DO VOTERS LEARN FROM PAST EXPERIENCE? YARDSTICK COMPETITION AND POLITICAL SELECTION

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1. Introduction

Yardstick competition in local public finance is one of the proposed solutions to the agency problem between voters and politicians (Besley and Case, 1995). Yardstick competition works as a mechanism of informational spillover in which voters benchmark the fiscal performance of their incumbent with the fiscal performance of the other incumbents in the region. When the cost of public provision is correlated among neighbors, in fact, the comparison of the tax rates set in the domestic jurisdiction and in the neighborhood reveals information about the incumbent's competence level.

In the theoretical literature, however, asymmetric information is not fully removed because the less competent incumbent still has the possibility to mimic the good incumbents' decision and be re-elected. The existence of a pooling equilibrium has been either theoretically proved (Besley and Case, 1995; Bordignon et al., 2003) and empirically tested (for a survey of the early works see Delgado et. al, 2011). The literature emphasized the advantage of yardstick competition as a constraint to the incumbents' rent during the electoral year, focusing on the incumbents' incentives to mimic (Bordignon et al., 2003; Solè Ollè, 2008; Shaltegger and Kuttel, 2002) and disregarding the effect of yardstick competition on voter's selection powers.

The present work contributes to the literature by calling into question asymmetric information again, investigating its persistence. Specifically, this paper poses the question: when yardstick competition is repeated over time, is mimicking always efficient for the incumbents?

The answer is provided by considering the evolution of the informational spillover in time. The literature on yardstick competition implies that the informational capital perishes every time the game is repeated and voters update their beliefs with the current fiscal information only. This setting allows the mimicking strategy to be optimal during every electoral period. In this paper, on the contrary, we assume that the stock of information accumulates over time and the learning process of the voters is modeled as a dynamic updating of their electoral beliefs. The introduction of the longitudinal

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dimension of the information is crucial because it makes it possible for voters to observe the true competence level of the past incumbent, the realization of the past cost shocks and compute the correlation of the shocks among the neighbors. Once obtained these information, voters are able to infer the electoral strategy of the current incumbent.
The learning process proposed is determined by three factors: an exogenous possibility to learn, an endogenous willingness to gather information and the weight attached to past experience. This paper shows that when past mimicking is observed and voters learn from the past, there is a range of values of the weight attached to past experience for which the less competent incumbent would not be re-elected. If voters do not observe past mimicking, on the contrary, voters do not learn and successful mimicking is always possible.
The predictions of the model are tested empirically on a dataset of Italian Municipalities. The comparative analyses of the beliefs correctly supports the hypotheses of a dynamic learning from tax rates hypotheses when the updating process uses as priors the average experience and its variability in the neighborhood. When we estimate the effect of the dynamically updated beliefs on the probability of re-election of the incumbent, however, the expected negative coefficient associated to the updated belief on the average tax rate is never statistically significant.
The rest of the paper is organized as follows. Section Two reviews the contributions in the literature that refer to yardstick competition and learning. Section Three describes the timing, the object and the exogenous conditions for learning to occur. The model is presented in Section Four, providing formal results of the effect of the dynamic learning process on selection powers. Section Five describes the methodology, the data and the results of the empirical analyses. Finally, Section Six concludes.

2. Related literature

Learning from tax rates has been mainly studied by the literature on local public finance. The baseline model of yardstick competition developed by Besley and Case (1995) shares the common view in economics that decentralized jurisdictions are 'local laboratories' in which policies are experimented and the observed outcomes determine the citizens' judgment of the policy makers (Salmon, 1987). Yardstick competition is a mechanism of informational spillover exploited by voters to overcome the agency problem between citizens and politicians regarding the cost of public provision. Since the cost is correlated among neighbors, the relative performance of the incumbent in the region reveals information about the size of his rent seeking activity. Voters learn the true type of the incumbent only if a separating equilibrium in tax rates is observed, because the good incumbent will always set a lower tax rate level than the bad incumbent. The baseline model of yardstick competition, however, proves the existence of a pooling equilibrium in tax rates when a bad incumbent observes lower tax rates in nearby jurisdictions and he experiences a positive cost shock. In such a situation the bad incumbent mimics the neighbors by setting their same tax rate, renouncing to a share of his ego rent to seek for re-election.

When mimicking occurs voters receive a deceiving signal of good competence, they update their electoral preferences with a misleading information and the incumbent's probability of being re-elected is distorted upwards. As a consequence tax mimicking advantages the bad incumbent to the detriment of voters' selection powers. The re-elected less competent incumbent, in fact, will set a tax rate higher than voters' expected tax rate conditional on good competence. The increase of voters' utility coming from the reduction of the incumbents' rent during the electoral year is offset by the decrease of voters' utility coming from the increase of the tax rate during the following term of office.

The assumptions of the model, however, are quite stringent. The prerequisite for static learning from yardstick competition to work is that voters gather and exploit information on the fiscal performance only during the current electoral year. This assumption is not trivial and should not be underestimated since voters' incentives to be informed are small. The change of regime, in fact, is a pure public good and the probability of being pivotal is reasonably close to zero, generating free riding concerns that discourage voters from acquiring information (Schnellenbach, 2005).

Assuming that voters obtain enough information, there is a set of exogenous conditions that make it possible a successful mimicking behavior of the bad incumbent. Bordignon et al. (2003) derived these conditions, referred to the probability of a negative cost shock q, the ratio $s=(1-\sigma)q/(1-q)$ where σ is the degree of correlation of the cost shocks between the neighbors, the share of resources diverted into rents k, and the pooling tax rate level $t^*+\Delta$. Formally: <<*Suppose* $q<1/2$, $s>1/2$ *and* $k<k^*$. *Then for* $\theta[\theta^*, 1)$ *and* $\delta[\delta^*, 1)$ *there exists a unique perfect Bayesian equilibrium in pure strategies where bad type's first period choices in both economies upon observing a positive shock are* $t^*+\Delta$."*>>* (Bordignon et al., 2003).

Similar results have been obtained in the industrial organization literature studying learning from prices (Benabou and Gertner, 1992). Assuming strategic competition in a market with two sellers of different types selling a homogeneous good to a customer, the price is a performance indicator revealing the true type of the seller. The scholars obtained the same theoretical results as Besley and Case (1993) as the bad seller mimics the good seller by reducing the markup. What is interesting in this strand of the literature is that, contrary to the yardstick competition literature, it developed dynamic models of learning. Bar-Isaac (2003) proved that when learning from prices occurs in the dynamic game, only the good seller survives in the market. By similarity, in the yardstick competition setting only the good incumbent should find it optimal to run for re-election.

