Does Tax Administration Matter?

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Introduction

- Tax administration refers to the implementation of tax policy
- In many countries there is a division of responsibilities between choice of tax policy and implementation of policy
    - US: Treasury and IRS
    - UK: Treasury and HMRC
- The welfare consequences of tax policy and the analytical questions it raises are clear
- Is the same true of tax administration?

Example: Differentiation of VAT Rates

- A first question is the relationship between tax structure and administrative costs
- The nature of the relationship is far from obvious
- In the UK biscuits are standard-rated for VAT but cakes are zero-rated
- UK HMRC argued that Jaffa Cakes were chocolate-covered biscuits not cakes:
  - Because of size and shape
  - Often eaten in place of biscuits
- The classification was used to justify the imposition of VAT on the product
- The ensuing litigation lasted for 7 years until a VAT tribunal ruled Jaffa Cakes were cakes

Tax Theory

- Research in tax theory has focussed on policy rather than administration
- There are some exceptions:
  - Slemrod (1990, 2002) has extended the Marginal Efficiency Cost of Funds to accommodate avoidance and evasion
  - A literature has developed since Kolm (1973) on enforcement policy
- But the link between tax administration and tax policy has received less attention
- And there remain many fundamentals on which we have little knowledge

Tax Theory

- The standard analysis of optimal taxation can be formulated as

$$\max_{\{\tau\}} W(\tau)$$

subject to

$$\begin{aligned} (i)\ Z(\tau) &\leq 0 \\ (ii)\ G(\tau) &\leq 0 \\ (iii)\ I(\tau) &\leq 0 \\ \tau &\in \mathcal{T} \end{aligned}$$

- $Z(\tau)$ are the equilibrium conditions, $G(\tau)$ revenue requirements, $I(\tau)$ incentive compatibility conditions, and $\mathcal{T}$ the set of feasible tax instruments
- The selection of the $\mathcal{T}$ determines the range of potential policy instruments

Information

- How can we conceptualize tax administration within this framework?
- Access to *information* is central to both tax policy and tax administration
- From an administrative perspective:
  - The cost of information collection makes evasion possible
  - Information also determine the costs of collecting taxes
- Most models assume information costs are either *zero* or *prohibitive*:
  - Zero: permitting differentiation of commodity taxes (Diamond and Mirrlees, 1971)
  - Prohibitive: Incentive-incompatibility of optimal lump-sum taxes (Mirrlees, 1985)

Costs

- The *operating costs* of a tax system are the sum of *administrative costs* and *compliance costs*
- Administrative costs are the direct cost of running the tax administration and compliance programme
- These are directly observable and relatively small:
  - UK HMRC revenue of £474 bn. in 2011-12 and administrative costs of approx. £4bn.
  - US IRS revenue of $2,345,337,177,000 in 2009 and collection costs of $11,708,604,000
  - Generally less than 1% of revenue (Evans, 2003)
- Compliance costs are borne by individuals and firms in conforming to the requirements of the system
- These costs are not directly observable but estimates are substantial:
  - Between 2% and 10% of revenue raised (Evans, 2003)

Incorporating Costs

- How can we incorporate costs within the optimization framework?
- Consider the costs of operating a *given* tax system
- Administrative costs can enter the revenue constraints, $G(\tau)$
- Individual compliance costs can enter $Z(\tau)$ through the budget constraints
- Corporate compliance costs can enter $Z(\tau)$ through production costs
- For example, Keen and Mintz (2004) model the cost of VAT compliance by

$$c(y) = c_0 + c_1 y$$

Complexity Costs

- It seems obvious that some tax systems should be more costly to operate than others:
  - A flat tax system compared to a progressive tax system
- But it is here that the literature is weakest with little evidence base for modelling
- Heller and Shell (1974) added an administrative feasibility set to the optimization that included the resource cost, c, of the system

$$A(\tau, c) \leq 0$$

- The Jaffa Cake example shows that the resource costs may not be simple to model
- These difficulties are compounded by *effectiveness* of administration also being a variable

