Satisfaction and adaptation in voting behavior: an empirical exploration

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Abstract.

Dynamic models of learning and adaptation have provided realistic predictions in terms of voting behavior. This study aims at contributing to their scant empirical verification. We develop a learning algorithm based on bounded rationality estimating the pattern of learning process through a two-stage econometric model. The analysis links voting behavior to past choices and economic satisfaction derived from previous period election and state of the economy. This represents a novelty in the literature on voting that assumes given voter preferences. Results show that persistence is positively affected by the combination of income changes and past behavior and by union membership.

Keywords: voting, bounded rationality, learning, political accountability.

JEL Classification: D030, D720, C230, C250.

FIRST PRELIMINARY VERSION. NOT TO BE QUOTED.

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1. Introduction

The voting paradox (Downs, 1957; Riker and Ordeshook, 1968) highlights a contrast between economic theory of voting and actual voting behavior. The paradox occurs because voting costs are generally higher than the expected benefits, originating when the favorite between two parties wins, which are negligible as the probability of casting the decisive vote is close to nil. According to the so-called *calculus of voting*, if individuals are rational and voting is purely instrumental to obtain the preferred electoral outcome, voting turnout should be negligible. However, voting is definitely more common than abstaining in democratic systems. A substantial literature has provided several potential solutions to the voting paradox, without infringing the assumption of fully rational forward looking voters.[2] A rather customary tenet of these voting models is that individual preferences for candidates are exogenous. Therefore, the focus is almost exclusively on the act of voting disregarding the impact of feedbacks form past political and economic performance.

In a dynamic perspective, a reasonable presumption would be that people may adjust their preferences along successive elections according to their satisfaction with their party politics and the economic outcome.[3] A class of voting models based on bounded rationality suggests that voting can be viewed as a dynamic process based on adaptation, driven either at individual - learning voting (LV) models - or aggregate level - evolutionary game-theoretic voting (EV) models. Namely, voters are believed to act in on the basis of previous actions and election outcomes. A well known example of individual-based stochastic learning process is developed by Macy (1990, 1992, 1994). This paper refers to Macy's process, more specifically to its application by Kanazawa (1998; 2000), and the related aspiration-based-adaptation rule (ABAR) developed by Bendor, et al. (2003). Their

[2] With fully rational voters, a simple solution to the paradox would be that individuals are driven by a consumption benefit, a warm glow associated with the act of voting itself (*expressive voting approach*). This approach has some conceptual limits, in spite of the received empirical support (Blais and Young, 2000). Mueller (2003a, 2003b) and Aldrich (1993; 1997) argue that this solution is inevitably tautological, as individuals end up voting when they feel they should vote. People may also regret not having voted. The minimax regret (Ferejohn and Fiorina, 1974) states that individuals try to minimize the regret they could have by choosing the wrong option. Unfortunately, the minimax regret leads to very unrealistic, ultra-cautious individual behavior. other solutions, within the fully rational framework, predicting a positive levels of turnout include the game-theoretical models (Palfrey and Rosenthal, 1983; 1985), info-based models (Larcinese, 2006) and group-based models (Ulhaner, 1989; Feddersen 2004; Feddersen and Sandroni, 2006; Fowler, 2005). Theoretical and empirical surveys of rational solutions are provided, among others, by Blais (2000), Blais and Young (2000), Mueller (2003a) and Geys (2006).

[3] The link between political decision-making and economic performance is central in the political economy literature. Here we do not deal with the determinants of political accountability. We just admit that individual (dis)satisfaction with a party politics may affect her decisions concerning voting.

basic conjecture is that individuals learn how to act in politics by trial and error. Although the hypothesis of backward looking and adaptive voters is apparently consistent with reality and highlights the dynamic aspect of voting, it has hardly been tested.

The present study aims at filling this lacuna by employing a two-step econometric model building Denny and Doyle (2009). It is shown that voting choice has indeed an adaptive component that can be modeled as a function of past behavior and election outcomes feedbacks. More importantly, we suggest that voter modeling may take in account also the effect of policies on the voter economic conditions. Therefore, under bounded rationality assumption, voting may be explained as a dynamic outcome-based process where voters' behavior is driven by feedbacks they receive in terms of economic satisfaction from past elections. In other words, we suggest a model of voting that combines the dynamic process derived under bounded rationality assumption with the instrumental approach that is typical to rational models. Moreover we employ an econometric model that meets Greene (2009) suggestions about consistency in turnout models; namely that they are biased because the fail linking the decisions of *whether* and *how* to vote. Those decisions are here confronted with the outcome of previous elections. In fact, it is reasonable to presume that people decide to vote having in mind their voting preferences and that both can be influenced by past politics under a dynamic perspective. Preferences may vary along successive elections and voters may decide to change the behavior if they are dissatisfied with party politics. For the above reasons, we think that our analysis offers a fresh view with respect to the standing assumption of the literature that preferences of voters are given and independent from party performances and policies (the *democratic accountability* problem).

The econometric analysis uses socio-economic and voting data derived by the British Household Panel Survey, for the period 1992-2006. The paper is organized as follows. Section 2 illustrates the characteristics of the dynamic approach of learning and adaption used in the econometric model. Section 3 presents the model based on an outcome-based learning algorithm. In section 4, we discuss our findings. Few comments in Section 5 conclude the paper.

