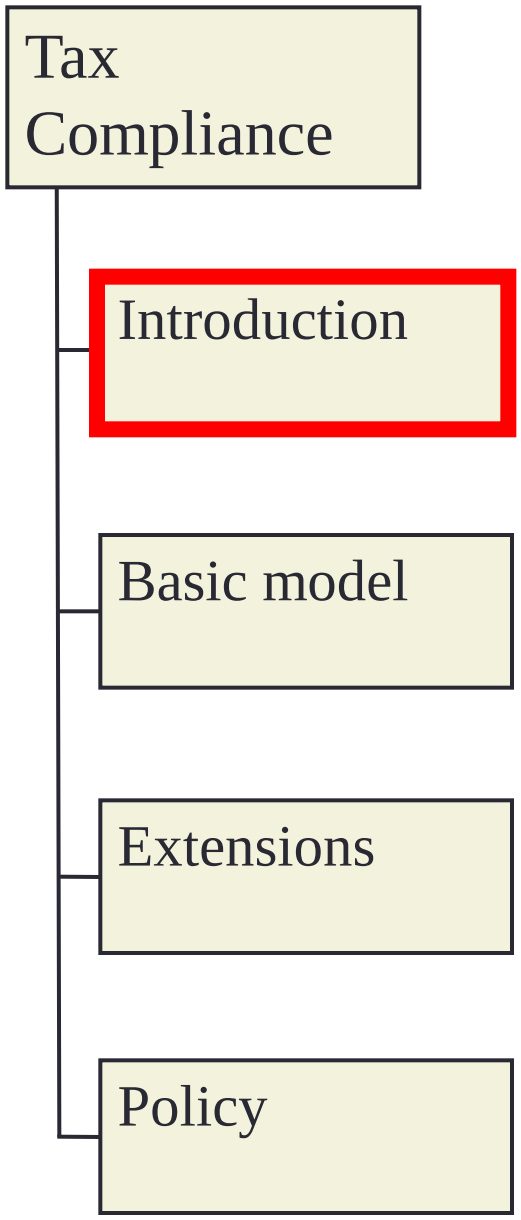
Tax Compliance

HMRC-HMT Economics of Taxation
http://darp.lse.ac.uk/HMRC-HMT

Frank Cowell, 7 December 2015

Overview...

How compliance fits into public economics



UK Tax Gap Estimates

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
				percent				
Value Added Tax (VAT)	12.9	11.7	14.7	12.6	11.2	11.7	11.9	11.1
Excise duties and other indirect taxes	7.9	7.3	7.1	6.6	6.0	4.9	4.7	5.2
Income Tax, National Insurance Contributions, Capital Gains Tax	5.3	5.8	4.6	5.3	5.5	5.1	4.9	5.0
Corporation Tax	11.5	10.2	10.8	11.3	9.3	6.4	7.1	6.7
Other direct taxes	4.5	4.4	4.5	5.0	4.4	4.2	4.1	3.8
Total tax gap	**7.6**	**7.5**	**7.5**	**7.3**	**7.0**	**6.6**	**6.6**	**6.4**
				£bn				
Total tax gap	*35*	*37*	*36*	*33*	*34*	*33*	*34*	*34*

Source HM Revenue and Customs Measuring Tax Gaps 2015) Tables 1.2, 1.3

Tax compliance: broader issues

- Tax gap
  - Lack of information? (McManus and Warren 2006)
  - US, UK evidence is not bad
  - but elsewhere can be scanty
- Shadow economy
  - broader than tax evasion / avoidance
  - includes other illegal, unobserved activities
  - estimates from Schneider and Enste (2000) based on currency demand

	1960	*1995*
Sweden	2%	16%
Denmark	4.5%	17.5%
Norway	1.5%	18%
Germany	2%	13.2%
United States	3.5%	9.5%
Austria	0.5%	7%
Switzerland	1%	6.7%

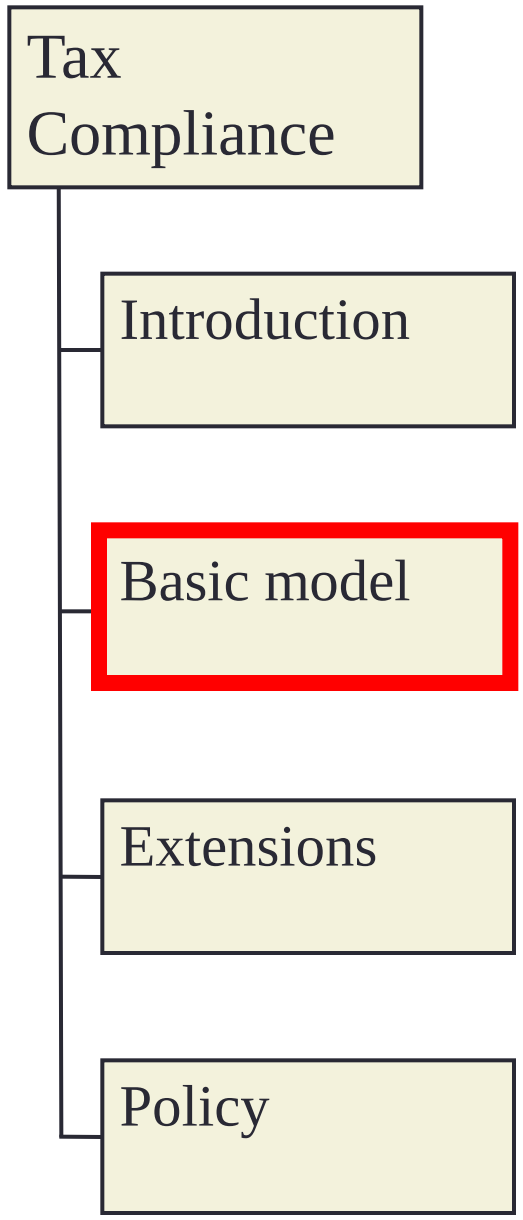
- Should we find this alarming?
  - definition of shadow economy is not always consistent
  - shadow economy estimates vary enormously according to method
  - difficult to test proposition that change in relationship due to non-compliance

Agenda

- Outline main approaches to tax compliance
  - 1 TAG
  - 2 Social interaction
  - 3 Strategic models
- Consider some important variants
  - public goods and the public sector
  - the role of firms
- Analyse implications for policy
- Literature overviews:
  - Cowell (1990, 2004)
  - Slemrod (2007)
  - Slemrod and Yitzhaki (2002)

Overview...

