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## Vote Shares in Spanish General Elections as a Fractional Response to the Economy and Conflict

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# Vote Shares in Spanish General Elections as a Fractional Response to The Economy and Conflict

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## Abstract

In this paper we study the response of vote shares to economic fluctuations and conflict. Spain seems to be the ideal niche for a case study like this since it has experienced both phenomena during the last decades. Recent Spanish democratic history has witnessed four complete economic cycles, with deep recessions and pronounced booms. During this period, there has been a nationalistic conflict with terrorist manifestation. We use Spanish provincial data from the ten congressional elections since the end of Franco's dictatorship. Vote shares at provincial level are modeled as fractional responses to unemployment, inflation, terrorism assassinations, turnout and other factors. The statistical model used, a fractional probit, specifies conditional means of district and election unobserved effects as linear functions of the covariates. Estimates of National Partial Effects (NPE), i.e. the effect on national vote shares of changes in unemployment, inflation and terrorism are statistically significant and quantitatively important. In addition, vote shares respond to participation rates and these also depend on economic factors and terrorism, thus creating an endogeneity problem. The expected margin of victory is then used as instrument for turnout.

**KEYWORDS:** vote shares, turnout, fractional probit, partial effects, unemployment, terrorism.

**JEL CODES:** C23, P16

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# 1 Introduction

The empirical evidence available indicates that electoral outcomes are related to economic conditions. More specifically, economic downturns punish incumbents as they are held responsible for economic adversity. For example, Fair (2009) finds that economic conditions affect U.S. presidential and House elections, Lewis-Beck (1986) reports evidence in favor of this relationship for Western European Countries and Pacek (1994) for East Central European countries.

Economic issues and electoral outcomes have been extensively analyzed in the political business cycle models. Nordhaus (1975) and Lindbeck (1976) assume voters dislike inflation and unemployment and they vote in favor of the incumbent (opposition) party if the economy experiences low (high) inflation and unemployment. Therefore, according to this hypothesis, the vote share of the incumbent party should be decreasing in past inflation and unemployment. Partisan models, e.g. Hibbs (1977), assume that members of left-wing parties are more concerned with unemployment and less concerned with inflation, whereas members of right-wing parties have opposite preferences. Voters have different preferences and vote for the right or left wing parties accordingly. Under these assumptions, we should observe an increase in the right-wing vote share after a period of high inflation and an increase in the left-wing vote share after a period of high unemployment. For the U.S. presidential elections, Fox and Phillips (2003) findings appear to be in line with the partisan models.

Terrorism has also been considered as another vote determinant. Berrebi and Klor (2006, 2008a) provide empirical evidence suggesting that terrorism affects electoral outcomes in Israel. They find that high terrorist activity in Israel increases right-wing support in subsequent elections. The mechanism by which terrorism affects vote shares could be sketched as follows. If voters dislike terrorism and they vote in favor of the incumbent party in case of an increase in terrorism activity, we should observe a rise in the incumbent party's vote share after a period of high terrorism activity. On the other hand, if voters dislike terrorism and identify a party as more likely to implement strong anti-terrorism policies, we should observe an increase in that party's vote share after a period of high terrorism activity, despite whether that party was the incumbent or not.

In this paper we study the response of vote shares to economic fluctuations and terrorist conflict. Spain seems to be the ideal niche for a study like this since it has experienced both phenomena intensively during the last decades. Recent Spanish democratic history has witnessed four complete economic cycles, with deep recessions and pronounced booms. During this period, there has been a nationalistic conflict with terrorist manifestation. To give an idea of how important economic conditions and terrorist activity are for Spaniards we rely on survey data from the Spanish *Centro de Investigaciones Sociológicas* (CIS).<sup>1</sup> Figure 1 shows the perception of the Spanish people about

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<sup>1</sup>See Shambaugh and Josiger (2005) for the effect of terrorism on public opinion in the U.S.

what are the most important problems in Spain during the last decade. Individuals surveyed are asked to select within a list which are the three most important problems in Spain. Each colored line in Figure 1 shows the percentage of people who selected a given problem as one of the three most important. The main feature of these data is that unemployment and terrorism have been the two most important issues in most surveys. Figure 1 also indicates that the importance of terrorism appears to be decreasing, in parallel with the number of terrorist assassinations during this period.

In the case of Spain, the importance of terrorism in shaping people's political preferences has been the core of a hot debate. The March 11th terrorists attacks in Madrid took place three days before general elections. Before the attacks, from January 24th to February 15th, CIS surveyed 24,109 people of which 42.2 per cent manifested they would vote for Partido Popular while 35.5 per cent would vote for Partido Socialista. Not surprisingly, many analysts argued that the terrorist attacks favored Partido Socialista in winning the elections, e.g. van Biezen (2005) and Rose and Murphy (2007). Garcia-Montalvo (2006) provided empirical evidence on the causal link between the attacks and the election's outcome. He pointed out that Spanish non residents voted before the attacks took place and therefore could be used as a control group. This coincidence allowed him to analyze a natural experiment by comparing vote shares of resident and non resident voters. García-Montalvo results suggest that there is a causal effect of the March 11th terrorists attacks in Madrid and the outcome of the election. Evidence in the same direction was also provided by Bali (2007) who used survey data to establish the link between the attacks and the elections outcome.

Al-Qaeda March 11th attacks were the bloodiest terrorist attack in Spanish History, with 195 people murdered. However Al-Qaeda had never before committed an assassination in Spanish soil. In addition to those assassinations, more than 800 terrorist assassinations were perpetrated in Spain during the democratic period, most of which correspond to *Euskadi Ta Askatasuna* (ETA). Inference with a single case, like the Al-Qaeda attack, is problematic because, as pointed out by Michavila (2005), the attacks might have had no effect by themselves if the unexpected vote for the Partido Socialista was due to the dual news manipulation hypothesis. According to this hypothesis, the government manipulated and hid from voters the evidence that Al-Qaeda was behind the attacks while promoting that ETA was responsible. Therefore, in order to avoid this single case problems we use the temporal and spatial variation in all the other terrorist assassinations to establish a causal link between terrorism and vote shares.

In addition to economic conditions and terrorism, vote shares also depend on other factors. One of these factors is turnout (see Pacek and Radcliff, 2003, van der Eijk and Egmond, 2007). A high turnout rate might not affect all parties equally. Partisan voters should most likely vote for the same party election after election while swing voters could change their vote from one election to another. If the fraction of partisan voters is not equal among parties, then changes in turnout rate should benefit some parties and hurt others. When turnout is low, parties with a high fraction of

partisan voters would not be hurt as much as parties with a low fraction of partisan voters.

A particularly important theme in the analysis of electoral data is the dynamics of turnout, that is, the way participation changes from one election to another. On the one hand, vote shares respond to participation rates as argued above. On the other hand, turnout itself may also depend on economic factors and terrorism. For instance, Blais (2000) argues that a rise in terrorism activity might increase turnout by inducing voters to feel more obliged to fulfill their civil duties. Turnout also responds to economic downturns as documented by Aguilar and Pacek (2000) who argue that macroeconomic downturns may increase voter participation as more lower status voters express their grievances at the polls. Turnout's response to economic factors and terrorism creates an endogeneity problem. The strategy used for identification is inspired by the model of Feddersen and Sandroni (2006), which predicts that turnout should be decreasing in the margin of victory, and the experimental evidence of Klor and Winter (2008), which suggests that turnout is high when electoral outcomes are expected to be close. Using the expected margin of victory as an instrument, we are able to circumvent the problem of endogeneity of turnout.