2. A dynamic approach to the analysis of voting behavior

The recent interest for a dynamic analysis of voting behavior is due to the limits showed by traditional, static, rational models in predicting observed turnout levels. Dynamic voting models

include EV and LV models. These adaptive models have two main common features: bounded rationality, and the time-dependence. In contrast to rational models, agents learn how to behave through experience. While EV models of voting behavior (Sieg and Schulz, 1995; Linzer and Honaker, 2003 and Conley and Toossi, 2006) assume evolution to be driven at aggregate level, LV models (Kanazawa 1998, 2000; Bendor 2001; Bendor et al. 2003) keep the agent as autonomous and evolution is drawn at individual level: agents adapt on the basis of their and others' experience, modifying their behavior over time (Selten, 1991; Fudenberg and Levine, 1998).

In particular, Bendor et al. (2003) presents a model where each individual i, at time t, has a starting propensity to vote denoted by p_{it} and an aspiration level a_{it}. Propensity probabilistically determines who votes and who is the winning candidate at time t. Given voting costs c_{ij} and a benefit b_{ij} ($b_{ij} > c_{ij} > 0$) for the voters of the winning candidate j,[4] individuals compare obtained payoffs (π_{ij}) and aspiration levels, and eventually adjust their propensity in the next stage.[5] The adjustment direction depends on the received feedback. Their aspiration-based adjustment rule (ABAR) is defined as follows:

$$\begin{aligned}
&\pi_{i,t} > a_{i,t} \rightarrow \Pr\ p_{i,t+1} > p_{i,t} = 1 \text{ and } \Pr\ \pi_{i,t} \geq a_{i,t+1} > a_{i,t} = 1 \\
&\pi_{i,t} = a_{i,t} \rightarrow \Pr\ a_{i,t+1} = a_{i,t} = 1 \\
&\pi_{i,t} < a_{i,t} \rightarrow \Pr\ p_{i,t+1} < p_{i,t} = 1 \text{ and } \Pr\ \pi_{i,t} \leq a_{i,t+1} < a_{i,t} = 1
\end{aligned} \tag{1}$$

They also allow for individuals to be partially or fully inertial. Nevertheless, Bendor et al. (2003) has been strongly criticized by Fowler (2006). He rejects their use of Bush-Mosteller (1995) reinforcement rule for the model simulation because it would lead to a biased outcome. That is, the reinforcement rule indeed has incoherent effects on individual propensity to vote so that individuals engage in casual voting.[6] This bias occurs as adaptation varies with the initial level of p_{it}.

Solutions with full or bounded rational voters generally fail modeling the act of voting as an outcome-based process. We suggest that voting behavior could follow an adaptation process that links election outcome to feedbacks that voters receives from party activities as well as on

[4] In Bendor et al. (2003), the benefit B is attributed only to the those who have preferences aligned to the winner, independently from the fact that they actually voted.

[5] Net payoff is equal to b_{ij}-c_{ij} if individual i voted and is of the same faction as the winning candidate j (b_{ij}, if i did not vote); or -c_{ij} if individual i voted and is not in the same faction as the winning candidate j (0, if i did not vote).

[6] Casual voting is also rejected by the empirical evidence for habitual voting (HV), thoroughly surveyed by Plutzer (2002). Habitual voting can be interpreted as an alternative dynamic explanation for voting still based on a reinforcement rule. However, in this case, the reinforcement rule is not based on a learning process but rather on voting reinforcement itself. Although this solution has received empirical evidences both by econometric studies (Green and Shachar, 2000) and experiments (Gerber et al., 2003), it presents a major shortcoming. On one hand, it confirms individual behavior to be an evolving process where dynamics play a relevant role; on the other hand, it overlooks the relation between voting and the political and economic situation.

economy's performance in between elections. In fact, we show that voting seems to a have a component reminding of habitual voting (HV) but voters may change their habits in order to obtain a higher level of economical satisfaction. In particular, we develop a dynamic learning algorithm, based on Bendor et al. (2003), where voting choices are driven by individual ex-post perceptions about parties' platforms and policies. In other words, we combine the instrumental approach, which is typical of rational models, with the dynamic learning process, which we derive under bounded rationality assumption. Moreover, we employ a model specification that refers to Bendor et al.(2003) by adopting a proxy for (π_{it}-a_{it}) [see (1)]. In order to cope with Fowler's criticism we directly estimate the starting point (the initial p_{it}) stage as a function of strictly exogenous covariates through an Heckman procedure, as in the two-stage estimation technique in Denny and Doyle (2009).

