we use in our current forecast models, the level of analysis at which these predictors are available, and the election years for which the models are applied to the Brazilian case. Note that these forecast models have been around for a long time. We present the latest versions published.

First, the models are adapted slightly, given the data availability. The dependent variable is the first-round vote for the incumbent candidate in the presidential elections, measured as a percentage of all votes received by the incumbent in each of the 27 states. Hence, this measure is computed based on the total number of votes each candidate received at the state level in Brazil. The incumbent was Fernando Henrique Cardoso in 1994 and 1998, and Jose Serra in 2002. Both candidates are from the Partido da Social Democracia Brasileira (PSDB). The vote for the incumbent in 2006 is that of Lula da Silva, from the Partido dos Trabalhadores (PT).

The first model (Abramowitz, 2008) is estimated in two different forms. The first specification includes only a measure of economic activity and a dummy for an incumbent party seeking a third term. The economic activity measure is the real annual growth of the GDP from the year preceding the election to the election year, by state. Unfortunately, no quarterly state-level economic data were found. The dummy for an incumbent seeking a third term identifies the 2002 election, when the PSDB was seeking a third term. Because the popularity of the incumbent is not available at the state level, we estimated a second equation that includes the real annual growth of the GDP, the third term dummy and the August popularity of the incumbent (measured at the national level and applied equally to all states for the same year). The polls are all from the Datafolha, and were conducted in August, about two months before the election.[5] The model is estimated for all 4 elections (1994, 1998, 2002 and 2006), generating 108 observations (27 states $\times$ four years). Given the panel structure of the data in model 1 (27 states over a period of four time-points), we estimate it using a random effects GLS regression, with standard errors adjusted for clustering at the state-level.[6]

The second model (Campbell, 2008) includes the same economic activity measure as the previous model, but adds a trial-heat poll variable by state. The trial-heat polls are all from IBOPE and were conducted in August.[7] State-level poll data were only available for 2006,[8] and consequently, this second model only uses data from the 2006 election, with a total of 27 observations. Estimates are obtained by OLS.

The third and last model is a slightly modified version of the model presented by Lewis-Beck et al. (2008), in that we use the real annual growth of the GDP instead of the unemployment rate, because the latter is not readily available at the state level. The model also includes the same popularity measure as was used in the first model presented above. This last model, like the first one, is estimated for all 4 elections (1994, 1998, 2002 and 2006), and has 108 observations. Coefficient estimates are also obtained by random effects GLS.

[4] According to the IBGE website, state-level economic data should be made available in November 2012.

[5] We took the average of the August polls when there was more than one.

[6] Hausman tests were conducted to evaluate whether a fixed or random effects model would be most appropriate. All of the tests indicated support for the random effects model.

[7] We used poll results from July or September, in that order, for states in which no August poll were conducted. In states for which we have more than one poll for August, we took the average value of the polls.

[8] National level data are also available for 2002, but not for previous years.

Table 1
Election forecasting models.

Models and authors	Predictors		Years
	Original model	Adapted model (level of availability)	
Model 1: Abramowitz (2008)	1. Popularity of the incumbent 2. Second quarter GDP 3. Third term	1. Popularity of the incumbent (national) 2. Real annual GDP growth (state) 3. Third term	1994–2006
Model 2: Campbell (2008)	1. Trial-heat poll 2. Second quarter GDP	1. Trial-heat poll (state) 2. Real annual GDP growth (state)	2006
Model 3: Lewis-Beck et al. (2008)	1. Popularity of the incumbent 2. Unemployment	1. Popularity of the incumbent (national) 2. Real annual GDP growth (state)	1994–2006

Table 2
Forecast models for Brazilian presidential elections: 1994–2006.

