THE UNIVERSITY OF HULL

The Role Of Costs In Tax Evasion:

Non-Selfish Attitudes Or Pecuniary Motivations?

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by

Maria Luisa Ratto, MSc(Econ)(London), Laurea (Econ and Business)(Milan)

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To My Family

Acknowledgements

CONTENTS

'The Eleventh Commandment – Thou shall not be caught' (Anon)

General Introduction

The focus of this thesis is the theoretical analysis of tax evaders' behaviour. Tax evasion is a crime that presents some peculiarities: the victim of the crime is not a single person, but an impersonal and abstract entity which can be identified as the Government, and hence the rest of the community. There are no reports for this crime, apart from the self-reporting by the evaders in case of tax amnesties. The tax authority, on the basis of some suspicions arising from tax returns or from comparing standards of living and declared income, communicate to the tax payers that they are under investigation, and it is up to the tax payers to prove their compliance by providing the relevant documents. Inferring the rate of detection of this crime is not easy in that the audit policy and the results of the investigations remain confidential information, and are not made public. The difficulty of observing the activity of evaders and inferring its extent from the results of the tax authority's investigations, makes the analysis of tax evaders' behaviour a challenging task both from an empirical and a theoretical point of view. This makes tax evasion a fascinating phenomenon to study.

The interest of the economic theoretical literature in tax evasion stems from its substantial distortionary effects on the horizontal and vertical equity of the tax system and on the overall efficiency of the economic system.

The seminal theoretical models on tax evasion aimed at explaining the motivations behind non-compliance and at examining the impact of the tax parameters on evaders' decision. The attention was focused on the question "why should individuals evade?" and the reply provided by these models was "because it pays to do so". Tax evasion was explained as a portfolio choice. The individual decides how to allocate his initial endowment (actual income) between a safe asset (true declared income) and a risky asset (concealed income) in order to maximise expected utility. The individual will decide to engage in non-compliance whenever the expected financial gain for an extra $1 of evasion is positive.

However, the picture depicted by the standard model appeared not to be completely satisfactory.

One problem is a counter-intuitive prediction, which is also not supported by empirical evidence, that an increase in the tax rate leads to less tax evasion.

A second aspect is that, under the assumption that individuals are expected utility maximisers and that the probability of detection is the same for everybody, the choice whether or not to evade is triggered by a unique value of the probability of detection. This implies that a mixed outcome where some individuals evade and others do not evade is not feasible, even if we allow for different degrees of risk aversion.

A third point to make is that empirical evidence from experiments and data collected by audit programs, suggests that the standard portfolio model tends to over-estimate the amount of tax evasion. In particular, the evidence collected by Andreoni et al. (1998) suggests that penalties are quite infrequently imposed and the probability of detection is very low (as we shall see for the US the estimated probability of audit was 1.7% in

1995, and it had been decreasing since 1960s). This would imply that the expected cost of evading is extremely low. Hence, if we are to apply the predictions of the standard portfolio model on the behaviour of tax evaders, we should expect a widespread non-compliance, which is not the case: the same data set suggests that the rate of compliance reached 91.7%.

In the light of these considerations, it appears that some determinants of tax evasion are missing in the analysis of the standard portfolio model.

This has stimulated further theoretical research. Some authors have relaxed some of the assumptions of the portfolio model in the attempt to reverse the result concerning the impact of an increase in the tax rate on evasion. Others have tried to alter the way of modelling tax payers' motivations, in order to explain why individuals should comply with their tax duties even if it would pay to evade. More specifically, individuals are assumed to be motivated not only by monetary considerations but also by moral rules: they do not evade because they suffer a psychic cost or a loss in utility in doing so.

In this thesis we examine the question of "non-selfish" motivations further and examine the non-selfish approach to tax evasion in some depth.

We organise our exposition in 5 chapters. The first two chapters review the existing literature and set the scene for our contribution to the theoretical research we develop in the following three chapters.

In chapter 1 we present one of the seminal models on tax evasion, the Yitzhaki model, where the choice of tax evaders is analysed as a portfolio choice. We shall comment on the predictions that are not in line with empirical evidence and briefly summarise the extensions that have been proposed to the standard portfolio model.

Chapter 2 is devoted to the analysis of the role of morals on tax payer's decision. We organise the chapter in two main parts: in the first one we consider the economic theoretical literature on the role of morals on tax evasion and in the second part we present the results of empirical studies on this issue. We shall focus on the Myles and Naylor (1996) model which considers tax compliance as a social custom. Individuals get utility from following the social custom and from conforming with the group of tax payers. We also consider Bordignon's (1993) analysis on the role of fairness considerations on the behaviour of tax payers.

Our main concern will be the predictions on the effect of an increase in the tax rate on tax evasion and on the feasibility of a mixed outcome, which are our cross-cutting themes in the thesis.

A general result is that the presence of morals or fairness considerations makes the entry condition for evasion more restrictive and hence makes it possible to explain the alleged tendency to evade less than predicted by the standard portfolio model. Under some conditions it is also possible to observe a mixed outcome of honest and dishonest tax payers, this outcome depends on the tax parameters and on the importance attached to morals.

We note that the argument of the theoretical models on social interactions is not completely satisfactory and seems rather ad-hoc. People are assumed to be motivated by non-selfish considerations: their utility function is modelled such that the amount of evasion they choose is necessarily less than what would be predicted by the portfolio model. But they do not explain why individuals should behave according to the preferences represented by those utility functions.

In the second part of the chapter we look at the empirical evidence on the role of non-selfish attitudes in tax payers' behaviour. The evidence in fact is rather thin, in that most of empirical studies do not consider this issue and are silent about the role of morals on tax evasion. The best data to test individuals' attitudes towards tax evasion is provided by audit data, tax amnesty programs, surveys and experiments.

We present two field experiments conducted by the Minnesota Department of Revenue for the 1994 and 1995 tax year filing seasons: one on the impact of normative appeals on tax compliance. The second focuses on the impact of an increased probability of audit on compliance.

Results suggest that appeals to social conscience are not effective and, even if morals do affect individuals' attitudes, it is not clear how those attitudes translate into behaviour. The response of tax payers seems to rely more on the level of income and opportunities to evade.

The same results emerge from the evidence on ghosts, those who do not file a tax return and escape from auditing programs. We examine two empirical studies conducted to analyse the characteristics of ghosts and the factors driving their decision not to file. Both studies emphasise that the level of income and the sources of income are important

determinants for the decision not to file. In particular those with high income and those subject to withholding and with relatively more offsets to income are more likely to file their tax returns.

Hence from an empirical point of view the role of morals is not clear and opportunities to evade seem to have a stronger impact on tax payers' behaviour.

These findings and the fact that the models on social interactions seem to assume rather than explain a sort of predisposition for altruistic behaviour, motivate our analysis in chapter 3. In chapter 3 we analyse how tax compliance could become a social norm. We assume that tax compliance may emerge in a community through a spontaneous and dynamic process, like a convention. In particular we investigate the possibility that morals can emerge spontaneously through some form of evolutionary mechanism. We analyse the Myles and Naylor model in an evolutionary context and examine the stability of morals, in a community where tax payers choose their strategies through a process of learning and imitation and can change their preferences and attitudes towards morals.

According to our results, the social custom "non-evading" is vulnerable to deviant behaviour. The behaviour of selfish utility maximisers undermines non-selfish attitudes and tax payers motivated by altruistic tendencies cannot coexist with selfish utility maximisers.

There is a parallel with this result and the literature on honesty, altruism, and cooperation. A common view in those models is that honesty, altruism and co-operation are not evolutionary stable strategies, unless there are some protective mechanisms, such

as emotions of guilt or moralistic aggression, or efforts to reduce exposure to opportunism.

We also point out a similarity with the public good game. On one hand theoretical models tend to rule out co-operation among many individuals and voluntary contributions to the provision of public goods. On the other hand, empirical evidence suggests that people do contribute voluntarily, even in large groups, where donations are completely anonymous, like in the case of Blood Banks. The explanations offered by some authors to fill in the gap between theory and evidence, however are not easily applicable to the case of tax evasion. Some authors have analysed the role of fairness considerations, inequity aversion, tendencies to reciprocate and the threat to punish cheaters, in deterring non co-operative behaviour. By modifying the individual's utility function to allow for those factors, they demonstrate that, under some conditions, co-operation can be sustained in large groups, with many individuals. The same arguments do not seem to be applicable for tax evasion: by its nature cheating the tax authority is a hidden activity and individuals may find it difficult, if not impossible, to observe the behaviour of their peers.

In the light of these results and the findings from the empirical evidence, the argument that some individuals are inherently honest and never evade is not very convincing, both from a theoretical point of view and from an empirical one.

In chapters 4 and 5 we explore the idea that opportunities rather than willingness to evade may determine tax evaders' behaviour. The Treasury report on the informal economy provides some evidence on actual cases of tax evasion and suggests that the

costs involved in the activity of concealing one's income may be quite substantial. In the standard portfolio model this issue is completely ignored, in that the only cost for evading is the fine, to be incurred only in case of detection.

In chapter 4 we analyse two issues: the possibility that the audit process imposes a cost even on honest taxpayers and the fact that concealing one's income is a costly activity.

In the first section we model the cost of dealing with the tax authority and make a distinction between a psychic cost and a monetary cost of being audited for an honest taxpayer. We shall see that, under some conditions, a mixed outcome of honest and dishonest tax payers becomes feasible.

In the following section we introduce a cost for evading to be incurred even if the tax evader is not caught. As in the standard model, we consider a representative taxpayer, maximising his/her expected utility and facing a given probability of detection. We distinguish three possible cases for modelling a cost attached to the activity of evasion: a fixed cost, a cost proportional to the amount of hidden income and a cost determined by the effort exerted to fool the tax authority and decrease the probability of detection.

We show that the consideration of a cost attached to the activity of concealing one's income, in some circumstances, makes it possible to predict an increase in tax evasion after an increase in the tax rate, and hence to reverse the Yitzhaki result. The degree of risk aversion becomes relevant for explaining the existence of a mixed outcome, consisting of honest taxpayers and cheaters.

An aspect implicit in the analysis is that if the cost of cheating varies across individuals, individuals will chose to declare different amounts to the tax authority, even if they have the same gross income. Hence different costs for hiding one's income imply different opportunities to evade, the idea being that individuals who have to incur higher costs for hiding their income have less opportunities to evade. In chapter 5 we develop this idea. We shall analyse how different opportunities to evade influence the optimal audit policy of a tax enforcement agency endowed with limited resources for auditing. We model two types of tax payers with different costs of evasion with the view to find out if it is optimal for the tax administration to concentrate on one group of tax payers, rather than targeting both groups indiscriminately.

Our results suggest that when individuals have different opportunities to evade and the tax enforcement agency has limited resources, the optimal audit policy depends on the available budget.

The tax enforcement agency should distinguish between the two types only if the resources are high enough. In this case, in fact, it is optimal to allocate the budget so that individuals with low opportunities to evade are just indifferent between evasion and non evasion and devote the remaining part to the other group with greater opportunities. The tax enforcement agency should first tackle tax evasion by individuals with lower opportunities to evade.

This policy determines a mixed outcome where honest taxpayers coexist with cheaters, which we couldn't observe in the standard model. In this case, given the assumption that individuals have the same income and same utility function, the feasibility of a mixed equilibrium is explained by individuals having different opportunities to cheat the

government. The disparity in opportunities to evade leads to a mixed equilibrium of honest taxpayers and cheaters, even in a community of individuals with the same income and the same attitudes towards risk.

CHAPTER 1

The standard approach to analyse tax evaders' behaviour: tax evasion as a portfolio choice.

1.1 Introduction

Tax evasion is a significant component of the underground economy and it has important distortionary effects on horizontal and vertical equity, and on the efficiency of the economic system. Increasing attention has been paid by the economic theoretical literature to analyse the behaviour of tax evaders.

The conventional approach is to model tax evasion as an economic crime, committed by an individual who bases the decision to engage in such an illegal activity on the evaluation of monetary costs and benefits. Following the economic model of crime introduced by Gary Becker (1968), attention is focused on a single individual maximising his/her expected utility.

In these models tax evasion is treated as a gamble: an individual chooses the optimal declaration of income in order to maximize his/her own expected utility. Evading is a risky activity in that, if detected, the individual is fined. The taxpayer, in deciding whether or not to evade, evaluates the return from evading and compares it with the certain outcome from a truthful declaration to the tax authority. Therefore the decision is based on an individual evaluation of financial returns, just as in a portfolio model, where

the individual decides how to allocate his initial endowment (actual income) between a safe asset (true declared income) and a risky asset (concealed income) in order to maximise expected utility.

In this chapter we shall present one of these seminal models on tax evasion: the Yitzhaki model and discuss some its predictions in the light of empirical evidence. We will identify three main puzzling results and then briefly review the main developments of the economic theoretical literature, which extended and modified some of the original assumptions. A substantial change in the interpretation of why individuals decide to evade is offered by models that consider social interactions among taxpayers. These models allow for the consideration of individuals being motivated by non-selfish attitudes and assume tax compliance as an ethical behaviour. Given the novelty of the approach and the support received by these models from other disciplines such as psychology and sociology we devote chapter 2 to analyse the role of morals in tax evasion.

1.2 The standard portfolio model

In the standard portfolio approach tax evasion is modelled as a gamble. The representative tax payer has to make a choice between a non risky activity (paying the due amount of taxes) and a risky activity (declaring only part of his/her income to the tax authority). If the individual opts for the risky activity his/her income will depend on two states of the world: detection and non detection. If the individual is not detected,

he/she will enjoy a greater net income than from a truthful declaration. If the tax authority performs an audit and the individual is detected he/she will have to pay the due amount of taxes and a fine applied on the amount of evasion and will attain a lower net income than from an honest declaration.

The individual will choose the amount of declared income that maximises his/her expected utility, given the tax parameters fixed by the tax authority.

The first portfolio model was developed by Allingham and Sandmo (1972). In the next section we consider the Yitzhaki model (1974). The only difference between the two models is the assumption regarding the fine rate: in the Yitzhaki model the fine is imposed on evaded tax, whereas in the Allingham-Sandmo model is applied on evaded income. As we shall see, this assumption will affect the relationship between declared income and the tax rate.

1.2.1 The tax authority

In the standard portfolio model the tax authority sets the tax rate, the probability of detection and the fine rate independently from the taxpayer's decision. There is no interaction between the tax authority and the representative tax-payer and this latter takes the tax parameters as exogenously given.

The tax authority asks the individual for a self-declaration of his/her income, which will be the basis to calculate the tax burden.

The tax is levied at a constant rate (t) on declared income. The probability of detection (p) is fixed and corresponds to the probability of being audited: we should mention that in these models the audit is always successful, so that in case of evasion an investigation automatically implies detection and therefore punishment. In case of detection a fine (f) is applied on evaded tax. It is assumed that $f > 1$. All the fiscal parameters are known to the taxpayer.

1.2.2 The representative taxpayer

The individual may choose either to honestly declare his/her income or to cheat the government and declare less than his/her actual income. In the latter case he/she faces two states of the world: being investigated and punished or not being investigated and getting away with it. In the good state of not being investigated the individual can attain an outcome, W_g, which is always better than the certain outcome from a truthful declaration, whereas in the bad state of detection the individual is worse off, getting an outcome of W_b. It is assumed that:

- the taxpayer's behaviour conforms to the Von-Neumann Morgenstern axioms for behaviour under uncertainty,

- the utility function has income as its only argument,

- actual income (Y) is exogenously given,

- the individual is risk averse.

The taxpayer chooses the amount of income to declare (I) in order to maximise expected utility:

$$\max_I EU = (1-p)U(W_g) + pU(W_b) \tag{1}$$

$s.t.$

$$W_g = Y - tI$$

$$W_b = Y - tI - ft(Y - I)$$

The first order conditions are:

$$t[-(1-p)U'(W_g) + p(f-1)U'(W_b)] = 0 \tag{2}$$

The second order conditions:

$$t^2[(1-p)U''(W_g) + p(f-1)^2 U''(W_b)] < 0 \tag{3}$$

are satisfied by the assumption of concavity of the utility function.

The individual will chose an interior solution, i.e. will evade a positive amount, but less than his/her whole income, when these two conditions are satisfied:

$$\left.\frac{\delta EU}{\delta I}\right|_{I=0} > 0 \Rightarrow -t(1-p)U'(Y) + tpU'[Y(1-ft)](f-1) > 0 \Rightarrow \frac{U'(Y)}{U'[Y(1-ft)]} < \frac{p(f-1)}{(1-p)} \tag{4}$$

$$\left.\frac{\delta EU}{\delta I}\right|_{I=Y} < 0 \Rightarrow -t(1-p)U'[Y(1-t)] + tpU'[Y(1-t)](f-1) < 0 \Rightarrow pf < 1 \tag{5}$$

We can illustrate the individual's optimal choice graphically. We refer to figure 1.1.

Point A on the certainty line represents a truthful declaration: the outcome in both states of the world is identical because the individual declares all of his/her income $(Y = I)$.

Point B represents instead a full evasion situation $(I = 0)$: the taxpayer does not declare his/her income. If he/she is not detected his/her net income corresponds to the actual income (Y); but if he/she is detected he/she will pay the due tax and the fine and his/her actual income will be $(Y\text{-}ftY)$. The segment AB represents the taxpayer's budget constraint. Between A and B the individual declares an amount of income which is less than his actual income $(I < Y)$. The closer the point to B the greater evaded income $(Y\text{-}I)$. The optimal declaration of income corresponds to the point of tangency between the taxpayer's indifference curve and the budget constraint at which the individual's expected utility is maximized. In figure 1 point E represents the optimal declaration. It's an interior solution. At E the slope of the budget constraint $(1\text{-}f)$ equals the slope of the

indifference curve $-\dfrac{(1-p)U'(W_g)}{pU'(W_b)}$.

At point A the slope of the indifference curve is $-\dfrac{(1-p)}{p}$ and the indifference curve is steeper than the budget constraint:

$$-\frac{(1-p)}{p} < 1 - f \Rightarrow pf < 1$$

which is condition (5) above, which rules out the case of a truthful declaration as the optimal choice for the taxpayer. This implies that whenever the expected fine (pf) is less than 1 the individual will evade.

We can interpret (*1-pf*) as the expected financial gain for an extra $1 of income hidden from tax authorities. In fact an extra dollar of evasion gives a return of *t* in the good state (non detection) and (*t-ft*) in the bad state (detection). Therefore the expected financial gain from evading one extra unit of income is:

$$(1-p)t + p(t-ft) = (1-pf)t$$

Therefore condition (5) implies that the individual will evade whenever the expected financial gain for an extra $1 of evasion is positive.

At point B the slope of the indifference curve is $-\dfrac{(1-p)U'(Y)}{pU'(Y(1-ft))}$ and the indifference curve is flatter than the budget constraint:

$$-\frac{(1-p)U'(Y)}{pU'(Y(1-ft))} > 1-f \Rightarrow \frac{U'(Y)}{U'(Y(1-ft))} < \frac{p(f-1)}{(1-p)}$$

which is condition (4) above.

Putting these two conditions together we are able to define a set of positive parameter values which will guarantee an interior solution,i.e. the taxpayer will partially declare his/her actual income.

$$\frac{U'(Y)}{U'(Y - ftY)}(1 - p) + p < pf < 1$$

Tax evasion is represented as an individualistic decision based on the evaluation of the expected monetary returns, in analogy with a portfolio decision. The individual will evade if the expected financial gain from evading is positive.

1.2.3 Comparative statics: the effect of a change in the tax parameter on the optimal choice

The effect of a *change in the tax rate* on declared income is given by:

$$\frac{\delta I}{\delta t} = -\frac{t}{D}(1 - p)U'(W_g)\{I[R_A(W_b) - R_A(W_g)] + f(Y - I)R_A(W_b)\}$$

$$\text{with } R_A(W_g) = -\frac{U''(W_g)}{U'(W_g)}, R_A(W_b) = -\frac{U''(W_b)}{U'(W_b)} \tag{6}$$

$$\text{and } D = t^2[(1 - p)U''(W_g) + p(f - 1)^2 U''(W_b)] < 0$$

Under the assumption of decreasing absolute risk aversion $R_A(W_b)$ is greater than $R_A(W_g)$ and the above expression is positive: as the tax rate increases declared income increases, i.e. evaded income decreases. The underlying intuition is that an increase in the tax rate for a single individual simply reduces his/her resources and the individual is less willing to take risk with lower income.

A diagram gives us a clearer explanation. We refer to figure 1.2. An increase in the tax rate will decrease income in both states of the world and shift the budget constraint

downwards (*A'B'*); in fact the slope of the budget constraint *(1-f)* is not affected by a change in the tax rate. We have a pure income effect: under decreasing absolute risk aversion if the individual faces a decrease in income he/she will become less willing to take risk and therefore the amount of evasion will decrease. The new point of tangency between the indifference curve and the budget constraint (*E'*) will lie to the left of the Constant Absolute Risk Aversion (CARA) line, which represents the combinations of W_b and W_g for which a variation in income does not affect the individual's willingness to accept risk, i.e. when absolute risk aversion is constant. Clearly the distance *A'E'* is less than the *AE*, this implies that the risk associated with E' is less than E.

Therefore under decreasing risk aversion an increase in the tax rate will lead unambigously to an increase in declared income , i.e. to a decrease in tax evasion.

This prediction seemed to solve the ambiguous results found by Allingham and Sandmo. In their model the fine is imposed on evaded income. The individual chooses the amount to declared which maximises his/her expected utility:

$$\max_{I} EU = (1-p)U(W_g) + pU(W_b)$$

$$s.t.$$

$$W_g = Y - tI$$

$$W_b = Y - tI - f(Y-I)$$

(1')

The fine rate is applied to evaded income (*Y-I*), rather than on evaded tax. Graphically this assumption will affect the slope of the budget constraint which becomes *1-f/t*. We illustrate this in figure 1.3. The optimal level of declared income is *E*, where the slope of

the indifference curve equals the slope of the budget constraint. An increase in the tax rate rotates the budget constraint, which becomes flatter. Note that point B is not affected by the tax rate.

There are two counteracting effects:

1) an income effect: an increase in the tax rate makes the individual less wealthy, reducing both W_g and W_b for a given I. Under decreasing absolute risk aversion the risky activity, i.e. the level of tax evasion, decreases;

2) a substitution effect: an increase in the tax rate increases the expected financial gain for an extra unit of evaded income (t-pf), making it more profitable to evade taxes on the margin[1]. In other words the entry condition for an understatement of actual income (in this model it is $t > pf$) becomes less restrictive and the individual is more inclined to evade[2].

The total effect depends on the magnitude of these two components. There are three possibilities:

a) income effect > substitution effect: the decrease in income has a greater impact than the increase in the expected monetary gain on evasion and the new optimal level of declared income will lie to the left of E and of the CARA line;

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[1]In this case an extra $1 of evasion gives a return t in the good state (non detection), and (t-f) in the bad state (detection). Therefore the expected financial gain from evading one unit of income is: $(1 - p)t + p(t - f) = t - pf$.

b) income effect = substitution effect: the decrease in income completely offsets the greater profitability of tax evasion on the margin and the optimal level of declared income will not change. The new point of tangency will be along the CARA line, even if the individual is risk averse;

c) income effect < substitution effect: tax evasion will increase and the new equilibrium will be to the right of E and of the CARA line, closer to B than before.

In the Yitzhaki model there is no substitution effect because the expected financial gain for $1 of evasion $(1-pf)$ is not affected by the tax rate. Therefore we get an unambiguous result, merely based on an income effect.

By differentiating (2) with respect to the *probability of detection* and the *fine rate* we get the effect of a change in these two parameters on the optimal declared income. It can be shown that an increase in the probability of detection or in the fine rate will have an unambiguous effect on declared income, which will rise. This result is found both in the Allingham- Sandmo and in the Yitzhaki model.

We illustrate the effect of an increase in the probability of detection in figure 1.4. An increase in the probability of detection affects the slope of the indifference curve, which rotates anticlockwise: optimal declared income moves from E to E', where less tax evasion is undertaken.

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[2] It is derived from $\frac{\delta E (U)}{\delta I}\Big|_{I=Y} < 0 \Rightarrow pf < t$, which corresponds to condition 5 above. It states that before an individual decides to evade , i.e. when Y=I, the expected financial gain from evading (t-pf) must be positive.

In figure 1.5 we illustrate the effect of an increase in the fine rate. An increase in the penalty rate rotates the budget constraint clockwise, the optimal choice for the individual will lie to the left of the CARA line and the individual will choose to evade less.

In figures 1.4 and 1.5 we use the Yitzhaki assumption that the fine rate is applied to evaded tax, however it can be shown that the same result is obtained in Allingham and Sandmo.

1.3 The standard portfolio model in the light of empirical evidence

The evidence on taxpayers' behaviour collected by empirical studies does not match some of the predictions of the standard model. In particular there are three main problems with the portfolio approach.

• The prediction that an increase in the tax rate decreases tax evasion, as in Yitzhaki model, is counterintuitive and is not supported by empirical evidence. The findings of econometric and experimental studies on the relationship between the tax rate and tax evasion suggest that tax rates have a significant effect on the amount of evasion and tend to stimulate tax evasion. In general, increases in marginal tax rates tend to increase both the level of unreported income and also the proportion of income underreported[3].

• Second, if we extend the analysis of the standard model to multiple individuals, each behaving as an expected utility maximiser and facing a fixed probability of detection, it is not possible to get a mixed equilibrium where some individuals evade and some others do not.

A diagram is useful in illustrating this point. We refer to figure 1.6.

Figure 1.6 illustrates the zero evasion choice for individuals with three different sets of preferences: more bowed indifference curves along the 45° line represent higher risk

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[3] See Clotfelter (1983), Crane and Nouzard (1986), Feinstein (1991), Alm et al. (1993) for econometric evidence and Friedland et al. (1978) for experimental evidence.

aversion. The individual whose preferences are represented by the indifference curve IC_3 is the most risk averse.

When the individual honestly declares his/her income to the tax authority, income in both states of the world is the same. Graphically the point corresponding to the zero evasion choice lies on the 45° line, where the slope of the indifference curve, with state independent utility functions, is $-\dfrac{(1-p)}{p}$.

With a fixed probability of detection, equal for everybody, the decision not to evade will be triggered by a unique value of the probability of detection, irrespective of the degree of risk aversion. We illustrate this in figure 1.7. The line AB is the budget constraint with slope 1-f. For non-evasion to be the optimal choice, it must be the case that an individual's indifference curve is tangent to the budget constraint along the 45° line.

In the diagram this occurs at point A, where all the three indifference curves have the same slope, equal to the slope of the budget constraint: $-(f-1) = -\dfrac{(1-p)}{p}$, i.e. $p = \dfrac{1}{f}$.

Therefore, whenever the probability of detection assumes a value at least equal to $\dfrac{1}{f}$, then nobody will evade, even if individuals differ in the degree of risk aversion.

If, instead, the actual probability of detection falls below $\dfrac{1}{f}$, then everybody will evade.

In this case the slope of the indifference curve along the 45° line is greater than the slope of the budget constraint. We illustrate this case in figure 1.7, for a given probability of detection: the dotted line AB' is the new budget constraint, flatter than the original one,

in order to allow the probability of detection to fall below $\frac{1}{f}$. With the new budget

constraint it is always optimal to evade, in that the individuals with the sets of

preferences represented by IC_1, IC_2, and IC_3 can reach a higher indifference curve, if

they evade.

Hence a mixed equilibrium, where some individuals opt for an honest declaration and

some others cheat the tax authority, is not feasible, even if we allow for different

degrees of risk aversion.

Under the assumptions that individuals are expected utility maximisers and that the

probability of detection is the same for everybody, the choice whether or not to evade is

determined by the value of the fine rate and the probability of detection, irrespective of

the degree of risk aversion.

In figures 1.6 and 1.7 we represent three different degrees of risk aversion. However the

result of the impossibility of a mixed outcome holds for any the degree of risk aversion,

as long as individuals are expected utility maximisers and face the same probability of

detection.

This result may be driven by the assumption of state independent utility functions: the

utility function depends only on the individual's income and not on the state of the

world. The utility in the bad state of detection is represented by:

$$U(W_b) = U[Y - tI - ft(Y - I)] \tag{7}$$

and the utility in the good state is:

$$U(W_g) = U[Y - tI] \tag{8}$$

When the individual honestly declares his/her income to the tax authority, income in both states of the world is equal:

$$W_b = W_g = W = Y(1-t) \tag{9}$$

and the individual gets the same utility, irrespective of the fact of being audited:

$$U(W_b) = U(W_g) = U(W) \tag{10}$$

This implies that the audit has no impact on an honest taxpayer: the utility he/she gets from being honest is the same, both in case he receives an audit and in the case he/she does not. In chapter 4 we shall see that this may not be the case in that individuals may dislike being audited by the fiscal authority, even in the case of a truthful declaration: the simple fact of having tax inspectors around may make them worse off. The audit may impose a psychic cost, even in the case of a truthful declaration. We shall model this situation by use of state dependent utility functions and see that the condition for entering tax evasion is not solely determined by the fine rate and the probability of detection and a mixed equilibrium become feasible.

• A third puzzle of the standard portfolio model is that it tends to overestimate the amount of tax evasion.

According to the evidence provided by micro data on tax evasion, people tend to evade less than is predicted by the standard portfolio model. As reported by Andreoni et al. (1998), US data collected for the Tax Compliance Measurement Program[4] in 1988 reveal that about 40% of U.S. households underpaid their taxes for that year, 53 % paid correctly and 7% overpaid. Assuming that overpayments are due to error and that a comparable portion of underpayments also is due to error, this would imply that about two-thirds of all taxpayers intended to pay their taxes correctly.

The same source of data suggests that for the US IRS, the audit rate has been falling over time since the 1960s, reaching 1.7% in 1995. Moreover penalties are quite infrequently imposed. Hence, the expected cost of detection would appear to be extremely low for most taxpayers, especially for small amounts of evasion such as slightly overstating charitable deductions or failing to report minor amounts of income.

If we were to apply the predictions of the standard portfolio model, we should expect a widespread non-compliance. The IRS estimates that for tax year 1992, provides the opposite evidence: 91.7% of all income that should have been reported was in fact reported.

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[4] As we shall consider in the next section the TCMP consists of intensive audits of a randomly selected group of taxpayers by experienced IRS tax examiners, with the aim of refining the audit selection mechanism. It provides the best available data on non-compliance.

We could argue that the tendency to overestimate tax evasion attributed to the theoretical models may be due to the assumption made in these models that income is equally easy to hide. In reality many types of income cannot be easily hidden, for example income taxed at source, so that, given gross income, the amount of observed evasion is necessarily less than expected by the standard models.

On the other hand, it would be interesting to find out the categories of taxpayers who are responsible for the above figure of 8.3% of concealed income. It might be the case that most individuals comply with their tax duty because they do not have many opportunities to cheat the tax authority. The percentage of hidden income should be calculated relative to that part of income that is actually possible to conceal, in order to have a reliable estimate of taxpayers' honesty. It might be the case that out of total income only a limited proportion can be discretionarily hidden by a taxpayer. The above figure of 8.3% for hidden income may actually imply a substantial amount of evasion, once adjusted for actual opportunities to evade, and may make people appear more honest than they actually are.

The fact that individuals may appear (we'd better be cautious!!) to be more honest than predicted by the standard portfolio model has encouraged further research, both empirical and theoretical.

Andreoni et al. provide alternative explanations on why many households may be honest. One explanation could be the dramatic increase in information reporting in the

U.S. since the 1960s, and the fact that now the vast majority of information documents are received on magnetic media, which greatly simplifies the matching of such documents to income tax returns. As noted by Andreoni "...Information reporting severely limits the scope for tax evasion on many significant income and deduction items, such as wages and salaries, interest, pensions, and mortgage interest payments"[5]. This, however, is not sufficient to explain the 91.7% compliance rate. Although information reporting is extensive in the U.S., certain income sources and certain deductions remain exempt from reporting requirements, and, according to IRS estimates, for tax year 1992, only ¾ of income that should be reported is subject to information reporting[6].

Another explanation for the observed extent of honesty may be the fact people tend to overestimate both the probability of an audit and the fine: empirical studies indicate that individuals make poor predictions of the probability of audit and magnitude of fines from tax evasion.

Personal characteristics such as age and marital status could also determine an individual's choice towards evasion: TCMP statistics indicate that married filers and taxpayers under 65 years of age have significantly higher average levels of non-compliance than their counterparts.

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[5] Andreoni (1998), p. 821.
[6] An interesting fact pointed out by Andreoni is that taxpayers with income sources that continue to be exempt from reporting requirements, such as income from farms or sole proprietorship, tend to understate their taxes by substantially more than other taxpayers. This would confirm the point we made above that the apparent greater compliance among taxpayers may be explained by the lack of opportunities to evade, rather than by personal convictions towards honesty.

People may also decide to comply with their tax duties because they fear social stigma or damage to their reputation if they were exposed as cheaters. In particular Andreoni et al. distinguish three social factors that could be responsible for driving an individual choice whether or not to evade. Moral rules and sentiments, issues of fairness, of either the tax code or its enforcement, and the evaluation of government expenditures and government corruption could directly guide individual reporting decisions.

In the light of these considerations the analysis of the standard portfolio model appears to depict only a partial picture of tax evaders' behaviour. Subsequent developments of the standard model have been proposed since the seminal work of Allingham-Sandmo and Yitzhaki, some of them with the precise intention to solve some of the puzzles pointed out above. In the next section we briefly recall the major developments.

1.4 Developments of the standard model

In the previous section we pointed out that the prediction of the Yitzhaki model according to which an increase in the tax rate leads to a decrease in tax evasion is both counterintuitive and not supported by empirical evidence. Some authors have addressed this issue and extended the standard approach. Cowell-Gordon (1988) for example analyse the influence of the quantity of public goods on the relationship between the tax rate and the amount of evasion and suggest that the effect of an increase in the tax rate on tax evasion depends on whether public goods are under- or over-provided. In particular, under the assumption of decreasing absolute risk aversion, they show that in

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case of under-provision of the public good an increase in the tax rate leads to an increase in tax evasion, whereas if the public good is over-provided an increase in the tax rate makes evasion decrease. The underlying intuition is that, if the public good is under-provided, an increase in the tax rate is perceived as an increase in real income and hence, under the assumption of decreasing absolute risk aversion, the individual will be more willing to accept risk, and he/she will increase tax evasion. If the public good is over-provided an increase in the tax rate will be perceived as a decrease in income. Hence the individual will be less willing to accept the risk of being detected by the tax authority and fined and will decrease tax evasion.

Other contributions have relaxed the assumption of the portfolio model according to which income is exogenously determined. In those models the decision to evade is related to the labour supply decision: successful income tax evasion raises the worker's net wage and this has an impact on his/her labour supply. The decisions about labour supply and tax evasion are made jointly and actual income becomes endogenous. However the analysis gets quite complicated, at the expense of clear-cut results for the comparative statics, in that there are no clear predictions on the impact of a change in any of the tax parameters on tax evasion.

We refer the interested reader to Pyle (1989, ch.5) for a more detailed survey of this literature.

An extension of the models with endogenous income is provided by Sproule (1985), who analyses the impact of imperfect information about the tax parameters on the individual choice of how much time to devote to the legal economy, to the hidden

economy and to leisure. It is worth mentioning this contribution in that the theoretical models on tax evasion usually assume perfect knowledge of all the tax parameters by the taxpayers. Sproule shows that a decrease in either the uncertainty of the probability of detection or of the fine rate increases the optimal amount of time devoted to the hidden economy, decreases the optimal amount of time devoted to the legal economy and has ambiguous effects on the time devoted to leisure. This prediction would be consistent with what indicated by empirical studies. As we mentioned above, people might evade less than predicted by the standard model because they are uncertain about the probability of detection and tend to overestimate it.

Later contributions have analysed, by use of game theoretical models, the interaction between taxpayers and the tax authority, under the assumption that the choice of the tax parameters depends on the extent of evasion, in that taxpayers' decisions have an impact on the tax revenues raised by the Government. The aim of these models consists of deriving optimal strategies for the tax authority given the presence of interactions with taxpayers. We refer to Pyle (1989, Ch. 8) for an overview of these models. In chapter 5 we shall mention some of these models in that our work is related to that literature.

Here we only point out that in general the optimal policy is such that individuals face different probabilities of detection, fine rates and tax rates, so that a mixed outcome with evaders and non-evaders becomes feasible.

In all these models the decision about evasion is examined by use of the standard economic approach: the analyses focus on a representative taxpayer who maximises his/her expected utility and is motivated purely by monetary and selfish considerations.

A recent development for the analysis of tax evasion, which moves from the standard economic approach, is provided by models that examine the role of social interactions among taxpayers on the decision whether or not to evade. In those models the representative taxpayer interacts with the other members of the community, and tax compliance assumes the characteristic of a social norm. Individuals attach a moral content to tax compliance and a breach of the social norm implies a loss in utility in the form of a psychic cost or social stigma. Hence utility is not only a function of income but it is also affected by non-monetary factors such as psychic costs or social stigma, to be incurred in case of evasion. These models allow for the consideration of non-selfish attitudes that may prevent individuals to evade.

As we already mentioned, the presence of moral rules and sentiments is a possible explanation for the apparent tendency to evade less than predicted by the standard model.

The approach generally adopted by the standard models on tax evasion and by the developments mentioned above is based on expected utility theory. Other authors have criticised the adoption of expected utility theory to analyse tax payers' behaviour, on the ground that individuals are not perfectly rational and their behaviour violates the principles of expected utility theory. It is worth mentioning the contribution of Robben (1991), Webley (1991), Elffers-Hessing (1997) and Yaniv (1999), who suggest the use

of prospect theory to analyse tax payers' behaviour. In line with Kahneman-Tversky (1979), these authors take the view that individuals are not rational decision makers. In making a choice over a prospect they will assign a value to gains and losses rather than to final states of wealth and they will adopt different preferences, depending on whether they expect a gain or a loss. In particular, given that they tend to underweight outcomes that are merely probable in comparison with outcomes that are obtained with certainty, they will be risk averse in choices involving sure gains and risk seeking in choices involving sure losses. These authors analyse tax payers' decision to file their tax return when they have to make advance tax payments to the tax authority. When prepaid taxes are greater than true tax liability, the taxpayer will expect a gain (a refund from the tax authority) from filing a tax return, and hence will be risk averse and opt to avoid the risk of an untruthful declaration. Whereas if prepaid taxes are less than the true tax liability, the tax payer will expect a loss (the additional payment to the tax authority) and hence will be risk seeking and opt for evasion. The amount of advance payment affects the entry condition for evasion, which becomes more restrictive, as well as the extent of evasion. The implication is that obligatory advance payments may substitute for costly detection efforts in enhancing compliance, in that the tax authority by setting the advance levies slightly too high could ensure a gain from filing a tax return and hence induce tax payers to opt for an honest declaration. We refer the interested reader to Yaniv (1999) for a formal model. His analysis shows that, if taxpayers substantially overweight the actual low probability of detection, high advance payments are likely to eliminate the incentives for non-compliance.

In this thesis we follow the approach of most of the literature on tax evasion and concentrate on expected utility models. We devote the next chapter to the analysis of models on social interactions, which analyse the role of morals on tax payer's behaviour. This with the view to find out if the puzzling predictions of the standard model concerning the effect of a change in the tax rate and a mixed equilibrium still hold.

1.5 Conclusion

In this chapter we considered the seminal theoretical models on tax evasion developed in the economic literature. We focused our attention on the standard portfolio model according to which tax evasion is a portfolio choice, determined by monetary considerations.

Some of its predictions are at odds with empirical evidence. We briefly presented the main developments of the theoretical literature, which were aimed at solving some of the predictions that do not seem to be supported by empirical evidence. Among these we mentioned the models on social interactions, which consider individuals being motivated not only by monetary considerations but also by moral sentiments. In particular these models allows for non-selfish behaviour among tax payers which may prevent them to evade even if the expected pecuniary gains are positive. We devote the next chapter to the analysis of these models and to the empirical evidence on the role of morals on tax payers' behaviour.

Figure 1.1

Figure 1.2

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Figure 1.3

Figure 1.4

W_b

W_g

CARA line

$Y(1-t)$

$Y-tl-ft(Y-l)$

$Y(1-ft)$

A

E'

E

B

$Y(1-t)$ $Y-tl$ Y

Figure 1.5

Figure 1.6

W_b

$Y(1-t)$

IC_3 IC_2

IC_1

$= -\dfrac{(1-p)}{p}$

$Y(1-t)$

W_g

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W_b

W_g

IC_3

IC_2

IC_1

A

B

$Y(1-t)$

$Y(1-ft)$

$Y(1-t)$

Y

$-\dfrac{(1-p)}{p} > -(f-1) \Rightarrow p < \dfrac{1}{f}$

$-\dfrac{(1-p)}{p} = -(f-1) \Rightarrow p = \dfrac{1}{f}$

Figure 1.7

42
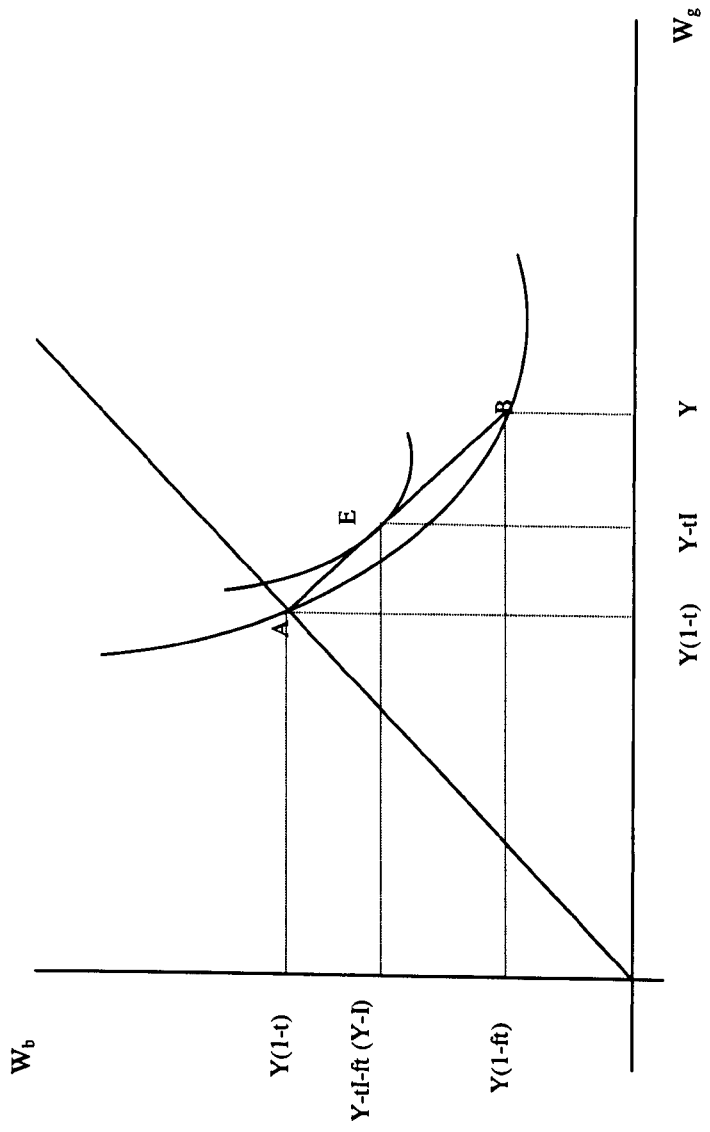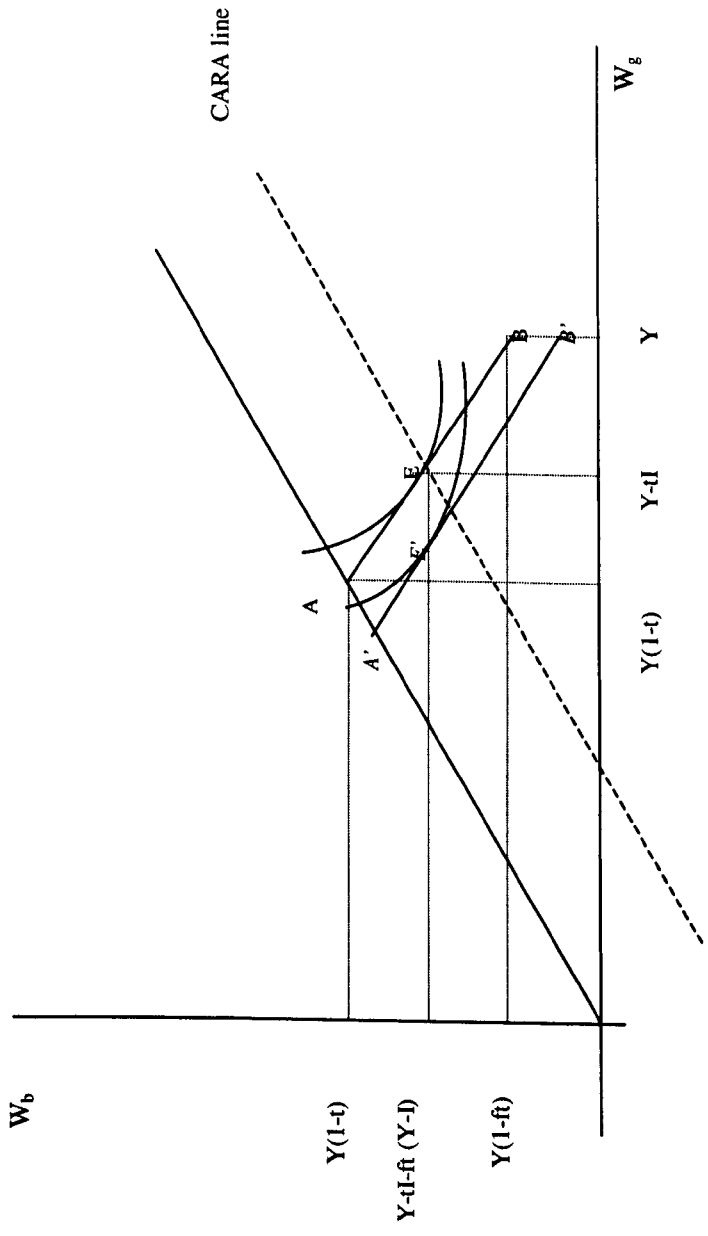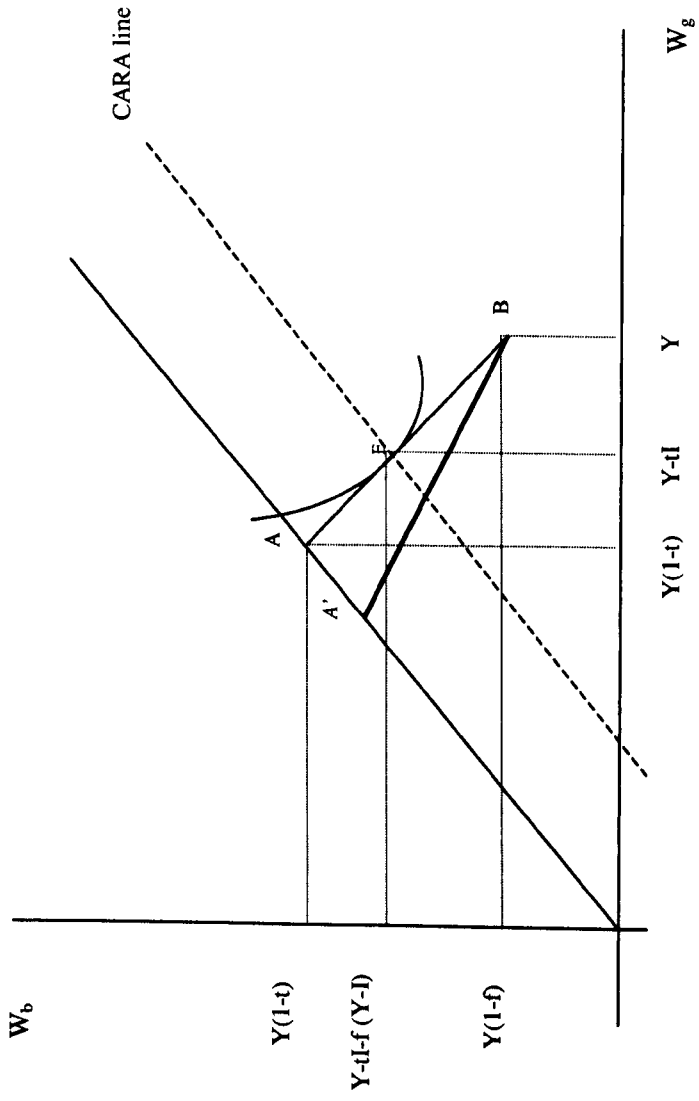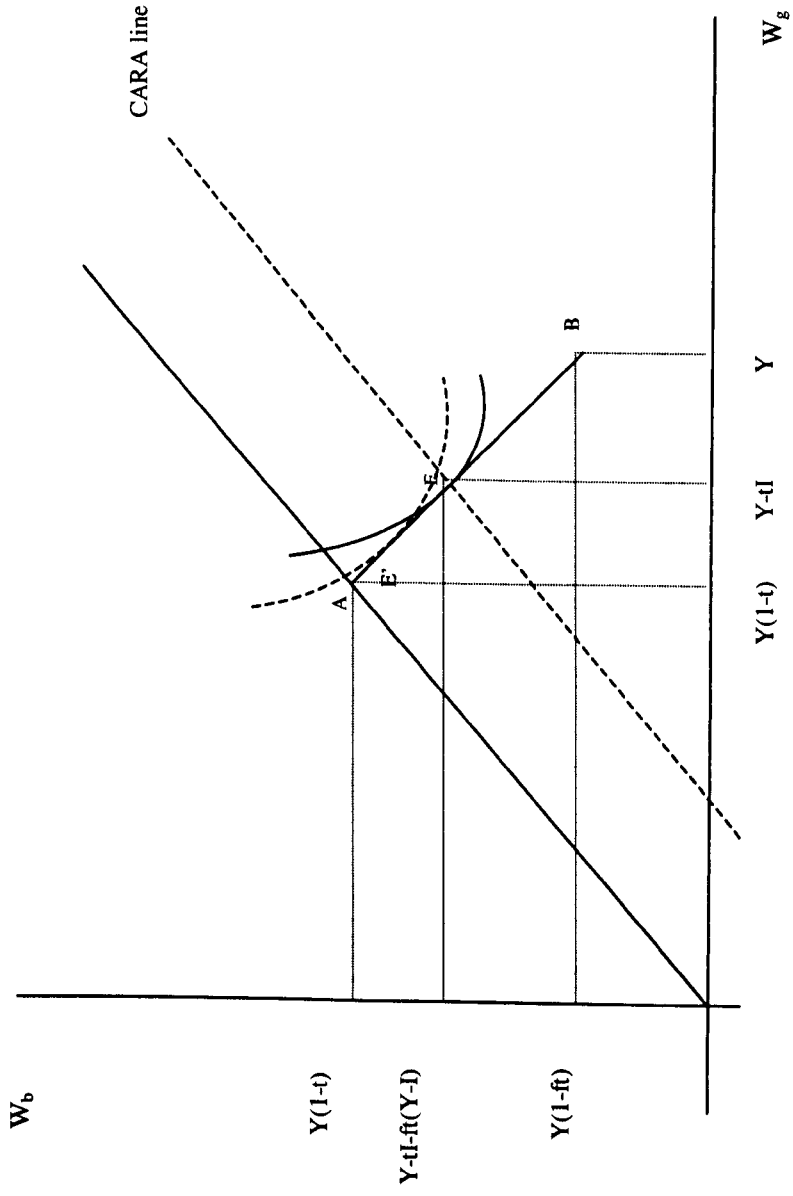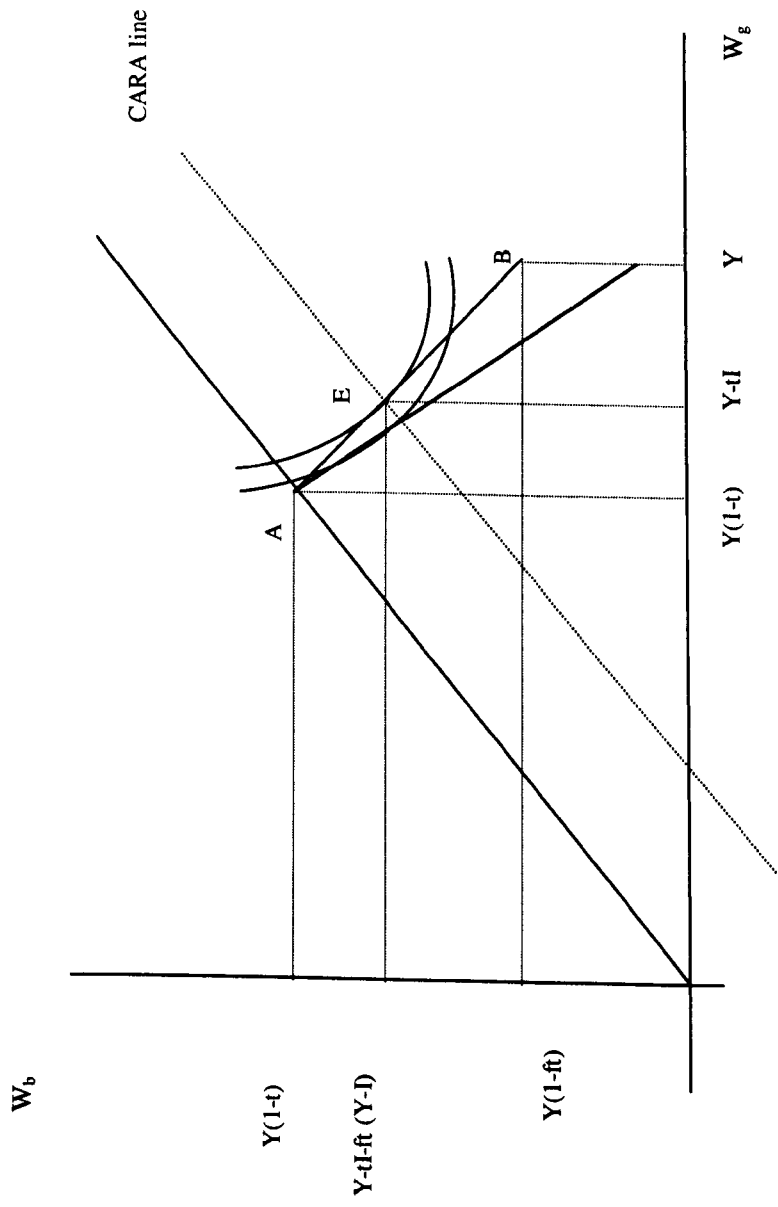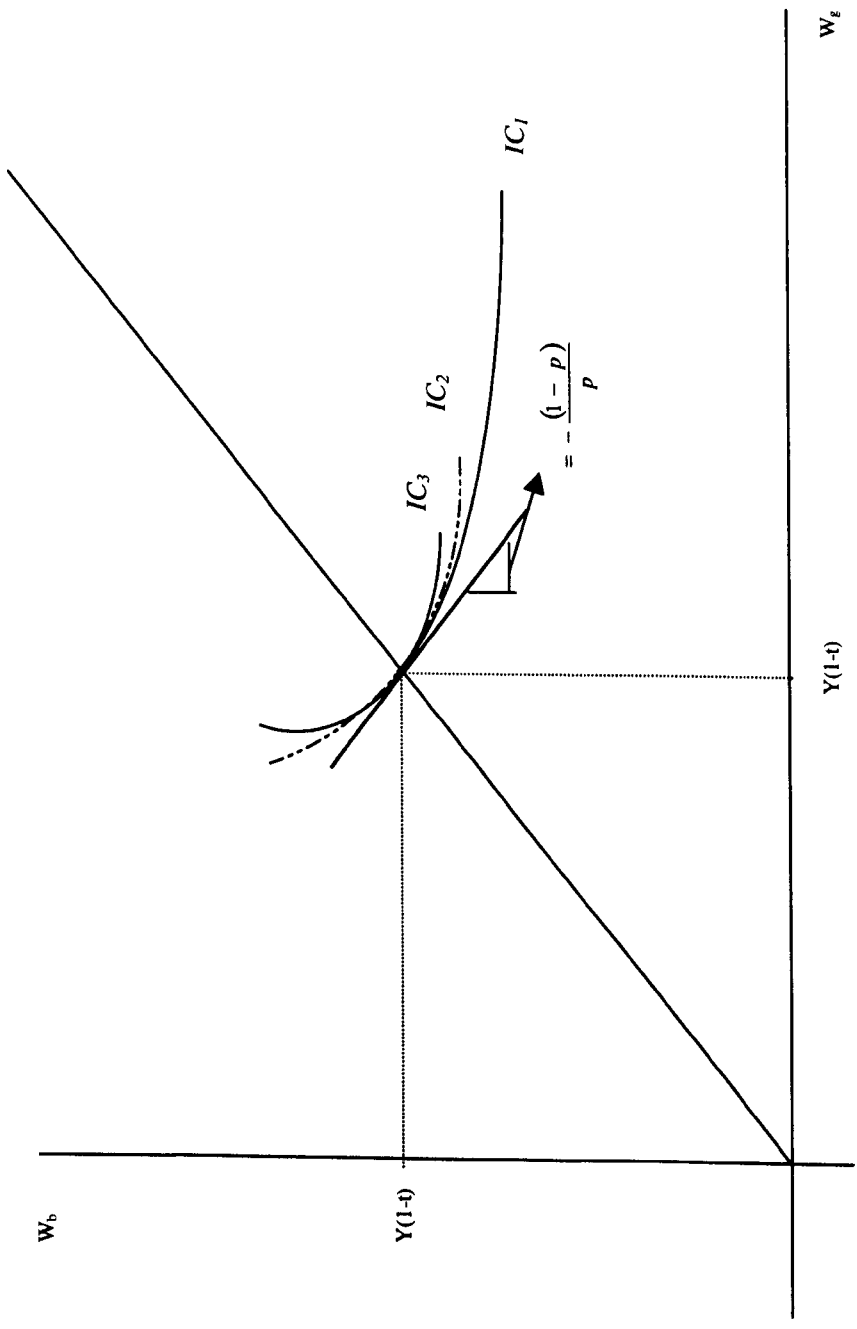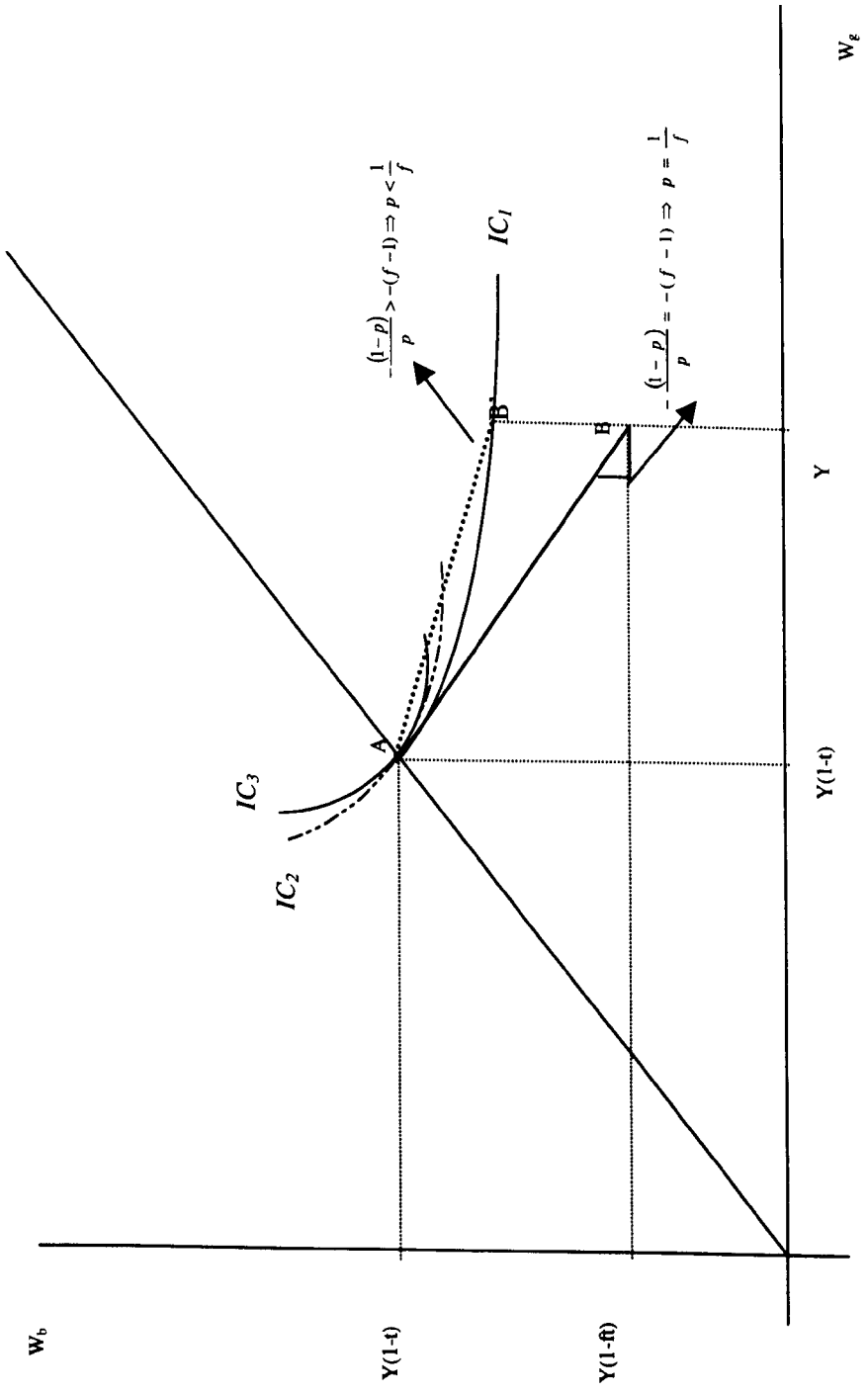
Chapter 2

