Experimental Economics, 6:299–310 (2003)

Linear Public Goods Experiments: A Meta-Analysis

JENNIFER ZELMER
Graduate Student, Department of Economics, McMaster University, 1280 Main Street West, Hamilton, Ontario, Canada
email: zelmerjl@mcmaster.ca

Received August 20, 2001; Revised September 14, 2002; Accepted January 7, 2003

Abstract

Objective: To use meta-analysis techniques to assess the impact of various factors on the extent of cooperation in standard linear public goods experiments using the voluntary contributions mechanism.

Data Sources: Potentially relevant experiments were identified through searches of EconLit, the Internet Documents in Economics Access Service (IDEAS), and a survey article.

Review Methods: A total of 349 potentially relevant studies were identified. Of these, 27 (representing a total of 711 groups of participants) met the inclusion criteria. Data were abstracted from these studies using a standardized protocol. Results were analyzed using weighted ordinary least squares. Average group efficiency was the dependent variable.

Results: The marginal per capita return, communication, constant group composition over the session ("partners"), positive framing, and the use of children as subjects had a positive and significant effect ($p < 0.05$) on the average level of contribution to the public good. Heterogeneous endowments to subjects, experienced participants, and soliciting subjects' beliefs regarding other participants' behaviour prior to the start of the session/period had a negative and significant effect. A number of other factors were not identified as significant.

Conclusion: The meta-analysis results parallel several key findings from previous literature reviews. In addition, they offer parameter estimates and an analysis of significance based on the totality of the available research evidence. More consistent reporting of the results of experiments would greatly improve the ability to conduct this type of research.

Keywords: public goods, voluntary contribution, experiment, meta-analysis

JEL Classification: H41, C70, C9, B40

1. Introduction

The academic literature is growing exponentially, doubling every ten to fifteen years (De Solla Price, 1981). In economics alone, EconLit (the electronic bibliographic index maintained by the American Economic Association) now tracks over 600 journals, as well as a wide range of books and dissertations (AEA, 1999). Unfortunately, single experiments or studies in the social sciences rarely provide definitive answers to research questions (Wolf, 1986). Often, many studies scattered throughout the formal, informal, and even unpublished literature can be relevant.

One area where a diverse, sometimes conflicting, body of literature has accumulated is how different institutions, organizational arrangements, and other factors affect individuals'

willingness to contribute to public goods. In linear public goods environments, payoff maximizers have a dominant strategy to either contribute all of their tokens or none of their tokens to a group activity. The conventional public goods environment is parameterized to create a social dilemma. The dominant strategy is to contribute nothing to the group activity, while the efficient outcome requires everyone to contribute his/her entire endowment to the group activity. For more than two decades, experimental economists and others have endeavoured to test this prediction and factors that influence cooperation in laboratory environments.

Excellent survey articles have been prepared, but as the number of studies grows, the ability of this approach to capture the full range of primary research is questionable (Glass, 1981; Hunter, 1982; Rosenthal, 1991). In addition, although qualitative reviews have indicated the likely direction of effect of a range of factors (e.g. communication and number of subjects), they do not provide estimates of the effect size based on the totality of the evidence.

Meta-analysis, "the statistical analysis of a large collection of results from individual studies for the purpose of integrating the findings into a single, generalizable finding," has the potential to address some of these concerns (Plath, 1992). It systematically identifies as complete a sample of studies pertaining to the issue of interest as possible, rather than highlighting the findings of key research only. The features and results of these studies are then described in a consistent quantitative or quasi-quantitative way. Statistical techniques are subsequently applied to aggregate the findings across studies and objectively examine the relationship between study characteristics and outcomes. Finally, there is a systematic and detailed description of the method used to integrate study results—ensuring replicability of the findings.