Generally, empirical voter models are developed in a cross sectional static settings as either turnout models or voter choice models. The former models individual decision to vote or abstain while the latter looks at voters' preferences over alternatives. Cross sectional static models of turnout are easy to employ but they usually fail in terms of consistency and furthermore, they are not able to catch any dynamic process. Exceptions include Plutzer (2002) and Denny and Doyle (2009) who employ turnout models in a dynamic setting. Unfortunately, similarly to most participation models, their analyses on HV consider just the decision on whether to vote or not. This is equal to assume that decisions on whether *and* how to vote are neither simultaneous nor correlated. Tillman (2008) shows this assumption to be unrealistic. A correct analysis on voting behavior should take in account that individuals face these two problems at the same time and choose whether to vote under evaluating all alternatives. The same problem can be explored from the econometrical point of view, by using Greene's (2009) remark: a discrete choice model choice assumes that individuals make always a choice when they face a choice situation. This is a basic and strong assumption, which, if violated, leads to biased results. Abstention is not only a political alternative, which individuals evaluate, as Tillman suggests, it is also a category needed for dealing with discrete choice model assumption since it completes the set of possible individual's responses. According to these points, simple turnout models are biased and another dependent variable is needed.

Although Multinomial responses are commonly explored by using Multinomial *Logit* (MNL) or *Probit* (MNP), these only work in a cross-sectional setting. We choose to use a dependent variable that directly refers to the response reinforcement process so imposing that individuals confirm their party choice or abstention in two consecutive elections, if they think they made the best choice, or to change their choice in case of disappointment. Such dependent variable (persistence) is a dummy taking the value 1 if a voter confirms previous choice (either voting for the Labour, voting for

Conservatives, voting for some other party including liberal-democrats and the others parties, abstaining) and 0 if she changes. In line with learning theory models (see, e.g. Kanazawa, 2000), we assume that individuals learn through trial and error eventually reaching an optimal choice after some attempts. Taking the political context fixed, a voter learns her optimal choice and then confirms it in the next stages. So when a choice is confirmed over two consecutive elections, we assume that an individual has reached a satisfactory choice (a "good match"). If the reinforcement learning process is true, then the probability of finding a satisfactory point (or, in other words, the probability of confirming the previous choice) should be increasing in individual lifetime and in satisfaction level.

Considering individual behavior to be driven by either a rational or a psychological process, we argue that learning process should work better when individuals play a reasonable number of games (elections). Namely, we suppose young voters will change their behavior more often than elders. On the other hand, if persistence depends on satisfaction proxies then voters act according to a learning mechanism. Following to Kanazawa (2000), satisfaction may arise if the voter voted for the winner. This is equal to add to a simple econometrical model a dummy variable. Since Kanazawa model suffers from a number of weaknesses both from the theoretical and the empirical point of view (see Martorana and Mazza, 2010), we suggest to formalize a satisfaction level that does not depend on voting for the winner only as in Sieg and Schulz (1995) and Collins et al. (2009). In particular Sieg and Schulz (1995) suggests individual satisfaction to be a reflection of individual relative income increase within population. A positive satisfaction may occur, in this case, if individuals perceive their economical status variation to be positive. This is equal to add a dummy variable coded 1 if individual perceived their economical status at least not to be worsening, and 0 otherwise[7].

Basically, we imply individuals to judge parties' performances on the basis of the effect policies have on individual economical status. Since income redistribution is a typical policy that governments undertake, we have only to assume individuals to act in an instrumental way, as in traditional rational voter models. The instrumental approach requires individuals to consider the benefit they may receive from the act of voting. Traditionally, the benefit is measured as the effect that party policies may have on individual utility. In a bounded-rationality context, though, voters do not perform a "forward-looking" *cost-benefit* calculus but adjust their behavior on the basis of satisfaction.

Assuming satisfaction to depend on utility is a way for adapting the instrumental approach to non-rational models. In addition to economic benefits, the learning process developed in this paper takes

[7] As it will be explained in detail later, the analysis will distinguish two cases of perceived and real income increase. Martorana (2010) shows that material and perception based measures of economic deviation are both relevant and determine almost equivalent impacts.

in account the effect of party performance on individuals so that individual adaptation process directly depends on how voters judge parties. Under this assumption, individual propensity to vote for the same party they have vote for, in the previous election, is reinforced or weakened if the voter has been satisfied or dissatisfied with the government.

3. The model

Consider any individual *i* in a population *N* facing *T* consecutive elections, one for each period *t= 1,...,T*. At period t_0 (year 1992, in our study) individual *i* faces the problem of deciding whether voting or not and, eventually how to vote. This decision is assumed to depend on socio-economic characteristics or parental attitudes, not on previous voting behavior. Starting from election *t=1* and at any further election, the voter may decide to confirm the choice made at the previous election. We define y_{it}, namely the probability that individual *i*'s choice at election *t-1* is confirmed at time t as follows:

$$y_{it} = 1 \; if\left(w_{i,t-1} - a_{i,t-1}\right) > 0 \qquad y_{it} = 0 \; if\left(w_{i,t-1} - a_{i,t-1}\right) < 0 \tag{2}$$

where $\left(w_{i,t-1} - a_{i,t-1}\right)$ is the difference between the outcome for *i* and the aspiration of the same subject evaluated in between elections. Individuals take this difference into account in order to choose whether and how to vote at time *t*. We estimate y_{it} as a function of the number of elections faced at time *t* and a satisfaction vector s_t. We define the latent variable $y^*_{i,t} = \left(w_{i,t-1} - a_{i,t-1}\right)$ as follows:

$$\left(w_{i,t-1} - a_{i,t-1}\right) = y^*_{i,t} = \vartheta s_{i,t} + \beta x_{i,t} + v_{i,t} \tag{3}$$