In this paper we use a fractional probit model to estimate vote shares equations using a panel of the fifty Spanish provinces (constituencies) during the ten general elections held after Franco's dictatorship. The fractional probit model takes into account the bounded nature of vote shares and specifies the conditional mean of vote shares as a nonlinear function of unemployment, inflation, terrorism, turnout and unobserved provincial and election effects. Instead of taking the unobserved effects as fixed, we follow Mundlak (1976) in specifying conditional means of district and election unobserved effects as linear functions of covariates. The estimated model is used to compute the partial effects of changes in the explanatory variables on vote shares at the provincial level. Unlike the linear model that constrains partial effects across provinces to be equal, the fractional probit model allows for province and election specific partial effects. These partial effects are aggregated at the national level to obtain the National Partial Effects (NPE), that is the effect on national vote shares of changes in covariates.

A by side contribution of this paper is methodological. To the best of my knowledge, this is the first paper that considers vote shares as fractional responses. The most frequently used method assumes vote shares are a linear function of covariates. This assumption misspecifies the conditional mean simply because predicted vote shares could lay outside the unit interval. Because vote shares are bounded, their conditional mean must be a nonlinear function of covariates. However, modeling vote shares as a linear function of covariates could be a reasonable approximation if vote shares cluster together. For instance, in a biparty democracy, with vote shares close to 0.5, the conditional mean of vote shares could be approximately linear.<sup>2</sup> As a vote share approaches either

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<sup>2</sup>Fair (2009) notices that U.S. national vote shares range from 0.35 to 0.65 and therefore their conditional mean should be approximately linear.

zero or unity its response to a change in covariates is likely to be different from the response when vote shares are near 0.5, where the linear relationship is more likely to hold. When the number of parties is greater than two, and therefore vote shares need not cluster together near 0.5, the linear approximation could be worse. In addition, when using panel data at the district level, even in a biparty system, vote shares for a party could vary a lot from one district to another, and more so with more than two parties. Arguably, this argument could be important in our application to Spanish provinces (constituencies) where, in addition to the national parties, regional parties run for general elections and obtain significant vote shares in about half the constituencies.

Another approach used in the literature to estimate vote share equations assumes the conditional mean of the log odds ratio is linear in the covariates. This procedure does not misspecify the conditional mean but introduces a problem in the estimation of partial effects. Computing the partial effect of a covariate on the conditional mean of vote shares requires numerical integration. Although computationally demanding this procedure is feasible, but as far as I know no one has taken this route.

For comparison purposes, we present results of the fractional probit and the linear model. This comparison allows us to assess the gain obtained from a proper treatment of vote shares as fractional responses.

The rest of the paper is organized as follows. Section 2 sets up the fractional response model under the assumption that all covariates, including turnout, are strictly exogenous. Section 3 extends the analysis to the more realistic case when turnout is endogenous. Section 4 describes the data used and reports the empirical findings. Section 5 concludes.

## 2 A fractional Probit model for vote shares

Let  $t = 1, \dots, T$  index elections,  $j = 1, \dots, J$  electoral districts and  $i = 1, \dots, I$  political parties. Let  $s_{ijt}$  be the vote share of party  $i$  in district  $j$  in election  $t$ . For most of the analysis the party index  $i$  will not be necessary, so we drop it. Vote shares, as other proportions, are classified as fractional response variables. Statistically speaking, fractional response variables are very common. This is the case of market shares, exam pass rates, regulation compliance rates, etc. Vote shares are bounded,  $0 \leq s_{jt} \leq 1$ , and therefore cannot be modeled as a linear function of the covariates. To see why this cannot be the case, assume that the conditional mean of vote shares is linear in the covariates, that is,

$$E(s_{jt} | X_{jt}) = \Theta X_{jt} \quad (1)$$

where  $X_{jt}$  is  $K \times 1$  vector of strictly exogenous covariates and  $\Theta$  is a row vector of parameters. Either we restrict the range of the linear index  $\Theta X_{jt}$  or the conditional mean can lay outside the unit



interval. Most of the empirical evidence on vote shares determinants, however, use this misspecified conditional mean. Some of the empirical evidence available assumes the log-odds conditional mean is linear in the covariates

$$E\left(\ln\left(\frac{s_{jt}}{1-s_{jt}}\right) \mid X_{jt}\right) = \Theta X_{jt}. \quad (2)$$

This specification implies that vote shares conditional mean is

$$E(s_{jt} \mid X_{jt}, u_{jt}) = \frac{e^{\Theta X_{jt} + u_{jt}}}{1 + e^{\Theta X_{jt} + u_{jt}}}, \quad (3)$$

where  $u_{jt} = \ln\left(\frac{s_{jt}}{1-s_{jt}}\right) - E\left(\ln\left(\frac{s_{jt}}{1-s_{jt}}\right) \mid X_{jt}\right)$ . Therefore, recovering the conditional mean of vote shares requires computing the following integral

$$E(s_{jt} \mid X_{jt}) = \int \frac{e^{\Theta X_{jt} + z}}{1 + e^{\Theta X_{jt} + z}} f(z) dz, \quad (4)$$

where  $f(\cdot)$  is the probability density function of  $u$ . This integral can be computed numerically using an estimate of the density function. In practice, researchers running log odds ratio regressions do not compute the previous integral. To the best of my knowledge, no one has ever estimated this conditional mean numerically.

In this paper we assume that vote shares conditional mean is a nonlinear function of an index of covariates

$$E(s_{jt} \mid X_{jt}) = F(\Theta X_{jt}), \quad (5)$$

where  $F(\cdot) : \mathbb{R} \rightarrow [0, 1]$  is a continuous and increasing function of a linear index of covariates. Two statistical procedures have been developed to analyze this type of data: the fractional logit and probit models. Papke and Wooldridge (1996) used the fractional logit model to analyze pension plans participation rates. Other applications of this procedure include Hausman and Leonard (1997), Liu, Liu, Hammitt and Chou (1999) and Warner (2003). Papke and Wooldridge (2008) argue that for the case of a panel data, as in our application, the fractional probit is better suited, and this is the procedure used in this paper. More specifically, we assume that the conditional mean of vote shares are linked to an index of observables and nonobservables as

$$E(s_{jt} \mid a_j, b_t, p_{jt}, X_{jt}) = \Phi(a_j + b_t + \alpha p_{jt} + \Theta X_{jt}), \quad (6)$$

where  $\Phi(\cdot)$  is the standard normal cumulative distribution function,  $a_j$  and  $b_t$  are district and election specific unobserved effects,  $p_{jt}$  is the turnout rate in district  $j$  and election  $t$ ,  $X_{jt}$  is  $K \times 1$  vector of strictly exogenous covariates,  $\alpha$  is a scalar parameter and the  $\Theta$  is a row vector of pa-

rameters. These strictly exogenous covariates include macroeconomic indicators (unemployment and inflation) a measure of conflict (terrorism assassinations), demographic variables (population density), political considerations (turnout) and other controls (dummy variables for landlock and vernacular language). Some of these covariates, the unemployment and turnout rates, are fractions. In those cases, the corresponding element of  $X_{jt}$ , say  $x_{kjt}$ , will enter the conditional mean transformed so that  $x_{kjt} = \Phi^{-1}(h_{kjt})$  where  $h_{kjt}$  is the original fraction. This transformation is such that the covariates range is the real line.<sup>3</sup>

District and election specific unobserved effects are modeled *à la* Mundlak (1978). Thus, we assume that the conditional mean of unobservable district specific effects,  $a_j$ , is linear in the mean value of the covariates

$$a_j = \Gamma \bar{X}_j + u_{aj} \quad (7)$$

where  $\Gamma$  is a vector of parameters,  $\bar{X}_j = (1/T) \sum_{t=1}^T X_{jt}$  and  $u_{aj} = a_j - E(a_j | X_{j1}, \dots, X_{jT})$ . This assumption amounts to saying that unobserved district specific effects are correlated with observable covariates. The time average of covariates can be interpreted as a measure of how important unemployment, inflation and terrorism have been for a specific province during the sample period. In other words a high time average of, say unemployment, for province  $j$  indicates a high degree of persistence of unemployment in that province. Therefore, equation (7) captures the influence of persistence in unemployment on the provincial unobserved effect. If unemployment favors a given party, and a province has experienced high levels of unemployment, that party vote share will exhibit a high value of the provincial unobserved effect.