Individual behaviour and the public sector



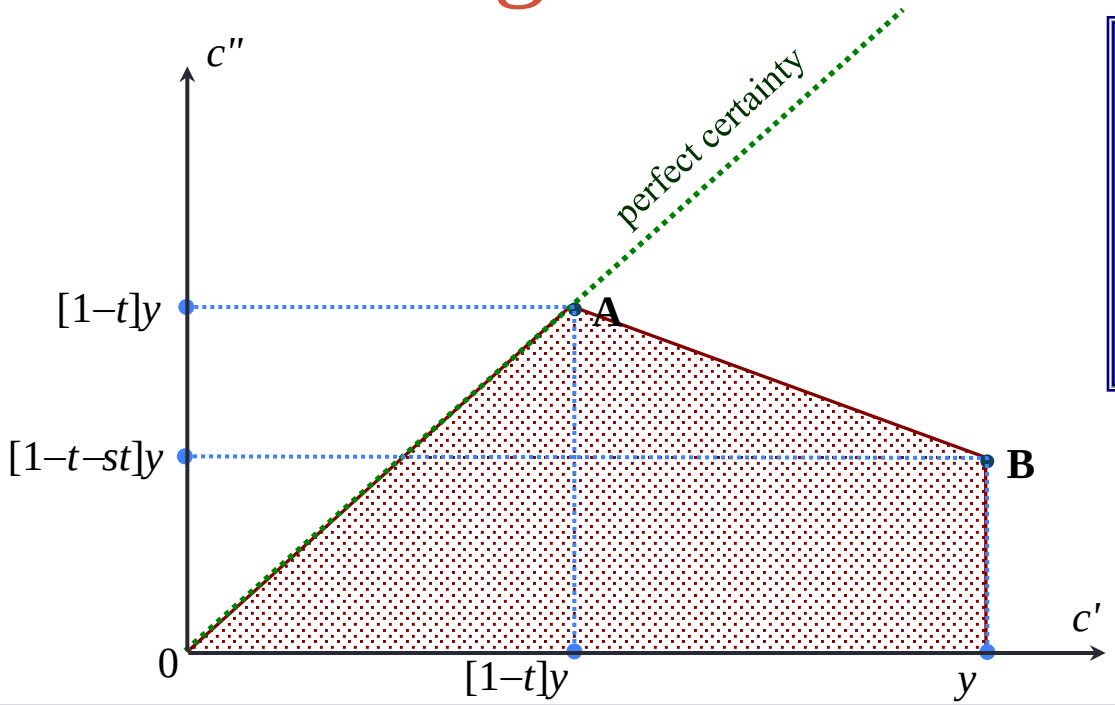
TAG model

- Standard model is essentially one of *T*axpayer *A*s *G*ambler
  - based on Allingham and Sandmo (1972)
- The gamble involves a bet with the tax authority
  - individuals bet on whether they will be caught concealing income
  - …or not reporting at all
  - …or working in underground economy
- Appropriateness relies on a special set of assumptions
  - about motivation of individuals
  - about the way that the government is perceived

TAG: taxes, penalties, returns

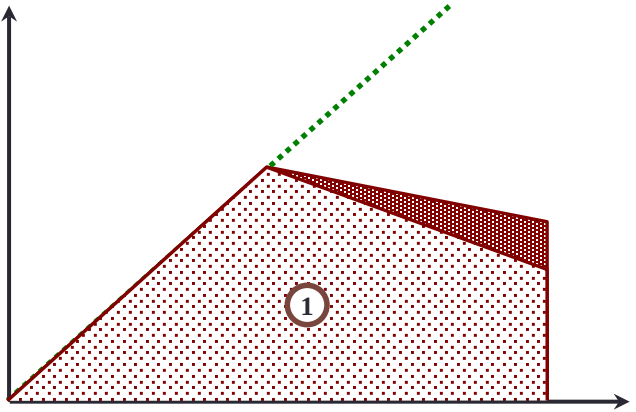
- Tax payer/evader has true income y
  - is supposed to pay tax on all of this at rate t
  - chooses to conceal an amount e, pays tax on the remainder
- Tax authority audits:
  - if evader is caught, pays a surcharge s on the evaded tax te
  - perceived probability of this happening is p
- Parameters determine returns to evasion:
  - consider rate of return to \$1 of evasion activity...
  - $\mathbf{r} = 1$ with probability $1 - p$
  - $\mathbf{r} = -s$ with probability p
  - expected rate of return is $1 - p - ps$
- Consumption (disposable income):
  - a function of income y, tax rate t, random rate of return $\mathbf{r}$
  - also of evasion choice e
  - a random variable $\mathbf{c}$ taking values (c', c'') with probabilities $(1 - p, p)$
  - $\mathbf{c} = [1 - t]\, y + \mathbf{r}te$

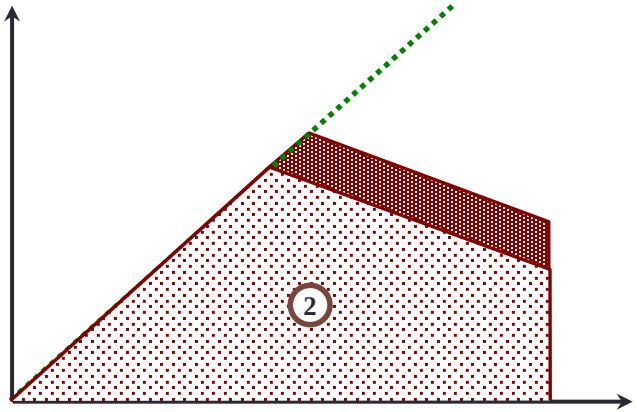
TAG: budget constraint

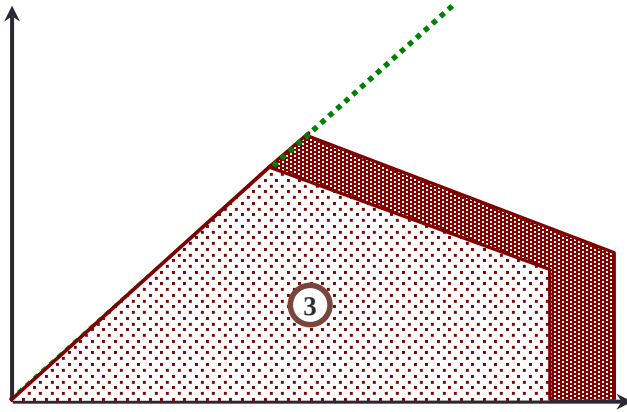


- *A: Payoffs if absolutely honest*
- *B: Payoff if blatantly dishonest*
- *Consumption possibilities for all e*