The role of morals in deterring tax evasion: tax compliance as an ethical behaviour.

2.1 Introduction

In this chapter we consider the role of morals in tax evasion. As already mentioned in chapter 1, a category of theoretical models have recently been developed to address the issue that in practice tax payers tend to be more honest than expected by the standard portfolio model, because their decision is influenced by moral rules and sentiments. The novelty of these models is the consideration of social interactions among tax payers, responsible for the emergence of tax compliance as a social norm, embodying a moral content. In the standard portfolio model tax compliance is merely regarded as a legal norm and the representative tax payer decides whether or not to evade without considering the behaviour of his/her peers.

The consideration of tax compliance as a social norm rather than a legal norm implies that the mechanism of enforcement is more complex. For a legal norm the only mechanism of enforcement is the law. For a social norm the individual is also affected by moral sentiments. In particular in the models on social interactions if an individual

evades, he/she will suffer a psychic cost or a utility loss, incurred irrespective of detection taking place.

A distinction is usually made between private psychic cost and social psychic cost. The former is due to feelings of anxiety, guilt, or fear of reduction in self-image, incurred irrespective of the act of evasion being observed. It is generated internally, from the knowledge of doing wrong. The latter is related to the damage of reputation suffered for being detected in front of the others and hence it is mediated externally via other's people view: its impact on the utility function depends on the proportion of people believed to condemn tax evasion. The greater such a proportion the greater the impact of social stigma costs on the utility function.

The mechanism of enforcement in the case of a private psychic cost relies on the inhibitory power of social conscience and civic responsibility. Individuals hold a personal conviction towards non evasion and are prepared to adhere to it, even if the other members of the community cannot observe any cheating activity.

In the case of a social psychic cost the mechanism of enforcement is more related to the loss of reputation and esteem from others, and the loss in utility depends on whether it is observed by other individuals. These latter must regard the act of cheating as morally wrong. The impact of a social psychic cost depends on the probability of being found out by other honest taxpayers. Therefore the social psychic cost should enter the utility function as a probabilistic term: a probability of detection by honest taxpayers needs to be put in front of the cost.

This reflects the distinction emphasised by sociological theories of social control[1] between the inhibitory power of moral commitment to the law and the inhibitory power of the threat of social disapproval. Both aspects have inhibitory effects on illegal behaviour and contribute together with legal punishment to deter illegal acts.

We should note that in the case where individuals follow the social norm because are concerned about how they would appear in front of the others, and not because they personally think it is the right thing to do, that social norm may be less stable. The enforcement mechanism consists exclusively of the threat of losing one's reputation and the social custom might be sustained by hypocrisy rather than a genuine and personal intention. If, for some reasons, the number of evaders increases these individuals will switch their behaviour more easily. We will discuss this aspect in more detail in chapter 3, section 3.3.

Moreover, given the nature of tax evasion, honest taxpayers may find it difficult to detect cheaters, so that the expected value of the social psychic cost may be very low.

The models on social interactions are able to explain the apparent tendency to evade less than predicted by the standard portfolio model because the entry condition for evasion becomes more restrictive. In particular the existence of a positive expected monetary gain from evasion is no longer a necessary and sufficient condition to evade because the expected financial gain from evasion must exceed the psychic cost or loss in utility.

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[1] See Grasmick-Green (1980) and Wrong (1961).

This chapter includes two main parts: in the first one we consider the economic theoretical literature on the role of morals on tax evasion, and in the second part we present the results of empirical studies on this issue.

As far as the theoretical literature is concerned, we shall briefly present the arguments of two models on the role of psychic costs in deterring tax evasion, we then analyse in greater detail Myles and Naylor's (1996) model, which considers tax compliance as a social custom. The reason for focusing on this particular model is that in chapter 3 we extend the same approach to a dynamic context with the view to investigate the reason why individuals should regard tax compliance as a social norm and the stability of such behaviour. We also mention the contribution of Bordignon (1993), who considers the role of fairness considerations on the optimal decision of tax payers.

The empirical evidence on the role of morals on tax evasion is quite scant. After a brief discussion on the difficulties of measuring tax evasion and on the best available data to test individuals' attitudes towards tax evasion, we present some experiments and econometric studies.

2.2 The introduction of psychic costs for evading: the Benjamini-Maital model

Benjamini and Maital (1985) model the assumption that people may not be comfortable with dishonesty and suffer a utility loss or psychic cost when evading. The authors define this utility loss as being due to the fear of apprehension or to the stigma of being discovered from the other members of the community. We should note that their

interpretation of stigma is different than the usual interpretation, to be found in the sociological and psychological literature, where the stigma is suffered only in case of detection by the other members of the community. Here the stigma is incurred irrespective of the state of the world: it is the act of evading itself which is felt as wrong, whether one is found or not. The stigma is modelled as a personal moral cost and is not mediated by the view of the other members of the community.

The taxpayer decision can be represented as follows:

$$\max_I EU = (1-p)[U(W_g) - \bar{v}] + p[U(W_b) - \bar{v}] \tag{1}$$

$$s.t.$$
$$W_g = Y - tI$$
$$W_b = Y - tI - ft(Y - I)$$

$\bar{v}$ is the psychic cost, incurred in case of evasion. It is fixed and exogenous.

The tax parameters are set by the fiscal authority, as in the standard portfolio model.

As the authors show, the effect of introducing a psychic cost affects the entry condition for evasion, which becomes more restrictive, in that the individual will evade if the expected financial gain is greater than the psychic cost from evading. In the standard model tax evasion was triggered when the expected financial gain from evasion was simply positive.

Benjamini and Maital consider also the influence of the expectation of how many other people are also evading (N) on the individual choice to evade.

More specifically the number of people who are evading affects both the utility from evading and the utility from non evading. It is assumed that the individual will benefit psychically when others evade: the individual's utility increases by an amount which is proportional to the number of people evading, even if the individual does not evade. This is a disputable assumption: how an honest taxpayer may benefit psychically from other individuals' dishonest behaviour seems rather difficult to explain. It would seem that Benjamini and Maital do not consider the existence of a public good financed by tax revenues. In this case there would be a problem of free-riding: if some members of the community did not accomplish their tax duties, they would benefit of the public goods without contributing to their provision, and thus would impose a negative externality on honest taxpayers.

If the individual decides to evade his/her utility will be decreased by the psychic cost. However a higher number of tax evaders in the community positively affects the utility of a dishonest individual: the stigma cost attached to evasion declines for each extra person who evades. Moreover, as in the case for an honest taxpayer, an individual will benefit psychically for each other person who evades.

Formally the utility from evasion and non evasion are represented as follows:

$$U^E = (-B + AN) + CN$$
$$U^{NE} = CN$$

(2)

where $(-B+AN)$ is the stigma cost, A being the decline in stigma cost for each person who evades and C is the utility incurred for each other person who evades independent of whether or not the individual evades.

The authors identify two stable equilibria in which either everybody evades or nobody evades.

We represent the two possible equilibria in figure 2.1. On the horizontal axis we plot the number of evaders and on the vertical axis the utility function. Both the utility from evasion and the utility from non evasion are positively affected by the number of evaders and hence are upward sloping. The utility from evasion is steeper than the utility from non evasion, because the number of evaders not only confers a psychic benefit, C, to the individual but it also decreases the psychic cost of evasion, A. Above $\hat{N}$ the individual will evade.

The authors show that the only stable equilibria are $N^* =N$ (the whole community evades) or $N^* =0$ (Nobody evades). $\hat{N}$ is a knife-edge situation: a small change in the norms (to the right if more people decide to evade, or to the left if more people decide to be more honest) will cause that equilibrium to collapse.

As the authors explain if all individuals have the same utility function and the prevailing social norm is not to evade the expectation that $N=0$ will produce a stable equilibrium where nobody evades. If the norm changes and there is some evasion there can be two case:

1) less than $\hat{N}$ people evade $\Rightarrow$ Eventually society will return to $N=0$

2) more than $\hat{N}$ people evade $\Rightarrow$ A new equilibrium will be reached where everybody evades.

Moreover a decline in the psychic cost (B) lowers the critical level $\hat{N}$ and makes the "everyone evades" equilibrium more likely.

As in the standard portfolio model a mixed outcome is not feasible.

2.3 The distinction between private stigma costs and social stigma costs: Gordon analysis

Gordon (1989) also defines the psychic cost from evasion as a stigma cost. As in Benjamini-Maital this stigma cost has a broader interpretation than in the sociological and psychological literature and assumes the characteristics of a personal moral cost, incurred irrespective of the other members of the community actually observing the act of evading. Gordon distinguishes two types of stigma costs:

- *private stigma cost (v)*, which is a private psychic cost defined as "...anxiety, guilt or a reduction in self image..."from a false income declaration (ibid. [1989]); we could think of it as being determined by cultural influences and education.

- *social stigma cost (R)*, which is a social psychic cost defined as "...damage of reputation suffered upon detection...", in this case it might be determined by the fact of belonging to a community sharing experiences, values and morals.

The private stigma cost is exogenous, varies across individuals and it increases with the amount of evasion, whereas the social stigma cost is the same for everybody but is made endogenous, because it increases linearly with the extent to which the individual feels out of step with society. In particular, the social stigma cost is modelled as a fixed reputation cost, from the individual point of view, and it increases with the proportion of the population, who is believed to consider tax evasion as morally wrong $(1-\mu)$. The taxpayer's decision can be represented as follows:

$$\max_{I_i} EU = (1-p)U(W_g) + pU(W_b) - v_i(Y-I) - (1-\mu)R(Y-I)$$

$$s.t. \tag{3}$$

$$W_g = Y - tI$$

$$W_b = Y - tI - ft(Y-I)$$

This is how Gordon models the private and social stigma costs. However, if the definition of social stigma cost is "..damage of reputation suffered upon detection" the last term in equation (3), representing the social stigma cost, should be a probabilistic term. It should be multiplied by the probability of being detected by other honest individuals. Given that the likelihood of being observed by other individuals in the community is quite small, we could expect this term to be very low. The way Gordon models it is more in terms of a personal moral cost, suffered irrespective of being found out. Its impact is greater the more tax evasion is *perceived* as morally wrong in the rest of the community.

We should point out two important differences with Benjamini-Maital model: in Benjamini-Maital there was just one type of stigma cost and it did not vary across individuals. In Gordon the private stigma cost varies across individuals and the degree of honesty varies in the population of taxpayers.

In Benjamin-Maital the individual benefits psychically from evasion by other individuals. Here there is no psychological benefit from evasion. However, as in Benjamini-Maital, the reputation cost decreases as the number of people evading increases: the greater the number of evaders in the community the lower the cost of losing one's reputation.

The effect of introducing a private and a social psychic cost attached to evasion is to make the entry condition for evasion more restrictive: now the individual will evade if the expected financial gain from evasion is greater than the sum of the private and social psychic cost of evading.

Unlike in Benjamini-Maital, Gordon shows that in this setting an interior equilibrium where honest and dishonest taxpayers coexist can be stable. This is due to the assumption that the private stigma cost varies across individuals: there is a critical private stigma above which individuals will not evade, in that the stigma of being detected is higher than the pecuniary gain from evading. Evaders can be distinguished in large and small evaders, depending on the distribution of the private stigma. For those with a very low private stigma the expected utility will be maximised at a very low level of declared income (large evaders). Those with a higher private stigma cost, which is

however less than the expected pecuniary gain net of the social stigma[2], will choose to evade relatively less (small evaders).

Gordon shows that a sufficient condition for the existence of an interior solution is that the benefits from evasion, which we can define by k, must be of intermediate size, i.e. $\max\{v, R\} > k > \min\{v, R\}$. The equilibrium is stable if the social stigma cost is less than the private stigma cost, i.e. $R < v$.

This model may also solve another puzzle we encountered in the standard portfolio model: the prediction that an increase in the tax rate leads to a decrease in tax evasion.

In particular, the distribution of the parameter v is crucial for determining the effect of an increase in the tax rate.

An increase in the tax rate will have two competing effects. It decreases wealth, which, under decreasing absolute risk aversion, leads to a decrease in tax evasion, and it increases the expected pecuniary gain from evasion.

For large evaders the author demonstrates that the first effect may dominate the second one, whereas for small evaders the opposite applies.

For the initial non-evaders, some of them will find it profitable to evade after the increase in the tax rate, in that the increase in the expected pecuniary gain will outweigh the psychic costs. Therefore the proportion of population who evades increases. Consequently next period the proportion of population who is believed to evade tax will increase, making the reputation cost or social stigma decrease. As a result all the original evaders (included the larger evaders) may well increase their level of tax evasion.

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[2] Otherwise they would declare their full income.

Hence, the more honest the population is initially, the more likely an increase in the tax rate will lead to an increase in tax evasion. This reverses the result in the Yitzhaki model.

2.4 Tax compliance as a social custom: Myles and Naylor model

Myles and Naylor (1996) criticise Gordon's model in that both the private and the social psychic cost depend on the amount of evasion. According to them " *There is no reason why such a relation should hold. For example if the psychic cost is due to the shame of prosecution then the extent of evasion is irrelevant, or if it is due to the fear of detection then it should be dependent on the detection probability rather than the extent of evasion.*"[3]. In their view, a more appropriate way to capture the influence of social interactions in the taxpayer's decision whether or not to evade, can be derived from the social custom and conformity approach.

The underlying idea is that tax compliance is a social custom, which, if followed, gives an individual two extra sources of utility: a *social custom utility* and a *conformity payoff*. When taxes are paid honestly, an individual gets utility from following the social custom and also from conforming with the group of taxpayers.

In particular, the utility function from non evading and from evading are represented as follows:

$$U^{NE} = U[Y(1-t)] + bR(1-\mu) + c \qquad \text{with } b \geq 0, \ c \geq 0 \ \text{ and } R' > 0 \qquad (4)$$

$$U^{E} = (1-p)U(Y-tI) + pU[Y-tI-ft(Y-I)] \qquad (5)$$

bR(1-μ) is the utility of conforming with the group of taxpayers: we can think of it in terms of a non-pecuniary gain from enhancing one's reputation within the community by

being honest. In line with the social custom approach[4], it is assumed that reputation depends on the proportion of individuals who believe in a given code of behaviour, so that the larger the number of believers the more reputation is lost by disobedience of the code. $(1-\mu)$ is the proportion of population not evading.

c is the utility of following the social custom: we can interpret it as a nice feeling for doing the right thing, a sort of warm glow.

The utility from evading is the expected utility as in the standard model.

The main idea of this model is that there are two separate decisions[5]:

- whether or not to evade

- how much to evade

The individual will decide to evade if the utility from evading is greater than the utility from not evading. Once the decision to evade has been taken, the individual will choose the optimal level of evasion in order to maximise the utility from evading.

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[3] Myles and Naylor (1996), p. 50-51.
[4] See Akerlof (1980) and Cowell (1990).
[5] Cowell (1990) also noted that individual's decision towards evasion could be considered as based on a two stage process. "...The two stage process is as follows. Stage 1: The person answers the question "Am I going to be essentially honest or not?". Stage 2: if the answer to the question in stage 1 is that the person is prepared to be dishonest, the person then asks himself "How much shall I do it?" The first stage may involve the possibility of a loss of reputation in the community, and this may not be related to the monetary amount of the wrongdoing. However, once one is prepared to risk public opprobrium if one is found out, one can proceed to calculate the size of the gamble one is prepared to take with the taxman's watchdogs."

The optimal solution is calculated by backward induction: on the basis of the optimal amount of income to declare to the tax authority, the individual compares the utility from evading and the utility from non evading and will choose whether or not to evade. The amount of evasion does not depend on the importance attached to the social custom: as in the standard model, the individual chooses the optimal level of income to declare, I^*, that maximises equation (5).

2.4.1 The decision of a single taxpayer

The decision whether or not to evade is taken by comparing the utility from evading with the utility from non-evading.

The individual will evade if the expected utility from evasion is greater than the utility from non evasion, i.e. if:

$$(1-p)U(Y-tI^*) + pU\big[Y-tI^* - ft(Y-I)\big] > U\big[Y(1-t)\big] + bR(1-\mu) + c \qquad (6)$$

where I^* is the optimal level of declared income. It is possible to show that the decision whether or not to evade is determined by the observed proportion of people evading.

We represent the decision whether or not to evade in figure 2.2. On the horizontal axis we plot the proportion of individuals who evade (μ), on the vertical axis the utility function. The utility from non-evading is negatively affected by the proportion of people evading, in that the greater the number of evaders in the community the smaller the gain in reputation from following the social custom. Hence the utility from non evading is

downward sloping. The utility from evasion does not depend on the number of evaders and can be represented as a straight line. For given income and tax parameters, there will be a critical value μ^* such that the individual is indifferent between evasion and non evasion and (6) is an equality. Hence, if the observed proportion of evaders is exactly μ^* the individual represented in figure 2.2, with given parameters (b,c), will be indifferent between evasion and non evasion. It the proportion of evaders falls below μ^* the individual will prefer not to evade, whereas he/she will opt for evasion if the observed proportion of evaders is greater than the critical level.

In conclusion, a taxpayer of parameters (b,c) will evade if $\mu > \mu^*$ and will not if $\mu \leq \mu^{*}$ [6].

Comparative statics.

If we analyse the comparative statics on the critical proportion of tax evaders, we get clear-cut results for the utility from following the social custom, c, the utility of conforming with the group of tax payers, b, the fine rate and the probability of detection. An increase in the utility from following the social custom, c, or in the utility of conforming with the group of tax payers, b, will increase the critical proportion of cheaters. So will an increase in the fine rate or in the probability of detection. Hence an

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[6] The idea of the existence of a critical proportion of evaders beyond which an individual will be less concerned about him/her losing reputation because of evasion is consistent with Cowell's observation that "... if it is part of the local folklore that everybody evades taxes, the individual might find himself less severily conscience-stricken..." or that "... evasion becomes less searing the more that other people do it." (Cowell, 1990).

increase in one of these parameters will make the entry condition for evasion more restrictive.

The effect of an increase in the tax rate or in income is instead not clear-cut.

As far as the tax rate is concerned, the effect of an increase in the tax rate depends on the concavity of the utility function and on the probability of detection and the fine rate. In fact:

$$\frac{d\mu^*}{dt} = \frac{pfU'(W_b)Y - U'(Y(1-t))Y}{bR'} \tag{7}$$

This is calculated by setting (6) as an equality and differentiating with respect to t. bR' is always positive and the sign of (7) depends on the numerator.

The greater p and f and more concave is the utility function, i.e. the more $U'(W_b) > U'(Y(1-t))$, the more likely is $\frac{d\mu^*}{dt} > 0$. It is interesting to analyse the significance of this condition: $pfYU'(W_b)$ is the absolute value of the change in the utility from evading due to a change in the tax rate, and $YU'(Y(1-t))$ is the absolute value of the change in the utility from non evading due to a change in the tax rate[7].

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[7] In fact. $\frac{\delta U^E}{\delta t} = (1-p)U'(W_g)(-I) + pU'(W_b)(-I - f(Y-I))$

From the f.o.c. $(1-p)U'(W_g) = -pU'(W_b)(1-f)$. Therefore $\frac{\delta U^E}{\delta t} = -pU'(W_b)$

And $\frac{\delta U^{NE}}{\delta t} = -U'(Y(1-t))Y$.

An increase in the tax rate makes both the utility from evading and the utility from non evading decrease. Therefore if the utility from evading is more sensitive to an increase in the tax rate than the utility from not evading, than the critical proportion of tax evaders will increase and the individual will be less inclined to evade. We illustrate this in figure 2.3: the bold lines represent the utility from evading and non evading before the increase in the tax rate. μ^* is the critical proportion of tax evaders above which the representative taxpayer of figure 2.3, with given parameters (b,c) will start to evade. The increase in the tax rate shifts down both schedules: the dotted lines represent the new levels of utility from evading and from not evading after an increase in the tax rate. If the utility from evading decreases by more than the utility from non evading, as it is illustrated in figure 2.3, the critical proportion of tax evaders will increase. The range over which the utility from not evading is higher than the utility from evading is now broader: the critical proportion of evaders beyond which the individual will evade is higher, i.e. the condition to engage in tax evasion has become more restrictive.

The converse applies when $pfU'(W_b) < U'(Y(1-t))$. We refer to figure 2.4.

As before the two dotted lines represent the new levels of utility after an increase in the tax rate. In this case the utility from not evading decreases by more than the utility from evading and the critical proportion of evaders decreases, making the single individual more inclined to evade.

2.4.2 Tax evasion in the whole community: social equilibria

Taxpayers differ in the evaluation of the utility from conforming with the group of taxpayers and from following the social custom, i.e. in the b and c parameters. This implies that the utility from non evading varies among individuals and, in the aggregate individuals differ with respect to the critical proportion of evaders which triggers evasion.

We should mention that here agents differ in b and c but are of fixed types: the importance every individual attaches to the return from conformity and to the social custom does not vary, i.e. b and c are given for each individual. In the next chapter we will set up a context where individuals can change their preferences over these two parameters.

By assumption taxpayers have identical incomes.

In order to investigate how individuals behave in the aggregate, it is first assumed that they are of a given type b and differ in c and the critical proportion of evaders, μ^*.

$\mu^*=\mu(b,c)$ is strictly monotonic in c, therefore it can be solved to give:

$$c = \chi(b,\mu *) \tag{8}$$

which represents the critical value of the utility from following the social custom. At this level of c the utility from non evading exactly equals the utility from evading. If individuals attached a higher value to following the social custom, this would increase

the utility from non-evading beyond the utility from evading. Therefore those who evaluate the social custom more than $\chi(b,\mu*)$ would not evade.

We represent graphically the schedule $\chi(b,\mu*)$ for a given b type in figure 2.5. The vertical axis measures the actual proportion of evaders, and the horizontal axis represents the utility from following the social custom, c.

Every point along the $\chi(b,\mu*)$ line represents the critical level of utility from following the social custom for type b individuals associated with a critical proportions of evaders. The diagram represents individuals of the same type b, with different c and $\mu*$. For example, point 1 represents the critical utility from following the social custom (c_1) for type b individuals whose critical proportion of evaders is μ_1^*, whereas at point 2 the critical proportion of evaders for type b individuals is μ_2^* and the critical utility from following the social custom is c_2. A more restrictive entry condition for evasion, i.e. a higher critical proportion of evaders, corresponds to a greater critical utility from following the social custom, hence the positive slope of the $\chi(b,\mu*)$ line[8].

We now fix the actual proportion of evaders at a level $\hat{\mu}$ and consider how type b individuals behave.

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[8] This is consistent with the previous analysis for a single individual with fixed b and c parameters. The critical proportion of evaders corresponds to the point of intersection between the utility from non evading and the utility from evading. A higher utility from following the social custom implies a higher intercept for the utility from non evading and therefore a new point of intersection between the utility form evading and the utility from non-evading, to the right of the original critical proportion.

When the $\chi(b,\mu^*)$ line lies below the observed proportion of evaders $\hat{\mu}$, the critical proportions of evaders associated with the different values of c, along the $\chi(b,\mu^*)$ line, will be lower than the actual level. This means that those individuals observe a number of evaders which is greater than the critical level above which they are induced to evade. Therefore those with $c < \hat{\chi}(b,\hat{\mu})$ will evade and those with $c > \hat{\chi}(b,\hat{\mu})$ will not evade: there is a critical level of utility from following the social custom below which individuals of type b will not adhere to the social custom.

The point of intersection between the $\chi(b,\mu^*)$ line and the actual proportion of evaders, $\hat{\chi}(b,\hat{\mu})$, depicts the critical level of c that divides type b individuals into evaders and non-evaders.

If the actual proportion of evaders rises, the critical level of c rises and the number of evaders increase.

Figure 2.6 illustrates this case: an increase in the actual proportion of evaders shifts $\hat{\mu}$ upwards and the new point of intersection between the $\chi(b,\mu^*)$ line and $\hat{\mu}$ will occur at a higher level of c.

This is true for all b types.

The overall proportion of evaders in the community can be calculated by averaging over all types b individuals with $c < \hat{\chi}(b,\hat{\mu})$. We define such a proportion as:

$$G(\hat{\mu}) = \int_0^B \int_0^{\hat{\chi}(b,\hat{\mu})} f(b,c)dcdb \tag{9}$$

where $f(b,c)$ is the density function for b and c and B is the upper-bound for b.

A *social equilibrium*[9], is defined when the proportion of evaders is *self-supporting*, i.e.when the distribution of the parameters (b,c) is such that if every individual faces the same critical proportion $\mu^* = \hat{\mu}$ before deciding to evade, the actual proportion of evaders in the whole economy $G(\hat{\mu})$ will be just $\hat{\mu}$, i.e $\hat{\mu}$ is the fixed point for $G(\hat{\mu})$.

$$G(\hat{\mu}) = \hat{\mu} \qquad (10)$$

We illustrate the concept of social equilibrium in figure 2.7. This is a diagram for the whole economy. The equilibrium occurs only when $G(\hat{\mu})$ crosses the 45° line. The dotted line, $G(\hat{\mu})$, represents the proportion of population who would choose to evade if $\mu = \hat{\mu}$. For them $c < \chi(b, \hat{\mu})$, or alternatively $\mu^* > \hat{\mu}$.

An equilibrium with no evasion can be observed when:

$$(1-p)U(W_g) + pU(W_b) \le U(Y(1-t)) + bR(1) + c \qquad \forall \ b,c \ge 0 \qquad (11)$$

In this case $G(\hat{\mu}) = \hat{\mu} = 0$

Intuitively the significance of this condition is that if the person who places no value on the social custom and social conformity ($b=0$, $c=0$ and $\mu^*=0$) does not evade then nobody will ever do.

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[9] The term *social* is used because the model refers to social behaviour which is taken into account by considering the social custom and the desire for conformity.

It is worth noting that an increase in p or f makes the zero-evasion equilibrium more likely whilst the effect of an increase in income or the tax rate is undetermined. Moreover this equilibrium can be supported by a sufficiently powerful return from conformity or from the social custom.

Whereas an equilibrium with full evasion will occur if and only if:

$$(1-p)U(W_g) + pU(W_b) > U(Y(1-t)) + bR(0) + c \tag{12}$$

In this case $G(\hat{\mu}) = \hat{\mu} = 1$

Intuitively this means that if the person who values the social custom and social conformity at most (for which the critical proportion of evaders is one) evades, then everybody will always evade.

The model may possess different forms of social equilibria, depending on whether (11) and/or (12) is satisfied. The authors show that an interior equilibrium with some taxpayers complying with their tax duties and some others evading is feasible and may be stable. Figure 2.7 represents this case.

Comparative statics

For the comparative statics the authors distinguish the case of an initial equilibrium with no evasion and the case of an interior equilibrium, where some individuals evade.

They show that the no-evasion equilibrium could vanish for a small perturbation of the tax rate or of the level of income. The idea is that if (11) is an equality for some taxpayers, a small change in either t or Y can make it an inequality for those taxpayers and hence induce them to evade.

We represent the situation graphically in figure 2.8.

The two bold lines represent the initial situation for some taxpayers: condition (11) is an equality, i.e. $U^E = U^{NE}$ at $\mu = 0$. $\mu^* = 0$ is an equilibrium, but it is unstable. If the tax rate increases both U^E and U^{NE} will decrease and shift down (dotted lines). If, $pfU'(W_b) < U'(Y(1-t))$ i.e. the utility from non-evading decreases by more than the utility from evading, the equilibrium $\mu^* = 0$ will be destroyed: at $\mu = 0$ U^E will be higher than U^{NE}, inducing those taxpayers to evade.

They conclude "... in an economy previously characterised by no tax evasion a small change in the tax rate could lead to a potential epidemic of evasion, the extent of evasion depending on the location of the interior equilibrium." This implies that there could be a jump from zero evasion to some substantial level.

For an interior equilibrium the effect of an increase in the tax rate on tax evasion also depends on how he utility from evading varies relative to the utility from non evading. In particular, if $pfU'(W_b) < U'(Y(1-t))$, then there are two counteracting effects (as in Gordon, 1989):

- declared income of existing evaders rises

- new evaders will be added at the margin

It is therefore possible for the total level of evasion to rise with t, a result which is consistent with the empirical findings and reverses the Yitzhaki result.

We represent the effect of an increase in the tax rate for $pfU'(W_b) < U'(Y(1-t))$ graphically and refer the interested reader to Myles and Naylor analysis. We refer to figure 2.9.

The original equilibrium is $\hat{\mu}^i$, where those with $c < \hat{\chi}(b, \hat{\mu}^i, t)$ evade.

If the tax rate increases and the utility from evasion varies less than the utility from non evasion, the critical proportion of evaders decreases. If individuals face a change in the critical proportion of evaders, this affects the position of the $\chi(b, \mu^*, t)$ line. A decrease in the critical proportion of evaders (μ^*), corresponds to a shift to the right of the $\chi(b, \mu^*, t)$ line. After an decrease in μ^*, every original critical value of c will now be associated with a lower critical proportion of evaders. This implies that the $\chi(b, \mu^*, t)$ line shifts to the right (dotted line). For type b individuals the critical level of evaders associated with any given utility from following the social custom is lower.

This means that for a given initial equilibrium $\hat{\mu}^i$ the new critical level of utility from following the social custom below which individuals of type b will evade is higher and some of the individuals who previously did not evade will start to evade.

2.5 The role of fairness considerations on taxpayers' behaviour: Bordignon analysis

In Bordignon (1993) model taxpayers are influenced by fairness considerations which impose a constraint on the optimal amount of tax evasion. There is a *fair* amount of taxes an individual would be willing to pay and the difference between what the Government asks to pay and this fair amount determines the level of tax evasion.

The situation is modelled as a constrained expected utility maximisation problem: at first the individual calculates the fair amount of taxes he/she is prepared to pay and compares it with the amount he/she is asked to pay to the Government. The difference will determine the maximum amount of tax evasion the individual will be willing to commit. This will be the *fairness constraint*.

The individual will then choose the optimal amount of evasion, i.e. the amount which maximises his/her expected utility subject to the fairness constraint.

Considerations of fairness are determined by social interactions and perceived inequity of the fiscal system.

In this respect the Bordignon model is more complex than the models on social interactions we have considered thus far in that it includes also the role of the Government providing public goods in influencing taxpayers' behaviour.

In the standard model the relationship between the taxpayer and the Government was a relationship of coercion: the fiscal authority imposed the payment of taxes on the taxpayer and if he/she did not comply with this obligation would face the possibility of being detected and fined. In Bordignon the relationship between the Government and

the taxpayer is a relationship of exchange: the taxpayer gives up private consumption in return for public goods, the level of which is determined by individuals' contributions. The individual is able to calculate the fair terms of trade of such an exchange, which reflect his/her willingness to pay for the public good if it were optimally supplied, i.e. if the Samuelson condition is satisfied and if the tax burden is equally distributed among individuals. Taxes to be paid can be considered as the terms of trade offered by the Government. In deciding whether or not to evade and by what extent[10], the individual compares his/her fair terms of trade with the ones offered by the Government and will evade in order to "...re-establish fairness in his/her relationship with the other actors of the fiscal system".

Fairness considerations rely on ethical rules. In this case it is assumed that each individual observes a *weak Kantian rule*, i.e. a Kantian rule weakened by reciprocity considerations. According to the Kantian rule an individual considers it fair to pay as much as he/she would wish other individuals to pay, so that a Kantian tax would correspond to the amount an individual would wish each individual to pay.

A taxpayer observes a weak Kantian rule in that he/she considers it fair to pay his/her Kantian tax if and only if he/she perceives that everybody else does the same and revises his/her desired payment otherwise. We can therefore define the fair tax as the Kantian tax corrected for perceived evasion by other taxpayers. The role of social interactions is to enable individuals to observe the behaviour of other taxpayers and form perceptions about their tax evasion.

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[10] We should mention that, unlike in Myles-Naylor, in this case the two decisions are taken simultaneously.

It is interesting to note a difference with the other models on social interactions we considered above. In Benjamini-Maital and Gordon social interactions were modelled in terms of morals, which imposed exogenous stigma cost on the act of evading. In Myles-Naylor social interactions were responsible for the fear of losing reputation and for the disutility from acting out of line with the rest of the community, in case of evasion.

Here social interactions sustain *reciprocal altruism* among taxpayers. If people's behaviour conforms to the Kantian rule individuals are altruistic. As we have already considered, in Bordignon's model taxpayers are willing to pay their Kantian tax provided everyone else does the same, so that we do not have pure altruism but reciprocal altruism. An individual will revise his/her desired payment if the others do not pay their Kantian tax. This reaction is similar to moralistic aggression, which is a mechanism of protection of reciprocal altruism.

Modelled as a fairness constraint the ethical rule underlying taxpayers' behaviour is endogenised, in that it depends on the tax structure, public expenditure and perceived evasion by other taxpayers.

It is worth considering in greater details how the fairness constraint is determined.

The model consists of two types of individuals, indexed by $i=1,2$[11], each endowed with an exogenously given income Y_i. The utility function is defined in terms of private consumption, C, and a public good, G. There are N/2 individuals of each type. For an individual h of type i the utility function is:

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[11] This extension is introduced with the aim to investigate the effects of income differences and distributional characteristics of public expenditure on tax behaviour.

$$U^i = U^i(C_{ih}, G) \qquad i = 1,2 \qquad h = 1,...,N/2 \qquad\qquad (13)$$

A taxpayer h of type i maximises his/her expected utility subject to the fairness constraint:

$$\max_{E_{i,h}} (1 - p_i)U^i[(1-t)Y_i + tE_{i,h}; G] + p_i U^i[(1-t)Y_i - (f-1)tE_{i,h}; G]$$

$$s.t. \qquad\qquad\qquad\qquad (14)$$

$$0 \leq E_{i,h} \leq \overline{E}_{i,h}(t, G, E_i^*, E_j)$$

$E_{i,h}$ and $\overline{E}_{i,h}$ are the optimal and the *fair* amount of evasion.

Let us define the fairness constraint. When a tax-payer selects the fair contribution, he/she aims at:

- paying a fair price for the provision of the public good,

- equally distributing the tax burden across individuals and

- making sure that everyone contributes the fair amount.

The tax payer selects the amount of the fair contribution as follows:

1) he/she first selects a *fair price* for the good G supplied by the Government. To do so he/she is assumed to be given average income and to pay a price for G equal to MRT divided by the number of individuals in the population (N).

$$w^i(G, \bar{Y}) = \frac{U_G^i}{U_C^i}(G, \bar{Y} - \Psi G)$$

(15)

2) The fair price is multiplied by the quantity of public good, the result representing a contribution that on average the taxpayer would wish that all individuals paid to the state:

$$w^i * G$$

(16)

3) This average contribution is redistributed across individuals so as to equalise private consumption.

$$q_j^i = (Y_J - \bar{Y}) + w^i(G, \bar{Y})G \qquad i = 1,2 \qquad j = 1,2$$

(17)

This is the *Kantian contribution* that an individual of type *i* would wish an individual of type *j* paid to the state.

4) Each individual's Kantian contribution is divided by his/her income the taxpayer to get the *Kantian tax rate*.

$$t_j^i = \frac{q_j^i}{Y_j}$$

(18)

In a community of pure altruists the fair contribution would correspond to the Kantian tax. A taxpayer would pay what he/she would wish the others to pay, irrespective of whether they did it or not. But as emphasised earlier, in this model an altruistic behaviour is observed only if it is reciprocated: in case of evasion committed by other individuals a single taxpayer would revise his fair contribution.

5) The *fair contribution* is the difference between the Kantian contribution and the perceived level of evasion, which is calculated as the difference between the Kantian tax and what the other taxpayers actually pay on average[12]:

$$q_{ih}^F = q_i^i - \beta_1^i \left(t_i^i Y_i - \left(t Y_i - t E_i^* \right) \right) - \beta_2^i \left(t_j^i Y_j - \left(t Y_j - t E_j^* \right) \right) \tag{19}$$

β_1 and β_2 are the reciprocity weights on perceived evasion by other individuals. They differ in that the influence of perceived tax evasion on an individual's decision may differ according to whether it is committed within the same group or not. $t E_i^*$ is the average level of tax evaded by all individuals of type i except h, and $t E_j x_j$ is the average level of tax evaded by all individuals of type j. The greater the perceived evasion by other individuals the lower the contribution individual h would consider fair to pay to the state.

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[12] The taxpayer is assumed to know the average amount of evasion for both the types of individuals.

If both reciprocity weights are zero we get a model of pure Kantian behaviour and the fair contribution coincides with the Kantian contribution.

We can define the amount of evasion which is considered fair by individual h of type i as the difference between the terms of trade offered by the Government and the fair contribution:

$$Z_{i,h} = tY_i - q_{i,h}^F \tag{20}$$

This defines the constraint under which people operate.

If $q_{ih}^F < 0$ the taxpayer would rather get a subsidy than paying taxes and therefore would evade everything.

If $q_{i,h}^F > tY_i$, the Government is asking to pay for a public good an amount which is less than what an individual would consider to be fair. Therefore the individual would not evade.

In the intermediate case $tY_i > q_{i,h}^F$, the individual would make his choice subject to the fairness constraint.

An equilibrium is defined as a vector of evaded taxes such that each individual takes the behaviour of any other agent in the economy and the parameters set up by the Government as given and maximises his/her expected selfish utility function, subject to his/her fairness constraint. The equilibrium is therefore a Nash equilibrium.

Bordignon presents the solution in two different cases:

- Exogenous public expenditure

- Endogenous public expenditure.

If **public expenditure** is **exogenous** the Government chooses the tax rate and the amount of public expenditure independently.

If $\beta_1^i + \beta_2^i < 1$[13] the equilibrium is unique and symmetric: each individual of the same type evades the same amount of tax.

Given that we have two types of individuals, the equilibrium may lie in one of four regions:

- both type 1 and type 2 individuals are constrained by fairness considerations;

- both type 1 and type 2 individuals are not constrained by fairness considerations;

- type 1 individuals are constrained and type 2 are not;

- type 2 individuals are constrained and type 1 are not.

The region in which the equilibrium will lie depends on the different values of the parameters selected by the Government.

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[13] This condition merely states that the desired level of tax evasion depends on the Kantian tax, calculated for each group and perceived evasion by other individuals (full model of reciprocal altruism). In case of equality, the Kantian taxes disappear from eq. (19) and the fair contribution is expressed in terms of differences in income distribution between the two groups and perceived evasion (model of reciprocity corrected by differences in income distribution). Individuals do not conform to the Kantian rule: considerations of fairness are dictated only by income differences, and not by altruistic tendencies.

If public expenditure is **endogenous,** the amount of the public goods depends on the tax revenues. This implies that taxpayers' choices have effects on G in that they determine the level of tax revenues, and that the tax rate (t) and the amount of public expenditure (G) become interdependent.

By assuming taxpayers are identical, the equilibrium will lie in two regions, where either all taxpayers maximise their expected utility with no constraints or all taxpayers are constrained by fairness considerations.

Comparative statics.

Bordignon examines the effects of a change in the tax rate and public expenditure on the optimal amount of evasion. Here we only consider the impact of an increase in the tax rate. There are two cases: exogenous public expenditure and endogenous public expenditure.

When public expenditure is **exogenous,** a change in the tax rate has a direct effect on the fairness constraint:

$$\Delta t \rightarrow \Delta \bar{x}$$

In this case, if the equilibrium lies in the region where *both types of individuals are constrained* by fairness considerations, an increase in the tax rate will lead to an increase in tax evasion. This is because taxpayers *perceive* the increase in t as *unfair,* i.e. the

difference between what they are now asked to pay and the fair tax becomes larger and therefore tax evasion increases.

If the equilibrium lies in the region where *both types are unconstrained* we get the same situation as in the Yitzhaki model. An increase in the tax rate decreases tax evasion. This is due to the income effect: an increase in the tax rate will decrease income in both states of the world (detection-non detection). Under decreasing absolute risk aversion if individuals face a decrease in income they will become less willing to take risk and therefore the amount of evasion will decrease.

In the region where *only one type* of individuals is *constrained* by fairness considerations, an increase in the tax rate decreases tax evasion for the unconstrained type, whereas the effect for the constrained type will be ambiguous. Tax evasion by individuals of the other type will decrease but within the same social group will increase. We recall eq. (19), defining the fair contribution for a single taxpayer h: if evasion in the other group decreases, the third term on the right hand side will increase, whereas if evasion within the same social group as individual h increases, the second term of the expression will decrease. The net effect on the fair contribution will be undetermined. Consequently the desired level of tax evasion which defines the fairness constraint, eq. (20), may either increase or decrease.

If public expenditure is **endogenous**, the impact of a change in the tax rate on the optimal amount of evasion is not direct as before. In this case a change in the tax rate will affect total revenues and therefore public expenditure. This will in turn influence taxpayers behaviour. We can illustrate this more complex relationship as follows:

$$\Delta \bar{x}$$

$$\Delta t \nearrow \qquad \updownarrow \uparrow$$

$$\searrow \qquad$$

$$\Delta G$$
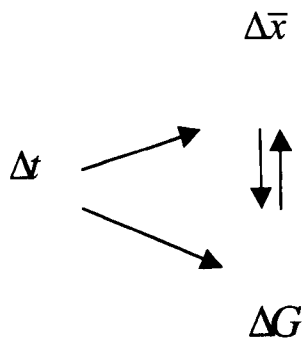
If we first consider an equilibrium lying in the *fully unconstrained* region we get the same model as Cowell-Gordon (1988). If the tax rate increases, evasion will increase if the public good is underprovided and decrease if it is overprovided. The idea is that if the public good is underprovided an increase in the tax rate is perceived as an increase in income: under the assumption of decreasing absolute risk aversion individuals will be more willing to accept risk, and they'll increase tax evasion. If the public good is overprovided an increase in the tax rate will be perceived as a decrease in income. Hence individuals will be less willing to accept the risk of being detected by the tax authority and fined and will decrease tax evasion.

As pointed out by Bordignon this result is counter-intuitive and at odds with empirical findings. If individuals are constrained by fairness considerations we actually reach the opposite result.

In the *fully constrained* region, given that t and G are now interdependent, an increase in the tax rate will simultaneously affect the quantity of the public good and individuals' behaviour. An increase in the tax rate increases tax revenue and therefore public expenditure. This will affect the fair price and hence the Kantian contribution. Taxpayers will *perceive* the increase in t as *unfair* and this will lead to greater perceived

tax evasion, as in the case of exogenous public expenditure. They will also revise their fair contribution (the q_i^i term in equation 19).

The final effect of an increase in the tax rate depends on whether the public good is under- or over-provided and on the quantity elasticity of the fair price. Bordignon shows that in case of overprovision an increase in the tax rate will certainly lead to an increase in the desired level of tax evasion, whereas in case of underprovision it depends on the quantity elasticity of the fair price: if the quantity elasticity of the fair price is greater than 1 tax evasion will increase.

Hence if individuals are constrained by fairness consideration, it is possible to observe an increase in tax evasion after an increase in the tax rate.

2.6 Empirical evidence on the role of morals

We now consider the empirical evidence on the role of morals and the importance of social customs in deterring tax evasion.

We shall focus on what the empirical evidence reveals on how tax compliance may be related to altruism and people being intrinsically honest.

In the next section we briefly describe the general strategy that has been adopted to get some evidence for tax evasion and identify which is the most suitable approach for testing people motivations and attitudes towards tax evasion. We then present some empirical studies and shall distinguish between evidence from audited tax returns on the behaviour of tax evaders who file their tax return and evidence for ghosts, i.e. people who do not file their returns and escape from auditing programs.

2.6.1 The most suitable approaches to study tax payers' attitudes

By its nature, the phenomenon of tax evasion is difficult to measure. People evade tax by concealing their income. Some of the transactions and activities that escape the payment of taxes are illegal and take part in the hidden economy. Tax evasion is therefore better dealt with in the more general context of the hidden economy.

The methods used to measure tax evasion are the same as those employed to measure the hidden economy. There are direct and indirect approaches to estimate the extent of tax evasion. The former are carried out at a micro level and are based either on intensive

audits of a sample of taxpayers or on surveys of people's economic activities and attitudes or on laboratory experiments. Indirect approaches are more used at a macro-level, to get an aggregate estimate of the extent of the hidden economy. These approaches are aimed at discovering the traces left by the hidden economy. They are based on the discrepancies between households' income and expenditures or different measures of income (calculated on the basis of tax returns or on the basis of the distribution side of the national accounts), on traces appearing in monetary aggregates[14], or on traces visible in the labour market[15].

Indirect approaches do not confer any information about individuals and their motivation to evade. For our purposes direct methods are better suited in that they provide some evidence on the behaviour of individual tax payers, rather than an aggregate measure of tax evasion.

In what follows we briefly present some alternative sources of information provided by direct methods such as audit data, tax amnesty data, data from surveys and data generated through laboratory experiments.

The most reliable information on non compliance is provided by *audit data*, based on actual tax return information that has been thoroughly examined by auditors. In the U.S. those data are collected through the Tax Compliance Measurement Program (TCMP). This consists of intensive audits by experienced IRS tax examiners of a randomly

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[14] Those methods are based on the assumption that the hidden economy transactions are dealt with mostly in cash. One method to size the underground economy consists of calculating the growth of currency in excess of the monetary base. See Tanzi (1980) and Feige (1989).