	Model 1[a] (Abramowitz, 2008)		Model 2[b] (Campbell, 2008)	Model 3[a] (Lewis-Beck et al., 2008)
	A	*B*		
Economic growth	0.10 (0.09)	0.09 (0.09)	0.03 (0.17)	0.02 (0.08)
Third term dummy	−33.36* (2.53)	−29.57* (9.49)	–	
Trial-heat poll	–	–	0.92* (0.05)	
Popularity	–	0.24 (0.65)		1.98* (0.17)
Constant	52.95* (1.34)	33.56 (52.52)	1.75 (2.71)	−108.57* (12.64)
R^2 (within)	0.69	0.69	–	0.66
R^2 (overall)	0.61	0.61	–	0.59
R^2	–	–	0.93	–
SEE	10.79	10.85	3.82	11.26
N	108	108	27	108

[a] Entries are random effects GLS coefficient estimates, with robust standard errors in parentheses.
[b] Entries are OLS coefficient estimates, with standard errors in parentheses.
* $p < 0.05$ (one-tailed).

3.3. Results

Table 2 presents results for the three models discussed above. The results from both versions of the first model indicate a very strong effect for the *Third Term Dummy*. As hypothesized, candidates (or actually parties) seeking a third term are generally expected to lose by a large amount.[9] *Economic Growth* shows the expected sign in each case, but fails to reach conventional levels of statistical significance. The second version of the Abramowitz (2008) model indicates a positive effect for popularity of the incumbent, although the effect is not statistically different from zero. The results for the second model show a very strong effect for the *Trial-heat* variable. Not surprisingly, vote intentions collected two months before the election are strong predictors of the final vote. *Economic Growth*, for its part, shows the expected sign, but fails to reach statistical significance. Finally, the third model shows a statistically significant effect for *Popularity*, but again no statistically significant effect for *Economic Growth*.[10]

Hence, we find a significant effect of political variables at both the state and national levels, but fail to do so with state-level economic variables. The trial heat polls collected at the state level demonstrate how promising the inclusion of state-level political variables (when available) appears to be for explaining national-level election results.[11]

[9] This result is influenced by a single election year, 2002, when the incumbent administration faced very low levels of popularity. In 2010, when the incumbent president was extremely popular, the result was completely different, with the incumbent candidate (Rousseff) almost winning the election in the first round. Hence, the result presented here should be interpreted with care until more data become available.

[10] Economic Growth is only statistically significant in Table A.1, model 1A, in the Appendix. In that table, the variables are weighted by population size at the state-level. The small *N* may explain the lack of statistical significance of this important variable; however, studies using even smaller samples have still found it to be statistically significant. Interestingly, it is also not strongly correlated with presidential popularity. One possible explanation may be that, since it measures the state's GDP growth, not national GDP, the state governor and not the president may be blamed (or credited) for the state's economic condition, thus attenuating its statistical effect on the outcome of presidential elections. However, that being said, note that all signs are in the right direction, and the estimated coefficients, although not statistically significant at conventional levels, certainly contribute greatly to the accuracy of the forecasts.

[11] States are meaningful political entities in Brazil (Samuels, 2003). The political and economic conditions of a state are an important intervening factor in the way in which citizens evaluate politics.

Table 3
In- and out-of-sample forecasts, by model and election.

Election year	Vote for the incumbent, in %	Forecast, in % (Forecast error, in %)			
		Model 1 (Abramowitz, 2008)		Model 2 (Campbell, 2008)	Model 3 (Lewis-Beck et al., 2008)
		A	*B*		
1994[a]	54.27	53.47 (−0.80)	53.81 (−0.46)	39.73 (−14.54)	55.95 (+1.68)
1998[a]	53.06	52.95 (−0.11)	52.37 (−0.69)	40.27 (−12.79)	47.93 (−5.13)
2002[a]	23.19	19.84 (−3.35)	19.94 (−3.25)	16.50 (−6.69)	22.22 (−0.97)
2006	48.61	53.33 (+4.72)	53.61 (+5.00)	45.88 (−2.73)	55.27 (+6.66)
2010[b]	46.97	20.32 (−26.65)	27.41 (−19.56)	42.62 (−4.35)	80.74 (+33.77)
Average	–	*−5.24*	*−3.79*	*−8.22*	*+7.20*

[a] Out-of-sample forecast for Model 2 only.
[b] Out-of-sample forecast for *all* models.