- *1 A cut in the surcharge rate s*
- *2 A cut in the tax rate t*
- *3 Increase in income y*



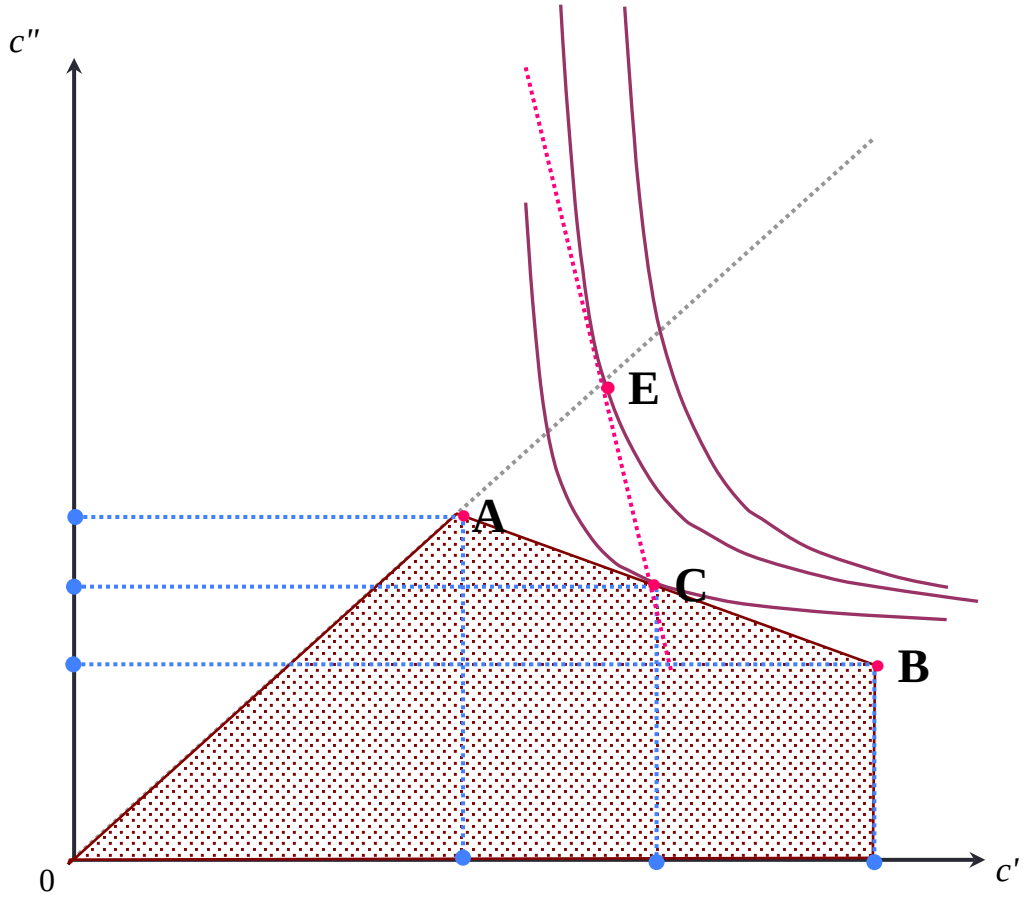




TAG: Preferences and beliefs

- Tax payer has von-Neumann Morgenstern preferences
  - gets no intrinsic pleasure from evasion and feels no shame
  - correctly perceives probability of detection p
  - assumes that it is exogenously given (alternative view: Kleven et al 2011)
- Consumer's welfare is expected utility of consumption:
  - $\mathrm{E}u(\mathbf{c}) = [1 - p]\, u(c') + p\, u(c'')$
  - $\mathrm{E}u(\mathbf{c}) = [1 - p]\, u([1 - t]\, y + te) + p\, u([1 - t]\, y - ste)$
- Cardinal utility function u has the "usual properties":
  - $u_c(\bullet) > 0$ (first derivative)
  - $u_{cc}(\bullet) \leq 0$ (second derivative)
- Both u and p determine shape of ICs in (c', c'')-space
  - curvature of ICs depends on risk aversion $-u_{cc}(\bullet)/u_c(\bullet)$
  - slope of ICs where crosses 45° line is $[1 - p]/p$

Equilibria of the tax-evader



- *Feasible set*
- *A: corner solution (honesty)*
- *B: corner solution (dishonesty)*
- *C: Interior (partial honesty)*
- *E: Expected payoff*

- solution depends on
  - tax parameters $\tau := (p, s, t)$
  - income y
  - personal attributes a
- $e^* = e(\tau, y, a)$

- $\mathsf{E}(\mathbf{r}u_c(\mathbf{c})) \leq 0$ if $e^* = 0$
- $\mathsf{E}(\mathbf{r}u_c(\mathbf{c})) \geq 0$ if $e^* = y$
- $\mathsf{E}(\mathbf{r}u_c(\mathbf{c})) = 0$ if $0 < e^* < y$

Comparative statics

- Focus on the interior solution
  - what happens when tax / enforcement parameters change?
  - do this graphically or analytically
  - differentiate the first-order condition $\mathsf{E}(\mathbf{r}u_c(\mathbf{c})) = 0$
- Effect of increased *p*:
  - indifference map "rotates"
  - for given budget constraint, tangency moves closer to A
- Effect of increased *s*:
  - point B moves down
  - for given utility function, tangency moves closer to A
- Effect of increased *t*:
  - assume decreasing absolute risk aversion (DARA)
  - amount "invested" in a risky asset increases with resources
  - so in this model, given DARA, evasion rises with *y*
  - but this will also imply that evasion *falls* with *t*

TAG model: Firms

- Conventional (non strategic firm)
  - marginal production cost μ
  - demand (sales) given by $x(P)$
  - P is market price
- Tax t payable on sales
- Firm conceals a proportion β of sales
  - concealment costs per unit of output $G(\beta)$
- Expected tax rate
  - p and s have same interpretation as before
  - effective tax if not caught: $[1 - \beta]t$
  - effective tax if caught: $[1 + s\beta]t$
  - so $\mathsf{E}t := [1 - p][1 - \beta]\, t + p\, [1 + s\beta]t$
- Expected profits are:
  - $\mathsf{E}\Pi = [P - \mu - \beta\, G(\beta) - [1 - p][1 - \beta]\, t + p\, [1 + s\beta]t\,]\, x(P)$
  - $\mathsf{E}\Pi = [P - \mu - g(\beta) - \mathsf{E}t]\, x(P)$ where $g(\beta) := \beta G(\beta)$

