

# **Income inequality and common provision of pure public goods**

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PAPER IN PROGRESS. EXTENDED ABSTRACT

## **Abstract.**

Can the voluntary supply of public goods be increased by making the income distribution more unequal? Theoretical economic literature provides clear answers to such a provision by individuals who maximize their utility while considering the other agents' utility constant. The present paper analyzes this hypothesis in an economic environment where voluntary contribution is determined following a bargaining process among agents who are willing to contribute, but tie their contribution to the contribution of others. It is demonstrated that the Warr (1983) neutrality condition does not hold in a cooperative setting. Moreover, aggregate contribution by individuals whose preferences can be presented by a homogeneous function results in a bargaining solution that is invariant to the distribution of wealth among the contributors. This, in return, implies that Bergstorm et al. (1986) conclusions do not hold for a common provision of public goods.

Key words: Income inequality, cooperative games, International Environmental agreements.

## 1. INTRODUCTION

Independent actions are often insufficient in achieving an efficient level public goods supply as participants fail to adjust for the benefits that their efforts confer to other. However, a collective action may also fail to supply the optimal level of the public goods if communication among agents is sensitive to heterogeneity, and in particular, when agents in the collective care not only of for the relative contribution but also for their ‘relative income’. Such a behavior could particularly arise when agents differ in their income level and characteristics. Unfortunately, these phenomena characterize many of the worlds most urgent problems, that involve the need for collective action among sovereign states at either the regional or the global level. Examples include transnational collectives that address problems involving acid rain, global warming, ocean pollution or biodiversity.<sup>1</sup> However, the environment is not the only source of such collective action problems; food security, political security and health concerns raise similar collective exigencies. When addressing a common public good problem agents must sequentially make two decisions. First, they must decide whether or not to participate formally in an agreement to provide the public good. Second, each agent must determine their actual level of provision in light of others’ strategies, endowments and opportunity costs.

The possibility that aggregate supply of public good is sensitive to the distribution of wealth among participating agents has been implied by Warr (1983) and further extended by Bergstorm et al. (1986). Warr (1983) had shown that a group contribution should be invariant under redistribution of income. His proof assumed that (i) a Nash equilibrium lay in the interior of the contribution space and hence that all individuals contributed to the public good both before and after redistribution, and that (ii) the contribution of each individual is linear in wealth, taking the Gorman form  $g_i = a_i + bw_i$ , where  $g_i$  is individual  $i$ ’s contribution to the public good and  $w_i$  is the individual’s wealth. The study conducted by Bergstorm et al. (1986) supports these findings and extends the argument to cases in which redistribution of wealth

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<sup>1</sup>On these environmental problems, see Sandler (1997); Carraro and Siniscalco (1998).

could change the set of contributors and to cases where each participant may have unique preferences over contribution to the provision of a public good, but keeps a restrictive assumption of quasi-homothetic demand for the public good. Under these assumption it has been shown that in a Nash equilibrium: (i) any change in the wealth distribution that leaves unchanged the aggregate wealth of current contributors will either increase or leave unchanged the equilibrium supply of public good: increasing inequality increases aggregate contribution; and (ii) Any change in the wealth distribution that increases the aggregate wealth of current contributors will necessarily increase the equilibrium supply of the public good;

However, recent literature casts a doubt over the generality of the conclusions presented above. Some contradicting findings were presented by Vicary (1990) and Jayaraman and Kanbur (1999) that have demonstrated that even if the set of participants is unaffected by the redistribution of wealth, income transfers may be Pareto improving when the public good abides by a weakest-link technology (non-summation technologies of aggregation). Similar contradicting results were reported in experimental studies by Hackett et al. (1994) and Kenneth S. Chan et al. (1996).