In sharp contrast to most panel data analysis, where typically unobserved time effects are treated as fixed, we allow unobserved election specific effects to be a function of the covariates, that is

$$b_t = \Lambda \bar{X}_t + u_{bt}$$

where  $\Lambda$  is a vector of parameters,  $\bar{X}_t = \sum_{j=1}^J g_{jt} X_{jt}$  is a weighted average of the vector of covariates and  $u_{bt} = b_t - E(b_t | X_{j1}, \dots, X_{jT})$ . These weighted averages are national wide values of the covariates. The analysis of vote shares suggests that national wide shocks and trends may affect provincial level outcomes. For instance, if the unemployment rate is very high at the national level, this may lower incumbent's vote shares in provinces where unemployment is not particularly high. Similarly, a high level of terrorism at the national level may affect vote shares at the provincial level, even in provinces where terrorism has no particular incidence. Notice that the national level of, say, unemployment is not the average of provincial level unemployment rates but a weighted average of provincial unemployment rates. For other variables, such as the number of terrorism

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<sup>3</sup>For example, suppose we want to explain  $y$  using a single covariate  $m$  and both variables are fractions, then the relationship we postulate is of the form  $G(y) = a + bG(m) + u$  with  $u \sim N(0, \sigma_u^2)$  and  $G(\cdot) = \Phi^{-1}(\cdot)$ . Therefore,  $y = \Phi(a + bG(x) + u)$  and  $E(y | G(x)) = \Phi(a_u + b_u G(x))$  where  $a_u = a / \sqrt{1 + \sigma_u^2}$  and  $b_u = b / \sqrt{1 + \sigma_u^2}$ .

assassinations, the national value is the sum of the provincial figures. In the latter case, all weights would be equal to one.

We can write vote shares conditional mean as

$$E(s_{jt} | p_{jt}, X_{jt}, u_{aj}, u_{bt}) = \Phi(\Gamma \bar{X}_j + \Lambda \bar{X}_t + \alpha p_{jt} + \Theta X_{jt} + u_{aj} + u_{bt}) \quad (8)$$

Further assuming that  $u_{aj} \sim N(0, \sigma_a^2)$  and  $u_{bt} \sim N(0, \sigma_b^2)$  and making use of the mixing properties of the normal distribution we can write

$$E(s_{jt} | p_{jt}, X_{jt}) = \Phi(\Gamma_u \bar{X}_j + \Lambda_u \bar{X}_t + \alpha_u p_{jt} + \Theta_u X_{jt}), \quad (9)$$

where subscript  $u$  indicates that coefficients are rescaled by a factor  $1/\sqrt{1 + \sigma_a^2 + \sigma_b^2}$ .

According to Mundlak's hypothesis vote shares conditional mean is a function of the time average of covariates,  $\bar{X}_j$ , and the average across individuals,  $\bar{X}_t$ . The time average is a district specific effect that, depending on its magnitude, can inflict a substantial persistence in vote shares.<sup>4</sup> The average across provinces is an election specific effect indicating how national aggregate unemployment, inflation and terrorism affect vote shares at the provincial level. Gélinau and Bélanger (2005) find that incumbent provincial vote shares are affected by national unemployment in Canada.

### 3 Endogenous turnout

It can be argued that the turnout rate is not a strictly exogenous covariate. There are at least two reasons why this might be case. First, Aguilar and Pacek (2000) provide evidence indicating that macroeconomic downturns may increase voter participation as more lower status voters express their grievances at the polls. Second, Blais (2000) suggests that a rise in terrorism activity increases turnout by creating a sense of civil duty on voters.<sup>5</sup>

In addition to macroeconomic factors and terrorism, it has also been claimed that turnout also depends on other variables that do not affect vote shares. For instance, the models of Feddersen and Sandroni (2006) and Li and Majumdar (forthcoming) and the laboratory evidence of Klor and Winter (2008) suggest that turnout should be decreasing in the expected margin of victory. That is, close electoral races are followed by high turnout. In addition to the expected margin of victory, other turnout determinants include some calendar effects. In particular, Mattila (2003) reported evidence indicating that the following indicators were significant determinants of turnout in other electoral races: dummy variables indicating (i) whether the election took place on a weekend or

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<sup>4</sup>Dolado, Gonzalo y Mayoral (2002) find that opinion polls in Spain exhibit a high degree of persistence.

<sup>5</sup>Degan and Merlo (2007) argue that civil duty is a determinant of turnout.

not, (ii) whether the election was the first general election and (iii) whether there were concurrent elections.

Notice that the source of endogeneity here is different from that considered by Papke and Wooldridge (2008). They consider a regressor that is correlated with time varying unobserved effects. In our case, the endogenous regressor, turnout, is correlated with other observed covariates.

Assume the turnout conditional mean depends on the vector of covariates  $X_{jt}$  (unemployment, inflation, terrorist assassinations) and also on other covariates included in a  $H \times 1$  vector  $Z_{jt}$  (expected margin of victory and other calendar effects). Stacking  $X_{jt}$  and  $Z_{jt}$  into a  $(K + H) \times 1$  vector  $W_{jt}$  we write

$$E(p_{jt} | c_j, d_t, W_{jt}) = c_j + d_t + \Pi_p W_{jt}, \quad (10)$$

where  $c_j$  and  $d_t$  are provincial and election specific unobserved effects and  $\Pi_p$  is vector of parameters. As before, the conditional mean of provincial and election unobserved effects are assumed to be functions of the covariates

$$c_j = C_p \bar{W}_j + u_{cj},$$

$$d_t = D_p \bar{W}_t + u_{dj},$$

where  $u_{cj} = c_j - E(c_j | W_{j1}, \dots, W_{jT})$  and  $u_{dj} = d_j - E(d_j | W_{j1}, \dots, W_{jT})$ . Therefore, we can write turnout as

$$p_{jt} = C_p \bar{W}_j + D_p \bar{W}_t + \Pi_p W_{jt} + v_{jt},$$

where  $v_{jt}$  is the unexpected turnout.

