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Predicting electoral behaviour in turbulent times: The Valencian Community case (Spain)

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***Abstract*— Lack of recovery of unemployment, more taxes, deterioration of the welfare system, high level of corruption and public debt, and lack of confidence in the Government's labour are driving a large proportion of the electoral register to support new emergent political parties. In this paper we construct a mathematical model to quantify this electoral change in the Valencian Community. By using a population model and splitting electoral options into five main categories, we modelled the dynamic transits among electoral choices by quantifying the expected electoral support scenario in the Valencian Community for the next local elections.**

Keywords*— *Mathematical population model, electoral analysis, socio-economic factors.

I. Introduction

The duration and intensity of the economic crisis [1], lack of Government solutions, the perceived level of corruption, the deterioration of the welfare system, the disproportionate and sustained high level of unemployment among youths, and increased poverty levels due to long-duration unemployment rates, together with the maintenance of privileges for politicians and the emergence of new centre-right new political choices, are giving rise to a shift of a major proportion of traditional abstentions and youth votes throughout these emergent political parties, which will change the political scenario in the short term.

Valencian citizens' perception of the weakness of its regional Government to provide socio-economic solutions favours growth of classical left wing political offers, together with the emergence of new democratic parties; i.e., Podemos, UPyD, Compromís and Ciutatans, [2]. Regarding electoral behaviour, electoral forecasting can be performed through polls, markets and models [3]. The market approach deals with the purchase of political stocks of different candidates, with forecasts based on the most frequently purchased stock [4].

The polls approach, which has been widely discussed due to pollers' unpredictable opinions, looks at changes throughout the pre-electoral period [5].

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Finally, the models approach is based mainly on applying statistical techniques to long time series of electoral results to forecast electoral results on a given date [6,7].This approach can be useful in more social stable times when the economy and political scenario are relatively stable, unlike in situations, like those of the present-day.

From the electoral point of view, we are witnessing a challenging new situation where a large proportion of the Valencian electoral register do not feel themselves captive to support the two main parties (Popular Party, PP, and Socialist Party, PSOE) in spite of the fact that these parties have held majorities since 1978. To some extent, and in agreement with [8], the ideas we predict are the appearance of an electoral Grey Swan in the Valencian Community; i.e., the appearance of a new political scenario where neither of the two main parties will gain the majority in next local Valencian elections, which has never occurred since 1978.

This paper proposes a mathematical model that was built after taking into account the economic, sociological, psychological and demographic factors to approach a consilient ambition in order to link the social sciences that provide the causes behind citizen electoral opinion transits with quantification performed by a system of difference equations.

This paper is organised as follows: Section II deals with the model construction; Section III offers the results and Section IV addresses the discussion and interpretation of the model results in relation to the possible Parliament scenarios after the next local elections held in the Valencian Community.

II. Model construction

A. *Subpopulations*

This section describes the study population, the sources of information and hypotheses employed, and the modelling of the dynamic subpopulation transits.

The Valencian Community is located on the east coastline of mainland Spain. This Community is composed of three provinces: Castellón, Valencia and Alicante. Its overall approximate population is 5,113,815 (2013) and the register of the last regional elections [9] was 3,549,687.

The study period of electoral behaviour began in June 2011 and ended in April 2015. This time interval has been divided into quarterly year periods, where n=0 represents the situation in June 2011 and period "n" means the number of quarters that have elapsed since June 2011.

This paper proposes a dynamic mathematical population model by splitting the electoral register of the Valencian Community into five subpopulations:

- P(n): Expected voters of Conservative Popular Party (PP) in quarter n.

- S(n): Expected Voters of the Socialist Party (PSOE) in quarter n.

- E(n): Expected Voters of Extremist Parties with Parliament representation in quarter n; in agreement with (De la Poza et al., 2013), extremist parties are those that are:

  a. Separatists and/or

  b. Breakers of the capitalist system and/or

  c. Racists

The extremist concept relates to the type of elections we are about to witness; for instance, IU is an extremist party in the Valencian Community, whereas it is an establishment party in the Andalusian Parliament (located in the south of Spain). CiU (Convergencia i Unió) is an establishment party in the Catalonian Parliament (located in the north east of Spain), but is also an extremist separatist party in the national scenario.