The analytical policy literature predicts that the same selection of the good type in time occurs when looking at the diffusion of policy decisions. In particular, if several policy makers face a decision and they are exposed to the same stock of information, their beliefs on the performance of the policy converge and they will select the best performing policy among the feasible set of alternatives. The contribution of this strand of the literature is the introduction of empirical methodologies to test for the presence of a learning process. Meseguer (2009), in particular, developed a model that can easily be adapted to the yardstick competition framework. In her model a government faces a

decision between two alternative policies; he learns in light of experience and then makes rational choices. Beliefs are updated with the information about own and neighboring past experiences according to the Bayes' rule. Since every agent in the model is exposed to the same information, the performance of each policy decision is common knowledge and the learning process is stimulated. Meseguer (2009) tests the model to a sample of south-American countries during the 90s, finding that the implementation of institutional and economic reforms has been driven by a learning process consistent with the theory.

3. The dynamics of the incremental learning process

This Section expands the two-period model of yardstick competition developed by Bordignon et al. (2003), showing how do voters solve the problem of asymmetric information when the game is repeated.

Consider a world made of two jurisdictions. Jurisdiction *i* is assumed to be a neighbor of *–i* and vice versa. The game lasts for *N* periods, (*t=1, 2, …, N*). Each period an election is held between the incumbent and a challenger.

The utility of the voters in each jurisdiction during the period *t* depends on the consumption of both private (*C*) and public goods (*g*):

$$u_{it}^{v} = C_{it} + g_{it} \qquad [1]$$

where private consumption is the amount of income (*y*) net of taxes (*T*):

$$C_{it} = y_{it} - T_{it} \qquad [2]$$

The tax rate proxies the cost of the public provision of goods and services, *T*:

$$T_{it} = p_t + \theta_{it} - \varepsilon_i \qquad [3]$$

where *i* refers to the jurisdiction and *t* refers to time. T_{it} is determined by the observed national price of the public provision (p_t), and by two factors that are observed by the incumbent but not by the voters: a random cost shock (θ_{it}) and the competence level of the incumbent (ε_i). The competence of the incumbent is an individual specific characteristic, constant in time, representing a measure of efficiency in providing public goods. The incumbent in each jurisdiction may be competent (good type) or not (bad type) where competence is inversely related with the undertaken rent-seeking activity:

$$\varepsilon_i = \begin{cases} \varepsilon_H & if \quad 'good' \\ \varepsilon_L & if \quad 'bad' \end{cases} \qquad [4]$$

such that $\varepsilon_H > \varepsilon_L > 0$ and Prob ($\varepsilon_i = \varepsilon_H$)= φ.

Substituting Equation 2 and Equation 3 in Equation 1 we obtain:

$$u_{it}^{V} = g_{it} + y_{it} - p_t - \theta_{it} + \varepsilon_i \qquad [5]$$

Equation 5 establishes the positive relation between the electoral decision of the voters and the voters' utility.

Voters are rational agents who choose between re-electing or not the incumbent with the purpose to maximize their expected utility. Information is costly, this is why the existing models assume that voters gather information about the performance of the incumbent only before elections. Furthermore, information is now assumed to entirely depreciate

every period and before the next election voters begin the process from scratch. The performance indicator considered by voters is the domestic local tax rate applied on a non mobile tax base (the house, as an example), which is benchmarked with the neighbors' tax rate. The incumbent is aware of this inter-jurisdictional comparison, and he chooses the tax rate as a best response to the performance of his neighbors.

The good incumbent does not extract any ego rent from being in office and his tax rate depends on the cost shock realization. When a negative shock occurs ($\theta_{it}>0$), an additional amount of resources ($\Delta>0$) is needed to finance the public provision. The good incumbent thus sets $T_{it} = T+\Delta$ when the shock is negative and $T_{it} = T$ otherwise.

The bad incumbent, on the contrary, sets the tax rate to finance both the public provision of goods and services and his private rent seeking activity. As a consequence, he will always – *ceteris paribus* - set a higher tax rate than the good incumbent does. Let us define the bad incumbents' tax rate as $T_{it} = T+k\Delta$, where k is the share of additional resources diverted to rents. When the shock is positive, $k=1$; when the shock is negative $1<k\leq R$, assuming some finite upper bound to the rent extraction R, which is determined by technology constraints or the fact that the size of the rent is so high that the incumbent is unmasked[2].

The tax rate level $T_{it} = T+\Delta$ is an alternative for both the types of incumbents, the so called pooling tax rate level. When this tax rate is chosen, voters cannot infer the incumbent's competence level by observing only the current performances in the neighborhood.

The timing of the game is set as follows:

1. At the beginning of period t Nature selects a competence level of the incumbent (ε_i) and a cost shock level (θ_{it});
2. The incumbent in i observes his competence level and his cost shock realization and sets a tax rate;
3. Voters in i observe the tax rates (T_{it}) and (T_{-it}), the realized tax rates (T_{it-1}) and (T_{-it-1}) conditional on the past electoral decisions, then they update their beliefs on the relative competence level of the incumbent in the neighborhood;
4. At the end of period t an election is held between the incumbent and a challenger with a majoritarian electoral rule;
5. At the beginning of period $t+1$ Nature selects a cost shock and the game restarts; if the challenger has been elected his competence level is randomly selected by Nature.

Assume that during period $t-2$ the incumbent set a pooling and tax rate was re-elected. If the conditions for a successful mimicking hold during the period t of the game, the bad incumbent in jurisdiction i sets $T_{it} = T_{it-2} = T+\Delta$. The information on the tax rates set in both i and $-i$ during both $t-1$ and $t-2$ are now available to voters. This information triggers the incremental learning process.

[2] Assuming a Laffer curve for the rent extraction of the type $L=k\Delta+ k\Delta^2$, the value R that maximizes L is $R=1/2\Delta$. For $k>R$ as the share of the revenue diverted to rents increases the effective rent received by the incumbent decreases.

As a first step, by comparing the tax rates set at *t-1* with the tax rate set at *t-2* voters learn about their past incumbent's true type and the past neighbor's true type. Tax rates in the non electoral period *t-1* are not strategic, therefore the bad incumbent will set $T_{it-1}=T+k\Delta$ regardless of the cost shock realization while the good incumbent will set $T_{it-1}=T+\Delta$ if the shock is negative and $T_{it-1}=T$ if the shock is positive. The tax rate decisions in period *t-1* are shown in Table 1.

