JENA ECONOMIC RESEARCH PAPERS

2013 – 013

Endogenous Community Formation and Collective Provision
- A Procedurally Fair Mechanism -

by

Werner Güth

www.jenecon.de

ISSN 1864-7057

The JENA ECONOMIC RESEARCH PAPERS is a joint publication of the Friedrich Schiller University and the Max Planck Institute of Economics, Jena, Germany. For editorial correspondence please contact markus.pasche@uni-jena.de.

Impressum:

Friedrich Schiller University Jena
Carl-Zeiss-Str. 3
D-07743 Jena
www.uni-jena.de

Max Planck Institute of Economics
Kahlaische Str. 10
D-07745 Jena
www.econ.mpg.de

Endogenous Community Formation and Collective Provision

- A Procedurally Fair Mechanism -

Werner Güth

March 20, 2013

Abstract

A group of actors, individuals or firms, can engage in collectively providing projects which may be costly or generating revenues and which may benefit some and harm others. Based on requirements of procedural fairness (Güth and Kliemt, 2013), we derive a bidding mechanism determining endogenously who participates in collective provision, which projects are implemented, and the positive or negative payments due to the participating members. We justify and discuss this procedural fairness approach and compare it with that of optimal, e.g. welfaristic game theoretic mechanism design (e.g. Myerson, 1979).

Keywords: Procedural fairness, Mechanism design, Equality axiom, Public provision, Collective action

JEL code: D44, D46, D61, D62, D63, D71, D72, D73, D74

1. Introduction

Via our residence, we usually become members of regional communities like municipalities and states. How these communities with exogenously given membership can regulate public provision in procedurally fair ways has been discussed elsewhere (Güth and Kliemt, 2013) and also studied experimentally (Güth et al., 2012) and will be briefly repeated. Here we want to demonstrate how to extend this approach in order to allow for endogenous community formation together with the selection of what is collectively provided as well as its financing.

Examples are sports clubs, private organizations like charities, political parties, non-profit organizations etc. for whom procedural fairness in regulating their activities is crucial – more crucial than optimality, e.g. allocative efficiency, dominating in welfaristic mechanism design, based on dominance solvability or the revelation principle (see Güth 2013 and 2014). Whereas “optimal mechanism design” tries to achieve the allocative best results via eliciting private evaluations for each and every specific situation, our procedural fairness approach is generally applicable and much more in line with the legal tradition of justifying mechanisms by their properties rather than by their allocative results in an unforeseeable future.

As suggested by its procedural fairness the essential requirement is an equality axiom (see Güth, 2011). It does not mean to make unequals equal but rather postulates equal treatment when possibly unequal community members choose equally like when just counting votes (one (wo)man – one vote). Imposing equal treatment only with respect to interpersonally observable behavior renders our approach applicable independent of private information, common knowledge, and incentive compatibility constraints. In game theoretic terminology, what we derive is just a game form mechanism without assuming commonly known private evaluations or beliefs concerning them.

Beside its procedural fairness its advantage is to be legally implementable. Of course, when applying the mechanism, for instance, when implementing it experimentally, private evaluations have to be added. But no commonly known beliefs concerning them as required by game theoretic equilibrium analysis, have to be experimentally induced or controlled.

In section 2, we derive the mechanism which we discuss in more detail in section 3. Section 4 concludes by relating our approach to optimal, e.g. welfaristic mechanism design.

2. On the related literature

Quite generally, one can distinguish between

(i) fairness of allocations and
(ii) (ii) fairness of procedures.

The former topic (i) is extensively discussed by economists, e.g. when arguing that low and therefore unfair wages go along with larger profits, more investments and therefore higher employment, and recently by experimentalists via distribution games featuring trade-offs between fairness (more equal payoffs) and efficiency (measured by the payoff sum of all parties). Although even fair procedures can allow for unfair allocations and even though unfair procedures may yield fair allocations (see Roth, 1995, for an early survey), we will neglect topic (i) as far as possible in the following.

Fair procedures, i.e., topic (ii), have a very long tradition of discourse in legal history and its religious forerunners as well as in sports contests. Unlike economists interested in optimal, e.g. efficiency enhancing regulation, legal norms are not justified by their likely allocation effects, i.e., in a consequentialistic way, but by the desirability of their properties, e.g. fairness. One wants to rule out arbitrary (dis)favoring by guaranteeing equal treatment of all parties involved (see for a comparison of optimal and legal mechanism design Güth, 2013 and 2014). In constitutional law the prominent principle of “one (wo)man one vote” is why we propagate democracy rather than objecting to possibly non-transitive majority voting and the ambiguity of allocation effects resulting from majority voting. In commercial law analogous norms rule out discrimination, insider trading, impose information disclosure, etc.