where $s_{i,t}$ is the satisfaction level of *i* at time *t* ; $x_{i,t}$ is the age of *i* at election time, as a proxy for the number of elections faced and a set of individual characteristics; $v_{i,t}$ is the error term. The error term can be decomposed in an individual unobservable heterogeneity (u_i) and an random term (ε_{it}), which is assumed to be normally distributed and independent of x_{it}. In order to treat such unobservable element we adopt a *Mundlak approach* consisting in approximating u_i as a function of the individual means of time-varying covariates (x_{it}), as suggested by Denny and Doyle (2009), namely:

$$u_i = \varphi \bar{x}_i + \eta_i \tag{4}$$

As a result, the latent variable model is:

$$y^*_{i,t} = \theta s_{i,t} + \beta x_{i,t} + \varphi \bar{x}_i + \eta_i + \varepsilon_{it} \quad \text{where} \quad \eta_i | \bar{x}_i \sim N(0, \sigma^2_\eta) \tag{5}$$

Then individual *i* is assumed to confirm her previous choice if $(w_{i,t-1} - a_{i,t-1})$ is positive and:

$$\begin{aligned} &\Pr(y_{i,t} = 1 | s_{i,t}, x_{i,t}, u_,) = \Pr(\theta s_{i,t} + \beta x_{i,t} + u_i + \varepsilon_{i,t} > 0) \\ &= \Pr(-\varepsilon_{i,t} < [\theta s_{i,t} + \beta x_{i,t} + u_i]) = \\ &= F(\theta s_{i,t} + \beta x_{i,t} + u_i) \end{aligned} \tag{6}$$

where *F(.)* is the distribution function of the error term that we assume to be logistic.

To map the effect of election outcomes into individual welfare we define the instrumental satisfaction index ($s_{i,t}$) as the combination of election outcomes and individual income variation. It combines past voting choices and income perceived variations between two consecutive elections. We use income variation as a measure of satisfaction as suggested by Sieg and Shulz (1995) and Collins et al. (2009). Moreover, the election outcome works as a predictor for electoral behavior as modeled in Kanazawa (1998, 2000). The instrumental satisfaction index $s_{i,t}$ is as follows:

1) $s_{i,t}=1$ if *i* voted for the winner and her income variation is not negative as well as if *i* either voted for the loser and her income variation is not positive, or voted for a third party or abstained and income decreased.

2) $s_{i,t}=-1$ if *i* voted for the winner and her income variation is negative; if *i* voted for the loser for a third party or abstained and her income variation is positive.

3) $s_{i,t}=0$ if *i* voted for a third party or abstained and there is not variation in income.

We adopt two different measures of income variation, deriving two alternative satisfaction indexes. The first one ("income-based") interprets a swing of individual position in income distribution toward a different quintile as a measure of economic deviation. Doing so, only significant income variations are taken in account. The second one, named "perception-based", defines income deviation as the difference in individual perceptions about economical status among two consecutive years.

Signs of the satisfaction index are summarized in Table 1. Rows indicate the change in income, which can be either perceived (with respect to the previous year) or real (in between elections). Columns on the contrary refer to voting in the previous election: an individual either voted for the winning party/candidate or for the loser one or she abstained.

Table 1: outcome-based satisfaction index.

	Winner	**Third/abstain**	**Loser**
Increased income	+	-	-
Unchanged income	+	0 (+)	+
Decreased income	-	+	+

It is evident that if *i* voted for the winner and income has increased, this economic variation provides positive satisfaction as it reinforces *i*'s voting choice, or does not rebuff the latter in case of unchanged income (thus the positive sign).[8] The same reasoning applies if *i* voted for the loser and income has not increased: she did not pick the winner who was indeed unable or unwilling to choose a favorable policy. It is equally straightforward to account for a negative satisfaction index if *i* sees her income decrease (increase) after having voted for the winner (looser). Finally, in case that *i* voted for a third party or abstained, this choice can be treated as (un)satisfactory if income has decreased (increased). A more grey area is represented by the cell in the center of Table 1. According to the previous reasoning we could say that the third party has indeed lost and therefore we are in the same situation as if we voted for the loser. On the other hand, a voter may not expect that this party is indeed able to win the elections. Therefore, an unchanged income may be a neutral signal. This argument applies if the voter abstains, as she does not expect to pick any winner.[9]

Finally, panel data procedures often require to control for the initial condition in order to avoid any overestimation of the analysed effect. The latter may occur since in such analyses the first observation is not necessarily the first in respondent's life. The starting point condition may depend on individual heterogeneity or by unobservable past experience. In the empirical section we adopt an Heckman two-stage procedure, derived by Orme (2001) by estimating in the first stage the reduced form of the latent process and then including the generalized error term in the second stage. The reduced form, which should include only strongly exogenous covariates, is modeled as follows:

[8] The extension of positive sign also to the case of unchanged income is justified by the idea that negligible variations in income distribution do not affect individual political preferences. We argue that political affection may not be modified unless significant income variations occurred.

