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A Meta-Analysis of Tax Compliance Experiments

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A meta-analysis of tax compliance experiments

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A meta-analysis of tax compliance experiments

Calvin Blackwell

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Since 1978, economists, psychologists, sociologists and accountants have used experiments to investigate the determinants of tax compliance. In this paper the author attempts to synthesize this literature in a meta-analysis to draw conclusions regarding the determinants of tax compliance. Specifically, the author examines the impacts of traditional economic determinants of tax compliance: the tax rate, the penalty rate, and the probability of audit. In addition the author examines the effect of a public good "return" to taxes paid. The author finds strong evidence that increasing the penalty rate, the probability of audit and the marginal-per-capita return to the public good lead to higher compliance, but finds no statistically significant effect of the tax rate on compliance.

JEL categories: C9, H2

Keywords: tax compliance, tax evasion, meta-analysis, experiment

Since 1978, economists, psychologists, sociologists and accountants have used experiments to investigate the determinants of tax compliance. Numerous experimental treatments have been tested, including economic incentive effects (such as changing the probability of audit, the severity of the fine for non-compliance, or the tax rate) and more psychological effects (for example the use of "neutral" terminology instead of tax terminology or appeals to morality). This paper adds to the existing survey literature on tax compliance (see Andreoni, Erard and Feinstein, 1998 and Slemrod, 2007) by using a meta-analysis to test some of the traditional incentive-effect hypotheses regarding tax compliance.

A compelling argument for a need to combine data from multiple studies is made by Goldfarb (1995). He argues that economists need a "methodology of Plausible Inference (MPI)" and makes some arguments to use meta-analysis as that MPI. Meta-analyses are appearing more and more often in the economics literature.[1] Stanley and Jarrell (1998), Stanley (2000) and Croson and Marks (2000) are three recent examples. Stanley and Jarrell (1998) examine the gender wage gap, while Stanley (2001) uses meta-analysis to draw conclusions from the literature examining Ricardian equivalence. Croson and Marks (2000) use a meta-analysis to examine the impact of step-return on contributions in a threshold public goods game.

Meta-analysis allows for a large increase in power, an important consideration in experimental research. Because data is relatively expensive to collect, experimentalists collect as little as possible, which means the power of any particular study will be small. By combining studies, meta-analysis increases the power of statistical tests to detect significant results. If reviewers use significance as a criterion, then lots of low power studies showing little or no significance will cause the reviewer to conclude no effect of the particular treatment. However,

[1] An ECONLit search in March 2002 on meta-analysis yields 97 papers.

a properly done meta-analysis will be able to combine the results of these small samples into one large sample, and take advantage of the increase in power to test for the hypothesized effect.

In this paper I will examine the impacts of the tax rate, the fine rate, the probability of audit and the marginal-per-capita return to the public good upon tax compliance. The data set used for this analysis consists of all the research papers written that address this issue with an experiment. I show that the theoretical predictions made regarding the impact of the fine rate, the probability of audit and the marginal-per-capita return to the public good are confirmed. I also show that although most experimental papers examining the effect of the tax rate upon compliance find a negative relationship, this relationship is not statistically significant. This indeterminate relationship is consistent with the theoretical prediction.

1. Data

The two primary criteria for inclusion in this meta-analysis were as follows:

- Study must have used an experimental design, i.e. a controlled environment with multiple treatments.
- Dependent variable must be observable directly, i.e. no reports of compliance behavior, but measurable compliance behavior.

The data for this study consist of 20 experimental studies. The papers used are listed in table 1. The search process for these studies was as follows. I first performed a keyword search of ECONLit on the terms “tax compliance” and “tax evasion” and found abstracts that seemed to describe experimental papers. I procured all these papers and kept the ones that fit my criteria. I also searched the 5 most recent issues of the Journal of Economic Literature for recent papers on these topics, and kept those that fit my criteria. I also searched PsycINFO and among the psychology literature database for my two keywords. I then searched the reference

sections/bibliographies of all the papers deemed acceptable for inclusion in the meta-analysis for other experimental papers, and procured those papers. This searching of bibliographies was recursive – all bibliographies were searched until all possible papers had been discovered.[2]

2. A typical tax compliance experiment

Subjects: Generally students, although occasionally tax professionals or adults. Subjects come from the United States, Central America, Europe and Israel.

