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VOTING BY BALLOTS AND FEET IN THE LABORATORY

ALESSANDRO INNOCENTI, CHIARA RAPALLINI

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Voting by ballots and feet in the laboratory

Alessandro Innocenti[1], University of Siena

Chiara Rapallini[2], University of di Firenze

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Abstract. This paper provides experimental evidence on the Tiebout efficiency-enhancing property in a decentralized system of public goods provision. Tiebout's (1956) model shows that if a sufficient number of local communities exist to accommodate the different types of preferences, individuals sort themselves in a way that provides the most desired allocations of public goods and taxes at the lowest cost. We test the model in the laboratory in order to assess if decentralization and local sorting produces efficiency gains. The design assumes the existence of a number of local communities, to which individuals are initially allocated. Heterogeneous individual preferences on public goods are predetermined and randomly attributed to the subjects. Our findings show that the validity of voting by feet depends on the mechanism of voting by ballot.

[1] Dipartimento di Politica Economica, Finanza e Sviluppo Piazza S. Francesco 7, 53100 Siena
+39.0577. 232785; e-mail: alessandroinnocenti@live.it

[2] Dipartimento di Studi sullo Stato, Edificio D5 Polo delle Scienze Sociali, Via delle Pandette 21, 50127 Firenze.
+39.328.8874961, fax +39.055.4374919; e-mail: chiara.rapallini@unifi.it

1.   Introduction

The claim that individuals may vote by feet is considered the pillar of the theory of fiscal federalism. In Tiebout's (1956) standard reference paper, if households are free to move from one local community to another, they sort themselves into groups that are homogeneous with respect to their demands for local services. In this way, the market allocation with local public goods tends to be an optimal one, such as the general equilibrium solution for a market economy.[3] From a theoretical point of view, the model provided an additional or alternative means which could implement the Pareto efficient outcome by revealing individual preferences better than voting by ballot. In this perspective, since its publication the Tiebout's argument has set the research agenda in public finance and urban economics both from a theoretical and an empirical point of view.

Theoretical work has aimed at formalizing the analytical conditions under which household mobility among jurisdictions result in the existence of stable and efficient equilibria.[4] These results have been investigated empirically in a multi-faced way by testing it in connection with other issues, related to decentralized finance as tax capitalization, the connection between tax–expenditures patterns and collective decision rules, the estimation of the demand for public goods, the number and the size of local communities. For what concerns the public service demand, empirical research has focused on educational services, as the most important public services provided by local communities in many countries. More recently, the model has been scrutinized through experimental methods, mainly by analyzing the dynamics of group formation.

In this paper, we focus on a point ignored by economists and not yet studied in the laboratory. It is evident that the validity of Tiebout's model strictly depends on the joint effect of voting by feet and by ballot, which is the other key constituent of the model. Theoretical work has generally used the majority rule to model collective choices within communities. In our experiment, we aim to disentangle the effect of different voting rules from all other aspects. To this purpose, we conducted our experiment in two treatments. In one condition, called the dictatorial treatment, the decision of which and how much public good to produce in each community is taken by only one subject, named the dictator, while the other members of the community are only free to stay in or to move to another community. In the other condition, called the democracy treatment, all the members of each community have the right to vote and to move to another community and decision are taken by majority rule.

Our findings show that the validity of Tiebout's model depends on the chosen method of voting, and that social welfare is critically affected by this variable. In the next Section 2, the debate

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[3] In Tiebout's words, "If consumer-voters are fully mobile, the appropriate local governments, whose revenue-expenditure patterns are set, are adopted by the consumer-voters. While the solution may not be perfect because of institutional rigidities, this does not invalidate its importance. The solution, like a general equilibrium solution for a private spatial economy, is the best that can be obtained given preferences and resource endowments." (Tiebout 1956, p. 424)

[4] Among many see Richter (1978), Wooders (1980) , Bewley (1981), Coonly and Wooders (2001), Konischi (1996), Nechyba (1997), Glomm and Lagunoff (1999).

on the empirical validity of Tiebout's argument is critically reviewed. Section 3 presents the experimental design and our starting hypotheses. In Section 4 laboratory findings are described and discussed. Section 4 concludes.