[9] Further estimations may be provided at request that results are unchanged if $s_{i,t}$ is equal to zero or one when *i* voted for a third party or abstained and there is not variation in income.

$$y^*_{i,t} = \zeta_1 age_{i,t_1} + \zeta_2 gender_i + \zeta_3 income\ quintile_{i,t_1} + \zeta_4 region_i + \zeta_5 education_{i,t_1} + \zeta_6 union_{i,t_1} + \zeta_7 household_{i,t_1} \quad (7)$$

Age is a proxy for the number of elections faced at time t_1; gender is a dummy variable; income quintile is a set of dummy variables added in order to control for voting costs; region is a set of three dummies controlling for geographical homogeneity in political preferences. Educational levels dummies, coded according to ISCED classification, capture the effect that individual education may have in processing information and the household control allows for homogeneity in parental groups. We employ the Heckman stage as a *logit* model and then add the *lambda* (IMR) in the main equation. In order to verify a learning process, the test should consider the political background as fixed. Individuals may learn how to act if facing the same context in repeated rounds. Of course, it does not mean that people do not understand how to move in time-varying world, but we should put this condition for isolating the learning effect. This is rather unrealistic in most countries but probably not in the UK where the political context is relatively stable. Moreover, we use an indirect control for variation in the political context by including a set of election-year dummies.

Table 1 random effects logit estimates: persistence models.

Variable	Model 1	Model 2 perceived	Model 2 income
Persistence			
Perceptions-based satisfaction (s^p)		.1843	
		(.0299)***	
Income-based satisfaction (s^i)			.1666
			(.0334)***
High education	-.0695	-.0649	-.0637
	(.0611)	(.0425)	(.0567)
Low education	.0243	.0271	.0259
	(.0611)	(.0544)	(.0548)
Union membership	.1687	.1550	.1570
	(.0556)**	(.0470)***	(.0470)***
Age	-.0071	-.0110	-.0010
	(.0117)	(.0110)	(.0137)
Female	-.0586	-.0605	-.0571
	(.0421)	(.0305)*	(.0334)
Region dummies	YES	YES	YES
Heckman and Mundlak	YES	YES	YES
Election year dummies	YES	YES	YES
Rho	.2871	.2825	.2827
Lr test *rho*=0			
Pr>*chibar*	0.000	0.000	0.000
Statistics			
N	23287	23287	23287
ll	-14262.850	-14249.303	-14251.747
chi2	2434.648	2326.202	2063.000

Legend: bootstrapped standard errors in brackets.
Stars: * p<0.05; ** p<0.01; *** p<0.001

In order to test both the satisfaction measures, we present estimation outcomes from several models. The first one is the null one. It only models voter behavior as a function of individual characteristics:

$$\Pr(y_{i,t} = 1 | x_{i,t}, u_i) = \mathrm{F}(\beta x_{i,t} + \varphi \bar{x}_i + u_i) \quad (8)$$

Model 2 is a voting model including only the perception-based satisfaction index ($s^p_{i,t}$):

$$\Pr(y_{i,t} = 1 | s^p_{i,t}, x_{i,t}, u_i) = \mathrm{F}(\theta_1 s^p_{i,t} + \beta x_{i,t} + \varphi \bar{x}_i + u_i) \quad (9)$$

Model 3 includes only income-based satisfaction index ($s^i_{i,t}$):

$$\Pr(y_{i,t} = 1 | s^i_{i,t}, x_{i,t}, u_i) = \mathrm{F}(\theta_2 s^i_{i,t} + \beta x_{i,t} + \varphi \bar{x}_i + u_i) \quad (10)$$

Both the Heckman and the Mundlak procedures have been applied to these models, respectively controlling for the starting condition, i.e. the probability of confirm at time t_1 the choice at time t_0 on the basis of the reduced equation derived in the previous stage of analysis and controlling for unobservable heterogeneity.

4. Results and discussion.

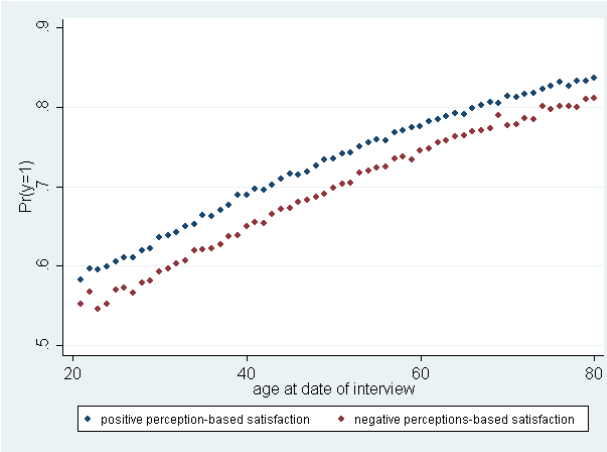
In this section we reassume the main results relative to the persistency of voting behavior derived by the econometric analysis. These are made evident by the graphs describing the predicted probability of a positive outcome with respect to age and the satisfaction levels.