While an article on meta-analysis appeared in the *Economist* as early as 1991, applications in economics continue to be relatively rare (van den Bergh et al., 1997). A 1997 review identified 19 major studies in environmental, regional, urban, and transport economics (van den Bergh et al., 1997). Subjects included urban pollution valuation, recreational benefits, recreational fishing, valuation of life estimates, contingent valuation versus revealed preference, noise nuisance, congestion, internal validity of contingent valuation and visibility improvement, multiplier effects of tourism, transport issues, and the price elasticity of demand in travel cost method studies. More recent studies cover areas such as Ricardian equivalence (Stanley, 1998), factors that systematically affect price and income elasticity estimates for gasoline demand (Espey, 1998), more work on regional tourist multipliers (Baaijens, 1998), and threshold public goods (Croson and Marks, 2000). This paper presents the results of a meta-analysis of standard linear public goods experiments using the voluntary contributions mechanism.

2. Voluntary contributions to public goods

Roads, parks, police services, projects to improve air quality, and radio—both ancient and modern society abound with examples of public goods, commodities for which use of the good by one agent does not preclude its use by others (Pigou, 1932). For more than two decades, experimental economists have explored under what conditions individuals are more likely to voluntarily contribute to the provision of public goods.

In experiments using the voluntary contribution mechanism (VCM) in linear public goods environments, subjects are divided into groups and play the same game for a finite number of periods. Each period, every subject is endowed with an income of w_i. The subject must then divide this income between a contribution to a private account (x_i) that yields a constant return to themselves only and a contribution to a public account (g_i) where consumption benefits accrue to all group members. At the end of each period, subjects typically learn the aggregate contribution to the public good by all members of their group and their earnings for the period. Mathematically, individual i's payoff is given by:

$$u_i = \alpha x_i + \beta G$$

The subject must maximize this utility function, subject to a budget constraint ($w_i = x_i + g_i$), a public goods identity ($G = \sum g_i$), and a non-negativity constraint ($g_i \geq 0$). In a linear public goods environment, both α and β are constants.

Typically, experiments are parameterized so that payoff maximizers in finitely repeated games have a dominant strategy to contribute nothing to the public good. The Nash equilibrium strategy is thus full free-riding. In contrast, the group as a whole is better off when contributions are made to the group account. The Pareto efficient outcome is for all subjects to contribute their entire endowment to the public good. Over several decades, a rich, but sometimes contradictory, body of experimental evidence has accumulated about this environment.

3. Study objective

The objective of this meta-analysis is to synthesize the results of existing experimental evidence on the impact of a variety of organizational arrangements and other factors on the extent of cooperation observed in standard linear public goods experiments using the voluntary contributions mechanism.

4. Methods

4.1. Searching

A search of the economics literature for results of standard single-stage linear public goods experiments using a voluntary contribution mechanism was undertaken using *EconLit*,[1] *Internet Documents in Economics Access Service (IDEAS)*,[2] and references cited in John Ledyard's (1995) survey of experimental research related to public goods.

4.2. Selection

Candidate studies from these bibliographic sources (or parts thereof) were included in the meta-analysis if, and only if, they:

- Were unique reports of a laboratory experiment where observations for one or more sessions were gathered in a controlled environment;
- Used a standard voluntary contribution mechanism in a single-stage linear public goods environment with a single public good where the marginal per capita return was less than one;
- Reported group-level results (or averages over groups of similar types) for at least one of the outcomes of interest; and
- Could be obtained through electronic access or libraries at the University of Toronto, McMaster University, and/or York University and/or through the World Wide Web.

In order to identify studies that might meet these criteria, four keyword searches were conducted using the following terms: "public goods" and "experiment*",[3] "voluntary contribution" and "experiment*", "variable contribution" and "experiment*", and "cooperation" and "experiment*". In addition, two subject heading searches were conducted using the Journal of Economic Literature classification system. The first used the subject area H410 (public goods) and the keyword "experiment*"; the second included subject areas C900, C910, C920, and C990 (design of experiments) and the keyword "public goods".

4.3. Validity assessment and data abstraction

The author abstracted bibliographic details on the primary source, contextual information about each experiment, and data on each of the sessions in the experiments. Data were entered into a custom-designed Microsoft Access database. Its data dictionary included standardized coding instructions designed to improve data reliability and to facilitate potential replication of data extraction and coding. A pilot test of this database and the extraction methodology was conducted using 7 experimental reports. Two subject experts also reviewed the study selection criteria and abstraction protocols (A. Muller and S. Mestelman) prior to implementation.