2.   Background literature

A critical survey of the empirical tests of the Tiebout's model is beyond the aim of our paper, as they "are legion and multifarious"[5]. Dowding and al. (1994) distinguish between researchers who attempt to test on or more of the implications of the Tiebout's model and those who try to test the assumptions and they classify all those works in five headings: capitalization studies, city-size interpretations, homogeneity and sorting interpretations, migrations studies, and micro-level tests. With the Oates seminal paper (1969), capitalization studies are probably the early tests of the Tiebout model, but the question to which extend property tax and local services differentials are capitalized into property values, and if this is a test of the validity of Tiebout, is out of our interest. On the contrary, both size-city, migration studies and micro-level tests of household behavior are important to settle the literature background of our experiment. Dowding and al. (1994) survey over 200 articles and books testing the assumptions and implications from the Tiebout family of models and, among a long list of conclusions, they state that: a. " *There is mixed but marginal support for the proposition that the greater the number of jurisdictions the greater the satisfaction level for some, though not all, locally provided collective goods*"; b." *It is almost tautologically true that the greater the number of jurisdictions, the more homogeneous they are. That this affects efficient allocation of resources is a reasonable assumption, though strong*"; c. "*Migration patterns do seem to be affected by differences in tax/service packages, though the evidence is subject to other interpretations*".

More recently, Rhode and Strumpf (2003) claim that "*in the Tiebout model social welfare is positively related to increased sorting (that is, lower within-community heterogeneity and higher across-community heterogeneity)*" but they argue on the basis of an extensive survey that "*non-Tiebout incentives are important and perhaps driving forces in residential decisions*" and that, as a consequence, "*Tiebout sorting has been historically overwhelmed by forces reducing across-community heterogeneity.*" Their conclusion is that: "*These findings do not mean that Tiebout motives are irrelevant, but rather that they have not been the primary factor in long-run location decisions. This implies that any theoretical or empirical model that adopts a pure Tiebout framework, as is common in the literature, is misspecified. In more general models where non-policy factors influence residential choice, many implications of the Tiebout theory no longer hold (for example, it is not typically possible to rank communities according to public good demands).*" Among the factors invalidating the Tiebout effect, Rhode and Strumpf explicitly mentions that local public goods have progressively become less important than federal and central public goods, that zoning policies, by shaping differently individual preferences, have hindered spontaneous reallocations a la Tiebout and finally, that local communities have progressively entered in competition in attracting specific typologies of individuals.

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[5] Dowding, John and Biggs (1994)

A more general and perhaps simplified view of the stylized fact may assume that: 1) material mobility costs are decreased[6] and immaterial costs are not increased (proximity, cultural homogeneity, family cohesion); 2) local public goods quantity, quality and cost are all increased then their importance has not been replaced by other factors, as for example the labor market opportunities, 3) people concentrated in metropolis; 3) local communities are now more heterogeneous because of immigration and factors 1-2-3. Accordingly, the increase in the communities' initial heterogeneity has been such as, even if the sorting process is in force, the within heterogeneity is still more than the between heterogeneity. This phenomenon seem to suggest that the Tiebout model is not longer useful to describe localization decisions.

An issue undervalued in this debate is the way by which the types and ways of financing local public goods are decided. There is an increasing percentage of the population who do not participate to this decision either because marginal (recent immigrants, illegal immigrants, ethnic minorities, abstensionists) or because it is the most mobile and formed by people who do not expect to stay in a given community for enough time. Those people are exactly those who increased the initial heterogeneity and their existence may be a possible explanation of the minor relevance of the Tiebout model. In our experiment this issue is considered in deep by the comparison between the dictatorial treatment and the democracy one. In the dictatorial case, in fact, there are subjects who can't vote by ballot but who may displace at each round of the experimental session. The treatment is called dictatorship because there is a subject, randomly chosen in each community, who has to decide the type and the quantity of local public good provided. The others contribute with taxes to the cost of that local public good, but if they prefer other solution they can change community. On the contrary, in the democracy design all subjects are entitle both to vote by ballot and to move to another local community.