TAG Firms: results

- Maximise $\mathsf{E}\Pi$ w.r.t. β and x.
  - From FOC for a maximum: $dg(\beta) / d\beta = [1 - p - ps]\, t$
  - marginal concealment cost = expected return
- For competitive firms:
  - $P = \mu + g + \mathsf{E}t$
  - price = expected augmented marginal cost
- Output and evasion decisions are taken independently
  - neutrality argument: applies to both competitive and monopolistic firms
  - result depends on risk-neutrality (Cowell 2004)
- Effects of penalty surcharge, detection probability:
  - $\partial\beta/\partial s < 0, \quad \partial\mathsf{E}t/\partial s > 0, \quad \partial P/\partial s > 0$
  - $\partial\beta/\partial p < 0, \quad \partial\mathsf{E}t/\partial p > 0, \quad \partial P/\partial p > 0$
- Effect of nominal tax increase:
  - ...raises proportion not declared $\partial\beta/\partial t > 0$
  - ...may or may not raise expected tax $\partial\mathsf{E}t/\partial p \lesseqgtr 0$
  - ...raises price $0 < \partial P/\partial t < 1$

TAG model: public sector

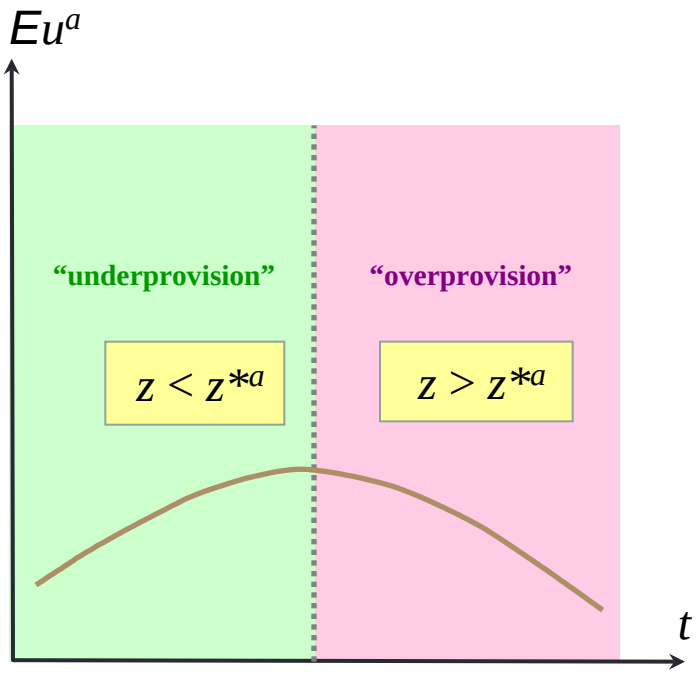
- Government budget constraint:
  - $R \geq \bar{R}$
  - revenue actually raised ≥ required target revenue
- Define economy-wide aggregates
  - aggregate income: $Y := \int y \, dF(y, a)$
  - aggregate nominal tax receipts: tY
  - aggregate "leakage" from evasion: $\int re(\tau, y, a) \, dF(y, a)$
  - cost of enforcing probability p across economy $\Phi(p)$
- Composition of revenue
  - $R = tY - t \int re(\tau, y, a) - \Phi(p)$
- So budget constraint becomes
  - $tY - t \int re(\tau, y, a) - \Phi(p) \geq \bar{R}$
- But this ignores how the government revenue may be used…

TAG model: Public Sector

- Taxes are used to pay for a public good z
- Government budget constraint in this extended model is:
  - $R \geq \psi z$
  - where ψ is the (constant) marginal rate of transformation
- Individuals benefit from provision of the good
  - …but they prefer that someone else pay for it
  - so there is still a motive for tax evasion
  - and expected utility is now $\mathsf{E}u(\mathbf{c},z)$, where $u_z(\mathbf{c},z) > 0$
- FOC for an interior maximum is:
  - $\mathsf{E}(\mathbf{r}u_c(\mathbf{c},z)) = 0$
  - essentially as before
- Response of e in this model is much the same for some cases:
  - Surcharge
  - Probability of detection
- But for the tax rate t we have new insights…

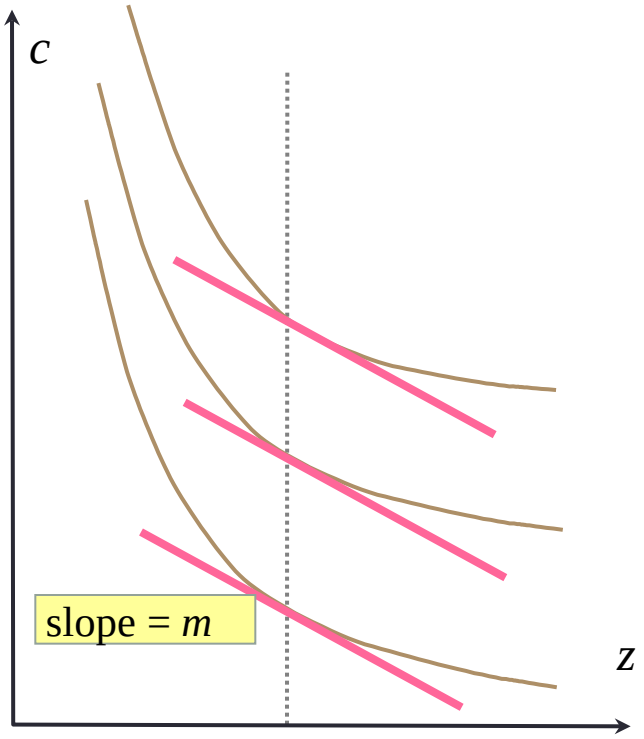
The effect of a rise in the tax rate

- There are still the conventional “income” and “substitution” effects
- But *t* also affects amount of public good available
- Increasing *t* will:
  - reduce private consumption *c*
  - increase availability of public good *z*
- Desirable to increase *t*?
  - depends on amount of public good already available
- Expect a “hump” shape:
  - for *t* close to 0 we have *z* close to 0: raising *t* is desirable
  - for *t* close to 1 we may have satiation in *z*: lowering *t* is desirable