Compared to this long legal tradition for which we partly provide an axiomatic foundation (see again also Güth, 2013 and 2014), experimental studies of fair procedures, topic (ii) above, are rather recent. Partly the experimental findings of unfair procedures like dictatorial allocation or ultimatum bargaining reveal strong intrinsic concerns for allocational fairness (see Roth, 1995, Güth and Kocher, 2012), partly one implements directly fair procedures to explore, for example,

- whether this crowds in monetary opportunism and
- how (dis)functional such mechanisms are.

Among the latter studies are Bolton et al. (2005) who focus on unbiased randomization as a fair procedure for allocating indivisible commodities and Chlaß et al. (2009) who compare game protocols differing in fairness but not in allocation effects. Note, of course, that even when experimentally implementing fair procedures, the mentally perceived positions of the parties involved can differ dramatically. Actually, one robust experimental finding is that in spite of fair procedures experimentally induced asymmetry of interacting participants still triggers intrinsic other regarding concerns (see Güth et al., 2011). Thus, fair procedures alone do not crowd in monetary opportunism across the board.

3. Requirements and Derivation of Mechanism

Let $i = 1, 2, ...$ denote an arbitrary potential community member. Whether i will join the community aiming at collective provision of services and/or commodities, in short projects, depends endogenously on

- the community formed
- the projects provided by this community
- the due payments of its members.

For the formal definition of our requirements and the derivation of the mechanism, we introduce the following notation:

$\varnothing$: the status quo with no community formed and no provision, evaluated by each i with 0 in terms of net improvement (0-payoffs)

$\Omega = \{p_1, p_2 ...\}$: the non-empty set of possible projects $p \in \Omega$ with $\varnothing \notin \Omega$

$C(p) \in \mathbb{R}$ for all $p \in \Omega$: known cost of project p

$b_i(p) \in \mathbb{R}$: i's monetary bid for project $p \in \Omega$

$b_i = \left(\left(b_i(p) \right)_{p \in \Omega} \right) = \left(b_i(p_1), b_i(p_2), \ldots \right)$: i's bid

$b = \left(\left(b_i \right)_{i=1,2,\ldots} \right)$: bid vector

$c_i\left(p(b), b \right) \in \mathbb{R}$: i's payment when becoming a member of the community providing $p(b)$ according to bid vector b

We first consider the easier case of exogenously given communities $N = \{1, \ldots, n\}$ with $n \geq 2$, i.e., of coercive membership as in most cases of regional communities. We rely on the following requirements which will be discussed and motivated more thoroughly in section 3 below:

(i) The status quo $\varnothing$ is maintained if for all possible projects $p \in \Omega$ the bid sum does not cover the possibly negative cost of project p, i.e., if $\sum_{i \in N} b_i(p) - C(p) < 0$ with $C(p) \in \mathbb{R}$. In that case all net improvements for $i = 1, 2, \ldots$ are nil (0 payoffs).

(ii) If otherwise $\varnothing$ is substituted, the chosen project $p^*(b) \in \Omega$ with non-negative bid surplus $\sum_{i \in N} b_i\left(p^*(b) \right) - C\left(p^*(b) \right)$ maximizes the bid surplus, i.e., $\sum_{i \in N} b_i\left(p^*(b) \right) - C\left(p^*(b) \right) \geq \sum_{i \in N} b_i(p) - C(p)$ for all $p \in \Omega$.

(iii) For all community members $i \in N$ the bid payoff $b_i(\bullet) - c_i(\bullet)$`is equal.

(iv) In case of $p^*(b) \in \Omega : \sum_{i \in N} c_i\left(p^*(b), b \right) = C\left(p^*(b) \right)$

Obviously (iii) is satisfied in case of $\varnothing$ being maintained. If therefore $p^*(b) \neq \varnothing$ it follows from (iii) and (iv) that $c_i\left(p^*(b) \right) = b_i\left(p^*(b) \right) - \frac{\sum_{i \in N} b_i\left(p^*(b), b \right) - C\left(p^*(b) \right)}{n}$ for all $i = 1, \ldots, n$.

We now adapt the four requirements in order to allow for an endogenously formed community providing possibly some project $p \in \Omega$. In the following, let K denote an arbitrary non-empty subgroup of potential community members $i = 1, 2, ...$ and by $K\left(p^*(b), b\right)$ the subset which is implied by the bid vector b determining some project $p^*(b) \in \Omega$. The adapted axioms are:

(i') The status quo $\varnothing$ is maintained with $K(\varnothing, b)$ as the empty set, i.e., no community is formed with 0 payoffs for all $i = 1, 2, ...,$ if for all $p \in \Omega$ and all sets K the K sum of bids does not cover the costs, i.e., $\sum_{i \in K} b_i(p) < C(p)$.