Effectiveness

- There are two dimensions to effectiveness:
  - Ensuring that the system is implemented correctly (*mistakes*)
  - Guaranteeing that taxes due are paid (*avoidance* and *evasion*)
- There has been some work:
  - Stern (1982) analyzed the consequences of errors in the administration of lump-sum taxes
  - Lee (2001) represented avoidance by introducing a cost of reducing tax liability
- But the focus of research attention has been evasion

Incorporating Evasion

- The location of evasion within the optimization programme is complex
- It affects the welfare function (uncertainty in individual welfare levels) and raises the question of how to define welfare (should evaders be included?)
- Evasion also affects the revenue constraint, $G(\tau)$
- The incentive compatibility constraints, $I(\tau)$, could force no-evasion but this need not be an optimal policy
- Cremer and Gahvari (1993, 1994, 1995) have added evasion to models of optimal tax
    - But the model of the evasion decision has limitations

Individual Compliance Behaviour

- Research on compliance behaviour has developed out of the basic model of Allingham-Sandmo (1972)
- The evasion level is chosen to maximize expected utility

$$\mathcal{E}U = pU(Y[1-t] - tfE) + [1-p]U(Y[1-t] + tE)$$

- Where:
  - p is the probability of audit
  - Y is income
  - t is the tax rate
  - f is the fine levied on tax evaded
  - E is the amount of evasion

Limitations

- There are two basic problems with the predictions of this model
  - $E > 0$ if $p < \frac{1}{1+F}$ which is satisfied for practical values f is at most 2, so $E > 0$ if $p < 1/3$
  - Decreasing absolute risk aversion is sufficient for $\frac{dE}{dt} < 0$
- Solutions proposed to improve the predictions include appeal to *non-expected utility theory* and to *social customs*
- The source of income also determines the *opportunity* for evasion:
  - Third-party reporting
  - Withholding

Non-Expected Utility

- One alternative is to adopt a non-EU choice theory

$$V = w_1(p, 1-p)v(Y[1-t] - tfE) + w_2(p, 1-p)v(Y[1-t] + tE)$$

- Several alternatives have been proposed:
  - *Rank Dependent Expected Utility* imposes structure on the weighting functions
  - *Prospect Theory* uses weights, changes payoff functions, and comparison to a reference point
  - *Non-Additive Probabilities* do not require the normal consistency of aggregation for probabilities
  - *Ambiguity* permits uncertainty over the probability of outcomes
- The weighting functions (or *beliefs*) can improve predictions but still do not give $\frac{dE}{dt} > 0$
- And these alternatives have their own shortcomings

Prospect Theory

- Yaniv (1999), al Nowaihi and Dhami (2001), and Bernasconi and Zanardi (2004) use variants of prospect theory
- Consider the standard Kahneman-Tversky value function

$$v(z) = \begin{cases} z^{\beta}, & \text{if } z > 0 \\ -\gamma\left(-z^{\beta}\right), & \gamma > 1, \text{ if } z < 0 \end{cases}$$

- And choose reference point as correct tax payment, $Y[1-t]$
- The payoff function becomes

$$V = E^{\beta} t^{\beta} \left[w_2 - w_1 \gamma f^{\beta} \right]$$

- So evasion is all or nothing

Social Customs

- A social custom is an informal rule of behaviour
- We interpret the social custom as summarizing the *attitude* toward compliance
- A loss of utility is incurred if the custom is broken

$$V = \begin{cases} U(Y[1-t]) + \chi^i, & \text{if } E = 0 \\ \mathcal{E}U, & \text{if } E > 0 \end{cases}$$

- There will be a cutoff χ^* such that $\chi^i < \chi^* \Longrightarrow E > 0$ and $\chi^i > \chi^* \Longrightarrow E = 0$
- If $\chi^i = \chi^i(m, E)$, (m the proportion of population evading) evasion becomes a social decision
- Myles and Naylor (1996) show that $\chi^i_m(m, E) < 0$ opens the possibility of multiple equilibria
- It is also possible that $\frac{dE}{dt} > 0$