Table 1. The incumbent's tax rate strategies during period t-1

	Bad i; Good –i	Bad i; Bad -i	Good i; Good -i
Ni; N-i	T+kΔ, T+Δ	T+kΔ, T+kΔ	T+Δ, T+Δ
Ni; P-i	T+kΔ, T	T+kΔ, T+kΔ	T+Δ, T
Pi; P-i	T+kΔ, T	T+kΔ, T+kΔ	T, T
Pi; N-i	T+kΔ, T+Δ	T+kΔ, T+kΔ	T, T+Δ

N=negative cost shock, P=positive cost shock; i refers to the domestic jurisdiction, -i to the neighbor(s).

If voters in *i* observed an increase of the tax rate from the past electoral to the past non electoral year, $T_{it-1} > T_{it-2}$, they know for sure that the incumbent mimicked at *t-2* and he is the bad type ($\varepsilon_i = \varepsilon_L$). Otherwise, if they observe $T_{it-1} \leq T_{it-2}$ they infer that the past incumbent's true type is good ($\varepsilon_i = \varepsilon_H$).

Voters know that the cost shock is spatially correlated in the region, according to the socio-economic interdependence of the jurisdictions[3]. The degree of correlation among neighbors is allowed to change over time but slowly and monotonically, that is either increasing or decreasing, but keeping the same sign. This assumption is reasonable because the technological interdependence between neighboring economies is based on the geographical nearness, common natural resources, possible joint public provision and other factors which are unlikely to unexpectedly change the correlation.

The cost shock is specified as:

$$\theta_{it} = \sigma\theta_{-it} \qquad [6]$$

where σ is a correlation parameter, $\sigma=(-1,1)$.

Given this setting, during the period *t-2* voters ignore both θ_{it-2} and ε_i. In period *t* the tax rates set reveal the strategy played by of the incumbent, the past cost shocks θ_{it} and θ_{-it}, and voters infer σ. The true type of the incumbents is correctly observed during period *t-1* only if a pooling equilibrium occurred at *t-2* and the good incumbent experiences a positive cost shocks during period *t-2*. In fact, this is the only situation in which all the three tax rates are observed and voters recognize the true type of the incumbent with no doubt. The conditions for the disclosure of the information about σ are stated in Lemma 1.

[3] As an example, the cost of streets maintenance work depends on weather conditions which are similar among neighbors, but they are unknown to laymen because the extent of the damage is difficult to gauge without expertise. Moreover, while the local government controls the whole territory of the jurisdiction, voters reasonably have not enough information on every street condition.

Lemma 1*: "Voters infer the value of θ_{it} and θ_{-it} and the spatial correlation parameter σ only if mimicking occurred during period t-2 and the good incumbent experienced a positive shock during period t-1"*

As shown in Table 2, Lemma 1 holds in five cases over twelve.

Table 2. The tax rates in period t-1 *and Proposition 1.*

	Bad-Good	*Bad-Bad*	*Good-Good*
NN	Does not hold	Does not hold	Does not hold
NP	Holds *	Does not hold	Holds *
PP	Holds *	Does not hold	Holds *
PN	Does not hold	Does not hold	Holds *

N=negative cost shock, P=positive cost shock; the first letter (or word) refers to i, the second to –i; starred cells indicate the cases in which Lemma 1 holds.

During the next electoral period, *t*, voters know the cost shock correlation between the economies. If they observe a pooling equilibrium again, they are now able to infer the electoral strategy of the pooling incumbent. If the correlation is positive, in fact, the similar fiscal decision is explained with a similar cost shock. Vice versa, if the correlation is negative the incumbent is behaving strategically. This mechanism of learning is stated in Proposition 1.

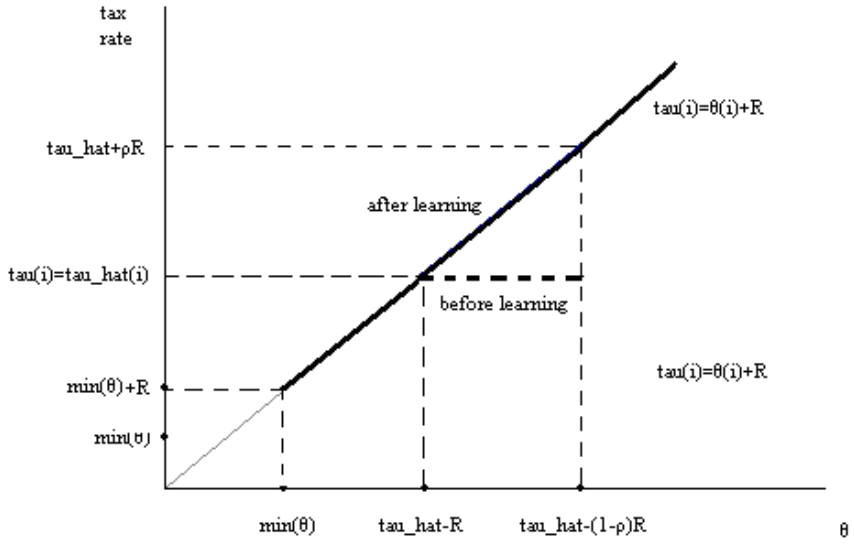
Proposition 1. *If σ is positive both the neighbors incumbents are competent and faced a negative cost shock, and the pooling incumbent is competent; otherwise, the neighbors incumbents face opposite cost shocks and the pooling incumbent is mimicking.*

When Lemma 1 holds, the bad incumbent would not find it optimal to mimic the good incumbent behavior not anymore because he would be unmasked and his strategic behavior would not increase his probability of being re-elected. As a consequence, a separating equilibrium would be observed. Eventually, the bad incumbent would not run for re-election and renounce to the future ego rent. On the contrary, if the bad incumbent is not aware of the voters' learning process he would mimic the good neighbors, but this time he will be unmasked and turned down. In both cases, the electoral competition would select only competent incumbents in time and entail an improvement in the quality of the political class.
The incremental learning entail an improvement of political selection with respect to the baseline model of static learning from tax rates. Graph 1 illustrates this result by depicting the graphical solution of the model by Besley and Case (1995). The cost shock level is measured on the horizontal axis while the tax rate level is measured on the vertical axis[4].