Under these assumptions the conditional mean of vote shares is

$$E(s_{jt} | W_{jt}, v_{jt}) = \Phi(C\bar{W}_j + D\bar{W}_t + \Pi W_{jt} + \alpha_u v_{jt}) \quad (11)$$

which is a reduced form equation for vote shares where  $C = (\Gamma_u + \alpha_u C_x, \alpha_u C_z)$ ,  $D = (\Lambda_u + \alpha_u D_x, \alpha_u D_z)$ ,  $\Pi = (\Theta_u + \alpha_u \Pi_x, \alpha_u \Pi_z)$ ,  $C_p = (C_x, C_z)$ ,  $D_p = (D_x, D_z)$  and  $\Pi_p = (\Pi_x, \Pi_w)$ . This reduced equation has two interesting features. First, the coefficient on  $v_{jt}$  is in fact an structural parameter: vote shares sensitivity to turnout in equation (9). Second, the relationship between the reduced form parameters and the structural ones could be used to get estimates of the structural parameters via classical minimum distance estimators.

Equation (11) can be estimated by the Pooled Fractional Probit (PFP) estimator (or Bernoulli quasi-MLE), see Papke and Wooldridge (2008). An asymptotically equivalent estimator is easy to obtain using the generalized estimating equation, `xtgee` command in STATA.

The estimation procedure has two steps: (i) first estimate  $\hat{v}_{jt}$  from a pooled regression of  $p_{jt}$  on  $\bar{W}_j$ ,  $\bar{W}_t$  and  $W_{jt}$ , (ii) second, estimate  $C$ ,  $D$ ,  $\Pi$  and  $\alpha_u$  from a Pooled Fractional Probit of  $s_{jt}$  on

$\bar{W}_j$ ,  $\bar{W}_t$ ,  $W_{jt}$  and  $\hat{v}_{jt}$ . Because we are using a two-step estimation procedure, standard errors must be corrected for the first stage estimation. In our application we use bootstrapped standard errors.

Parameter estimates together with their standard errors can be used to draw inference on causality from covariates to vote shares. However, quantitative assessment of the effect of covariates on vote shares requires additional calculations. The partial effect of a change in the  $k$ -th (continuous) covariate on the expected vote shares is

$$\frac{\partial E(s_{jt} | W_{jt}, v_{jt})}{\partial w_{kjt}} = \phi(C\bar{W}_j + D\bar{W}_t + \Pi W_{jt} + \alpha_u v_{jt}) \pi_k \quad (12)$$

where  $w_{kjt}$  is one of the elements of  $W_{jt}$ ,  $\phi(\cdot)$  is the standard normal density function and  $\pi_k$  is the  $k$ -th element of  $\Pi$ . Notice that for those covariates that are fractions, the partial effect should be multiplied by  $\frac{d\Phi^{-1}(z)}{d(z)}$ .<sup>6</sup> Thus coefficients indicate the direction of the partial effects but not their magnitude. The Fractional Probit model allows for province and election specific partial effects, that is, the effect of a given covariate on vote shares depends on which province and election is considered. This heterogeneity of partial effects is an advantage of the Fractional Probit model over the standard linear model, which predicts the same partial effect across provinces and elections. Since partial effects have a geographical consideration, it is therefore feasible to display partial effects in a map.

Oftentimes, the  $J \times T$  partial effects like (12) are averaged out to obtain the average partial effect (APE). In our analysis of vote shares we are interested in the partial effect of covariates on national vote shares. Vote shares at the national level are a weighted sum of the provincial vote shares  $s_t = \sum_{j=1}^J l_{jt} s_{jt}$ , where  $l_{jt} = V_{jt}/V_t$  is the share of valid votes in province  $j$  at election  $t$ . Weighted average partial effects evaluated at the observed values of covariates can be obtained by computing derivatives in

$$E(s_t | W_{jt}, v_{jt}) = \sum_{j=1}^J l_{jt} \Phi(C\bar{W}_j + D\bar{W}_t + \Pi W_{jt} + \alpha_u v_{jt}),$$

with respect to the elements of  $\bar{W}_j$ ,  $\bar{W}_t$ ,  $W_{jt}$  or  $v_{jt}$ . For instance

$$\frac{\partial E(s_t | W_t, v_t)}{\partial w_{kjt}} = \sum_{j=1}^J l_{jt} \phi(C\bar{W}_j + D\bar{W}_t + \Pi W_{jt} + \alpha_u v_{jt}) \pi_k.$$

We will refer to this quantity as the National Partial Effect (NPE).

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<sup>6</sup>For numerical calculations we use  $\frac{d\Phi^{-1}(z)}{dz} = 2\sqrt{2} \frac{d(\text{erf})^{-1}}{dz}$ ,  $z \in (0, 1)$ , where  $\frac{d(\text{erf})^{-1}(z)}{dz} = \sqrt{2\pi} \left( 1 + \frac{\pi}{4} z^2 + \frac{7\pi^2}{96} z^4 + \frac{127\pi^3}{5760} z^6 + \frac{4369\pi^4}{645120} z^8 + \frac{34807\pi^5}{16588800} z^{10} \right)$ .

Multiplying the Fractional Probit estimates by the scale factor

$$\frac{1}{JT} \sum_{j=1}^J \sum_{t=1}^T \phi(C\bar{W}_j + D\bar{W}_t + \Pi W_{jt} + \alpha_u v_{jt})$$

we can compare them with the linear model estimates.

Goodness of fit comparison of the linear and fractional probit models is problematic. The linear model  $R^2$  measure is not available for the the fractional probit model. For goodness of fit comparison across models we use the modified chi-squared measure,  $\sum_{j=1}^J \sum_{t=1}^T \frac{(s_{jt} - \hat{s}_{jt})^2}{s_{jt}}$  where  $s_{jt}$  and  $\hat{s}_{jt}$  are observed and predicted vote shares. Notice that the traditional chi-squared goodness of fit measure uses the model predicted values in the denominator, but then negative vote shares predictions generated by the linear model would contribute to reducing the value of the chi-squared measure. To avoid this inconvenience, we use the observed vote shares which are always positive in the denominator.

## 4 The data and empirical results

Table 1 summarizes national vote shares and turnout in the ten Spanish general elections after Franco's dictatorship. The third general election in 1982 led to an abrupt fall in the vote share of the ruling party Unión de Centro Democrático (UCD) and winner of the first two general elections. In subsequent elections, UCD vote share fell to less than one per cent vote shares after the 1996 election. This irregular party behavior induced us to exclude it from the analysis hereinafter. Thus, we focus the analysis in the three national parties, Partido Socialista Obrero Español (PSOE), Partido Popular (PP) and Izquierda Unida (IU).<sup>7</sup> The fall in UCD vote share was accompanied by a rise in PSOE and PP vote shares. Table 1 also indicates that turnout rate ranges from a low 68 per cent in 1979 to a maximum of 80 per cent in 1993. Table 2 shows descriptive statistics on vote shares and the explanatory variables at the national and provincial levels. Partido Socialista exhibits the highest average vote share at both national and provincial levels. Partido Popular scores the second at national and provincial levels and exhibits the highest variability of vote shares. Notice that the expected margin of victory from polls is only available in 373 cases, none of which correspond to the first two elections. Therefore, all the analysis is restricted to 373 observations corresponding to the last eight elections.

Tables 3 reports the turnout equation estimates. According to these estimates, domestic terrorism affects turnout positively and significantly at the provincial and national levels. Unemployment, however, has a positive effect on turnout at the provincial level and a negative and larger

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<sup>7</sup>Up to the 1989 elections, IU vote shares are those of the Partido Comunista.

effect at the national level. When the provincial and national figures affect turnout in different directions, the reading of the estimates should be as follows. National unemployment lowers turnout in all provinces, but not that much in provinces where unemployment is particularly high. Inflation does not appear to affect turnout in a significant way. The expected margin of victory affects turnout negatively, that is, the closer the expected margin of victory, the higher turnout. The province specific unemployment time mean affects turnout negatively meaning that turnout is higher in provinces with lower level of unemployment.