3. Design and hypotheses

The experimental design intends to verify how participants sort themselves into different communities on the basis of their preferences over local public goods in the two different treatments. i.e. the democracy and the dictatorship. In both treatments we assume the existence of five communities, each of which is allowed to provide only one of four alternative local public goods, identified by four different cards. Individual preferences over local public goods are randomly allocated at the beginning of the experiment to each participant. To compare results of the two treatments, individual preferences and allocations of people in community at the beginning of the experiment are the same in the two series of experimental sessions.

In the democracy treatment each community determines the type and the level of provision of the public good by means of the majority voting rule. In the dictator design, one of the member of each community is randomly selected as the decision maker and he/she is the only who can decide the type and the level of the provision of the local public good.

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[6] In 1903 to drive a car cost 143.8 cents/mile in 1998 dollars, while in 1998 it was 54.9 cents; a passenger mile by train cost 37.4 cents in 1895 and 13.4 cents in 1995; a passenger mile by fly cost 108 cents in 1929 vs. 13.7 cents in 1995; 3 minutes of transcontinental call in January 1915 cost $20.70 in current dollars, which was almost $314 in 1998 dollars.

In both treatments, the level of provision is identical for all the members of the community. The tax cost of the public good for each member is given by the product of a unitary fixed cost multiplied by the level of production chosen and divided by the number of the members of the community. The individual payoff is equal to the difference between the community level provision and the tax cost paid. This payoff might be also negative in case of an overprovision of that good with respect to individual preferences or if the good provided is not in the preferred bundle of the participant. The welfare of each community is be given by the sum of individual payoffs, while the social welfare is calculated by summing all the communities' welfare.

The experiment starts with the random allocation of students to each of the five communities in both treatments. After the first decision on public good provision, whether with the majority vote or by the dictator, the information on community's choice concerning the level of public good as well as the tax rate for the community is made public. In the democracy treatment, in the following periods all participants are free to move to a different community. In the dictator framework those who can't decide the type and the level of provision of the local public good are free to move in one of the other local communities, while the dictator can't displace. The sequence of choices will continue for ten periods.

In the first experimental period, local communities will determine their level of taxation for public good provision with the simple voting mechanism or the dictator decision. In the following 9 periods, all subjects of the democracy design and the non-dictators in the other setting, are allowed to move to communities different from that originally assigned. After each sorting, each community determines a new level of taxation and public good provision. At the end of the experiment, subjects are paid according to the decisions taken during all the experiment.

An important issue in our design is the degree of information required to make efficient decisions. In both treatments, we assume that subjects are provided with complete information about the number of components of each community and the choices made by all the communities in the previous periods. This may be not the case in real environments but we believe that this assumption is more consonant with Tiebout's model than different ones. The condition for being able to vote efficiently by feet is that information on the choices of communities as a whole is shared by all the individuals, not that individual preferences on public local goods are known. We also excludes that outputs of some local public goods (such as roads and clean rivers) can produce interjurisdictional spillover benefits: they provide benefits for residents of other jurisdictions,

The experiment was run at the Universities of Firenze and Siena (Italy) between January 2009 and January 2010, in six different sessions, three for each treatment. Each session involved 15 subjects; overall, the subjects involved were 90, recruited as volunteers from the Political Sciences Faculty of Firenze and the Economics Faculty of Siena. They spent about 80 minutes in the lab: 20 minutes for the instructions reading and 60 minutes for each experimental session. Each experimental session consisted of 10 periods and subjects earned on average 12 Euros. The laboratory of experimental economics LabSi (http://www.labsi.org) provided the technical and the practical support for the experiments. Experimental techniques followed the standard methodology. The test was computerized using the software Z-tree provided by the University of Zurich. During

the sessions the subjects were seated at computer terminals in separate seats to prevent communication or visual contact among them. For each treatment we conducted pilot experiments.