[4] The model of Besley and Case (1995) assumes a positive cost shock taking different values, while the model of Bordignon et al. (2003) assumes a positive/negative cost shock of given magnitude. Both the models lead to similar results regarding the spatial interaction of the fiscal decisions and the electoral concerns underlying the mimicking strategy. The notation in this paper refers to Bordignon et al. (2003),

When the cost shock assumes values too low or too high a separating equilibrium arises because the bad incumbent can either signal good competence while maximizing his ego rent (low cost), or he finds it too costly to seek for votes and he sets the highest tax rate no matter the electoral consequences (high cost). The tax function in this situation is a positive sloping line depending on the cost shock level and the amount of rent diverted *R*. When the cost shock takes intermediate values, the bad incumbent faces a trade off between vote seeking and rent seeking. The horizontal dotted segment of the tax function represents the mimicking tax level set to signal good competence to voters.
When the incremental learning process occurs, on the contrary, successful mimicking becomes much more difficult to implement because voters learn the degree of economic integration with the neighbors and they infer the incumbents' strategy. The bad incumbent running for re-election would not find it optimal to behave strategically because he would renounce to a share of rent without increasing the probability of re-election. As a consequence a separating equilibrium will be observed also for intermediate values of the cost shock. In the Graph below, this result is represented by the bold continuous segment of the tax function. The same segment indicates the interval of values for which selection powers are enhanced and yardstick competition is effective in improving accountability at the local level.

Graph 1. Dynamic learning and bad incumbent's tax rate decision



4. A model of incremental learning from tax rates

4.1 The learning function

Voters are rational agents that during the electoral period maximize the following inter-temporal utility function:

$$V_t(\varepsilon_i) = \max_j \left(u_t^V(T_t) + \beta \left(I_L * V_{t+1}^{VI}(\omega_t) + (1 - I_L) * V_{t+1}^{VI}(\mu_t) \right); u_t^V(T_t) + \beta (V_{t+1}^{VC}) \right) \quad [8]$$

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but since the most popular illustration of yardstick competition is the one by Besley and Case (1995), we decided to present this Graph.

The present utility of the voters u_t^V depends on the tax rate T_t, as already stated in Equation 5. The future utility is discounted according to the factor $0<\beta<1$, and it depends on the politician in office during the next period. Specifically, V_{t+1}^{VI} is the expected utility from re-electing the incumbent while V_{t+1}^{VC} is the expected utility from electing the challenger. The expected performance of the incumbent is updated according to his observed fiscal performance. When the incremental learning occurs the updated beliefs consider both the present and the past performance (ω_t); otherwise, they consider only the present information (μ_t).

The mechanism of updating of the voters' beliefs depends on the completion of the incremental learning process. For this purpose the indicator function I_L has been introduces. When $I_L = 1$ the incremental learning function has been maximized and voters learn from past experience. For $I_L = 0$, on the contrary, incremental learning does nor occur and the static updating of the existing model of yardstick competition is restored. Given a pooling equilibrium during period t, this means that the bad incumbent will be re-elected as long as successful pooling is feasible.

Incremental learning is modeled as a function L assumed to be bounded between zero and a maximum value $\bar{L}$, and it depends on both the feasibility of learning ($1 - q_{t-1}$) and the probability of gathering enough information (π). These two factors represent respectively the rational ignorance (Downs, 1957) and the rational irrationality (Caplan, 2007) hypotheses on voters' behavior. The two factors are independent from each other, e.g. a variation in the propensity to learn does not affect the realization of the cost shock and vice versa. Hence, L can be expressed as a product function:

$$L_t = (1 - q_{t-1})\pi \qquad [9]$$

The feasibility of the incremental learning refers to the conditions stated in Lemma 1: if they do not hold, any information is useful in inferring the incumbent's strategy. As a pooling equilibrium is observed during the first period of the game, the respect of Lemma 1 relies on the realization of a positive shock in the neighborhood at $t-1$. Defining $0 \leq q_{t-1} \leq 1$ as the probability of the realization of a negative cost shock at $t-1$ in the jurisdiction governed by the good incumbent, incremental learning is a decreasing function of q_{t-1}. As it shows, the feasibility of the incremental learning is a factor exogenous to the model because voters' decisions cannot affect it. However, as pointed out, it is a necessary condition for the process to work.

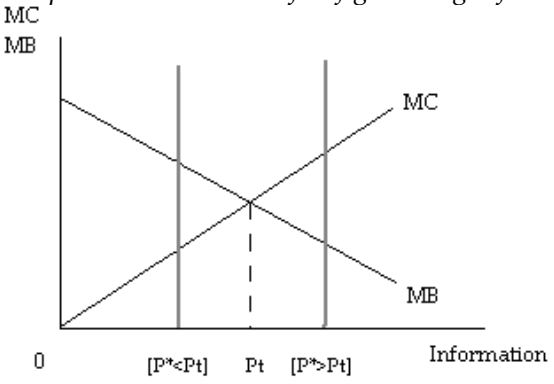
The probability that voters gather enough information to learn, π, is indeed an endogenous factor shaping L. Incremental learning requires a stock of information P^* including the tax rates set in the neighborhood during each period and the probability π depends on the propensity to gather the sufficient information. Voters are rational agents and they acquire new information when costs are no larger than benefits. The costs of obtaining information are represented by the marginal cost of obtaining both the domestic and the neighbors' tax rate information. The marginal cost of observing the domestic tax rate is assumed to be small and constant, since a tax rate is a piece of information that the government must periodically release and make visible to claim its

payment. The marginal cost of observing the neighbors' tax rate, on the contrary, is supposed to increase depending on the size of the neighborhood. The information spillover created by the inter-jurisdictional comparison of citizens, however, may generate economies of scale in the diffusion of the information. Following this alternative reasoning the marginal cost of the information decreases as the number of neighbors increase. Finally, there is a cost attached to the action of retaining information, implying the effort of storing information in memory and being able to recall it when an election is approaching. The marginal information needs a larger memory capacity, therefore its cost increases with the size of the information stock retained.

The marginal benefit of being informed, on the contrary, is determined by the difference between the realized fiscal performance of the past incumbent during his second period of office, T_{t-1}, and the updated belief of the fiscal performance before his re-election, $E(T_{t-1})$. To understand the reason for this specification, assume that the realization of the tax rate set by the past incumbent is higher than its expectation. Voters infer if the incumbent was strategic (bad) during the first period and they attach a larger marginal benefit to new information if compared with a situation in which the incumbent was non strategic (good). In other words, voters find it more convenient to improve their monitoring powers when they realize that their past beliefs have been mistaken and they become more prone to obtaining new information to correct them in time. The slope of the marginal benefit curve is assumed to be negative because voters may come out with a clear idea about the incumbent after having acquired the first pieces of information. In such a situation, the utility from the marginal information decreases.