In spite of the existence of widely available guidelines on reporting experimental results in economics (e.g. Palfrey and Porter, 1991), the type and extent of data reported in primary studies varied significantly. Some factors, including the marginal per capita return (or the information required to calculate it), group size, and whether or not the experiment was fully computerized, were almost universally reported. In contrast, many sources did not include key information regarding experimental design, such as the nature of the subject pool (e.g. whether or not subjects had training in economics), when and where the experiment was conducted, and average payments to subjects. In three cases (average payments to subjects as a proxy for salience of rewards, the year the experiment was conducted, and the method(s) used to randomize subjects to different treatment groups), variables were dropped from the quantitative analysis because of inconsistent reporting. For selected other variables, standardized imputations were conducted where required according to the study protocol. For example, subjects were assumed to be inexperienced unless otherwise specified and where session-by-session data were not reported at the group or individual level, aggregate data were used in the weighted least squares regression.

4.4. Quantitative data synthesis

Following Croson and Marks (2000), the quantitative data synthesis employed a meta-regression method based on weighted least squares of group-level results.[4] The dependent variable was the average efficiency of the group's contributions over the session, weighted by the number of groups represented in each observation (in some cases authors reported only aggregate results covering several groups). Results of planned analyses related to the decay in efficiency over a session and the proportion of complete free riders are not reported because fewer primary studies included these data.

Independent variables included characteristics of the public goods environment that have been hypothesized in the literature to affect cooperation levels, such as the marginal per capita return, group size, gender of subjects, extent of subject experience, and the extent of communication allowed between subjects (Ledyard, 1995). Variables describing the study design and experimental design were also included. These ranged from whether subjects were rewarded with cash or other benefits to whether the experiment was run in a fully computerized experimental environment. In addition, while an independent assessment of study quality was not performed, a dummy variable was used to track quality problems reported by the primary researchers. Potential publication bias effects were evaluated by the inclusion of a dummy variable indicating whether or not the primary source was a published journal or other article, versus a working paper.[5]

Dummy variables for each experiment were also included where possible. Following Croson and Marks (2000), parameter estimates and other information for these dummy variables are not reported to facilitate interpretation of results.

5. Results

5.1. Trial flow

The search strategy yielded 349 potential primary sources. Titles and abstracts for each item were screened using the study inclusion criteria. Where possible, potentially relevant studies were then retrieved for a more detailed evaluation. The results of the search and review process are shown in figure 1. Appendix A lists the 27 studies included in the meta-analysis; Table 1 provides a summary of their characteristics. Due to space constraints, a complete list of studies reviewed and a full description of the characteristics of included studies are not presented here but are available from the author on request.

5.2. Quantitative data synthesis

The meta-analysis focused on the effect of a variety of factors on the average percentage of their endowment that subjects' contributed to the public good. The analysis covered 711 distinct groups (a set of subjects participating in an experimental session with the same conditions) who together took part in 7240 experimental periods. 13 other groups were excluded due to missing data for the dependent variable. Mean values for the dependent and independent variables are shown in Table 2.

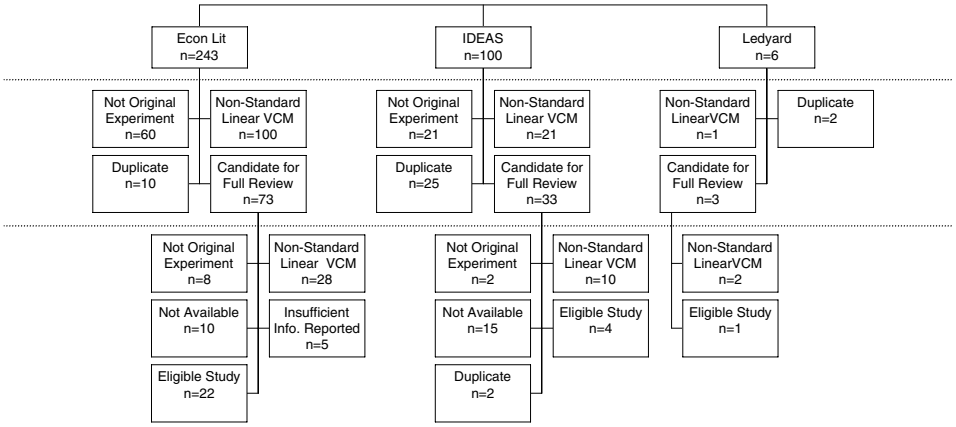

Figure 1. Status of potentially relevant primary sources.