[15] According to those methods a low official labour force participation rate can be partially explained by the existence of the hidden economy. An *actual* participation rate can be estimated through interviews, proxy variables like energy consumption, or projection of past employment rates. The difference between the official participation rate and the actual rate provides an estimate for the size of the hidden economy.

selected group of taxpayers. The U.S. IRS conducted the first TCMP survey for the 1963 tax year with the aim to refine the audit selection mechanism[16], and has subsequently conducted household TCMP surveys about every three years, until 1988. For most of these years the surveys included between 45,000 and 55,000 households. The TCMP data record the taxpayer's report and the examiner's correction for most line-items on the return, providing extremely detailed information about non-compliance.

The TCMP provides a unique data-set for the U.S.: no other country regularly collects a random sample of audited tax returns of comparable quality to the TCMP. However some researchers have obtained tax return and tax audit data for other countries (Netherlands and Jamaica, but smaller number of observations)[17].

Although data based on the TCMP are the most reliable, there are some drawbacks which we should point out: being based on audits of filed returns non filers are missing and there are no information about hidden cash payments and transactions. This might lead to an understatement of tax evasion. In addition, little information about socio-economic and demographic characteristics are available.

Information on non-filers can be obtained from *tax amnesty data*, which provide direct measures on non-compliance, based on self-reported evasion by amnesty participants. They can be related to taxpayer and tax returns characteristics. This source of data however is affected by sample selection problems, as only a subset of all evaders is

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[16] The results of the TCMP audits are used by the U.S. IRS to formulate a strictly guarded *discriminant function*, used to assign each return a score (called the DIF score) for the likelihood that it contains some irregularities or evasion. See Andreoni (1998).

[17] See Andreoni (1998).

likely to participate in a tax amnesty, and this subset may not be fully representative for the overall population.

Surveys of people's economic activities and attitudes have the advantage of including many socio-economic, demographic and attitudinal variables that are not available with tax return and audit data. However data provided by survey are less reliable in that they are based on self-reports, which often provide very inaccurate information[18]. Individuals will supply answers consistent with their tax returns, with no incentives to tell the truth.

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[18] Evidence on negligible correspondence between self-reports on tax evasion and actual tax evaders' behaviour is provided in Elffers et al. (1987), who present the results of an investigation in the Netherlands and discuss the problems of measuring tax evasion.

Finally, *laboratory experiments* generally consist of a multi-period reporting game involving participants (frequently students) who make declarations, pay taxes, experience audits, pay penalties for detected non-compliance and, in some cases, receive rewards for compliant behaviour, all within a controlled environment. The problem with this source of data is that the setting is unrealistic by nature. Moreover there may be aspects of the compliance decision that cannot be replicated in a laboratory, such as moral, emotional, and social influences. *Field experiments*, conducted on random sample of selected groups of tax payers and using tax returns data are set in less artificial environments and hence may provide more reliable evidence.

Field experiments combined with TCMP data seem to provide the best available data for our purposes: testing tax payers' attitudes towards tax evasion and the existence of social customs requires the use of micro data, as the TCMP data, matched with evidence on people's behaviour. As we already noted TCMP data do not include any information on socio-economic and demographic characteristics and on how people may react to changes in the environment, which instead are provided by experiments.

In the next section we consider two recent field experiments which provide some revealing results.

2.6.2 Empirical evidence on the relevance of social norms on filers' behaviour

The models on social interactions we considered in this chapter all cite Baldry's (1986) experiment as a piece of evidence that some taxpayers are inherently honest and do not conform to the behaviour modelled in the standard approach. According to the results of

the experiment, individuals do not treat the decision whether or not to evade as a gamble and are prepared to comply with their tax duties even if the expected financial gain from evasion is positive. The argument suggested is that morals influence tax payers' behaviour and moral costs together with monetary costs deter tax evasion and lead to more compliant behaviour than expected by the standard model. However, if we look at how the experiment was conducted, this piece of evidence seems rather thin.

The experiment was conducted in six rounds on 104 subjects, who were students. They were given a gross income, presented with a tax schedule from which tax liabilities could be calculated and asked to complete a tax return. They were told the proportion of returns which would be audited in each round, and the penalties for concealing taxable income. A second experiment, formally equivalent to the tax evasion experiment was presented as a gambling experiment. Subjects were presented with the same true net income and were asked to lay a bet. In the event of win they got an income which was the same as net income from evasion in case of non detection in experiment 1 and lost an amount of income which was equivalent to net income from evasion in case of detection.

Subjects in the second experiment acted very differently even if the expected prospects from tax evasion and from the gamble were the same. In the first experiment 72 evasion attempts out of 104 observations were registered. When tax evasion was presented as a gamble every participant laid a bet, even when the expected gain was negative. The conclusion drawn by Baldry was that tax evasion and gambling were perceived quite differently by individuals: some people did not evade even when the expected gain was positive.

A number of limitations regarding the plausibility of this piece of evidence should however be pointed out. Inferring the behaviour of individuals from the behaviour of 104 students seems quite hazardous. Moreover the setting is indeed artificial: subjects knew they would be judged on their compliant behaviour. In reality tax evaders are not 100% sure that they will be caught cheating. In the experiment cheating would be observed by the experimenters and appearing to be a nice person in front of them could have been more important than showing one's true attitudes towards evasion. It would be hard to establish if the subjects regarded the experiment as a game or if they thought they would be assessed for their behaviour. Last but not least, 72 attempts of evasion out of 104 is quite a lot: the figure underlines a substantial extent of evasion.

The difficulty of testing how attitudes actually translate into behaviour through laboratory experiments, due to their artificial environment, has been emphasised by Slemrod et al.(2001). According to the authors, field experiments using tax return data would do a better job. However the results of field experiments, until now, have been conflicting and the sample has been very small, too small to convincingly link behaviour to individual tax payer characteristics.

A field experiment on the effects of compliance of normative appeals.

Slemrod et al. (2001) present the result of a field experiment conducted by the Minnesota Department of Revenue to study the effect on compliance of normative appeals during the 1994 and 1995 tax year filing seasons. The experiment was part of a

unique set of experiments run in that period to measure the effectiveness of alternative enforcement strategies, including normative appeals, advanced notice on increased audit rates and enhanced taxpayers' services.

The Minnesota Department of Revenue sent alternative letters to two groups of 20,000 randomly selected taxpayers, drawn from the population of Minnesota taxpayers who filed 1993 income tax returns.

Data was also collected from a third group of 20,000 people who received no letter, which served as a control group. One letter described how income tax dollars were allocated amongst state services in Minnesota and made an appeal to support the provision of socially valuable actions. The second letter stated that audits by the Internal Revenue Service showed that the people who file tax returns pay voluntarily 93% of the income tax they owe and made an appeal to conform with the majority of honest citizens. It is interesting to note that we can relate this experiment to Myles and Naylor model. The first letter appealed to an individual conscience, irrespective of the other taxpayers' behaviour. The underlying idea is that, given that taxes are collected to finance the provision of public goods, if an individual cares for the community he/she should be less inclined to evade once informed on how collected taxes are used. Hence it is assumed that an individual is concerned about the services provided by the government to the community and gets a non-monetary reward from non evading. In terms of the Myles-Naylor model, this could correspond to the c term in the utility from non evading, although in their model the c term is given a more general interpretation of a warm-glow, or a nice feeling to do the right thing. Contributing to the provision of the

public goods could be a reason for feeling good about submitting an honest declaration to the tax authority.

The second letter makes an appeal to an individual conforming with the underlying honest behaviour. This corresponds to the b term in the utility from non evading in the Myles and Naylor model.

Federal tax return data from the Inland Revenue Service were merged with the state data.

The data contain 60,061 observations of Minnesota taxpayers regarding over 300 variables. Those of particular interest for the experiment were: the date of filing, the taxpayer's filing status, the presence and magnitude of particular sources of income (e.g. self-employment income or income not subject to information reporting) and of itemised deductions (e.g. for medical expenditures or a home mortgage), the use of a practitioner, and whether the taxpayer was entitled to a refund or obliged to pay more tax at the time of filing.

The dependent variables were the federal taxable income, as reported on the Minnesota individual income tax form, and the Minnesota tax liability.

The effectiveness of normative appeals to social conscience on compliance was tested by comparing the change between 1993 and 1994 in income reported and taxes paid for treated versus control taxpayers. If those receiving the letter reported a larger year to year income compared to the control group, then this would have suggested that normative appeal are actually effective and there actually exist attitudes, beliefs and social norms about compliance.

The results, however, do not seem to support the existence of such attitudes and social norms: the comparison did not find any significant difference in the change in reported income or tax liability between those taxpayers who received the letter and the control group. This was also the result when the difference in difference approach controlled for particular sources of income.

In the absence of an overall effect of the normative appeal, the authors checked if the appeal was successful for some sub-groups of the population. With this aim they ran a multiple regression in which a treatment dummy variable was interacted with characteristics of taxpayers. The independent variables consist of dummy variables for income ranges, filing status, age, preparer use, presence of a tax balance due, dummy variables for the presence of each of eight tax schedules or types of income, medical expense and home mortgage deductions, filing date and the marginal tax rate. Two independent variables were regressed against the above explanatory variables: the difference between 1994 and inflation adjusted 1993 for reported income and tax liability.

One interesting result was that upper-middle income taxpayers (those with total positive income between $100,000 and $200,000) were influenced by each letter to report more income.

We should point out that this result is inconsistent with the social custom argument. If individuals observe a social custom and are not prepared to evade, this attitude should not depend on the level of income they owe. According to Myles and Naylor the appeal

should cause a reaction only by those who were previously evading, presumably more or less equally represented in different income levels.

Another result from the experiment is that for those with income from self-employment and rents and royalties as well as partnerships and S corporation income, i.e. with greater opportunity to evade, the appeal did not appear to be successful. The authors conclude: "...This is consistent with the hypothesis that those with greater opportunity to evade will be less susceptible to a normative appeal."

A field experiment on the effects of compliance of an increase in the probability of audit.

A second experiment, part of the same field experiment conducted by the Minnesota Department of Revenue, was designed to learn about the impact of an increased probability of audit on compliance.

Although it does not address the issue of individuals' attitudes towards evasion, it is worth considering in that it presents some revealing results.

A group of 1724 randomly selected taxpayers (treatment group) was informed by letter that the returns they were about to file, both state and federal, would be "closely examined". They received a letter from the Commissioner of Revenue in January 1995 telling:

- they had been selected at random to be part of a study "that will increase the number of taxpayers whose 1994 individual income tax returns are closely examined"

- both the state and federal tax returns for the 1994 tax year would be closely examined by the Minnesota Department of Revenue

- they will be contacted about any discrepancies

- if any irregularities were found, their returns filed in 1994 as well as prior years might be reviewed, as provided by law.

Data from 1993 Minnesota income tax returns and from federal tax returns was collected and matched to corresponding data from 1994 returns of the same taxpayers after the experiment.

The data sample consists of 22,368 returns, 1,537 for the treatment group and 20,831 for similar groups of taxpayers who were not subject to any treatment and served as a control group. The sample was stratified by income and by opportunity to evade. There were three stratifications by 1993 income: low-income (with Adjusted Gross Income less than $10,000), middle income (with AGI between $10,000 and $100,000) and high income (with AGI over $100,000). Taxpayers were also divided in two groups, according to the opportunity to evade: high opportunity taxpayers, who filed a federal Schedule C or F (for business or farm income respectively) and who paid Minnesota estimated tax[19]. The rest of taxpayers was referred to as low-opportunity.

As in the experiment we discussed earlier, the authors examine the difference in reported tax liability (measured in terms of federal tax after credits and Minnesota tax liability) and in taxable income (federal taxable income) between 1993 and 1994 for the treatment group relative to the control group.

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[19] A Minnesota taxpayer is required to file and pay estimated tax quarterly if expected tax will be $500 or more above withholding and expected tax credits.

A result that confirms a previous finding is that the treatment effect varies depending on the level of income and on opportunities to evade. Among both the low and middle income strata, the audit notice had a very large impact on the high opportunity taxpayers(12.1% increase in reported tax for middle-income, high-opportunity taxpayers and 145% for low-income , high-opportunity).

We could give different explanations for the lack of impact of the audit notice for the high income taxpayers:

- their elasticity of the probability of an audit is very low

- they may have become more efficient to evade, in that, for example, after receiving the letter they may have hired a tax practitioner to help them file their tax return.

Changes in federal taxable income, federal tax liability and Minnesota tax liability were regressed against dummy variables for ranges of total positive income, marital status, age, presence of a paid preparer, marginal tax rate and presence of various supplemental schedules, in order to control for return characteristics. The results indicate a positive treatment effect for those who filed additional schedules: those taxpayers associated with itemised deductions, interest and dividend receipts, farm income and estimated tax payments would report more in federal tax liability after receiving the letter.

A positive treatment effect implies that these groups of tax payer were previously evading. Hence the evidence suggests that evaders were more likely to be those who had better opportunities to evade.

In conclusion, the evidence presented by Slemrod et al. suggests that appeals on social conscience on compliance are not effective. No significant difference in the change in reported income or tax liability was found between those taxpayers who received the two letters and the control group. The author concludes that social norms can affect individuals' attitudes, but whether these attitudes translate into behaviour still remains to be explained.

Once the experiment was tested for sub-groups of individuals, upper-middle class taxpayers were influenced by each letter to report more income. A particularly interesting result was that those taxpayers with particular sources of income, who benefit from greater opportunities to evade, were less susceptible to normative appeals on social conscience, in that they decreased the amount of reported income after receiving the letter from the tax authority.

The second experiment we considered, on the effects of sending an audit notice to taxpayers, reveals that the level of income and opportunity to evade are important determinants for the response of taxpayers. In particular, for low-middle income strata the audit notice had a very large impact on the change of declared income and tax liability for individuals classified as high opportunity tax payers.

Putting together the results from the two experiments presented by Slemrod et al., the evidence suggests that evaders are more likely to be individuals with higher opportunities to evade, and these are the ones who seem to be less affected by normative appeals on social conscience. Hence we can draw the conclusion that tax evasion may

be driven by opportunities and these might have a more important role than individuals' attitudes.

2.6.3 Empirical evidence on the behaviour of ghosts

The field experiments we considered in the previous section are based on a random sample of tax payers who filed their tax returns. Information on non-filers behaviour is therefore missing. It could be interesting to consider some evidence on the characteristics of non-filers: the comparison with information on filers could reveal some interesting insights.

Data from Amnesty Programs.

Crane and Nourzad (1993) use data from Michigan's amnesty program, with the aim to identify certain economic and demographic factors that distinguish evaders who cheat by filing fraudulent income tax returns from those who do not file. Data from amnesty programs have the advantage of including data on non-filers, but are affected by some limitations and complications. Data are often limited in terms of both quality and quantity, moreover there is the need to correct for sample selection bias: a sample of amnesty participants is not entirely random, because amnesty filers decided themselves to be in the program. In order to correct for sample selection bias, Crane and Nourzad use a maximum-likelihood procedure and estimate a linear probability model which relates the probability of filing to various economic and demographic characteristics.

In particular, the explanatory variables considered by the authors, which might discriminate between filers and non-filers, are: true income (AGI as reported on the amended return), the presence of automatic withholding, different occupations (self-employed, sales, farming, foods and beverages, construction and personal services)[20], gender and marital status.

Information is taken from 4,203 returns, 2,985 of which concerning individual income taxes. Of these, 588 were filed by individuals who were amending a return and 2,397 were by individuals who had not filed previously for the year in question.

The sample used in their study is a subset of the individual income tax amnesty. It consists of 1,748 returns filed under amnesty. Of these 213 amended a return and 1,535 were new returns by individuals who had not filed previously.

Results suggest that:

- Evaders are more likely to file as true income increases, which implies that non-filers are more likely to be low income individuals.

- The probability that an evader is a non-filer decreases if the individual is subject to withholding.

- Males and single individuals are more likely to be non-filers.

The authors were unable to establish a link between non-filing and the group of occupations that were thought to be associated with tax evasion.

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[20] Individuals in those occupations are suspected to have higher opportunities to evade.

A unique data set is used by Erard and Ho (2001) to analyse the characteristics of ghosts and the factors driving their decision not to file. They combine data from the TCMP Phase III Survey (1988), which contains the results of intensive audits of a random stratified sample of approximately 54000 individual income tax returns for tax year 1988, with data from TCMP Phase IX Non-filer Survey for taxpayer 1988, on a stratified random sample of the locatable non-filer population, i.e. all ghosts who could be located through an intensive search by U.S. IRS agents. Based on random samples of individuals, their analysis is not affected by sample selection bias.

Data on filers include declared income, the amount that should have been declared as determined by the examiner, information on the filing history of the tax payer and the occupation category. The authors select a 25% random sub-sample of the TCMP Phase III Survey.

The TCMP Phase IX Non-filer Survey includes information for a stratified random sample of approximately 23,000 cases from a population of 83 million individuals for whom there was no record of a 1988 individual income tax return. These individuals were identified through a social security number match of the IRS tax records with the Social Security Administration Date of Birth/Date of Death Master File, which lists all individuals with valid social security numbers. The potential non-filers identified through this match include actual ghosts, late filers, and individuals who were not required to file a return. IRS agents located each of the individuals in the sample.

Information is available on individual's age, whether a return had been filed for the previous year and whether third-party information return documents were available for the 1988 tax year.

A total of 18,689 of the 23,286 potential non-filers in the sample were located by IRS officers. This corresponds to 57% of the potential non-filer population. Of these, 3,549 were deemed to have been in violation of their tax filing requirements. A random sub-sample of 2,195 (examination-based segment) of the 3,549 identified non-filers was subjected to intensive line-by-line audits. The information recorded in the examination-based segment of the survey is comparable to that recorded in the TCMP Phase III Survey of filers.

Sample weights are used to make the filers and ghosts in the sample broadly representative of the overall filer and locatable non-filer population.

By using a two-stage estimation procedure the authors first regress the probability of being located against filing from previous year, third-party information on any 1988 income, age and marital status[21]. They use the sample of located and unlocated individuals who did not file (23,283 observations).

They then define the conditional likelihood functions for filing for filers and non-filers, which both depend on the probability of being located[22]. The probability of filing is regressed against dummy variables to take into consideration previous filing decisions,

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[21] Age and marital status are included in the explanatory variables for the probability of being detected under the assumption that the elderly and married individuals are less mobile and hence easier to locate.

[22] Erard and Ho use the prediction of their model that an individual is more likely to file if the probability of being located is high.

the cost of filing[23], how far the individual is from the filing threshold, the residence in a jurisdiction with a state-level income tax[24], different sources of income (business and farm income), different occupations[25], age, filing status (married joint returns), the number of dependents, gross income and an index for the likelihood of being located. Data consist of the two sub-samples for filers and located non-filers (15,489 observations).

We summarise the key results as follows:

- Unlike in Crane and Nourzad (1993) opportunities to evade seem to matter for the filing decision: individuals with business income are relatively less likely to file a return. Among the different occupations, mechanics and helper are the least likely to file.

- Relative to ghosts, filers tend to have substantially larger incomes. For example, their total income before adjustments is on average over two and one-half times larger than that of no-filers. This confirms the result found by Crane and Nourzad (1993): non-filer are more likely to be low income individuals.

- Wages and salaries, interest, dividends and pension income, form a much more substantial share of total income for filers than non-filers. Business income and net capital gain receipts, instead, are relatively more important for non-filers. This

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[23] This is an IRS estimate of the number of hours required to complete the tax return, given the sources of the individual's income and deductions.
[24] This is to consider the case that states may share information with the federal government, so that the perceived probability of being apprehended may be higher.
[25] Dummies are used to identify professionals, supervisors or managers, individuals working in a service occupation or providing administrative support, individuals employed in agriculture, foresty or fishing occupation, individuals who are mechanics, helpers or handlers, individuals who work in a construction, extraction or production occupation, individuals who work in the military.

finding reflects the fact that the ghost population includes a disproportionate share of self-employed individuals.

The two empirical studies we presented on the evidence on ghosts, suggest that the level of income and the source of income are important determinants for the filing decision. Moreover, individuals subject to withholding and with relatively more offsets to income are more likely to file their tax returns.

The link between these findings and the role of personal attitudes towards tax evasion is not straightforward. Non-filers should be those individuals who do not attach any value to compliance being a social custom. From the results we presented the decision whether or not to file a tax return seems to be driven more by opportunities to evade rather than by personal characteristics. Unless we are prepared to accept the idea that those with greater opportunities to evade are also the less inclined to consider tax compliance as a social custom, the role of morals in determining the filing decision is not clear.

2.7 Conclusion

In this chapter we considered the issue that taxpayers may be motivated by non-selfish considerations and induced not to evade even if the expected pecuniary gains from evasion are positive.

We organised our exposition in two main parts: we first analysed the theoretical models on social interactions which regard tax compliance as an ethical behaviour, and then presented the empirical evidence on the role of morals in tax evasion.

In the theoretical literature, the assumption that tax payers are motivated also by non-selfish attitudes and care about non-monetary considerations is modelled by modifying the tax payer's utility function.

In Benjamini-Maital (1985) and Gordon (1989) models the utility function includes a psychic cost if the individual decides to evade. We analyse in details Myles-Naylor (1996) model, in which tax compliance is assumed to be a social custom. The individual derives two extra sources of utility from adhering to it: the individual gets utility from following the social custom (a sort of warm glow) and from conforming with the group of tax payers. The greater the proportion of compliant individuals the greater the utility gain from conformity.

Somehow different is Bordignon's approach, which allows for non-selfish attitudes by assuming that tax payers are affected by fairness considerations. In this case individuals maximise their expected utility subject to a fairness constraint which limits the amount of evasion an individual is willing to engage. In his model tax payers conform to a Kantian rule according to which they are prepared to pay the amount of taxes they would wish other individuals to pay. This Kantian rule is weakened by reciprocity considerations: an individual will pay the Kantian tax if and only if he/she perceives that everybody else does the same and revise his/her desired payment otherwise. There is a constraint on the amount of evasion an individual is willing to undertake, which is determined by the Kantian rule and reciprocity considerations.

In the following table we provide a summary of how the role of morals is modelled and a brief taxonomy of the types of costs or conventions described by the authors we reviewed.

Authors	Morals are modelled in terms of:
Benjamini-Maital	*Psychic cost.* Defined as a stigma cost and modelled as a personal moral cost, incurred irrespective of being detected. The cost is fixed from the individual point of view and decreases with the proportion of individuals who evade.
Gordon	*Psychic costs.* Distinction between private stigma cost and social stigma cost. They are both modelled as personal moral costs, in that they are incurred irrespective of being detected by honest tax payers. The private stigma cost is due to feelings of anxiety, guilt and reduction in self image. It varies across individuals and is proportional to the amount evaded. The social stigma cost is due to damage of reputation or loss of esteem in other individuals' eyes from evading. It is fixed from the individual point of view and it increases with the proportion of the population who is believed to consider tax evasion as morally wrong and with the amount evaded.
Myles-Naylor	*Social custom.* Tax compliance is considered as a social custom. The individual gets a *utility gain from conforming* with the group of honest taxpayers. This extra source of utility comes from enhancing one's reputation for being honest and depends on the proportion of honest taxpayers in the population. By being honest the individual gets also a *utility gain from following the social custom.* This is experienced by a single individual, regardless of the behaviour of the other tax payers. It is modelled as a fixed term, a sort of warm glow.
Bordigon	Ethical rules. *Fairness considerations.* There is a *fair* amount of taxes an individual is willing to pay, which limits the extent of evasion an individual chooses to undertake. This amount depends on: - the terms of trade offered by the government (quality/quantity of public goods) - perceived evasion by other individuals

In the Myles-Naylor model, the results suggest that the decision whether or not to evade depends on the proportion of individuals following the social custom. If the observed proportion of evaders falls below a critical level, the individual will not evade.

It is possible that an increase in the tax rate leads to greater tax evasion. This happens if the utility from evading decreases more than the utility from non-evading. In this case, in fact, the critical proportion of evaders above which an individual would decide to break the social custom increases, i.e. the entry condition for evasion becomes more restrictive. By extending the analysis to the whole community, different forms of equilibria are feasible and a mixed outcome is possible. The fiscal parameters and the return from conformity and the social custom will determine the feasibility of a mixed outcome.

In the Bordignon model, the analysis focuses on two types of individuals with different levels of income and shows that a mixed outcome consisting of one type of tax payers being constrained by fairness consideration and the other one unconstrained (utility maximisers) is feasible. This occurs when public expenditure is exogenous, i.e. when the government chooses the tax rate and the amount of the public expenditure independently, and is subject to the government choice of the tax parameters. Other equilibria are also feasible where both types are constrained or unconstrained by fairness considerations. When both types are constrained an increase in the tax rate unambiguously leads to an increase in tax evasion.

For each of these models we focused on the predictions concerning the equilibrium and the effect of an increase in the tax rate on the optimal amount of evasion. As we considered in chapter one, these were the puzzling issues of the standard model. The result we get in these models is that it is possible to get a mixed outcome of evaders and non-evaders and an increase in the tax rate may increase tax evasion.

However, the argument of the theoretical models seems rather ad-hoc. People are assumed to be driven by non-selfish considerations: their utility function is modelled such that the amount of evasion they choose is necessarily less than what would be predicted by the portfolio model, but they do not explain why individuals should behave according to the preferences represented by those utility functions. In chapter 3 we analyse why taxpayers should regard tax evasion as a social custom and consider the possibility that individuals may change their preferences towards the social custom. This with the aim to find out the stability of a mixed outcome where only some individuals are motivated by non-selfish attitudes.

Empirical evidence on the role of morals in tax evasion has to rely on direct approaches used to measure tax evasion, namely on audit data, tax amnesty data, surveys and experiments. Some evaders do not file any tax return and hence they are not easily observable. We collected studies based on data on filers and also evidence for the behaviour of ghosts, those who do not file any tax returns, based on data from Michigan's amnesty program and from a special survey on non-filers conducted by the U.S. IRS.

The evidence we could gather is rather thin, in that most of empirical studies do not consider this issue and are silent about the role of morals on tax evasion.

From the evidence we collected we do not get convincing results on the role of morality in deterring tax evasion. Much tax evasion seems to be driven by opportunity and costs of evading.

None of the theoretical models we have considered so far assumed evasion is a costly activity. In chapters 4 and 5 we shall explore this idea.

Utility

$$U^E = -B + (A+C)N$$

$$U^{NE} = CN$$

-B

$\hat{N}$ N   Number of evaders

Figure 2.1

U^E, U^{NE}

$U^{NE} = U(Y(1-t)) + bR(1-\mu) + c$

$U^E = (1-p)U(W_g) + pU(W_b)$

does not evade

evades

0

μ^*

1

μ

Figure 2.2

U^E , U^{NE}

$U^{NE}=U(Y(1-t)+bR(1-\mu)+c$

$U^E=(1-p)U(W_g)+pU(W_b)$

does not evade

evades

μ^*

0   1

Figure 2.3

Figure 2.4

U^E, U^{NE}

$U^{NE}=U(Y(1-t)+bR(1-\mu)+c$

$U^E=(1-p)U(W_g)+pU(W_b)$

evades

does not evade

μ^*

0

1

108
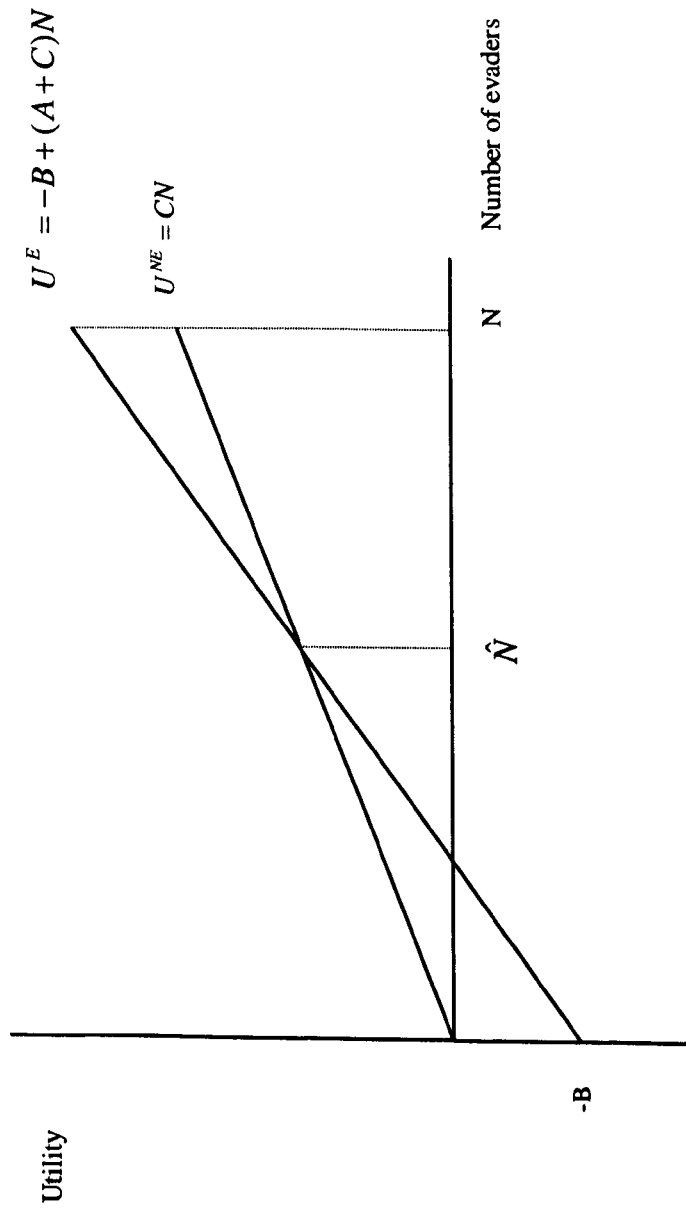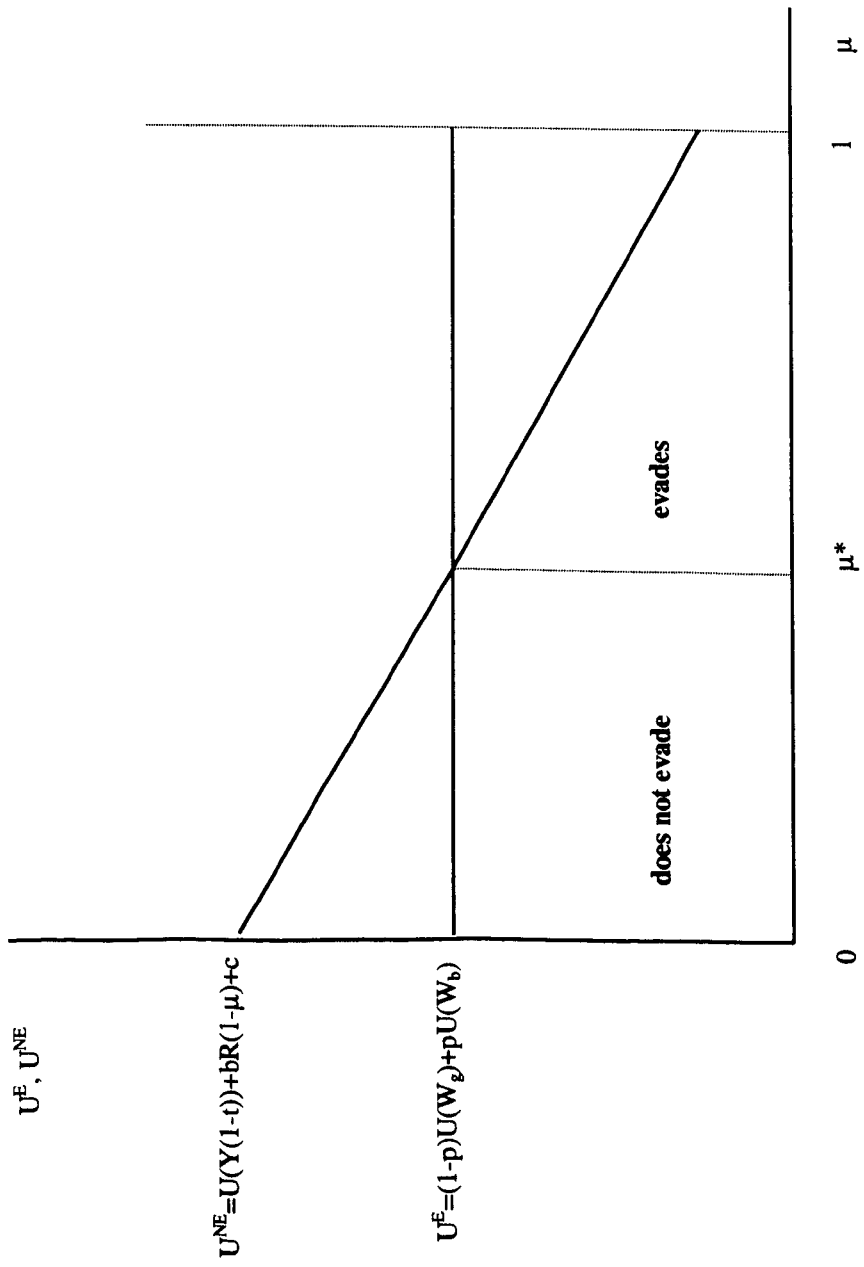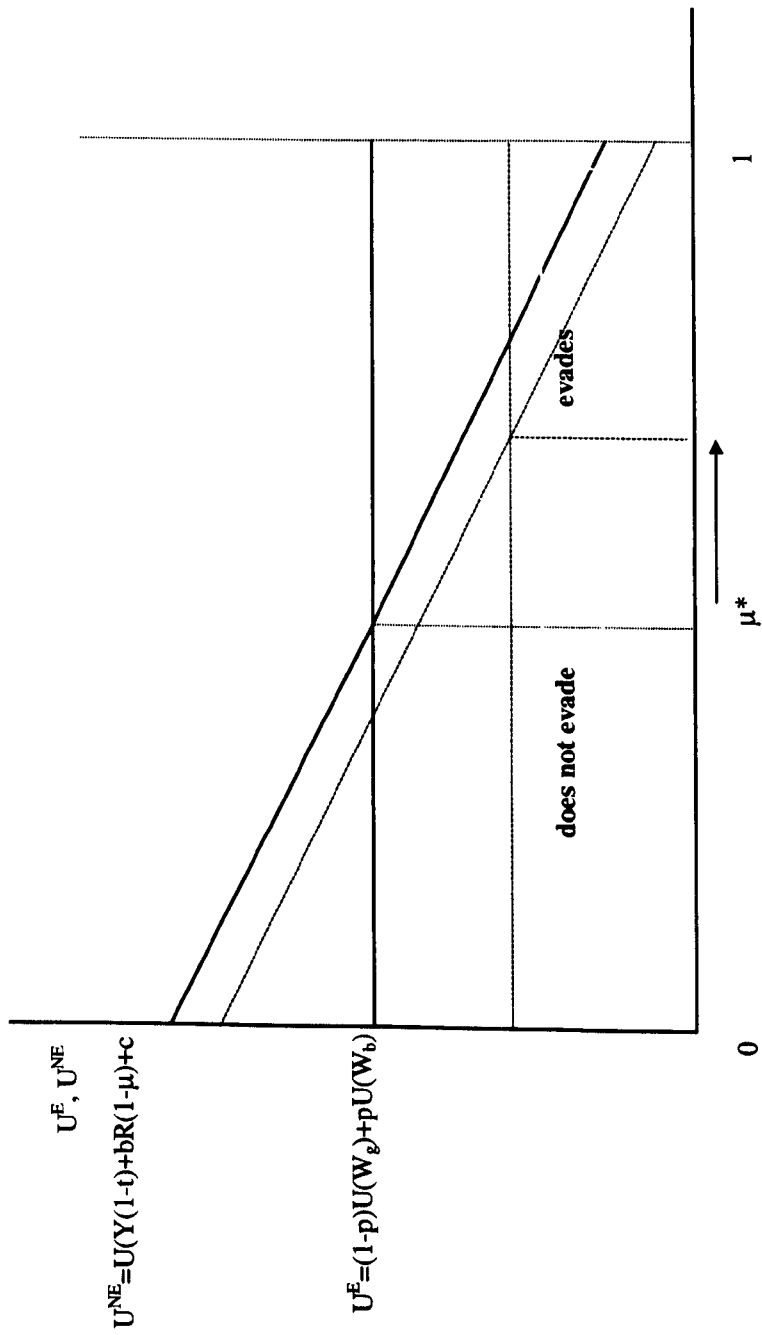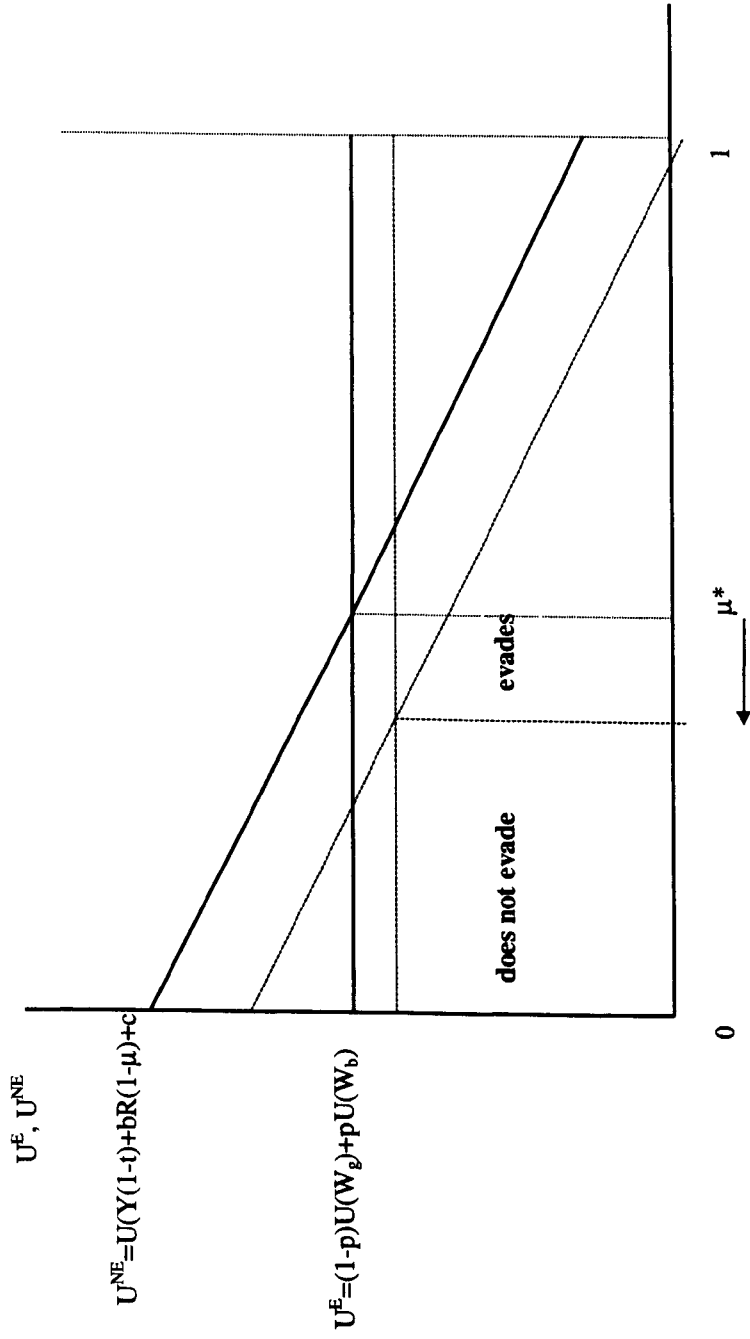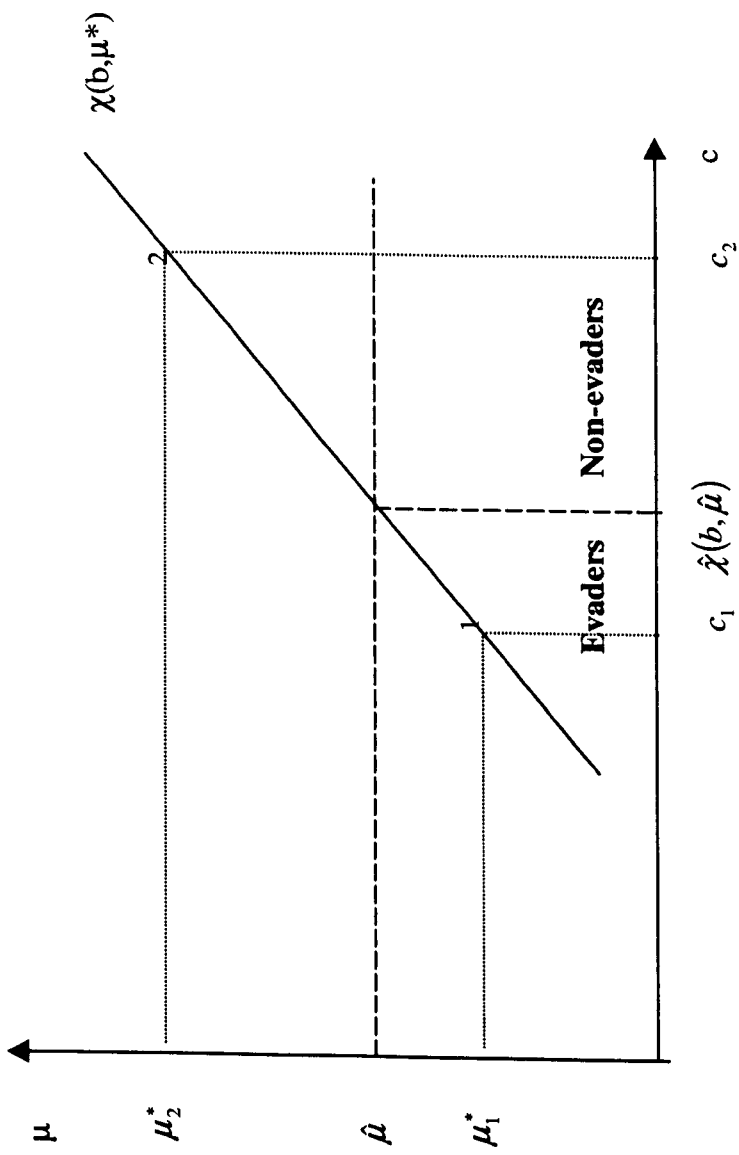
Figure 2.5

Figure 2.6

G(μ)

G(μ̂)

0   μ̂   μ

Figure 2.7

111
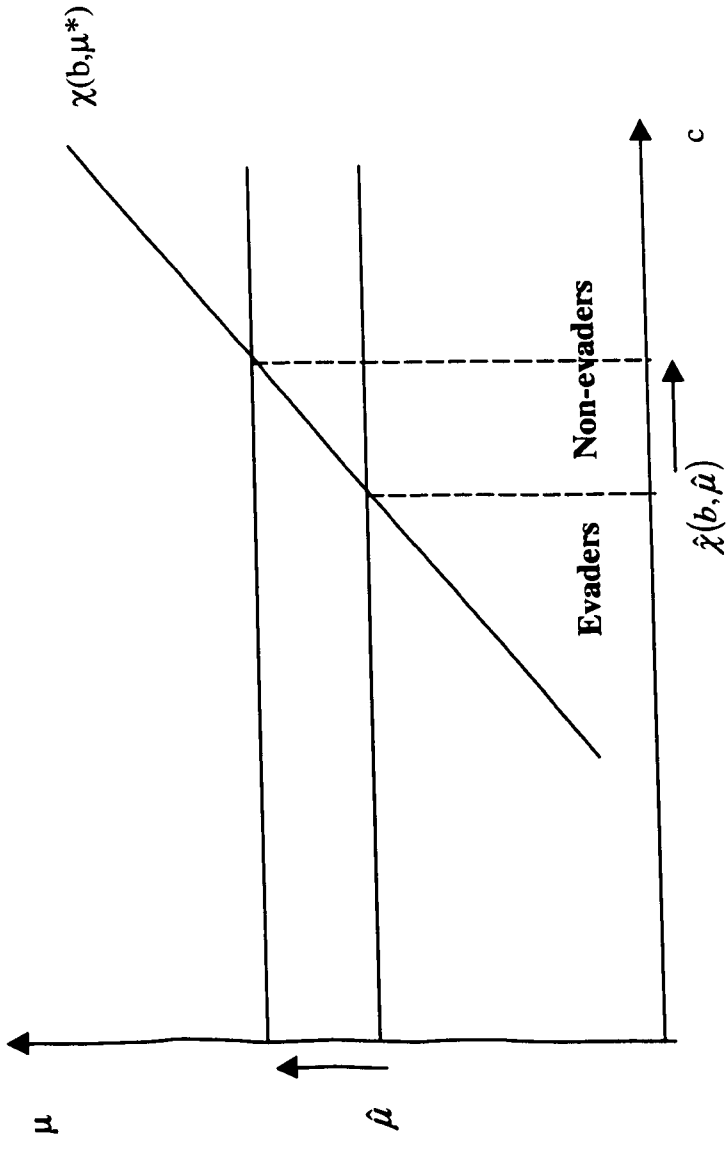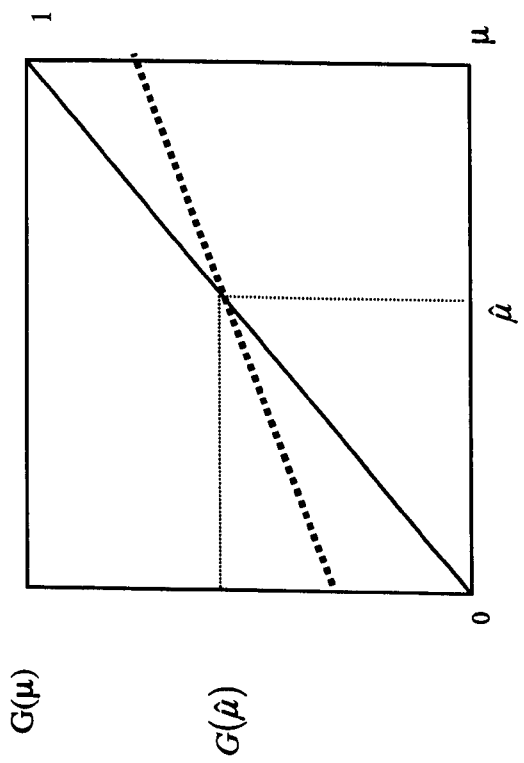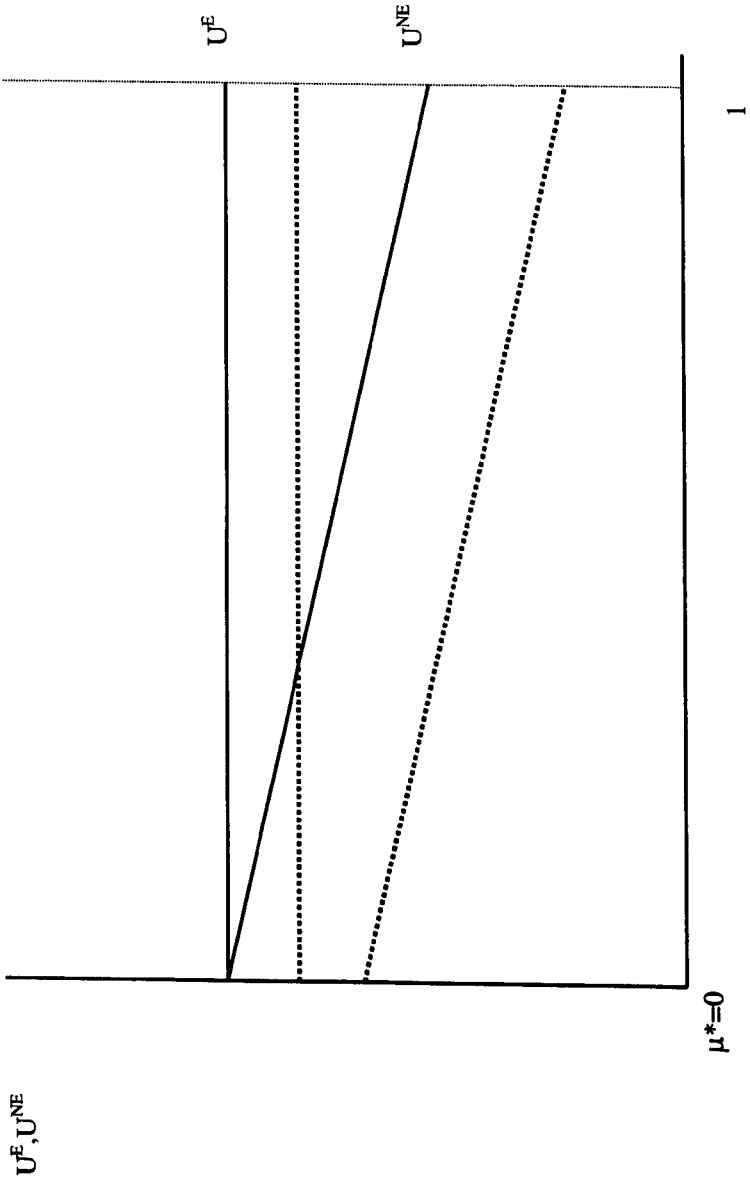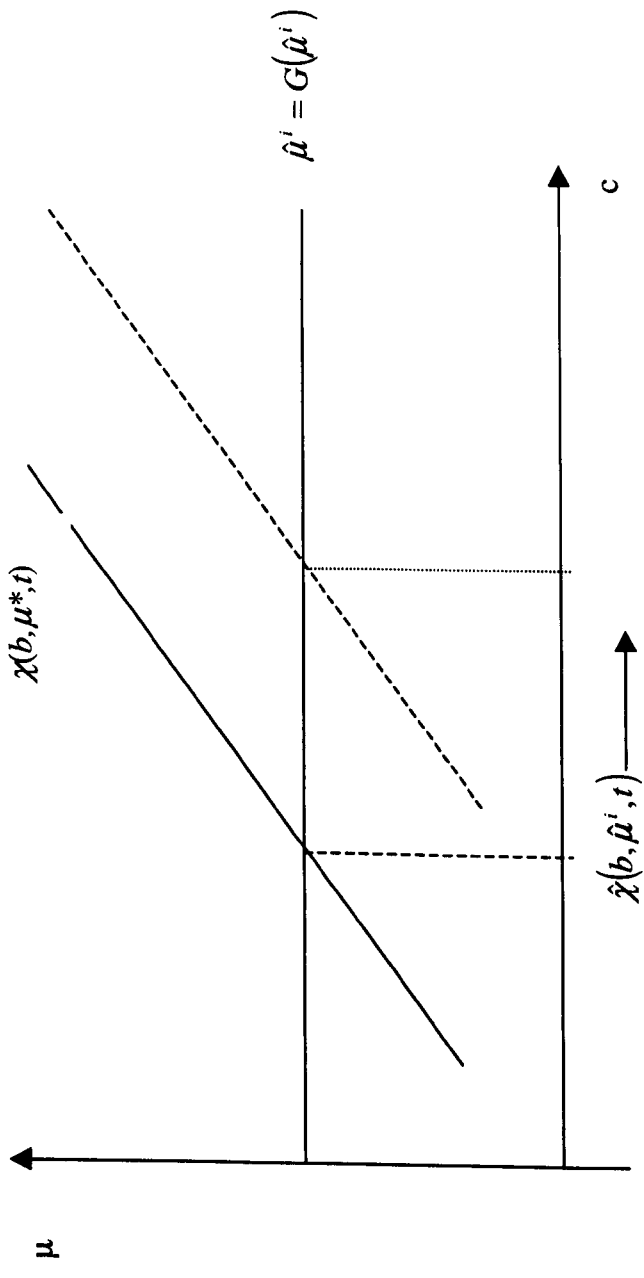
Figure 2.8

Figure 2.9

Chapter 3

Tax compliance as a social norm: an investigation of the process underlying its emergence and preservation.

3.1 Introduction

The comparison between the standard approach and the models on social interactions we considered in chapter 2 reveals a substantial change in the interpretation of how individuals may decide to evade: the analysis of tax evaders' behaviour moves from an individualistic approach into an interactive context. In the models on social interactions tax compliance is considered as an ethical behaviour: interactions among taxpayers are assumed to be responsible for the establishment of morals, according to which tax evasion is *felt* as a wrong action.

Tax evasion implies a loss in utility, which is modelled in terms of a psychic cost[1]. The evader might feel uncomfortable with his/her own conscience and/or damage his/her image in the eyes of the others once caught cheating.

Bordignon (1993) provides an alternative way of modelling tax compliance as an ethical rule: in his model taxpayers are assumed to follow a Kantian behaviour, in that they are prepared to pay a fair tax, provided everybody else does the same.

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[1] Benjamini-Maital (1985), Gordon (1989), Myles-Naylor (1996).

The underlying idea of those models is that people may be driven by non-selfish attitudes and have a personal conviction that paying taxes honestly is morally right. A common theme is that the greater the number of people complying with their tax duties, the greater the impact of moral considerations on the utility function. Non evading assumes the characteristic of a social norm or convention: it is self-enforcing, in that the greater the degree of adherence, the more established it becomes.

This aspect remains incidental to the analysis of all those models, in that the existence of the social norm is taken for given, exogenously determined by the interactions among taxpayers. In this chapter we explore the reason why individuals should decide to follow the ethical rule "not evading". We assume that the social norm may emerge spontaneously through an evolutionary process and we analyse if the emergence of new preferences with no concerns for the social custom could be able to attract previously honest taxpayers to the extent of wiping out the social custom. The expected utility framework, where taxpayers are regarded as perfectly rational expected utility maximisers, does not fit with our intentions. The mechanism underlying the adoption of a convention relies more on a dynamic context, where individuals learn and imitate a certain behaviour, rather than being driven by deductive reasoning and choosing among an alternative set of choices.

In the first section we present our argument for interpreting tax compliance as a convention, expected to emerge through an evolutionary process. After briefly presenting the main features of an evolutionary model, we then set Myles-Naylor model in an evolutionary context and analyse the stability of the social custom. The findings will promote a discussion, which is the content of the last section.