(ii') If, otherwise, $\varnothing$ is substituted, the chosen project $p^*(b) \in \Omega$ with formation of community $K\left(p^*(b), b\right)$, the bid surplus for this community $K\left(p^*(b), b\right)$ is maximal, i.e., $\sum_{i \in K\left(p^*(b), b\right)} b_i\left(p^*(b), b\right) - C\left(p^*(b)\right) \geq \sum_{i \in K'} b_i(p) - C(p)$ for all non-empty sets K' and all $p \in \Omega$.

(iii') In case of $p^*(b) \in \Omega$ for all $i \in K\left(p^*(b), b\right)$, the bid payoff $b_i\left(p^*(b)\right) - c_i\left(p^*(b), b\right)$ is equal.

(iv') In case of $p^*(b) \in \Omega$:

$$\sum_{i \in K\left(p^*(b), b\right)} c_i\left(p^*(b), b\right) = C\left(p^*(b)\right).$$

Let $n^*\left(p^*(b), b\right)$ denote the number of members of community $K\left(p^*(b), b\right)$. From (iii') follows for $p^*(b) \in \Omega$:

$b_j\left(p^*(b)\right) - c_j\left(p^*(b), b\right) =: \Delta$ for $j \in K\left(p^*(b), b\right)$ and thus, due to (iv'), also

$$\sum_{j \in K\left(p^*(b), b\right)} b_j\left(p^*(b)\right) - C\left(p^*(b)\right) = \Delta n^*\left(p^*(b), b\right),$$

respectively

$$\Delta = \frac{\sum_{j \in K\left(p^*(b), b\right)} b_j\left(p^*(b)\right) - C\left(p^*(b)\right)}{n^*\left(p^*(b), b\right)} (\geq 0).$$

Inserting this above, finally implies

$$c_i\left(p^*(b),b\right)=b_i\left(p^*(b)\right)-\frac{\sum_{j\in K\left(p^*(b),b\right)} b_j\left(p^*(b)\right)-C\left(p^*(b)\right)}{n^*\left(p^*(b),b\right)}.$$

Thus, the four requirements (I'), (ii'), (iii'), (iv') uniquely determine via the bid vector b:

- whether or not the status quo $(\varnothing)$ is maintained
- if not, which $p^*(b)\in\Omega$ is provided by which community $K\left(p^*(b),b\right)$,
- which payments $c_i\left(p^*(b),b\right)$ are due to the community members $i\in K\left(p^*(b),b\right)$.

Note that, due to (iii') equal treatment is restricted to community members $i\in K\left(p^*(b),b\right)$ what allows for non-equal bid payoffs in the sense of $b_i\left(p^*(b)\right)\neq b_j\left(p^*(b)\right)$ of two community outsiders $i, j\notin K\left(p^*(b)\right)$ as well as for inequality of community members and outsiders, i.e.,
$b_j\left(p^*(b)\right)\neq b_i\left(p^*(b)\right)-c_i\left(p^*(b),b\right)$
for some $j\in K\left(p^*(b),b\right)$ and some $i\in K\left(p^*(b),b\right)$.

Of course, this non-equal treatment outside the community and when comparing members and outsiders had to be expected. One can view this outsider problem as the price one has to pay for voluntary community formation for the sake of collective provision. If outsiders would complain, one could argue that their too low bids are responsible for not qualifying as community members. Only community members $i\in K\left(p^*(b),b\right)$ will be monetarily compensated when bidding negatively for $p^*(b)$, i.e., in case of $b_i\left(p^*(b)\right)<0$, and only community members $i\in K\left(p^*(b),b\right)$ with $b_i\left(p^*(b)\right)>0$ can be asked for positive payments $c_i\left(p^*(b),b\right)$.

Let us briefly mention further requirements, implied by the ones stated above. Since Δ, as derived above, is non-negative, no community member $i\in K\left(p^*(b),b\right)$ has ever to pay more than the own bid $b_i\left(p^*(b)\right)$. Conversely, this means that by bidding sufficiently low, one may prevent $p^*(b)$ to be implemented and/or becoming a community member. Remember, however, that an individual j with $b_j(p^*(b))<0$ and $j \notin K(p^*(b),b)$ is not monetarily compensated, contrary to members $i \in K(p^*(b),b)$ who have submitted negative bids $b_i(p^*(b))$. This illustrates again that equal treatment does not apply to community outsiders.