Graph 2 depicts information (quantitatively measured) as a function of the marginal cost and the marginal benefit of gathering information. When the cost is larger than the benefit, voters do not to search for new information. When the benefit is larger than the cost voters find it profitable to gather new information up to the critical level P_t pinned down by the intersection of the two curves. The quantity P_t represents the maximum amount of information that voters would gather given the shape of the cost and benefit curves. The probability that voters obtain enough information to learn is the probability that P_t is at least as large as a critical value P^*, $\pi = Pr\,(P_t \geq P^*)$.

Graph 2. Costs and benefit of gathering information



The function L is maximized when the conditions π=1 and q_{t-1}=0 jointly hold. On the contrary, if π=0 or q_2=1, that is if voters do not want or they cannot learn, incremental learning does not occur.

4.2 Voting decision and mimicking

Voters' expectations about the fiscal performance of the incumbent at *t+1* are:

$$E(T_{t+1}) = \rho E(T_{t+1})_{t-1} + (1-\rho)T_t \quad [10]$$

The electoral belief, updated with both present and past information, is:

$$\omega_t = \rho\mu_{t-1} + (1-\rho)\mu_t \quad [11]$$

Where $0<\rho<1$ is the weight attached to past experience, μ_{t-1} is the updated belief at time *t-1* and μ_t is the updated belief at time *t*.

The mimicking incumbent is re-elected if the pooling tax rate successfully signals good competence to voters and the updated belief about his competence level is larger or equal the prior belief φ:

$$\rho\mu_{t-1} + (1-\rho)\mu_t \geq \varphi \quad [12]$$

The belief μ_{t-1} reveals the past incumbents' true type and it is computed as the statically updated belief at *t-1*: $\mu_{t-1} = f(\varphi_{t-1}, T_{i,t-1}, T_{-1,t-1})$.

Define:

$$\mu_{t-1} = \begin{cases} \geq \varphi \rightarrow \mu^G & \textit{if the past incumbent was good} \\ < \varphi \rightarrow \mu^B & \textit{if the past incumbent was bad} \end{cases}$$

with $\mu^G > \mu_t > \mu^B$. This condition reflects the fact that voters know the past incumbents' true type with certainty, while they cannot be sure of the correctness of their present belief, therefore they never consider the extreme values of the scale of competence.

If the updated beliefs during period *t* are the same as in period *t-1* ($\mu_{t-1} = \mu_t \equiv \mu$), Equation 11 states that the dynamically updated beliefs equal the statically updated beliefs ($\omega_t = \mu_t$) and the model comes back to the baseline static signaling model. Following the literature, successful mimicking is possible only under the conditions stated by Bordignon et al. (2003). In fact, Equation 12 would lead to the well-known condition:

$$\mu_t \geq \varphi \quad [13]$$

If the updated beliefs during period *t* are different from the updated beliefs at period *t-1* ($\mu_{t-1} \neq \mu_t$), the parameter ρ becomes crucial.

In particular, if the past incumbent was the good type, substituting $\mu_{t-1} = \mu^G$ in equation 12 and solving it, we get:

$$\rho \geq \frac{\varphi - \mu_t}{(\mu^G - \mu_t)} \quad [14]$$

The right hand side of Equation 14 is negative. The numerator is negative since the pooling tax rate observed during period *t* signals good competence and $\mu_t \geq \varphi$, while the denominator is positive because $\mu^G > \mu_t$ by definition. Since ρ is bounded between zero and unity, the inequality in [14] always holds. Following the same reasoning we

obtain the condition for the pooling incumbent not to be re-elected at time *t* conditional on a good incumbent at time *t-1*:

$$\rho < \frac{\varphi - \mu_t}{(\mu^G - \mu_t)} \qquad [15]$$

Equation 15 never holds for the same motivations explained above. As a consequence, when the past incumbent was good successful mimicking at time *t* can always occur because voters are faced with a history of efficient signaling.

On the other hand, if the past incumbent was the bad type and he mimicked, substituting $\mu_{t-1} = \mu^B$ in Equation 12 we get the condition:

$$\rho \leq \frac{\varphi - \mu_t}{(\mu^B - \mu_t)} \qquad [16]$$

The pooling incumbent at time *t*, conditional on a good incumbent at time *t-1,* is not re-elected if:

$$\rho > \frac{\varphi - \mu_t}{(\mu^B - \mu_t)} \qquad [17]$$

The right hand side of Equation 16 and Equation 17 is positive because $\mu^B < \mu_t$ by definition and also the denominator of the ratio is negative. Being ρ bounded between zero and unity, the weight attached to past experience plays a crucial role in determining the electoral success of the mimicking strategy.

Table 3 draws all the possible outcomes of the dynamic game.

Table 3. Conditions for successful mimicking in the dynamic game

Period: t-2	*Period: t-1*	*Period: t*
Incumbent/ Challenger electoral competition	Challenger/ Challenger electoral competition	Incumbent/ Challenger electoral competition
- Pooling tax rates observed - Beliefs statically updated	-Term limited incumbent -Competence level is revealed	
- $\mu_1 \geq \varphi$ the incumbent is re-elected	Good incumbent: $\mu_2 = \mu^G$	Incumbent reelected if: $\rho \geq \frac{\varphi - \mu_t}{(\mu^G - \mu_t)}$
		Incumbent reelected if: $\rho < \frac{\varphi - \mu_t}{(\mu^G - \mu_t)}$
		Condition not feasible
	Bad incumbent: $\mu_2 = \mu^B$	Incumbent reelected if: $\rho \leq \frac{\varphi - \mu_t}{(\mu^B - \mu_t)}$
		Incumbent not reelected if: $\rho > \frac{\varphi - \mu_t}{(\mu^B - \mu_t)}$

The formal conditions for successful mimicking in the dynamic game are summarized in Proposition 2.

Proposition 2. *"When mimicking was not observed in the past, the contribution of past experience on voters' updated beliefs does not affect the conditions for a successful mimicking in the present. When mimicking was observed in the past, successful mimicking in the present is feasible only if, in addition to the conditions for a successful mimicking with statically updated beliefs, the inequality* $\rho \leq \frac{\varphi - \mu_t}{(\mu^B - \mu_t)}$ *holds."*

As a conclusion, the theory suggests that when yardstick competition is repeated over time and voters consider past experience in forming their electoral beliefs, the probability that a bad incumbent mimics the good incumbent and he is re-elected decreases as the weight attached to the past mimicking experience increases.