3.2 Why should individuals regard tax compliance as a social norm?: from rational to adaptive behaviour.

One aspect emerging from the analysis of the models on social interactions we presented in chapter 2 is that the individual, in making the choice whether or not to evade and by how much, is influenced by the social context. This is in line with the view adopted by some authors in psychology, according to which behaviour is related to what is generally considered acceptable, reasonable and expected in the social context in which the action is to be taken[2].

This aspect is modelled by Bordignon (1993) in terms of reciprocity. In his analysis the ethical norm supporting tax compliance consists of the Kantian rule according to which "*an individual considers it fair to pay as much as he would wish other individuals to pay*". Individuals are expected to observe it, provided the rest of the community also do so. The assumption made is that "*a taxpayer considers it fair to pay his Kantian tax if and only if he perceives that everybody else does the same and that he revises his desired payment otherwise.*"

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[2] See Cullis-Lewis (1997) for a discussion.

The greater the number of people observing such a rule, the more binding the constraint and the greater the impact of the ethical norm in limiting the amount of evasion which will be chosen[3].

The number of other people evading is a crucial aspect for the decision of a single individual in all the models on social interactions we considered in the previous chapter. A common result is that the greater the number of people complying with the fiscal legislation, the greater the impact of moral considerations on the individual's utility function in case of cheating and the more likely it is that the single individual will not evade.

Thus tax compliance assumes the feature of a convention: the greater the number of adherents the greater its impact on individuals' behaviour.

In all the models we analysed, the existence of the convention non evading is taken as given. It could be interesting to examine which is the mechanism underlying the emergence of the convention and how it gets preserved.

According to certain ad hoc theorising in convention thinking, the emergence of a social custom or convention does not find an explanation among perfectly rational individuals. The criterion of deductive reasoning does not explain why an individual follows a convention. Following a convention implies being prepared to subscribe a generally accepted behaviour, in the absence of a system of enforcement, even if, from an individualistic point of view, a different conduct could be more profitable.

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[3] As an extreme case, if all individuals paid what they ought to, i.e. the Kantian contribution, then the fair tax would correspond to the Kantian tax. This implies that the amount to subtract to what the tax authorities actually require to taxpayers to find the level of evasion will be greater. Hence tax evasion would be smaller. See Ch.2, par.2.5 for more detail.

When individuals decide to adhere to a social custom or convention they do not seem to consider all alternative actions in order to choose the most successful one. The emergence of a convention seems to be more attributable to a process of *learning* from the social context and *adaptation*, the idea being that individuals might base their choice on analogies with other situations or they might just *imitate* a group of other individuals.

Rationality does affect individuals' choice but is it not the only determinant. Social interactions are equally important. To clarify this point we can cite Hargreaves Heap-Varoufakis (1995): "...The emergence of a particular convention...will depend both on the presumption that agents learn from experience (the rational component of the explanation) and on the particular idiosyncratic (and non rational) features of initial beliefs and precise learning rules." These latter are determined by social interactions. Individuals have only some control on their decisions, in that their choice is also influenced by events that are determined by the environment they live in. Those events are subject to changes, which sometimes are purely random. As already anticipated, a convention gets established when the majority of individuals follow it. There are no written rules that oblige individuals to follow it, and the mechanism of enforcement is entirely based on social interactions. As suggested by Sudgen (1989)"...It may be more useful to put less stress on rationality and to think of conventions as the product of evolutionary processes."

The emergence of a convention assumes the characteristics of a spontaneous and dynamic process, which hinges upon learning and adaptation. As Gintis (2000) suggests"...Adaptive learning leads with probability 1 to a convention."

The idea is that a convention is generated through an endogenous mechanism: it is the increasing number of individuals who subscribe the same behaviour which makes that behaviour become a convention.

Hence if tax compliance can be considered as a social custom or convention, we can assume it may spontaneously emerge in a community of tax payers through a process of learning and imitation and evolve under the pressure of social conscience and civic responsibility.

It is interesting to analyse more in detail how this could happen, with the view to check the stability of the social custom against a deviant behaviour such as tax evasion. Tax evasion could undermine and lead to the *erosion* of the social custom "paying taxes honestly": if an increasing number of taxpayers switch their behaviour and follow the new emerging dishonest behaviour, the degree of acceptance of the previously established convention "non evading" will decrease. This might lead to the erosion of such a convention. In what follows we shall analyse under which conditions this may happen.

3.3 A theoretical framework to analyse adaptive behaviour: evolutionary games

We need a dynamic analysis to establish if the presence of evaders might increase at such a level to change the emerging rule of conduct *making a truthful declaration of income to the tax authorities*.

A promising recent development that might enable us to analyse the evolutionary process underlying the adoption of a convention is given by *evolutionary game theory*.

Evolutionary game theory was firstly introduced in biology[4], with the purpose to apply game theory to biological evolution. It has been recently extended to other disciplines, including economics[5].

In the next two sub-sections we briefly recall the main features of an evolutionary game, which we will use to model the evolutionary process that might explain the emergence of the social custom.

3.3.1 Evolutionary Games: the mechanism of strategy selection

The main difference between evolutionary game theory and traditional game theory concerns the mechanism of strategy selection and the concept of equilibrium. In this

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[4] According to John Maynard Smith(1982) the first explicit use of game theory terminology in the context of biological evolution was by Hamilton (1967), who introduced the concept of "unbeatable strategy", which has the same meaning of an ESS defined later on by Maynard Smith and Price (1973).
[5] See Hirshleifer (1977) for a general discussion on analogies of evolution in biology with economics; Nelson and Winter (1974) for applications to the evolution of the industrial structure and Nelson (1995) for applications to economic progress. For a more general and formal analysis we refer to Witt (1992), Vega-Redondo (1996), Samuelson (1997) and Weibull (1995).

sub-section we focus on the selection of strategy in an evolutionary context and devote the next sub-section to the concept of equilibrium.

Traditional game theory models how agents select their strategies on the basis of two main assumptions: common knowledge of rationality (CKR) and consistent aligned beliefs (CAB). CKR assumes that each player is instrumentally rational, i.e. acts to maximise his/her utility, and knows that his/her opponent will do the same, knowing that he/she is instrumentally rational. The assumption of CAB implies that everybody's beliefs are consistent with everybody else's so that if two individuals had the same information set they would develop the same thought processes. Given these assumptions each player forms his/her beliefs on the opponent's strategy and selects accordingly his/her best strategy on the basis of the resulting payoff: in an interactive context in fact the payoff of a strategy depends on the opponent's move.

An equilibrium occurs when strategies selected by each player are *mutual best replies*: each agent's strategy is optimal given their opponent(s) strategy(ies). Such an equilibrium is defined as Nash equilibrium and implies two properties:

a) beliefs are confirmed by the opponent's choice,

b) players have no incentive to deviate from the chosen strategy.

In evolutionary game theory, the process of selection of a strategy is not entirely directed by single players, who independently form beliefs on their opponents' move and choose accordingly their best reply. Players simply observe the strategies undertaken by the others and exhibit adaptive behaviour, in that they tend to imitate the more successful behaviour. Players are still rational in that they are induced to choose the more profitable behaviour, but there are some systematic forces of the

selection mechanism which are determined by interactions among players and are not directly under the control of the single agent.

In biology these systematic forces consist of natural selection, inheritance and mutation. Modelling human behaviour being driven by such mechanistic forces would be unrealistic, however some evolutionary process might be expected in social behaviour.

The idea of the existence of a mechanism of selection acting on individuals' behavioural attitudes was presented by Richard Dawkins (1976).

In particular he emphasised cultural transmission as another kind of selection mechanism, able to "... *give rise to a form of evolution.*"[6].

He identifies the basic units of cultural transmission as *memes*, defined as "*tune, ideas, catch-phrases, clothes, fashions, ways of making pots or building arches*"[7].

Memes, in analogy with genes, are able to replicate in that they propagate themselves from brain to brain via a process of *imitation*. We can borrow Dawkins' example to illustrate such a mechanism: "*If a scientist hears, or reads about, a good idea, he passes it on to his colleagues and students. He mentions it in his articles and his lectures. If the idea catches on, it can be said to propagate itself, spreading from brain to brain*"[8].

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[6] See R. Dawkins, (1976) p.192, first ed.
[7] Ibid, p.192.
[8] Ibid, p.192

Imitation and cultural transmission fulfil an analogous function as genetic transmission (inheritance) and natural selection.

As the process of imitation is not perfect, a sort of mutation process can be observed. As Dawkins affirms "...*every time a scientist hears an idea and passes it on to somebody else, he is likely to change it somewhat.*"

A peculiarity of memes, which is not identifiable in genes is the capacity for altruism. Genes are by definition selfish in that "...*they cannot be expected to forgo short-term selfish advantage, even if it would really pay it, in the long term, to do so*"[9]. For memes, the hosting organism is the human brain, capable of "*conscious foresight (capacity to simulate the future in imagination)*". As men are able to see long-term benefits from altruistic behaviour and to discuss and agree ways of adopting it, altruistic tendencies could favour high survival in memes and hence be selected and transmitted among individuals.

This aspect is quite interesting for our analysis. The social custom "paying taxes honestly" could be considered as a form of altruism, evolved in the community of taxpayers through education and cultural transmission.

With the aid of evolutionary game theory we could analyse if such a form of altruism is an evolutionary stable strategy. In particular we could verify if a community of socially aware individuals, with Myles and Naylor's type of preferences, is able to survive an invasion of expected utility mutants.

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[9] Ibid, p.200.

By considering taxpayers' behaviour as adaptive behaviour, we implicitly assume that people observe the amount of tax evasion that is taking place. In this case we should borrow the idea of reference group theory: an individual, in taking his/her own decision, refers to a group of people with whom he/she interacts. The specification of a reference group might be based on a status variable, such as social class, occupation, or income[10]. In our case we need to address to a reference group in that a single individual is not able to observe the emerging level of tax evasion: neither can the tax authorities estimate it precisely. A reference group consists therefore of a group of people easily observable by an individual, e.g. neighbours, friends, or colleagues. The definition of the reference group is not based on status variables but rather on closeness of the interpersonal relationships.

With no lack of realism we can expect an individual to know the professional position of his/her neighbours, friends and obviously colleagues and to observe their standard of living. If there is a substantial discrepancy between the earning possibilities and the standard of living the individual might infer that his/her peers are evading.

An individual tends to observe the behaviour of his/her reference group and adapts his/her choices accordingly. Therefore an increasing number of peers suspected of tax evasion could persuade a single individual to engage in tax cheating as well.

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[10] See Cowell (1986) for an example of reference groups based on income in an analysis of claiming benefits.

3.3.2 Evolutionary games: the equilibrium concept

In an evolutionary game, equilibrium is determined by strategies which are mutual best replies, and which are able to resist the forces of natural selection, inheritance and mutation.

The equilibrium concept introduced by evolutionary game theory is defined as *Evolutionary Stable State*. It is reached once the proportion of organisms playing the same strategy is such that if any deviant behaviour emerges, it will not be followed and the distribution of strategies across the population will be stable over time.

An evolutionary stable state occurs when each member within a population adopts an *evolutionary stable strategy* (*ESS*).

The concept of ESS was developed by Maynard Smith and Price (1973).

An ESS consists of an *uninvadable* strategy in that "... If all members of a population adopt it, then no mutant strategy could invade the population under the influence of natural selection"[11] .

According to this definition, an ESS consists of an uninvadable strategy: if almost all members in the population adopt it, then the fitness or payoff attached to it is greater than that of any possible mutants.

We can illustrate this concept by use of an example.

We can imagine an infinite population of individuals who can opt for two different strategies: being honest (H) or being dishonest (D). Initially everybody adopts an honest behaviour. Subsequently a proportion of mutants appears, adopting the strategy being dishonest. The condition for H to be an evolutionary stable strategy is:

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[11] John Maynard Smith (1982), Ch. 2, p. 10.

H is an ESS if, for D≠H, there exists some $\bar{\varepsilon}$ such that, if $0 < \varepsilon < \bar{\varepsilon}$ [12]:

$$E[H, \varepsilon D + (1 - \varepsilon)H] > E[D, \varepsilon D + (1 - \varepsilon)H] \qquad (1)$$

E stands for payoff or expected return. The term in the left hand side represents the expected return from playing H when the probability of meeting a H is $(1 - \varepsilon)$, whereas the second term represents the expected payoff of playing D in a population with $(1 - \varepsilon)$ honest and ε dishonest agents.

This definition states that playing H is ESS when the expected payoff of playing H in a mixed population of honest and dishonest individuals in proportion $(1 - \varepsilon)$ and ε, is higher than the expected payoff of playing D.

We assume an original population of honest individuals, hence H is the incumbent strategy and D is a mutant strategy. Thus we can interpret definition (1) as follows: strategy H is an ESS, if there exists an invasion barrier $\bar{\varepsilon}$, such that if mutant entrants appear in a proportion below $\bar{\varepsilon}$, they won't get a higher fitness (payoff). This implies that mutants won't be able to "reproduce" at a faster rate and invade the population. H is an uninvadeable strategy.

Definition (1) is satisfied when either of these two conditions holds [13]:

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[12] We use Samuelson (1997) definition.
[13] Samuelson (1997).

H is an ESS, if and only if, for all strategies D≠H:

(i) $E(H,H) > E(D,H)$ (2)

or

(ii) $E(H,H) = E(D,H)$

and for small ε $E(H, \varepsilon D + (1-\varepsilon)H) > E(D, \varepsilon D + (1-\varepsilon)H)$

Condition *(i)* states that strategy H always fares better than D: *H is a best reply to itself* and it corresponds to the condition for a strict Nash equilibrium. It means that all possible mutations *D* have a lower payoff.

According to condition *(ii)* even if dishonest mutants might get the same payoff as honest individuals when they are very rare, they can't permanently invade the original population because they will not be imitated. In fact for a small proportion of mutants ε, an individual playing H *against a population* which is playing H with probability *(1-ε)* and D with probability ε (*post-entry population*), always gets a higher payoff than playing D.

In order to explain the link between definition (1) and conditions (2) we can use a diagram.

In Figure 3.1 we represent conditions 2: on the vertical axis we plot the payoff function, on the horizontal the proportion of mutants ε. When ε is zero one player's opponent will be honest with probability one: in this case the payoff of a strategy played against a population of honest individuals will lie on the vertical axis. Condition *(i)* requires that playing H within an honest population fares better than playing D: therefore the payoff E(H,H) must lie above E(D,H). When ε is unity the

population will consist of dishonest agents and the payoffs E(H,D) and E(D,D) can be represented on the vertical line $\varepsilon=1$. If we join E(H,H) and E(H,D) we get the expected payoff of playing H against a mixed population of honest and dishonest individuals in proportion ε and $(1-\varepsilon)$:

$$E[H, \varepsilon D + (1-\varepsilon)H]$$

By joining E(D,H) and E(D,D) we get the expected payoff of playing D in a mixed population:

$$E[D, \varepsilon D + (1-\varepsilon)H]$$

As figure 3.1 shows, if condition *(i)* is satisfied, and for small ε, the expected payoff of playing H is greater than the expected payoff of playing D, there will exist an interval for ε over which playing H fares better than playing D. That is to say, a population of honest individuals is resistant to a mutation which occurs in proportions less that $\bar{\varepsilon}$, i.e. definition 1 holds.

In figure 3.2 we illustrate the case when playing H is always an ESS, i.e. a population of honest individuals is never vulnerable to mutant behaviour. Initially, in a population of honest individuals, H and D get the same payoff against H and therefore E(H,H)=E(D,H), condition 2*(ii)* is satisfied. However, playing D in a population of dishonest against itself is not a best reply in that E(H,D)>E(D,D). Therefore when $\varepsilon=1$, E(H,D) will lie above E(D,D).

Again, if we join E(H,H) with E(H,D) and E(D,H) with E(D,D) we get that the expected payoff of playing H against a mixed population is always higher than the expected payoff of playing D. In this case, a population playing H is always resistant to a mutant strategy D.

In conclusion the concept of ESS is a refinement of NE. An ESS is a NE which satisfies a specific stability condition: robustness against an invasion by a small proportion of mutants. Stability is checked against the appearance of previously non-existing behaviour (mutation).

We now apply the concept of strategy selection and equilibrium typical of an evolutionary process to the Myles and Naylor analysis.

3.4 Myles and Naylor's model in an evolutionary context: does the act of evading lower the survival prospects of moralistic taxpayers?

In the Myles and Naylor model tax compliance is assumed to be a social custom. If the individual does not evade he/she gets utility from following the social custom [c] and from conforming with the group of tax payers [$bR(1-\mu)$].

The existence of the social custom is taken as given: the parameters b and c are allowed to differ among individuals but they are fixed. A single individual is associated with *given b* and *c parameters*, and does not change his/her preferences over them.

Here we consider an environment where individuals *can change* their preferences over b and c. Instead of focusing on *"why does the individual evade?"*, we now turn

the attention to the question "*Does the act of evading lower or raise the survival prospects of evaders?*".

We assume that three main forces affect the emergence and duration of the social norm: *learning*, or cultural transmission, *mutation* (appearance of new behaviour) and *imitation*.

We set the game as follows: b and c do not vary among individuals[14], in that all individuals have the same b and c, but there is the possibility of a mutation: some individuals may change their preferences over b and c.

Our aim is to find out if the social custom being an honest taxpayer is evolutionary stable, i.e. able to resist an invasion of evaders.

We recall that according to Myles and Naylor evaders and non evaders might coexist and characterise a social equilibrium: a stable population might consist of mixed proportions.

We assume the same decision process as in Myles and Naylor: an individual will decide whether or not to evade after comparing the utility from evasion with the utility from non-evasion and will cheat if the former is greater than the latter.

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[14] We make this assumption in order to simplify the analysis. In this case, in fact, we do not need to consider the density function for b and c. However, this assumption does not affect our results.

In order to test for the stability of the social custom, we start from an initial population where all individuals follow it (the *b* and *c* parameters are positive) and allow for the appearance of mutant cheaters, who are driven by the maxim "From now on I'm only going to think of myself"[15]; they do not attach any importance to the social norm (*b* and *c* are zero) and start to evade because for them the utility from non evading is $U^{NE}=U(X)$, always less than the expected utility from evading. Will morals be strong enough to prevent such a deviant behaviour to be imitated and spread in the whole community? Or can cheaters coexist with honest taxpayers in equilibrium? We are going to verify this by considering the evolutionary stable state(s) in our game.

We should note that preferences here are not modelled in the ordinary way. Usually preferences are inferred from individuals' choices, in that only individuals' choices can be observed. Under the assumption that individuals are instrumentally rational and therefore select the action which best satisfies their preferences, the observed actions can be used to infer the preferences agents aim to satisfy.

In this case we allow for the possibility that agents might be of two different types: *socially aware*, with positive *b* and *c* parameters, or *individualists*, who do not attach any importance to being members of a community, for whom the *b* and *c* parameters are zero.

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[15] This statement is part of a quotation from Joseph Heller(1962) which is quite suitable to describe a mutation in a community of honest people: ""From now on I'm only going to think of myself", *"What would happen if everybody thought that way?""*, ""Then I'd be a damned fool to think any other way"", p. 208.

Therefore, if we observe the choice to evade has been made, it could either have been made by socially aware individuals[16] or by individualists[17]. The choice in favour of evasion is not associated with a unique type of preferences.

If we want to distinguish between socially aware agents and individualists, we need to define their preferences concerning the *b* and *c* parameters, which will determine their utility function and, given the assumed decision process, their choice towards evasion. The definition of preferences has to come prior to the individual's decision. Hence the analysis should focus on preferences rather than choices.

A mutation occurs when a previously non-existing preference appears by modifying the utility function. A modification in the utility function could lead to a change in behaviour. For example if the mutation consists of new preferences over *b* and *c* that take the value of zero, such a mutation will be observed in a new utility from non-evading function, precisely $U^{NE} = U(Y(1-t))$. Given the decision process, individuals with this new utility function will opt for evasion.

This approach is slightly different to the standard approach in an evolutionary game. In the latter a mutation consists of a change in strategy. In our case the mutation consists of a change in preferences over *b* and *c*. Such a change implies a mutation in the utility function and as a result in behaviour. Therefore instead of observing a mutation in strategies we observe a mutation in payoffs.

A model where the evolutionary process acts on the utility payoff is presented by Robson (2001). The paper examines how a utility function could emerge from an evolutionary process. For our purposes, it is interesting to note that in this model the

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[16] Those are individuals for whom $U(Y(1-t))+bR(1-\mu)+c<(1-p)U(W_g)+pU(W_b)$, i.e $1-pf> bR(1-\mu)+c$.
[17] Those are individuals for whom $U(Y(1-t)) <(1-p)U(W_g)+pU(W_b)$, i.e $1-pf>0$.

process of selection acts on utility payoffs. This is due to the assumption that there exists a biological utility function that relates the payoff to the rate of production of expected offspring[18]. The evolutionary process consists of a change in the rate of production of expected offspring. Hence, if the rate of production is linked to the payoff, the selection process will act on the payoffs, rather than on strategies.

Our analysis presents a similarity with Robson's context: the utility function as modelled in Myles-Naylor, depends on the proportion of individuals adopting the social custom. The evolutionary process consists of a change in the proportion of individuals following the social custom. A change in the proportion of individuals following the social custom determines a change in the utility from non evading: the selection mechanism of the evolutionary process acts on the utility function. It is the link between the utility function and the outcome of the evolutionary process which implies that the selection mechanism acts on payoffs rather than on strategies.

We can model the situation as a *symmetric game* in that all individuals in the population have the same strategy set and payoff functions, i.e. we deal with a *single population*.

There are two available strategies: evade (E) or not evade (NE).

The payoff to evasion is $U^E=(1-p)U(W_g)+pU(W_b)$: people who evade are expected utility maximisers, who do not take into account the behaviour of other taxpayers. Their payoff is simply the expected utility from evading.

The payoff to non evasion is $U^{NE}=U(Y(1-t))+bR(1-\varepsilon)+c$. $(1-\varepsilon)$ is the proportion of people who follow the social custom.

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[18] In this model payoffs are consumption rates. These rates of consumption have biological implications and determine the rate of production of expected offspring.

Each individual plays against n-1 individuals.

We start with an initial situation in which the social custom "not evading" has been established: the whole population adopts the same incumbent strategy NE.

This means that the b and c parameters are positive for everybody, in that the importance attached to conforming to honest behaviour and to following the social custom is recognised in the whole community. We can think of this idyllic situation, where everybody is wise and honest and morals and civic conscience are very well rooted, as the outcome of a specific process of cultural transmission: education. People have been brought up with a solid social conscience and the evaluation of morals is far more important than any pecuniary aspect, so that even in the presence of a positive expected gain from evasion they would not follow the temptation.

Everybody gets the same payoff $U^{NE} = U(Y(1-t)) + bR + c$, the highest level of utility from non-evading, attainable when everybody follows the social custom, i.e.$(1-\varepsilon) = 1$. We recall that b and c are the same for socially aware individuals.

We then allow for a small group of mutants to appear, for whom b and c are zero, because they do not recognise and subscribe the social custom. For them $U^{NE} = U(Y(1-t))$. They evade because the expected utility from evading is always greater than $U^{NE} = U(Y(1-t))$, it is as if they were all programmed to play E. We denote the share of mutants as ε.

Our aim is to verify what happens in the post-entry population. We can think of three possible outcomes:

a) The strategy not evading is an evolutionary stable strategy: mutant expected utility maximisers get a lower relative payoff and tend to disappear.

b) The behaviour of expected utility maximisers can overthrow the social custom and the dynamic process could converge to the socially undesirable outcome where tax evasion becomes a socially accepted behaviour. In this case the evolutionary stable strategy is evading

c) An interior evolutionary stable equilibrium exists where evaders and non-evaders coexist.

Is NE an ESS?

If we start with a monomorphic population, where all individuals play NE and then a proportion ε of mutants appears, the post-entry population will consist of a mixture of evaders and non-evaders in proportion ε and *(1-ε)* respectively.

Mutants will play against the post-entry population.

Using definition *(1)*:

NE is an ESS if, for any other E≠NE there exists some $\bar{\varepsilon}$ such that, if $0 < \varepsilon < \bar{\varepsilon}$:

$$\Pi[NE, \varepsilon E + (1 - \varepsilon)NE] > \Pi[E, \varepsilon E + (1 - \varepsilon)NE] \tag{3}$$

The conditions in order for non evasion to be an evolutionary stable strategy become:

(i) $\Pi(NE, NE) > \Pi * (E, NE)$ *or*

(ii) $\Pi(NE, NE) = \Pi * (E, NE)$

$\qquad$ *and for small* ε $\Pi(NE, \varepsilon E + (1 - \varepsilon)NE) > \Pi * (E, \varepsilon E + (1 - \varepsilon)NE)$

$\tag{4}$

The payoff function differs according to whether someone is socially aware or not. Π is the payoff of socially aware individuals, whereas Π^* is the payoff of expected utility maximisers.

We can analyse if either of these two conditions is satisfied graphically.

In figure 3.3 we draw the two curves $U^E=(1-p)U(W_g)+pU(W_b)$ and $U^{NE}=U(Y(1-t))+bR(1-\varepsilon)+c$.

Given our assumption that everybody has the same b and c parameters, the two curves represent the utility from non-evading and the utility from evading for the whole population. This graph is similar to the one we encountered in Myles and Naylor analysis, but we should point out some important differences. First of all in Myles and Naylor it applies only to the single individual of type (b,c): we used it to represent how a single individual decides whether or not to evade. μ and μ^* denoted the actual and the critical proportion of evaders respectively: if a single individual observed a proportion of evaders below the critical level he/she would not evade.

In this case ε is the proportion of evaders in the population and $\bar{\varepsilon}$, as we shall see, has a different interpretation from μ^*.

We rule out the two extreme cases, depicted in figures 3.4 and 3.5, where the utility from non evading always lies either above or below the utility from evading. In fact in the former case nobody would ever evade, whereas in the latter everybody would evade, so that testing for the stability of the social custom would be trivial.

Let us focus on figure 3.3.

Initially everybody follows the social custom and makes a truthful declaration of income to the tax authority. In the diagram this situation corresponds to the vertical intercept of the U^{NE} function, where $U^{NE}=U(Y(1-t))+bR(1)+c$, which represents the highest level of utility from non evading, attainable when ε is zero.

If mutant expected utility maximisers appear, they will get $U^E=EU$.

In an evolutionary context when a mutation occurs, a new strategy will emerge and individuals in the population will observe (*learn*) the payoff of the mutant strategy. If it turns out to be higher than their own, they will *imitate* the mutant strategy and switch their behaviour to the more successful strategy.

In this game, socially aware individuals will face mutants with a different utility function. Mutants will not recognise the importance of the social custom, and, after comparing the utility from net true income with the expected utility from evading, will start to evade, getting $U^E=EU$. What socially aware individuals observe is the emergence of a group of evaders who get $U^E=EU$. They will compare this new outcome with their own and will switch to evasion if the mutant strategy gives a higher payoff.

In terms of our diagram, if the proportion of mutants is less than $\bar{\varepsilon}$, the utility from non evading always lies above the utility from evading. A truthful declaration of income makes individuals better off than evasion and socially aware individuals will not change their preferences over b and c. On the other hand, mutant expected utility maximisers will observe that they could get a higher payoff if they observed the social custom and therefore they will switch to the incumbent strategy.

The mutation in preferences is not able to survive in the original population. Therefore there exists a critical proportion of evaders, $\bar{\varepsilon}$, which we can define as an

invasion barrier, such that if mutant expected utility maximisers enter a population of socially aware individuals in a proportion below $\bar{\varepsilon}$, the incumbent strategy of non evading will be preserved. $\varepsilon=0$ is an evolutionary stable state and non-evading is an evolutionary stable strategy. Condition *(i)* is always satisfied over the range $0 < \varepsilon < \bar{\varepsilon}$.

Is E an ESS?

We now check if the other extreme case where everybody evades, $\varepsilon=1$, could be another evolutionary stable state. We consider an initial population of evaders, with no concerns for the social custom and examine what happens if someone decides not to evade, inspired by some non-selfish motivations. One possibility for this mutant altruistic behaviour could be due to some religious motivations. We could think of someone like Brother Jed who starts not to evade in the attempt to convert a population of people with no concerns for morals into righteous individuals[19].

We define evasion (E) as an evolutionary stable strategy if and only if :

for any other NE≠E there exists some $\bar{\varepsilon}$ such that, if $0 < \varepsilon < \bar{\varepsilon}$:

$$\Pi[E, \varepsilon NE + (1-\varepsilon)E] > \Pi[NE, \varepsilon NE + (1-\varepsilon)E] \qquad (5)$$

The conditions for this to happen are:

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[19] Brother Jed is the main character of an exercise on profit maximisation in Bergstrom and Varian(1996). Brother Jed is the character of a question on production, a profit maximising prophet who takes heathens and reforms them into righteous individuals. These are the outcome of a production process whose arguments are the number of heathens who attend Jed's sermons and the number of hours of preaching.

(i) $\Pi^*(E,E) > \Pi(NE,E)$ *or*

(ii) $\Pi^*(E,E) = \Pi(NE,E)$

and for small ε $\Pi^*(E,\varepsilon NE + (1-\varepsilon)E) > \Pi(NE,\varepsilon NE + (1-\varepsilon)E)$

We analyse this graphically and refer back to figure 3.3.

If we start with a population of evaders who do not attach any importance to the social custom, everybody will get $U^E = EU$ and $\varepsilon=1$. If mutant socially aware individuals enter the population, in a proportion $\eta < (1-\overline{\varepsilon})$, and start not to evade, they will get a lower payoff than the incumbents. According to the principle regulating the process of strategy selection in an evolutionary context, their behaviour won't be followed and eventually their good intentions will be wiped out and they will conform with the cheaters. Condition *(i)* is satisfied for $\eta < (1-\overline{\varepsilon})$, and E is an ESS, i.e. $\varepsilon=1$ is an evolutionary stable state. Again $\overline{\varepsilon}$ assumes the role of an *invasion barrier*.

Is a mixed outcome an evolutionary stable state?

A mixed outcome consisting of selfish utility maximisers and honest tax payers, motivated by moral considerations, would not be an evolutionary stable state. At $\overline{\varepsilon}$, which could qualify for an interior equilibrium in that $U^E = U^{NE}$, any arbitrary small number of mutants would drive the equilibrium to one of the two ESS we described above. The conditions for an evolutionary stable state would be never satisfied for a mixed outcome.

In conclusion, the analysis of the behaviour of individuals with Myles and Naylor utility functions in an evolutionary context would suggest that the only two stable equilibria would be either a fully honest community or a community of cheaters. The only two evolutionary stable states are $\varepsilon^*=0$ and $\varepsilon^*=1$. The two basins of attraction of these two equilibria are delimited by $\bar{\varepsilon}$.

The more $\bar{\varepsilon}$ approaches unity the larger the basin of attraction for $\varepsilon^*=0$ and therefore the higher the number of mutations required to switch the system from all-non-evaders to all-evaders.

It is interesting to note that if the social custom is not supported by a personal conviction, and it is followed only to conform with the community of taxpayers, i.e. $c=0$, then the basin of attraction for the nice equilibrium $\varepsilon^*=0$ will get smaller. This is due to the fact that the vertical intercept of the utility from non evading will be lower, so that the utility from non evading will result higher than the utility from evading on a smaller interval of values for ε.

We should note that here we assume that individuals have the same b and c parameters. This assumption is made to simplify our analysis, but does not affect our results: even if we allowed for a continuum of b and c parameters, a mixed outcome of utility maximisers and socially aware individuals would not be an evolutionary stable state.

Our results contrast the findings in the Myles and Naylor model: in Myles and Naylor a mixed outcome consisting of evaders and non-evaders was one of the possible social equilibria. Here we allow for the possibility that individuals can change their

preferences over tax compliance and disregard the social custom. In this context a mixed outcome of selfish expected utility maximisers opting for tax evasion and socially aware individuals who truthfully declare their income is not feasible.

The behaviour of expected utility maximisers can displace the social custom and the dynamic process can converge to the socially undesirable outcome where tax evasion becomes a socially accepted behaviour. The smaller the critical proportion of tax evaders for which $U^E = U^{NE}$ the more likely this unsatisfactory outcome. The level of the critical proportion of evaders depends on the strength of the social custom: the larger the number of adherents, the higher the critical proportion of tax evaders for which $U^E = U^{NE}$, the larger the basin of attraction for the evolutionary stable equilibrium $\varepsilon = 0$ and the less likely the socially undesirable outcome.

The social custom non evading is stable as long as it is followed by a critical number of people. If the number of mutants goes above $\bar{\varepsilon}$, the social custom is not evolutionary stable.

As we considered in the previous chapter, the assumption made by Myles and Naylor that some taxpayers are inherently honest and do not evade because they consider tax compliance as a social custom, could have explained the mixed outcome of honest tax payers and cheaters that was not predicted by the standard portfolio model but is actually observed. However, if we allow for the possibility that individuals might change their preferences and behavioural attitudes after observing the behaviour of their peers and learning from the social context in which they live, that argument does not seem to be fully satisfactory. The fact that non-selfish attitudes are not invulnerable to selfish behaviour, would suggest that a mixed outcome is not totally explained by individuals being inherently honest.

3.4.1 The role of the Government in altering the basin of attraction

The Government could have an active role in preventing a deterioration of the social custom.

The Government, in implementing an effective anti-evasion policy, should attempt at widening the basin of attraction for the equilibrium $\varepsilon^* = 0$.

In particular the Government could intervene in two directions:

1) implementing educational programmes aimed to establish and consolidate a social conscience against tax evasion

2) altering the tax parameters.

Both interventions could discourage tax evasion, in that $\bar{\varepsilon}$ would increase. In terms of our diagrams this would enlarge the basin of attraction for the evolutionary stable equilibrium where nobody evades, making it more difficult for a population of non evaders who follow the social custom to be invaded by mutant (expected utility maximisers) evaders.

Educational programmes could be aimed at making people aware that tax evasion is bad both for the community (it may mean less public spending), and also for the single individual (the free-riding of tax evaders imposes a greater tax burden on those who do not have any opportunities to evade, such as those with an income taxed at source). The filed experiment presented by Slemrod (2001)[20] on the attempt made by the Minnesota Department of Revenue to influence tax payers' behaviour through normative appeals, is an example.

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[20] See Chapter 2, section 2.6.2.

By doing this the government could make the enforcement mechanism against tax evasion more effective. In accordance with what discussed earlier, if people believe that tax evasion is something to fight against, moral commitment and social disapproval may become important inhibitory factors.

However the process for establishing moral commitment and social disapproval may be quite long, in that it requires cultural changes in individuals attitudes.

The government could rely on the tax parameters for a more immediate impact.

In what follows we analyse the effect of a change in the tax rate on the basin of attraction of the nice equilibrium. We will check if it is always the case that the government can discourage tax evasion by increasing the tax rate.

We consider an increase in the tax rate.

Myles and Naylor show that an increase in the tax rate will lead to an increase (decrease) in the critical proportion of evaders for a single individual of type b and c if $pfYU'(W_b) > (<)YU'(Y(1-t))$.

Given our initial assumption that all individuals have the same b and c parameters, this condition determines the effect of an increase in the tax rate for the whole economy. Let us first recall the significance of this condition.

$pfY \ U'(W_b)$ is the absolute value of the change in the expected utility from evading due to a change in the tax rate[21].

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[21] See Ch. 2 p. 29.

Whereas $YU'(Y(1-t))$ is the absolute value of the change in the utility from non evading due to a change in the tax rate[22].

Let us consider first the case when $pfYU'(W_b) > YU'(Y(1-t))$. We refer to figure 3.6.

An increase in the tax rate will shift downwards both the U^E and the U^{NE} curves. But if $pfYU'(W_b) > YU'(Y(1-t))$ the U^E curve shifts by more than the U^{NE} curve.

In this case the basin of attraction for $\varepsilon* = 0$ will become larger, i.e. it is more difficult to eradicate the social custom. The anti-evasion policy is effective.

In figure 3.7 we analyse the case for $pfYU'(W_b) < YU'(Y(1-t))$. The U^{NE} curve shifts by more than the U^E curve and the basin of attraction for the nice equilibrium will get narrower and it will be easier to overcome the social *custom making a truthful declaration of income.*

If the Government kept on increasing the tax rate the policy could lead to a catastrophical outcome: the basin of attraction would become smaller and smaller until the critical proportion of tax evaders is zero (the utility from non evading curve intersects the origin). At that point everybody would evade.

When $pfYU'(W_b) < YU'(Y(1-t))$ it would be more appropriate to decrease the tax rate to tackle tax evasion . In fact, as we show in figure 3.8, a decrease in the tax rate would shift upwards both the U^E and the U^{NE} curves but as $pfYU'(W_b) < YU'(Y(1-t))$ the U^{NE} curve would shift by more than the curve U^E. As a

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[22] Ibidem.

result the basin of attraction for $\varepsilon = 0$ would be larger. The actual number of tax evaders would decrease.

In conclusion, the tax authorities must be aware that an increase in the tax rate does not necessary increase the critical proportion of tax evaders $\bar{\varepsilon}$. This will occur only if $pfYU'(W_b) > YU'(Y(1-t))$. The efficacy of an increase in the tax rate with the purpose to decrease tax evasion depends also on the probability of detection and the fine. The higher the probability of detection and the fine the more successful an increase in the tax rate to deter tax evasion.

This suggests that the three fiscal parameters $(t, f$ and $p)$ are interdependent for the efficacy of an anti evasion policy: they are complements rather than substitutes as it was suggested by the original literature[23].

3.5 An intuition for the survival prospects of reciprocal Kantian taxpayers

The same extreme outcomes we presented for Myles and Naylor model, could occur when we consider a community of tax payers who follow a Kantian behaviour, as modelled by Bordignon and we allow for a change in preferences in favour of expected utility maximising behaviour.

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[23] See Yitzhaki (1974)

The instability of Kantian behaviour has already been argued by Tullock (1959). In his paper Tullock considers the implications of the majority rule on the outcome of governmental decisions under two restrictions:

- allowing for the possibility that a voter can trade his vote for one issue for votes on others (logrolling),

- a standard referendum (logrolling not permitted).

Among the possible forms of logrolling he considers voters who adopt a Kantian behaviour and argues, by use of an example, that such behaviour would not be stable in a community where individuals could opt for a deviant maximising behaviour.

It is worth considering his argument in that it can be used to show that the behaviour of taxpayers who conform to a Kantian ethical rule as in Bordingnon model is not an evolutionary stable strategy.

He considers the example of a township of 100 farmers, where local roads, giving access to main roads maintained by the state, are built and maintained by the township. The repairing of local roads is approved once the majority of farmers have voted for it. The cost of repairing is assessed to all farmers as part of real property tax.

Under the assumption that only four or five farmers are dependent upon a particular local road to access the main roads, with a referendum no local roads would be repaired in that an overwhelming majority of farmers would vote against it.

The author contrasts this situation with an alternative case where farmers follow a logrolling rule according to which they behave as Kantian individuals. In particular each farmer votes on each proposal to repair a given road as he would vote for repairs on his own road. Under these circumstances all roads would be repaired at the median preference.

However this is not a stable outcome. Any coalition of utility maximisers which comprises 50%+1 of the voters can insure that their roads are repaired. As 50%-1 of the costs are to be born by all the others, the coalition would vote for a better quality of the roads than the Kantians. The Kantians would bear the cost or repairing other people's roads and would not get the support from the utility maximisers for repairing their roads. The Kantian farmers, becoming tired of being exploited by maximisers, would then switch to a maximising policy. Implicit in this view is an evolutionary argument: an initial population of Kantian individuals can be wiped out by maximisers, who always fare better (get better than average repairs on their roads) than the Kantians.

In the Bordignon model tax payers are assumed to conform their behaviour to a Kantian rule, according to which they are prepared to pay the amount of taxes that they wish other individuals to pay, weakened by reciprocity considerations. Each taxpayer maximises his/her expected utility subject to the constraint that the optimal tax evasion can't exceed the *fair* level. However perceived evasion by other taxpayers directly enters the individual's fairness constraint. If perceived evasion increases, the individual will revise his/her desired payment and the amount of taxes he/she considers fair to evade will increase.

By an argument similar to Tullock we can expect a population of individuals behaving as in Bordignon model to be wiped out by expected utility maximisers.

In an initial population of Kantian taxpayers, if one individual decides to maximise his/her expected utility under no constraint, he/she will get a higher expected utility and will evade a greater amount. If other individuals decide to follow the same behaviour, the greater extent of evasion will begin to get noticed in the community

and Kantian individuals will revise their fair contribution to adjust for the increase in perceived evasion. This will increase the amount of evasion they consider fair (the upper limit of the fairness constraint) and hence will lead to greater evasion by the Kantians. So we have two effects after observing a deviant behaviour: some individuals will follow the cheaters and those who stick to the Kantian behaviour will increase the amount of evasion, by reciprocity considerations.

The overall amount of evasion will increase and this will have a further negative effect of the fair contribution. The fair contribution will keep decreasing until it becomes negative: perceived evasion will be so high that the Kantians would rather get a subsidy than paying taxes. The upper limit of the fairness constraint will become full evasion, and we will end up with a population of unconstrained expected utility maximising tax payers. We should note that we can expect the switch from Kantians to expected utility maximisers to occur even more rapidly than in Tullock. This is due to the reciprocity considerations, which make the Kantians revise their payment in case other individuals do not observe the same ethical rule.

By the same argument it is possible to show that a mixed equilibrium with one type of individuals constrained by fairness consideration and one type not constrained is not stable.

On the other hand, in a population where both types are unrestricted by fairness considerations a preference for fairness cannot emerge spontaneously. If a mutation occurs and some individuals start to maximise their expected utility under the fairness constraint, the level of utility they are able to attain will always be lower than that for unconstrained expected utility maximisers. Hence their relative payoff will always be lower: they won't be imitated and they will eventually give up any concern for fairness.

Hence the only evolutionary stable outcome is a population of expected utility maximisers.

3.6 How to explain the coexistence of honest and dishonest behaviour: an unresolved issue

In the previous two sections we have argued that the argument that some individuals honestly declare their income to the tax authorities because they are prepared to observe a social custom or a Kantian ethical rule appears rather ad hoc, once we allow for the possibility that individuals may change their preferences and attitudes. The strategy of being honest is evolutionary stable only if it is followed by a critical number of individuals. Hence it is hard to explain, on those grounds, why there may be some individuals who never evade.

Altruism and honest behaviour in an evolutionary context.

This result matches with other models that analyse altruism as adaptive behaviour[24], emerging through an evolutionary process. A common result presented in those models is that altruistic behaviour is not evolutionary stable and some protective mechanism is required for its stability.

Robert Trivers (1971)[25] was the first author to address altruistic behaviour as adaptive behaviour subject to a mechanism of selection and evolution. His argument is that altruistic behaviour is a form of *adaptive behaviour*, in that it tends to

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[24] We refer the interested reader to Zamagni (1995), who provides a collection of essays on altruism.
[25] See R. Trivers (1971).

propagate among individuals through a mechanism of reciprocity: the performance of an altruistic act may induce the recipient to respond by reciprocating.

The motive of an altruistic act relies on the psychological system, which is very complex and includes altruist impulses and cheating tendencies. These cheating tendencies undermine the stability of altruism and call for some sort of protective mechanism, such as emotions of guilt or moralistic aggression in case of cheating. In the absence of a protective mechanism, altruism is not evolutionary stable.

The same seems to be valid also for honesty and co-operation.

Nyberg (1997) analyses the evolution of honesty in a population of honest and dishonest individuals, where honest agents can invest time and resources in partially safeguarding their transactions, by exerting some effort to reduce exposure to opportunism. The author shows that, in the absence of safeguards, dishonesty dominates honesty and the only feasible equilibrium is a situation where everybody is dishonest. However, when honest agents can invest in safeguards, other equilibria containing some proportion of honest agents (nice equilibria) become also feasible.

Witt (1994) consider the evolution of co-operation in a one-shot Prisoner's Dilemma and shows that co-operative behaviour cannot gain a foothold in an amoral population.

The problem is that, in a mixed population, moralists cannot systematically discriminate against immoral members by orientating themselves in their interactions towards the moralists'side. However there is a chance for cooperation to emerge from a Prisoner's dilemma if innovators appear in clusters rather than as single individuals in their neighbourhood. If the cluster is large enough the innovators will

have a chance to invade the entire population. A cluster may consists of a homogeneous group of agents migrating into the population from outside, or religious founders, prophets, preachers and moral philosophers.

As time elapses the cluster may grow and moral conduct may eventually become the prevailing social model.

The common view in those models is that in a playing the field situation, where an agent interacts with the whole population, altruism, honesty and co-operation cannot spontaneously emerge in a community and be preserved as an evolutionary stable strategy in the absence of some protective measure.

This may not necessarily be true with pairwise interactions, where an agent interacts with one agent at a time. Some authors, suggest that altruistic behaviour can be evolutionary stable. Instances of evolutionary stable altruistic behaviour can be found for example within siblings, or between relatives or neighbours, as argued by Bergstrom-Stark, (1993), and Bergstrom (1995).

Their argument is similar to the one suggested for the survival of the Species. The preservation of species could be interpreted as a public good in the animal kingdom. Organisms should act altruistically towards their species. But what is observed is that altruistic behaviour is exhibited towards those organisms with genetic similarities: organisms are altruist towards their family. This is due to the fact that, to use Richard Dawkins's words, "... close relatives have a greater than average chance to share genes[26]." So altruistic behaviour is performed with the intention of enhancing the survival possibilities of one's genes.

However, these arguments do not seem to be applicable to our context of tax evasion: taxpayers interacts with the whole community.

Similarity with the public good game.

There is a similarity between our result and the public good game, which models the problem of supplying public goods through voluntary contributions.

As argued by Sudgen (1986), in such a setting where there are many individuals, co-operation is difficult to organise. This is due to the fact that "...the benefits of any player's co-operation is reaped by all players - co-operators and defectors alike...If each person pursues his own interest, it is most unlikely that genuine public goods will be produced by co-operative arrangements involving many individuals....Each potential defector can be deterred only by the threat that if he defects, the whole co-operative scheme will be brought down: no one will co-operate with anyone. This means that the scheme *must* be fragile: it cannot work at all unless it is capable of being wrecked by any maverick who refuses to co-operate when the rules of the scheme prescribe that he should[27]"". This situation is similar to the outcome of the evolutionary game we considered above.

But what we observe in practice is that some public goods are indeed paid by the voluntary sacrifices of many individuals.

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[26] Richard Dawkins, (1976), p. 89.
[27] Sudgen (1986), p. 140.

According to Sudgen an explanation for these instances of co-operation could rely on the presence of conventions of reciprocity. In particular, individuals may be induced to co-operate if there exists a convention such that "...individuals adopt a tit-for-tat strategy of reciprocal co-operation and co-operate as long as their opponent does the same." The stability of such a strategy however depends on the number of people adopting it, in that *conventions of reciprocity* are fragile in large groups. As Sudgen argues "...conventions of reciprocal altruism are likely to be increasingly fragile as the number of co-operators increases[28]". One problem for having many players is that they may not all interpret the convention in the same way.

In large groups, where donors don't even know the identities of the other donors, as in the case of the British Lifeboat service or the Blood Banks, an explanation for observing voluntary contributions may rely on *moral beliefs*.

If we shared the view that morality could explain co-operative behaviour in environments where there are no individual incentives to act altruistically, then we should ask what determines the level of morality in a community and how the government can intervene.

Other authors argue that *fairness considerations* could make individuals co-operate in situations like the public good game.

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[28] Ibidem, p.136.

Fehr and Schmidt (1999) model fairness considerations in terms of inequity aversion[29] and show that the prospects of co-operation in a public good game are greatly improved if there is a group of inequity averse individuals who can punish defectors. In particular, full co-operation can be sustained as an equilibrium outcome if there is a critical number of inequity averse individuals, who are prepared to punish defectors. However the argument that some tit-for-tat strategy or fairness or reciprocity considerations may explain honest or altruistic behaviour does not seem to work for tax evasion, where interactions are anonymous. Each taxpayer interacts with the whole community of taxpayers. The punishment of the cheaters would not be straightforward: first of all because everything is hidden, so that the cheating activity may not be easily observed. Second, the cheating activity of one individual would directly affect the public good and not single individuals, in that it would decrease revenues and its impact would spread on the whole community. This could imply that individuals may be less willing to punish a cheater, in that the cost of cheating is born by quite a vast community.

Another explanation for observing voluntary contributions is based on *group specific cultural factors*.

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[29] Inequity averse individuals are those who aim at achieving an equitable distribution of material resources. They are altruistic towards other persons (i.e. they want to increase their payoff), if the other persons' material payoff falls below an equitable benchmark, otherwise they are envy (i.e. they want to decrease other persons' payoff). See Fehr-Fischbacher (2001).

An experiment conducted by Henrich et al. (2001) on public good games played in seven small-scale different societies, situated in different countries with very diversified cultural backgrounds, shows great variation in behaviour, which is typically not found in experiments with students. As the authors point out: "...Typical distributions of public good games contributions with students have a U-shape, with the mode at contributing nothing, a secondary mode at full co-operation, and mean contribution between 40 per cent and 60 per cent. By contrast, for instance, the Machiguenga [a society located in Peru] have a mode at contributing nothing, with not a single subject co-operating fully, yielding a mean contribution of 22 per cent. Also the Aché [a society from Paraguay] and Tsimané [a society from Bolivia] both exhibit inverted distributions, with few or no contributions at full free-riding or full co-operation". This would suggest "...that preferences are affected by group-specific conditions, such as social institutions or cultural fairness norms."

To go back to tax evasion, according to official statistics, tax evasion is higher in Italy than in Great Britain. If we interpret tax compliance as co-operative behaviour, influenced by social institutions and cultural traits, we should conclude that in Italy fairness norms are less stringent than in Great Britain or social institutions have less impact on people preferences in Italy. The difference in behaviour between Italian tax payers and British tax payers, however, cannot be completely explained by cultural traits. We should cite Burlando-Hey (1995) experiment on public bads problems, which compares free-riding attitudes in Great Britain and Italy and reveals a greater extent of free-riding among the British than the Italians.

It would be too simplistic to explain the fact that people in Italy tend to evade more than people in Britain on the assumption that Italians are intrinsically more dishonest. The higher tax evasion experienced in Italy could also be related to the political environment and greater opportunities to evade. If we could swap populations and move British citizens in Italy, they might start evading more!

In general *different opportunities* to evade might have an important role in the choice in favour of tax evasion. Some people never evade simply because their income is taxed at source and they do not have any opportunity to evade.

On this point, it is interesting to mention the evidence reported by Goolsbee (1999) on taxes on Internet purchases in the United States. In the United States, in general Internet sales are treated the same as mail-order sales or sales from catalogue companies. Given the different tax regimes in the different states, any company which is not physically present in a state (i.e. does not have a nexus) cannot be required to collect that state's sales tax even if the customer lives in the state. The transactions, however, are not legally tax free. Every state requires consumers to pay a use tax (at the same rate as the sale tax) for any out-of-state catalogue or Internet purchases. By decision of the Supreme Court, though, vendors with no nexus cannot be required to collect the use tax, and governments have to rely on consumer self-reporting. The result is widespread non-compliance. The paper was presented at a conference where the author also added that the tax office of one state received only two forms for reporting the sale tax and these two forms were from employees of the tax office.

This seems to suggest that when the probability of detection is very small, taxpayers go for full evasion, when they have the opportunity to do so. Moral beliefs might not have much of an impact.

3.7 Conclusion

In this chapter we explored the idea that the social custom non-evasion may spontaneously emerge through an evolutionary process. We set the Myles and Naylor model in an evolutionary context with the aim of testing if we can expect moral beliefs to be stable in a social environment where individuals can change their preferences and attitudes towards non-selfish behaviour. In particular we investigated if the act of selfish expected utility maximisers, who start evading in a population who initially was prepared to follow the social custom and do not to evade, can erode the social custom and wipe out a population of moralistic taxpayers.

The results suggest that there are only two evolutionary stable outcomes: one where everybody follows the social custom and the other one where nobody follows it and everybody behaves as expected utility maximisers. A mixed outcome consisting of tax payers motivated by altruistic tendencies, who consider tax compliance as a social custom, and selfish utility maximisers cannot be explained as the equilibrium of an evolutionary process.

This was confirmed also for tax payers behaving as Kantians, as modelled in Bordignon. The ethical rule according to which a taxpayer considers it fair to pay the amount of taxes he wishes other individuals to pay is not invulnerable to deviant selfish behaviour. This result is reinforced if individuals tend to reciprocate and adjust their payment in the light of perceived evasion by the other tax payers.

We pointed out a parallel with our result that non-selfish attitudes cannot coexist with selfish behaviour with the literature on altruism modelled as adaptive behaviour. A common view in those models is that, in a playing in the field situation, where each

player interacts with the whole community of other players, honesty, altruism and co-operation are not evolutionary stable strategies, unless there are some protective mechanisms, such as emotions of guilt or moralistic aggression, or efforts to reduce exposure to opportunism.

There is a similarity with this result and public good games. Theoretical models tend to rule out co-operation among many individuals and voluntary contributions to the provision of public goods are not expected to be an optimal strategy for players. Empirical evidence however suggests that people do contribute voluntarily, even in large groups, where donations are completely anonymous, as in the case of Blood Banks.

Different explanations have been proposed to fill in the gap between theory and evidence.

Some authors have considered the role of fairness considerations, inequity aversion, tendencies to reciprocate and the threat to punish cheaters, in deterring non co-operative behaviour. By modifying the individual's utility function to allow for those factors, they demonstrate that, under some conditions, co-operation can be sustained in large groups, with many individuals. We pointed out the difficulty of applying the same arguments to tax evasion: by its nature cheating the tax authority is a hidden activity and individuals may find it difficult, if not impossible, to observe the behaviour of their peers.