Attitudes, Beliefs, and Opportunities

- A model of the compliance decision needs to combine *attitudes*, *beliefs*, and *opportunities*
- It must also recognize the social setting for the decision
- What the components of the model should look like can be explored using:
  - *Data* - this is now becoming available
  - *Experiments* - permit testing of hypotheses
  - *Simulation* - can capture the effect of interaction
- Recent research on the latter two is now discussed further

Compliance Experiments

- There have been many experiments since the original work of Friedland, Maital, and Rutenberg (1978)
- The typical experiment takes a subject group of university students who must choose how much income to declare to the tax authority
- This choice problem is repeated over a number of rounds
- Many different treatments can be applied within this structure:
  - Changes in exogenous variables
  - Information public or unknown
  - Public goods to test reciprocity theories

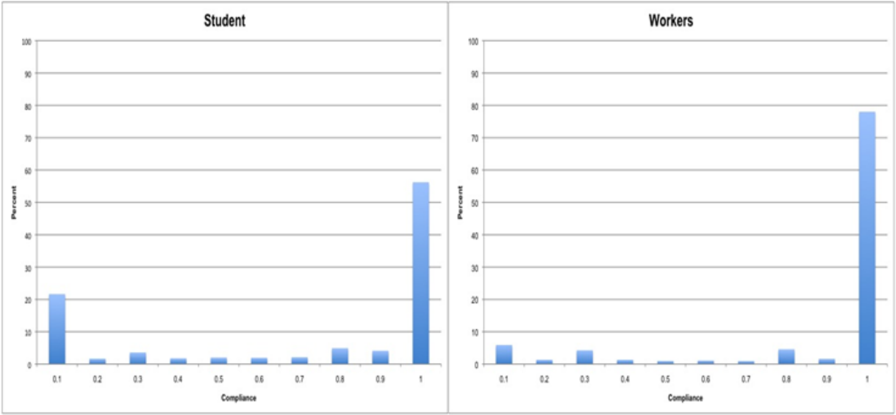
Previous Experiments

Experiment	Subjects	Sample size	Income	Treatments
Friedland et al (1978)	Students	15	Allocated	Fine rate, tax rate
Spicer and Becker (1980)	Students	57	Allocated	Information on average tax rate
Friedland (1982)	Students	13	Allocated	Vague or precise information
Spicer and Thomas (1982)	Students	54	Allocated	Information on audit probability
Spicer and Hero (1985)	Students	36	Allocated	Level of compliance in prior game
Baldry (1986)	Unreported	Unknown	Allocated	Evasion or gambling
Becker et al (1987)	Students	116	Earned	Transfer of tax revenue
Alm et al (1990)	Students	60	Allocated	Probability, fine, amnesty
Beck et al (1991)	Students	112	Allocated	Uncertainty about tax liability
Collins and Plumlee (1991)	Students	120	Earned	Information used in audit rule
Alm et al. (1992)	Students	72	Random	Probability, multiplier, terminology
Alm et al. (1993)	Students	80	Random	Rule for audit selection
Alm and McKee (2004)	Students	40	Random	Audit rule and chat
Alm et al. (2004)	Students	326	Earned	Percentage of matched income

Experimental Validity

- In an experiment conducted with Miguel Fonseca we have explored the validity of these results
- We used a large sample size (1000 subjects)
- And divided the sample between students (500 subjects) and workers (500 subjects)
- If tax compliance is a socialized activity then these subject pools will behave differently
  - Students who have not paid tax will not have internalized the social custom of compliance

Experimental Validity



Differences

- We found three significant differences between the two samples:
  - Workers have significantly higher compliance rates than students
  - Students are more responsive to incentives than worker
  - Workers respond to information about fines, while students respond to information about audit rates
- We conclude that compliance experiments should not rely on students as subjects