Preferences for public and private goods

- How is z^* determined?
  - Optimal provision uses standard ΣMRS = MRT rule
  - Because of the risk component general formula is unwieldy
- So take a simplified set of preferences
  - $u^a(c, z) = c + v^a(z)$
  - $m^a := u_z^a(c, z)/u_c^a(c, z) = v_z^a(z)$
  - $m := \Sigma m^a$ = MRT
- Evasion erodes effectiveness of tax in providing z...
  - feeds back into effect of tax on evasion
  - change in (et) has sign of $m - y / z_t$
  - a simple criterion for determining under / over provision
- If the public goods are…
  - *under-provided*: a rise in t increases evasion
  - *over-provided*: a rise in t decreases evasion
  - Cowell and Gordon (1988)



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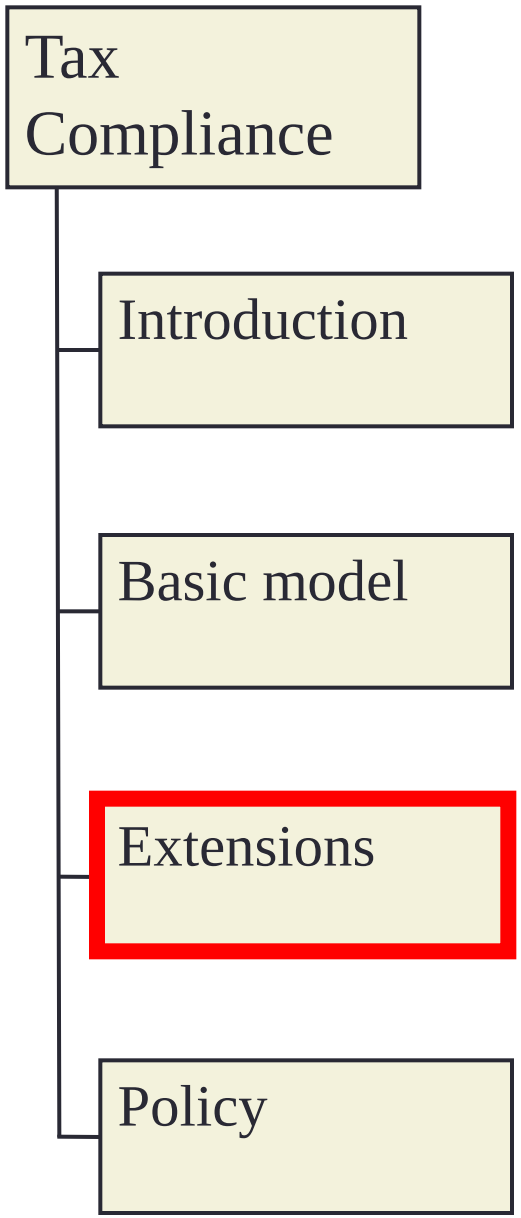


Alternative model of rational behaviour.

Climate of evasion and social sanction

Strategic interaction

- Based on a application of game theory
  - Two players: tax authority and taxpayer
  - Tax authority chooses whether or not to investigate
  - Taxpayer chooses whether or not to cheat
- Intuition of simple strategic model: simultaneous move
  - if tax authority plays “audit” best response of taxpayer is “report”
  - if taxpayer plays “report” best response of tax authority is “not audit”
  - etc, etc.
  - no equilibrium in pure strategies
- Intuition of simple strategic model: leader-follower
  - if tax authority moves first, perhaps get a simple outcome
- Develop this into a richer policy model?
  - focus on tax-collector/tax-payer interaction
  - what role is there for beliefs about others’ goals and actions?
  - can tax authority precommit to an audit strategy?

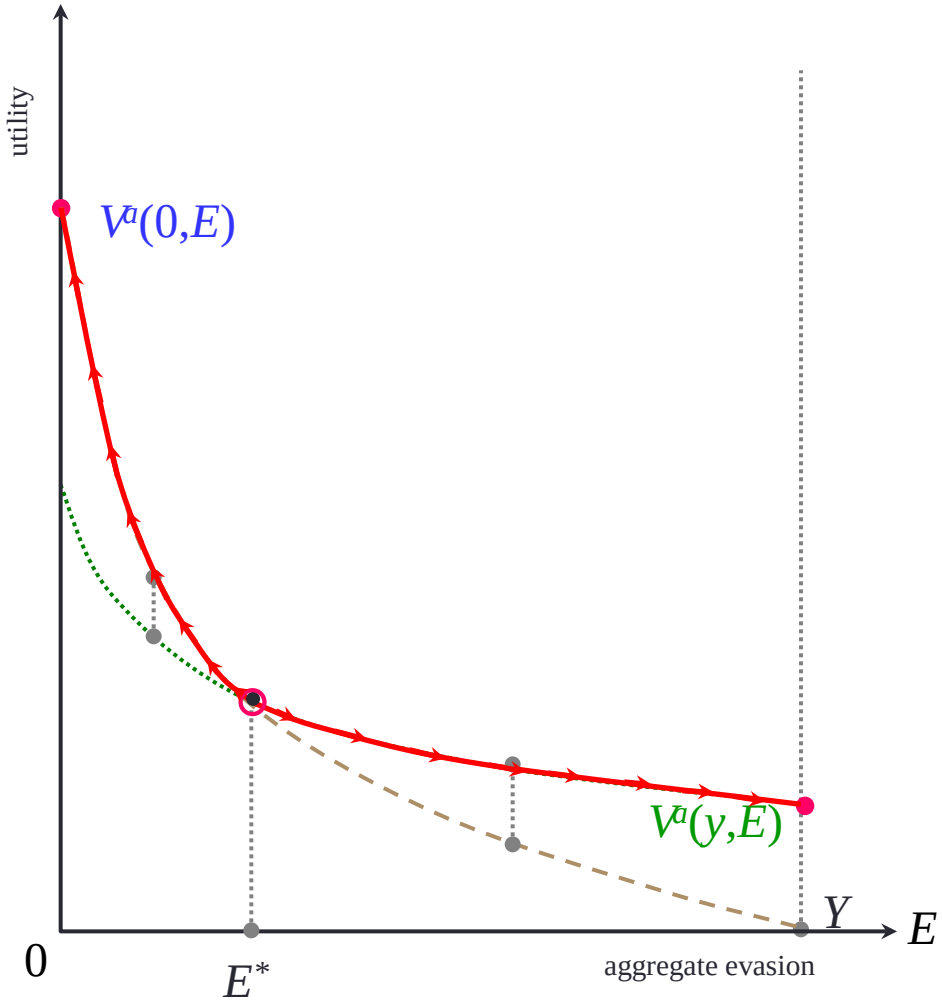
Climate: motivation

- Different countries, different compliance behaviour?
  - develop a model of a compliance climate? (Cummings, et al. 2009)
  - others' evasion choices affect my evasion decision (Fortin et al. 2007)
  - several possible foundations…
- 1 Symmetric consumption externality
  - if you evade maybe I feel less pain if caught behaving antisocially
  - social stigma (Kim 2003)
- 2 Technological (production) externality
  - the more others evade, the easier to find a corrupt accountant
  - leads to reduction in "noncompliance costs"
- 3 May also be induced by tax authority
  - auditing rules may induce a perceived interdependence
  - creates a "co-ordination game" (Alm and Mckee (2004)