- A(n): Expected Abstentions and blank voters in quarter n.

- U(n): Expected Voters of Emergent Political Parties (UPyD; Ciutatans, Compromís, and Podemos), those who have never had representation in the Valencian Parliament, or were irrelevant in quarter n.

The last group comprises those parties which, to date, have not had enough electoral support to achieve representation in the Valencian Parliament, or their representation is expected to grow considerably in the next elections. So we believe that they can hold a seat in forthcoming Parliament representation (UPyD, Ciutatans, Podemos) or they will significantly grow (Compromís). Our assumption disregards the "small" parties that have never held a seat in Parliament and probably will not hold one in the next Parliament.

Having divided the electoral register, we studied the dynamic subpopulation transits for the period since the last local elections in the Valencian Community and the expected schedule for the next ones (approximately March 2015). The dynamic transit was modelled by taking into account economic, socio-political and demographic factors.

Having modelled the dynamical transit between subpopulations, we obtained a system of difference equations whose solution was computed, starting from the initial condition obtained from the previous Valencian local elections and the data derived from the questionnaire.

In the following section, we model the transit coefficient between the subpopulations into which the electoral register is split.

B. *Coefficients modelling*

The transits between subpopulations are explained by economic [10] and socio-political factors, which are dynamic, apart from demographic factors.

- $\alpha_1(n)$: The economic factor
- $\alpha_2(n)$: Trust in the Government's labour indicator
- $\alpha_3(n)=\alpha_3$: The poverty indicator
- $\alpha_4(n)$: Trust in the main opposition party
- $\alpha_5(n)=\alpha_5$: The hope coefficient

Coefficients α_3 and α_5 are assumed constant because of the short study period, and also due to human herding, changes in electoral citizens' behaviour require a certain time delay.

We assume that the economic influence ($\alpha_1(n)$) is determined by the unemployment rate $\beta_1(n)$, while the poverty indicator ($\alpha_3(n)$) is closely linked to the long-term unemployment rate [11]. This model considers two socio-political factors: ($\alpha_2(n)$) based on the trust in the Government's labour indicator (GLI); $\alpha_4(n)$ obtained from the trust placed in the main opposition party.

The study population is variable given the income of new voters ($B_i(n-72)$, $0\leq i\leq 4$), the amount of emigrants (M) and those voters (D) who have left the system, which are assumed constant due to the few changes in these demographic factors during the study period, [12].

The initial subpopulations at the beginning of the study period (June 2011) were the electoral results of the previous Valencian elections:

P(0)= P(June 2011)=1,211,112

S(0)= S(June 2011)= 687,141

A(0)= A(June 2011)=1,118,769

U(0)= U(June 2011)=237,072

E(0)= E(June 2011)=144,703

Let's begin by constructing the demographic coefficients composed of the birth and death rates, but also the new effect of Valencians emigrating abroad to look for work.The amount of new voters for each subpopulation is given by:

$$B_i(n-72) = \alpha_b(n-72) * T(n-72) * r_i; \quad 0 \leq r_i \leq 4 \qquad (1)$$

α_b(n-72), is the birth rate of the Valencian population in quarter (n-72). This parameter is estimated according to the data from the Spanish Institute of Statistics. *T(n-72)* represents the Valencian population in the quarter, n-72; r_i is the proportion of new voters that support each subpopulation obtained from the questionnaire.

We assume that the Valencian citizens who have reached the age of 18 will enter the system, according to the results obtained from the questionnaire passed in January 2012. We developed and passed a questionnaire to test new voters' opinions in January 2012. The questionnaire covered all the possible population segments, N=400 (university students, community college students, employees, unemployed). As the social, political, and economic environment is stagnated, we assume that the tested new voters' opinions will remain constant throughout the 4-year study period. Table 1 shows the questionnaire results.

P	9
S	8.60
AB	30.70
EX	20.90
U	30.80

Table 1. First time voters trend (as a %).