In the light of these considerations, the argument that some individuals are inherently honest, which was used in the models on social interactions to explain why some tax payers never evade, is not very convincing. Once we allow for the possibility that individuals may change their preference on the basis of what they observe in their

social environment, a mixed outcome of honest tax payers and cheaters is not feasible and we are back to the result of the standard portfolio model.

The weakness of this argument has also been pointed out by the empirical evidence we gathered on tax payers' attitudes towards honesty, which we presented in chapter two. The evidence suggests that the role of morals in determining the filing decision is not clear. Individuals may have personal convictions about tax compliance being morally right, but how these personal convictions translate in actual behaviour remains to be explained.

The choice of being an honest tax payer may be driven by the lack of opportunities to evade. We presented an example of nearly full evasion for the case of Internet sales, when the opportunity of getting away with evading is very high and evasion simply consists of not filing a form. The argument that opportunities may have an important role for tax evasion is also supported by the evidence we considered in chapter two, which pointed out that much evasion seems to be attributable to opportunities and costs of evading. This point has been neglected by the models we considered thus far. In what follows we are going to pursue this idea.

In the chapters 4 and 5 we explore this idea. In chapter 4 we extend the portfolio model and introduce a cost for cheating the government. As we shall see this will affect the possibility of getting a mixed equilibrium where honest taxpayers coexist with dishonest taxpayers, even if they face the same probability of detection. Under some circumstances this assumption will also reverse the Yitzhaki result of a negative effect of an increase in the tax rate on tax evasion.

In Chapter 5 we model a situation where individuals have different opportunities to evade by assuming that evasion is more costly for individuals with lower opportunities to evade. We will endogeneise the behaviour of the tax enforcement agency and analyse which is the optimal audit policy for a tax administration with a limited budget, confronting tax payers with different opportunities to evade.
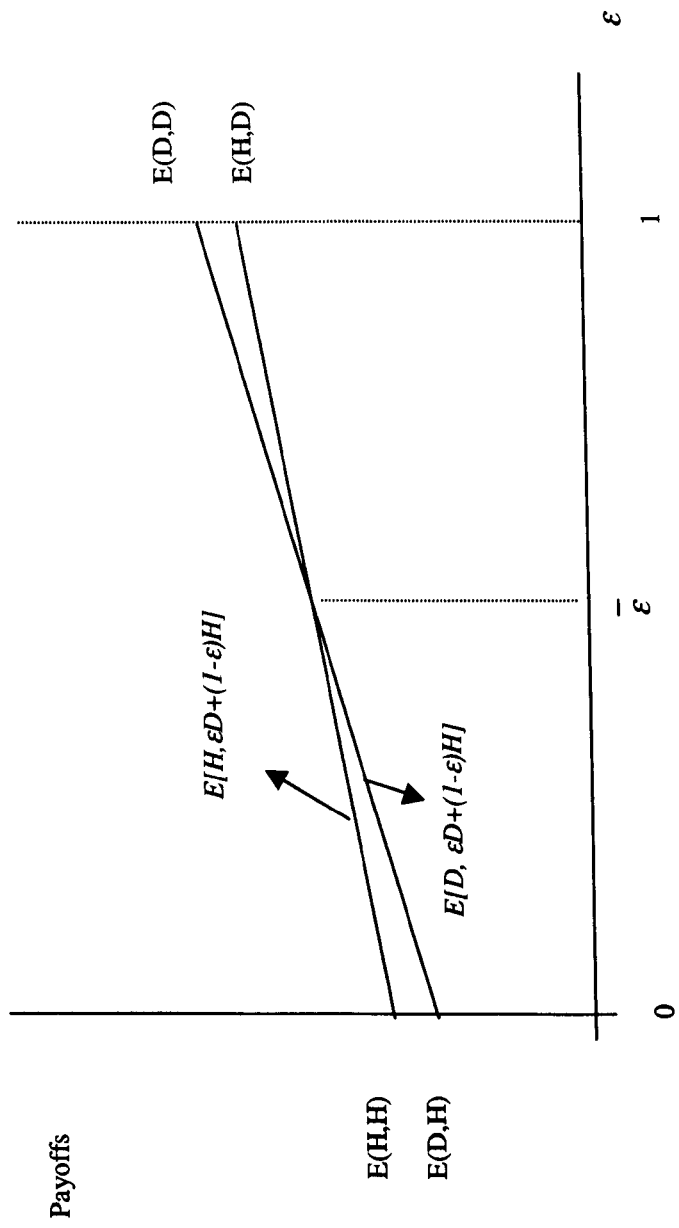
Payoffs

E(D,D)

E(H,D)

E[H, εD+(1-ε)H]

E[D, εD+(1-ε)H]

E(H,H)

E(D,H)

0   ε̄   1   ε

Figure 3.1

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Payoffs

E[H, εD+(1-ε)H]

E[D, εD+(1-ε)H]

E(H,D)

E(D,D)

E(H,H)= E(D,H)

0   1   ε

Figure 3.2

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Figure 3.3

U^E, U^{NE}

$U^{NE}=U(Y(1-t))+bR(1-\varepsilon)+c$

$U^E=EU=(1-p)U(W_g)+pU(W_b)$

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U^E, U^{NE}

$U^{NE} = U(Y(1-t)) + bR(1-\varepsilon) + c$

$U^E = EU = (1-p)U(W_g) + pU(W_b)$

0   1 ε

Figure 3.4

U^E, U^{NE}

$U^E = EU = (1-p)U(W_g) + pU(W_b)$

$U^{NE} = U(Y(1-t)) + bR(1-\epsilon) + c$

0   1 ϵ

Figure 3.5

U^E , U^{NE}

$U^{NE}=U(Y(1-t)+bR(1-\epsilon)+c$

$U^E=(1-p)U(W_g)+pU(W_b)$

0 $\qquad$ $\bar{\epsilon}$ $\qquad$ 1 $\qquad$ ϵ

Figure 3.6

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Figure 3.7

U^E, U^{NE}

$U^{NE} = U(Y(1-t)) + bR(1-\varepsilon) + c$

$U^E = (1-p)U(W_g) + pU(W_b)$

$\overline{\varepsilon}$

0

1

ε

167

U^E, U^{NE}

$U^{NE}=U(Y(1-t))+bR(1-\epsilon)+c$

$U^E=(1-p)U(W_e)+pU(W_b)$

$\bar{\epsilon}$

ϵ
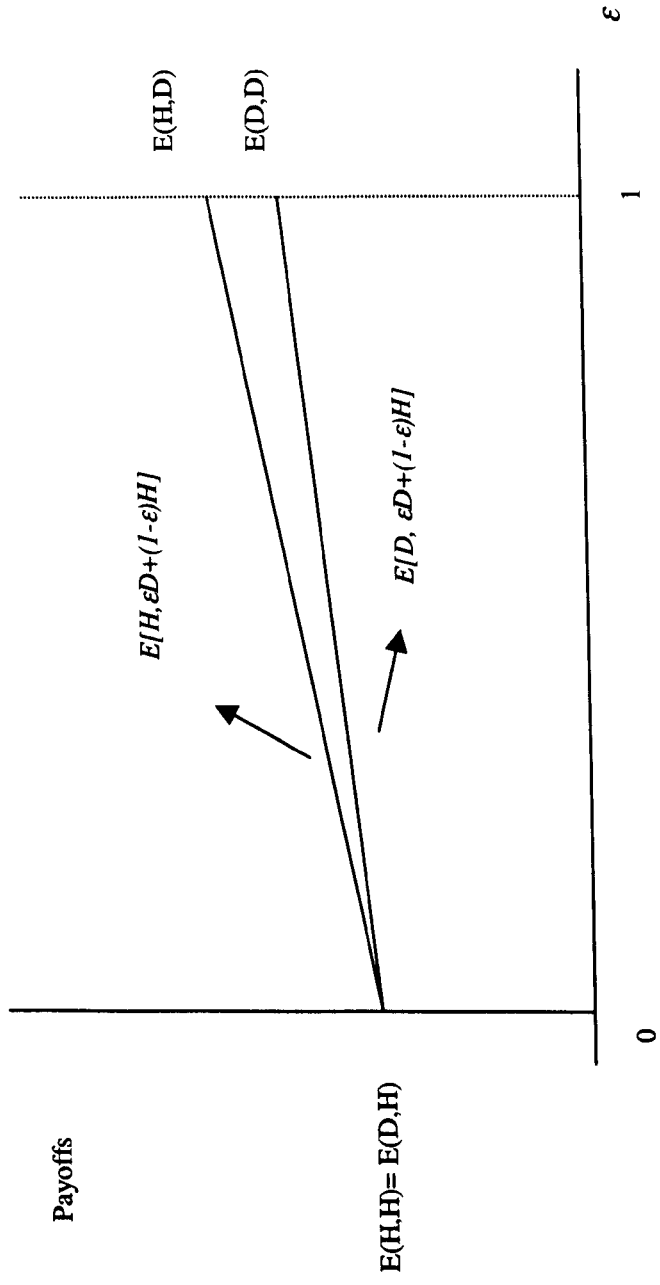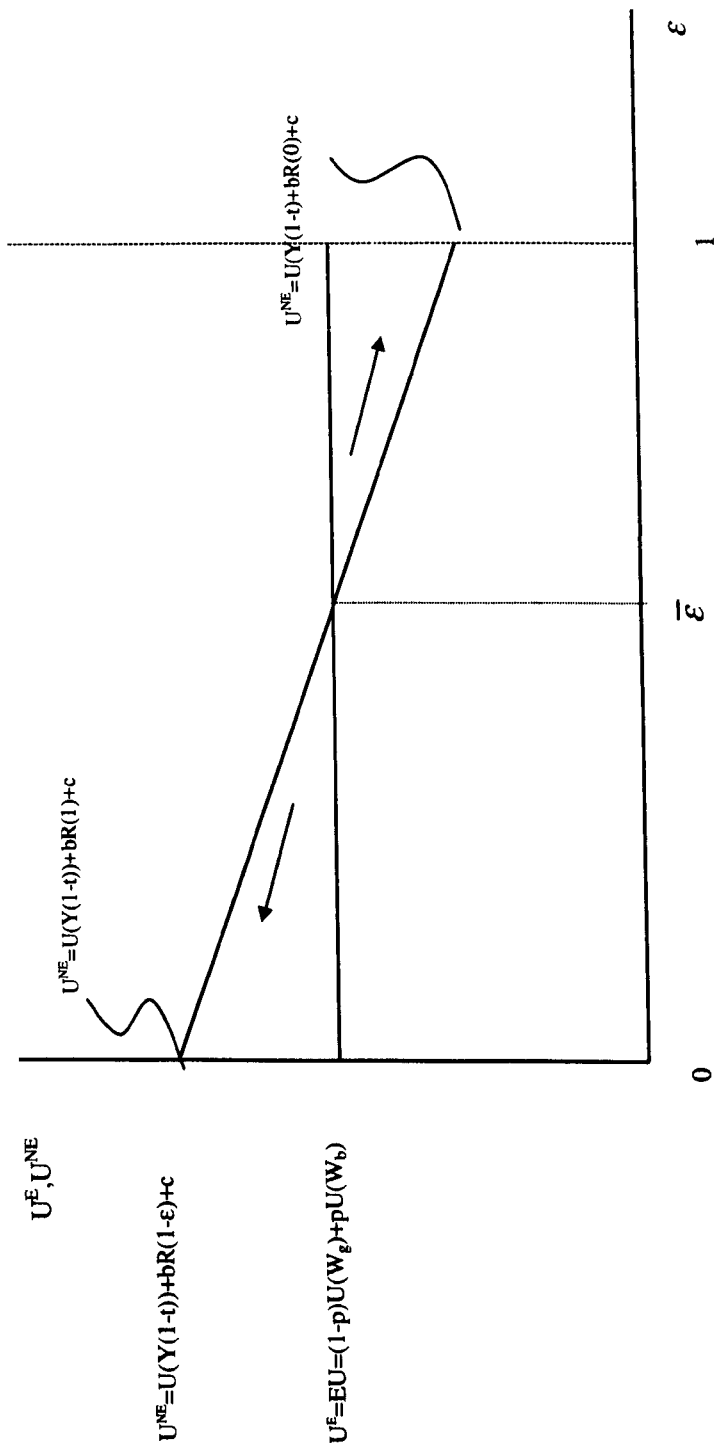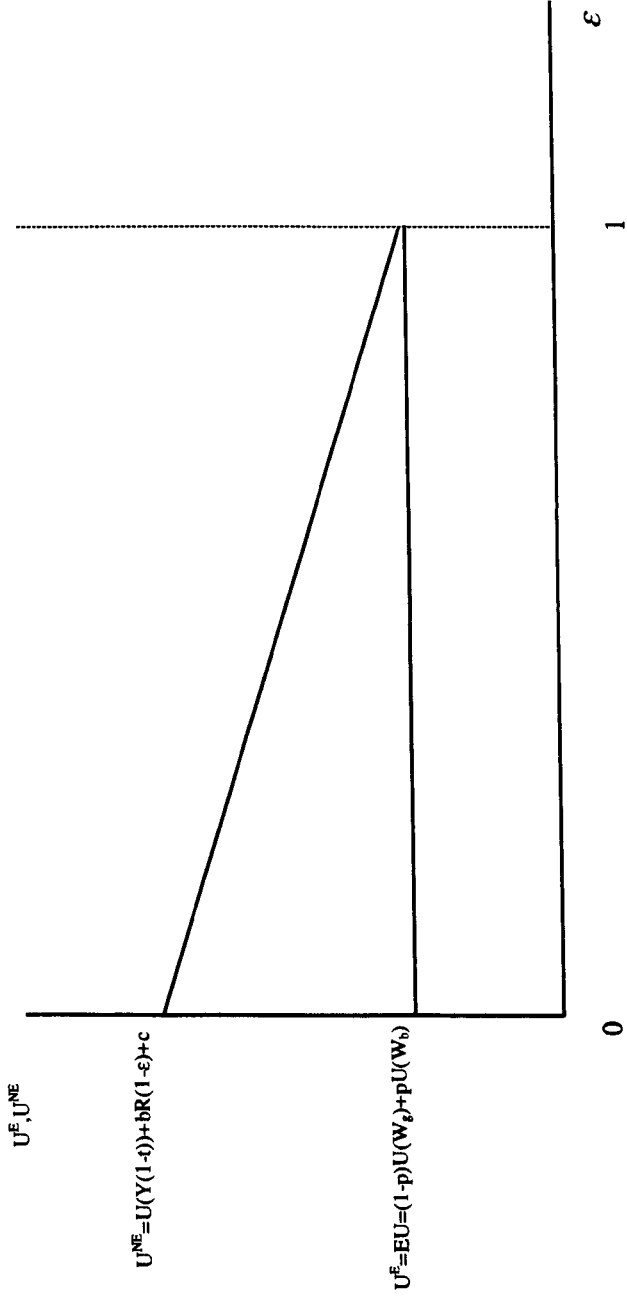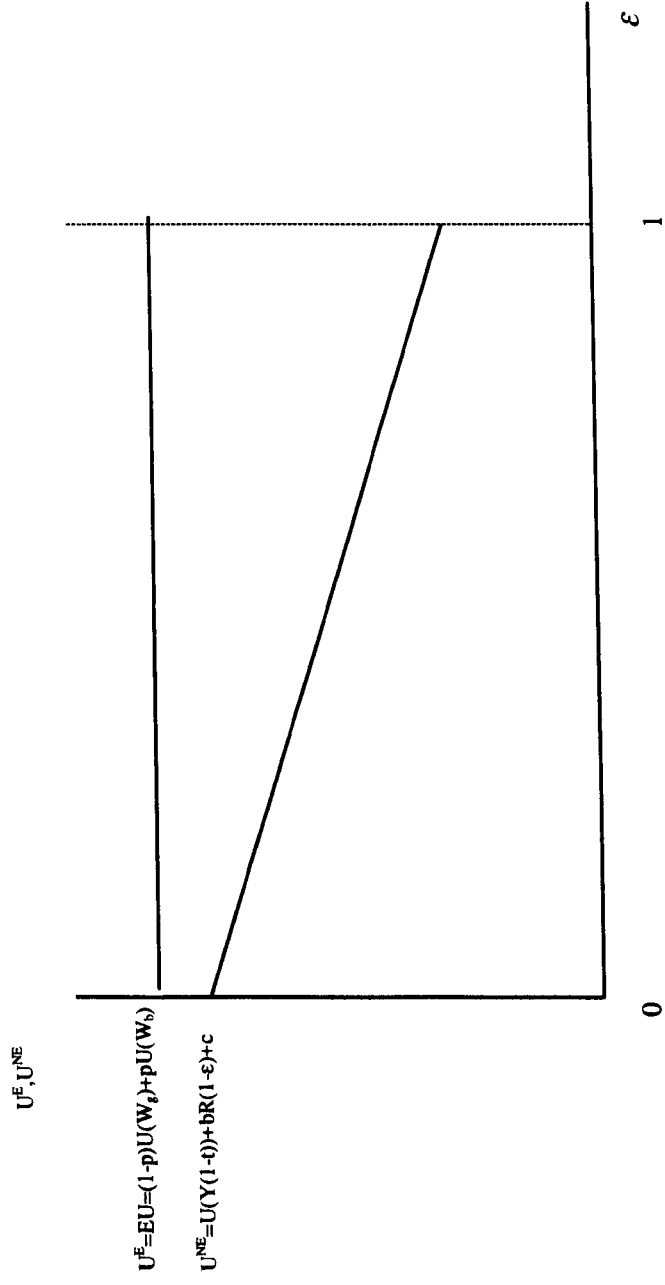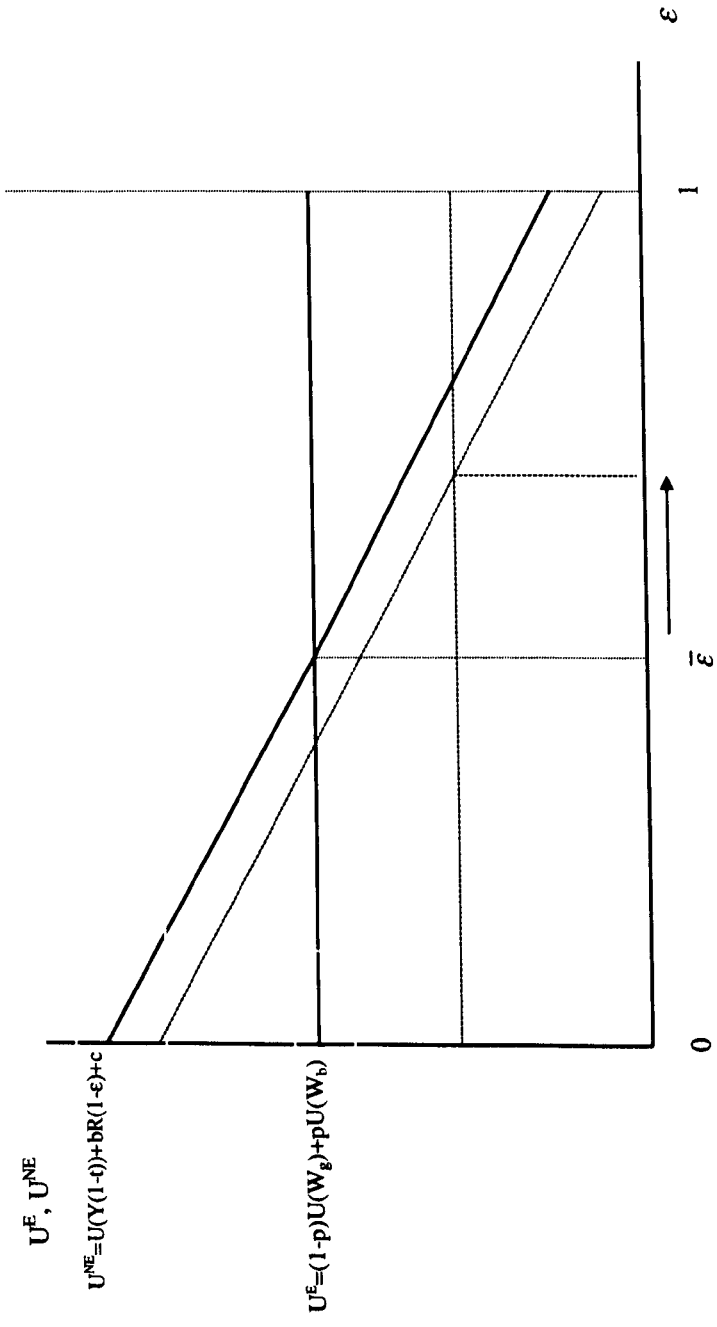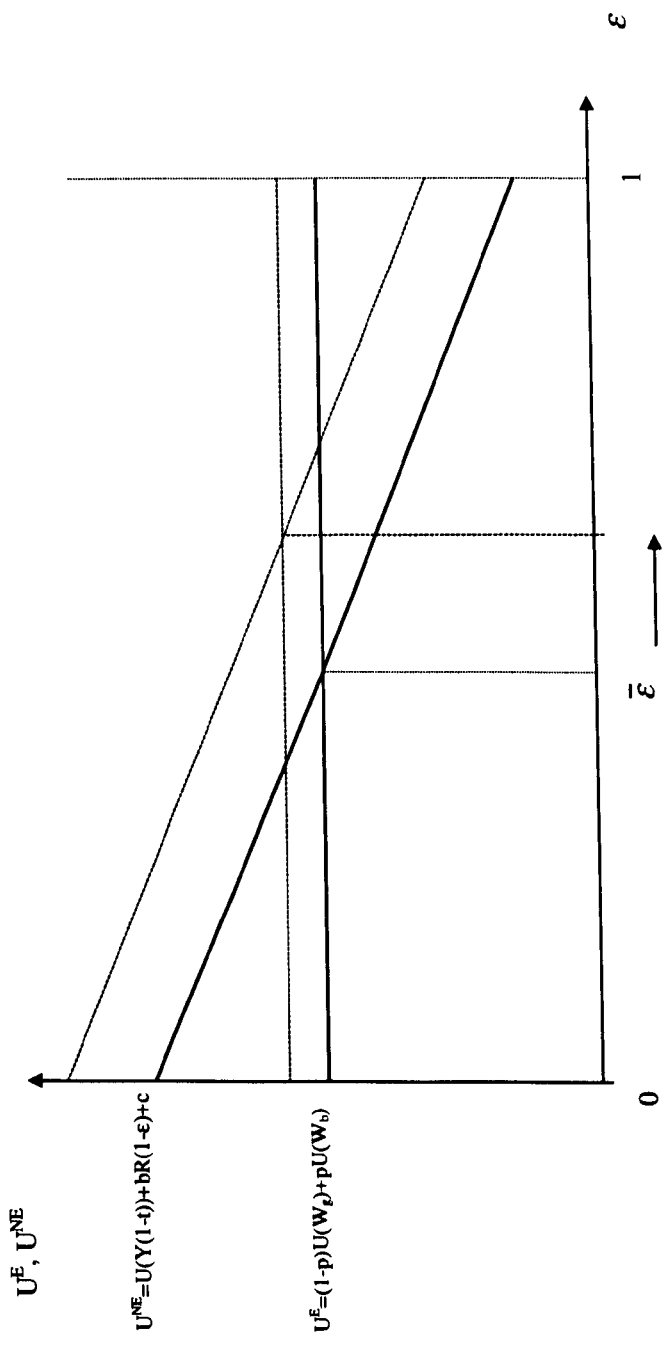
Figure 3.8

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Chapter 4:

The role of pecuniary costs in deterring tax evasion.

4.1 Introduction

In the standard portfolio model the only cost for evading is the fine, to be borne only in case of detection.

However, we can think of other costs that taxpayers have to bear. There are costs of honest compliance, incurred for complying with the requirements of the tax system and also costs of dishonest evasion, intrinsic in the activity of concealing one's income. Tax evasion may in fact require individuals to arrange their affairs in a way that is costly.

Compliance costs and costs of evading work in the opposite directions: compliance costs induce individuals to evade more, while a cost attached to the activity of hiding one's income deters tax evasion.

There is a large literature on the compliance costs of taxation. The implicit idea of these models is that the cost of honest compliance is greater th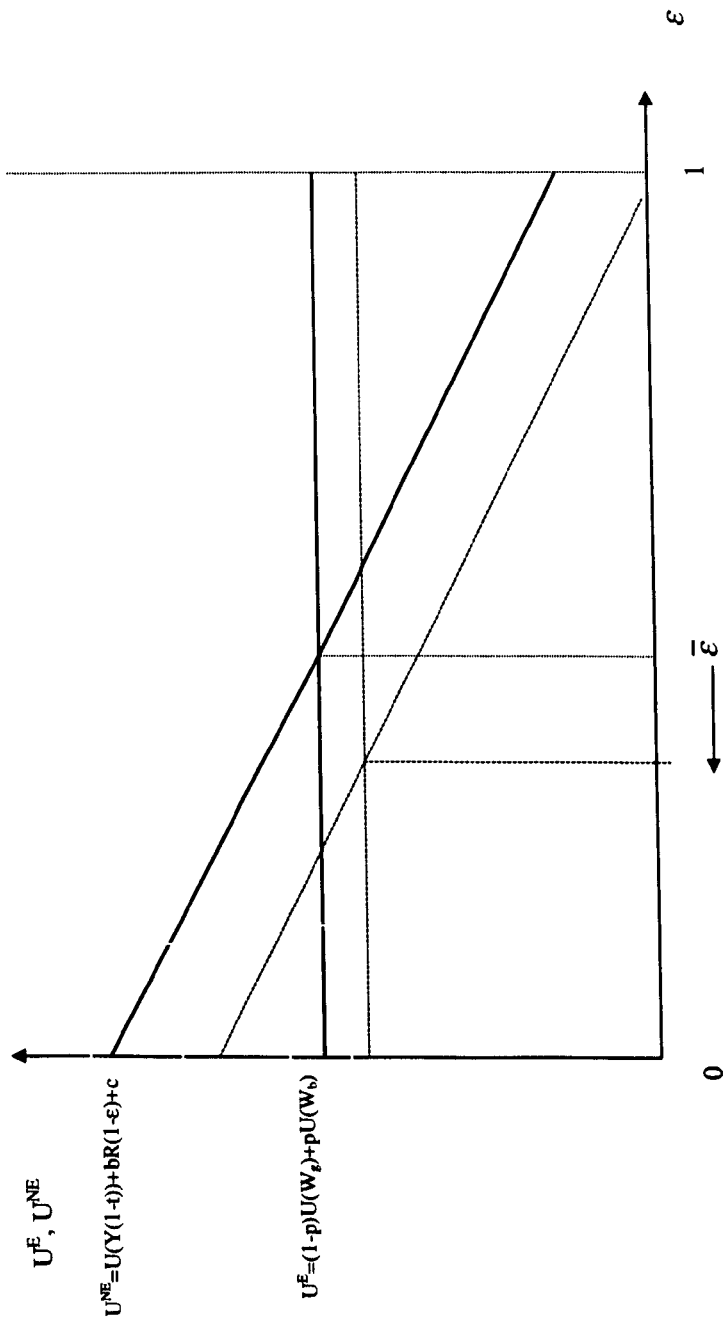an the cost of dishonest evasion and so there is a net cost of being a non-evader. We refer the interested reader to Sandford (1973), Sandford et al. (1989), and Hudson and Godwin (2000).

In the standard portfolio models the cost of honest compliance is made equal to the cost of evasion, so that the net cost for a tax payer is only the fine, to be borne only in case of detection.

In this chapter we consider a third case, which has not been pursued in the literature, where the cost of evasion is greater than the cost of compliance, so that there is a net cost for being an evader. In this situation an individual would be less inclined to evade than in the case of the standard model. This may provide an alternative explanation for the greater extent of honest behaviour that seems to be suggested by empirical evidence: people may be induced not to evade not because of moral considerations but simply because evading is too costly.

Compliance costs and costs for evasion affect the decision whether or not to evade. We should point out another possibility: tax payers have to incur costs for being subject to an audit, even if they have honestly declared their income to the tax authority. In this case the cost does not affect the decision whether or not to evade in that it is incurred for being subject to an audit, after the individual has decided to be honest.

For example, individuals may dislike being audited by the fiscal authority, even in the case of a truthful declaration: the simple fact of having tax inspectors around may make them worse off. This could be due to the fact that they feel anxious about being audited, in that they become potential offenders in the eyes of their peers and suffer a stigma. Another possibility is that individuals fear that the audit may disclose an involuntary mistake in the declaration and end up with a fine. In both cases it is difficult to quantify the loss to the individual in monetary terms, as this is more related to the frustration of dealing with the tax authority and hence depends on the personal psychological attitudes and characteristics of the individual. The cost of receiving an audit in these cases manifest itself as a psychic cost.

It is also possible that the tax authority makes mistakes in auditing taxpayers, and wrongly charges honest taxpayers with neglecting their tax duties. As the burden of proof is on the taxpayers, in that they have to get in touch with the tax authority and prove its mistake, they have to bear the cost of the tax authority mismanagement. A recent case of administrative confusion happened to the Inland Revenue Service in April 2001, when the agency sent a letter (Rita 500) to more than 400,000 taxpayers, asking to pay unsettled tax payments which, in some cases, had already been paid or should have been demanded. As a result the switchboard of the helpline at the Revenue's accounts office in Shipley, Yorkshire, got jammed by callers who tried to make sense of the letter requesting to pay the amount as specified in a statement recently sent, which they never received. The situation of chaos imposed some costs on taxpayers who had already settled their accounts in full, at least in terms of time to be spent to get in touch with the tax authority. As reported in a national newspaper "...One taxpayer spent two and a half days trying to get through to the Revenue's helpline, at which point the operator confirmed that he had settled his tax bill in June."[1]

In these cases the cost of being subject to the audit manifest itself as a monetary cost: it is quantifiable in terms of time to be devoted to provide all necessary documents and prove one's innocence.

We can then distinguish two cases in which the cost of receiving an audit can manifest itself: it could be a psychic cost, due to the frustration of dealing with the tax authority, or a monetary cost, due to the time spent on providing the necessary documents to prove one's innocence. Some tax payers may not feel anxious about

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[1] The Guardian, Saturday April 7 2001.

receiving an audit, but they may indeed suffer a loss for the time they have to spend in tracing back their transactions. We should therefore represent these two manifestations of the cost of being subject to an audit in different ways.

In this chapter we consider these two issues:

- the audit may impose a cost even on honest tax payers and

- concealing one's income is a costly activity.

We devote section 2 to the analysis of the first issue, and consider two possible ways of modelling how the cost of being audited could manifest to the tax payers. We shall focus on the implications of this assumption on the possibility of getting a mixed outcome of honest and dishonest tax payers, which was not feasible in the standard model.

In section 3 we model the assumption that there is a net cost for being an evader. As we shall consider, the evidence from the report on the informal economy issued by the Treasury in March 2000, suggests that evaders have to incur costs for concealing their income. Those costs may be intrinsic in the activity of evasion, or they may vary depending on the effort to conceal one's income. In the former case the tax evader does not have any control on the cost, whereas in the latter tax evaders are able to choose among different opportunities to conceal their income and hence have a control on the cost for cheating the tax authority.

In this light, we shall consider three different ways of modelling a cost attached to the activity of evasion. Our interest is to examine how the consideration of an additional cost for tax evaders modifies the predictions of the standard model concerning the feasibility of a mixed outcome and the effect of an increase in the tax rate.

Section 4 summarises the results and concludes the chapter.

4.2 The cost of being subject to an audit for an honest tax payer.

We model the possibility that the audit has a negative effect even when an individual is honest and distinguish the case where the tax payer suffers a utility loss for *feeling* worse off from the case where the loss due to the audit is quantifiable in monetary terms. In the first case the evaluation of the loss is completely subjective and depends on the psychological attitudes and characteristics of the individual: we can imagine a situation where the individual has a different perception of his/her welfare in the two states of the world, even if monetary income is the same. This is due to the frustration of dealing with the tax authority. In the second case the utility loss is quantifiable in monetary terms: it is the opportunity cost of time spent in providing all necessary documents and receipts to prove one's innocence.

4.2.1 The audit of a truthful declaration imposes a psychic cost on the taxpayer: the case of state dependent utility functions.

We model the possibility that an individual may suffer a psychic cost attached to the audit, in the case he/she has honestly declared his/her income by use of state dependent utility functions:

$$U_b(W_b) = U_b[Y - tI - ft(Y - I)]$$
$$U_g(W_g) = U_g[Y - tI]$$

(1)

In existing literature such a characterisation is only for devastating effects such as the loss of beloved spouse or child[2]. Here we adopt the same mechanism, to model the psychological loss of honest taxpayers for being audited, even if the implications of the bad state (detection) are less serious.

With state dependent utility functions the utility differs in the two states of the world even if income is the same, as in the case of a truthful declaration:

$$U_g(W_g) \neq U_b(W_b) \quad \text{even if } Y = I \Rightarrow W_g = W_b = W$$

(2)

The marginal utility in the good state differs from the marginal utility in the bad state even if income in both states is the same and the slope of the indifference curve along the 45° line is:

$$-\frac{(1-p)U_g'(W)}{pU_b'(W)} \quad \text{with } W = W_g = W_b$$

(3)

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[2] See Cook and Graham (1977).

The zero evasion choice is not triggered by the probability of detection, as in the case of state independent utility functions. Even if the probability of detection is fixed and equal for everybody, individuals may differ in how they dislike being audited and a mixed outcome where not all individuals evade becomes feasible. If the ratio between the marginal utilities is such that the slope of the indifference curve along the 45° line is greater than or equal to the slope of the budget constraint, the optimal choice is not to evade, whereas evasion is optimal if the opposite occurs. This means that as long as individuals have different marginal utilities in the two states of the world, we can observe a mixed outcome, even if the probability of detection and fine rate are the same for everybody. To clarify this point we can assume the following functional form for the utility in the bad state of detection:

$$U_b(W) = a + bU_g(W), \quad \forall W, \text{ with } a < 0 \text{ and } b > 1 \tag{4}$$

If the individual makes a truthful declaration to the tax authority, incomes in both states of the world will be the same, but utility differs:

$$Y = I \Rightarrow W_b = W_g = Y(1-t) = W \Rightarrow U_b(W) = a + bU_g(W) \neq U_g(W) \tag{5}$$

a represents the utility loss when the individual honestly declares his/her income and is audited by the fiscal authority.

We can interpret it as a psychic cost, due, for example, to the anxiety of being audited[3]. The parameter b is to allow for the marginal utility to differ in the two states: in this case we assume it is greater than one. This implies that for a given unitary increase/decrease in income, the utility in the bad state increases/decreases more than the utility in the good state. In fact:

$$U_b'(W) = bU_g'(W), \quad b > 1 \qquad (6)$$

This means that the value of money is greater in the bad state, which is likely to be the case when an individual has to suffer a psychic cost for the audit. In fact, we can argue that, due to the psychic cost of being audited, true income is less than money income (W), because of the pain of being examined by the tax collectors. As $U'' < 0$ this means that the marginal utility of money will indeed be higher in the audit state if money income is the same in the two states:

$$U_g'(W) < U_b'(W) \qquad (7)$$

In figure 4.1 we draw two indifference curves: IC_{sd} represents the indifference curve for an individual with state dependent utility function, who suffers a psychic cost in case of an audit. IC_{si} is the indifference curve for an individual with state independent utility function as in the standard model. If we compare the two a

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[3] In chapter 2 we reviewed models considering the role of social interactions for the decision whether to cheat the government. Those models introduced the concept of psychic cost, to be incurred in case of evasion. We should note that the psychic cost as modelled above, by use of a state dependent utility function, has a different interpretation. In the above analysis, the psychic cost is incurred when an individual is audited by the tax authority, even in the case of a truthful declaration of income. In the models on social interactions the psychic cost is modelled as a loss in utility suffered when the individual decides to evade, irrespective of whether he/she is audited.

indifference curves, IC_{sd} is flatter than IC_{si} ($\dfrac{AB}{BD} < \dfrac{AB}{BC}$). When the individual suffers

a psychic cost for being audited, even in the case of a truthful declaration, a given

decrease in income in the bad state will require a greater increase in income in the

good state to compensate the individual and keep him/her on the same indifference

curve.

The greater the psychic cost, the greater the value of money in the bad state of

receiving an audit, the flatter the indifference curve.

With the assumed state dependent utility function, the slope of the indifference curve

along the 45° line will be:

$$-\frac{(1-p)U'_g(W)}{pbU'_g(W)} = -\frac{(1-p)}{pb} \tag{8}$$

If individuals differ in the parameter b, even if they face the same probability of

detection, the zero evasion condition will vary across individuals. In fact, for each b_i,

zero evasion will occur whenever:

$$-\frac{(1-p)}{pb_i} = -(f-1) \Rightarrow p = \frac{1}{1+b_i(f-1)} \tag{9}$$

In this case, the value for the probability of detection below which tax evasion will

be chosen, is determined by b_i and is unique to individuals. Figure 4.2 represents the

choice for two individuals, with two different b parameters. For the high b-individual

it is optimal to make a truthful declaration to the tax authority, whereas, the optimal

choice for the individual with a low b is to evade, in that tax evasion guarantees a

higher indifference curve. Intuitively, a high b-individual could be someone who

suffers greatly from the process of an audit. His/her indifference curve is flatter because he/she needs more money to be compensated for an audit.

If we extend the analysis to n individuals with different b parameters, even if the probability of detection is fixed and equal for everybody, a mixed outcome consisting of honest and dishonest tax-payers becomes feasible.

The b_i may vary across individuals because individuals may dislike being audited to different degrees. This result is very similar to the one obtained in the models on social interactions we considered in chapter 2: individuals with higher psychic costs will choose to be honest, even if they face the same tax parameters than tax evaders.

4.2.2 The audit of a truthful declaration imposes a monetary cost on the taxpayer: the shift in the endowment point.

Another way of modelling the cost of being audited for honest tax payers is as an opportunity cost, in terms of time to be devoted to provide all necessary documents and receipts to the tax inspectors. In this case the cost can be quantified in monetary terms. We model this situation as follows:

$$
\begin{aligned}
W_b &= Y - tI - ft(Y - I) - a \\
W_g &= Y - tI
\end{aligned}
\tag{10}
$$

a is the monetary cost, to be incurred in the bad state of detection, even if the individual honestly declares his/her income.

The individual will choose the amount of income to declare in order to maximise his/her expected utility:

$$\max_I EU = pU(W_b) + (1-p)U(W_g) \tag{11}$$

$$s.t. W_b = Y - tI - ft(Y - I) - a$$

$$W_g = Y - tI$$

We represent this case in figure 4.3. The budget constraint is the line AB. The zero evasion point does not lie on the 45° line: the cost to be incurred in case of an audit reduces net income in the bad state, even in the case of a truthful declaration. The endowment point shifts downwards by the amount of the cost.

We draw two indifference curves, IC_1 and IC_2, for two individuals with different degrees of risk aversion. IC_2 represents a more risk averse individual. The two indifference curves have the same slope along the 45° line, in that we assume that the two individuals face the same probability of detection. The individual who is more risk averse (IC_2) will prefer not to evade, in that point A guarantees the highest indifference curve, whereas the individual who is less risk averse (IC_1) will reach a higher indifference curve in case of evasion (IC'_1)[4]. Thus when there is a monetary cost attached to the audit, even if individuals face the same probability of detection, a mixed outcome with honest tax payers coexisting with tax evaders will be feasible when individuals have different degrees of risk aversion. There will be a critical level of risk aversion above which individuals will not evade: in terms of figure 4.3, individuals who are as risk averse as the individual with the indifference curve IC_2 will never evade. The community will be perfectly partitioned into evaders and non evaders on the basis of their degree of risk aversion.

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[4] This analysis assumes some uniformity in the degree of risk aversion. The two indifference curves IC_1 and IC_2 intersect only once and, as we shall demonstrate in section 4.3.1, this guarantees global constant/decreasing absolute risk aversion.

4.3 The cost of evading.

The report on the informal economy, issued by the Treasury in March 2000[5], offers some evidence on actual cases of tax evasion. According to the report, detected cases of untruthful declaration to the tax authority mainly consisted of unregistered business, individuals claiming benefits while not entitled to, self-employed and employees working in the hidden economy, engaging in illegal activities. Among the cited cases, we select some of them:

- " Unemployed man with family, claiming Job-seeker's Allowance, did a few decorating jobs, cash-in-hand, for neighbours to earn some extra money before Christmas. Failed to declare earnings (but not liable for income tax)."

- "Customs estimate that nearly £1 billion of revenue is lost each year from cross-Channel bootlegging of tobacco and alcohol. Over 90 per cent of those involved are thought to be claiming benefits."

- "A firm of drivers where the employer failed to provide a full list of employees and kept two sets of financial accounts. He also colluded in benefit fraud by allowing employees to sign on as unemployed."

- "A man who worked for a number of employers, using false identities, and claiming benefit at the same time."

- " A London-based organisation of bogus companies specialising in large-scale benefit, mortgage and property fraud; importing illegal immigrants; and cocaine dealing. Evidence of over 500 fraudulent benefit claims, worth around £4

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[5] Grabiner (2000).

million. 50 known cases of identity fraud. Over 40 claims for Child Benefit supported by counterfeit identity documents."[6]

Tax evaders also seem to make an effort to constantly update their techniques for cheating the tax authorities. The report, for example, warns for the increased difficulty to enforce tax compliance with the growing use of the Internet: "...Many market traders and restaurants have their own web sites, which they use to receive payment for goods and services. If this payment goes into a bank account which has not been declared, it can be a way to conceal taxable income (though still not as convenient for them as the ability to withdraw cash)."[7]

The examples above suggest that concealing one's income is costly. Keeping large amount of money in cash, driving to France to load one's car of alcohol or tobacco, falsifying documents, keeping separate accounts and investing money abroad, safely away from any inspection from the tax authority, are all activities that involve some costs. In some cases the cost is inherent in tax evasion taking place: for example, the only way of getting unemployment benefits while not entitled to is to sign on at the Unemployment Benefit Agency, or bootlegging tobacco and alcohol requires travelling abroad. In these cases the cost is involuntary. In other cases the individual may be able to influence and control the cost of cheating: this happens when the individual can choose how to conceal his/her income. For example an individual who decides not to declare some earnings can either be paid in cash and simply hide the amount received, or can keep a false set of accounts and transfer the money to foreign banks, in tax heavens, or can organise an activity of money laundering.

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[6] Ibidem, p.4.
[7] Ibiden, p. 7.

These different possibilities of concealing one's income imply different costs and may influence the probability of detection: in some cases the effort exerted to successfully hide one's income may substantially decrease the probability of being detected by the fiscal authority.

From the examples above it is clear that in modelling an additional cost to be incurred for hiding one's income we need to distinguish if the cost is intrinsic in the activity of hiding one's income or if it depends on the effort chosen to cheat the tax authority. Keeping large amounts of money in cash, creating professional looking false invoices to exaggerate a firm's tax-deductible expenses, or organising a large-scale fraud imply different levels of effort and costs. The effort for keeping money in cash is not so substantial as in the case of an organised large-scale fraud.

In the light of this we model the assumption of an additional cost in three different ways:

a) We first consider the case of a fixed cost, to be incurred irrespective of the amount of concealed income. We assume that if the individual decides to engage in tax evasion, he/she has to pay a sort of *licence to evade*. Formally the cost function is simply:

Cost = *c*

An example could be an entrepreneur who decides to pay somebody to keep up to date with the best opportunities to evade. This is not unusual in small size firms where business consultants are hired for the purpose of minimising the tax bill, sometimes not only by use of tax avoidance. The licence to evade is in this case the

compensation paid to the business consultant to keep double accounts and choose the best opportunities to evade.

b) We then consider a *cost proportional* to the amount of concealed income. The idea is that the greater the extent of tax evasion the higher the cost to be incurred. We can think of an individual who keeps large amounts of money in cash in order to evade tax. In this case, the greater the income hidden from the tax authority, the greater the (opportunity) cost to be incurred, in the form of forgone interest payments.

Another example could be a firm which allows employees time to sign on as unemployed: the greater the number of employees off the books and signing on with the Employment Benefit Agency, the greater the amount of work time which needs to be sacrificed.

In this case a functional form for the cost is:

$$Cost = c(Y - I)$$

We model the fixed cost and the proportional cost as involuntary costs: cheating the tax authority requires incurring some costs, which however do not depend on the particular effort exerted to hide one's income. The individual has no control on the cost and is not able to have any influence on the probability of detection by choosing among different alternatives to conceal his/her income. The probability of detection is fixed and set by the fiscal authority. The Government implements its audit procedure according to pre-set plans, for example by random audits, and agents are

not able to influence the chance of being caught. If audited, an agent is certain to be detected, as in the standard model.

c) We finally extend the analysis to the more general case of an *endogenous cost*. In this case the individual not only chooses an optimal declaration of his/her income but also an optimal effort to look for the best alternatives and hide his/her income. Such an effort, aimed at making the monitoring activity of the fiscal authority less effective, is costly but at the same time has an impact on the probability of detection, which becomes lower. In this new setting both the probability of detection and the cost for hiding one's income are endogenous, in that they are determined by the individual's effort to reduce the probability of being caught. The Government, by choosing its auditing strategy, sets the probability of audit, which however does not correspond to the probability of detection. Due to the effort exerted for hiding one's income, the audit is not always successful and the probability of detection is lower than the probability of receiving an audit.

An example of such a costly effort could be the attempt to alter the category perceived by the tax authorities by living in a cheaper house, or confining the use of the Ferrari at nights to deceive one's life style. An extreme case could be the organisation of large-scale frauds.

The cost can be modelled as:

$$Cost = c(x)(Y - I)$$

where x is the effort to hide one's income.

This is a more interesting case in that it allows for the consideration that those individuals, who spend more resources in selecting the best opportunities and in hiding their income, are able to decrease the probability of being caught.

In the next sections we are going to analyse these three possibilities of modelling the cost of cheating the government.

4.3.1 Paying a licence to evade: the fixed cost case.

We assume that individuals have to incur a fixed cost to enter tax evasion.

As in the standard portfolio model we consider individuals who are utility maximisers and decide whether or not to evade on the basis of pure monetary considerations.

We can model our assumption in terms of a representative tax payer who chooses the amount of income to declare to the tax authorities that maximises his/her expected utility:

$$EU = (1-p)U(W_g) + pU(W_b) \qquad (12)$$

W_g and W_b represent net income in the good state of non-detection and net income in the bad state of detection respectively. p is the probability of detection. As in the standard model it is exogenously fixed by the tax authority and it is taken as given by the individual. The fiscal authority sets an audit rule and, if audited, a tax evader is detected: the probability of detection corresponds to the probability of receiving an audit.

In case of a truthful declaration to the tax authorities, the individual does not incur any cost and net income is the same in both states of the world[8]:

$$W_g = W_b = Y(1-t) \qquad (13)$$

Y is gross income and t the tax rate.

If, instead, the individual decides to evade he/she has to pay a price for doing so, a sort of licence to evade. Net income both in case of detection and non-detection will be consequently decreased. If detected, the tax evader has also to pay a fine. Income in the good and in the bad state of the world can be formalised as follows:

$$W_g = Y - tI - c \qquad (14)$$
$$W_b = Y - tI - ft(Y-I) - c$$

I is declared income, c the cost to engage in tax evasion and f the fine rate, applied to evaded tax as in the Yitzhaki model.

The feasibility of a mixed outcome.

An important implication of the assumption of a fixed cost is that the budget constraint is not a straight line anymore. The zero evasion point along the 45° line will not lie on the same segment of the points representing every possible level of tax evasion.

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[8] We rule out the possibility of incurring a cost in case of an audit for an honest taxpayer, which we considered in the previous section.

We can illustrate this diagrammatically. In figure 4.4 we represent three sets of preferences, belonging to individuals with different degrees of risk aversion, illustrated by the indifference curves IC_1, IC_2 and IC_3. These three individuals face the same probability of being detected: the indifference curves have the same slope along the 45° line. The individual whose indifference curve is IC_1 is the most risk averse. With a fixed cost, to be incurred in case of evasion, the budget constraint is the discontinuous line AB: point A belongs to the budget constraint and represents the zero evasion point. If the individual evades any positive amount, the budget constraint moves from A to the dotted line down to B by the amount of the fixed cost to be incurred. Point A' does not belong to the budget constraint.

The most risk averse individual, with the indifference curve IC_1, prefers not to evade, in that the non evasion point guarantees a higher indifference curve. The individual whose preferences are represented by the indifference curve IC_2 is indifferent between evasion and non-evasion, in that point A (zero evasion) and point C (optimal declared income, with a positive amount of evasion) lie on the same indifference curve. The individual whose preferences are represented by the indifference curve IC_3, instead, prefers to evade: given the budget constraint AB, he/she can reach a higher indifference curve than the one drawn, passing through the zero evasion point (A). Hence even if the probability of detection is the same for everybody the degree of risk aversion will determine individuals' choice. We reach the same conclusion as in section 4.2.2 when we considered the case of the monetary cost to be incurred in case of a truthful declaration when the individual is audited. There will exist a critical degree of risk aversion above which individuals will never evade and the community will be partitioned in evaders and non evaders according to the degree of risk aversion.

A mixed equilibrium where honest tax payers coexist with cheaters becomes feasible even if individuals face the same probability of detection. The degree of risk aversion will determine that outcome.

The impact of an increase in the tax rate on the optimal decision of the tax payer.

We can now analyse the effect of an increase in the tax rate. Figures 4.5 and 4.6 represent the impact of an increase in the tax rate on the optimal decision of an individual who, before the increase in the tax rate, is indifferent between evasion and non-evasion. Figure 4.5 illustrates the case for constant absolute risk aversion, whereas figure 4.6 analyses the case of decreasing absolute risk aversion.

In both cases a higher tax rate shifts the budget constraint parallel downwards: income in both states of the world decreases by the same amount. Graphically, point A shifts to point A_t and point B to B_t: the new budget constraint after the increase in the tax rate, consists of point A_t and the dotted line up to B_t, excluding point A'_t.

Under constant absolute risk aversion, the indifference curves are shifted version of themselves along the 45° line and any line parallel to the 45° line, such as the c.a.r.a. line. The marginal rate of substitution is constant along the 45° line and any line parallel to the 45° line. As it is illustrated in figure 4.5, a decrease in income does not modify the individual's willingness to accept risk: the indifference curve shifts parallel downwards and the point of tangency between the budget constraint and the indifference curve shifts down parallel to itself. In this case the individual remains indifferent between evasion and non-evasion: the indifference curve is tangent to the budget constraint at C_t and passes through A_t (zero evasion). We do not represent the case of an individual who initially prefers to evade, but it is straightforward to see

that, after an increase in the tax rate a tax evader would continue to evade the same amount as before. The indifference curve would move down parallel and the point of tangency between the indifference curve and the new budget constraint would lie on the constant absolute risk aversion line.

Therefore, with a fixed cost attached to evasion, under constant absolute risk aversion, an increase in the tax rate does not affect the taxpayer's choice. An individual who was initially indifferent between evasion and non-evasion remains indifferent, and an individual who initially evaded a certain amount continues to evade the same amount.

Under decreasing absolute risk aversion, a decrease in income in both states of the world, caused by an increase in the tax rate, makes the individual less willing to accept the risk of being detected and fined. In figure 4.6 we represent the case of an individual who is initially indifferent towards tax evasion (IC_0). Points A (the endowment point, associated with zero evasion) and C (optimal tax evasion) lie on the same indifference curve. After an increase in the tax rate, the budget constraint is defined by point A_t and the dotted line down to B_t.

The dotted curve (IC_{cara}) represents the indifference curve of an individual with constant absolute risk aversion. As we have just considered, after an increase in the tax rate the indifference curve shifts parallel downwards and the individual remains indifferent between evasion and non evasion.

The solid indifference curve (IC_{dara}) represents the individual with decreasing absolute risk aversion. In this case, an increase in the tax rate makes income in both states of the world decrease by the same amount and the individual becomes less

willing to take risk. This is illustrated by point C_t in figure 4.6. If we compare C to C_t, the risk associated with C_t is lower than the risk associated with C: C_t lies to the left of the fixed portfolio line. Given the budget constraint A_tB_t, the individual, who was originally indifferent between evasion and non evasion, will prefer not to evade after an increase in the tax rate, under decreasing absolute risk aversion. In fact point A_t, the endowment point after an increase in the tax rate, is preferred to point C_t in that the individual can be on a higher indifference curve at A_t. The individual will get a higher utility from not evading.

Hence individuals who were previously indifferent between evasion and non evasion, after an increase in the tax rate prefer not to evade. This reinforces the Yitzhaki result: with decreasing absolute risk aversion we should expect a decrease in tax evasion after a rise in the tax rate.

In figure 4.6 the indifference curve of the individual with decreasing absolute risk aversion intersects the indifference curve of the individual with constant absolute risk aversion only once. This guarantees global constant/decreasing absolute risk aversion and drives the result we obtained above.

In figure 4.7 we draw the indifference curve of the individual with decreasing absolute risk aversion in such a way that the individual switches to evasion after an increase in the tax rate, in that point x is preferred to the endowment point A_t. We demonstrate graphically that this case is not feasible, if we assume global decreasing absolute risk aversion. We draw the indifference curve for the individual with decreasing absolute risk aversion (IC_{dara}) such that the individual faces the same probability of detection than for IC_0 and IC_{cara} (the two indifference curves have the same slope along the 45° line), the point of tangency C_t lies to the left of the c.a.r.a

line and the intersection with the 45° line is above A_i, so that the individual will prefer to evade after an increase in the tax rate.

In this case, the indifference curve of the individual with constant absolute risk aversion intersects the indifference curve of the individual with decreasing absolute risk aversion twice, at points D and E.