Table 3 shows the weighted least squares regression results (adjusted $r^2 = 0.6115$). As expected, several factors significantly affected mean contributions to the public good. For example, as the marginal payoff to a subject from allocations to the public good relative to the private good increased—that is with higher marginal per capita returns–significantly larger contribution levels were observed. Likewise, communication among subjects improved cooperation (even though in game theoretic terms it was "cheap talk"). So did maintaining a constant group of subjects over the session (frequently referred to as a "partners" instead of a "strangers" design), explicitly framing the instructions in terms of altruism or fairness, and using children as subjects. In contrast, experienced subjects tended to make significantly lower contributions than those participating in an experiment for the first time. Two other factors were also identified as leading to lower contributions: providing subjects with heterogeneous endowments and asking them about their beliefs regarding other participants' behavior prior to the start of the session or period. A number of other factors were not identified as significant, perhaps in some cases (e.g. possibly gender and geography) because there was little variability among the studies.

Variables were also included in the regression in an effort to identify potential influences related to problems with study quality, publication bias, and heterogeneity in the primary literature. Neither of the first two factors proved to be statistically significant, and only one of the individual study dummies (Isaac and Walker, 1988) had $p < 0.05$. This suggests that these factors had relatively little overall influence on the meta-analysis results.

6. Discussion

In the relatively short period since Ledyard (1995) proposed a series of stylized facts based on six experiments available at the time, many more public goods experiments have been conducted. The results of this meta-analysis support his view that higher marginal per capita returns, allowing communication among subjects, and heterogeneous endowments

Table 1. Selected parameters for experiments included in the meta-analysis.

Author(s)	Year of publication	# Periods	Group size	MPCR
Andreoni	1988	3–10	5	0.5
Andreoni	1995a	10	5	0.5
Andreoni	1995b	10	5	0.5
Asch, Gigliotti, and Polito	1993	5	8–12	0.3
Cason and Khan	1999	6–24	4	0.3
Croson	1996	10	4	0.5
Croson	2000	10	4	0.125
Dorsey	1992	10	4	0.3
Falkinger, Fehr, Gächter, and Winter-Ebmer	1999/2000[6]	10	4–16	0.1–0.4
Fehr and Gächter	1999/2000[6]	6–10	4	0.4
Fisher, Isaac, Shatzberg, and Walker	1995	10	4	0.3–0.75
Gächter, Fehr, and Kment	1996	10	4	0.4
Goeree, Holt, and Laury	1999/2002[6]	1[7]	2–4	0.2–0.8
Harbaugh and Krause	2000	10	6	0.33–0.67
Isaac and Walker	1988a	10	4	0.003
Isaac and Walker	1988b	10	4–10	0.3–0.75
Isaac and Walker	1998	10	4	0.3
Isaac, Walker, and Thomas	1984	10	4–10	0.3–0.75
Isaac, Walker, and Williams	1994	10–60	4–100	0.03–0.75
Keser and van Winden	1996/2000[6]	25	4	0.5
Laury, Walker, and Williams	1995	15–30	4	0.55
McCorkle and Watts	1996	1	49	0.04
Nowell and Tinkler	1994	13	4	0.3
Ockenfels and Weimann	1999	10	5	0.33
Saijo and Nakamura	1995	10	7	0.7
Weimann	1994	10	5	0.5
Wilson and Sell	1997	18	6	0.003

increase average contributions; that the number of subjects in a group and their genders are not significant; and that experienced subjects contribute less on average. In some cases, however, findings diverge. For example, Ledyard suggested that repetition strongly decreases contributions, but the meta-analysis did not find that the number of periods in a session had a significant effect. However, a separate analysis showed that at least in those studies where data were reported, contributions declined sharply between the first and last periods. This suggests that there may be a non-linear relationship between repetition and contributions, probably at least partly because of end-game effects. Likewise, Ledyard felt that economics training strongly decreased contributions, but this factor was not significant in the meta-analysis. In part, this may reflect the relatively low levels of training among