Table 4 reports the Pooled Fractional Probit estimates of model (11) for PSOE, PP and IU. Columns (1), (4) and (7) report parameter estimates and columns (2), (5) and (8) t-stats. Unemployment at the provincial level does not have a significant effect on any party, but national unemployment lowers PSOE vote share and increases IU's. Provincial inflation has a positive effect on PSOE vote share and a negative one on PP vote share. National inflation lowers IU vote share. Domestic terrorism affects PSOE vote share negatively at the provincial level. National aggregate figures of domestic terrorism lower PP's vote share and increase IU's. When terrorism has an international origin, it affects positively PSOE and negatively PP and IU. When the expected margin of victory at the national level is large, all parties vote shares decrease, but less so in provinces with large expected margin of victory. The chi-squared goodness of fit statistics indicate that the fractional probit model fits better the PSOE and IU vote shares data than the PP ones.

Table 5 reports the linear model estimates. With only a few exceptions, coefficient estimates have the same sign than the fractional probit estimates. A formal comparison of the linear model estimates and the fractional probit marginal effects (columns (3), (6) and (9) in Table 4) indicates that their order of magnitude is similar. There seems to be no bias in either direction as 22 of the 42 cases where a comparison is feasible the linear model estimate is larger than the fractional probit estimate. However, differences in parameter estimates are sometimes relatively sizable. Statistical significance of parameters would be almost the same with the linear or the fractional probit model except for IU. Comparing the chi-squared goodness of fit statistics in Tables 3 and 4, the fractional probit model fits better vote shares data for all three parties. The fractional probit outperforms the linear model in terms of goodness of fit, particularly in the case of IU.

Tables 6 and 7 report the fractional probit and linear model estimates this time including interactions with an incumbency dummy variable. These models allow for a differential effect of covariates when the party under consideration is the incumbent or not. Since IU has never been the incumbent party, the analysis is restricted to PSOE and PP. Comparing the goodness of fit measures of this models and those of Table 4, the fit is now better. Interactions with party specific incumbency dummy appear to be significant for PSOE, both at the provincial and national levels, and only at the national level for PP. Comparing the fractional probit estimates with the linear model estimates of Table 7, we can see that the results are similar. While the fractional probit model fits

better PP vote shares data, the linear model outperforms the fractional probit model in terms of goodness of fit for PSOE.

The quantitative effect of covariates on vote shares depends on the scale of measurement of covariates. In order to compare the quantitative effect on vote shares of changes in different covariates we rely on standardized parameter estimates. We multiply parameter estimates by the standard deviation of the corresponding covariate and report the results in Table 8. Standardized coefficient estimates for PSOE indicate that the incidence of terrorism on a particular province has an effect quantitatively smaller than inflation and larger than unemployment. National aggregate terrorism figures have a larger impact (in absolute value) than national inflation but smaller than national unemployment.

The fractional probit model generates heterogeneous provincial partial effects. This is illustrated in Figure 2 which plots provincial partial effects of national terrorism on PSOE vote shares in a map of Spanish provinces for the 2008 general election. Alternatively, provincial partial effects can be aggregated into national partial effects and plotted against the election year. Figure 3 shows the partial effect of national terrorism on the national vote share for PSOE (the NPE) for all elections after 1982. The NPE of national terrorism changes from negative when PSOE was in the opposition to positive when it was the incumbent.

## 5 Conclusions

This paper investigates the role of economic factors and terrorism as vote share determinants using Spanish general elections as the benchmark. This paper contributes the following results. First, previous empirical evidence has found economic factors and terrorism significant vote share determinants. However, this evidence has looked at either economic factors or terrorism at a time. We include them together and are able to compare their relative magnitude. We find that unemployment, inflation and terrorism activity have a statistically significant and quantitatively sizable impact on vote shares. Second, allowing province and election specific unobserved effects to depend on covariates linearly, we are able to assess the effect of national aggregates of macroeconomic magnitudes and terrorism activity on vote shares. We find that national aggregates have a much larger effect on provincial vote shares than the particular incidence of covariates at the provincial level. Third, this is the first attempt to use the Fractional Probit model for panel data vote share data analysis. The model allows for district specific partial effects which are constrained to be constant in the linear model. The fractional probit fits the data better than the linear model in 4 out of 5 models. A possible way of improving the fit could be to use a non-parametric fractional response model.



# Appendix

## Data sources

Data on Spanish general elections at the municipal, provincial and national levels were collected from the Spanish Ministry of Interior web page <http://www.elecciones.mir.es/MIR/jsp/resultados/index.htm>

Data on the number of people murdered by terrorist acts comes from Asociación de Víctimas del Terrorismo (AVT). <http://www.avt.org/victimasdelterrorismo.php>

Data on inflation and unemployment was downloaded from Instituto Nacional de Estadística (INE) web site <http://www.ine.es>

People's opinion pools before elections are from CIS (Centro de Investigaciones Sociológicas).

## Variable definition

Unemployment: fraction of the labor force unemployed measured at the month previous to the election.

Inflation: inflation rate in percentage during the year before the election.

Domestic terrorism: number of assassinations by domestic terrorist organizations between elections.

International terrorism: number of assassinations by international terrorist organizations between elections.

Population density: million of inhabitants per squared kilometer

Coastline: dummy variable that takes the value of one if the province has coastline.

Vernacular language: dummy variable that takes the value of one if the province has a vernacular language.

Turnout: fraction of valid votes over the census.

vote share: fraction of valid votes to a party over total valid votes.

Expected margin of victory: difference between the vote shares of the highest and second high vote share intentions.

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Table 1: Vote shares and Turnout in Spanish General Elections at the National level

Date	PSOE	PP	IU	UCD+CDS	Turnout	Days between elections
June 15, 1977	0.29	0.08	0.09	0.34	0.79	-
March 1, 1979	0.30	0.06	0.11	0.35	0.68	616
October 28, 1982	0.48	0.26	0.04	0.10	0.76	1317
June 22, 1986	0.44	0.26	0.05	0.09	0.74	1314
October 29, 1989	0.40	0.26	0.09	0.08	0.69	1207
June 6, 1993	0.39	0.35	0.10	0.02	0.80	1297
March 3, 1996	0.38	0.39	0.11	0.00	0.76	987
March 13, 2000	0.34	0.45	0.05	0.00	0.70	1450
March 14, 2004	0.43	0.38	0.05	0.00	0.70	1441
March 9, 2008	0.44	0.40	0.04	-	0.77	1435

PSOE = Partido Socialista Obrero Español, PP = Partido Popular, IU = Izquierda Unida,  
UCD = Unión de Centro Democrático, CDS = Centro Democrático y Social.