A further requirement (see Güth, 1986 and 2011) of procedural fairness is that according to his bid no community member $i \in K(p^*(b),b)$ should prefer another community member's net trade to his own one. We mention this here only since this envyfreeness according to bids is guaranteed by the equality axiom (iii), respectively (iii'). Of course, again this does not extend to community outsiders or to no envy between outsiders and insiders.

4. Discussion

The mechanism only respects overt and interpersonally observable behavioral input, summarized by the bid vector. There is no speculation about the true and usually only privately known evaluations and the beliefs concerning them. Furthermore, there is no common knowledge assumption concerning true evaluations and the corresponding beliefs. What has to be known is the behavior, here the bid vector, and this is elicited and thus a readily available input of the mechanism.

For our analysis above we have assumed known costs $C(p) \in \mathbb{R}$ for all projects $p \in \Omega$. If these costs are at best stochastically predictable, for example, in the sense of $C(p \mid z)$ where z devotes one of several possible random events, then one might ask for bids $b_i(p \mid z)$ for all possible random events z and require cost balancing in the sense of $\sum_i b_i(p \mid z) = C(p \mid z)$ for all z and implement a project $p \in \Omega$ only if its bid surplus is non-negative for all z and maximal for at least one z or, when probabilities exist for all random events z, maximizing the expected bid surplus.

One may object to our mechanism that it rules out provision of several projects $p \in \Omega$. This is, however, no restriction at all since bundling several projects can be captured as a further project of set Ω. Actually, one may view the different projects in Ω as different subsets of a set of single projects (see Cicognani et al., 2012). One then would have to argue whether the costs of such subsets are just the sums of the costs of its individual projects or whether bundling of single projects increases or decreases the cost of the whole bundle. Here we have avoided this by focussing on alternative projects $p \in \Omega$ of which at most one can be implemented.

Cost balancing, as captured by (iv), respectively (iv') is natural but not necessary at all. One can allow for subsidies to cover the cost $C\left(p^*(b), b\right)$ as well as for taxing collective provision, e.g. requiring some fee when the status quo is given up (see Güth, Levati, Montinari, 2012). Cost balancing becomes more demanding when costs are not given and known but randomly determined (see above).

In our analysis it has been assumed that community members will accept their due payments. Our justification is that one can avoid becoming a community member and, even when being included, one can prevent unwelcome projects by bidding sufficiently low for them. There is some sort of veto power and unanimity principle in the background which should make it easy for all potential community members $i = 1, 2, ...$ to participate in the bidding and to submit to the rules of the mechanism.

Axioms (i') and (ii') can be described as efficiency conditions in view of bids: if according to bids the status quo is preferable, it should be maintained where we, however, did not allow to bid for $\varnothing$, the status quo. It is giving up the status quo what has to be justified by efficiency according to bids. Similarly, (ii') asks for the most efficient project $p \in \Omega$ according to bids when giving up the status quo. Thus, via bidding, community members determine whether $\varnothing$ is maintained and, if not, which community $K\left(p^*(b), b\right)$ provides which project $p^*(b) \in \Omega$.

The main advantage – the procedural fairness of our mechanism – is due to the equality requirement (iii), respectively (iii'). It essentially rules out any arbitrary (dis)favoring of specific community members although it may treat community outsiders quite unequally. Rather than viewing this as a drawback of our mechanism, one can consider this as a reason to enter the community and enjoy its procedural fairness. But, of course, some may not be welcome since they bid too low and thus question every community including them.

If this is not sufficiently comforting, one would have to argue for compulsory membership of all potential community members $i = 1, 2, ...$ for which requirements (i), (ii), (iii), (i,v) guarantee general procedural fairness. In our view, since both mechanisms, the one for exogenously given communities based on (i), (ii), (iii), (i,v) and the one for endogenously formed communities based on (i'), (ii'), (iii'), (iv'), rely on similar procedural requirements, one can easily recognize the advantage and drawback of compulsory membership, respectively of allowing to opt out of the community, formed for the purpose of collective provision.

5. Conclusions

What we consider are rules for endogenously determined collective provision by endogenously formed communities to select and finance collective projects. In our view, the requirements characterizing the mechanism are rather obvious and intuitive when wanting to apply the mechanism to possibly many future situations about which hardly anything can be known when implementing the mechanism, for example, in the sense of legal rules. It is in this sense that our approach can be claimed to be in line with the legal tradition (of mechanism design) what has been discussed in more detail elsewhere (Güth, 2013 and 2014).