Incentives: Money for showing up, money based upon performance, none.

Setting: Pencil and paper, computer environment. Neutral or tax framing. Sometimes tax compliance is mis-directed, so as not to be focus of experiment.

Dependent variables: amount/percentage of income reported, dichotomous variable – evaded or not, amount/percentage of income evaded.

Independent variables: tax rate; penalty rate; audit probability; the existence and return to a public good; neutral or contextual instructions; audit "scheme" (exogenous or endogenous, back audits or not, etc.); income, amnesty; decision framed as loss or gain and/or withholding status; uncertainty regarding true income, tax rate, penalty rate and audit probability; collective decision making about any of the above; equity.

Co-variates: Age, Income, Sex, risk-preference

Researchers: Economists, psychologists, accountants, lawyers

The basic framework of the type of experiment considered is as follows. Subjects are asked to make a decision regarding their own tax compliance given a set of circumstances. Only experiments in which subjects decide their own level of compliance are considered – many experiments ask for other types of choices to be made, and those experiments are not part of this

[2] Caveat: As of this writing, this search continues.

analysis.[3] In a typical experiment subjects are presented with a set of circumstances and asked to make a decision. This decision is typically to report some amount of income to the tax agency, or to fully comply or evade in a particular scenario. Most experiments use the model presented in Allingham and Sandmo (1972) model as the basis for the experimental setting.

2.1. Allingham and Sandmo Tax Compliance model

In the Allingham and Sandmo (1972) model (hereafter abbreviated A&S), the taxpayer's choice variable is declared income. Taxpayers are assumed to maximize expected utility.[4] There are two possible states of the world – taxpayer is audited, taxpayer is not audited. Define the following variables:

x = Declared income

y = True income

t = Tax rate owed on declared income, $0 \le t \le 1$

p = Probability of audit, $0 \le p \le 1$

θ = Fine for being caught with undeclared income, $\theta \ge 0$

U = Utility function over wealth position[5]

If the taxpayer is not audited, his/her wealth is:

W_{NA} = Wealth if not audited

$W_{NA} = y - tx$

If the taxpayer is audited, his/her wealth is:

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[3] For example, Pei, Reckers and Wyndelts (1992) examine experimentally the impact of client's preferences upon tax professionals advice to that client. Although this paper describes an experiment, the experimental subjects were not asked about their own compliance behavior, and so this paper is not included in my analysis.

[4] Although in the model taxpayers are assumed to maximize utility, given the small stakes gambles involved in the experiments, a useful simplification is to assume subjects maximize earnings. See Starmer (2000) for a good review of issues involving expected utility.

[5] Assume the individual is risk averse, or $U' > 0$, $U'' < 0$

W_A = Wealth if audited

$W_A = y - tx - \theta(y - x)$

The taxpayer's decision then is to maximize expected utility:

$$\max_x EU = (1-p)U(W_{NA}) + pU(W_A)$$

This maximization yields the following first order condition:

$$U'(W_A)/U'(W_{NA}) = (1-p)t/p(\theta - t)$$

The A&S model indicates that any risk averse taxpayer should evade some amount given some basic conditions on the audit probability and tax and penalty rates are satisfied. This model predicts a risk averse individual will evade some taxes if:

$$p\theta > t \qquad (1)$$

In most of the papers included this condition does hold. Given equation 1 is true, A&S show that an increase in p will cause compliance to rise, as will an increase in θ. In this particular formulation, an increase in t or y has an ambiguous effect upon compliance.

A slight modification to the A&S model by Yitzhaki (1974) (hereafter denoted A&S/Y) changes one assumption about the fine rate, making it a function of unpaid taxes instead of unpaid income. The fine rate (f) is assumed to be some ratio of unpaid taxes that is greater than 1. Therefore:

f = The fine rate applied to unpaid taxes, $f \geq 1$

$\theta = ft$

For the A&S/Y model,

$W_A = y - tx - ft(y - x)$

Which yields the following first order condition:

$$U'(W_A)/U'(W_{NA}) = (1-p)/p(f-1)$$

The A&S/Y model predicts a risk averse individual will evade some taxes if:

$$pf > 1 \qquad (2)$$

Yitzhaki shows that an increase in the tax rate will cause a decrease in tax evasion.