5. An empirical test of the dynamic learning from tax rates

5.1 Italian Municipalities: institutional setting, accountability system and yardstick competition

Municipalities are the lowest tier of government in Italy, and they are a suitable framework for an empirical test of dynamic learning from tax rates. In the early 1990s, in fact, an institutional reform introduced a link of local accountability by implementing tax decentralization and by reforming the electoral rule. This newly established setting represents a favorable framework for yardstick competition to arise.

The local property tax rate (*ICI, Imposta comunale sugli Immobili*), introduced in 1993, increased the tax autonomy of local governments and in the period 1993-2007 it accounted for more than 55% of total Municipality revenue and more than 25% of local expenditure. *ICI* is a highly autonomous tax rate, specifically a level '*b*' in the *OECD* tax autonomy scale ranging from *'a'* to *'e'* (*OECD*, 1999). The previous setting was characterized by the lowest degree of tax autonomy, the level *e*, being the tax rate and the tax base both set by the central government. In 1995 the tax rate has been differentiated between the house tax rate applied to the main living property and the business tax rate applied to holiday houses, offices, shops, and so on. Local house property taxation accounts only for 6% of local tax revenues, but it is a cost that voters directly link to the house and makes it clear to the citizens the relationship between the costs and the benefits of local public services in a certain jurisdiction. In addition to this, more than 80% of the residents in Italy are home-owner[5], making the local house tax rate the main indicator of jurisdictional performance. Since the tax base is fixed and property value reassessments are nationally implemented, local autonomy is restricted to only one dimension, the tax rate level. The tax rate can be set in a range between 4‰ and 7‰. Although the tax interval is small, a marginal variation of the tax rate determines a consistent variation in the per capita tax paid by the citizen and in the overall tax revenue[6]. Moreover, the single dimension of the decision makes it easier for the voters to exploit this information when forming their voting preferences.

[5] Source: ISTAT, *L'abitazione delle famiglie residenti in Italia - Anno 2008*, published in Spring 2010.

[6] The average value of the house properties in Italy was 182000 euro in 2008 (source: Dipartimento delle Finanze and Agenzia del Territorio, *Gli Immobili in Italia,* published in 2010). Using this value as a proxy for the tax base of *ICI*, a marginal variation in the tax rate leads to a variation of 182 euro of the individual

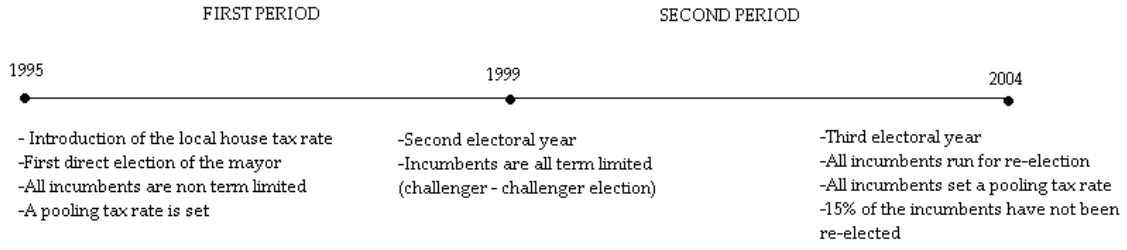
Regarding election, the Italian local electoral rule has been reformed in 1993 from proportional to majoritarian, introducing the direct election of the mayor according to the plurality rule in Municipalities with less than 15000 inhabitants (9% of the total number of Municipalities) and according to the majority rule with runoff elections in the others. The local legislature has been extended in 1999 from four to five years, and a two term limitation has been introduced. In case of motion of no confidence both the mayor and the council must resign and new elections are held. Because of the early fall of many executives in the past Italian Municipalities hold elections in different years. There is, however, a concentration of local elections in 1995, 1999 and 2004, when more than 60% of the jurisdictions are called to the ballot.

The data used for the empirical estimation come from a comprehensive dataset of Italian Municipalities (Padovano, 2007). The considered observations are those 227 Municipalities meeting the following requirements:

- are members of the cohort of Municipalities that held local elections in 1995, 1999 and 2004;
- a local house tax rate set in 1995 at most equal than the average tax rate set by its neighbors (defined as a 'pooling' tax rate);
- a local house tax rate set in 1999 higher than the average tax rate set by its neighbors (defined as 'non pooling' tax rate);
- an incumbent running for re-election in 2004;
- a local house tax rate set in 2004 at most equal than the average tax rate set by its neighbors ('pooling' tax rate).

As the following graph shows, the selected observations are in their third electoral year since the local fiscal and electoral system has been reformed, and they belong to a cohort of jurisdictions experiencing two full local legislatures (1995-1999, 1999-2004). Among them, in 2004 the incumbent was defeated in 33 Municipalities (about the 15% of the sub-sample) while in the remaining 194 Municipalities he was re-elected.

Graph 3. Electoral dynamics of the 227 Municipalities in the dataset



There is evidence of strategic tax setting among Italian Municipalities, as studied by Bordignon et al. (2003), Padovano (2008), Santolini (2007), Bartolini and Santolini (2009). Section 4 predicts that, election after election, voters learn the incumbents' strategy and

tax burden. In turn, this amount accounts for a 7‰ of the he average yearly income of an employee in 2009 (ISTAT).

they can correctly update their voting preferences. The next paragraph tests this hypothesis.

5.2 Empirical methodology

The methodology applied stems from the model of learning from economic policies by Meseguer (2009). This section adapts the original cross-countries economic policy decision setting to the sub-national electoral decision setting.

The analyses includes three-steps:

1. calculation of the posterior beliefs using dynamic Bayesian updating;
2. comparison of posterior beliefs conditional on the voting decision;
3. regression estimation using the voting decision as dependent variable and the updated beliefs as independent variables.

For a clear presentation of the analyses and its results, the following sub-paragraphs deal with the three steps separately.

5.2.1 Posterior beliefs

During the electoral period voters observe both the past and present fiscal performance of the incumbent in the domestic and the neighboring jurisdiction, and they update their electoral beliefs according to this information.