Table 2: Summary statistics

	Obs.	Mean	Std. dev.	Min	Max
Panel A: National level					
Vote share PSOE	10	0.3890	0.0618	0.2915	0.4824
Vote share PP	10	0.2884	0.1312	0.0605	0.4452
Vote share IU	10	0.0721	0.0287	0.0377	0.1077
Turnout	10	0.7389	0.0437	0.6809	0.7988
Unemployment	10	0.1431	0.0630	0.0472	0.2265
Inflation	10	0.0702	0.0445	0.0240	0.1530
Domestic terrorism	10	83.7	65.0	5	223
International terrorism	10	19.5	61.7	0	195
Expected margin of victory	10	0.0877	0.0698	0.0116	0.2181
Population Density	10	79.374	5.3802	74.790	91.466
Panel B: Provincial level					
Vote share PSOE	500	0.3792	0.1002	0.1239	0.6376
Vote share PP	496	0.3140	0.1614	0.0299	0.6531
Vote share IU	497	0.0578	0.0373	0.0069	0.1986
Turnout	500	0.7412	0.0672	0.4438	0.8761
Unemployment	500	0.1331	0.0790	0.0036	0.4139
Inflation	500	0.0688	0.0444	0.0120	0.2000
Domestic terrorism	500	2.0640	11.796	0	201
International terrorism	500	0.3900	8.7207	0	195
Expected margin of victory	373	0.1401	0.1084	0.0009	0.5390
Population Density	500	111.38	143.55	8.8237	781.80
Coastline	500	0.44	0.4969	0	1
Vernacular language	500	0.32	0.4669	0	1

Table 3: Turnout equation

	Estimate	t-stat
Constant	-0.6735	-2.02
<i>Provincial variables</i>		
Unemployment	0.2416	5.16
Inflation	0.0084	0.79
Domestic Terrorism	0.0015	3.78
International Terrorism	0.0002	0.87
Expected Margin of Victory	-0.0109	-1.14
Population density	0.0001	0.92
Coastline	-0.0127	-3.09
Vernacular language	-0.0879	-1.39
<i>National aggregates</i>		
Unemployment	-0.5075	-8.79
Inflation	-0.0079	-0.59
Domestic Terrorism	0.0019	9.26
International Terrorism	-0.0001	-0.67
Expected Margin of Victory	-0.2902	-28.53
<i>Time Means</i>		
Unemployment	-0.2039	-2.68
Inflation	0.0007	1.48
Domestic Terrorism	-0.0047	-1.75

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 $R^2 = 0.5652$ 


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Robust t-stat with clustering on provinces

Table 4: Fractional Probit Estimates of Vote share equations

	PSOE			PP			IU		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Estimate	t-stat	Margin	Estimate	t-stat	Margin	Estimate	t-stat	Margin
Constant	-0.6270	-1.03		-0.1804	-0.20		-1.9201	-3.82	
<i>Provincial variables</i>									
Unemployment	-0.0044	-0.08	-0.0016	0.0212	0.36	0.0078	0.0132	0.13	0.0014
Inflation	0.0198	2.70	0.0076	-0.0184	-2.82	-0.0067	0.0050	0.46	0.0005
Domestic Terrorism	-0.0022	-2.75	-0.0008	-0.0009	-0.53	-0.0003	-0.0051	-1.49	-0.0005
International Terrorism	0.0007	7.20	0.0003	-0.0001	-0.81	-0.0001	-0.0007	-2.27	-0.0001
Expected Margin of victory	0.0243	2.17	0.0093	-0.0105	-0.82	-0.0039	0.0342	2.45	0.0036
Unexpected turnout	0.2669	2.80	0.1018	-0.0864	-0.65	-0.0316	0.1741	1.19	0.0186
Population density	-0.0001	-0.52	-0.0000	-0.0001	-0.16	-0.0000	0.0004	1.15	0.0000
Coastline	-0.0340	-0.73		-0.0290	-0.31		-0.0733	-0.89	
Vernacular language	-0.0796	-1.68		-0.2323	-1.75		-0.1389	-1.44	
<i>National aggregates</i>									
Unemployment	-0.2337	-4.18	-0.0892	-0.0777	-1.19	-0.0284	0.2267	2.21	0.0241
Inflation	-0.0047	-0.42	-0.0018	0.0152	1.52	0.0055	-0.0930	-5.88	-0.0099
Domestic Terrorism	0.0005	1.60	0.0002	-0.0017	-5.46	-0.0006	0.0036	11.33	0.0039
International Terrorism	0.0003	3.19	0.0001	-0.0003	-3.75	-0.0001	-0.0013	-10.73	-0.0001
Expected Margin of victory	-0.0349	-2.81	-0.0133	-0.1279	-10.46	-0.0468	-0.1559	-7.88	-0.0166
<i>Time Means</i>									
Unemployment	0.4963	4.63		-0.3353	-1.52		0.4931	2.98	
Inflation	0.0010	1.21		-0.0007	-0.55		0.0018	2.58	
Domestic Terrorism	-0.0099	-1.06		-0.0184	-1.10		0.0032	0.18	
Chi-square goodness of fit	3.1677			13.5726			3.6063		

Number of observations=373. Bootstrap standard errors based on 1000 replications.



Table 5: Linear Model Estimates of Vote Share Equations

	PSOE		PP		IU	
	(1)	(2)	(3)	(4)	(5)	(6)
	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
Constant	0.2582	1.18	0.3154	1.13	0.0068	0.14
<i>Provincial variables</i>						
Unemployment	0.0131	0.51	0.0332	1.08	0.0018	0.16
Inflation	0.0082	2.21	-0.0138	-2.58	0.0001	0.04
Domestic Terrorism	-0.0009	-4.52	0.0005	1.87	-0.0003	-2.05
International Terrorism	0.0005	2.85	0.0005	1.27	-0.0000	-0.06
Expected Margin of victory	0.0064	1.15	0.0043	0.62	0.0014	0.87
Unexpected turnout	0.1058	3.17	0.0902	0.96	0.0343	2.79
Population density	-0.0000	-0.72	-0.0000	-0.02	0.0000	1.62
Coastline	-0.0169	-1.02	-0.0078	-0.26	-0.0081	-1.01
Vernacular language	-0.0267	-1.61	-0.0752	-1.92	-0.0114	-1.32
<i>National aggregates</i>						
Unemployment	-0.1022	-3.58	-0.0469	-1.26	0.0156	1.44
Inflation	-0.0032	-0.63	0.0165	2.41	-0.0101	-5.07
Domestic Terrorism	0.0002	1.73	-0.0008	-5.19	0.0004	8.39
International Terrorism	0.0001	2.44	-0.0001	-2.54	-0.0002	-9.64
Expected Margin of victory	-0.0114	-1.83	-0.0495	-6.41	-0.0224	-8.83
<i>Time Means</i>						
Unemployment	0.1847	4.24	-0.1754	-2.85	0.0549	2.98
Inflation	0.0004	1.28	-0.0002	-0.48	0.0002	2.75
Domestic Terrorism	-0.0036	-3.77	-0.0065	-3.54	0.0000	0.09
Chi-square goodness of fit	3.1847		13.7604		4.0668	
$R^2$	0.6148		0.4874		0.5673	

Number of observations=373. Robust t-statistic with clustering on provinces.