4.   Results and discussion

The discussion of our results is organized as follows: in section A we document the differences in social welfare reached in the democracy and dictator designs. As known, one of the main statement of the Tiebout model is that social welfare is positively related to increased sorting, that is lower within-community heterogeneity and higher across-community heterogeneity. For that reason, in section B we analyze how heterogeneity within the community matters in augmenting social welfare in our experiment and in Section C we will focus on heterogeneity between community along the ten rounds of each experimental session.

A.   Social welfare

In both the democracy and the dictator framework, our experiment is designed such as individual welfare is as bigger as closer to the individual preferences is the quantity of the public good produced by one's own community, and as many members share the production total cost (see formula…). As far as social welfare is concerned, this is simply defined as the sum of individual welfare in each community at each round.

Result 1. *In all the three sessions social welfare finally reached in the democracy design is higher than that attained in the dictator framework***.** Our interpretation of this first outcome is that voting by feet increases efficiency if all member are allowed to vote by ballot on local public goods. In other words, even if in both designs the total welfare at the end of the experiment is higher than at the beginning, the increase is bigger if all members are able to vote both by ballot and by feet. More precisely, as Table 1 shows, in the second session social welfare is higher in the democracy design along all the experiment, while in the first and third session there are a few rounds in which this result is reversed. In both sessions the main outcome is inverted in the early rounds and just before the last round of the experiment.

Result 2. *The average cost per capita is higher at the end of the dictator experiment*, as shown in Table 3. More in details, in democracy cost per capita increases in the first part of the session, but it decreases after the 5th and 6th round. The comparison between the quantity produced in the two designs does not show any significant difference along all the experiment in the three session. In brief, the social welfare result in democracy seems to be achieved mainly by reducing cost per capita, mainly in the second part of the session, whereas in the dictator design the rights allocation is such that the average cost per capita is still constant along all the experiment, if not increases.
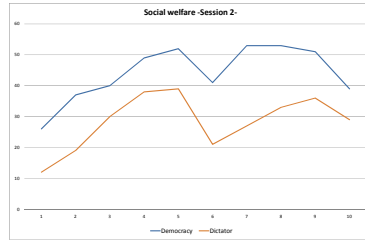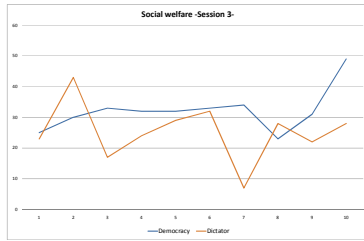
Table 1. Social welfare
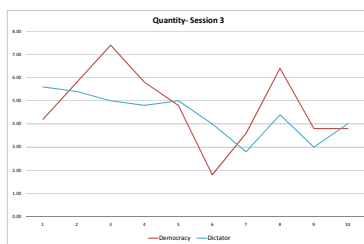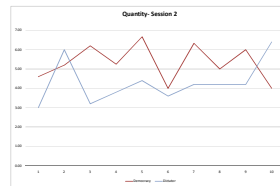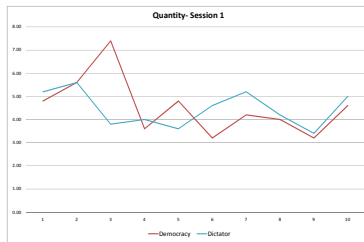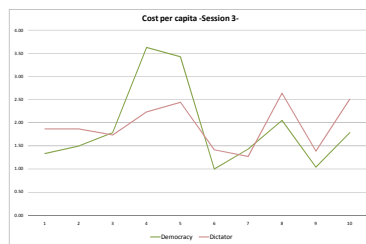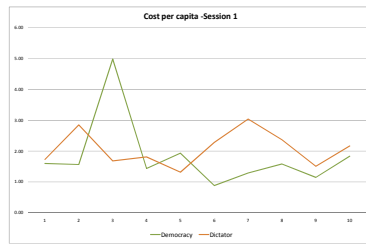

Table 2. Quantity produced

Table 3. Cost per capita

Result 3. *The number of individual displacements is positively related with the increase in individual welfare between the 1ˢᵗ and the 10ᵗʰ rounds in all the three sessions of the democracy design experiment, whereas in the dictator design in two out of three sessions.* We investigate the connection between voting by feet and increase in social welfare with the help of two econometric models. The first is an OLS regression in which the dependent variable is the difference in individual welfare between the 1ˢᵗ and the 10ᵗʰ round and one of the dependent variable is the "number of moving" in the ten rounds. In this case, the coefficients of the variable "number of moving decisions taken in 10 rounds" are positive and significant at 1% in all the democracy sessions, while they are positive in two out of three in the dictator sessions.