Assume that the fiscal performance T to be a random variable normally distributed with an unknown mean M and an unknown variance V. M and V are random variables, and voters learn about them by observing the performance of other incumbents under alternative past voting decisions j. The conditional distribution of the mean is Normal while the conditional distribution of the variance is scaled-Inverse X^2. The decision of these distributions is a classical assumption in Bayesian updating and allows the mean and the variance to be interdependent. Formally,

$$T_j = N(M_j, V_j)$$
$$M_j = N(m_j, \sigma_j^2 / \tau_j)$$
$$V_j = ScaledInv - \chi^2(v_j, \sigma_j^2) \qquad [18]$$

Where m is the location of the mean, σ_j^2 / τ_j is the variation of the mean, v are the degrees of freedom and σ_j^2 is the scale of the variance, τ is the factor that relates the prior variance of the mean to the sampling variance.

During the period t the information available to voters is $T_t^j \mid j$, the performance of the incumbent under alternative voting decisions for all the jurisdiction that re-elected ($j_t=1$) or did not re-elect ($j_t=0$) the incumbent during the period t-2. The information is assumed to be a random variable independent and identically distributed. Hence, the sample mean and the sample sum of squares are sufficient statistics to summarize the information in the sample of countries under each of the alternative voting decisions.

When prior beliefs are combined with new information, by applying the Bayes' rule the posterior belief about the mean of the tax difference is[7]:

$$\omega_t = \rho\omega_{t-1} + (1-\rho)\bar{x}_t \quad [19]$$

where $0<\rho<1$, ω_2 is the updated belief on the performance of the past incumbent at the end of $t\text{-}1$, $\bar{x}_3$ is the current observed performance of the incumbent and $\omega_{t-1}=\mu_{t-1}$ if $t\text{-}1$ is the first year for which data are observed in the dataset.

The posterior belief about the variation of the tax difference is:

$$s^2_3 = \frac{S_3}{v_3} \quad [20]$$

where S_3 is the posterior for the sum of squares, and v_3 is the posterior for the degrees of freedom.

As Equation 19 shows, although extreme values of ρ are ruled out, when the parameter is close to zero the past experience has a negligible influence on the updating process and voters hardly learn the determinants of the public cost function; vice versa, when ρ tends to one the belief hardly takes into account new information.

When the electoral rule prescribes a term limitation, the past incumbent is a different person than the current incumbent and voters may find it useless to gather information. Competence is in fact an individual specific characteristic, and if voters believe that the electoral strategy of the past incumbent does not affect the electoral strategy of the current incumbent in any possible way, ρ is close to zero. The probability that the current incumbent is strategic, however, is not independent from the probability that past incumbents have been strategic. If a bad incumbent knows that his predecessor mimicked and he was re-elected (incumbents know the performance of the past incumbents), it is likely that he would play the same strategy, especially if the correlation between the economies does not change significantly in the short period. As a consequence, voters always gain positive utility from the marginal information since that is the only way to come out with a distribution of the type of the past pooling incumbents.

In the empirical analyses several set of priors have been used to calculate different updated beliefs. The first set considers as priors the average of the tax difference in the dataset and its variability, measured as the standard deviation from the possible interval of values of the tax difference. The tax difference is measured as the difference between the domestic tax rate and the average tax rate in the neighborhood. This set of priors (*UPTD*) is closer to the specification of the model presented in this paper, but since the existing literature on yardstick competition focused separately on the domestic and the neighbors' tax rate, alternative sets of priors have been investigated.

The alternative sets of priors calculate updated beliefs with respect to the average and the variation of the domestic tax rate, taking as priors the average and the variation from the possible interval (*UP1*) or from the average and the variation from the observed values in the neighborhood (*UP2*).

[7] For a detailed description of how to obtain this result, see Meseguer (2009), Appendix to Chapter 2.

Summary statistics for the posterior point estimates for the location and the scale are reported in Table 4.

Table 4. Posterior beliefs using different sets of priors

	Priors	Obs	Mean	Std. Dev.	Min	Max
Updated average, μ	UPTD	227	-0.504	0.372	-1.696	0.159
Updated variance, s		227	0.497	0.741	0.000	5.768
p (rho)		227	0.353	0.022	0.333	0.43
1-ρ		227	0.647	0.022	0.573	0.67
Updated average, μ	UP1	227	4.776	0.477	4.000	5.880
Updated variance, s		227	0.894	0.953	0.000	2.638
p (rho)		227	0.364	0.026	0.333	0.4
1-ρ		227	0.636	0.026	0.595	0.67
Updated average, μ	UP2	222	4.769	0.485	4.000	5.878
Updated variance, s		222	0.331	0.273	0.020	2.024
p (rho)		223	0.351	0.012	0.334	0.41
1-ρ		223	0.649	0.012	0.594	0.67

The mean updated domestic tax rate using the sets of priors *UP1* And *UP2* is about 4.77 (the tax rates are scaled between 4 and 7), but the variation is smaller when using the set of priors exploiting the neighbors' information. These figures suggest that benchmarking the domestic performance with the neighboring performance provides voters with a more precise expectation of the future performance.

When voters' belief are updated with the priors on the tax difference, μ ranges from -1.696 to 0.159, with a mean negative tax difference of -0.504. These figures indicates that in some Municipalities voters expect a bad performance (positive tax difference) and in other Municipalities they expect a good performance (non positive tax difference).

From these results we can also see that the contribution of past information to the updating process is stable at about 35% regardless the specification of the priors. These results for ρ suggest that voters form their electoral beliefs taking into account both the current incumbents' performance and the past performance. Meseguer (2009) argues that a low value of ρ indicates that the learning process has already occurred, while a high value tells that new information is still relevant for voters and in time they will complete the learning. We can comment that a learning process started in the analyzed sample, but we cannot say if this is the level of ρ that grants re-election. Consequently, to answer the question if a learning process took place or not we need to proceed in the analyses.

5.2.2 Comparison of posterior beliefs

Table 5 reports the posterior beliefs conditional on the voting decision.

The comparison of the updated beliefs on the tax levels does not support the learning hypotheses since the level of the posterior belief about the performance of the incumbent re-elected in 2004 is always higher than those associated to the incumbent non re-elected in 2004.

The results regarding the variation of the updated beliefs disaggregated by the incumbent status indicate as expected that the re-elected incumbent is always associated with a smaller or equal variation than the non re-elected incumbent. An explanation for these results is that voters behave as risk adverse agents and prefer fiscal stability than the lowest tax rates.