In Graph 1A, the blue dots represents the predicted probability for positive perceptions-based satisfaction and the red one for negative satisfaction, according to model 2. In Graph 1B we show predicted probabilities for positive (blue dots) and negative (red dots) income-based satisfaction (model 3). While the persistence path represents the habitual voting pattern, the vertical distance captures the effect of learning on individual propensity. Although the distance is not massive, the satisfaction index combining either the income-based or the perceptions-based satisfaction and the

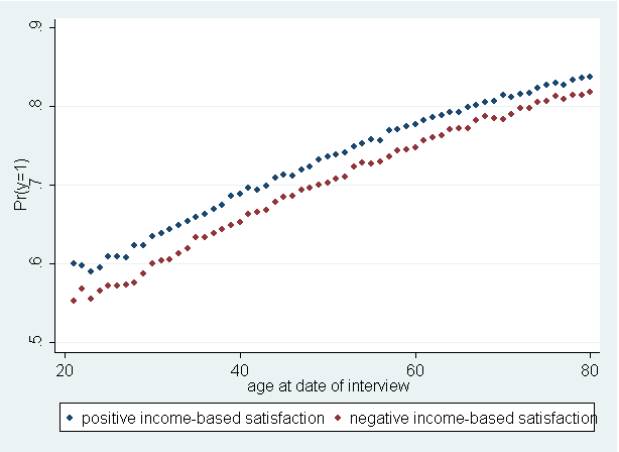
win-stay lose-shift mechanism has a clear effect on individual behaviour in the direction we expect. Our predictions about voter behaviour are then confirmed by this result.

RESULT 1. *For each class of age, the predicted probability of confirming the previous choice, associated to a positive value of satisfaction is higher.*

Graph 1A: perceptions-based.

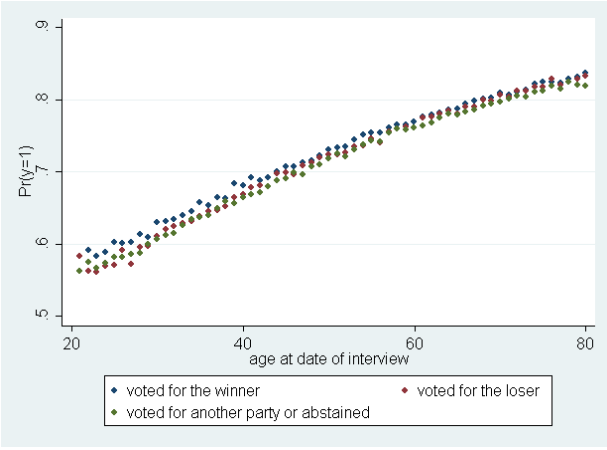


Graph 1B: income-based.

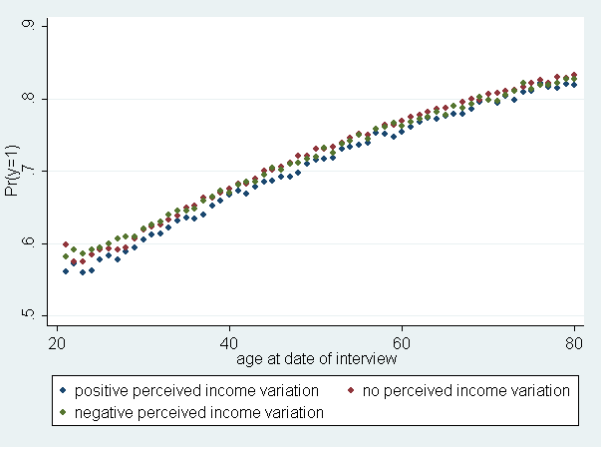


In order to qualify the result above we verify whether persistency of choice changes according to previous election voting, namely if the voter supported the winner or the loser (Conservative or Labour) or a third party (or abstained). From Graph 2a we see that, notwithstanding the presumption of a higher persistency for the voter of the winner in previous elections, no relevant difference emerges among the impacts of the three options of voting behavior on persistency.

Graph 2A. Persistence and past behavior.



Graph 2B. Persistence and perceived variation.



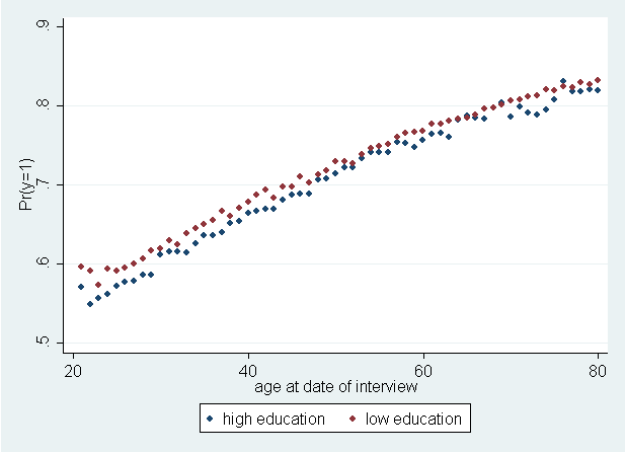
Interestingly, also perceived variation in economic status alone does not seem to have an impact on persistency, as shown by Graph 2b. Reassuming, we obtain the following result.

RESULT 2. *The probability of persisting in choices depends neither on past behaviour nor on economical variation but only on their interaction*.

The interaction between past behaviour and instrumental voting (perceived or income based) is highlighted by the impact of $s_{i.t}$, described in Graphs 1a and 1b. Comparison between Result 1 and Result 2 proves that economic variations per se are not fundamental to ascertain persistency. In fact, voters adapt their behaviour along elections on the basis of how they evaluate election outcomes in terms of economic satisfaction. These results also offer useful insights for empirical and theoretical studies investigating the influence of economic trend on elections.