Agent-Based Modelling

- Work with Nigar Hashimzade, Frank Page, and Matt Rablen has applied agent-based modelling to explore the effects of evasion
- An agent-based model:
  - Creates a set of agents
  - Assigns abilities, objectives, and knowledge
  - Allows them to interact
  - Observes the outcome
- Three uses of agent-based models are now described
  - The effect of *opportunities* are considered within the Allingham-Sandmo framework
  - Next the endogenous development of *attitudes* and *beliefs* within a *social network* is added
  - The final step is to review the effect of *predictive analytics* on audit outcomes

Opportunities

- The model allows each individual to make a choice of occupation
- *Employment* is safe (wage is fixed) but tax cannot be evaded (withholding, third-party reporting)
- *Self-employment* is risky but provides an opportunity to evade
- An individual is described by $\{w, \rho, s_1, s_2\}$
  - $w =$ wage in employment
  - $\rho =$ (relative) risk aversion
  - $s_i =$ skill in self-employment occupation i

Occupational Choice

- The outcome of self-employment is $s_i y_i$ where y_i is drawn from a lognormal distribution
- It is assumed that $\mu(y_1) < \mu(y_2)$ and $\sigma^2(y_1) < \sigma^2(y_2)$
- The evasion level is chosen after income from self-employment is known
- With outcome y_i the amount evaded E_i is determed by

$$\max \mathcal{E} U_i = pU((1-t)s_i y_i - ftE_i) + (1-p)U((1-t)s_i y_i + tE_i)$$

- The occupation offering highest (expected) utility is chosen

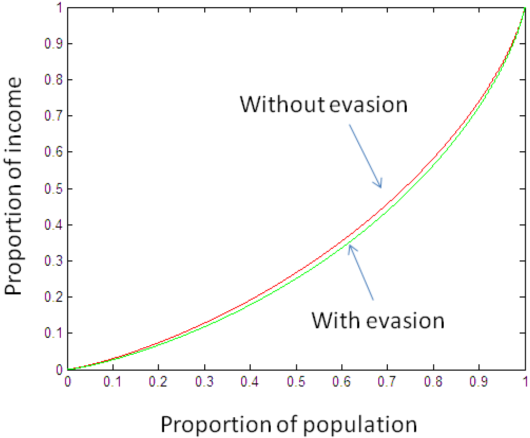
Simulation Process

- Individual characteristics $\{w, \rho, s_1, s_2\}$ are randomly drawn at the outset
- The simulation then iterates the following steps:
  - Occupation is chosen
  - Incomes are realized (as random draws in self-employment) and the evasion decision is made
  - The tax authority audits and punishes any evasion that is detected
- For each iteration the outcome with honesty and with evasion are calculated
- A generalization of Pestieau and Possen (1991)
- 1000 individuals in the simulation, 200 iterations and data averaged across iterations

Evasion and Income Distribution

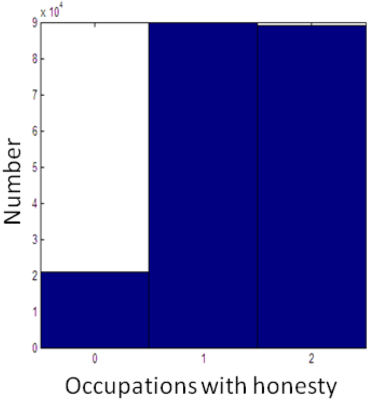
- Evasion increases mean income (after taxes and fines) and the inequality of income

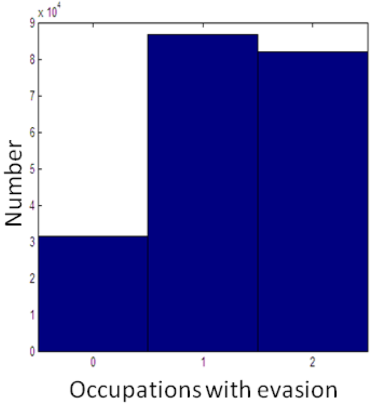
	Honesty	Evasion
Mean Income	13.63	14.82
Gini Coefficient	0.342	0.368