Thus citizens leaving the system can occur for two reasons: biological death measured with the death rate ($\alpha_d(n)$) in quarter n, which is uniformly distributed quarterly. This parameter was estimated with the data provided by the Spanish Institute of Statistics. We assume that this rate will remain constant for the whole study period. The equi-distributed estimated amount of deceased people in quarter n is = 13,596. The expression is given by:

$$\alpha_d(n) * \frac{T(n)}{5} = \frac{D(n)}{5} = \frac{D}{5} \qquad (2)$$

The second reason for leaving the model is the Valencian emigration effect due to jobs lacking in the Valencian market. The number of Valencian emigrations is about 64,000 people per year [12]. We assume that the number of Valencian citizens leaving the Valencian Community annually (M = 64,000) will remain constant until January 2016 due to the stagnated economy, and leaving is equally distributed among the five subpopulations, M/5=16,051.

From the time our study started (June 2011) to the expected time of the next local elections (March 2015), information about the economic and political coefficients derives from publicly available sources of information, [13, 14, 15].

Thus the values of these coefficients during the period covering June 2014-March 2015 are estimated according to the forecasted public information from the institutions that design a hypothetical scenario, [15].

Coefficient ($\alpha_1(n)$) measures the variation between the unemployment rate of the Spanish population in the Valencian Community from June 2011 and for estimated quarter "n". We consider that the unemployment rate relates to the Spanish population since foreigners do not have the right to vote.

The unemployment effect is somewhat mechanical in that we assume that a new unemployed citizen who previously supported the Government could transit to abstention or become a blank voter (A). We also assume that as the potential recovery of the economy is minimum, and as the current Government does not capture votes from other political options, the economic factor does not influence the transition of voters between the other political options.

$$\alpha_1(n) = 0.01 * [\beta_1(n) - \beta_1(0)]\ n \geq 1 \qquad (3)$$

$$\alpha_1(n) = 0.01 * [\beta_1(0) - \beta_1(March2011)] = 0.01 * [19.97 - 0.21] - 0.0103 \qquad (4)$$

where $\beta_1(0)$ is the unemployment rate in June 2011 and β_1(March 2011) denotes the unemployment rate in the previous quarter (March 2011).

From September 2014 to the end of the period, we assume that unemployment will lower by 0.25% per quarter.

Coefficient $\alpha_2(n)$ measures the quarter-based change in the citizenship's opinion about the Government's labour. We applied the GLI indicator [15] . Thus from the beginning of the study to July 2014, the GLI was obtained from the Spanish Center for Sociological Research, and then a slight drop in the GLI is forecasted from July 2014 to March 2015, assumedly due to the unaccomplished electoral programme, non-popular decisions such as recent cuts in welfare, combined with more taxes and the recurrent corruption scandals published in the international media.

Although it is feasible to think that the vote behaves as a random variable, this is not the case since, apart from the ideology, the two main political parties (PP and PSOE) have a percentage of loyal supporters owing to private interests developed over long governance periods and a network of institutions managed by politicians [16].

For the sake of realism, we assume that a proportion of unconditional loyal voters to the Popular Party (PP) will not change their electoral support under almost any circumstances [17]. In fact, we estimate that members and sympathisers, together with military servants and clergy [18], will support PP, and also half the Valencian population older than 60 years who voted PP in the previous elections will remain loyal to this party.

This hypothesis is based on a lower mobility vote intention of the population aged more than 60 years, and in spite of the fact that half of them will change their vote support because the welfare system has deteriorated, combined with a decline in the living standards of their descendants, which means they feel morally obliged to sustain children, and even grandchildren.

Furthermore, due to family contagion, each sympathiser or party member, or voter older than 60 years, produces at least 2 voters who share their electoral behaviour.

However as this contagion rate is uncertain, we did a robustness analysis of the results in relation to this contagion parameter by simulating that the coefficient will change during the interval [1.5, 2.5] for sympathisers and party members. For the remaining loyal population older than 60 years old, the robustness analysis was performed during the interval [7/16, 13/16].

The obtained results reveal that the change in the voting support of the PP party varies by only 0.01%, which proves the robustness of the model with changes of support loyalty to PP as the governing party (which also occurs during the study period).

Having estimated the proportion of unconditional (loyal) voters to the PP (667,974 voters), we quantified the proportion of potential movers from the PP option to other political offers (0.11005139), about 11.005139% per quarter.