Result 4. *An individual loss in the previous round is always significant of the decision to move both in the democracy and in the dictator design and most of the displacement choices are taken in the first five rounds.* The second econometric model we use to study moving choices is a Probit model. This estimation points out that an individual loss in the previous round is significant to explain the choice to move in all the democracy sessions and in two out of three of the dictator sessions. As well in four out of six sessions most of the moving decisions are taken in the first five rounds.

In short, our experiment shows that social welfare attained in democracy is higher than in dictatorship and the outcome is attained by voting by feet in the first part of the experimental sessions and by cutting cost per capita by voting by ballot in the last rounds. In fact, in democracy

not only displacement decisions are crucial in explaining increase in individual welfare, but those decisions are taken in the first five rounds of the experiment, while cost per capita decrease design mainly after the 5th and the 6th round. On the contrary, even if displacement's choices follow a loss and most of those are taken in early rounds, in the dictator design the relation between the number of displacements and the individual welfare is not clear and the average cost per capita is constant along all the experiment.

Table 4. Welfare difference between 10th and 1st round -OLS Estimation-

VARIABLES	Session 1		Session 2		Session 3	
	Democracy deltaW	Dictator deltaW	Democracy deltaW	Dictator deltaW	Democracy deltaW	Dictator deltaW
Nr of moving in 10 rounds	1.019***	0.295**	0.278***	0.380***	0.325***	-0.480***
	(0.098)	(0.142)	(0.103)	(0.088)	(0.070)	(0.090)
Nr. of Rounds in wich a person with an opposite SC is meet	-0.439***	-0.168	-3.320***	2.440***	-0.813***	0.447***
	(0.063)	(0.120)	(0.593)	(0.275)	(0.242)	(0.084)
Nr. of Rounds in wich at least two people with an opposite SC are meet	-0.576***	-0.091	-0.096	-0.419*	-0.729***	0.511***
	(0.045)	(0.119)	(0.113)	(0.229)	(0.099)	(0.127)
Moving/non moving decisions taken rightly	1.106***	-1.003***	4.795***	-0.481***	-0.544***	0.076
	(0.147)	(0.289)	(0.275)	(0.148)	(0.172)	(0.364)
Community in which the individual move is chosen rightly	-0.291***	1.625***	-5.218***	0.577***	0.783***	0.060
	(0.102)	(0.241)	(0.317)	(0.158)	(0.115)	(0.165)
Constant	-4.460***	-3.230***	4.991***	-1.552	2.729**	0.615
	(0.765)	(1.223)	(0.806)	(1.023)	(1.254)	(1.960)
Observations	150	100	150	100	150	100
R-squared	0.764	0.685	0.787	0.667	0.762	0.444

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

B. *Heterogeneity within communities*

In the Tiebout framework, increase in social welfare is the outcome of sorting people with similar preference pattern for public goods. In our experiment preferences are randomly assigned to each subject at the start of the session and for the whole experiment and we evaluate heterogeneity in preferences within communities by calculating Spearman's rank correlation coefficients between each one experimental subject and all the others[7]. We use those rank correlation coefficients in both the estimation models, to test if the presence of one person, or at least two people, with a correlation coefficient with the opposite sign in one's own community explains the choice to move, in the Probit model, and the difference in individual welfare attained between the 1st and the 10th round, in the OLS model. Finally, preference patterns in the three sessions are identical in both the democracy and dictator designs such as we are able to underline any difference in sorting people under the two regimes. Finally, in the Tiebout model the sorting process and the welfare raise are the outcome of rational agents' choices. In our experiment we verify this assumption with the Probit model in two ways: first of all, we compare the individual welfare associated with the public good produced in her/his community with all the alternative individual welfares each one may attained in all other collectivities, given the choices on public good taken by each community, and we verify if people

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[7] Fischbacher, U. Gachter, S. (2008)

displace in case of a positive difference. As a second step we control if the community chosen is that associated with the maximum individual welfare each experimental subject may reach, given the decision on public goods taken by each collectivity.