Our first goal is to evaluate the models, considering the four criteria presented by Lewis-Beck (2005): *accuracy, lead, parsimony*, and *reproducibility*. We evaluate the accuracy of the models based on goodness-of-fit measures. Models 1*A* and 1*B* present overall R^2 values which are nearly the same as the value of 0.62 that was reported by Abramowitz (2008) for his forecast model of US presidential elections. However, the values of the standard error of the estimate (SEE) for versions *A* and *B* of Model 1 are each nearly three times larger than that obtained by Abramowitz (3.80). The R^2 value of Model 2 is much higher, and is also very similar to that reported by Campbell (2008) in his forecast of US presidential elections (0.90). Again, the standard error of the estimate of Model 2 is higher than that of Campbell's, at 1.80. Finally, Model 3 shows an overall R^2 which is slightly higher than that reported by Lewis-Beck et al. (2008) in their analysis of French presidential elections (at 0.56), but a much larger SEE than theirs, at 6.05. The statistics just reported indicate that Models 1, 2 and 3 all appear to show acceptable degrees of accuracy. Admittedly, the SEEs of the first and third models are high, but that is also because there is greater variation in the vote functions of these models to be explained, given the larger number of cases used (108 observations—27 states in four distinct elections—for Models 1 and 3, vs. 27 observations—27 states in one election—for Model 2).

Another way to evaluate the accuracy of forecasting models is to use the coefficient estimates to predict the actual presidential vote of the incumbent (within-sample forecasts for 1994, 1998, 2002 and 2006, and out-of-sample forecast for 2010). Table 3 presents these predictions by model and election. It is worth noting here that the simulations use national measures of trial-heat polls, popularity of the incumbent, and economic growth. The findings indicate that Model 1*B* is the most accurate model. This model predicts two elections (1994 and 1998) to within one percentage point, but fails dramatically to predict the most recent election of now President Dilma Roussef, by nearly 20%. The average forecast error for Model 1*B* is 3.79%, which is nearly three times as large as that obtained by Abramowitz for the last 15 American presidential elections (1.33%). Model 1*A* is the next most accurate model. It also predicts the 1994 and 1998 elections to within one percentage point, but clearly underestimates the last presidential election, this time by over 26%. Its average forecast error is large, at 5.24%. Models 2 and 3, for their part, perform rather poorly relative to Models 1*A* and 1*B*. Model 2's most accurate prediction is for the 2006 presidential election, with a forecast error of 2.73%. However, its average forecast error is 8.22%, which is much larger than the average forecast error reported by Campbell for the last 15 American presidential elections (1.62%). Model 3 shows a slightly lower average forecast error, at 7.20%, but manages to predict the 1994 and 2002 elections well, with forecast errors of 1.68% and 0.97%, respectively.[12] The problem with this last model is how badly it predicts the 2010 contest, with a forecast error of 33.77%. Finally, it is worth noting that the least accurate model of all, Model 2, is the one that predicts the 2010 outcome best, though it still has a large forecast error of 4.35%.

Before discussing the other three criteria, it is worth pausing here to try to understand why the forecasts for 2010 are so far off the mark. We believe that the explanation is twofold. First, 2009 was a year of economic crisis in the world, which did affect the performance of the Brazilian economy, but not as much as in other countries. Hence, the economy may have fared worst in 2009, but not for factors which were clearly attributable to the incumbent president, and this may have distorted the forecasting, which is based mostly on economic variables. Second, and more importantly, the extraordinary popularity of the then president Luis Inácio Lula da Silva is central in explaining the results of this election. The approval ratings for Lula in 2010 beat all prior records, with over 80% of the population evaluating him as good

[12] Unfortunately, Lewis-Beck et al. (2008) do not report the average forecast error of their model, because the focus of their paper is on predicting the 2007 contest. Consequently, we cannot compare our findings with theirs.

or excellent. This popularity contrasts strongly with that of Fernando Henrique Cardoso in 2002, when Serra (the PSDB incumbent candidate) was seeking a third mandate for the party. Back then, Cardoso's popularity was at 23%, less than a third that of Lula in the same period. The low popularity of Cardoso explains to a fair extent why Serra lost badly to Lula in 2002, and this is captured by the strongly negative coefficient estimate for the *Third Term Dummy*. We believe, however, that once we are able to include the 2010 data in our forecast models, part of the anomaly of that particular election will be accounted for by readjusting the coefficient estimate for the *Third Term Dummy* variable downward.