To summarise, the dynamic change in the local Government trust coefficient $\alpha_2(n)$ is expressed as follows:

$$\alpha_2(n) = [GLI(0) - GLI(n)] * 0.11005139; n \geq 1 \qquad (5)$$

$$\alpha_2(0) = [GLI(March2011) - GLI(0)] * 0.110 \quad (6)$$

where GLI(0) is the GLI measured in June 2011, while GLI (March 2011) is the GLI in the previous quarter (March 2011). The GLI indicator values for the period covering September 2014-March 2015 were forecasted following last year's trend because of the stagnated socio-economical scenario.

The poverty indicator $\alpha_3(n)= \alpha_3=0.005$ is the coefficient that estimates the radicalisation of votes.

We assume that those people who did not vote in the last local elections due to their standard of living worsening and loss of confidence in the two main political parties will transit to the extremist subpopulation (E) as a result of the radicalisation of their vote, but they will also transit to emergent political offers (U) to seek democratic political choices (Podemos and Compromís).

It is well-known that the poverty indicator is related to the long-term unemployment rate (no work for more than 2 years). This indicator is assumed constant for the study period due to scarce employment recovery. Following [11], we estimated the quarter rate to be 0.5% of subpopulation A.

Spanish citizens no longer trust the two main political parties that have alternatively been in Government since 1980. Thus, not only the Government party (PP) loses support, but also the main opposition party (PSOE).

The main reason, apart from frequent corruption cases (also in the Communities governed by the PSOE since 1980, like the Andalusian Community), is that citizens believe that their disposable income is being continuously cut by increasing taxes and the welfare system is deteriorating, while any existing privileges and administration costs do not diminish in any way that is comparable.

These new effects reinforce the successful emergence of new political offers (UPyD, Cititatans, Compromís, Podemos, etc.) that attract the support previously granted to the two main political parties in the past (PP and PSOE). This effect somewhat goes against the establishment of the two-party Spanish system. Loss of votes from PSOE (the non-governing main opposition party in the Valencian Community) measured by coefficient α_4.

$$\alpha_4(n) = C * [\beta_2(n) - \beta_2(n-1)] \quad (7)$$

where $\beta_2(n)$ is the political trust indicator value in quarter n obtained from the Spanish Center of Sociological Research, and C is a sociological constant adjusted by matching the electoral data of the last three Spanish General elections. After matching the data, we obtained C=0.00299.

From the time this study began (June 2011) to June 2014, the available data allowed us to compute coefficient α_4. As the socio-political environment has not improved, but continuously worsens, we assume that coefficient $\beta_2(n)$ will lower by 0.2 per quarter.

The hope coefficient $\alpha_5(n)=\alpha_5=0.0508666$ is assumed constant for the study period since it is assumed that any new political offer will be taken into account.

This coefficient is distributed uniformly among the 12 study trimesters. This coefficient measures the proportion of employed people aged 30-65 years who did not vote in the last elections and who move to emergent parties attracted by new political offers, along with their unconcern for the two main political parties.

This coefficient is expressed as follows: where 0.8 is the proportion of people in the Valencian Community who is employed during the age interval [30,65]; 0.763 is the proportion of Valencian citizens during the age interval [30, 65]; 12 is the number of quarters in this study period.

Subpopulations change dynamically over time as they follow the influence of economic, sociological and demographic drivers, and this behaviour can be drawn according to the following block diagram (Figure 2):

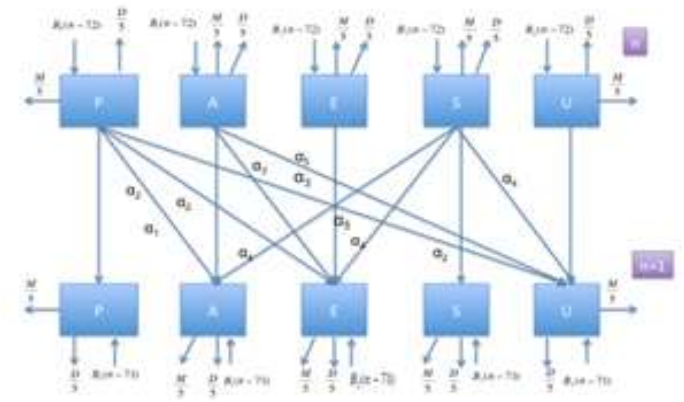

Figure 2. Dynamic electoral transits.