Table 6: FP Estimates of Vote share equations with interactions

	PSOE			PP		
	(1)	(2)	(3)	(4)	(5)	(6)
	Estimate	t-stat	Margin	Estimate	t-stat	Margin
Constant	-2.7094	-3.75		-0.5496	-0.55	
<i>Provincial variables</i>						
Unemployment	0.0692	1.73	0.0264	-0.0273	-0.50	-0.0100
Unemployment×Incumbent	-0.0805	-2.72	-0.0306	0.0750	1.85	0.0274
Inflation	0.0241	2.50	0.0092	-0.0090	-1.37	-0.0033
Inflation×Incumbent	-0.0135	-1.23	-0.0052	-0.0090	-0.45	-0.0033
Domestic Terrorism	-0.0015	-0.59	-0.0006	-0.0001	-0.10	-0.0000
Domestic Terrorism×Incumbent	-0.0040	-1.63	-0.0015	0.0056	0.39	0.0020
International Terrorism	0.0007	7.09	0.0003	-0.0004	-0.99	-0.0002
Expected Margin of Victory	0.0280	3.26	0.0107	-0.0054	-0.64	-0.0020
Population density	-0.0002	-0.92	-0.0001	0.0003	0.71	0.0001
Unexpected turnout	0.1803	1.82	0.0687	-0.0266	-0.24	-0.0097
Coastline	-0.0294	-0.60		-0.0421	-0.47	
Vernacular language	-0.0810	-1.65		-0.2859	-2.30	
<i>National aggregates</i>						
Unemployment	-1.4567	-7.62	-0.5552	-0.2221	-3.44	-0.0811
Unemployment×Incumbent	0.5315	9.04	0.2026	0.6859	10.40	0.2505
Inflation	0.1698	3.13	0.0647	-0.0099	-1.18	-0.0036
Inflation×Incumbent	-0.0153	-0.45	-0.0058	0.3698	11.89	0.1350
Domestic Terrorism	-0.0075	-3.03	-0.0029	0.0001	0.42	0.0000
Domestic Terrorism×Incumbent	0.0105	3.47	0.0040			
Expected Margin of Victory	-0.5502	-5.94	-0.2097	-0.2366	-17.31	-0.0864
<i>Time Means</i>						
Unemployment	0.4704	4.51		-0.2586	-1.21	
Inflation	0.0009	1.15		-0.0006	-0.42	
Domestic Terrorism	-0.0068	-0.63		-0.0191	-1.66	
Chi-squared goodness of fit	2.6490			12.1739		

Number of observations=373. Bootstrap standard errors based on 1000 replications.

Table 7: Linear Model with interactions

	PSOE		PP	
	(1)	(2)	(4)	(5)
	Estimate	t-stat	Estimate	t-stat
Constant	-0.6052	-2.25	0.1834	0.66
<i>Provincial variables</i>				
Unemployment	0.0423	2.02	-0.0009	-0.03
Unemployment×Incumbent	-0.0309	-2.26	0.0450	1.19
Inflation	0.0087	1.75	-0.0102	-1.99
Inflation×Incumbent	-0.0020	-0.32	-0.0156	-0.66
Domestic Terrorism	-0.0008	-4.0	0.0004	1.27
Domestic Terrorism×Incumbent	-0.0011	-3.91	-0.0073	-1.25
International Terrorism	0.0005	2.64	0.0007	1.59
Expected Margin of Victory	0.0073	1.56	0.0083	1.19
Population density	-0.0000	-0.63	0.0000	0.01
Unexpected turnout	0.1012	3.01	0.1834	0.66
Coastline	-0.0181	-1.09	-0.0072	-0.24
Vernacular language	-0.0290	-1.75	-0.0745	-1.91
<i>National aggregates</i>				
Unemployment	-0.5934	-7.30	-0.0868	-2.20
Unemployment×Incumbent	0.2070	8.02	0.2454	4.01
Inflation	0.0734	3.10	0.0064	0.96
Inflation×Incumbent	-0.0152	-0.98	0.1545	4.54
Domestic Terrorism	-0.0032	-2.98	-0.0001	-0.85
Domestic Terrorism×Incumbent	0.0045	3.38		
Expected Margin of Victory	0.0073	1.56	-0.0883	-10.24
<i>Time Means</i>				
Unemployment	0.1702	4.16	-0.1546	-2.58
Inflation	0.0004	1.25	-0.0002	-0.43
Domestic Terrorism	-0.0031	-3.22	-0.0059	-2.86
$R^2$	0.6773		0.5382	
Chi-squared goodness of fit	2.6113		12.5412	
Number of observations=373.				

Bootstrap standard errors based on 1000 replications.

Table 8: Standardized PSOE Fractional Probit Estimates

	Std. dev. Covariate	Parameter Estimate	Standardized Estimate
<i>Provincial variables</i>			
Unemployment	0.3311	-0.0044	-0.0015
Inflation	3.4436	0.0198	0.0682
Domestic Terrorism	8.2366	-0.0022	-0.0181
International Terrorism	10.0967	0.0007	0.0071
Expected Margin of victory	0.6033	0.0243	0.0147
Unexpected turnout	0.1221	0.2669	0.0326
<i>National aggregates</i>			
Unemployment	0.2093	-0.2337	-0.0489
Inflation	3.3678	-0.0047	-0.0158
Domestic Terrorism	70.0808	0.0005	0.0350
International Terrorism	66.5266	0.0003	0.0200
Expected Margin of victory	0.4344	-0.0349	-0.0152

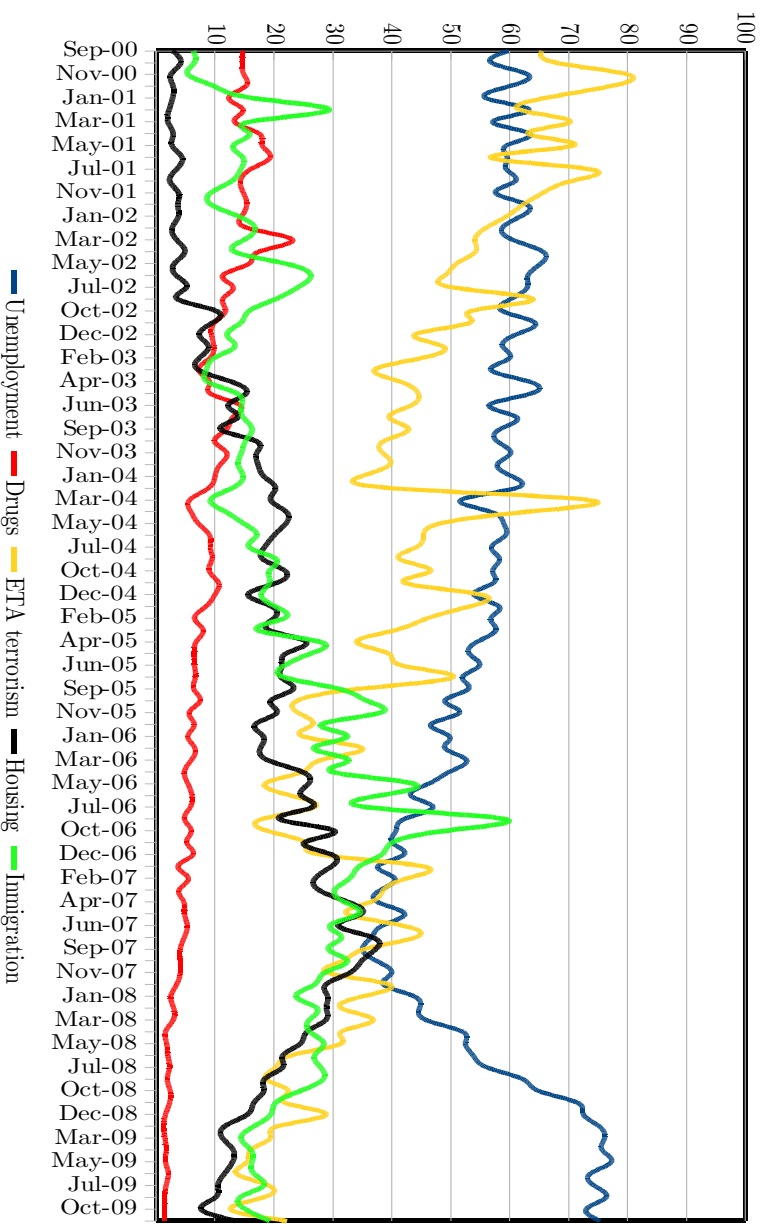


Figure 1: Percentage of people naming a problem as one of the three most important problems in Spain. CIS barometer data. Since surveyants are asked to select three items, the sum of percentages over all items adds up to 300. Several less important items are omitted.