But if we look at the diagram carefully, we realise that the assumption of constant/decreasing absolute risk aversion is not globally satisfied. For example if we draw a budget constraint through point D (dotted line), the individual with decreasing absolute risk aversion would evade more than the individual with constant absolute risk aversion. In fact at D the marginal rate of substitution for the individual with decreasing absolute risk aversion is greater than the marginal rate of substitution for the individual with constant absolute risk aversion. This implies that the individual with decreasing absolute risk aversion takes more risk than the individual with constant absolute risk aversion for that given budget constraint, passing through D. This contradicts the result that more risk averse people tend to evade less. Decreasing absolute risk aversion does not hold globally.

In conclusion, when the cost to be incurred in case of evasion is fixed, the degree of risk aversion affects the decision whether or not to evade. There will exist a critical degree of risk aversion below which individuals will evade: the community of taxpayers will be partitioned into evaders and non evaders according to this critical level. A mixed outcome becomes feasible.

An increase in the tax rate will lead to a decrease in tax evasion, if agents have decreasing absolute risk aversion. In particular we showed that for a representative taxpayer who was previously indifferent between evasion and no evasion, the best

choice after a rise in the tax rate will be not to evade. This reinforces the Yitzhaki result, in that it is possible to observe a decision to stop tax evasion after an increase in the tax rate.

In the next section we are going to consider a cost attached to evasion modelled as a proportional cost.

4.3.2 The cost for engaging in tax evasion is proportional to the amount of hidden income

We now assume that individuals have to bear a cost proportional to the amount of concealed income. The greater the amount of hidden income, the greater the cost to be incurred. A greater cost is not related to a greater effort exerted to lower the probability of detection, but is simply due to a greater *volume* of evaded income. As in the standard portfolio model, the probability of detection is not affected by the actions of tax evaders and is taken as given. The effort to hide one's income is not modelled because in this case it is the amount of concealed income that determines the cost to be incurred for evading. As already anticipated an example of such a case could be undeclared receipts kept in cash. Keeping one million dollars in cash requires the same effort as keeping one hundred dollars in cash, but it is more expensive in terms of forgone interest payments.

In this new setting net income in the good state of non detection and net income in the bad state of detection can be defined as follows:

$$W_g = Y - tI - c(Y - I) \tag{15}$$
$$W_b = Y - tI - (ft + c)(Y - I)$$

c the cost for hiding one's income[9]. The cost is incurred in both states of the world.

A representative taxpayer will choose the amount of income to declare to the tax

authorities in order to maximise his/her expected utility:

$$\max EU = (1 - p)U(W_g) + pU(W_b) \tag{16}$$

s.t.

$$W_g = Y - tI - c(Y - I) \tag{16a}$$
$$W_b = Y - tI - (ft + c)(Y - I) \tag{16b}$$

The first order condition is:

$$\frac{\partial EU}{\partial I} = pU'(W_b)(-t + ft + c) + (1 - p)U'(W_g)(-t + c) = 0$$

and hence

$$p[t(f - 1) + c] = \frac{(1 - p)U'(W_g)(t - c)}{U'(W_b)} \tag{17}$$

It should be noted that for the satisfaction of the first order condition, it is required

that the tax rate always exceeds the marginal cost.

The second order conditions are:

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[9] We assume that the cost is incurred for every unit of evaded income.

$$pU''(W_b)[t(f-1)+c]^2 + (1-p)U''(W_g)(-t+c)^2 < 0 \qquad (18)$$

and are satisfied by assuming a concave utility function.

The entry condition for tax evasion is :

$$\frac{\delta EU}{\delta I}\bigg|_{I=Y} < 0 \qquad \text{and hence} \qquad pf < 1 - \frac{c}{t} \qquad (19)$$

This confirms the intuition that if the taxpayer has to bear a cost for hiding his/her income, the entry condition for evasion becomes more restrictive[10].

The impact of an increase in the tax rate on the optimal decision of the tax payer.

We can now consider how the tax-payer reacts to an increase in the tax rate. We rearrange the two constraints in order to obtain an expression for W_b in terms of W_g, more similar to a conventional budget constraint.

We solve (16a) for I and substitute it in (16b):

$$I = -\frac{W_g}{t-c} + Y\frac{(1-c)}{t-c} \qquad (16a')$$

$$W_b + W_g\frac{(-t+ft+c)}{t-c} = \frac{Yft(1-t)}{t-c} \qquad (16b')$$

We can rewrite the initial problem as follows:

$$\max \ EU = (1-p)U(W_g) + pU(W_b)$$

$$s.t.$$

(16')

$$W_b + W_g \frac{(-t+ft+c)}{t-c} = \frac{Yft(1-t)}{t-c}$$

which looks like the standard utility maximisation problem. Combinations of W_b and

W_g are chosen in order to maximise expected utility under the condition that their

value does not exceed a certain amount, represented by the budget constraint.

It is worth focusing on the budget constraint: it is of the usual form $P_x x + P_y y = M$. In

this case $P_{W_b} = 1$, $P_{W_g} = \dfrac{(-t+ft+c)}{t-c}$ and $M = \dfrac{Yft(1-t)}{t-c}$. An individual chooses

combinations of W_b and W_g by changing his/her declaration to the tax authority (I): a

decrease in I, i.e. an increase in tax evasion, increases W_g and decreases W_b. The

"price" an individual has to pay for a unit increase of W_g, relative to W_b, is

$\dfrac{(-t+ft+c)}{t-c}$. A unit increase of W_g corresponds to an increase in tax evasion equal

to $\dfrac{1}{t-c}$. Given Y, t, f, and c, the optimal level of declared income (I) must be such

that the value of net income in the good state ($W_g P_{W_g}$) plus the value of net income

in the bad state (W_b) is $M = \dfrac{Yft(1-t)}{t-c}$. We can define M as aggregate net income.

Eq. (16a') and (16b') are very useful in analysing the impact of a change in the tax

rate on tax evasion. From eq. (16b') we can obtain an explicit demand function for

W_g and analyse the impact of a change in the tax rate on the optimal W_g. Using eq.

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[10] The entry condition for evasion in Yitzhaki model was $pf<1$.

(16a'), which relates W_g to I, we are able to verify how declared income varies accordingly.

The standard demand function for W_g is:

$$W_g = f(P_{W_g}, M)$$

(20)

with $P_{W_g} = \dfrac{(-t + ft + c)}{t - c}$ and $M = \dfrac{Yft(1 - t)}{t - c}$.

A change in the tax rate affects both P_{W_g} and M. As we shall see, an increase in the tax rate decreases the relative price of W_g. This will induce the individual to *substitute* W_g for W_b, by changing his/her declared income, I. The effect of the change in the tax rate on the relative price of W_g can be defined as the *relative price* effect.

At the same time a higher tax rate decreases M and makes the original optimal combination of W_g and W_b not affordable anymore. We can define this second effect as the *wealth* effect of an increase in the tax rate.

The relative price effect of an increase in the tax rate tends to increase W_g, whereas, if W_g and W_b are normal goods, the wealth effect tends to decrease it. Hence the two effects work in the opposite direction.

This is not observed in the Yitzhaki model, where an increase in the tax rate has a pure wealth effect and makes tax evasion decrease[11]. In fact, if we set $c=0$, we get the Yitzhaki model, and the relative price of W_g becomes (f-1), independent of t. A change in the tax rate alters income in both states of the world, but not the relative

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[11] This happens if the individual does not evade 100% of his/her income. In fact, if the conditions for an interior solution hold, an increase in the tax rate reduces income in both states of the world and the individual, under the assumption of decreasing absolute risk aversion, becomes less willing to accept the risk of being detected.

price: the effect on declared income will be unambiguously positive for an increase in the tax rate.

A graphical analysis.

We can use a diagram to clarify how the wealth and the relative price effects of a change in the tax rate interact when there is a cost attached to the activity of evasion. We refer to Figure 4.8.

The line AB represents the budget constraint as in equation (16b'). A is the endowment point: it represents income in the bad state and income in the good state before the individual considers whether to engage in tax evasion. It is along the 45° line because if the individual does not evade, income in both states of the world is the same:

$$W_g^e = W_b^e = Y(1-t) \tag{21}$$

Here the subscript e stands for endowment.

If the individual decides not to evade, he/she will stay put at the endowment point. If instead the individual opts for evasion he/she will move down the budget constraint towards B: in this case $W_g > W_g^e$ and $W_b < W_b^e$. Being a tax evader corresponds to being a "purchaser" of W_g. In fact, an increase in the amount of W_g purchased occurs when the individual decreases I, the amount of declared income. This is clear from eq. (16a'): an increase in W_g, ceteris paribus, corresponds to a decrease in I.

Given the individual's preferences, the optimal combination of W_g and W_b is represented in figure 4.8 by point C.

From eq. (16b'), the slope of the budget constraint is $1 - \dfrac{ft}{t-c}$.

As already anticipated, an increase in the tax rate will decrease the relative price of W_g. With a given endowment, this will make the budget constraint flatter (its slope becomes less negative). In terms of our diagram this means that the budget constraint pivots anti-clockwise around the endowment point, A, (dotted line AB_{rp}). The new optimal combination of W_g and W_b is C_{rp}. The movement from C to C_{rp} represents the relative price effect of an increase in the tax rate and corresponds to the change in the demand for W_g due to a change in the relative price. C_{rp} lies more towards the full evasion case than C: the individual "purchases" a greater amount of W_g and engages in greater tax evasion.

Therefore the effect on an increase in the tax rate on the relative price of W_g goes in the direction of greater tax evasion.

However the relative price effect is not the final effect in that an increase in the tax rate affects also the initial endowment as it decreases aggregate net income: point A, the endowment point, is not affordable anymore and the budget constraint shifts parallel downwards, (line $A_t B_t$). The movement from C_{rp} to C_t represents the wealth effect. It should be noted that here we make the same assumption of decreasing absolute risk aversion as in the Yitzhaki model. The wealth effect represents the consequence of the change in the value of the endowment, which is the movement from A to A_t on figure 4.8 and corresponds to an equal decrease in income in both states of the world. C_t lies to the left of the constant absolute risk aversion line drawn through C_{rp}: an equal decrease in income in both states of the world decreases the individual's willingness to accept risk and the individual tends to engage in less tax evasion.

The bold line A_tB_t represents the new budget constraint, after an increase in the tax rate. The distance AA_t measures the increase in the tax rate. The final effect of an increase in the tax rate is the movement from C to C_t: in this case tax evasion increases after an increase in the tax rate, the reverse than the Yitzhaki result. This is due to the fact that the change in the slope of the budget constraint has a greater impact on W_g than the shift: the relative price effect offsets the wealth effect.

Therefore, even assuming decreasing absolute risk aversion, if a taxpayer has to incur a cost proportional to the amount of concealed income, the Yitzhaki result might be reversed: an increase in the tax rate does not have a clear-cut positive effect on declared income, and the final effect depends on the magnitude of the relative price and the wealth effect.

Figure 4.9 compares the two cases: AB is the original budget constraint when the individual has to bear a cost for evading, AB_Y is the original budget constraint as in Yitzhaki. C and Y represent the optimal combination of W_g and W_b in the two cases. The slope of AB_Y is $(1-f)$, independent of t. In this case, the wealth effect is the only effect of a change in the tax rate. An increase in the tax rate decreases aggregate net income: the budget constraint shifts parallel downwards. At the new equilibrium, Y_t, the representative individual declares a higher income than before.

When the individual has to incur a cost for concealing his/her income, we may get the opposite result: if the relative price effect outweigh the wealth effect, the individual evades more after an increase in the tax rate. We represent this case in figure 4.9 by the movement from C to C_t.

The diagram above describes how the demand for W_g, as represented by equation (20), varies with the tax rate:

$$\frac{dW_g}{dt} = \frac{df(P_{W_g}, M)}{dt} \tag{22}$$

Equation (22) measures the movement from C to C_t in figure 4.8 and 4.9, but it does not confer any information on declared income.

In order to investigate the effect of a change in the tax rate on declared income we need to differentiate equation (16a') with respect to the tax rate:
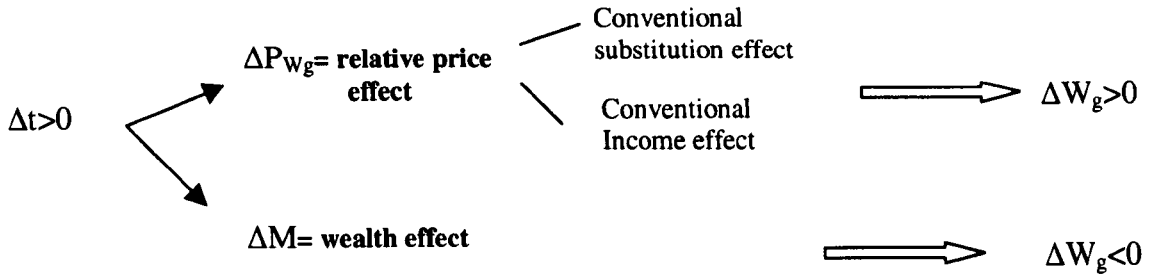
$$\frac{\delta I}{\delta t} = -\frac{dW_g}{dt}\frac{1}{t-c} + W_g \frac{1}{(t-c)^2} - \frac{Y(1-c)}{(t-c)^2} \tag{23}$$

By (16a') the sum of the last two terms is always negative and so the sign of (23) depends on (22). If (22) is positive, (23) becomes negative and an increase in the tax rate will decrease declared income, i.e. will increase tax evasion. Given the crucial role of equation (22) in determining the impact of an increase in the tax rate on declared income, it is worth examining it more precisely.

A decomposition of the final effect of an increase in the tax rate.

A change in the tax rate leads both to a change in the price of net income in the good state, P_{W_g}, and in M. These two effects have an opposite impact on W_g. The impact of a change in the relative price on W_g can be decomposed into the conventional substitution and income effect used in the standard microeconomic theory to explain how a change in the price of one good affects the optimal consumption bundle.

We can summarise the impact of an increase in the tax rate on W_g as follows:

$\Delta t > 0$

ΔP_{Wg}= relative price effect

Conventional substitution effect

Conventional Income effect

$\Delta W_g > 0$

ΔM= wealth effect

$\Delta W_g < 0$

The *relative price* effect is the effect the change in the tax rate has on the optimal W_g, which is due to a change in P_{W_g} and hence:

$$\frac{\delta W_g}{\delta P_{Wg}} \frac{dP_{Wg}}{dt} \tag{24}$$

As already anticipated, the tax rate has a negative impact on the price of W_g, in fact:

$$\frac{dP_{Wg}}{dt} = \frac{(-1+f)(t-c)-(-t+ft+c)}{(t-c)^2} = -\frac{fc}{(t-c)^2} < 0 \tag{24a}$$

As far as $\dfrac{\delta W_g}{\delta P_{Wg}}$ is concerned, in the standard microeconomic theory this would correspond to the final effect of a change in price. Using the Slutsky equation, it could be decomposed as follows:

$$\frac{\delta W_g}{\delta P_{W_g}} = \left(\frac{\delta W_g}{\delta P_{W_g}}\right)_{sub} + (W_g^e - W_g)\frac{\delta W_g}{\delta M} < 0 \qquad (24b)$$

The first term on the right hand side represents the conventional *substitution effect*: it measures how the individual would change his/her consumption of W_g in response to a change in the price after being compensated for the induced change in aggregate net income, in order to keep the individual's real wealth constant. The second term is the conventional *income effect*.

Both the substitution and the income effect work in the same direction and the sign of equation (24b) is negative.

Figure 4.10 illustrates how the relative price effect can be decomposed in the substitution effect and the income effect. As in figure 4.8, the movement from C to C_{rp} represents the relative price effect. In this diagram we break this movement in two parts. The movement from C to C_s represents the substitution effect: the budget constraint pivots around the original chosen point C, (A_sB_s line), so that point C is still affordable, i.e. the purchasing power is held constant[12]. With a lower P_{W_s}, the individual substitutes W_g for W_b and moves from C to C_s.

The movement from C_s to C_{rp} describes the income effect.

Both the substitution effect and the income effect make W_g increase. As a purchase of W_g corresponds to an increase in tax evasion, this leads to greater tax evasion.

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[12] We use the Slutsky decomposition.

Equations (24a) and (24b) imply that $\dfrac{\delta W_g}{\delta P_{W_g}}\dfrac{dP_{W_g}}{dt} > 0$: an increase in the tax rate

decreases the "price " of net income in the good state and hence induces the

individual to increase W_g (movement from C to C_{rp}).

The *wealth* effect is the effect of a change in the tax rate on the optimal W_g and W_b,

which is driven by a change in M:

$$\frac{\delta W_g}{\delta M}\frac{dM}{dt} \qquad\qquad (25)$$

where

$$\frac{dM}{dt} = \frac{(Yf - 2Yft)(t-c) - (Yft - Yft^2)}{(t-c)^2} = \frac{-Yf[(t-c)^2 + c(1-c)]}{(t-c)^2} < 0 \qquad (25a)$$

An increase in the tax rate will decrease aggregate net income and, given that W_g is a

normal good, $\dfrac{\delta W_g}{\delta M}\dfrac{dM}{dt} < 0.$

In figure 4.10 the wealth effect is the movement from C_{rp} to C_t.

The final effect of a change in the tax rate is represented by equation (22), which, in

the light of what we have just considered, can be rewritten as follows:

$$\frac{dW_g}{dt} = \frac{\delta W_g}{\delta P_{W_g}}\frac{dP_{W_g}}{dt} + \frac{\delta W_g}{\delta M}\frac{dM}{dt} \qquad\qquad (22')$$

An increase in the tax rate will have an unclear effect on W_g, the final effect depending on the magnitude of the relative price and wealth effect.

$$\frac{dW_g}{dt} = \frac{\delta W_g}{\delta P_{W_g}}\frac{dP_{W_g}}{dt} + \frac{\delta W_g}{\delta M}\frac{dM}{dt} = ?$$

(26)

If the relative price effect is greater than the wealth effect, then the optimal amount of W_g will increase, i.e. declared income will decrease. If the wealth effect is greater than the relative price effect the sign remains ambiguous: a wealth effect greater than the relative price effect is only a sufficient and not a necessary condition for greater tax evasion.

We can see this from equation (23): if $\frac{dW_g}{dt} > 0$, i.e. the relative price effect is greater than the wealth effect, equation (23) is always negative, and an increase in the tax rate will always lead to a decrease in declared income, i.e. an increase in tax evasion.

However, an increase in tax evasion could still occur if $\frac{dW_g}{dt} = 0$, i.e. the relative price effect completely offsets the wealth effect. If this happens, in fact, the first term in equation (23) disappears and we are left with $\frac{W_g}{(t-c)^2} - Y\frac{(1-c)}{(t-c)^2}$, which, by equation (16a') is always negative: if W_g is fixed then an increase in the tax rate increases tax evasion. The increase in tax evasion, in this case, is determined by the individual's reallocation of the portfolio. In fact, if the tax rate increases and income

in the good state is kept constant, the individual has to change his/her portfolio to compensate for the increase in the tax rate: the amount of evasion must increase. The two terms in equation (23), $\dfrac{W_g}{t-c} - Y\dfrac{(1-c)}{t-c}$, represent the change in the individual's portfolio. We illustrate this in figure 4.11. AB is the original budget constraint and C is the original optimal point. After an increase in the tax rate the budget constraint is A_tB_t. We assume that the relative price effect completely offsets the wealth effect, so that the new optimal point is C_t and income in the good state stays constant. The amount of tax evasion associated with C_t is greater than at C. This can be shown in the diagram once we draw a line parallel to A_tB_t through C: the risk associated with the choice C_t is greater than the risk involved with C[13]. Hence at C_t the individual evades more than at C. The two terms in equation (23), $\dfrac{W_g}{t-c} - Y\dfrac{(1-c)}{t-c}$, describe the movement along A_tB_t from the fixed portfolio line up to C_t, which represents the readjustment of the individual's portfolio choice after an increase in the tax rate.

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[13] In figure 9 we can show that $\dfrac{a}{a+b} > \dfrac{AC}{AB}$. In fact $\dfrac{a}{a+b} > \dfrac{c}{c+d}$, and by extending the vertical line through point A we can use Thalès argument of similar triangles to show that $\dfrac{c}{c+d} > \dfrac{AC}{AB}$ and hence $\dfrac{a}{a+b} > \dfrac{AC}{AB}$, QED.

The effect of an increase in the tax rate for tax payers who were previously indifferent between evasion and non evasion.

Another aspect that is worth considering is the behaviour of tax payers who, before the increase in the tax rate, were indifferent between evasion and non-evasion.

In the Yitzhaki model the tax rate did not affect the entry condition for tax evasion $pf<1$: those tax payers on the margin, who were indifferent between a truthful declaration of income and cheating because $pf=1$, were not affected by an increase in the tax rate.

In the case of a cost attached to tax evasion, the entry condition of evasion is $pf < 1 - \dfrac{c}{t}$. If tax payers are indifferent between evasion and non-evasion then

$pf = 1 - \dfrac{c}{t}$. An increase in the tax rate will affect these tax payers: with $t' > t$, then

$pf < 1 - \dfrac{c}{t'}$. The entry condition for evasion is now satisfied and that tax evasion becomes more profitable than a truthful declaration. Hence previous non-evaders will be induced to switch to evasion.

We represent this situation in figure 4.12. Part *a)* illustrates the case when there is a cost to be incurred for hiding one's income. When the tax rate is t, the individual is better off by declaring all of his/her income to the tax authority: the budget constraint AB is tangent to the indifference curve at C along the 45° line. On the 45° line, the MRS is $-\dfrac{(1-p)}{p}$. At C the slope of the indifference curve is equal to the

slope of the budget constraint, $-\dfrac{(1-p)}{p} = 1 - \dfrac{ft}{(t-c)}$. Hence $pf = 1 - \dfrac{c}{t}$. If the tax rate increases from t to t', the individual starts to evade. In fact the budget constraint

rotates and shifts downwards to A_tB_t and the new optimal combination of W_g and W_b becomes C_t. If the individual kept on declaring his/her full income, he/she could only reach a lower indifference curve.

Part b) represents the Yitzhaki model when an individual maximises his/her expected utility by choosing not to evade (point A). At A the indifference curve is tangent to the budget constraint on the 45° line, hence $1 - f = -\dfrac{1-p}{p}$, i.e. $pf = 1$. An increase in the tax rate shifts the budget constraint but does not change the individual's decision: the new equilibrium is A_t and the individual still declares his/her true income.

Hence, the consideration of an additional cost for evading, proportional to the amount of hidden income, allows to reverse the Yitzhaki result. As we have just shown, a rise in the tax rate might induce people to start evading. This allows for an increase in the number of evaders and in total evasion when the tax rate rises.

In conclusion, when the activity of cheating the Government is costly and the cost is proportional to the amount of concealed income, it is possible to observe an increase in tax evasion after an increase in the tax rate.

For tax-payers who were previously indifferent between evasion and non-evasion and did not evade this result will always hold in that they will switch to evasion after an increase in the tax rate. For previous tax evaders the effect of a higher tax rate depends on the relative price and the wealth effect. If the relative price effect is greater than the wealth effect, an increase in the tax rate leads to even greater tax evasion. In this case no one ever ceases to evade as a result of an increase in the tax rate.

Which one of the two effects prevails depends on the individual's preferences over W_b and W_g.

The degree of risk aversion may have a key role in determining the outcome. In general the lower the degree of risk aversion, the flatter the indifference curve and the stronger the substitution effect. In terms of our analysis, a stronger substitution effect makes equation (24b) more negative and hence reinforces the relative price effect. It follows that individuals who are more willing to accept a substantial loss in the bad state of detection might be more likely to respond to an increase in the tax rate by decreasing their declared income.

The possibility of observing an increase in total evasion when the tax rate rises, which counters Yitzhaki's result, is obtained by simply introducing a cost attached to the activity of hiding one's income. It hence depends on the magnitude of the cost: the lower the cost, the more likely the Yitzhaki result.

4.3.3 The cost of the effort to fool the tax authority

In the previous two sub-sections we modelled the cost attached to tax evasion as an involuntary cost, intrinsic in the activity of concealing income to the tax authority. The individual did not have any control on the cost to be incurred for evading. In case of a fixed cost, the individual had to pay a sort of licence to enter the activity of cheating, whereas in case of a cost proportional to the amount of evaded income, the individual incurred a cost for each unit of evaded income. In this latter case the agent could control the total cost by varying the amount of concealed income, but not the unitary cost. Hence, from the individual's point of view, the cost was a parameter, to be taken as given. In this section we assume that the cost attached to evasion depends on how hard an individual tries to conceal his/her income.

In particular we assume that a tax evader has different opportunities to conceal his/her income and is able to choose a level of effort to cheat the tax authority. The effort is costly, but will decrease the probability of detection. In this case the probability of detection does not correspond to the probability of an audit, as in the standard portfolio model. The fiscal authority, by choosing an audit strategy, sets the probability of audit. However an audited tax-evader may not get caught thanks to the effort exerted to successfully hide his/her income. We assume that the greater the level of effort, the higher the cost and the lower the probability of getting caught for hiding one's income.

The individual chooses the amount of income to declare and a level of effort which maximise expected utility. The optimal effort will determine the probability of detection and the cost to be incurred, hence both the cost and the probability of detection are endogenised in the model.

We should expect that individuals with different degrees of risk aversion will choose different levels of effort to hide their income, even if the tax parameters are equal for everybody. In particular, we can expect that less risk averse individuals will opt for a higher effort and a lower declared income. It seems reasonable to assume that less risk averse individuals choose more risky activities, such as running a firm or self-employment which are the ones providing greater opportunities to evade.

We can model a representative individual's choice as follows:

$$\max_{x,i} \quad EU = p(x)U\left[1-ti-(ft+c(x))(1-i)\right]+(1-p(x))U\left[1-ti-c(x)(1-i)\right] \tag{27}$$

s.t.

(1) $x \geq 0$

(2) $i \geq 0$

(3) $i \leq 1$

(4) $i \geq \dfrac{-1+ft+c(x)}{-t+ft+c(x)}$

The individual chooses the level of effort (x) and the proportion of declared income (i) that maximise his/her expected utility. We normalise money units so that income is 1 and $i = \dfrac{I}{Y}$ is the proportion of declared income.

The constraints are imposed to guarantee that the choice variables assume feasible values. They define a sensible area for the solution. In fact, they require the solution to lie in a feasible range: the level of effort must be non negative (condition 1), the proportion of declared income must lie between zero and one (conditions 2 and 3). Condition 4 is obtained by imposing $W_b \geq 0$.

In the standard model this condition was implied by $ft < 1$[14], which also guaranteed

both interior and corner solutions[15]. In this case income in the bad state of detection

is affected by the cost, and hence by the effort chosen by the individual:

$$W_b = 1 - ti - (ft + c(x))(1-i) \tag{28}$$

If we do not impose a constraint on the income in the bad state, there would be no

limit to what the individual can lose in the bad state. We can interpret condition 4 as

a non-bankruptcy condition, which establishes that an individual can't lose more

than his income in case of detection.

We represent the area of feasible solutions, determined by these four constraints in

figure 4.13. The area $ABCD$ depicts the feasible set of values for x and i. In the

figure the intercept of the curve representing $W_b=0$ is negative as we assume that

$|ft| < 1$. If $ft > 1$, the intercept would be positive and constraint (1), $x \geq 0$, would

become redundant. The curve drawn for $W_b=0$ is asymptotic to $i=1$ for $x \to \infty$.

We assume that the effort for hiding one's income decreases the probability of

detection but becomes less and less effective and more and more costly:

$$
\begin{aligned}
p'(x) &< 0, \quad p''(x) > 0 \\
c'(x) &> 0, \quad c''(x) > 0
\end{aligned}
\tag{29}
$$

The idea is that hiding a greater amount of income is more costly. For example,

living in a block of flats to disguise one's category to the fiscal authority is more

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[14] In fact, in the standard model $W_b = Y - tI - ft(Y-I) = Y(1-ft) - I(t-ft) \cdot$ $ft < 1$ implies that $W_b > 0$.
[15] See Yitzhaki (1974), p. 202.

costly, in terms of forgone alternatives, for a multimillionaire than for someone who could just afford a house.

For the solution we can use the Lagrangian method and incorporate the constraints in the objective function:

$$(30)$$

$$L = p(x)U\big(\!\left[1 - ti - (ft + c(x))(1 - i)\right]\!\big) + (1 - p(x))U\big(\!\left[1 - ti - c(x)(1 - i)\right]\!\big) + \lambda_1(1 - i) +$$

$$+ \lambda_2\left(\frac{-1 + ft + c(x)}{-t + ft + c(x)} - i\right)$$

The first order conditions are:

$$\frac{\delta L}{\delta x} \leq 0, \qquad\qquad x \geq 0, \qquad\qquad x\,\frac{\delta L}{\delta x} = 0 \qquad\qquad (31a)$$

$$\frac{\delta L}{\delta i} \leq 0, \qquad\qquad i \geq 0, \qquad\qquad i\,\frac{\delta L}{\delta i} = 0 \qquad\qquad (31b)$$

$$\frac{\delta L}{\delta \lambda_1} \geq 0 \qquad\qquad \lambda_1 \geq 0 \qquad\qquad \lambda_1\,\frac{\delta L}{\delta \lambda_1} = 0 \qquad\qquad (31c)$$

$$\frac{\delta L}{\delta \lambda_2} \leq 0 \qquad\qquad \lambda_2 \geq 0 \qquad\qquad \lambda_2\,\frac{\delta L}{\delta \lambda_2} = 0 \qquad\qquad (31d)$$

For an interior solution, i.e. *x>0* and *1<i<0*, we should impose some restrictions on the behaviour of the Lagrangian function along the boundaries. In particular, we should specify the behaviour of the objective function along the boundaries as follows:

$$\left.\frac{\delta L}{\delta x}\right|_{x=0} = \left.\frac{\delta EU}{\delta x}\right|_{x=0} > 0 \qquad\qquad (31a')$$

$$\left.\frac{\delta L}{\delta i}\right|_{i=0} = \left.\frac{\delta EU}{\delta i}\right|_{i=0} > 0 \qquad\qquad (31b')$$

$$\left.\frac{\delta L}{\delta i}\right|_{i=1} = \left.\frac{\delta EU}{\delta i}\right|_{i=1} < 0, \qquad \text{i.e. } p(x)ft < t - c(x) \qquad\qquad (31c')$$

either $\left.\dfrac{\delta L}{\delta x}\right|_{i=\frac{-1+ft+c(x)}{-t+ft+c(x)}} = \left.\dfrac{\delta EU}{\delta x}\right|_{i=\frac{-1+ft+c(x)}{-t+ft+c(x)}} < 0$

or $\left.\dfrac{\delta L}{\delta i}\right|_{i=\frac{-1+ft+c(x)}{-t+ft+c(x)}} = \left.\dfrac{\delta EU}{\delta i}\right|_{i=\frac{-1+ft+c(x)}{-t+ft+c(x)}} > 0$, which both imply $W_b > 0$ (31d')

Conditions (31b')-(31d') rule out solutions such as $i=0$, $i=1$ and $W_b=0$. Conditions (31b') and (31c') are the same as in the standard model and call for an interior solution for optimal declared income[16].

In figure 4.13, these conditions determine the direction of the arrows, towards an interior solution for x and i.

If we are in the interior of region ABCD, i.e. condition (31a')-(31d') are satisfied, the first order conditions simply become:

$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (32)$$

$$\frac{\delta EU}{\delta i} = p(x)U'(W_b)(-t + ft + c(x)) - (1 - p(x))U'(W_g)(t - c(x)) = 0$$

which requires $t > c(x)$, and

$$\frac{\delta EU}{\delta x} = p'(x)\{U(W_b) - U(W_g)\} - c'(x)(1 - i)\{p(x)U'(W_b) + (1 - p(x))U'(W_g)\} = 0$$

$$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (33)$$

With $\quad W_b = 1 - ti - (ft + c(x))(1 - i), \quad W_g = 1 - ti - c(x)(1 - i)$

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[16] We recall that, in the standard model, the condition for an interior solution were: $\left.\dfrac{\delta Eu}{\delta i}\right|_{i=0} > 0 \left.\dfrac{\delta Eu}{\delta i}\right|_{i=1} < 0.$

The second order conditions are:

$$\frac{\delta^2 EU}{\delta i^2} < 0 \qquad\qquad (34a)$$

$$\frac{\delta^2 EU}{\delta x^2} < 0 \qquad\qquad (34b)$$

$$\begin{vmatrix} \dfrac{\delta^2 EU}{\delta i^2} & \dfrac{\delta EU}{\delta i \delta x} \\[2ex] \dfrac{\delta EU}{\delta x \delta i} & \dfrac{\delta^2 EU}{\delta x^2} \end{vmatrix} > 0 \qquad\qquad (34c)$$

Condition (34a) is implied by the concavity of the utility function, as in the standard model:

$$\frac{\delta^2 EU}{\delta i^2} = p(x)U''(-t + ft + c(x))^2 + (1 - p(x))U''(t - c(x))^2 < 0$$

Conditions (34b) and (34c), instead, do not automatically hold: the convexity of the cost function and the concavity of the probability function are not sufficient to guarantee the second derivative of the expected utility with respect to effort to be negative and determinant of the Hessian to be positive. We show this in the appendix.

The satisfaction of the second order conditions depends on the functional forms defined for $p(x)$ and $c(x)$. The optimal effort and proportion of declared income can't be determined by simply solving the system of first order conditions and a general

solution for the problem is not possible. In what follows we will look for a numerical solution.

4.3.3.1 The optimal effort and declared income after an increase in the tax rate: a simulation

In the previous section, when we modelled a cost attached to tax evasion proportional to the amount of hidden income, we got the result that, an individual might respond to an increase in the tax rate by increasing tax evasion. This was due to the fact that a change in the tax rate affects the relative price $\dfrac{P_{W_r}}{P_{W_b}}$.

In this setting we may expect that, after an increase in the tax rate, an individual will exert a greater effort to hide his/her income. This will decrease the probability of detection and increase the cost to be incurred. Being less exposed to detection, the individual might decide to evade more.

Our aim is therefore to get a numerical example which shows that, after an increase in the tax rate, the optimal level of effort will increase and the optimal proportion of declared income will decrease.

We are also interested in the role of risk aversion: as already anticipated, our intuition is that less risk averse individuals are more inclined to engage in activities offering greater opportunities to evade. In terms of our analysis they should choose a lower optimal declaration of income and a higher effort to decrease the probability of being caught. We might also expect a clearer response to an increase in the tax rate by less risk averse individuals. In particular they should be more likely to increase

the effort to hide their income and decrease their optimal declaration to the tax authority after an increase in the tax rate.

In what follows we define an explicit functional form for the utility function, the probability of detection and the cost functions.

A tractable functional form for the utility is the constant relative risk aversion function:

$$U(W_g) = \frac{1}{1-\rho}W_g^{1-\rho} = \frac{1}{1-\rho}[1 - ti - c(x)(1-i)]^{1-\rho}$$

$$U(W_b) = \frac{1}{1-\rho}W_b^{1-\rho} = \frac{1}{1-\rho}[1 - ti - (ft + c(x))(1-i)]^{1-\rho}$$

(36)

ρ represents the coefficient of relative risk aversion.

A constant relative risk aversion means that the income expansion path is a straight line through the origin, i.e. a decrease (increase) in wealth will not affect the proportion of one's wealth in the risky asset, in this case the proportion of income hidden from the tax authority[17].

The expected utility function becomes:

$$EU = p(x)\frac{1}{1-\rho}[1 - ti - (ft + c(x))(1-i)]^{1-\rho} + (1 - p(x))\frac{1}{1-\rho}[1 - ti - c(x)(1-i)]^{1-\rho}$$

(37)

We define the probability of detection and the cost functions as follows:

$$p(x) = \beta - \alpha x \quad \text{with } \alpha > 0, \beta > 0$$
$$c(x) = ax^b \qquad \text{with } a > 0, b > 1$$

(38)

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[17] See Stiglitz, (1969).

β is the probability of an audit, exogenously determined by the fiscal authority and α is the impact of the effort to hide one's income on the success of an audit. For simplicity we assume that α is a parameter, equal for all individuals. Hence, a given level of effort will have the same impact on the probability of detection for all individuals. We should note that in this case, in order to simplify the analysis, the functional form for the probability of detection is linear and hence $p''(x) = 0$: a higher effort to conceal one's income decreases the probability of detection at a constant rate.

We run the simulation by fixing the values for t, f, a, b, α and β and calculating the values for i and x that maximise expected utility for different ρ.

We look for an interior solution, so the range of choice for $t, f, a, b, \alpha,$ β and ρ is limited by conditions (31a')-(31d'). With the chosen functional forms for the utility, the probability of detection and the cost, conditions (31b') and (31c') become:

$$\frac{(\beta - \alpha x)(-t + ft + ax^b)}{(1 - \beta - \alpha x)(t - ax^b)} \geq \frac{(1 - ft - ax^b)^\rho}{(1 - ax^b)^\rho} \tag{39}$$

and

$$(\beta - \alpha x)ft < t - ax^b \tag{40}$$

Condition (39) implies that we are above the curve $W_b=0$, hence it must be the case that $W_b>0$:

$$W_b = 1 - ti - (ft + ax^b)(1 - i) > 0 \Rightarrow i > \frac{-1 + ft + ax^b}{-t + ft + ax^b} \tag{41}$$

Parameters are selected such that conditions (39), (40) and (41) are satisfied. We then find the value of x and i which maximise the utility function.

We think it reasonable to set the tax rate at 0.33 and the fine rate at 2.25, so that the tax evader, if detected, has to pay 2.25 times the tax payment he/she failed to comply with. As noted above, due to the first order condition, the cost can't exceed the tax rate, so that in this case $c(x)$ cannot be greater than 0.33, hence the choice for a=0.04 and b=1.25. The tax rate also determines the range over which x can vary: for a tax rate of 33% condition (40) is not satisfied for x>1.8. This is because beyond a certain point, the action of hiding one's income becomes too expensive: the cost incurred is greater than the tax rate and the expected gain for an extra unit of evaded income becomes negative[18], condition (40) is violated. The lower the tax rate, the smaller the interval over which x is allowed to vary.

No information is usually released on the probability of audit: in the name of confidentiality, the fiscal authority makes it very hard to try to get an estimate of the efficacy of its auditing activity. We arbitrarily assume that the probability of an audit is 44%, i.e. β=0.44. The impact of one's effort to hide income is α=0.06.

For ρ<0.035 condition (39) is not satisfied.

We calculated expected utility for all i=0,....1 and the feasible range $0 \leq x \leq 1.8$ using the parameters as defined above and for $0.035 \leq \rho \leq 400$. The combinations of x and i which maximise expected utility, for different degrees of risk aversion are listed in table 4.1 and illustrated in figure 4.14. As represented in figure 4.14 the relationship between the optimal declared income and risk aversion is as expected: declared income increases with the degree of risk aversion. For $\rho \geq 10$, the optimal proportion of declared income is 1 (truthful declaration).

An unexpected result is that optimal effort is invariant with risk aversion. Optimal effort is 0.65 for $0.035 \leq \rho \leq 8$ whereas for $\rho \geq 8$ utility is maximised for i=1, and

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[18] The expected gain for an extra unit of evaded income is $(1-p(x))(t-c(x))+p(x)(t-c(x)-ft)=t-c(x)-p(x)ft$.

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assumes the same value irrespective of x. This result may be due to our choice of the functional form for the utility function, and the cost, as both are characterised by constant elasticities.

We can now consider how the optimal proportion of declared income and the optimal effort vary with the tax rate.

In choosing the range over which the tax rate changes, we have to bear in mind two aspects:

- the cost cannot exceed the tax rate, otherwise condition (40) is not satisfied,

- income in the bad state of detection cannot be negative, even when the individual evades all of his/her income, otherwise conditions (39) and (41) are not satisfied.

In both cases x cannot exceed a certain value, otherwise the cost for hiding one's income becomes too high and the above requirements are not met. The following table summarises the interval over which x can vary for each tax rate:

Tax rate	Feasible values for x	Boundary conditions otherwise violated
$t=0.28$	$x \leq 1$	Otherwise condition (40) is not satisfied
$t=0.33$	$x \leq 1.8$	Otherwise condition (40) is not satisfied
$t=0.35$	$x \leq 2.2$	Otherwise condition (40) is not satisfied
$t=0.37$	$x \leq 2.7$	Otherwise condition (40) is not satisfied
$t=0.40$	$x \leq 2.05$	Otherwise conditions (39) and (41') are not satisfied
$t=0.41$	$x \leq 1.65$	Otherwise conditions (39) and (41) are not satisfied
$t=0.42$	$x \leq 1.29$	Otherwise conditions (39) and (41) are not satisfied
$t=0.43$	$x \leq 0.8$	Otherwise conditions (39) and (41) are not satisfied
$t=0.44$	$x \leq 0.35$	Otherwise conditions (39) and (41) are not satisfied

For $t > 0.44$ conditions (39) and (41) are not satisfied, for any value of x.

We therefore restrict our attention to the range $0.28 \le t \le 0.42$ and calculate the optimal x and i for $0.035 \le \rho \le 8$.

Figure 4.15 shows the relationship between the tax rate and declared income for different coefficients of relative risk aversion. A change in the tax rate seems to have more of an impact with low coefficients of relative risk aversion. For rho above 0.9, an increase in the tax rate from 0.28 to 0.42 leads only to a small decrease in declared income, for rho=8 it has hardly any impact. We did not include the figures for $\rho>8$, in that declared income results to be invariant with the tax rate for those values.

This confirms our intuition: the degree of risk aversion has a role in determining the impact of an increase in the tax rate on declared income. Less risk averse individuals tend to respond to an increase in the tax rate by decreasing their declaration to the tax authority. This result reinforces the conclusion we suggested in section 4.3.2: if the cost attached to tax evasion is proportional to the amount of evaded income, the effect of an increase in the tax rate on declared income depends on the magnitude of the relative price effect and the wealth effect. Less risk averse individuals have a flatter indifference curve. This implies that the substitution effect is stronger, and hence that the relative price effect is stronger. For less risk averse individuals it is more likely that the relative price effect dominates the wealth effect and therefore they respond to an increase in the tax rate by increasing tax evasion.

It is worth noticing that for very low coefficients of relative risk aversion, namely for $\rho=0.035$, $\rho=0.04$ and $\rho=0.05$, the relationship between the tax rate and declared income is not monotonic: declared income decreases with the tax rate up to a point

and then begins to increase. This seems to be particularly true when the degree of risk aversion is very small. For example for $\rho=0.035$, declared income decreases from 3% to 0% when the tax rate rises from 28% to 35%; but it increases to 9% if the tax rate increases from 35% to 42%. The same trend is observed for $\rho=0.04$ and to a lesser extent for $\rho=0.05$. It is interesting to consider how the effort varies with declared income and the tax rate in the same diagram. It might be the case that after a certain point increasing the effort to hide one's income becomes too expensive (x approaches its upper limit in the table above). As a result the individual may decide to give up the effort and increase his/her declaration to the tax authorities despite the increase in the tax rate.

Figures 4.16-4.18 illustrate how the optimal declared income and effort change with the tax rate for three different degrees of risk aversion: $\rho=0.04$, $\rho=0.1$ and $\rho=8$.

The optimal level of effort exhibits the same pattern and assumes almost the same values for all the three coefficients of relative risk aversion we considered. For $t=0.42$ x hits its upper limit 1.29. Therefore a decrease in effort observed after $t=0.41$ is due to the non-bankruptcy condition: the optimal effort can't be higher than 1.29, otherwise income in case of detection becomes negative and conditions (39) and (41) are not satisfied. This confirms the intuition that after a certain level, increasing the effort to hide one's income becomes too costly and the individual might increase his/her declaration of income if the tax rate increases further.

This is the case for $\rho=0.04$ when the tax rate increases from 0.4 to 0.42: the optimal level of effort decreases and the optimal declared income increases.

For $\rho=0.1$ the relationship between the optimal proportion of declared income, the optimal effort and the tax rate is always as expected: an increase in the tax rate leads the individual to reduce his/her declaration of income and increase the effort to

cheat. For $\rho=8$ declared income does not change with the tax rate. By comparing the three diagrams we can note that the greater the degree of relative risk aversion, the less responsive the optimal proportion of declared income to a change in the tax rate.

In this section we considered the case where the auditing activity of the tax authority is not 100% successful in that it might not lead to detection. This is due to the assumption that a tax payer can choose an optimal level of effort to conceal his/her income and fool the tax authority. In trying to fool the tax authority the individual has to bear a cost, but is able to lower the probability of detection.

In the absence of a general solution, we ran a simulation to get a numerical solution with the view to find out how the optimal declared income and the optimal effort to disguise the tax authority varied with the degree of risk aversion and the tax rate.

An interesting result, which is worth emphasising, is the impact of an increase in the tax rate on declared income. The numerical example we provide shows that an increase in the tax rate may induce individuals to exert more effort to hide their income and evade more. Hence it is possible to observe a decrease in declared income after a rise in the tax rate, and reverse the Yitzhaki result. This is more likely to happen for low coefficients of relative risk aversion. This is exactly the same result we obtained in the previous section when we considered a cost attached to tax evasion proportional to the amount of concealed income. In that case the cost was exogenous for the tax payer in that it wasn't related to the effort to fool the tax authority. In that setting we found that for previous tax evaders the impact of a rise in the tax rate was determined by the magnitude of the relative price effect and the wealth effect. For less risk averse individuals the relative price effect was more likely to offset the wealth effect and hence induce more tax evasion.

A novelty resulting from the simulation is that for low coefficients of relative risk aversion the relationship between the tax rate and declared income is not monotonic. Initially, after an increase in the tax rate, the optimal declared income decreases and the optimal effort to fool the tax authority increases, but after a certain point increasing the effort to hide one's income becomes too expensive and declared income starts rising again. The individual is able to affect the probability of detection up to a certain point, beyond which the action to fool the authorities becomes too expensive and after an increase in the tax rate the individual may decide to give up the effort and increase his/her income declaration.

4.4 Conclusion.

In this chapter we considered two issues: the possibility that the audit process imposes a cost even on honest taxpayers and the fact that concealing one's income is a costly activity.

The audit may make honest individuals worse off both in non-monetary and in monetary terms. We distinguished between a psychic cost and a monetary cost of being audited for an honest taxpayer.

We modelled a psychic cost for an audit by use of state dependent utility functions and we demonstrate that a mixed outcome is feasible, as long as individuals differ in how much they dislike being audited.

We modelled the monetary cost as a shift in the endowment point so that if the individual does not evade he/she is not along the 45° line. In this case the degree of risk aversion matters for the decision whether or not to evade. A mixed equilibrium is feasible if individuals have different degrees of risk aversion. There will be a

critical degree of risk aversion above which individuals will not evade. The community will be partitioned into evaders and non evaders on the basis of their degree of risk aversion.

When we considered the issue that evading is a costly activity, we made a distinction between the case of a cost intrinsic in the activity of evasion and the case of a voluntary cost, determined by the effort chosen to fool the tax authority in the attempt to lower the probability of detection. In the former case we distinguished between a fixed cost (a licence to evade), and a proportional cost.

When the cost for evading is fixed, optimal declared income depends on the attitudes towards risk: more risk averse individuals will tend to evade less. Hence, even if individuals face the same probability of detection, they will opt for different amounts of declared income as long as they differ in the degree of risk aversion: a mixed outcome is feasible. In particular, there will exist a critical degree of risk aversion above which individuals will never evade and the community will be partitioned into evaders and non evaders according to the degree of risk aversion. An increase in the tax rate won't change the amount of evasion under constant absolute risk aversion, whereas if individuals have decreasing absolute risk aversion an increase in the tax rate will rise the level of tax evasion. This reinforces the Yitzhaki result. Individuals who were previously indifferent between evasion and non evasion will prefer not to evade after a rise in the tax rate.

If the cost for cheating the tax authority is proportional to the amount of concealed income, the entry condition for tax evasion becomes more restrictive. An increase in the tax rate will have a relative price effect, which works in the direction of an

increase in the tax rate, and a wealth effect, which instead works for a decrease in tax evasion.

Tax payers who were previously indifferent between evasion and non evasion will always prefer to evade after an increase in the tax rate.

For previous tax evaders the impact of an increase in the tax rate on tax evasion depends on the relative price effect and the wealth effect. If the relative price effect outweighs the wealth effect, an increase in the tax rate will make previous tax evaders increase tax evasion. This reverses the Yitzhaki result. The degree of risk aversion has a role in determining the outcome. The lower the degree of risk aversion, the flatter the indifference curve and the stronger the substitution effect. This reinforces the relative price effect. Hence less risk averse individuals are more likely to respond to an increase in the tax rate by evading more.

When the cost for evading depends on the effort to fool the tax authority, the predictions concerning a mixed outcome and the effect of an increase in the tax rate on tax evasion seem to be similar to the case of a proportional cost. Although we couldn't get a general solution, our simulation showed that less risk averse individuals tend to respond to an increase in the tax rate by evading more.

The consideration of a cost attached to the activity of concealing one's income makes it possible to reverse the Yitzhaki result and to get a mixed outcome consisting of honest taxpayers and cheaters.

Implicit in this analysis is the fact that if the cost for hiding one's income varies across individuals, they will choose to declare different amounts to the tax authority, even if they have the same gross income. Hence by allowing for different costs of

evasion we are able to model a situation where individuals have different opportunities to evade: those with higher costs have lower opportunities to evade. We didn't pursue this aspect in this chapter, in that we only considered a cost equal for all individuals. Our objective was to compare the predictions concerning a mixed outcome and the effect of an increase in the tax rate on tax evasion when there is a cost for evading with what happens in the standard portfolio model.

In the next chapter we analyse the idea that individuals have different opportunities to evade and model this in terms of different costs to be incurred in case of evasion.