Graph 3 shows predictions referring to high and low educated people. In this case, there is not any clear pattern even if low educated individuals look marginally more persistent (but the effect is not statistically different than 0).

Graph 3. Education and persistence.



RESULT 3. *Education level does not affect persistence.*

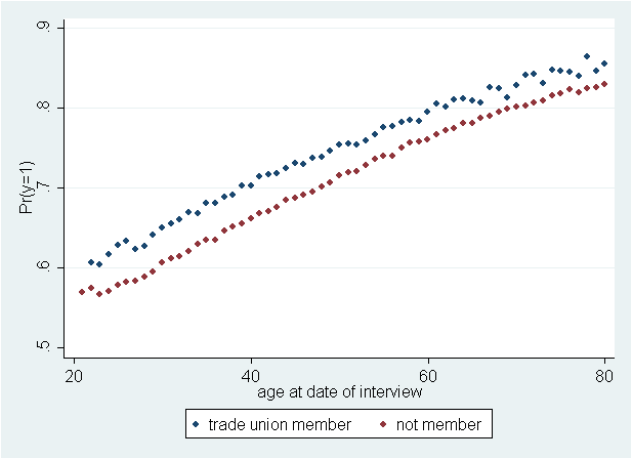
Indeed, we could expect that low education results in a lower ability in judging parties performances so that they persist more as they can be easily mobilized. On the other hand, low educated people live more often with parents and parental attitudes affects young voters' behaviour (Plutzer, 2002). Moreover, it may be interesting a comparison between the effect of education in predicting both turnout propensity and persistence: high qualification (and an higher income level) resolves in a higher turnout propensity (the *class bias* effect) but also in a marginally lower

persistence. A reason for this outcome could be that more educated people are more informed; thus their reaction to perceived changes would be more elastic and induce more frequent changes. An interesting result concerns the effects of unionization on persistence.

RESULT 4. *Trade union membership positively affects individual probability of persisting in choices.*

As we can see from Graph 4, union membership has a relevant impact on voting persistence. A straightforward explanation, from the analysis provided by group-based models (see Introduction), would be that a union member would find more difficult to change her choice because of the homogeneity of interests, the high internal organization able to pursue the latter and the generally well defined political representation of the group, often concentrating in one party.

Graph 4. union membership and persistence.



In conclusion, we can affirm that there is evidence of a learning process. Even if the effect is not massive, these results deny voting to be just a habit format or a self-reinforcing process. According to our econometric findings, individual propensity to confirm the choice along consecutive elections depends on how voters judge governmental policies. Voters vary their behavior until they reach a good match, i.e. when their choices give them a positive satisfaction in terms of economical status.

5. Concluding comments

This study has provided an empirical analysis of a dynamic model of voting as an outcome based process. Voters learn and adapt from feedbacks of previous voting and economic satisfaction determined by past elections. Regarding the latter, a distinction has been made between perceived variation in individual economic conditions, consistent with bounded rationality, and real changes of income quintile, in line with the with the instrumental approach typical of rational models.

The results confirm that voters adapt along elections on the basis of the evaluation of past election outcomes in terms of economic satisfaction, which in turn depends on previous voting choices. Interestingly, persistency of voting behavior is not affected by education or the kind of voting: who voted for the winner is as likely to confirm her choice as who voted for the loser. Finally, economic improvements alone have an ambiguous effect on persistency: they support the choice of who voted for the winner but wane the choice of who voted for the loser. This result contributes to qualify the identification of swing voters as those who adapt their (partisan) preferences according to the performance of their party or the opponent.

This study presents two main novelties with respect to most models on voting behavior. First, it allows voting preferences to adapt along elections depending on the voter's satisfaction with party politics. This contrasts with previous analysis generally presuming given preferences. Second, the dynamic approach presented connects the decisions concerning the act of voting and the choice of the party, or candidate. In this way, it deals with the criticism of Fowler (2006) and Greene (2009) about consistency in turnout models. This approach may also provide new interesting insights for further explorations on the voting paradox. In particular, the outcome of previous elections is likely to affect the benefits of voting and then represents a determinant of abstention whose relevance requires additional empirical investigation.

Appendix A: Sensitivity analysis.

In order to verify the accurateness of estimation outcomes and the correctness of our conclusions, we employ three different tests. Firstly, we compare our random effects results with pooled logit estimation. Then, we re-estimate the model on the balanced subsample. Finally, we check outcomes robustness with respect to the assumption about the distribution of the error term.

1) The LR *chibar* test on *rho* provided in previous tables compares pooled versus panel solution. Technically, if the test does not reject the H0, the panel solution diverges from the pooled one, which is inconsistent due to the omission of the individual effect. However, in the next table, we present pooled estimation outcomes in order to verify that estimation outcomes previously shown, not to be affected by such choice. Pooled estimation provides considerable variation in the magnitude of the lagged dependent variable, as expected since here we do not control for individual specific effect. Though, pooled estimation outcomes do not reject our findings, provided in previous sections, nor the direction of the effect of selected determinants changes in term of odds. Effectively, our conclusions are consistent with both pooled and random effects estimations.

Table 2. pooled logit estimation outcomes.