Table 5. Posterior beliefs conditional on voting decision

re-elected incumbent				*not re-elected incumbent*			
Variable	*priors*	*Obs*	*Mean*	*Variable*	*priors*	*Obs*	*Mean*
Updated average, μ	UPTD	194	-0.50	Updated average, μ	UPTD	33	-0.53
Updated variance, s		194	0.49	Updated variance, s		33	0.55
Updated average, μ	UP1	194	4.79	Updated average, μ	UP1	33	4.71
Updated variance, s		194	0.89	Updated variance, s		33	0.89
Updated average, μ	UP2	189	4.78	Updated average, μ	UP2	33	4.71
Updated variance, s		189	0.33	Updated variance, s		33	0.35

At this stage of the analyses it is interesting to perform a comparison based on the history of voting decision. If a learning process occurred we expect that the average updated beliefs in the jurisdictions switching from re-election in 1995 to not re-election in 2004 (coded as *´RNR´*) should be higher than the updated beliefs in the jurisdictions that re-elected the incumbent in 2004 (coded as *´NRR´*). The summary statistics in Table 6 support this hypothesis only when the updating process exploits the set of priors *UP2,* (column 8). This figure suggests that a learning process have occurred if voters updated their beliefs based on the performance in the neighborhood.

Table 6. Comparison of posterior beliefs with respect to the history of voting decisions

						RNR>NRR
Variable	*priors*	*RR*	*NRR*	*NRNR*	*RNR*	*Column 8*
Updated average, μ3	UP1	4.792	4.775	4.507	4.769	FALSE
Updated variance, s3		0.895	0.893	1.324	0.748	FALSE
Updated average, μ3	UP2	4.785	4.763	4.506	4.769	**TRUE**
Updated variance, s3		0.326	0.337	0.634	0.253	FALSE
Updated average, μ3	UPTD	-0.493	-0.521	-0.560	-0.525	FALSE
Updated variance, s3		0.467	0.559	0.796	0.473	FALSE
Observations		*150*	*44*	*8*	*25*	

Notes: Rr=re-elected in both 1995 and in 2004; Nrr=not re-elected in 1995 and re-elected in 2004; Rnr=re-elected in 1995 and not re-elected in 2004; Nrnr = not re-elected in both 1995 and in 2004. 227 total observations.

5.2.3 Regression estimation

This Section estimates the effect of the voters' beliefs updated according to the incremental learning process on the re-election probability of the incumbent[8].

[8] The estimation differs from the methodology of Meseguer (2009) as we include the updated beliefs and not the difference in the updated beliefs conditional on the past voting outcome. Meseguer, in fact, estimated if Costa Rica learnt from the past policy experiences of other South-American countries while this work estimates the average learning effect in the Municipalities coming from past experience.

The function estimated is:

$$j_t = \beta_1 \mu_t + \beta_2 s_t + \beta_3 X_t + \xi_t \quad [21]$$

The empirical predictions are that β_1 and β_2 should be significantly negative because both a high average and a high volatility of the fiscal performance reduce the voters' utility. A large mean of the tax difference is associated with an incumbent extracting rent, while a large volatility of the tax difference is associated with an ambiguous outcome. Assuming that voters are risk averse and they prefer certainty of policy outcomes rather than uncertainty, also β_2 is expected to be negative.

If the learning process does not take place, updated beliefs on the tax difference do not have a negligible influence on the decision to re-elect the incumbent. As a consequence, the coefficients in Equation 21 will be not statistically significant.

Table 7 presents the marginal effects estimated from a probit model without covariates (Model 1-3) and with covariates (Model 4-9).

The explanatory variables included consider factor that may explain the variation in the dependent variable. The political affiliation of the government (*right wing dummy*) controls for the ideological bias of the voters, while the unemployment rate lagged one period (*unemp*) controls for the state of the economy (Paldam and Nannestad, 1994). Finally, the lagged popularity of the incumbent (*popularity lag*), measured as the share of votes obtained during the previous election, controls for an eventual persistent shock or the presence of an autoregressive process in the popularity of the elected mayors.

The variables of interest are the updated belief on the average (μ)and the variability (s) of the fiscal performance of the incumbent. The set of priors *UP1*, *UP2* and *UPTD* have been alternatively used to investigate the fit of each updating process.

The fit of the model is very limited, and the coefficients do not show a high degree of significance. The coefficients on the variables of interest are significant only when using the priors UP1, but the signs are unexpectedly positive. In all the other specifications, the coefficients are non significant and only the updated variability in Models 2 and 3. These results indicate that a incremental learning process did not occur in the dataset analyzed, and the evidence suggests a pattern opposite to the one predicted.

Table 7. Dynamic learning from tax rates, probit regression, marginal effects

	Model 1	p	Model 2	p	Model 3	p	Model 4	p	Model 5	p	Model 6	p
	UP1		UP2		UPTD		UP1		UP2		UPTD	
μ UP1	0.364	**					0.379	***				
s UP1	0.162	**					0.180	***				
μ UP2			0.041						0.029			
s UP2			-0.006						0.009			
μ UPTD					0.028						0.035	
s UPTD					-0.001						0.006	
Right wing							-0.052		-0.062		-0.065	
Unempl lag							-0.398		-0.180		-0.135	
Popularity lag							0.075		0.081		0.065	

Note: dependent variable is a binary variable equal to one if incumbent re-elected in 2004 and zero otherwise.

.6. Concluding remarks

The political economics literature recognized that re-election mechanism is an imperfect device to select good politicians when the candidate incumbent exploits information advantages and behaves strategically. This paper investigated the persistency of asymmetric information when information spillovers accumulate over time.

The theory predicts that the less competent incumbent cannot successfully mimic the most competent incumbent when voters accumulate information over time and attach a weight large enough to the past mimicking experience. The learning process, however, relies on a set of stringent conditions as the feasibility of learning and the willingness to learn that may not occur in the real world.

The predictions of the model are tested empirically on a dataset of Italian Municipalities, estimating the effect of the dynamically updated beliefs on the probability of re-election of the incumbent. The results reject the presence of a voters' learning process in the data because the regression coefficient associated to the variable of interest are positive when significant.

This paper represented the first attempt at analyzing the contribution of yardstick competition to political selection in time, therefore its nature and the contradictory empirical results call for future research. In particular, it should be useful to investigate the effect of different stock of information on learning. The empirical results of this paper, in fact, suggest that when the game is repeated and the informational spillover intensifies, the relevant information for the voters' update is not the electoral fiscal decision but the whole term fiscal performance of the candidate incumbent.

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