It is also worth noting that the regression equations could also be estimated by weighting the data by the state populations, since presidents are elected by the popular vote. Thus, it would be reasonable to give larger states greater weight in the estimation. State populations certainly vary a great deal in Brazil. For example, São Paulo is by far the most populous state, with nearly 37 million inhabitants. On the other end, the population of Roraima is a little over 300,000 inhabitants. In that spirit, we re-estimated all three models, weighting the data by state population. Given the panel structure of Models 1 (versions *A* and *B*) and 3, we used the average state population over the period and estimated the equations using random effects MLE.[13] The downside is that maximum likelihood estimation does not provide an R^2 value comparable to that obtained using OLS. Moreover, maximum likelihood estimation does not produce a measure equivalent to the SEE. These two shortcomings severely limit the comparison of these adjusted Models 1 and 3 with the original ones. However, Model 2, because it is again estimated by OLS, remains comparable even after weighting the data by state population. The results indicate a slight improvement in the R^2, from 0.93 to 0.95, as well as in the SEE, from 3.82 to 3.14. As for the in- and out-of-sample forecasts, only those for Models 2 and 3 are improved. The average forecast errors for Models 2 and 3 are now −6.42% and +5.83%, respectively. The average forecast error for Model 1*A* is slightly larger, at 5.69%, but that for Model 1*B* is more than doubled, from 3.79% to 7.96%. The details of these additional analyses, including coefficient estimates and forecasts, are reported in Tables A.1 and A.2 in the Appendix.

The second criterion for evaluating forecast models is the lead. *All* models presented here can be used to predict Brazilian first round presidential elections with a 2-month lead. Trial-heat polls and the popularity of the incumbent are all measured in August, and presidential elections occur in October. The real annual economic growth by state — which we used in the estimations — is generally only made available two years after the election. Instead, for our forecasts we used the Central Bank's national economic forecast of the annual economic growth.[14] These forecasts are accurate. For instance, the real annual economic growth for 2010 was 7.5%. In August, the Central Bank's real annual economic growth forecast for 2010 was 7.12%. Similarly, the real annual economic growth for 2006 was 3.97%, and the Central Bank's forecast in August 2006 was 3.57%.

The third criterion is parsimony. Three of the four forecast equations use only two predictors in producing their forecasts. Only Model 1*B* includes a third independent variable in its forecast equation. Although Model 1*B* includes an additional predictor, we can confidently say that *all* models presented here are parsimonious.

The fourth and last criterion is reproducibility. Again, we can say that *all* four forecast equations are equally reproducible. The data are publicly available and are easily accessible over the Internet for anyone who is interested in forecasting Brazilian presidential elections.

Finally, given that all models presented are nearly equally good concerning lead, parsimony and reproducibility, we can conclude that Model 1*B* is, for now, the best forecasting model we have at hand, given its greater accuracy.

4. Conclusion

This article is a first attempt to apply election forecasting models to a newly democratized country in Latin America. The main challenge relates to the very low number of elections one can use to obtain valid coefficient estimates in order to produce electoral forecasts. To work around the low *N* problem, we proposed relying on data collected at the subnational and national levels for estimation, recognizing that such a decision also implies some data limitations, especially regarding subnational level public opinion data. Examining Brazilian presidential elections, we collected data about four presidential contests (1994, 1998, 2002 and 2006) for the 27 states that comprise the union. We estimated four regression equations from theoretical models of election forecasting proposed for American and French presidential contests. All models are nearly equally good in terms of lead, parsimony and reproducibility. However, Model 1*B* of Abramowitz (2008) presents the most accurate forecasts, and therefore stands as the current best model for forecasting Brazilian presidential elections. To be sure, models which use trial-heat polls at the subnational level are also promising in their ability to explain election results. Model 2's strong showing for 2010, relative to the other three models, is a good indication of that.