The factual implementability has so far been checked only experimentally but under varying conditions for:

- projects favoring each and everybody competing with more efficient projects harming some and favoring others (Güth, Koukoumelis, Levati, 2011)
- projects generating revenues competing with more efficient but costly ones (Güth, Koukoumelis, Levati, Ploner, 2012)

- commonly known evaluations and no information at all concerning the true evaluations by others (Cicognani et al., 2012).

Altogether the mechanism is surprisingly functioning, at least in the lab environment. There is reliable collective provision and mostly of the truly most efficient project. One bias, according to the preliminary experiments so far, is that participants often implement projects with negative costs, even when they are not the most efficient ones.

How does optimal, e. g. welfaristic mechanism design differ from our procedural fairness approach? Whereas we justify our mechanism by its properties, i.e., by arguing that what we want is to guarantee these properties when acting collectively, optimal mechanisms are justified by their allocative implications (e. g. Myerson, 1979). The idea is to induce truth telling in bidding what then allows to derive the allocation effects and to evaluate them according to these true evaluations rather than according to bids as in our procedural fairness approach.

The method is either dominance solvability, i.e., bidding truthfully is the only weakly undominated behavior, what does not require any kind of common knowledge since each bidder has a best choice irrespective of the others' behavior. Thus, this relies on similarly weak assumptions as our approach but is, unfortunately, hardly ever applicable. The rule is rather impossibility than possibility of dominance solvability.

The other method is the revelation principle assuming common knowledge as required by game theoretic equilibrium analysis. One derives a revelation mechanism (for which general truthful bidding is an equilibrium) for each equilibrium of each well defined (Bayesian) game. This is suitable for exploring allocational possibilities via the limited class of revelation mechanisms but not at all for mechanism design when confronting an unknown future with all sorts of situations which mostly are ill-defined in the game theoretic sense (see Güth, 2013 and 2014) for a more thorough comparison and discussion).

References

G. E. Bolton, J. Brandts and A. Ockenfels (2005). Fair procedures: Evidence from games involving lotteries. The Economics Journal 115, 1054-1076.

N. Chlaß, W. Güth and T. Miettinen (2009). Beyond Procedural Equity and Reciprocity. Working Paper Series of the Max Planck Institute and Friedrich Schiller University of Jena JERP #2009-069.

S. Cicognani, A. D'Ambrosio, W. Güth, S. Pfuderer and M. Ploner. Community Projects: An Experimental Analysis of a Fair Implementation Process. Working Paper Series of the Max Planck Institute and Friedrich Schiller University of Jena JERP #2012-015.

W. Güth (1986). Auctions, public tenders, and fair division games: An axiomatic approach, Mathematical Social Sciences 11, 283-294.

W. Güth (2011) Rules (of Bidding) to Generate Equal Stated Profits: An Axiomatic Approach, Journal of Institutional and Theoretical Economics 167(4), 2011, 608-612.

W. Güth (2013). Institutional Regulation of Public Provision. Working Paper Series of the Max Planck Institute #2013-001.

W. Güth Mechanism Design and the Law, forthcoming in: Oxford Handbook of Law and Economics (ed. Francesco Parisi). Oxford University Press (2014).

W. Güth and H. Kliemt (forthcoming) Fairness That Money Can Buy: Procedural Egalitarianism in Practice RMM (Rationality, Markets and Morals).

W. Güth and M. Kocher (2013). Ultimatum Bargaining (Experiments), forthcoming in: Real World Decision Making: An Encyclopedia of Behavioral Economics (ed. Morris Altman).

W. Güth, A. Koukoumelis and V. Levati. Voluntarily providing public projects that raise mixed feelings by a procedurally fair rule. Working Paper Series of the Max Planck Institute and Friedrich Schiller University of Jena JERP #2011-034.

W. Güth, A. Koukoumelis, V. Levati and M. Ploner. Public projects benefiting some and harming others: three experimental studies. Working Paper Series of the Max Planck Institute and Friedrich Schiller University of Jena JERP #2012-034.

W. Güth, V. Levati and N. Montinari. Ranking Alternatives by a Fair Bidding Rule: A Theoretical and Experimental Analysis. Working Paper Series of the Max Planck Institute and Friedrich Schiller University of Jena JERP #2012-005.

R. B. Myerson (1979). Incentive compatibility and the bargaining problem. Econometrica 47(1), 61-73.

Roth, A. (1995). Bargaining Experiments, in: Handbook of Experimental Economics, J. Kagel and A. Roth (eds.), Princeton: Princeton University Press.