Variable	Model 1	Model 3 perceptions	Model 2 income
Persistency			
Income-based satisfaction (s^i)			.1808
			(.0331)***
Perception-based satisfaction (s^p)		.1936	
		(.0277)***	
High education	-.0554	-.0502	-.0497
	(.0481)	(.0479)	(.0413)
Low education	.0253	.0279	.0266
	(.0312)	(.0485)	(.0387)
Union membership	.1600	.1447	.1460
	(.0407)***	(.0356)***	(.0411)***
Age	-.0054	-. 0099	-.0090
	(.0085)	(.0130)	(.0089)
Female	-.0446	-.0469	-.0436
	(.0257)	(.0260)	(.0289)
Region dummies	YES	NO	NO
Heckman and Mundlak	YES	YES	YES
Election year dummies	YES	YES	YES
Statistics			
N	23287	23287	23287
ll	-14498.538	-14476.097	-14478.827
chi2	4625.0371	3301.7061	4250.3540

2) Estimation outcomes may be biased when the panel is not balanced. In order to verify that our results do not depend on that, we re-estimate the models on the balanced subsample that includes only those individuals that we observe continuously over all the four elections. In this case all our predictions are confirmed but the effect of union membership results to be statistically significant at the 95% confidence.

Table 3. random effects estimation outcomes – balanced subsample.

Variable	Model 1 balanced	Model 2 balanced perceived	Model 2 balanced income
Persistence			
Perceptions-based satisfaction (s^p)		.3554 (.0507)***	
Income-based satisfaction (s^i)			.2920 (.0488)***
High education	.1275 (.0857)	.1274 (.0659)	.1207 (.0782)
Low education	.0387 (.0667)	.0419 (.0979)	.0395 (.0744)
Union membership	.1770 (.0789)*	.1557 (.0739)*	.1575 (.0831)*
Age	.0047 (.1135)	-.0059 (.1258)	-.0119 (.1135)
Female	-.0746 (.0732)	-.0811 (.0546)	-.0753 (.0653)
Region dummies	YES	YES	YES
Heckman and Mundlak	YES	YES	YES
Election year dummies	YES	YES	YES
Rho	.2976	.2883	.2896
Lr test *rho*=0 Pr>*chibar*	0.000	0.000	0.000
Statistics			
N	12150	12150	12150
ll	-727.850	-7256.221	-7232.211
chi2	770.900	1131.716	1270.660

3) Finally, a robustness check should involve the assumption about the distribution of the error term. Both Random effects and pooled probit estimations, run on the sample and on the balanced subsample[10] - assuming the error term to be normally distributed – confirm our results about learning determinants.

[10] Probit Random effects estimations may be provided at request.

Appendix B: descriptive statistics and data analysis.

The data for the analysis is based on the British Household Panel Survey (BHPS). This is a longitudinal study of persons living in Great Britain based on household units. It includes more than 9000 individuals and household for eighteen waves (1991-2008). The BHPS does not provide many information about political attitudes that are usually include in Political datasets, but it allow us to employ a panel analysis including four election years (1992, 1997, 2001, 2005) and three electoral cycles. BHPS includes only individuals who live in households while those who live in institutions are excluded and this can be considered the first possible source of bias.

According to Uhrig (2008), attrition occurs mainly between the first two waves while it is negligible in the rest of the panel set. However, as our research question refers to elections according to in-time characteristics there are no reasons for using information belonging to the first wave. Finally, there are new entrants in the dataset, starting with 2001 election. The corrected *Heckman* procedure we adopt in estimation allow us to control for such potential source of bias.

Table 3. Descriptive statistics and variables description.

Variable	Obs	mean	Std.dev	Min-max	Variable description
Persistance	23287	.6716	.4696	(0,1)	Dummy variable taking value 1 if *vote at time t-1=vote at time t* and 0 otherwise.
Instrumental perception-based satisfaction ($s^p_{i,t}$)	23287	.2882	.8304	(-1,1)	See table 1. economical measure: individual perceptions about variation in economical status in the last year.
Instrumental income-based satisfaction ($s^i_{i,t}$)	23287	.2051	.8792	(-1,1)	See table 1. economical measure: coded 1(-1) if individual $quantile_t$>(<)individual $quantile_{t-1}$; 0 otherwise.
Education dummies:	23287	2.094	.5989	(1,3)	A set of three dummies: *high education* (ISCED 5-6), *intermediate* (ISCED 3-4), *low education* (ISCED 0-2).
Union membership	23287	.1677	.3736	(0,1)	-
Age	23287	44.4241	15.3624	(21,80)	-
Female	23287	.5499	.4975	(0,1)	-
Region dummies	23287	2.0180	.8249	(1,3)	A set of three dummies coding people living in: *north*, *midlands* and *walsct* (Wales and Scotland).
Household	23287	2.7425	1.2150	(1,5)	Household: number of members (5=more than 4)
Income quintile	23287	3.132	1.364	(1,5)	Individual annual income

Data source.

University of Essex. Institute for Social and Economic Research, *British Household Panel Survey: Waves 1-15, 1991-2006* [computer file]. *3rd Edition.* Colchester, Essex: UK Data Archive [distributor], June 2007. SN: 5151.

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