This basic model can be (and has been) altered. In particular, A&S examined the impact of allowing the probability of detection to be a function of declared income. A more general model might allow for some (or all) of the following possibilities:

$$p = p(y, x) \qquad (3)$$

$$t = t(x) \qquad (4)$$

$$f = f(y, x) \qquad (5)$$

These possibilities make the probability of audit a function of "true" income and declared income, make the taxes owed a more complex function of declared income (e.g. a progressive income tax), and make the penalty rate a more complex function of undeclared income.

Later work has further added to the model's complexity. Some, like Cowell (1981) have included labor supply into the tax compliance decision, or added public goods to the model. Generally, as the models become more complex, it becomes more difficult to make predictions about the effects of the tax rate, the probability of audit or the fine rate upon compliance.

2.2. Hypotheses

The experiments analyzed in this paper all create an environment broadly consistent with the basic A&S model. When models incorporating equations 3, 4 and 5 are used, some of the comparative statics change. This change is most evident with regards to the effect of increasing the tax rate on compliance. The basic A&S model makes an ambiguous prediction, while the A&S/Y model makes the counter-intuitive prediction that higher taxes lead to higher compliance. Other versions of the model also make ambiguous predictions (e.g. Cowell, 1981).

Given that most of the experiments here follow the Yitzhaki penalty structure, this suggests the following hypothesis (H1):

$H1_0$: Increasing the tax rate has no effect upon compliance.

$H1_A$: Increasing the tax rate has a positive effect upon compliance.

No matter what modifications are made to the A&S model, the probability of audit is always predicted to have a positive relationship with compliance. The A&S model makes the following hypothesis (H2):

$H2_0$: Increasing the probability of audit has no effect upon compliance.

$H2_A$: Increasing the probability of audit has a positive effect upon compliance.

The A&S model makes a clear prediction regarding fine rate. As the fine rate rises, compliance should rise. The A&S model suggests a test of the following hypothesis (H3):

$H3_0$: Increasing the fine rate has no effect upon compliance.

$H3_A$: Increasing the fine rate has a positive effect upon compliance.

Some papers incorporate fiscal exchange into the model via the introduction of a public good. In these experiments tax revenues are used to fund a public good, and the benefits of the public good are returned to the participants. The marginal-per-capita return is typically between 0 and 1, so that a dollar put into the public good returns less than a dollar to the participant, while the social return is typically greater than 1, reflecting the fact that contributing to the public good is Pareto superior to not contributing. Although the Nash equilibrium is typically not to contribute (pay taxes), research on public goods (see Ledyard, 1995 for a survey) suggests a significant portion of subjects will contribute and that their contributions will vary positively with the marginal-per-capita return. This analysis leads to the following hypothesis (H4):

$H4_0$: Increasing the marginal-per-capita return on the public good has no effect upon compliance.

$H4_A$: Increasing the marginal-per-capita return on the public good has a positive effect upon compliance.

3. Results

Twenty papers contain useable data for regression analysis; these papers are shown in tables 1 and 2. These papers contain information on the following parameters: the percentage of income declared, the tax rate, the probability of audit, the penalty rate, and the marginal per capita return on the public good. The regression model (fixed effects) to be estimated is given by equation 5:

$$x\%_{i\tau} = \delta_i + \beta_1 t_{i\tau} + \beta_2 p_{i\tau} + \beta_3 f_{i\tau} + \beta_4 p_{i\tau} f_{i\tau} + \beta_5 \alpha_{i\tau} + \beta_6 pos_{i\tau} + \beta_7 neg_{i\tau} + \varepsilon_{i\tau} \quad (6)$$

where

$x\%_{i\tau}$ = Mean level of declared income for treatment τ in paper i

δ_i = The intercept term for each paper i

$t_{i\tau}$ = Tax rate on declared income for treatment τ in paper i

$p_{i\tau}$ = Probability of audit for treatment τ in paper i

$f_{i\tau}$ = Penalty rate on undeclared income for treatment τ in paper i

$p_{i\tau} f_{i\tau}$ = Interaction term between the probability of audit and the penalty rate

$\alpha_{i\tau}$ = Marginal-per-capita return to the public good for treatment τ in paper i

$pos_{i\tau}$ = A dummy variable taking the value of 1 if there is a factor that should increase compliance relative to the standard A&S model and 0 otherwise for treatment τ in paper i

$neg_{i\tau}$ = A dummy variable taking the value of 1 if there is a factor that should decrease compliance relative to the standard A&S model and 0 otherwise for treatment τ in paper i

$\varepsilon_{i\tau}$ = A normally distributed error term with mean zero and standard deviation σ associated with each treatment τ in paper i

Note that I include the interaction term *pf* because the A&S/Y model indicates that for risk averse taxpayers, this interaction term creates a threshold effect. Equation 2 illustrates this relationship.