Table 2. Weighted means of selected meta-analysis variables.[8]

Variable	Mean
Average contributions as % of total endowment	37.7
# Periods	10.4
Friendship among subjects	0.060
Group size	6.6
Cash rewards	0.879
Fully computerized environment	0.595
Marginal per capita return	0.404
Male subjects only	0.007
Female subjects only	0.008
Child subjects	0.048
Heterogeneous MPCR	0.028
Heterogeneous endowments	0.020
Experienced subjects	0.346
Communication without punishment	0.070
Punishment of subjects allowed	0.056
Economics training	0.599
Positive framing	0.020
Optimum announced	0.038
End of session announced	0.902
Quality problems identified	0.105
Imperfect monitoring of group contributions	0.142
Beliefs re: Others' behaviour solicited	0.017
Constant groups for session ("partners")	0.696
Published in journal	0.688

most subjects categorized as "economics-trained"—most were students in undergraduate economics courses. Furthermore, the meta-analysis suggests that the relationship between friendship/group identification may be complex. Specifically, previous friendship among subjects did not have a significant effect on contributions, but maintaining the same group throughout the experiment (the "partners" treatment) did have a positive and significant effect. Finally, there is now some evidence in an area that Ledyard indicated had not yet been measured at the time of his survey—positive framing, a type of moral suasion, appears to have a positive and significant effect on contributions.

In addition to these qualitative findings, the meta-analysis offers parameter estimates for each variable. These may be useful, for instance, in developing hypotheses regarding the combined effect of different factors on contributions. For researchers designing new experiments, the meta-analysis results may also be helpful in *a priori* power calculations (estimations of the likelihood of detecting a difference of a specified size if such a difference

Table 3. Weighted least squares results—Average contributions as a percent of the total endowment.

Variable	Estimate	Std error	*p*-value	sig
Intercept	−14.87	18.44	0.4207	
# Periods	−0.44	0.29	0.1376	
Friendship among subjects	1.50	7.05	0.8320	
Group size	0.15	0.09	0.0948	
Cash rewards	15.36	10.92	0.1605	
Fully computerized environment	1.10	5.72	0.8479	
Marginal per capita return	39.53	6.12	<.0001	**
Male subjects only	1.00	13.16	0.9395	
Female subjects only	8.00	12.60	0.5260	
Child subjects	44.85	22.49	0.0472	*
Heterogeneous MPCR	−0.54	12.65	0.9657	
Heterogeneous endowments	−14.51	7.10	0.0421	*
Experienced subjects	−6.15	2.55	0.0167	*
Communication allowed	40.46	4.16	<.0001	**
Punishment of subjects allowed	1.86	6.16	0.7637	
Economics training	6.05	5.87	0.3039	
Positive framing	19.30	7.90	0.0151	*
Optimum announced	−0.46	12.99	0.9716	
End of session announced	6.48	9.98	0.5168	
Quality problems identified	−5.55	6.95	0.4255	
Imperfect monitoring of group contributions	2.25	7.19	0.7550	
Beliefs re: others' behaviour solicited	−20.00	8.49	0.0193	*
Constant groups for session ("partners")	15.67	3.54	<.0001	**
Subjects from western europe	−0.55	10.14	0.9568	
Subjects from eastern europe	−10.78	11.20	0.3368	
Japanese subjects	−10.60	13.22	0.4232	
Published in journal	−6.28	15.24	0.6807	

truly exists) and in focusing future research on areas where existing experimental evidence is less strong.