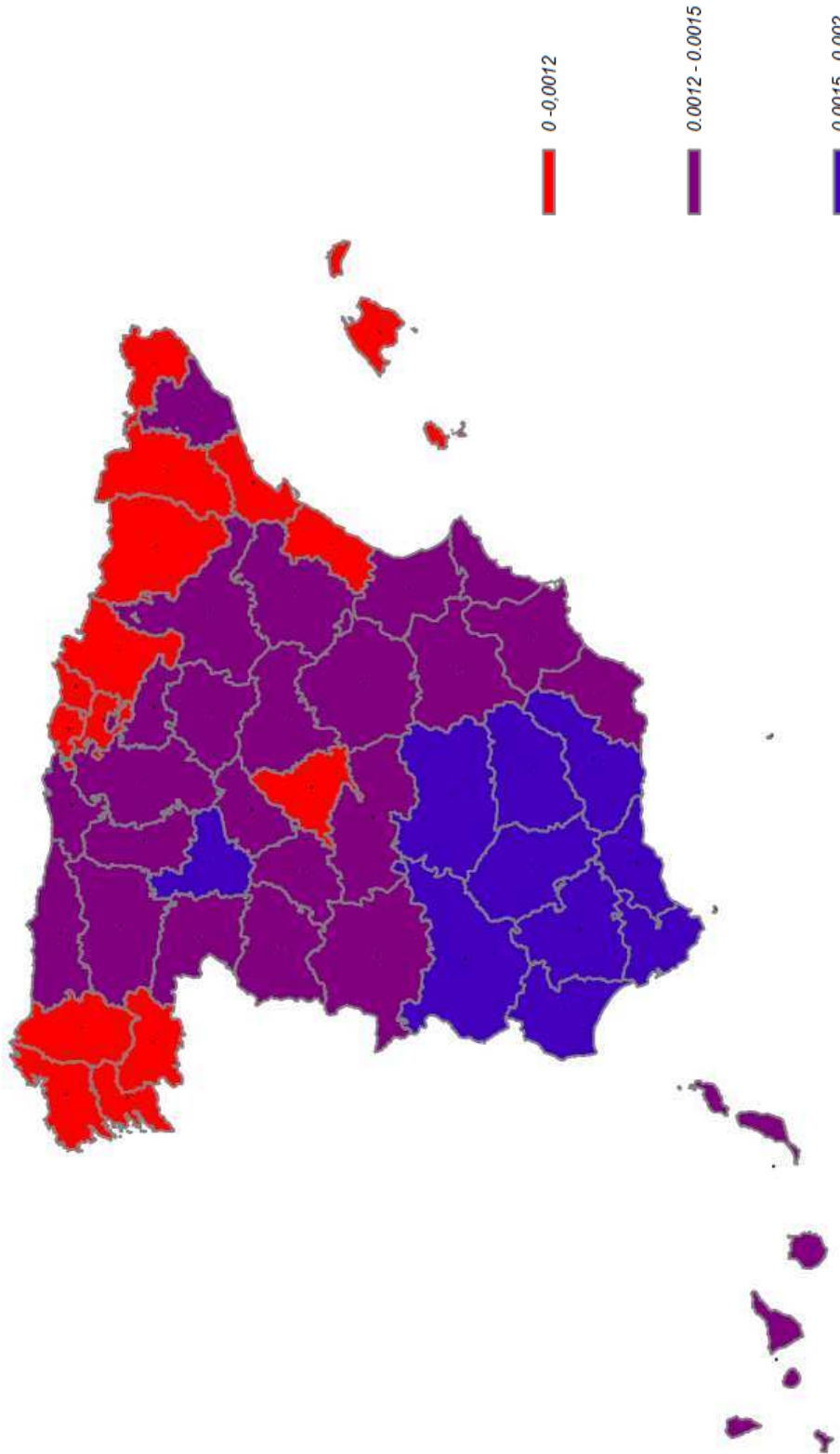


Figure 2: Provincial partial effects of national terrorism

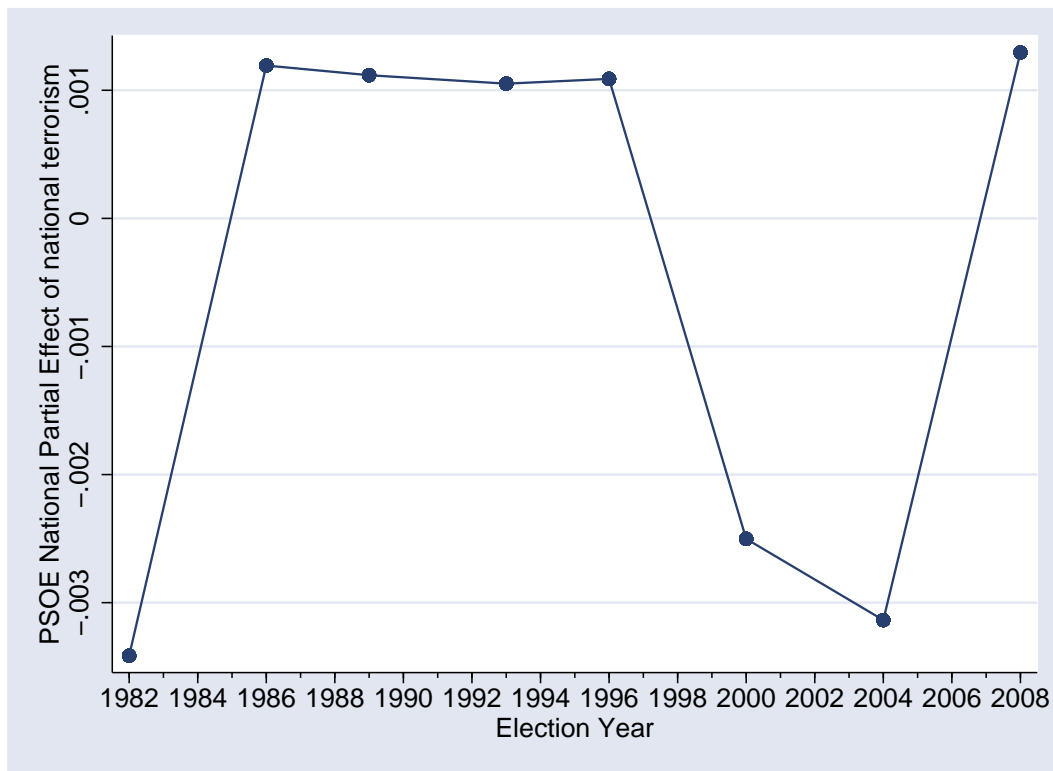


Figure 3: PSOE National partial effect of domestic terrorism at the national level.