The variables *pos* and *neg* are used in an attempt to capture additional treatment effects in a parsimonious way. Instead of creating a dummy variable for each possible treatment used in these experiments, I made the decision to "fold" the less frequent treatment effects into these two variables. For example, the existence of an endogenous audits scheme is used as a treatment in several papers. Rather than creating a dummy variable for this treatment effect, I instead chose to note that, compared to the A&S/Y model, a model with endogenous audits should increase compliance, and used the *pos* variable to capture this effect. The *neg* variable was used in a similar way for treatment effects that should reduce compliance relative to the standard A&S/Y model.

Equation 5 is estimated using weighted least squares with the inverse of the number of observations in each treatment as the weight. The results of this regression are shown in Table 3. Note that individual intercept terms (δ_i) are suppressed.

From these results hypotheses one, two, three and four can be tested. It does not appear that raising the tax rate consistently increases or decreases compliance. Although the coefficient on the tax rate is positive, it is not statistically significant. I find little support for hypothesis one. Hypotheses two and three receive support; the coefficient on the interaction term *pf* is positive

and statistically significant. Although the coefficient on the fine rate is not statistically significant, the findings on the interaction term show that an increase in the fine rate or the probability of audit will increase compliance, supporting hypotheses two and three. Hypothesis four receives support; the coefficient on α is positive and statistically significant. The results regarding these four hypotheses hold whether I include the *pos* and *neg* variables or not. These variables were included to capture other aspects of the experiments that have an impact on compliance but do not directly change t, p, f, or α. Goodness of fit improves with the addition of these variables, indicating they ought to be included in the statistical model.

4. Conclusion

The experimental tax compliance literature unambiguously shows that raising either the fine rate or the probability of audit will increase tax compliance. The theory of fiscal exchange receives support; increasing the return received upon a public good increases tax compliance. This data set does not return clear results as to the impact of raising the tax rate on tax compliance.

4.1. Future Research

Clearly, more research is needed on the effect of tax rates upon compliance. This issue has important implications for tax policy, and as the state of the literature is confused (results conflict in both experiments and from field data), more research must be done. Raising the stakes in an experiment (so that monetary incentives more closely approximate those found in the real world) would seem to be a next step, so as to more accurately measure the tax rate elasticity of compliance.

Other variables play a role in tax compliance, and these variables have been examined in multiple papers, making them excellent candidates for meta-analysis. Some of these variables include: the audit scheme (endogenous or exogenous audit selection, uncertainty regarding some or all of the parameters, equity, sex and income. As the experimental literature on tax compliance grows, future meta-analyses should be able to capture the effects of these variables.

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Yitzhaki, S., (1974), "A Note on Income Tax Evasion: A Theoretical Analysis," *Journal of Public Economics*, vol 3, pp 201-202.

Table 1. Data Set.