Climate: model background

- Evasion decisions affect outcomes in two ways
  - each person's outcome affected by own choices (as before)
  - also affected by evasion of others (independently of public goods)
- Nature of the consumption externality
  - aggregate evasion affects utility
  - moral climate?
- Utility of an a-type is $V^a(e,E)$ where
  - e: Own evasion activity
  - E: aggregate evasion
- In principle there are two subcases:
  - 1 where aggregate E increases utility
  - 2 where aggregate E reduces utility

Interaction: model behaviour



- *The Evasion-Utility Space*
- *Payoffs if act honestly*
- *Payoffs if act dishonestly*
- *Check incentive to switch*
- *Dominant behaviour*
- *Find equilibrium…*
- *Check stability…*

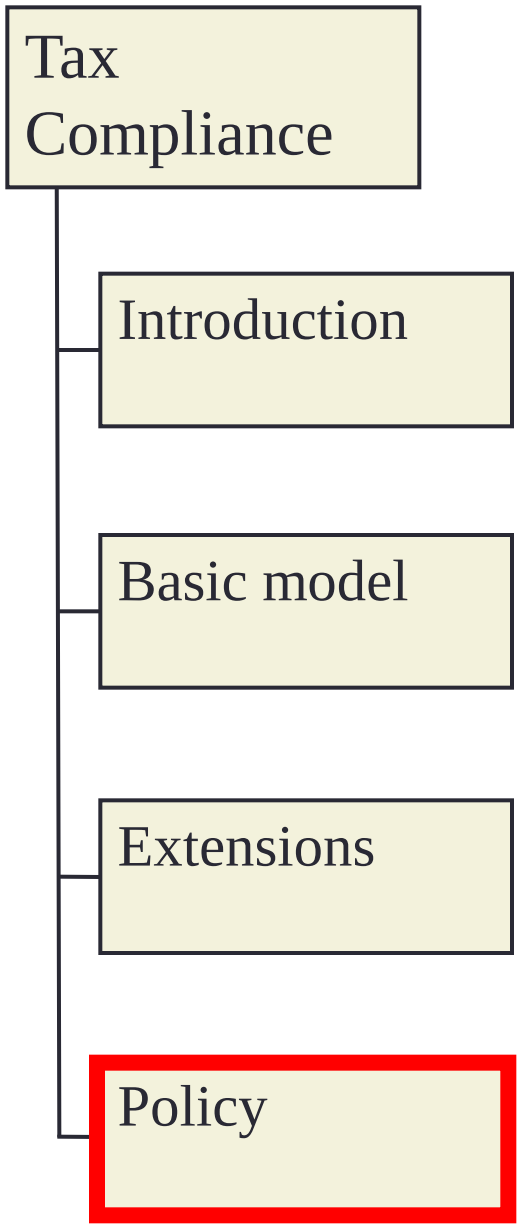
- min $E = 0$, max $E = Y$
- low E : individual switches to 0
- high E: individual switches to y
- $E < E^*$: switching decreases E
- $E > E^*$: switching increases E
- **Three equilibria**:
  - $E = 0$ (stable)
  - $E = E^*$ (unstable)
  - $E = Y$ (stable)

Climate: industry

- Firms' interdependence: a type of climate effect
- Corporate income presents problems
  - volatility – depends on market conditions
  - idiosyncratic – depends on particular industry characteristics
  - firms have better market information than tax authority?
- Make use of information
  - partition by industry
  - relative auditing rather than simple auditing
  - create an informational externality (Bayer and Cowell 2009)
- Outcome depends on nature of firm interaction
  - production: collusion / competition?
  - reporting: response to informational externality?

Overview...

Utilitarian and strategic approaches to audit policy



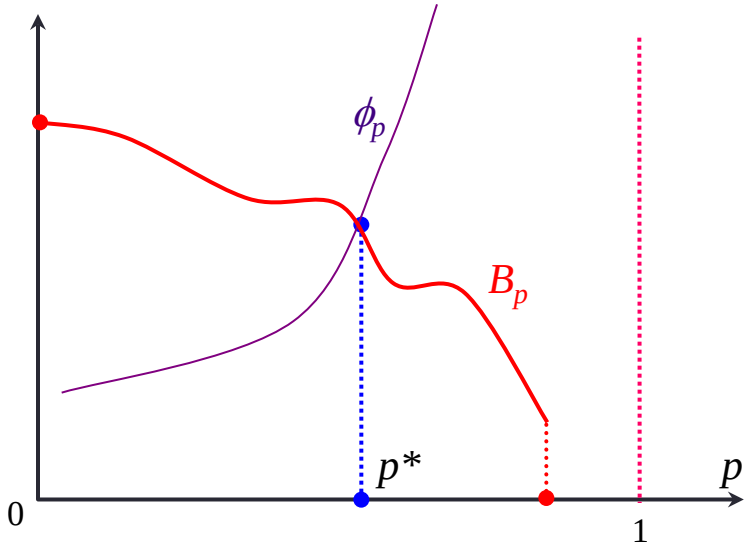
Utilitarian enforcement problem

- Basic behavioural model
  - taxpayer maximises expected utility $\mathrm{E}u(\mathbf{c}) = \mathrm{E}u([1 - t]\, y + \mathbf{r}\, te)$
  - y: taxable income
  - t: proportionate tax rate
  - e: concealed income
  - $\mathbf{r}$: rate of return to evasion (= $-s$ with prob p, 1 with prob $1 - p$)
- Outcome of basic model
  - determines optimal evasion response $e^* = e(p, s, t; y, a)$
  - depends on tax parameters (p, s, t) and personal characteristics (y, a)
- Welfare model
  - Take expected utility of representative taxpayer as welfare criterion
  - $W = [1 - p]\, u([1 - t]\, y + te) + p\, u([1 - t]\, y - ste)$
- Should evasion be eliminated?
  - t fixed : don't eliminate evasion
  - p fixed: eliminate evasion
  - p, s, t all variable: no solution

Optimal degree of enforcement?