Improving upon inefficient individual provision requires voluntary cooperation for which cooperative game theoretic concepts can be applied. Game theoretic concepts to analyze the effect of income inequality on the provision of public environmental goods were adopted by Carraro and Siniscalco (1993) to explain the role of transfers in encouraging participation in international environmental agreements. Carraro and Siniscalco (1993) show that transfers have no effect in a model with symmetric countries. However, former experimental studies suggest that heterogeneity in income reduces voluntary contributions to public goods when agents can communicate prior to making contributions (Isaac and Walker, 1988). In this same line, some recent empirical studies (Botteon and Carraro (1997), ? Bosello et al. (2003)) illustrate the effect of ex-ante transfers on a Nash Bargaining solution and the Shapley value. These studies basically confirmed earlier studies concluding that transfers can be conducive to the success of self-enforcing agreements, that is for the creation of a

stable coalition. Nevertheless, the effect of income inequality among contributors on the public good supplied by the coalition was not addressed.

The primary purpose of this paper is to contribute to the debate on the effect of income inequality and common provision of public goods in two dimensions. First, developing a theoretical model demonstrating that the coalition's contribution does depend on the allocation of wealth among contributors when contributors' preferences are represented by a quasi-homothetic utility function. This implies that the results presented by Bergstorm et al. (1986) may not apply in a cooperative setting. However, a neutrality characteristic arises when preferences are represented by a homogeneous utility function. Under these conditions collective contribution is independent of the distribution of income among the agents.

The theoretical section (Section 2) includes a static model of Nash-Bargaining game with  $N$  agents, whose preferences can be represented by a twice differentiable utility function of the Cobb Douglas form. Qualitative characteristics relating public good provision and income inequality are derived. Section 2 includes an empirical analysis and discussion on the Kyoto Protocols (reported on January 1997) that includes detailed proposals by countries that decided to commonly contribute to the threat of global warming. I outline the correlation between the nations' (declared) contribution and their per capita income, testing it against the theory. Concluding remarks are included in Section 3.

#### REFERENCES

- Bergstorm, T. C., Blum, L. E., and Valian, H. R. (1986). On the private provision of public goods. *Journal of Public Economics*, 29:25–49.
- Bosello, F., Buchner, B., and Carraro, C. (2003). Equity, development and climate change. *Journal of the European Economic Association*, 1:601–611.
- Botteon, M. and Carraro, C. (1997). *International Environmental Negotiations: Strategic Policy Issues*, chapter Burden Sharing and Coalition Stability in Environmental Negotiations with Asymmetric Countries, pages 26–55. Edward Elgar.

- Carraro, C. and Siniscalco, D. (1993). Strategies for the international protection of the environment. *Journal of Public Economics*, 52:309–328.
- Carraro, C. and Siniscalco, D. (1998). International environmental agreements: incentives and political economy. *European Economic Review*, 42:561–572.
- Hackett, S. C., Schlager, E., and Wallker, J. (1994). The role of communication in resolving commons dilemmas: experimental evidence with heterogeneous appropriators. *Journal of Environmental Economics and Management*, 27:99–126.
- Isaac, M. R. and Walker, J. (1988). Communication and free riding behavior: the voluntary contribution mechanism. *Economic Inquiry*, 24:585–608.
- Jayaraman, R. and Kanbur, R. (1999). *Global public goods: International cooperation in the twenty-first century*, chapter International public goods and the case for foreign aid, pages 418–435. Oxford University Press, Oxford.
- Kenneth S. Chan, S. M., Moir, R., and Muller, A. R. (1996). The voluntary provision of public goods under varying income distributions. *Canadian Journal of Economics*, 29:54–69.
- Sandler, T. (1997). *Global Challenges: An Approach to Environmental, Political and Economic Problems*. Cambridge University Press, Cambridge.
- Vicary, S. (1990). Transfers and the weakest-link: An extension of Hirschleifer's analysis. *Journal of Public Economics*, 43:375–394.
- Warr, P. (1983). The private provision of public goods is independent of the distribution of income. *Economics Letters*, 13:207–211.