C. *Model dynamics*

After modelling the transition between subpopulations, we established the system of difference equations by drawing the model dynamics obtained using the block diagram:

$$S(n+1) = (1+\alpha_4(n))S(n) + \beta_3(n-72) - \frac{1}{5}(D + M) \quad (9)$$

$$P(n+1) = (1-\alpha_1(n)-\alpha_2(n))P(n) + \beta_0(n-72) - \frac{1}{5}(D+M) \quad (10)$$

$$A(n+1) = (1-\alpha_3-\alpha_5)A(n) - \frac{4}{10}\alpha_4(n)S(n) + (\frac{3}{10}\alpha_2(n) + \alpha_1(n))P(n) + \beta_1(n-72) - \frac{1}{5}(D+M) \quad (11)$$

$$E(n+1) = E(n) + \frac{1}{2}\alpha_3 A(n) - \frac{3}{10}\alpha_4(n)S(n) + \frac{1}{10}\alpha_2(n)P(n) + \beta_2(n-72) - \frac{1}{5}(D + M) \quad (12)$$

$$U(n+1) = U(n) + (\frac{1}{2}\alpha_3 + \alpha_5)A(n) + \beta_4(n-72) - \frac{1}{5}(D + M) \quad (13)$$

III. Results

The difference system can be explicitly solved by giving the following values in March 2015 corresponding to n=16.

Table 3 shows the results obtained by solving the difference equations at n=0 and n=16.

Quarter	P	A	E	S	U
Jun -11	1,211,112	1,118,769	144,703	687141	237072
Mar-15	517,968	847,309	219,270	413130	1,088,517

Table 3. Subpopulations forecast (absolute values).

The results expressing the electoral register as a percentage compared with the electoral results from last elections (June 2011) are shown in table 4.

Quarter	P	A	E	S	U
June 2011	35.63%	32.92%	4.26%	20.22%	6.98%
March 2015	16.78%	27.45%	7.10%	13.39%	35.27%

Table 4. Forecasted electoral results compared with the last election ones.

The figure below graphically illustrates the electoral results.

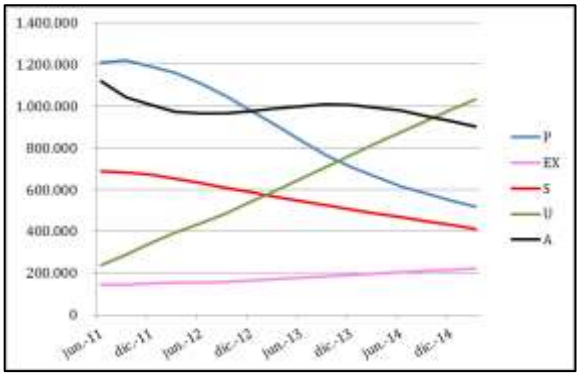

Figure 3. Subpopulations forecast.

IV. Conclusions

The first conclusion drawn from the proposed model is the end of the two-party system in the Valencian Community, and the sure fact that the two main political parties will gain a minority in the next local elections, expected around March 2015, for the first time since 1978. This means that the next government will be a coalition comprised of at least three parties. Since the deterioration of the governing party with absolute majority is so great, it is unlikely that any potential emergent partners parties (Ciutatans, UPyD) will decide to form part of a government coalition with it (PP). Thus the almost sure conclusion is that the next government in the Valencian Community will be a left wing coalition of PSOE (S) and several emergent parties (Compromís, Podemos) and/or extremist left wing parties (IU).

It is important to point out that our model forecasts the level of expected vote support of parties and abstentions, and we do not consider seats in Parliament because this is closely related to the Electoral Law on which the model is applied; in our case, emergent parties, given the D'Hondt method effect that favours large parties and coalitions to punish emergent parties.

The model can be applied to any other geographical area if it bears in mind the (economic, sociological, demographic) factors and data of the electoral register. As shown in previous sections, our model allows the simulation of the results to change uncertain situations by merely making changes in the system parameters. This fact is a definitive advantage as opposed to pure statistical approaches based on the analysis of fixed pictures of electoral behaviour by taking polls during the time immediately prior to Election Day.

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