As the body of experimental evidence grows, it is likely that meta-analysis will become more popular in economics. This type of analysis, however, depends on consistent and complete reporting of the methods and results of primary research. Many of the articles reviewed for this paper—even those published relatively recently—do not include key information about experimental design and results. Application of existing guidelines for reporting the results of economic experiments (e.g. Palfrey and Porter, 1991) has the potential to greatly facilitate both interpretation of primary research and secondary analysis, such as meta-analysis. Increased sharing of experimental data would also be helpful. Both approaches

are being strongly encouraged in other fields, such as medicine, where there is increasing interest in meta-analysis (Clarke and Oxman, 2002).

Nevertheless, even with the current state of reporting, there are many opportunities for further secondary research. One possibility would be to build on this meta-analysis by expanding the search strategy (e.g. to include hand searching of relevant journals) or by contacting the original authors to acquire data missing from the published experimental reports. Another would be to conduct additional meta-analyses on parallel experimental environments, such as common property resource and public "bads" experiments, non-linear public goods studies (building on the work by Croson and Marks), and/or environments where token allocations from one period can be carried forward and invested in subsequent periods.

Acknowledgments

Special thanks are due to Stuart Mestelman and Andy Muller (both with the Department of Economics, McMaster University) for their advice and encouragement throughout the development of this paper and to two anonymous referees for suggestions regarding its improvement.

Notes

1. This search was conducted on June 28, 2000 using the on-line access to EconLit available at the University of Toronto. No restrictions were placed on the publication type, language of publication, or date of publication.
2. This search was conducted on June 17, 2000. The top 100 items from this search were reviewed (based on a computer-based algorithm to identify the "similarity" of items to the search strategy). The "similarity" score of items retrieved ranged from 96% to 70%. No items with a score of 70–73% met the study inclusion criteria.
3. The asterisk (*) is a wildcard character. That is, this search returns abstracts with any of the following terms: experiment, experimental, experimentally, etc.
4. Recent meta-analyses in other fields have tended to compare effect sizes in different studies, rather than to use the meta-regression approach employed in this paper (Clarke and Oxman, 2002). Unfortunately, calculating effect sizes requires data not reported in most of the primary studies.
5. Guidelines for reporting the results of meta-analyses require that the potential impact of publication bias be assessed (Moher et al., 1999) and that unpublished studies be explicitly considered (Clarke and Oxman, 2002). In this paper, the dummy variable for publication status in the meta-regression model was not significant, suggesting little or no systematic difference between included published and unpublished experimental reports. The regression analysis was also repeated without the data from the unpublished studies. As expected, estimated coefficients changed somewhat, but there was little impact on the overall interpretation of the results, except that the effect of a "partners" treatment was no longer significant, perhaps due to a lack of power, and the effect of children as subjects could no longer be assessed. Note that by the time that the revised (post peer-review) version of this paper was prepared, versions of all included studies that were unpublished at the time of the literature scan had subsequently been published.
6. The first date reflects the publication of the working paper; the second is for the journal publication.
7. Although subjects in this study made 10 consecutive decisions, unlike a typical public goods game, experimental parameters changed after each decision, participants received no earnings feedback between decisions, and participants were paid based on the results of only one decision round. Accordingly, the authors argue that "the context is best viewed as a one-shot game."
8. For dummy variables, a value of zero indicates that the condition does not apply and a value of one indicates that it does. Means can therefore be interpreted as the weighted proportion of groups with the characteristic in question.

References

American Economics Association. (September 26, 1999). http://www.econlit.org/econlit/ellistjn.html.

Baaijens, S.R., Nijkamp, P., and van Montfort, K. (1998). "Explanatory Meta-Analysis for Comparison and Transfer of Regional Tourist Income Multipliers." *Regional Studies.* 32(9), 839–849.

Clarke, M. and Oxman, A.D. (eds.). (1999). *Cochrane Reviewers' Handbook 4.1.5* [Updated April 2002]. In The Cochrane Library, Issue 2, 2002. Oxford: Update Software.

Croson, R.T.A. and Marks, M.B. (2000). "Step Returns in Threshold Public Goods: A Meta- and Experimental Analysis." *Experimental Economics*. 2, 239–259.

De Solla Price, D. (1981). "The Development and Structure of the Biomedical Literature." In K. Warren (ed.), *Coping with the Biomedical Literature*. New York: Praeger Publishers. Cited in E.R. Siegel et. al. (1990). "Bibliographic-Retrieval Systems." In E.H. Shortliffe, et. al. (eds.), *Medical Informatics: Computer Applications in Health Care*. Reading, Massachusetts: Addison-Wesley.