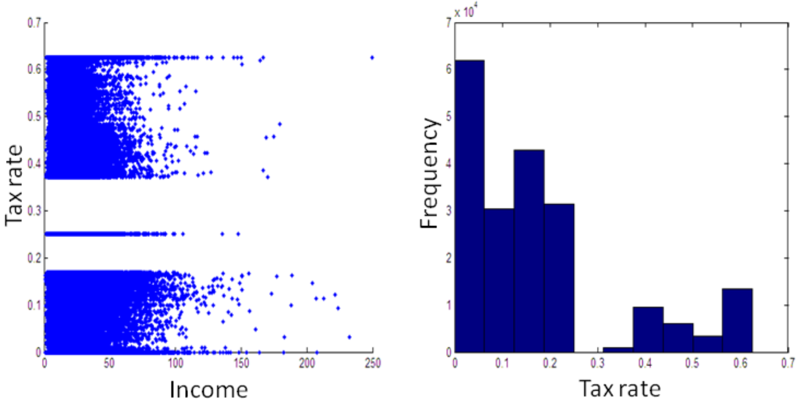
Evasion and Risk-Taking

- The distribution shifts towards the safer occupations
- There is less occupational risk-taking





- The flat tax of 0.25 is undermined by evasion and punishments
- The distribution of tax rates is unrelated to income



Effective tax rate

Attitudes and Beliefs

- The analysis of tax evasion has demonstrated two important features:
  - The social setting influences the evasion decision (*attitudes*)
  - The probability of audit is subjective not objective (*beliefs*)
- We have incorporated these into the simulation by adding learning within a *social network*
- Individuals meet with their contacts in the network and meetings allow exchange of information on beliefs
- This can explain why social groups have different behaviour with respect to tax evasion

Information Exchange

- The network is described by a symmetric matrix A of 0s and 1s (bi-directional links)
- In each period a random selection of meetings occur described by a matrix C of zeros and ones
- Individuals i and j meet during a period if $A_{ij}C_{ij} = 1$
- At a meeting of i and j there is a probability that information is exchanged
- The probability of information exchange depends on the occupational groups to which i and j belong
- The probabilities are given by p_{ij} where $i, j = e, 1, 2$, and $p_{ii} > p_{ij}$, all i, j, $i \neq j$

Attitudes

- The importance of the social custom is determined by interaction in the social network
- Each individual is randomly assigned a level of importance, χ_0^i, at time 0
- This value is then updated each period *if* there is an information exchange between two individuals
- The updating process is described by

$$\chi_{t+1}^i = \frac{1}{X(i)+1}\left[\chi_t^i X(i) + \mathbf{1}_{\left[E_t^j=0\right]}\right]$$

  where $X(i)$ is the number of previous meetings for i at which information was exchanged

- $\chi_{t+1}^i > \chi_t^i$ if information is exchanged with an honest taxpayer and $\chi_{t+1}^i < \chi_t^i$ if information is exchanged with an evader

Beliefs

- The belief about the probability of audit is determined by audits and interaction
- Occupational choice in period t is made on the basis of the belief p_t^i
- The updating effect of an audit is

$$\tilde{p}_t^i = X_t^i P + \left(1 - X_t^i\right) d\left(p_t^i\right), \ \ P \in [0,1]$$

  where $X_t^i = 1$ if i was audited in t and $X_t^i = 0$ otherwise
- Two different processes for the formation of subjective beliefs:
  - *Target effect*: $P = 1$ and $d\left(p_t^i\right) = \delta p_t^i$, $\delta \in [0,1]$ (rise, then decay)
  - *Bomb-crater effect* (Guala and Mittone, 2005): $P = 0$ and $d\left(p_t^i\right) = p_t^i + \delta\left(1 - p_t^i\right)$, $\delta \in [0,1]$ (fall, then rise)
- The evidence on which is correct is not compelling

Beliefs

- Individuals meet *after* audits take place
- *If an information exchange occurs* at a meeting the belief is updated according to the rule