Using sub-national data to predict national outcomes involves some problems. First, as was noted earlier, economic data measured at the state level only become available two years after the election. Consequently, upcoming elections cannot be included in the regression part of the analysis. Thankfully, though, the election remains "forecastable", because we can use the predicted

[13] Unfortunately, the xtreg Stata command for panel data analysis does not allow the use of weights for random effects GLS.

[14] The Banco Central do Brasil Time Series Management System is available at https://www3.bcb.gov.br/sgspub/localizarseries/localizarSeries.do?method=prepararTelaLocalizarSeries. To get the economic forecasts, click on the Market Expectations icon.

national annual economic growth to make a forecast. Second, public opinion data are not available consistently at the state level (or at least, have not been until recently), which forces forecasters to use national level data instead when they want to include such information in their forecast models.

Finally, despite all of the limitations met in forecasting election results in recently democratized countries, this paper has shown, using data from Brazil, that the task is not a forlorn enterprise. We believe that, with time, more data, especially those related to public opinion surveys at the state level, will become more readily available. This is likely to mean that we will be able to produce more accurate forecasts than our current models allow.

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Appendix

This appendix presents the regression and forecast analyses by weighting the data by state population (Tables A.1 and A.2).

Table A.1
Forecast models for Brazilian presidential elections with observations weighted by state population: 1994–2006.

	Model 1[a] (Abramowitz, 2008)		Model 2[b] (Campbell, 2008)	Model 3[a] (Lewis-Beck et al., 2008)
	A	*B*		
Real annual GDP growth	0.21* (0.12)	0.23 (0.15)	0.12 (0.11)	0.04 (0.10)
Third term dummy	−31.35* (3.31)	−37.34* (15.43)	–	–
Trial-heat poll	–	–	0.87* (0.02)	–
Popularity of the incumbent	–	−0.37 (1.09)	–	1.82* (0.25)
Constant	51.27* (1.69)	81.60 (88.10)	5.00* (1.07)	−97.17* (19.25)
Pseudo R^2	0.11	0.11	–	0.10
Adjusted R^2	–	–	0.95	–
SEE	–	–	3.14	–
N	108	108	27	108

Obs.: Data weighted by state population.
[a] Entries are random effects MLE coefficient estimates, with jackknife standard errors in parentheses.
[b] Entries are OLS coefficient estimates, with standard errors in parentheses.
* $p < 0.05$ (one-tailed).

Table A.2
In- and out-of-sample forecasts with observations weighted by state population, by model and election.

Election year	Vote for the incumbent, in %	Forecast, in % (Forecast error, in %)			
		Model 1 (Abramowitz, 2008)		Model 2 (Campbell, 2008)	Model 3 (Lewis-Beck et al., 2008)
		A	*B*		
1994[a]	54.27	53.38 (−1.89)	51.88 (−2.39)	41.53 (−12.74)	54.33 (+0.06)
1998[a]	53.06	51.27 (−1.79)	52.14 (−0.92)	41.52 (−11.54)	46.82 (−6.24)
2002[a]	23.19	20.46 (−2.73)	20.24 (−2.95)	19.24 (−3.95)	23.23 (+0.04)
2006	48.61	52.09 (+3.48)	51.68 (+3.07)	47.23 (−1.38)	53.67 (+5.06)
2010[b]	46.97	21.47 (−25.50)	10.37 (−36.60)	44.48 (−2.49)	77.21 (+30.24)
Average	–	*−5.69*	*−7.96*	*−6.42*	*+5.83*

[a] Out-of-sample forecast for Model 2 only.
[b] Out-of-sample forecast for *all* models.

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