Espey, M. (1998). "Gasoline Demand Revisited: An International Meta-Analysis of Elasticities." *Energy Economics*. 20(3), 273–295.

Glass, G.V., McGaw, B., and Smith, M.L. (1981). *Meta-Analysis in Social Research*. Beverly Hills: Sage Publications.

Hunter, J.E. et al. (1982). *Meta Analysis: Cumulating Research Findings Across Studies*. Studying Organizations: Innovations in Methodology Number 4. Beverly Hills: Sage Publications.

Ledyard, J.O. (1995). "Public Goods: A Survey of Experimental Research." In J. Kagel and A. Roth (eds.), *The Handbook of Experimental Economics*. Princeton: Princeton University Press.

Moher, D. et al. For the QUORUM Group. (1999). "Improving the Quality of Reports of Meta-Analyses of Randomised Controlled Trials: The QUORUM Statement." *The Lancet*. 354(9193), 1896–1900.

Palfrey, T. and Porter, R. (1991). "Guidelines for Submission of Manuscripts on Experimental Economics." *Econometrica*. 59(4), 1197–1198.

Pigou, A.C. (1932). *The Economics of Welfare*. 4th edn. London: Macmillan.

Plath, I. (1992). *Understanding Meta-Analysis: A Consumer's Guide to Aims, Problems, Evaluation, and Developments*. Baden-Baden: Nomos Verlagsgellschaft.

Rosenthal, R. (1991). "Meta-Analysis: A Review." *Psychosomatic Medicine*. 53(3), 247–271.

Stanley, T.D. (1998). "New Wine in Old Bottles: A Meta-Analysis of Ricardian Equivalence." *Southern Economic Journal*. 64(3), 713–727.

Van den Bergh, J.C.J.M., Button, K.J., Nijkamp, P., and Pepping, GC. (1997). *Meta-Analysis in Environmental Economics*. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Wolf, F.M. (1986). *Meta-Analysis: Quantitative Methods for Research Synthesis*. Beverly Hills: SAGE Publications.

Appendix A: References for studies included in the meta-analysis

Andreoni, J. (1988). "Why Free Ride? Strategies and Learning in Public Goods Experiments." *Journal of Public Economics*. 37(3), 291–304.

Andreoni, J. (1995a). "Cooperation in Public Goods Experiments: Kindness or Confusion?" *American Economic Review*. 85(4), 891–904.

Andreoni, J. (1995b). "Warm-Glow versus Cold-Pickle: The Effects of Positive and Negative Framing on Cooperation in Experiments." *Quarterly Journal of Economics*. 110(1), 1–21.

Asch, P., Gigliotti, G., and Polito, J.A. (1993). "Free Riding with Discrete and Continuous Public Goods: Some Experimental Evidence." *Public Choice*. 77(2), 293–305.

Cason, T.N. and Khan, F.I. (1999). "A Laboratory Study of Voluntary Public Goods Provision with Imperfect Monitoring and Communication." *Journal of Development Economics*. 58(2), 533–552.

Croson, R.T.A. (1996). "Partners and Strangers Revisited." *Economics Letters*. 53(1), 25–32.

Croson, R.T.A. (2000). "Thinking Like a Game Theorist: Factors Affecting the Frequency of Equilibrium Play." *Journal of Economic Behavior and Organization*. 41(3), 299–314.

Dorsey, R.E. (1992). "The Voluntary Contributions Mechanism with Real Time Revisions." *Public Choice*. 73(3), 261–282.

Falkinger, J., Fehr, E., Gächter, S., and Winter-Ebmer, R. (1999). "A Simple Mechanism for the Efficient Provision of Public Goods—Experimental Evidence." Working Paper No. 3. Zurich: Institute for Empirical Research in Economics, University of Zurich. Subsequently published as Falkinger, J., Fehr, E., Gächter, S., and Winter-Ebmer, R. (2000). "A Simple Mechanism for the Efficient Provision of Public Goods: Experimental Evidence." *American Economic Review.* 90(1), 247–264.