Appendix

In this appendix we show that the second order conditions for problem (32) do not automatically hold. The convexity of the cost function and the concavity of the probability function are not sufficient for the second order conditions to hold.
The second order conditions are as follows:

$$\frac{\delta^2 EU}{\delta x^2} < 0 \tag{34b}$$

$$\begin{vmatrix} \dfrac{\delta^2 EU}{\delta i^2} & \dfrac{\delta EU}{\delta i \delta x} \\[2mm] \dfrac{\delta EU}{\delta x \delta i} & \dfrac{\delta^2 EU}{\delta x^2} \end{vmatrix} > 0 \tag{34c}$$

These two conditions are not automatically satisfied, in fact:

$$\frac{\delta^2 EU}{\delta x^2} = p''(x)\left[U(W_b) - U(W_g)\right] - 2p'(x)c'(x)(1-i)\left[U'(W_b) - U'(W_g)\right] +$$

$$+ p(x)[c'(x)]^2(1-i)^2\left[U''(W_b) - U''(W_g)\right] - p(x)c''(x)(1-i)\left[U'(W_b) - U'(W_g)\right] +$$

$$- c''(x)(1-i)U'(W_g) + [c'(x)]^2(1-i)^2 U''(W_g) < 0 \qquad \text{holds if and only if :}$$

$$- 2p'(x)c'(x)(1-i)\left[U'(W_b) - U'(W_g)\right] < p''(x)\left[U(W_b) - U(W_g)\right] + p(x)[c'(x)]^2(1-i)^2\left[U''(W_b) - U''(W_g)\right] +$$

$$- p(x)c''(x)(1-i)\left[U'(W_b) - U'(W_g)\right] - c''(x)(1-i)U'(W_g) + [c'(x)]^2(1-i)^2 U''(W_g)$$

this inequality depends on the functional form of $p(x)$ and $c(x)$. By the same argument

$$\frac{\delta EU}{\delta i \delta x} = \frac{\delta EU}{\delta x \delta i} = \frac{p'(x)}{p(x)}U'(W_g)(t - c(x)) + c'(x)(1-i)(t - c(x))(1 - p(x))U'(W_g)\left\{R_A(W_b) - R_A(W_g)\right\} +$$

$$+ p(x)c'(x)U'(W_b) + (1 - p(x))c'(x)U'(W_g) > 0 \text{ holds if and only if}$$

$$\frac{p'(x)}{p(x)}U'(W_g)(t - c(x)) < + c'(x)(1-i)(t - c(x))(1 - p(x))U'(W_g)\left\{R_A(W_b) - R_A(W_g)\right\} +$$

$$+ p(x)c'(x)U'(W_b) + (1 - p(x))c'(x)U'(W_g)$$

As above, this holds only for specific functional form for $p(x)$ and $c(x)$. Hence the satisfaction of the second order conditions depends on the functional form defined for $p(x)$ and $c(x)$.
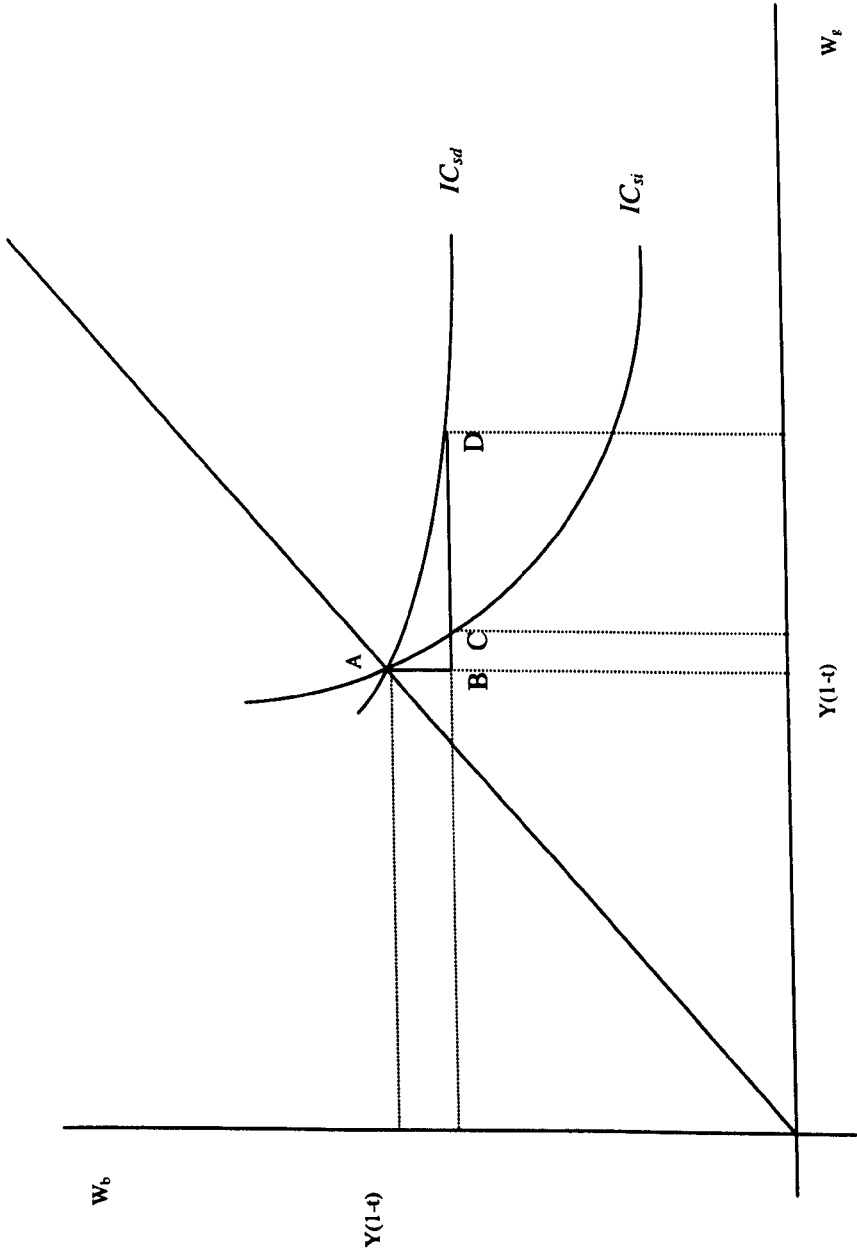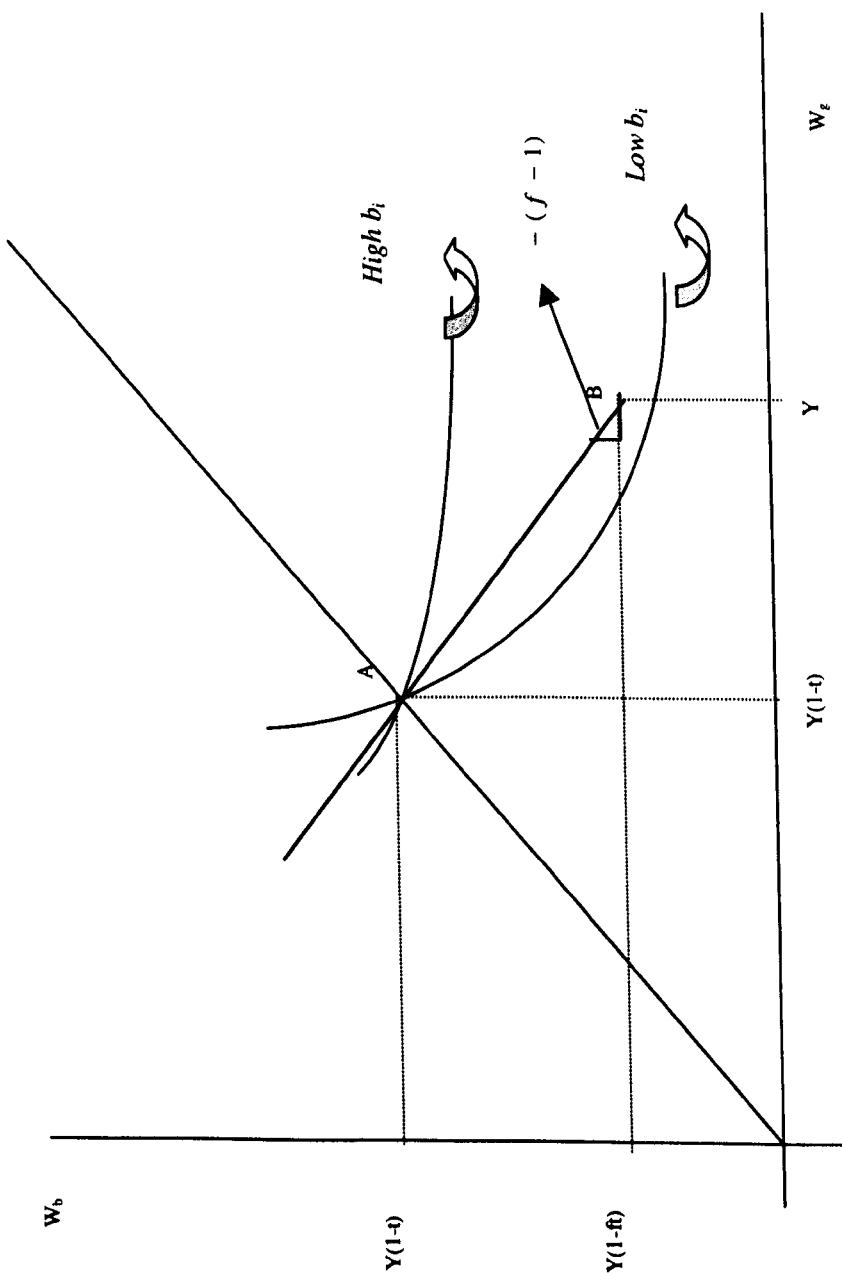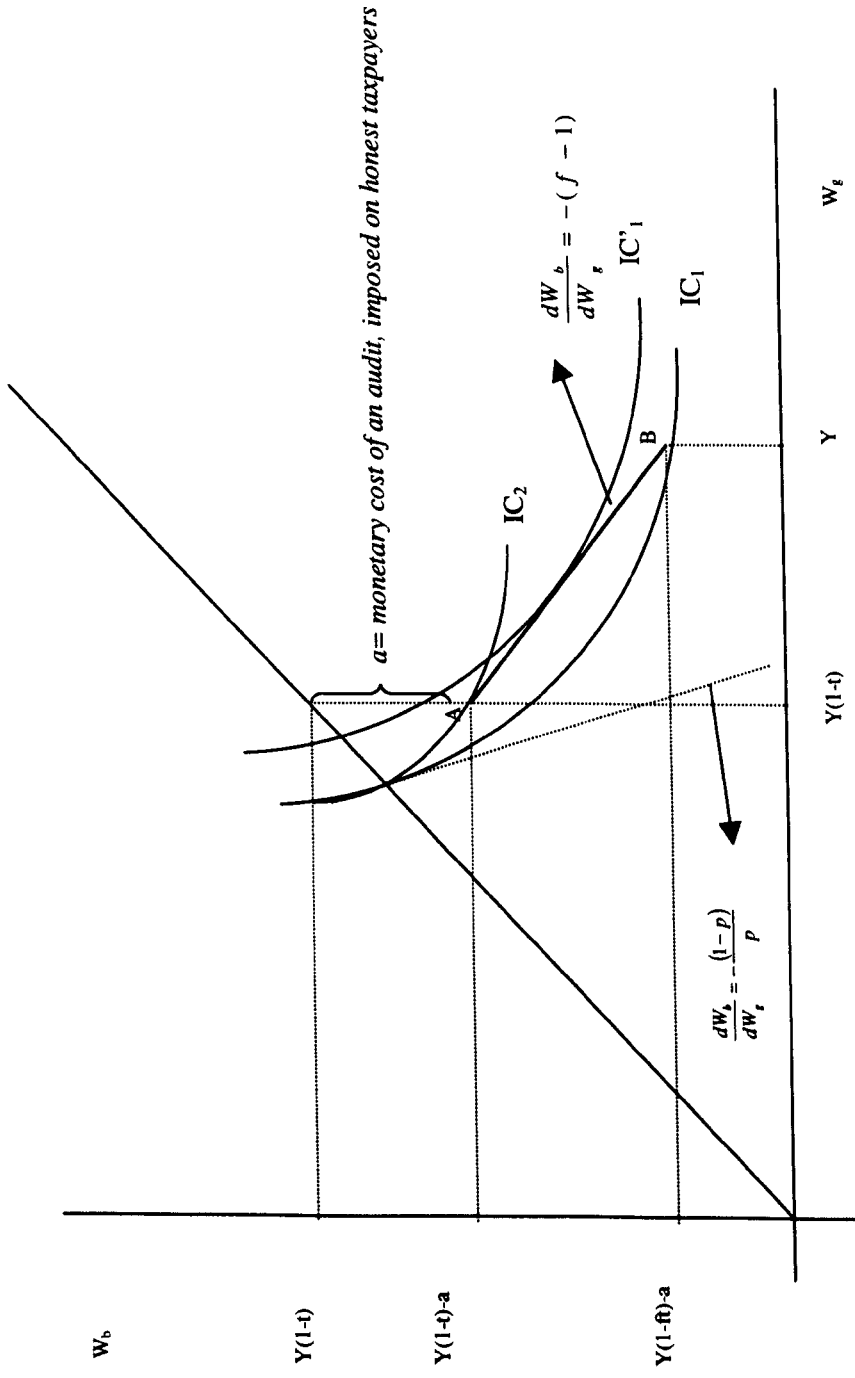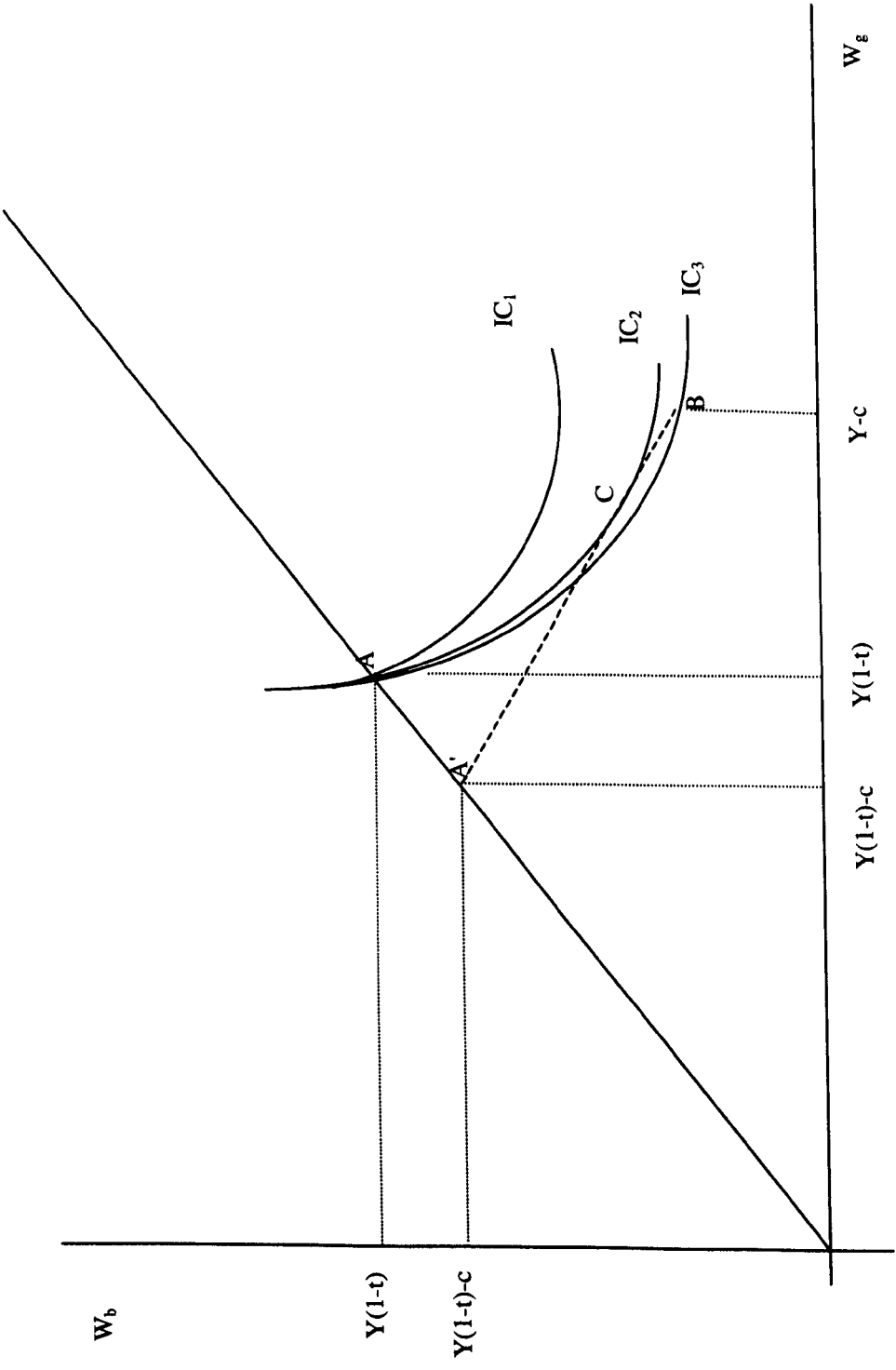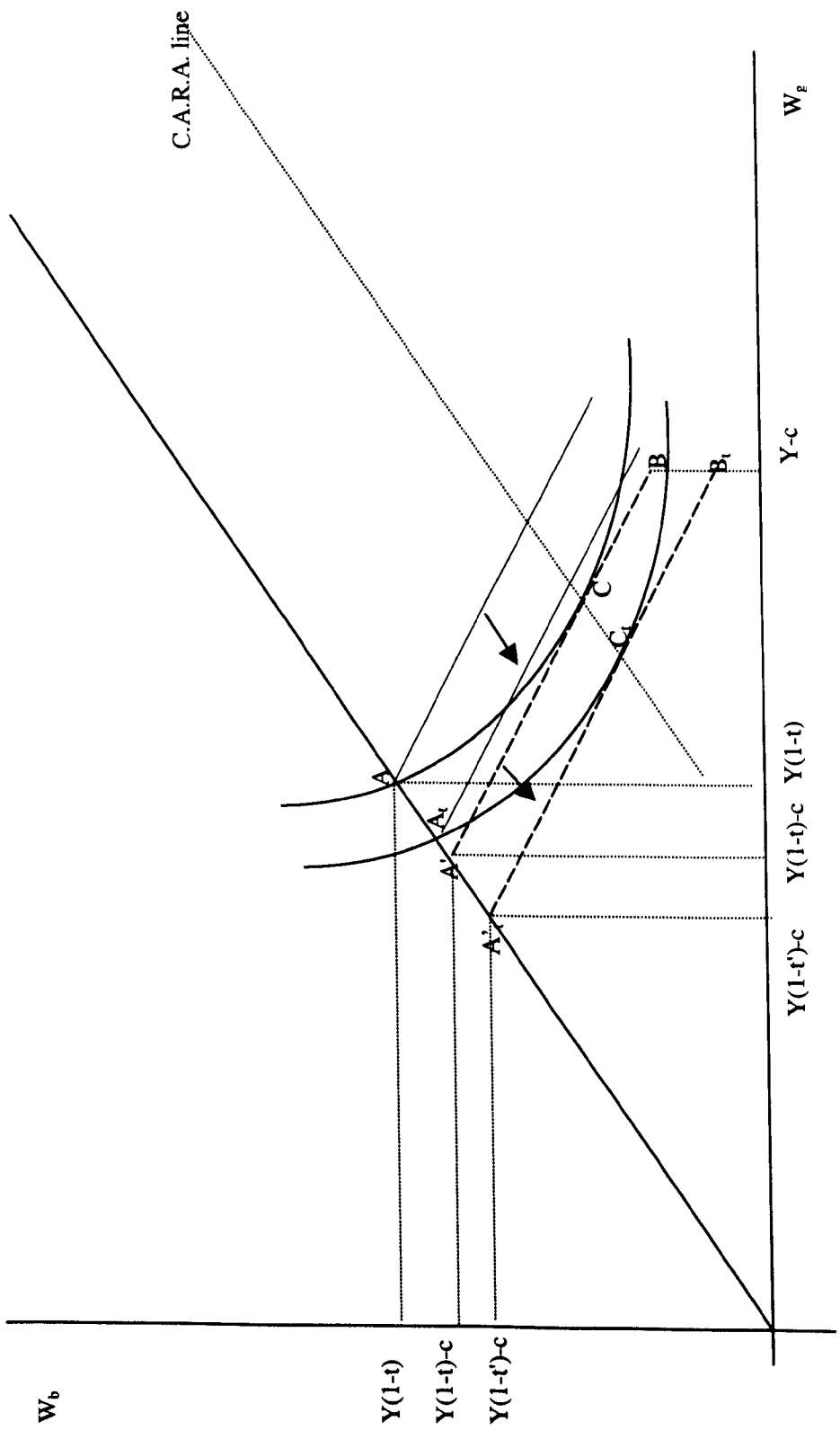
Figure 4.1

Figure 4.2

229

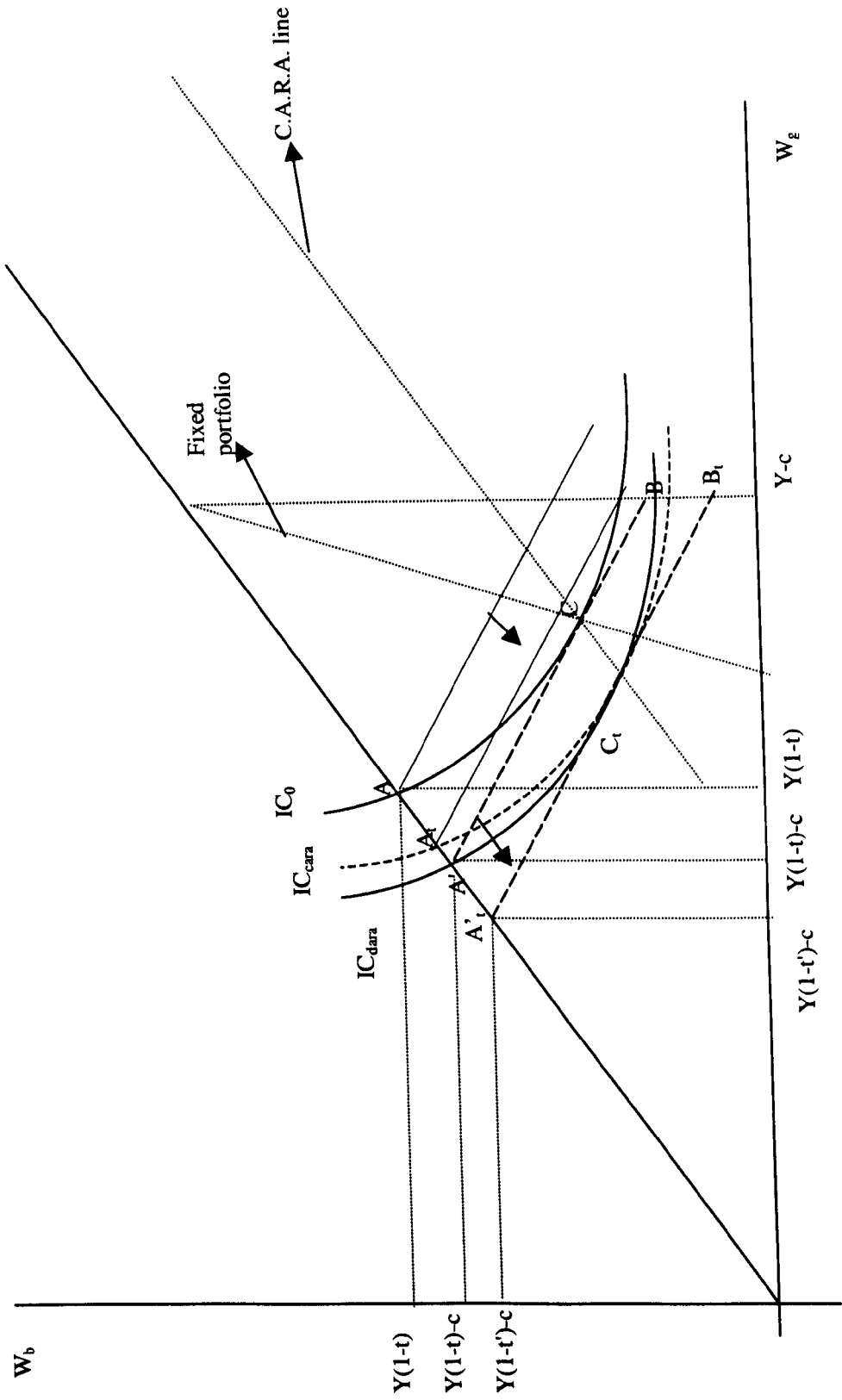Figure 4.3

Figure 4.4

231

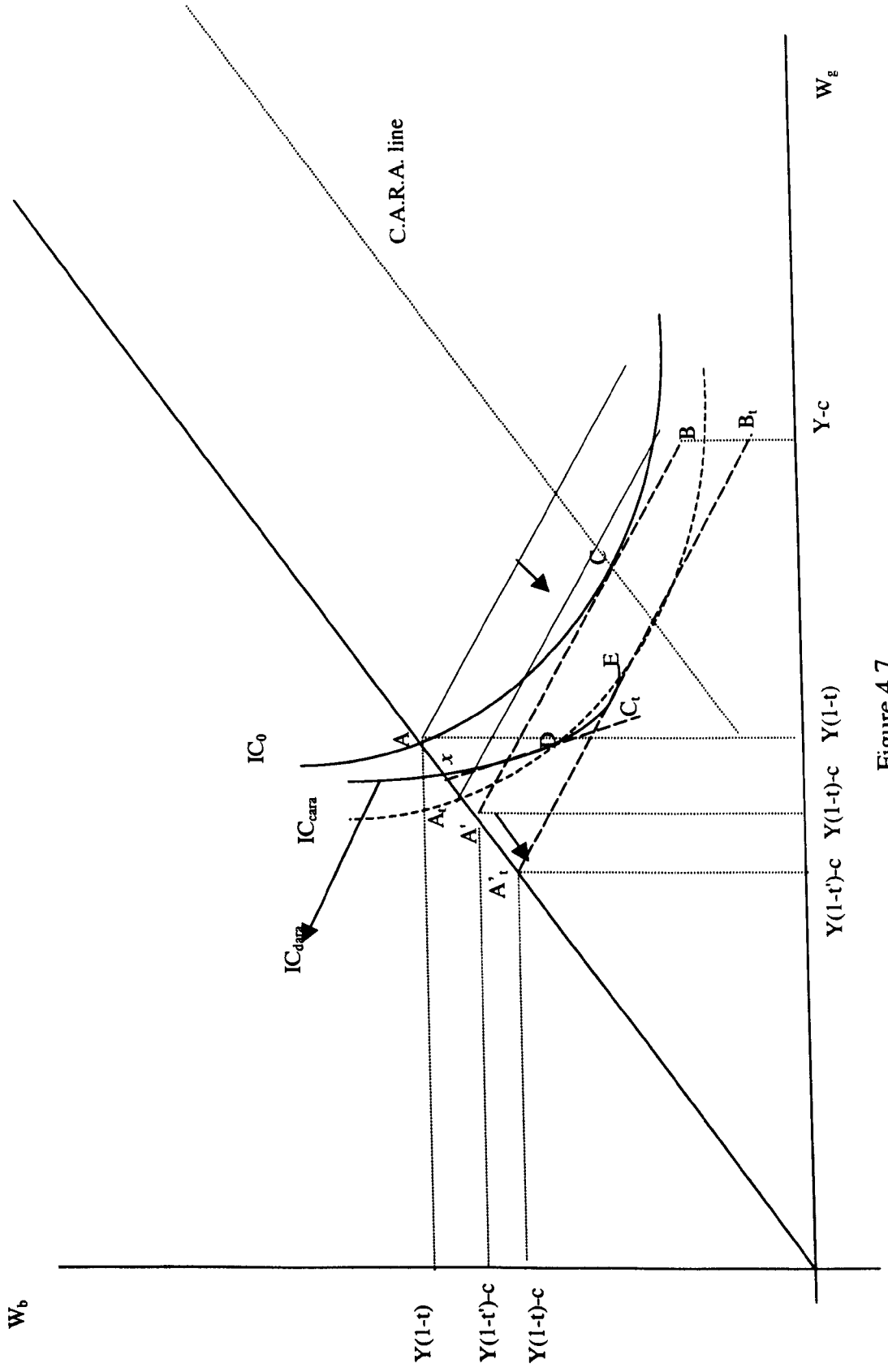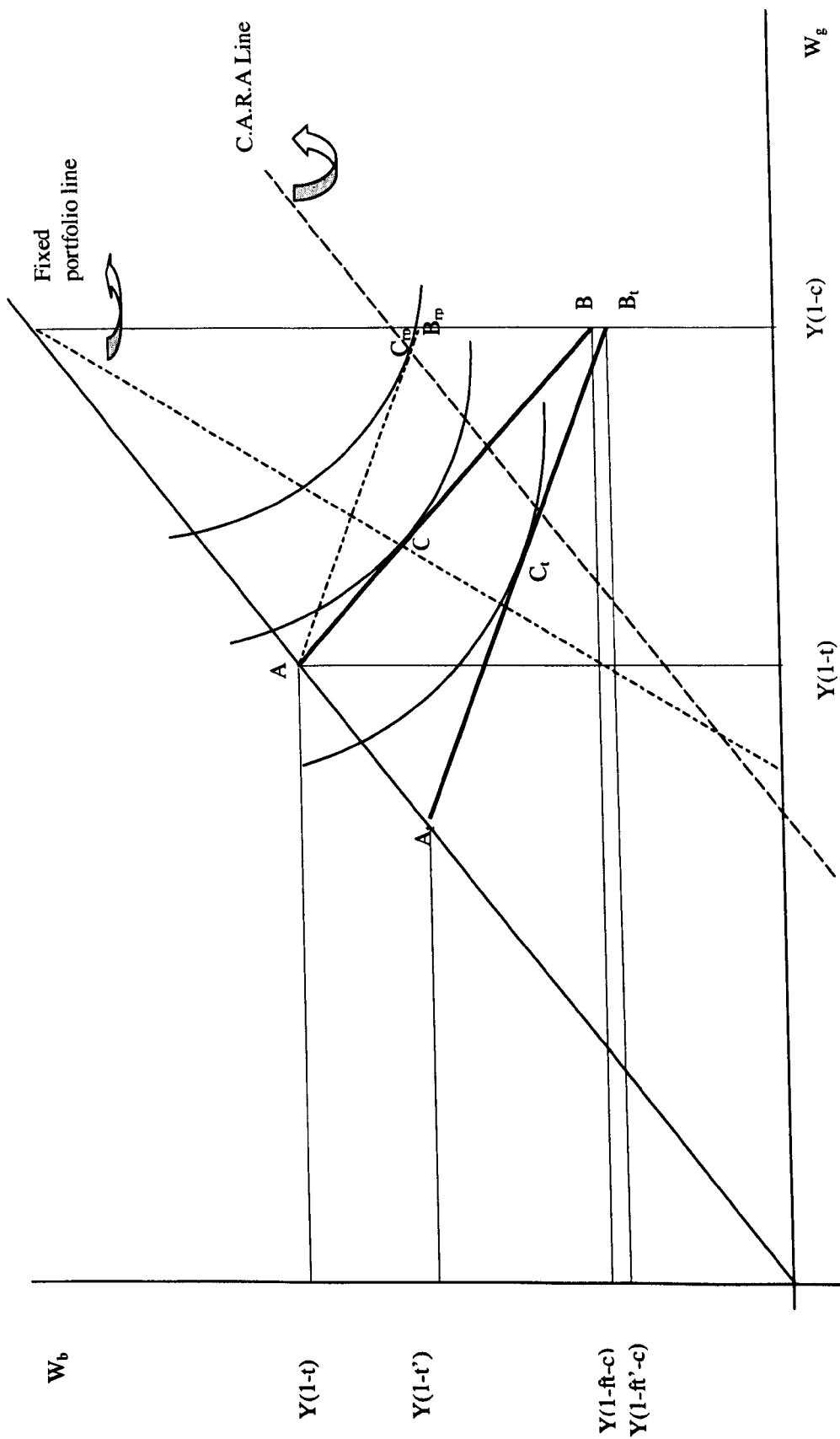Figure 4.5

232

Figure 4.6

233

Figure 4.7

234
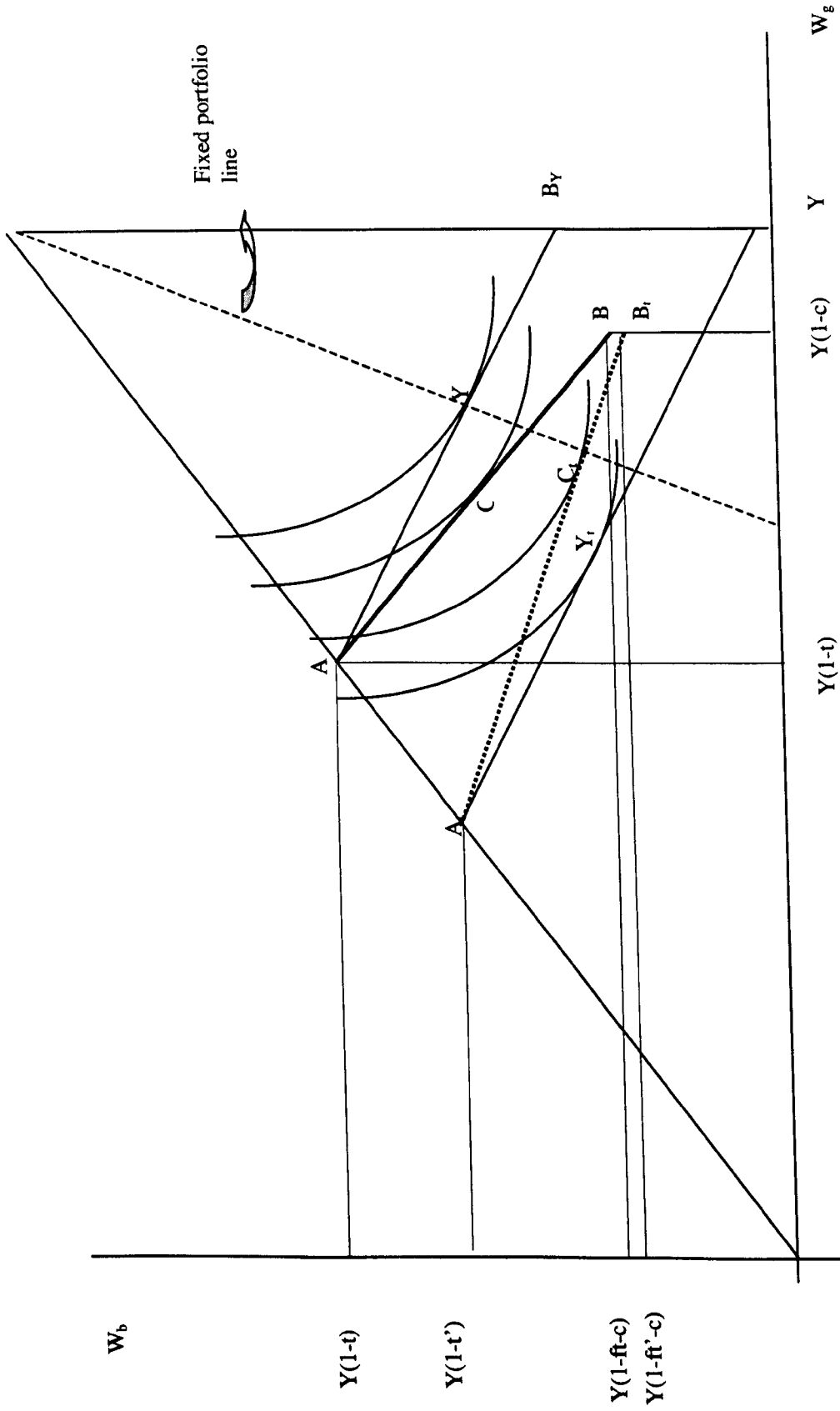
Figure 4.8

Figure 4.9

Figure 4.10

Figure 4.11

238

b)

a)

Figure 4.12

239

$$i = 1$$

D

$$W_b = 0 \Rightarrow i = \frac{-1 + ft + c(x)}{-t + ft + c(x)}$$

$$i$$

1

C

A

B

0

$$x$$

$$\frac{-1 + ft}{-t + ft}$$
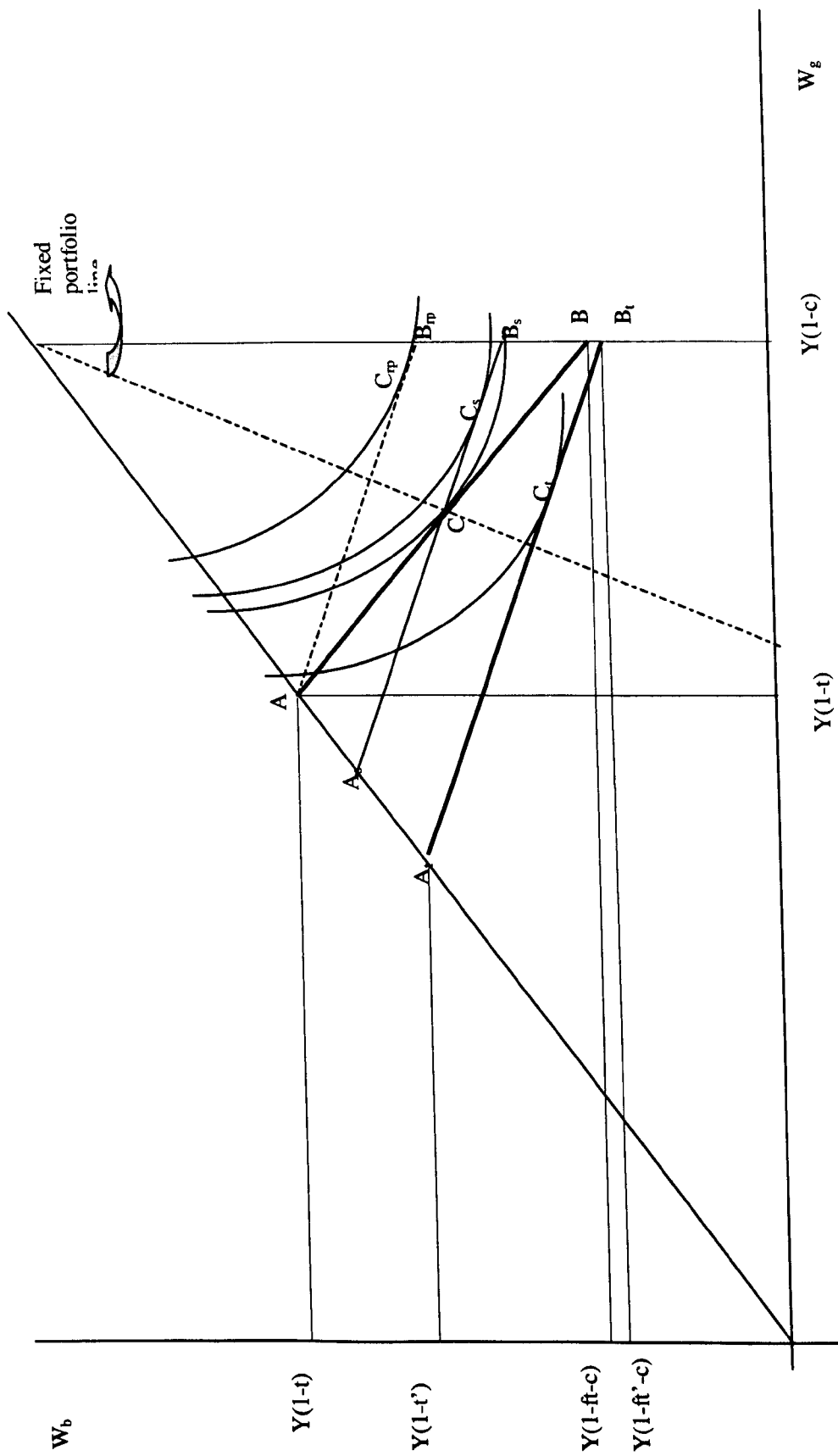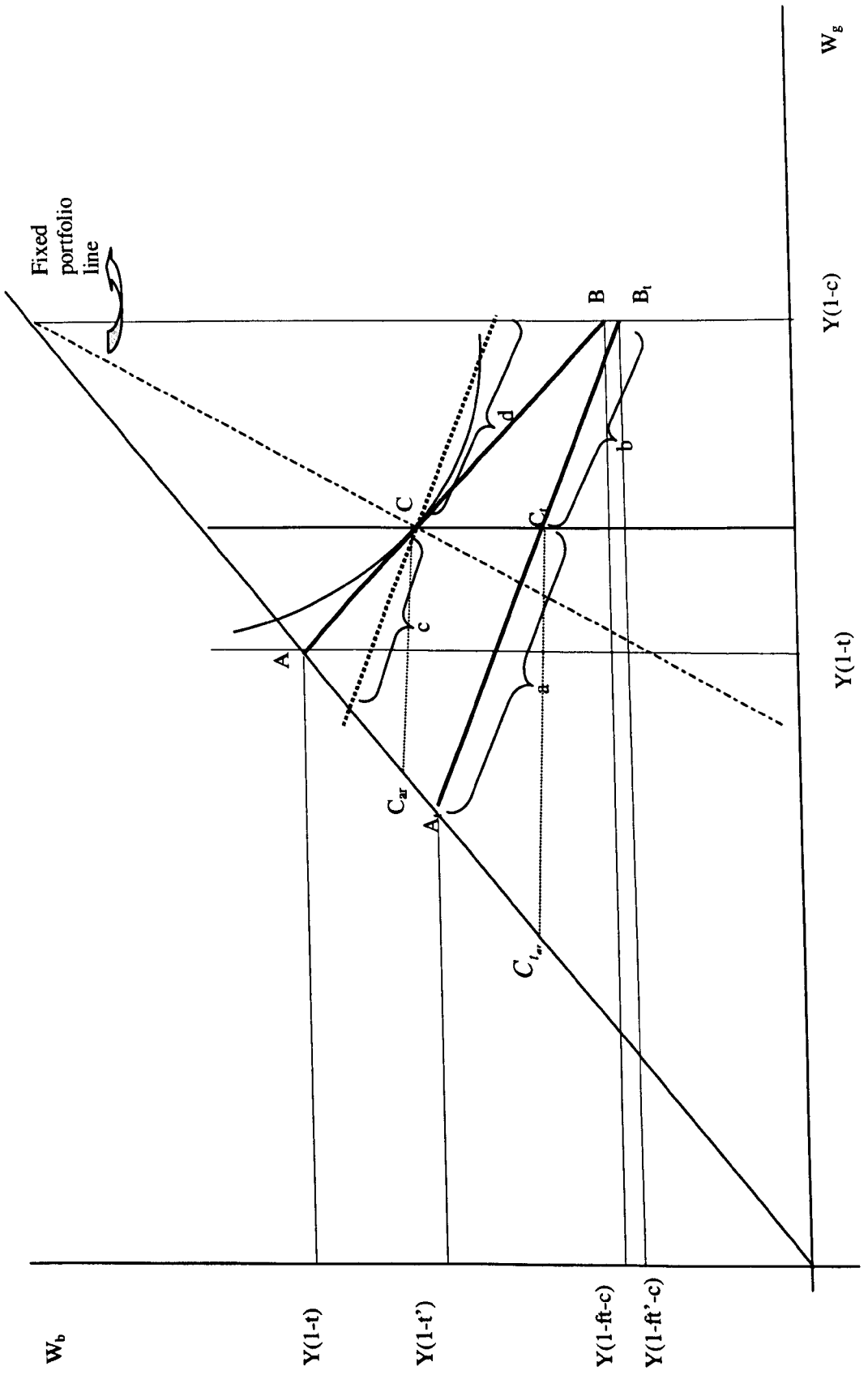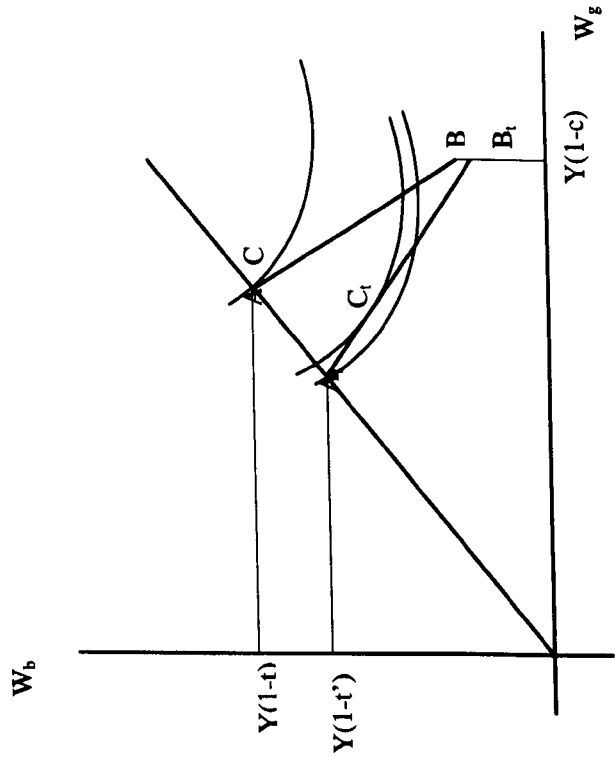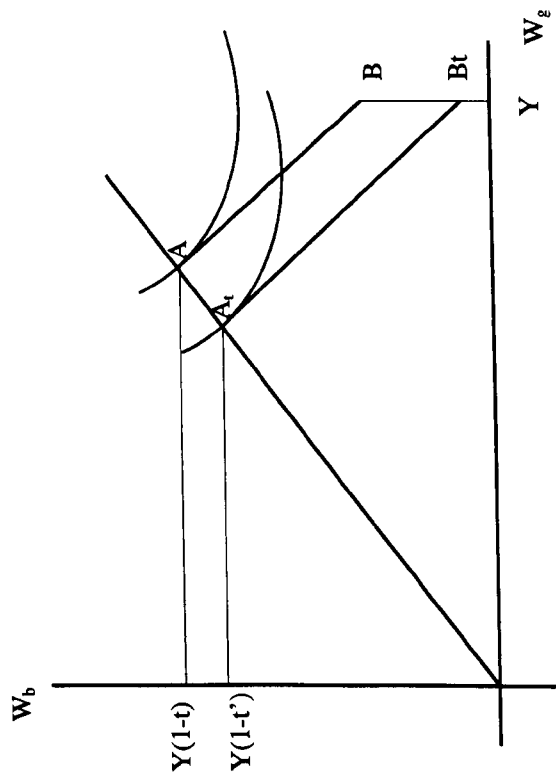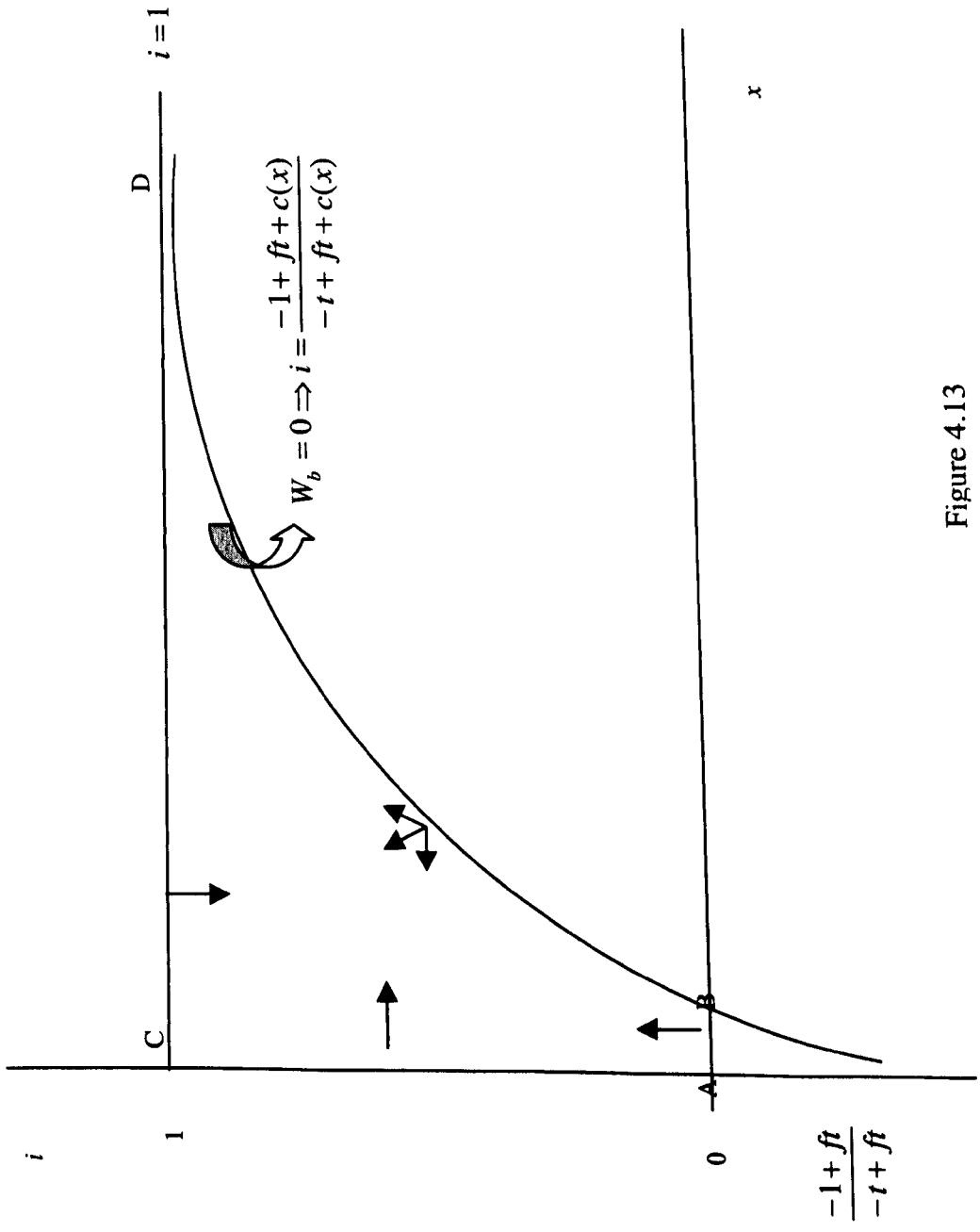
Figure 4.13

Table 4.1

rho	declared income	effort
0.035	0	0.65
0.04	0.09	0.65
0.05	0.25	0.65
0.1	0.58	0.65
0.5	0.91	0.65
0.9	0.95	0.65
1.5	0.97	0.65
2	0.98	0.65
8	0.99	0.65
10	1	
20	1	
100	1	
400	1	

Figure 4.14
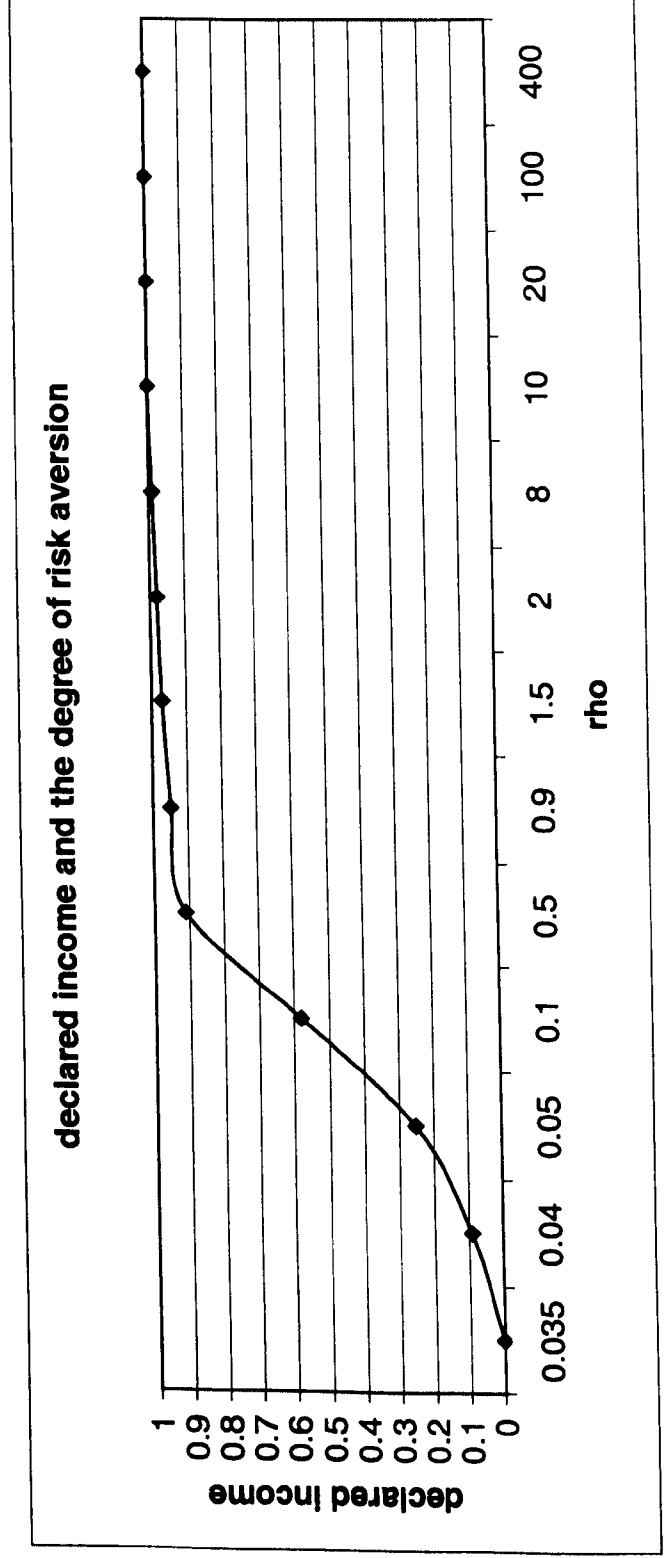
declared income and the degree of risk aversion

Table 4.2

t	i for rho=0.035	i for rho=0.04	i for rho=0.05	i for rho=0.1	i for rho=0.5	i for rho=0.9	i for rho=2	i for rho=8
0.28	0.03	0.13	0.28	0.62	0.92	0.96	0.98	1
0.33	0	0.09	0.23	0.58	0.91	0.95	0.98	0.99
0.35	0	0.08	0.21	0.55	0.9	0.95	0.98	0.99
0.37	0.01	0.08	0.19	0.53	0.9	0.94	0.97	0.99
0.4	0.05	0.1	0.19	0.49	0.88	0.93	0.97	0.99
0.41	0.07	0.12	0.19	0.48	0.88	0.93	0.97	0.99
0.42	0.09	0.12	0.2	0.48	0.88	0.93	0.97	0.99

Figure 4.15

Tax rate and declared income for different rho

Legend:
- rho=0.035
- rho=0.04
- rho=0.05
- rho=0.9
- rho=2
- rho=8
- i for rho=0.1
- i for rho=0.5

x-axis: tax rate (0.25, 0.27, 0.29, 0.31, 0.33, 0.35, 0.37, 0.39, 0.41, 0.43, 0.45)

y-axis: declared income (0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1)

Figure 4.16

Tax rate, effort and declared income for rho=0.04
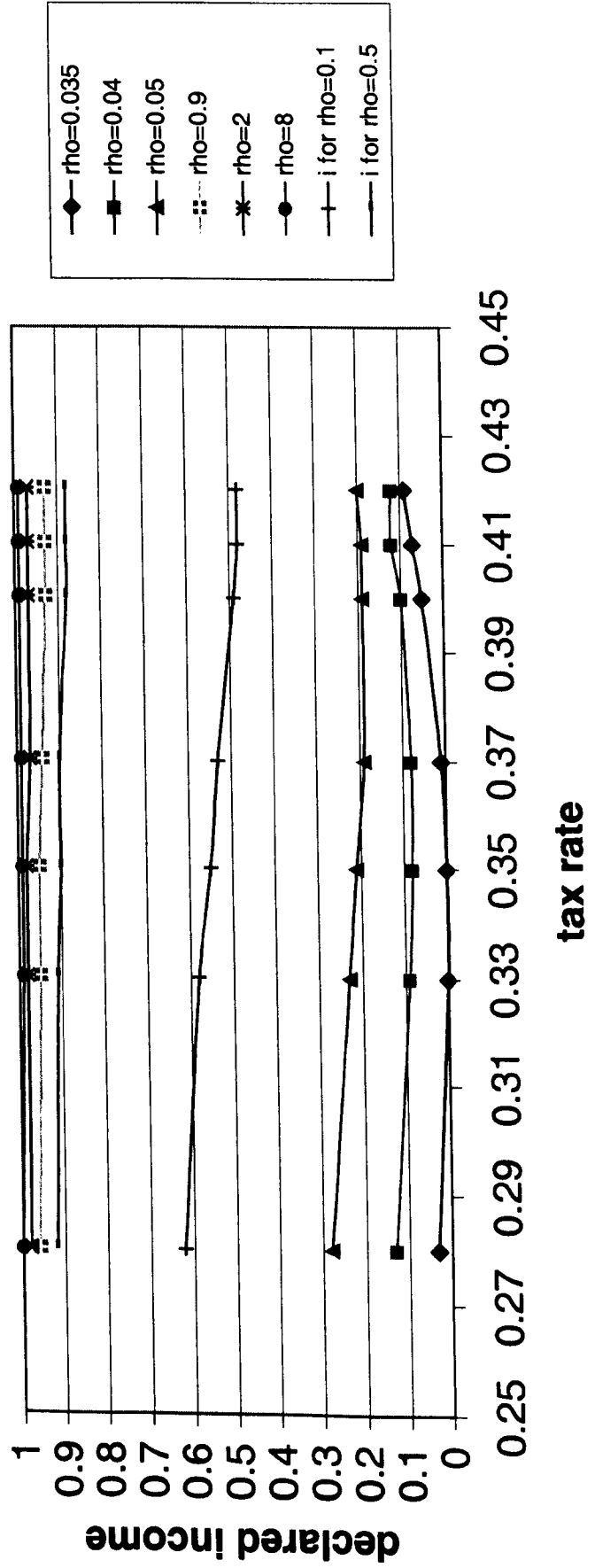
rho=0.04		
tax rate	effort	decl. inc.
0.28	0.35	0.13
0.33	0.65	0.09
0.35	0.8	0.08
0.37	1	0.08
0.4	1.35	0.1
0.41	1.5	0.12
0.42	1.29	0.12