Result 1. *Under democracy the social welfare increase is negatively related with the number of rounds in which each subject met a person with a Spearman coefficient of the opposite sign, whereas in the dictator design this variable is not statistically significant or positively related with the welfare raise.* The interpretation of this outcome is that heterogeneity among members of the same community is an obstacle in increasing social welfare in democracy (see in Table 4 the negative and significant sign of the coefficients of all of the three democracy sessions), while under the dictator scheme heterogeneity has not a direct influence on the social welfare attained along the experiment. The same conclusion can be draw if the "number of rounds in which at least two people with an opposite Spearman Coefficient are met" is considered. In other words, only in a democracy sorting people may rise welfare.

Result 2. *In the democracy design the decision to move is influenced by the collective decision on the type and quantity of good.* As clearly show in Table 5, in democracy if displacement choice is not related with preference pattern of other community's members, as represented by Spearman rank coefficients, it is clearly associated with a different individual vote on the type or/and quantity of good produced by the community. That it means that people chose to change community if they became aware to be different with respect to others by means of the vote by ballot.

Result 3. *In the dictator design the increase in welfare is positively related with a right decision of moving or not moving only if the community is correctly chosen, while in democracy there is a positive coefficient if the displacement decision is rightly chosen*

Table 5. Moving-non moving decision -Probit Estimation-

VARIABLES	Session 1		Session 2		Session 3	
	Democracy move	**Dictator move**	Democracy move	**Dictator move**	Democracy move	**Dictator move**
Individual loss in the previous round(dummy)	1.972***	**2.160***	1.174***		2.004***	**1.642***
	(0.374)	**(0.550)**	(0.268)		(0.422)	**(0.378)**
Decision taken in the first five rounds(dummy)	0.564**	**0.889***		**0.529***	1.398***	**-0.229**
	(0.263)	**(0.313)**		**(0.276)**	(0.388)	**(0.310)**
Presence of at least one subject with an opposite SC	1.137***	**-0.540**		**0.425**		**1.063***
	(0.308)	**(0.418)**		**(0.388)**		**(0.352)**
Presence of at least two people with an opposite SC	0.744**	**0.033**		**-0.596**		**0.010**
	(0.336)	**(0.398)**		**(0.651)**		**(0.483)**
Different individual vote on the type of good produced			1.278***			
			(0.487)			
Different individual vote on the quantity of good produced			0.623**			
			(0.243)			
Constant	-1.700***	**-1.184***	-1.277***	**-0.698***	-2.277***	**-0.639***
	(0.265)	**(0.251)**	(0.205)	**(0.197)**	(0.368)	**(0.219)**
Observations	150	**100**	150	**100**	150	**100**

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.   Conclusions

In this paper, we aim to disentangle the effect of different voting rules from all other aspects that affect the Tiebout proposition. To this purpose, we conducted our experiment in two treatments: in the dictatorial treatment, the decision of which and how much public good to produce in each community is taken by only one subject, named the dictator, while the other members of the community are only free to stay in or to move to another community. In the other condition, called the democracy treatment, all the members of each community have the right to vote and to move to another community and decision are taken by majority rule. Our findings show that total welfare is always higher in democracy, i.e. voting with your feet increases efficiency only if all the community members vote. More precisely, under democracy the increase in individual welfare is positively related to the number of decisions to move. The reason why in democracy the social welfare increases more than in the dictator framework is the decrease in the average cost per capita of public goods that is more significant in the first design than in the second. In democracy, the welfare increase is negatively related to the heterogeneity of people in each community, while in the dictator design this variable is not significant. In the dictator design, the increase in welfare is positively related to a right decision on moving/not moving only if the community is correctly chosen, while in the democracy design there is a positive coefficient if the moving/not moving decision is rightly taken.

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