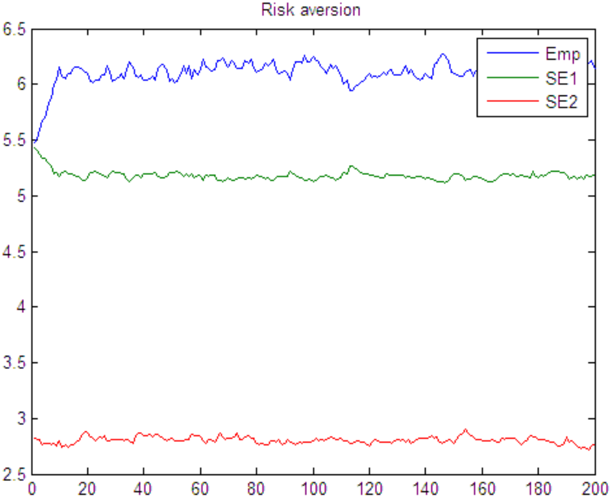
$$p^i_{t+1} = \mu \tilde{p}^i_t + (1-\mu)\left[X^j_t P + \left(1 - X^j_t\right)\tilde{p}^j_t\right]$$

- This can also be written

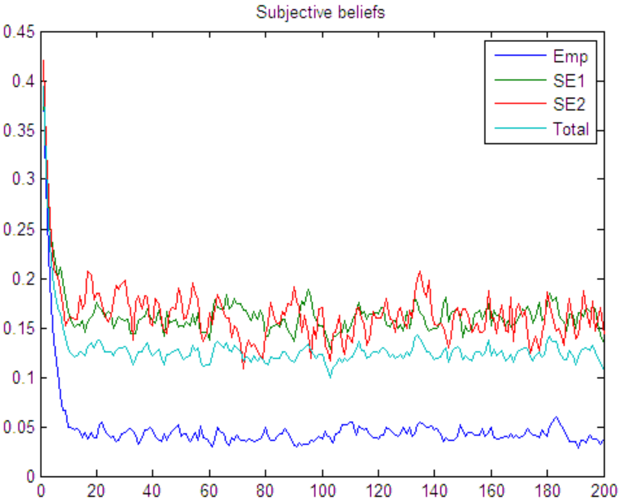
$$p^i_{t+1} = \begin{cases} \mu \tilde{p}^i_t + (1-\mu) P, & \text{if } j \text{ audited at } t \\ \mu \tilde{p}^i_t + (1-\mu) \tilde{p}^j_t, & \text{otherwise} \end{cases}$$

- The belief p^i_{t+1} is carried into the next period

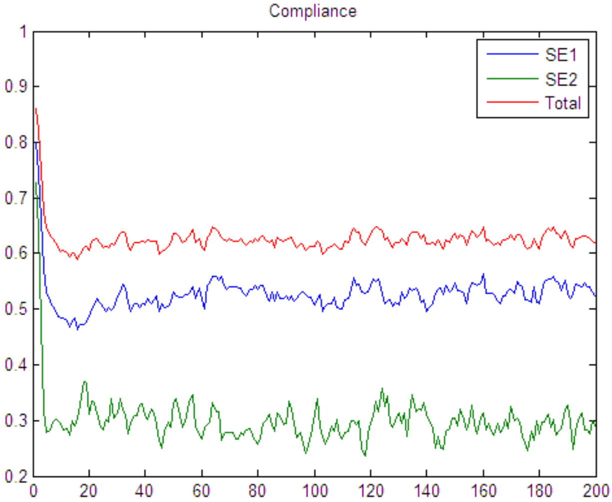
Risk Aversion



Subjective Beliefs



Compliance


Compliance
SE1
SE2
Total
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
20
40
60
80
100
120
140
160
180
200