Authors	Date	Title	Journal	Vol.	Pages
Friedland, N.,Shlomo, M., Rutenberg, A.	1978	A Simulation Study of Income Tax Evasion	Journal of Public Economics	10	107-116
Spicer, M.W., Becker, L.A.	1980	Fiscal Inequity and Tax Evasion: An Experimental Approach	National Tax Journal	33	171-175
Friedland, N.	1982	A Note on Tax Evasion as a Function of the Quality of Information about the Magnitude and Credibility of Threatened Fines: Some Preliminary Research	Journal of Applied Social Psychology	12	54-59
Webley, P., Halstead, S.	1986	Tax Evasion on the Micro: Significant Simulations of Expedient Experiments?	Journal of Interdisciplinary Economics	1	87-100
Webley, P.	1987	Audit Probabilities and Tax Evasion in a Business Simulation	Economics Letters	25	267-270
Beck, P.J.,Davis,J.S., Jung, W.	1991	Experimental Evidence on Taxpayer Reporting under Uncertainty	Accounting Review	66	535-558
Alm, J., Jackson, B., McKee, M.	1992	Institutional Uncertainty and Taxpayer Compliance	American Economic Review	82	1018-1026
Alm, J., Jackson, B., McKee, M.	1992	Estimating the Determinants of Taxpayer Compliance with Experimental Data	National Tax Journal	45	107-114
Alm, J., Jackson, B., McKee, M.	1992	Deterrence and Beyond: Toward a Kinder, Gentler IRS	Why people pay taxes: Tax compliance and enforcement		311-332
Alm, J., McClelland, G. H., Schulze, W. D.	1992	Why do people pay taxes?	Journal of Public Economics	48	21-38
Alm, J,, Cronshaw, M. B., McKee, M.	1993	Tax Compliance with Endogenous Audit Selection Rules	Kyklos	46	27-45
Alm, J., Jackson, B., McKee, M.	1993	Fiscal Exchange, Collective Decision Institutions and Tax Compliance	Journal of Economic Behavior and Organization	22	285-303
Alm, J., Sanchez, I., deJuan, A.	1995	Economic and Noneconomic factors in Tax Compliance	Kyklos	48	3-18
Callihan, D.S., Spindle, R.M.	1997	An Examination of Contingent and Noncontingent Rewards in a Tax Compliance Experiment	Advances in Taxation	9	1-23
Alm, J., McClelland, G. H., Schulze, W. D.	1999	Changing the Social Norm of Tax Compliance by Voting	Kyklos	52	141-171
Wartick, M.L., Madeo, S.A., Vines, C.V.	1999	Reward Dominance in Tax Reporting Experiments: The Role of Context	Journal of the American Taxation Association	21	20-31
Feld, L.P., Tyran, R.	2002	Tax Evasion and Voting: An Experimental Analysis	Kyklos	55	197-222
Torgler, B.	2003	Beyond Punishment: A Tax Compliance Experiment with Taxpayers in Costa Rica	Revista de Analisis Economico	18	27-56
Clark, J., Friesen, L., Muller, A.	2004	The Good, the Bad, and the Regulator: An Experimental Test of Two Conditional Audit Schemes	Economic Inquiry	42	69-87
Cadbsy, C.B., Maynes, E., Trivedi, V.U.	2006	Tax compliance and obedience to authority at home and in the lab: A new experimental approach	Experimental Economics	9	343-359

Table 2. Number of Observations in each Paper.

Authors	**Date**	**# Treatments**	**# Rounds**	**# Subject-Rounds**
Friedland, Shlomo, Rutenberg	1978	4	4	240
Spicer, Becker	1980	3	10	570
Friedland	1982	16	1	240
Webley, Halstead	1986	15	8	256
Webley	1987	4	2	184
Beck, Davis, Jung	1991	16	30	13440
Alm, Jackson, McKee	1992	8	25	9000
Alm, Jackson, McKee	1992	8	15	3000
Alm, Jackson, McKee	1992	9	20	3375
Alm, McClelland, Schulze	1992	9	25	3240
Alm, Cronshaw, McKee	1993	8	6	1600
Alm, Jackson, McKee	1993	5	18	1875
Alm, Sanchez, deJuan	1995	14	18*	4446
Callihan, Spindle	1997	1	1	39
Alm, McClelland, Schulze	1999	42	10	4260
Wartick, Madeo, Vines	1999	4	14	1260
Feld, Tyran	2002	6	1	264
Torgler	2003	4	2	74
Clark, Friesen, Muller	2004	18	10	6920
Cadsby, Maynes, Trivedi	2006	10	1	305
	Sum	204		54588

* 18 is the average number of rounds for this paper. Some subjects participated in 6 rounds, some in 18 rounds and some in 36 rounds.

Table 3. Regression Estimates.

Variable	Model 1 Estimate	Model 2 Estimate
t	10.27 (13.06)	3.52 (12.84)
p	61.45*** (12.00)	63.97*** (11.71)
f	0.41 (0.52)	0.31 (0.51)
pf	11.62*** (3.16)	11.03*** (3.08)
α	23.17** (7.55)	26.86*** (7.49)
pos		5.29* (2.07)
neg		-11.65* (5.07)
R^2	0.9674	0.9696
Adj. R^2	0.9629	0.9649
F	212.71***	208.92***

Standard Errors are in parentheses.

* indicates significance at the 5% level.

** indicates significance at the 1% level.

*** indicates significance at the 0.1% level.