- Take a standard welfare-economics approach
  - choose the optimal p, given fixed s, t
- Basic utilitarian model
  - homogeneous population
  - simple revenue target
  - a type of cost-benefit approach to enforcement
- Individual (slightly extended)
  - income: $y = wh$
  - consumption: $\mathbf{c} = [1 - t]y + \mathbf{r}te$
  - leisure: $\ell = 1 - h$
  - utility: $u(\mathbf{c}, \ell)$
- Government/tax authority
  - enforcement cost per taxpayer: $\phi(p)$
  - revenue requirement: $\bar{R}$
  - expected revenue leakage per tax dollar: $\bar{r} = 1 - p - ps$
  - budget constraint: $twh - [1 - p - ps]t\, e(\tau, w) - \phi(p) \geq \bar{R} / n$
- Utilitarian model, homogenous population
  - objective function: $v(\tau, w) = \max \mathsf{E} u(\mathbf{c}, \ell)$
  - Lagrangean: $v(\tau, w) + \lambda\, [twh - [1 - p - ps]t\, e(\tau, w) - \phi(p) - \bar{R} / n\,]$

Choosing p for given (s,t)



- ***Probabilities, costs and benefits***
- ***Marginal cost of audit***
- ***Marginal benefit of audit***
- ***Optimum investigation effort***

- MC is marginal audit cost
  - is monotonic increasing
- MB is marginal audit yields + supply side and risk effects
  - may not be monotonic
  - may go to zero
- Optimum where MB = MC
  - $\phi_p = [1+s]te - r\,t\partial e/\partial p - w_0\partial \ell/\partial p\; e(\tau, w) + v_p/\lambda$

Extensions – agent interaction

- Cost-benefit approach is essentially individualistic
  - compute MB for each agent
- Social interaction models
  - prevent epidemics?
  - shift the equilibrium?
  - manipulate expectations? (Iyer et al 2010)
  - raise search costs?
- Focus on smart use of information
  - recognise that agents may have better market information
  - exploit information about *all* agents' behaviour
- Example: tax compliance by firms
  - relationships amongst firms is essential to the impact of policy choice
  - Cournot behaviour: get effect on output as well as tax receipts
  - collusion amongst firms – smart auditing less effective (Bayer and Cowell 2009)

Tax-payer v. Tax-collector game

- Model ingredients
  - tax rate *t*, surcharge *s*, cost of audit φ are exogenously determined
  - tax enforcement powers are delegated, like contract farming
- To find a solution we need to look closely at:
  - the structure of taxpayer population
  - control that can be exercised by tax authority
- Essence of model is taxpayer heterogeneity
  - differ by income and by attitude to tax-paying
  - authority does not know individual taxpayer attributes and incomes...
  - but does know distribution in the population
- Take a simple 2x2 version:

type	**income**	**attitude**	**pop proportion**
poor	y_0	???	α_0
honest rich	$y_0 + \Delta y$	always pay	α_1
chancers	$y_0 + \Delta y$	cheat if can	α_2

A mixed-strategy approach

		Tax-Authority	
		Investigate	*Not Investigate*
Taxpayer	*cheat*	$([1-t-st]\,\Delta y, [1+s]\,t\Delta y - \varphi)$	$(\Delta y, 0)$
	not cheat	$([1-t]\,\Delta y, t\Delta y - \varphi)$	$([1-t]\,\Delta y, t\Delta y)$

- Each side expects the other to play probabilistically:
  - tax authority investigates low incomes with probability p
  - taxpayer cheats with probability π
- Expected net tax receipts

  $\Delta T = [\alpha_1 + \alpha_2\,[1-\pi]\,]\;t\,\Delta y \;+\; \alpha_2 p\pi\,[[1+s]t\,\Delta y - \varphi\,] \;-\; \alpha_0 p\varphi$
- Marginal impact on receipts from increasing p is:

  $\alpha_2\pi\,[[1+s]t\,\Delta y - \varphi\,] - \alpha_0\varphi$
- This is positive if π is greater than a threshold value:

$$\pi > \pi^* \;:=\; \frac{\alpha_0\varphi}{\alpha_2\,[[1+s]t\,\Delta y - \varphi\,]}$$

Equilibrium concepts

- Taxpayers and tax agency each form beliefs about the other's actions
- Equilibrium where each adopts a consistent set of beliefs
- What is the optimal "tailored" audit strategy?
- Two types of relationship between taxpayer and tax authority:
  - tax authority precommits to a strategy
  - tax authority does not precommit

Precommitment: policy

- If the tax authority were permissive, net receipts would be low:
  - $\Delta T|_{\pi=1,p=0} = \alpha_1 \, t \, \Delta y$
- If authority can commit it ought to audit all low-income reports:
  - $p = 0$ if report is $y_0 + \Delta y$
  - $p = 1$ if report is y_0
- Tax receipts net of audit costs are
  - $\Delta T|_{\pi=0,p=1} = [\alpha_1 + \alpha_2] \, t \, \Delta y \; - \alpha_0 \varphi$
- This amounts to a “Punish the poor” policy
- Is this in fact optimal?
  - viability
  - credibility

Precommitment: optimality?

- Condition 1 for financial viability is:
  - $\Delta T|_{\pi=0,p=1} \geq \Delta T|_{\pi=1,p=0}$
  - $[\alpha_1 + \alpha_2]\, t\, \Delta y - \alpha_0 p \varphi \geq \alpha_1 t\, \Delta y$
  - $\alpha_2 t\, \Delta y \geq \alpha_0 \varphi$
- Condition 2 for financial viability is:
  - net return from investigating a false report must be non-negative
  - $[1 + s]\, t\, \Delta y - \varphi \geq 0$
- Combining the two conditions
  - $[1 + s]\, t\, \Delta y - \varphi \geq [1 + s - [\alpha_2/\alpha_0]] t\, \Delta y$
  - satisfied if audit cost is not too high and there are not too many honest people
- Credibility:
  - everyone sees that only the genuinely poor people are audited
  - no revenue is ever raised in equilibrium
  - policy may not be credible in a repeated setting