Fehr, E. and Gächter, S. (1999). *Cooperation and Punishment in Public Goods Experiments*. Paper available through Internet Documents in Economics Access Service. Subsequently published as Fehr, E. and Gächter, S. (2000). "Cooperation and Punishment in Public Goods Experiments." *American Economic Review*. 90(4), 980–994.

Fisher, J. et al. (1995). "Heterogeneous Demand for Public Goods: Behavior in the Voluntary Contributions Mechanism." *Public Choice*. 85(3/4), 249–266.

Gächter, S., Fehr, E., and Kment, C. (1996). "Does Social Exchange Increase Voluntary Cooperation?" *Kyklos*. 49(4), 541–554.

Goeree, H., Holt, C.A., and Laury, S.K. (1999). *Altruism and Noisy Behavior in One-Shot Public Goods Experiments*. Paper available through Internet Documents in Economics Access Service. Subsequently published as Goeree, H., Holt, C.A., and Laury, S.K. (2002). "Private Costs and Public Benefits: Unraveling the Effects of Altruism and Noisy Behavior." *Journal of Public Economics*. 83(2), 257–278.

Harbaugh, W.T. and Krause, K. (2000). "Children's Altruism in Public Good and Dictator Experiments." *Economic Inquiry*. 38(1), 95–109.

Isaac, R.M. and Walker, J.M. (1988a). "Communication and Free-Riding Behavior: The Voluntary Contribution Mechanism." *Economic Inquiry*. 26(4), 585–608.

Isaac, R.M. and Walker, J.M. (1988b). "Group Size Effects in Public Goods Provision: The Voluntary Contribution Mechanism." *Quarterly Journal of Economics*. 103(1), 179–199.

Isaac, R.M. and Walker, J.M. (1998). "Nash as an Organizing Principle in the Voluntary Provision of Public Goods: Experimental Evidence." *Experimental Economics*. 87(5), 829–846.

Isaac, R.M., Walker, J.M., and Thomas, S.H. (1984). "Divergent Evidence on Free Riding: An Experimental Examination of Possible Explanations." *Public Choice*. 43, 113–149.

Isaac, R.M., Walker, J.M., and Williams, A.W. (1994). "Group Size and the Voluntary Provision of Public Goods: Experimental Evidence Utilizing Large Groups." *Journal of Public Economics*. 54(1), 1–36.

Keser, C. and van Winden, F. (1996). *Partners Contribute More to Public Goods than Strangers: Conditional Cooperation*. Paper available through Internet Documents in Economics Access Service. Subsequently published as Keser, C. and van Winden, F. (2000). "Conditional Cooperation and Voluntary Contributions to Public Goods." *Scandinavian Journal of Economics*. 102(1), 23–39.

Laury, S.K., Walker, J.M., and Williams, A.W. (1995). "Anonymity and the Voluntary Provision of Public Goods." *Journal of Economic Behavior and Organization*. 27(3), 365–380.

McCorkle, S. and Watts, M. (1996). "Free Riding Indexes for Ukrainian Economics Teachers." *Journal of Economic Education*. 27(3), 233–237.

Nowell, C. and Tinkler, S. (1994). "The Influence of Gender on the Provision of a Public Good." *Journal of Economic Behavior and Organization*. 25(1), 25–36.

Ockenfels, A. and Weimann, J. (1999). "Types and Patterns: An Experimental East-West German Comparison of Cooperation and Solidarity." *Journal of Public Economics*. 71(2), 275–287.

Saijo, T. and Nakamura, H. (1995). "The 'Spite' Dilemma in Voluntary Contribution Mechanism Experiments." *Journal of Conflict Resolution*. 39(3), 535–560.

Weimann, J. (1994). "Individual Behavior in a Free-Riding Experiment." *Journal of Public Economics*. 54(1), 1–36.

Wilson, R.K. and Sell, J. (1997). "'Liar, Liar . . . ': Cheap Talk and Reputation in Related Public Goods Settings." *Journal of Conflict Resolution*. 41(5), 695–717.