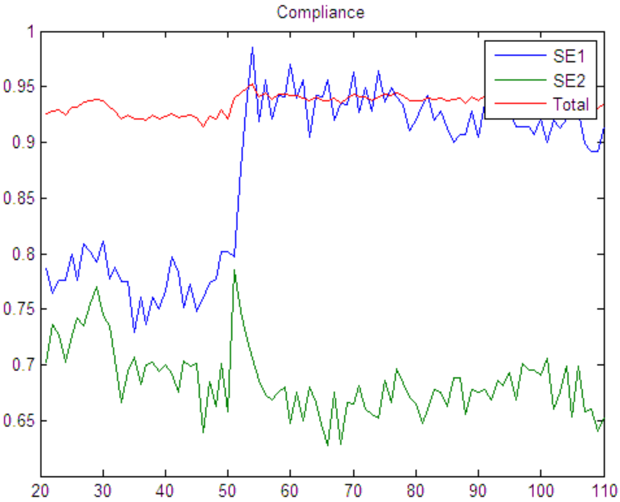
Predictive Analytics

- The role of *predictive analytics* is to identify the best audit targets
- Predictive analytics are used by the IRS, HMRC etc.
- Various methods are used including credit scoring and econometric analysis
- We want to explore the effects of predictive analytics and the extent to which they improve on random audits

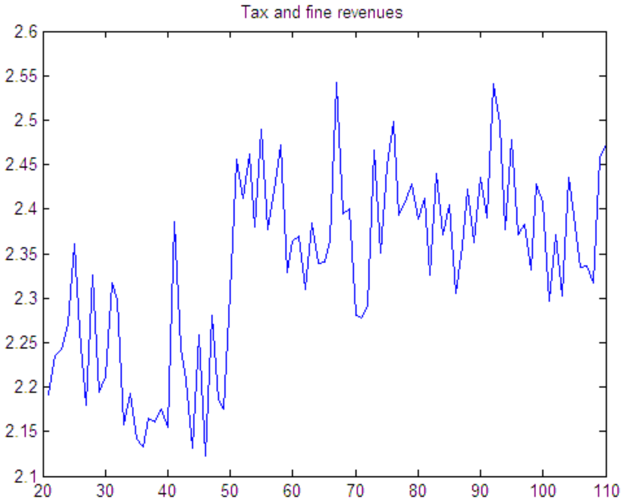
Predictive Analytics

- The simulation uses random audits for the first 50 periods
- The data from audits is collected and used to run a Tobit (censored) regression
- The amount of non-compliance is regressed on occupation, declaration, and audit history
- The estimated equation is used to predict non-compliance
- For periods 51-80 the top 5 percent are audited and audit outcomes used to update regression
- For periods 81-110 the top 2.5 percent are audited and 2.5 percent are randomly audited

Predictive Analytics



Predictive Analytics



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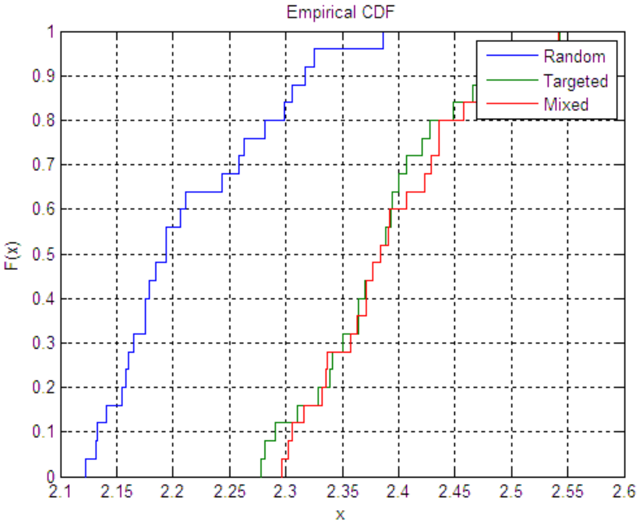

Conclusions

- Tax administration is not distinct from tax policy: the two need to be analyzed in conjunction
- Public economic theory has focussed on policy leaving many open research questions in administration
- These question can be approached using a range of methodologies
- Theory is definitely of value and will lead to am improved understanding of tax administration and policy