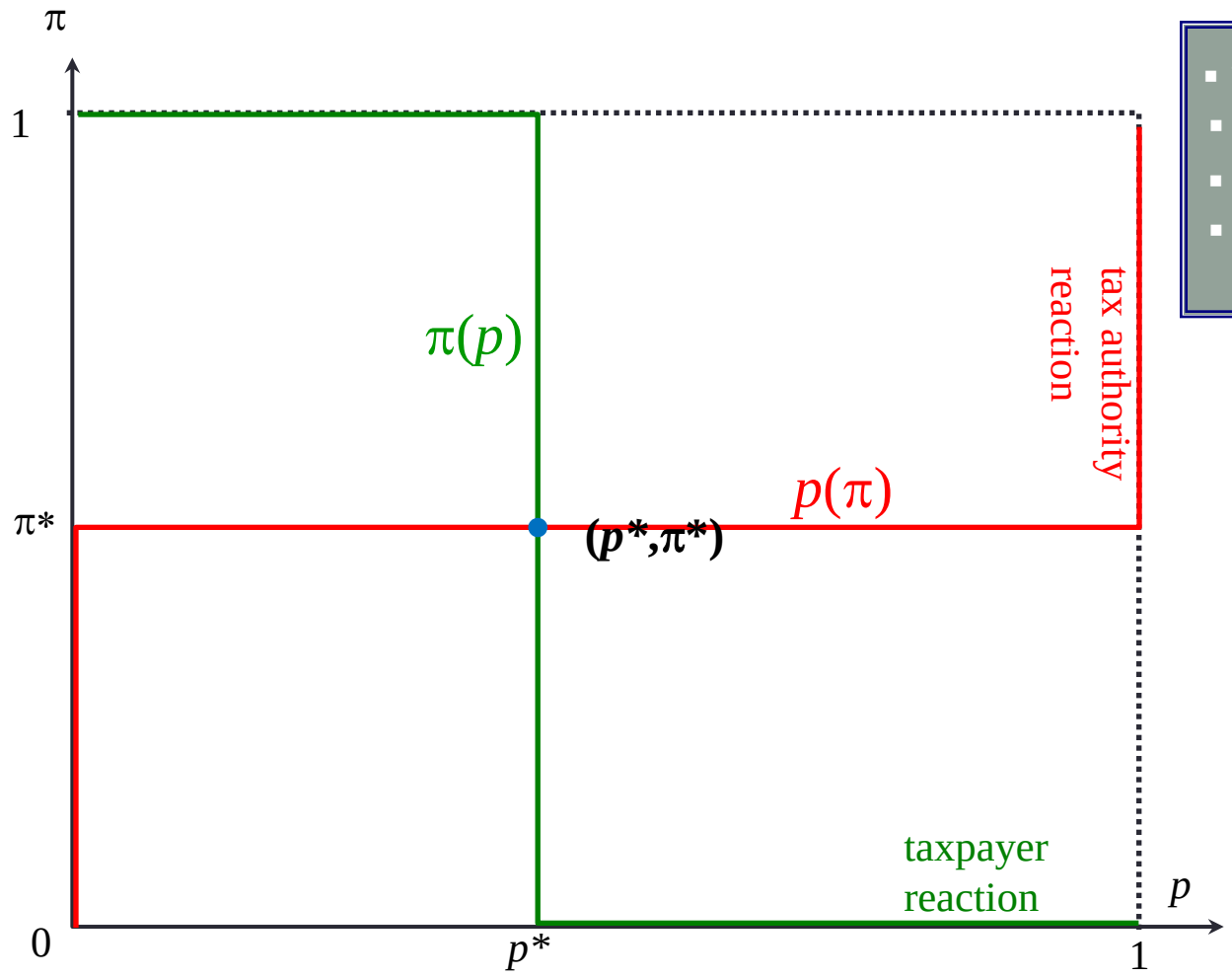
No commitment: outline

- Tax authority:
  - believes probability that a chancer will cheat is π
  - perceived probability of catching an evader is $\theta := \alpha_2\pi/[\alpha_0+\alpha_2\pi]$
  - expected net tax receipts can be written as:

$$\text{const} + \frac{\alpha_0 \varphi}{\alpha_0+\alpha_2\pi}[\,\pi / \pi^* \; - \; 1]$$

  - π^* is pivotal value of belief (computed earlier)
- Chancers:
  - believe that probability of audit is p
  - expected utility if cheat is: $pu([1-t]y_0 + [1-t-st]\Delta y) + [1-p]u([1-t]y_0 + \Delta y)$
  - expected utility if don't cheat is: $u([1-t][y_0 + \Delta y])$
  - there is a pivotal probability satisfied p^* which equates these two utilities
  - if u is risk neutral then $p^* = 1 / [1+s]$
- Solution:
  - tax authority's best response given belief π defines reaction function $p(\pi)$
  - chancers' best response given belief p defines reaction function $\pi(p)$
  - equilibrium where beliefs consistent – where reaction functions intersect

No commitment: Solution



- *The strategy space*
- *Tax authority's strategy*
- *Chancer's strategy*
- *Equilibrium*

- always audit if proportion of cheats is believed high
- always cheat if probability of detection is believed low

- $p^* = 1 / [1 + s]$
- $\pi^* = \dfrac{\alpha_0 \varphi}{\alpha_2 [[1+s]t\,\Delta y - \varphi]}$

How the model works

- Response to tax-enforcement parameters:
  - $\partial\pi^*/\partial\varphi > 0$ $\quad\quad$ $\partial p^*/\partial\varphi = 0$
  - $\partial\pi^*/\partial t < 0$ $\quad\quad$ $\partial p^*/\partial t \geq 0$
  - $\partial\pi^*/\partial s < 0$ $\quad\quad$ $\partial p^*/\partial s < 0$
- Changing population proportions:
  - $\partial\pi^*/\partial\alpha_0 > 0$ $\quad\quad$ $\partial p^*/\partial\alpha_0 = 0$
  - $\partial\pi^*/\partial\alpha_2 < 0$ $\quad\quad$ $\partial p^*/\partial\alpha_2 = 0$

Assessment

- Compliance is a central component of public economics
  - Arises naturally from the issues concerning the provision of public goods
- Analysed using standard microeconomic techniques
  - Incentives issues similar to those of labour supply
- Important to model the interactions involved in evasion
  - Perceptions of others' behaviour may be important.
  - Also interaction between tax-payers and enforcement agencies
- Crucial issues on policy concern the institutional background
- What is the nature of the optimisation problem?
  - Is a standard reporting model appropriate?
  - What information should each party be assumed to have?

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