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Figure 4.17

Tax rate, effort and declared income for rho=0.1
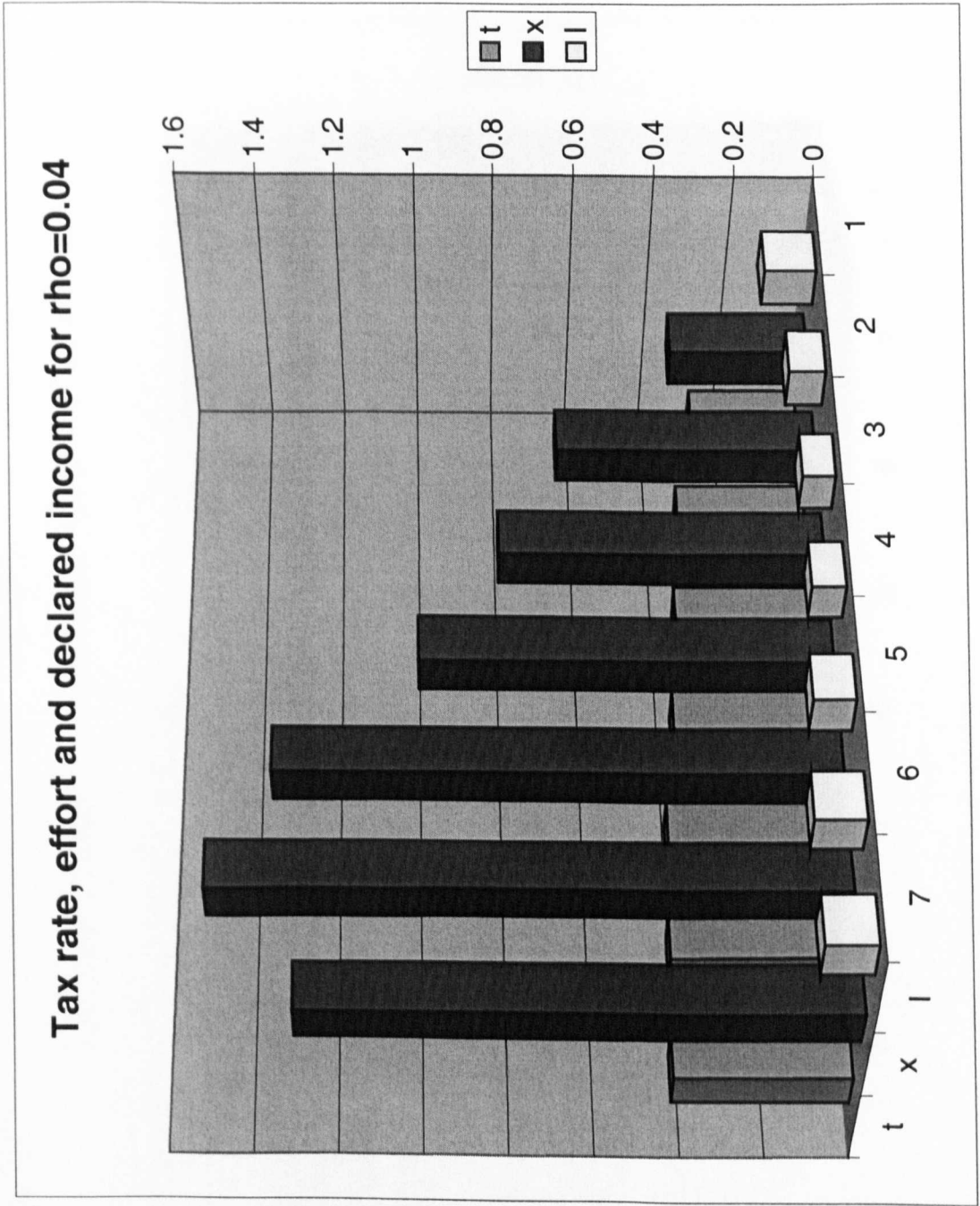
rho=0.1

tax rate	effort	decl. inc.
0.28	0.35	0.62
0.33	0.65	0.58
0.35	0.8	0.55
0.37	1	0.53
0.4	1.4	0.49
0.41	1.55	0.48
0.42	1.29	0.48

Figure 4.18

Tax rate, effort and declared income for rho=8
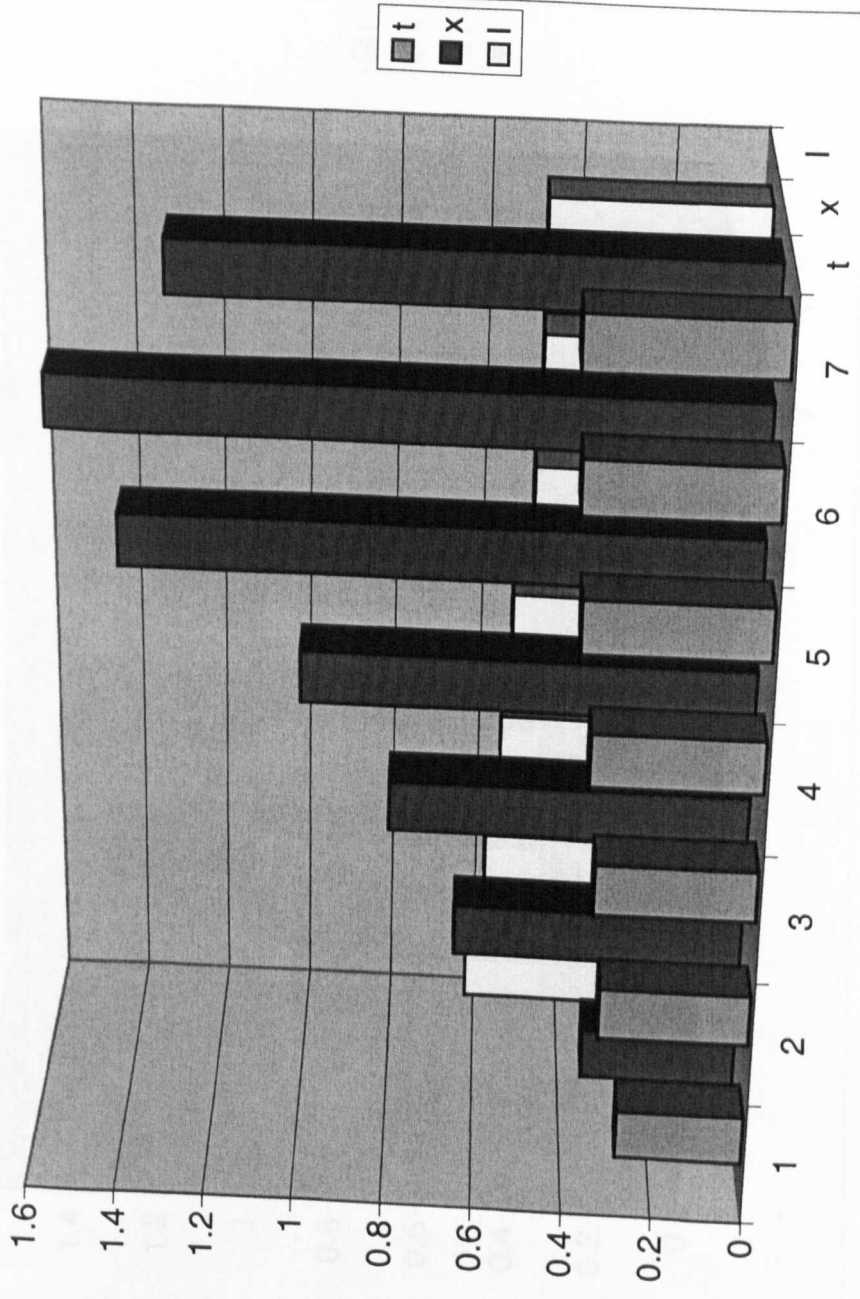
rho=8	tax rate	effort	decl. inc.
	0.28	0	1
	0.33	0.65	0.99
	0.35	0.85	0.99
	0.37	1.05	0.99
	0.4	1.45	0.99
	0.41	1.6	0.99
	0.42	1.29	0.99
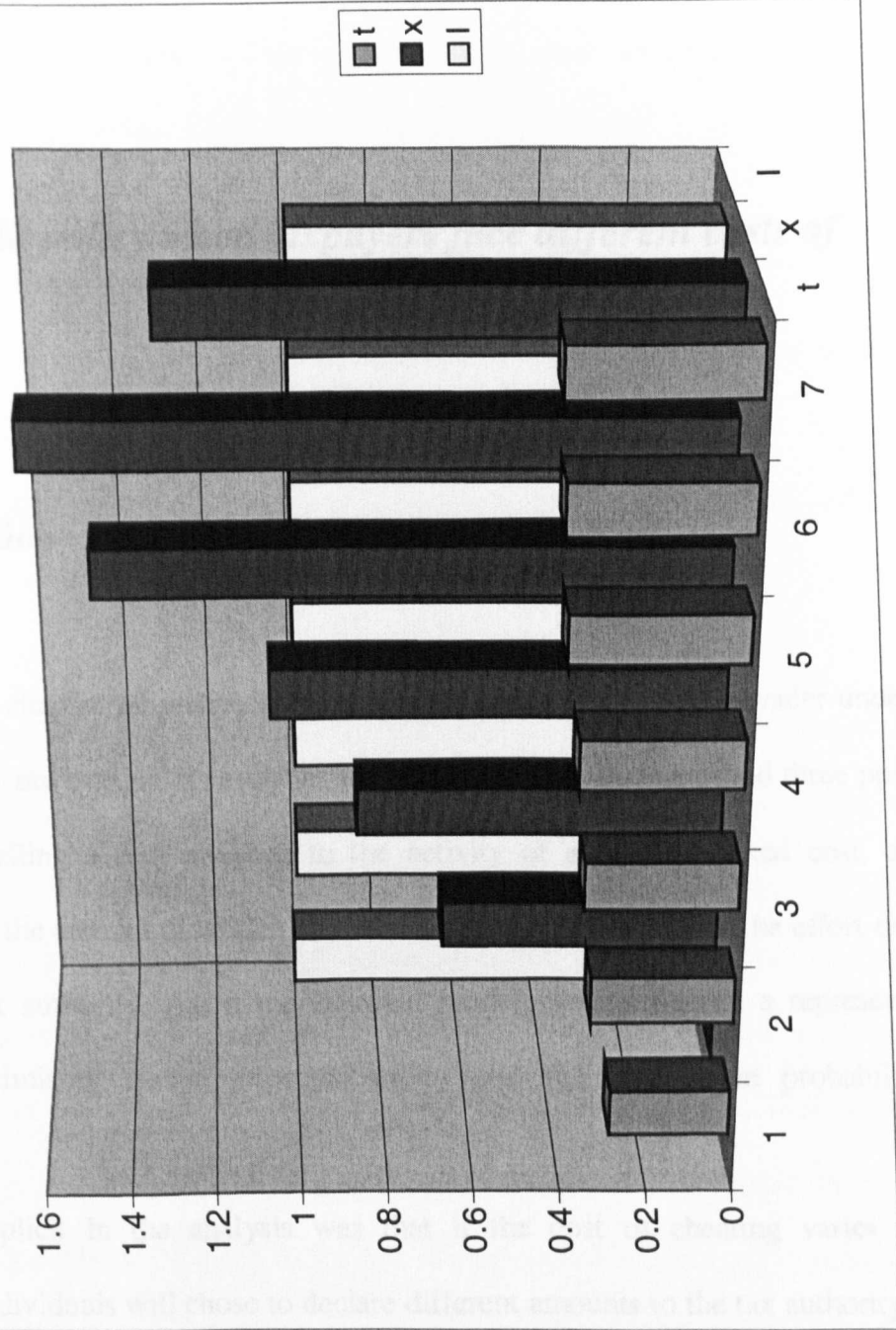
Chapter 5

Optimal audit policy when taxpayers face different costs of evasion.

5.1 Introduction

In the previous chapter we analysed the choice of a representative tax evader under the assumption that tax evasion is costly for the individual. We distinguished three possible cases for modelling a cost attached to the activity of evasion: a fixed cost, a cost proportional to the amount of hidden income and a cost determined by the effort exerted to fool the tax authority. As in the standard model, we considered a representative taxpayer, maximising his/her expected utility and facing a given probability of detection.

An aspect implicit in the analysis was that if the cost of cheating varies across individuals, individuals will chose to declare different amounts to the tax authority, even if they have the same gross income. Hence different costs for hiding one's income imply different opportunities to evade, the idea being that individuals who have to incur higher costs for hiding their income have less opportunities to evade. In this chapter we pursue this idea and shall analyse how different opportunities to evade influence the optimal audit policy of a tax enforcement agency, endowed with limited resources for auditing. This is done with a view to finding out if it is optimal for the tax administration to

concentrate on some groups of tax payers, rather than targeting all taxpayers indiscriminately.

Two aspects distinguish our approach from the standard model:

- we allow for different opportunities to evade, modelled in terms of different costs to be incurred in case of evasion;

- the behaviour of the tax administration is endogenous, that is the probability of audit is endogenous.

Our work is related to the literature on optimal enforcement policy. In particular, we should cite the Reinganum and Wilde (1991) model which analyses the linkage of tax payers' use of tax practitioners, non-compliance and the audit policy. In their model a taxpayer can choose to prepare his own tax return or use a tax practitioner. In case of a self-declaration, the tax payer has to incur a (fixed) cost for filing his/her tax return and also a (fixed) cost for dealing with the tax authority in case of an audit. The use of a tax practitioner eliminates the cost for filing and being engaged in enforcement proceedings but requires the payment of a fee to the tax practitioner. The tax agency decides how much enforcement effort to devote to a given return, with the objective to maximise net total revenue. This decision may be contingent on whether the return has been filed by the tax payer or the tax practitioner. The authors show that, if the objective of the tax agency is to maximise net revenue, the use of tax practitioners results in greater efforts at detection by the tax agency, and the level of compliance and the expected revenue to the tax agency vary with the parameters of the model.

There are two similarities with our model:

- the budget constraint for the taxpayer is affected by a fixed cost. In our case the fixed cost is intrinsic in the activity of concealing one's income. In Reinganum-Wilde the cost is intrinsic in filing the tax returns and in dealing with the tax authority in case of detection.

- The tax agency selects the optimal audit policy taking as given the tax and the fine rate.

The aspect which distinguishes our approach from Reinganum and Wilde analysis is that we are interested in the role of different opportunities to evade in determining the audit policy, whereas they are interested in the interactions between tax payers and tax practitioners on the audit policy and on compliance. We model individuals with different costs for evading, whereas they model only one type of tax payers, with the same costs.

In line with Graetz et al. (1986) and Cremer et al. (1990) we make a distinction between the enforcement agency, setting the auditing strategy, and the tax authorities, setting the tax and the fine rate. This with the view that they differ in objectives, instruments and hierarchy. As in Graetz et al. we take the tax and the fine rate as exogenously given and focus on the optimal audit policy of the tax enforcement agency. In their model the optimal audit policy is a function of reported income: taxpayers reports their income and on the basis of their report the enforcement agency decides whether or not to perform an audit. There is no need for pre-commitment in that tax payers move together with the tax enforcement agency. The tax administration sets the probability of an audit based on a cut-off-rule: those who report above the cut-off level are not audited. A similar strategy

is adopted in Cremer et al. although their model presents some differences. They analyse the optimal tax regime and the optimal audit policy and hence endogenise the behaviour of the Government, who sets the optimal income tax to maximise social welfare, given the reaction of tax payers and the tax administration. A key feature of their model is that the tax payers move after the tax enforcement agency and it is assumed that the tax enforcement agency can credibly commit to an ex ante optimal policy. We adopt the same timing and make the same assumption of the tax enforcement agency being able to commit to an ex ante optimal policy.

In Graetz et al. (1986) and Cremer et al. (1990) the objective of the tax enforcement agency is assumed to be the maximisation of total net revenue. In our case we assume that the objective of the tax enforcement agency is to minimise total expected evasion. This assumption is similar to Greenberg (1984), where the goal of the tax authorities is to minimise the number of tax evaders. Greenberg analyses a repeated game in which tax payers selects their best strategies in response to the audit policy. The tax authority has limited resources to devote to investigate tax payers, and it is assumed that only a maximum fraction of the population can be audited in each time-period.

In what follows, we model the assumption that the tax enforcement agency has limited resources for auditing in the same way as Greenberg: there is a maximum number of tax returns which can be audited by the tax enforcement agency.

We organise our exposition as follows: in section 5.2 we present the assumptions we make about the behaviour of the tax payers, and derive their optimal choice as a function of the probability of being audited. In section 5.3 we discuss the assumptions about the

behaviour of the tax enforcement agency and formalise its program. In section 5.4 we

derive the optimal audit policy and the optimal response by the tax payers.

5.2 Taxpayers' behaviour.

We model a population of two types of taxpayers with different opportunities to evade.

In particular, we assume that the population, normalised to 1, is equally shared between

two types of individuals, C and N. Type C individuals incur a monetary cost $c > 0$ if

they decide to evade. We model the cost as a fixed cost, to be borne irrespective of the

amount of evaded income. In line with the analysis in chapter 4, we can think of it in

terms of a licence to evade. Type N individuals do not incur any cost for evasion: they

have greater opportunities to evade than type C individuals.

Both types have the same gross income Y and the same Von Neumann-Morgenstern

utility function. We assume individuals have constant absolute risk aversion, so that the

utility function can be represented by:

$$U(y) = -e^{-ay}$$

Individuals are expected utility maximisers and choose the optimal amount of evasion

E^*, given that they have to pay a tax rate t on declared income and with probability p

(which may differ from one type to another) are investigated and end up paying a fine

$f > 1$[1], applied on evaded tax, ftE. As in the standard model the audit is 100%

successful, in that if audited a tax evader is always detected.

5.2.1 Type N taxpayers (zero evasion cost)

We can represent the choice for a type N agent as follows:

$$\max_{E} EU_N = (1-p)(-e^{-aW_s}) + p(-e^{-aW_b})$$

(1)

s.t.

$$W_g = (1-t)Y + tE$$

$$W_b = (1-t)Y - (f-1)tE$$

From the first order conditions we express the optimal amount of evasion for type N

taxpayers as a function of the probability of detection $E_N^*(p)$:

If $p \geq \dfrac{1}{f}$, then the optimal choice is zero evasion[2], i.e. $E_N^*(p) = 0$

If $p < \dfrac{1}{f}$, the optimal choice is to evade $E_N^*(p) = \tilde{E}(p) = \dfrac{1}{aft} \ln\left(\dfrac{1-p}{p(f-1)}\right)$.

---

[1] This is the standard requirement: if the fine rate is lower than 1, agents always have incentives to evade an infinite amount.

[2] This is because, when $p \geq \dfrac{1}{f}$, then $\dfrac{\delta Eu}{\delta E}\bigg|_{E=0} < 0$.

Hence a type N taxpayer evades as long as the probability of being audited is less than

$\frac{1}{f}$, and evades an amount equal to $E_N^*(p) = \tilde{E}(p)$ when he/she faces a greater

probability.

We should note that here, for formal reasons, we make the assumption that the amount

of evasion can be greater than actual income. In practice individuals or firms can evade

more than their gross income. One example could be a self-employed who inflates or

double claims his/her expenses to lower the tax bill. Another example could be a

company who overestimates its losses to pay less corporate tax or even get tax credits

for the forthcoming years.

Restricting our attention to cases where evasion is lower or equal to actual income

would complicate our analysis without altering our results. This assumption is only for

the sake of clarity of our exposition, in that even in this model the probability below

which an individual would evade more than his/her income is so low that it is not going

to be an issue[3].

---

[3] Evading more than actual income would only be a marginal case: it would be optimal when $p < \underline{p}$, with

$\underline{p} = \frac{1}{1 + (f-1)e^{atY}}$. This is the value of p for which $\left. \frac{\delta Eu}{\delta E} \right|_{E=Y} = 0$. If $p = \underline{p}$, the optimal choice is full

evasion, i.e. $E_N^*(p) = Y$. If $p < \underline{p}$, the optimal choice is $E_N^*(p) > Y$, i.e. the individual evades more than

his/her gross income. For reasonable values of the parameters $\underline{p}$ is very small, close to zero.

In fact, for any $\varepsilon > 0$ and any given $f > 1$, we have: $\underline{p} \leq \varepsilon \Leftrightarrow atY \geq \frac{1}{f} \ln\left(\frac{1-\varepsilon}{\varepsilon(f-1)} \right)$. For example, for

$f=1.5$ we have $\underline{p} \leq 0.001 \Leftrightarrow atY \geq 5.06$. Hence if we assume that income is large enough, $\underline{p}$ is

sufficiently close to zero.

The function $\tilde{E}(p)$ is strictly decreasing in p, strictly convex for any $p < \dfrac{1}{2}$ and strictly

concave for $p > \dfrac{1}{2}$. We show evasion patterns for type N taxpayers in figure 5.1a). If

$f \geq 2$, then $\dfrac{1}{f} \leq \dfrac{1}{2}$ and $p < \dfrac{1}{2}$, so that optimal evasion is a decreasing and strictly

convex function. If $f < 2$, then $\dfrac{1}{f} > \dfrac{1}{2}$ and optimal evasion is decreasing and strictly

convex for $p < \dfrac{1}{2}$ and strictly concave for $p > \dfrac{1}{2}$.

5.2.2 Type C taxpayers (positive evasion cost).

Type C agents have to incur a cost in case of evasion. Their choice can be represented

by:

$$\max_{E} EU_C = (1-p)(-e^{-aW_g}) + p(-e^{-aW_b})$$

$$s.t.$$

$$W_g = (1-t)Y + tE - c \tag{2}$$

$$W_b = (1-t)Y - (f-1)tE - c \qquad \text{for } 0 < E \leq Y$$

$$W_g = W_b = (1-t)Y \qquad \text{for } E = 0$$

As we already considered in chapter 4, when there is a fixed cost to be incurred in case

of evasion there is a discontinuity in the budget constraint. The zero evasion point lies

on the 45° line, but when the individual decides to evade there is a jump, in that income in both states of the world decreases by the amount of the cost.

We illustrate the budget constraint for type N and C individuals in figure 5.2. The budget constraint for type N individuals is the line AB. Type N individuals can choose any point along AB and if their preferences are represented by the indifference curve IC_N, the optimal choice will be a positive amount of evasion, point E in figure 5.2. For type C agents the zero evasion point is the same as for type N individuals, point A, but in case of evasion, income in both states of the world will decrease by c. The budget constraint consists of point A and any point along the segment $A'B'$ excluding A'. The optimal choice for type C will be not to evade as they are indifferent between evasion and non evasion. In fact the zero evasion point (A) lies on the same indifference curve as the optimal under-declaration point (E').

For type C individuals the condition for evasion is more restrictive. This means that it is easier to induce them not to evade, in that the probability above which they will not evade is smaller than for the N types.

In deciding whether or not to evade type C individuals compare the expected utility from evading:

$$U_C(E_C^*(p)) = (1-p)(-e^{-a[(1-t)Y + tE^* - c]}) + p(-e^{-a[(1-t)Y - (f-1)tE^* - c]}) = e^{ac}U_N\left(E_N^*(p)\right) \tag{3}$$

with the utility from a truthful declaration:

$$U((1-t)Y) \tag{4}$$

and will decide to evade whenever:

$$e^{ac}U_N(E_N^*(p)) > U((1-t)Y) \Leftrightarrow U_N(E_N^*(p)) > e^{ac}U((1-t)Y) \tag{5}$$

It is worth noticing that, under the CARA assumption:

$$EU_C(E_C^*(p)) = e^{ac}EU_N(E_N^*(p)) \tag{6}$$

and when both types of agents decide to evade , they will evade the same amount, if they face the same probability of detection.

It is easy to show that an increase in the probability of audit induces less evasion. $U_N(E_N^*(p))$ is therefore a decreasing function of p. For any cost c, there exists a unique probability $\overline{p}_C(c)$ such that

$$EU_N(E_N^*(\overline{p}_C(c))) = e^{ac}U((1-t)Y) \tag{7}$$

and this probability is a strictly decreasing function of the cost of evasion c, such that

$$\overline{p}_C(0) = \frac{1}{f} \text{ and } \lim_{c \to \infty} \overline{p}_C(c) = 0 \tag{8}$$

A taxpayer of type C evades only when the probability of audit is lower than $\overline{p}_C(c)$.

Hence, for any cost $c > 0$, there exists a critical value $\bar{p}_C(c) < \dfrac{1}{f}$, above which a type C

individual decides not to evade. For any probability of detection p lower than this

threshold, a type C agent chooses to evade $E_C^*(p) = \tilde{E}(p) = \dfrac{1}{aft} \ln\left(\dfrac{1-p}{p(f-1)} \right)$.

Type C agents can therefore be characterised by this threshold $\bar{p}_C(c)$ rather than by the

monetary cost.

We represent the optimal evasion for type C individuals in figure 5.1b). In this case

evasion is a discontinuous function of p: above $\bar{p}_C(c)$ there will be a jump in the amount

of evasion from a positive value to zero. This is because above $\bar{p}_C(c)$, the expected

gain from optimal evasion no longer covers the fixed cost that has to be incurred. The

higher the cost the lower the value of $\bar{p}_C(c)$ (the more distant $\bar{p}_C$ from $\dfrac{1}{f}$).

5.3 The tax enforcement agency.

As in Cremer et al. (1990), we make the distinction between the tax authorities (the

government) and the tax administration (enforcement agency). The tax authorities

decide upon the tax and the fine rates, whereas the enforcement agency sets the

probability of detection. In this model we take the behaviour of the government as

exogenously given: the tax rate and the fine rate are determined by the government, and

are taken as given by the taxpayers and the tax enforcement agency. There is no

interaction between the government and the tax enforcement agency.

We assume that the tax services are endowed with a limited budget (M) to audit tax forms. These services can costlessly determine the type of individual (N or C) with which they are dealing, but they cannot observe whether they have cheated or not without performing an audit. To do so the tax inspection services have to spend money and investigate the case. If they decide to investigate, they find out if the agent has evaded and the amount of evasion, i.e. the audit is 100% successful[4].

Given the limited budget M, the tax enforcement agency can investigate only a proportion n of the total population.

In line with Greenberg (1982), we assume that the objective of the tax services is to minimise the amount of evasion. An alternative objective for the tax enforcement agency, which has been assumed in most of the literature on the optimal audit policy, could be maximising total revenues. As pointed out by Cremer et al. (1990), the choice of the objective function for the tax enforcement agency affects the optimal enforcement policy. However, establishing which objective function is the most realistic is an empirical question.

In the light of the evidence suggested by US data we presented in chapter 1, according to which penalties are quite infrequently imposed, we could argue that, with the tax rate fixed and minimal revenue from fines, minimising the monetary value of evasion is probably equivalent to maximising total revenue in practice.

---

[4] This is not a critical assumption in that imperfect auditing could be taken into account. If taxpayers are audited with probability π and then caught with probability p_s, then this situation is equivalent to ours, with $p = \pi p_s$.

Our assumption that the objective of the tax enforcement agency is to minimise the amount of evasion does not seem too unrealistic also if we consider the recommendation in the Grabiner report[5], on the importance to improve the rate of detection for offenders and implement a more effective approach to tackling non-compliance[6].

In any case, however, even if we choose maximising total revenues as the objective function, our results would not be qualitatively modified.

We analyse the following game:

1) the tax enforcement agency allocates the budget between the two populations, i.e. sets (p_N, p_C), as in (9).

2) Each type of individuals decides the amount of evasion, according to (1) and (2).

3) The audit takes place, according to the policy set at the first stage.

---

[5] The Informal Economy, A report by Lord Grabiner QC, March 2000.

[6] In particular, given that the hidden economy has an impact on the activities of a number of Government Departments, such as the Inland Revenue, Custom & Excise, the Department of Social Security and the Department of Education and Employment, those Departments should co-ordinate and improve their investigations. This suggestions is welcome in the Departmental Report 2000[HM Custom & Excise Departmental Report, 2000] of the Custom & Excise. As the document states: "...The Department is developing a series of strategic partnerships with other departments and agencies with the aim of providing improved services. An important part of this work is the Closer Working Programme with the Inland Revenue." One performance indicator for the effectiveness of the Programme is the number of major excise smuggling organisations disrupted or dismantled.

As in Cremer et al. (1990), we assume that the tax enforcement agency can credibly commit to apply its announced policy, so that there is no time inconsistency. This does not seem too unrealistic, in that applying the announced policy is the only way for the tax enforcement agency to keep their reputation, and hence to be able to implement any enforcement strategy.

The objective of the tax inspection services is to allocate the investigations n between the two types of agents, in order to minimise expected evasion. Allocating this budget is equivalent to setting the two probabilities of audit (p_N, p_C) with the constraint that there are limited resources to devote to auditing.

Given a budget M and a cost for auditing a tax return, γ, which we assume to be the same for each type of tax payers, the maximum number of investigations that the enforcement agency can carry out is:

$$n = \frac{M}{\gamma} \qquad (9)$$

The tax enforcement agency will choose how many tax returns of the C type agents (n_C) and how many tax returns of the N type agents (n_N) to audit out of these n. Hence the budget constraint can be expressed as:

$$n_C + n_N = n \qquad (10)$$

Given that the population is equally distributed between the two types and is normalised to 1 ($P = 1$), the probability of auditing a tax return of a type C individual will be:

$$p_C = \frac{n_C}{1/2P} = 2n_C \qquad (11)$$

and for type N individuals:

$$p_N = \frac{n_N}{1/2P} = 2n_N \qquad (12)$$

The budget constraint as in (10) can be written in terms of probabilities:

$$\frac{1}{2}p_C + \frac{1}{2}p_N = n \qquad (13)$$

Formally, the program of the enforcement agency is:

$$\min_{p_N, p_C} E_N^*(p_N) + E_C^*(p_C) \qquad (14)$$
$$s.t. \quad p_N + p_C = 2n$$

We can now assume that $2n \le \overline{p}_C + \dfrac{1}{f}$, i.e. $n \le \dfrac{1}{2}(\overline{p}_C + \dfrac{1}{f})$, otherwise the tax authority

simply sets $p_C \ge \overline{p}_C$ and $p_N \ge \dfrac{1}{f}$ and expected evasion is zero.

5.4 The optimal audit policy.

The optimal audit policy consists of a combination of (p_N, p_C) such that the total amount of evasion, as determined by equations (1) and (2), is minimised.

More formally, given the objective of the enforcement agency (14), the optimal solution can be written as:

$$p_C^* = \arg\min_{0 \leq p_C \leq 2n} E_C^*(p_C) + E_C^*(2n - p_C) \tag{15}$$

where $E_C^*(p_C) = \tilde{E}(p)$ if $p < \overline{p}_C$ and zero otherwise, and $E_N^*(p_N) = \tilde{E}(p)$ if $p \leq \dfrac{1}{f}$ and zero otherwise.

We distinguish three cases: $f \geq 2 \Leftrightarrow \left(\overline{p}_C, \dfrac{1}{f}\right) \leq \dfrac{1}{2}$, $f \leq 2 \Leftrightarrow \dfrac{1}{f} \geq \dfrac{1}{2}$ and $\overline{p}_C \geq \dfrac{1}{2}$, and $f \leq 2$ and $\overline{p}_C \leq \dfrac{1}{2}$.

5.4.1 The optimal audit policy when $f \geq 2$.

We first analyse the case for $f \geq 2$ and refer to figure 5.3. We can divide the space (p_N, p_C) in 3 zones, where we can analyse the behaviour of each type of agent and the tax enforcement agency.

We should first notice that at $p_C = \overline{p}_C$ there is a discontinuity in the pattern of total expected evasion, in that just below $\overline{p}_C$, i.e. at $\overline{p}_C^-$, type C agents evade a positive amount, but at $\overline{p}_C$ the fixed cost to be incurred for evading outweighs the expected gain and they jump to zero evasion. Hence the bold line at $p_C = \overline{p}_C$.

In section 5.3 we made the assumption that $2n \leq \overline{p}_C + \dfrac{1}{f}$, in order to rule out the possibility that the tax enforcement agency can set the two probabilities such that nobody evades. In terms of figure 5.3 this implies that we do not consider the area above the budget constraint $2n = \dfrac{1}{f} + \overline{p}_C$.

In zone 1 $p_C > \overline{p}_C$ and $p_N \leq \dfrac{1}{f}$.

Type C individuals do not evade whereas type N agents evade a positive amount. An increase in p_C increases expected evasion, as it does not change anything for type C agents, who continue not to evade at all, and increases the amount evaded by type N

agents. Hence the tax enforcement agency wants to move towards $p_C = \overline{p}_C$, as represented by the arrows.

In zone 2 $p_C < \overline{p}_C$ and $p_N \geq \dfrac{1}{f}$.

Type C individuals evade a positive amount, whereas type N agents do not evade. An increase in p_C decreases expected evasion, as it decreases the amount evaded by type C agents. It is therefore never optimal to set $p_N > \dfrac{1}{f}$ and the tax enforcement agency wants to move towards zone 3.

In zone 3 $p_C < \overline{p}_C$ and $p_N < \dfrac{1}{f}$.

We differentiate (14) with respect to p_C and get:

$$\tilde{E}'(p_C) - \tilde{E}'(2n - p_C) = -\frac{2(1-2n)(n-p_C)}{p_C(1-p_C)(2n-p_C)(1-2n+p_C)aft} \tag{16}$$

In this case the tax enforcement agency wants either to go to $p_C = p_N = n$ (for $2n \leq \overline{p}_C$), or to $p_C = \overline{p}_C$ (for $\overline{p}_C \leq 2n \leq 2\overline{p}_C$).

The optimal policy.

The optimal policy depends on the resources available for auditing.

➤ If the budget constraint lies in the area below $2n = \overline{p}_C$, it is optimal for the tax enforcement agency to set $p_N = p_C = n$.

➤ If the budget constraint lies in the area between $2n = 2\overline{p}_C$ and $2n = \dfrac{1}{f} + \overline{p}_C$, the optimal policy will be $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$. In fact the enforcement agency could either set $p_C = \overline{p}_C$ (optimal for zone 1) or just below it (optimal in zone 3). However it would prefer $p_C = \overline{p}_C$, because the C type would jump to zero evasion.

➤ For the area $\overline{p}_C < 2n < 2\overline{p}_C$, the optimal policy could be either $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$ or $p_N = p_C = n$.

The tax enforcement agency will choose the policy which minimises total expected evasion, and hence in order to establish which of these two strategies to choose, we need to compare total expected evasion in the two cases.

At $p_N = p_C = n$ total expected evasion is:

$$E_1 = 2\tilde{E}(n) \tag{17}$$

At $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$ total expected evasion is:

$$E_2 = \tilde{E}(2n - \overline{p}_C) \tag{18}$$

The difference between these two values will determine the optimal audit policy;

$$\Delta(n) = E_1 - E_2 = 2\tilde{E}(n) - \tilde{E}(2n - \overline{p}_C) \tag{19}$$

If (19) is negative the optimal policy will be $p_N = p_C = n$, otherwise it will be optimal

to set $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$.

We note that:

$$\Delta'(n) = 2\tilde{E}'(n) - 2\tilde{E}'(2n - \overline{p_C}) = 2[\tilde{E}'(n) - \tilde{E}'(2n - \overline{p}_C)] \tag{20}$$

In the area we are considering $\overline{p}_C \geq n \Leftrightarrow n \geq 2n - \overline{p}_C$. For the convexity of the total

evasion function, this implies that $\tilde{E}'(n) \geq \tilde{E}'(2n - \overline{p}_C)$ and hence (19) is a monotonic

function.

At the beginning of the interval, i.e. for $n \to \frac{1}{2}\overline{p}_C$, $\Delta(n) \to -\infty$ and the tax enforcement agency will opt for $p_N = p_C = n$.

At the end of the interval, i.e. for $n \to \overline{p}_C$, $\Delta(\overline{p}_C) \to 2\tilde{E}(\overline{p}_C) - \tilde{E}(\overline{p}_C) > 0$ and it will be optimal to set $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$.

Hence, given that (19) is monotonic, *there exists a certain threshold n* for the tax authority's budget above which it will be optimal to set* $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$ *and below which* $p_N = p_C = n$. *For* $f \geq 2$ *this n* will lie in the interval* $\frac{1}{2}\overline{p}_C < n^* < \overline{p}_C$.

5.4.2 The optimal audit policy when $f \leq 2$ and $\overline{p}_C \geq \frac{1}{2}$.

We now analyse the case for $f \leq 2 \Leftrightarrow \frac{1}{f} \geq \frac{1}{2}$ and $\overline{p}_C \geq \frac{1}{2}$.

Figure 5.4 represent this case. By the same argument than before in zone 1 the tax enforcement agency will want to move towards $p_C = \overline{p}_C$, and in zone 2 towards zone 3. In zone 3 the optimal policy depends on the availability of resources to devote to auditing.

➤ If $2n \leq \overline{p}_C$, the optimal policy will be to set $p_N = p_C = n$.

➤ If $2n \geq 1$ there are two possibilities: either $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$ or

$$p_N = \frac{1}{f}, p_C = 2n - \frac{1}{f}.$$

As before, we compare total expected evasion in the two cases in order to identify the optimal policy. At $p_C = \overline{p}_C$ total expected evasion is:

$$E_1 = \tilde{E}\left(2n - \overline{p}_C\right) \qquad (21)$$

and at $p_N = \frac{1}{f}$ it is :

$$E_2 = \tilde{E}\left(2n - \frac{1}{f}\right) \qquad (22)$$

As $2n - \overline{p}_C \geq 2n - \frac{1}{f} \Rightarrow E_1 \leq E_2$, so that the optimal audit policy is

$$p_C = \overline{p}_C, p_N = 2n - \overline{p}_C.$$

If $\overline{p}_C \leq 2n \leq 1$ the optimal policy can either be $p_C = \overline{p}_C, p_N = 2n - \overline{p}_C$ or $p_N = p_C = n$.

By comparing total expected evasion at the beginning and at the end of the interval, it can be shown that for $n \to \frac{1}{2}\overline{p}_C$, $\Delta(n) \to -\infty$ and the tax enforcement agency will opt

for $p_N = p_C = n$. For $n = \frac{1}{2}, \Delta\left(\frac{1}{2}\right) > 0$ and the tax enforcement will set

$$p_C = \overline{p}_C, p_N = 2n - \overline{p}_C.$$

Hence, given that (19) is monotonic, *there exists a certain threshold n* for the tax authority's budget above which it will be optimal to set* $p_C = \bar{p}_C, p_N = 2n - \bar{p}_C$ *and below which* $p_N = p_C = n$. *For* $f \le 2$ n^* *will lie in the interval* $\frac{1}{2}\bar{p}_C < n^* < \frac{1}{2}$.

5.4.3 The optimal audit policy when $f \le 2$ and $\bar{p}_C \le \frac{1}{2}$.

The last case to consider is for $f \le 2$ and $\bar{p}_C \le \frac{1}{2}$. We refer to figure 5.

If $\bar{p}_C + \frac{1}{f} < 1$ (this case is represented in figure 5.5 by he dotted line being below point

B) the situation is identical to the first case we considered, for $f \ge 2$.

If $\bar{p}_C + \frac{1}{f} > 1$ (this case is represented in figure 5.5 by the dotted line being below point

A) by applying the same argument than before it is possible to show that *there exists a certain threshold n* for the tax authority's budget above which it will be optimal to set*

$p_C = \bar{p}_C, p_N = 2n - \bar{p}_C$ *and below which* $p_N = p_C = n$. *For* $f \le 2$ *and* $\bar{p}_C \le \frac{1}{2}$, n^* *will*

lie in the interval $\frac{1}{2}\bar{p}_C \le n^* \le \bar{p}_C \le \frac{1}{2}$.

5.4.4 A general proposition for the optimal audit policy.

We can summarise our results in the following proposition:

For any probability $0 < \overline{p}_C < \dfrac{1}{f}$ and any fine rate $f > 1$, there exists a threshold n^*,

with $\dfrac{1}{2}\overline{p}_C < n^* \leq \min\left(\dfrac{1}{2}, \overline{p}_C\right)$, unique solution of the equation $2\tilde{E}(n^*) = \tilde{E}(2n^* - \overline{p}_C)$,

such that:

> *if the tax authority's budget is too small, i.e. such that $n < n^*$, the optimal audit*
>
> *policy is to allocate equally the resources between the two types of individuals, that*
>
> *is $p_C^* = p_N^* = n$.*

> *if the tax authority's budget is large enough, i.e. $n^* \leq n \leq \overline{p}_C + \dfrac{1}{f}$, the tax authority*
>
> *first ensures that the agents with the highest cost of evasion (type C) do not evade*
>
> *($p_C^* = \overline{p}_C$) and then allocate the remaining share of the budget to the other*
>
> *individuals ($p_N^* = 2n - \overline{p}_C$).*

These results are represented in figures 5.6 and 5.7.

The intuitions for these results are as follows:

1. If the budget is too small ($2n < \overline{p}_C$), both types will necessarily evade: it is not possible to make sure that type C do not evade. The tax enforcement agency compares the marginal benefit of increasing the probability of detection for type C individuals (the decrease in tax evasion for type C agents) and the marginal cost (the increase in tax evasion by type N agents). Since group sizes are identical and agents evade the same amount if they face the same probability of audit, the marginal cost equals the marginal benefit when the probabilities are the same, i.e. $p_C^* = p_N^* = n$.

2. If the budget is large enough ($2n > 2\overline{p}_C$), setting equal probabilities would not be optimal, in that $p_C^* = p_N^* = n$ would imply $p_C^* > \overline{p}_C$: the tax enforcement agency would devote more resources than necessary to induce the C types not to evade. The tax enforcement agency optimally selects the probability of auditing the C types exactly at $\overline{p}_C$ and can use the rest of the resources for the N types.

3. For intermediate values, the tax enforcement agency has to compare the two previous policies. Switching from equal probabilities (policy 1) to a case in which the tax enforcement agency concentrates first on type C individuals (policy 2) has two effects.

   a. increasing the probability of audit for type C agents from $p_C = n$ to $p_C = \overline{p}_C$ increases total evasion. This effect is larger when the budget is more limited. (lower n).

b. setting a probability equal to $\overline{p}_C$ (from $p_C = \overline{p}_C^-$ to $p_C = \overline{p}_C$) for type C agents in order to ensure that they do not evade decreases total evasion as the tax enforcement authority benefits from the discontinuity in the evasion pattern of type C individuals.

If the budget is sufficiently large ($2n$ close to $2\overline{p}_C$), the benefit overweighs the cost, and the optimal policy is to concentrate first on type C (policy 2). On the contrary, the discontinuity does not compensate for the loss when the budget is too low ($2n$ close to $\overline{p}_C$) and the tax authority prefers to set equal probabilities of audit.

5.5 Conclusion

The analysis above suggests that when individuals have different opportunities to evade and the tax enforcement agency has limited resources, the optimal audit policy depends on the available budget.

The tax enforcement agency should distinguish between the two types only if the resources are high enough. In this case, in fact, it is optimal to allocate the budget so that individuals with low opportunities to evade are just indifferent between evasion and non evasion and devote the remaining part to the other group with greater opportunities. The tax enforcement agency should first tackle tax evasion by individuals with lower opportunities to evade. Depending on the available budget two possible cases may arise: for low values, ($n^* \leq n \leq \overline{p}_C$) individuals with greater opportunities to evade face a

lower probability of being audited. The optimal audit policy further increases the disparity in opportunities to evade.

On the other hand, for higher values, individuals with greater opportunities face a higher probability of being investigated.

When the resources are low, the optimal audit policy consists of setting the same probability for the two types.

We should note these results still hold when the share of the population of the C types is not the same as the share of the N types.

If we allow for different population sizes for the two types, the result that if the budget is high enough the tax enforcement agency should first ensure that the C types do not evade still holds. Moreover, for smaller budgets, expected tax evasion is minimised when the tax agency sets equal probabilities for both types. The only difference with the previous case is in the allocation of the budget: when the population is equally shared between the two types, setting equal probabilities implies devoting the same share of the budget to each type. When instead there are different proportions of the two types, setting equal probabilities implies devoting a greater share of the budget for the largest group. This is because probabilities are inversely related to the size of the relevant group. When probabilities are the same, the tax agency must devote a greater share of the budget to the largest group.

In most models on the optimal audit policy the objective of the tax agency is assumed to be the maximisation of total net revenue. In our model we assume that the tax

enforcement agency aims at minimising the amount of evasion. This assumption however is not crucial for our results. Even if the tax enforcement agency aimed at maximising total net revenue, the optimal audit policy would still depend on the budget, and above a certain threshold it would still be optimal to target first the tax payers with low opportunities to evade.

In our model, when the optimal audit policy is $p_C = \overline{p_C}, p_N = 2n - \overline{p_C}$, individuals with low opportunities (type C) never evade and individuals with high opportunities (type N) evade part of their income. This policy determines a mixed outcome where honest taxpayers coexist with cheaters, which we couldn't observe in the standard model. In this case, given the assumption that individuals have the same income and same utility function, the feasibility of a mixed equilibrium is explained by individuals having different opportunities to cheat the government. The disparity in opportunities to evade leads to a mixed equilibrium of honest taxpayers and cheaters, even in a community of individuals with the same income and the same attitudes towards risk.

Figure 5.1
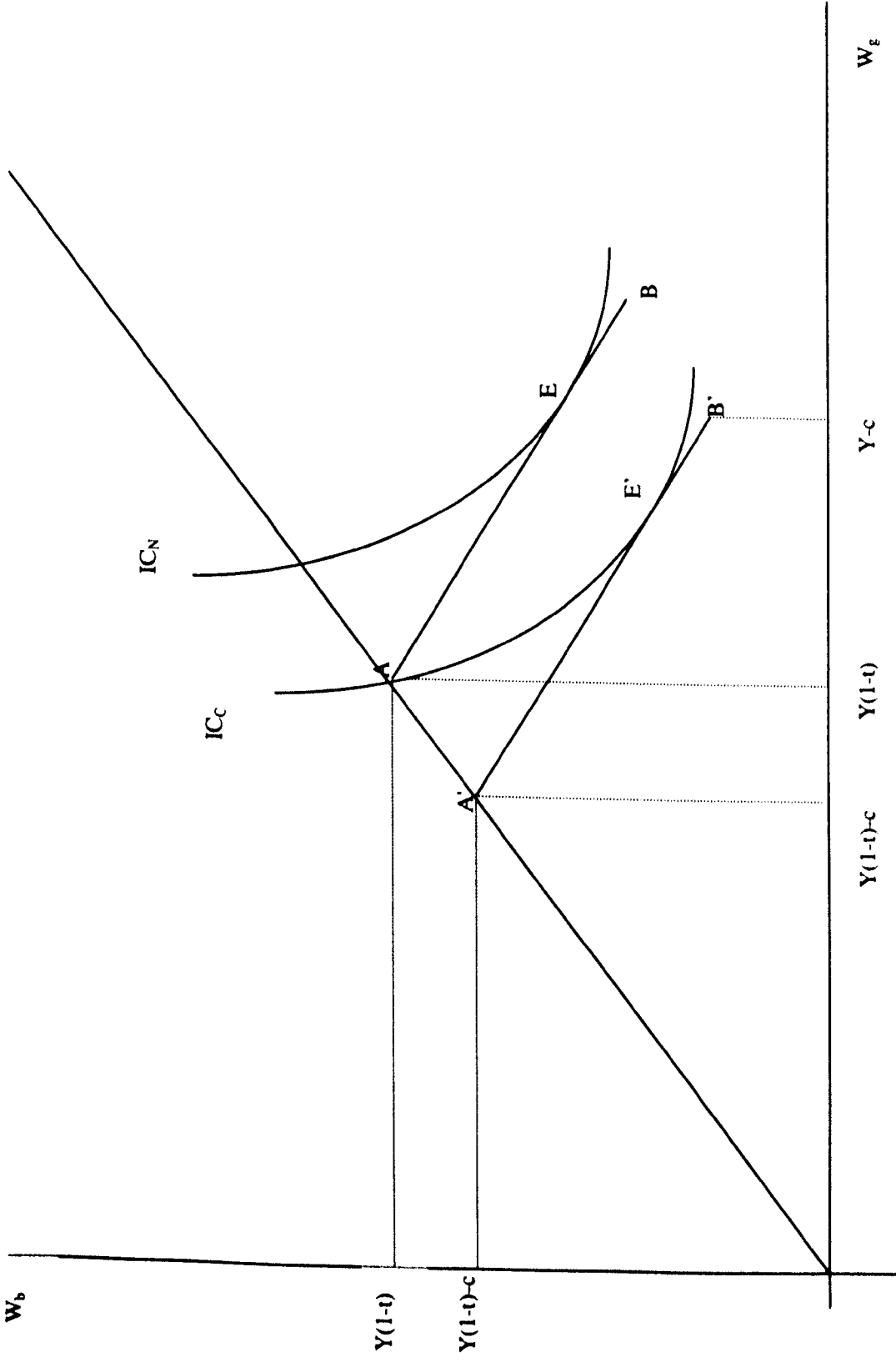
Figure 5.2
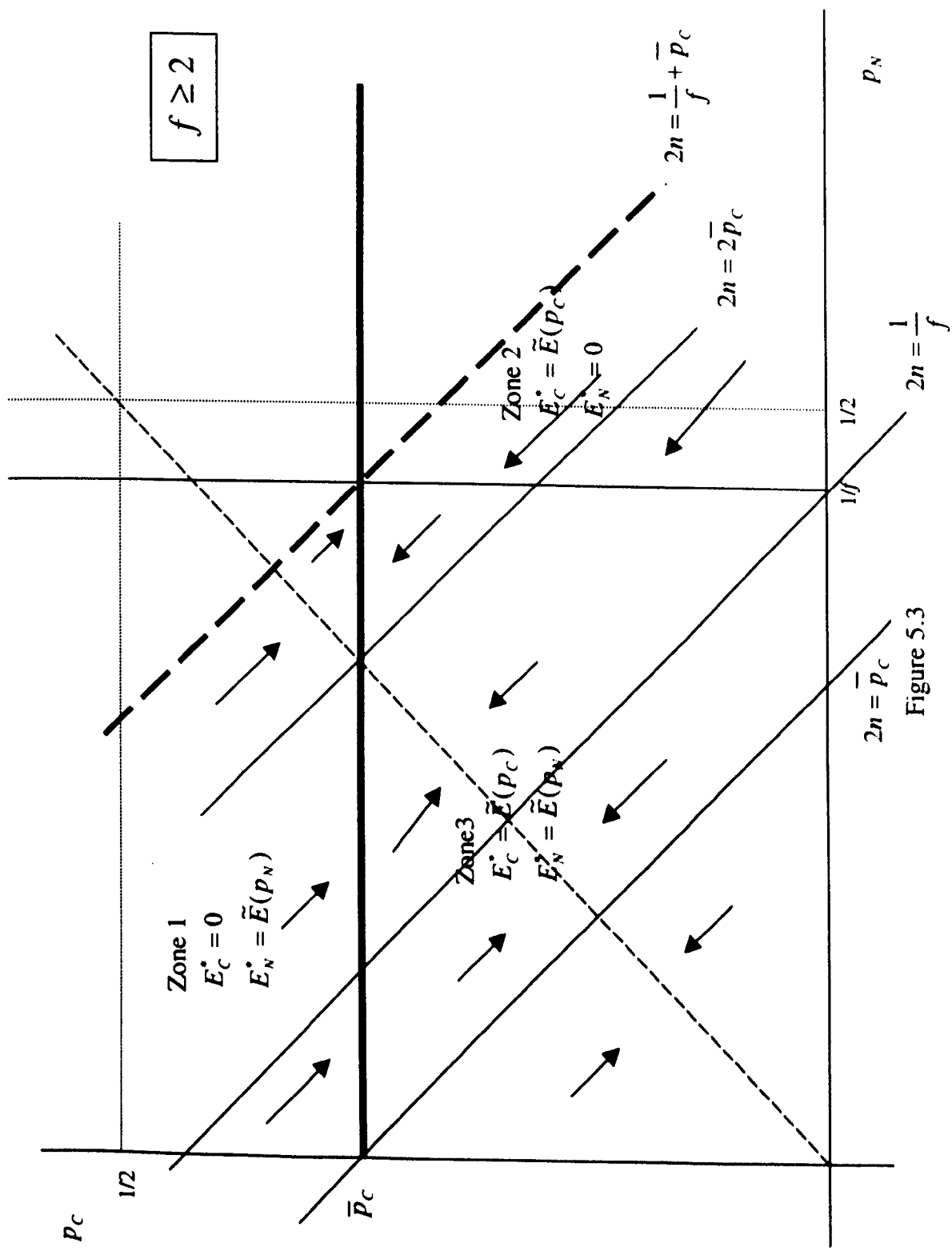
$$f \geq 2$$
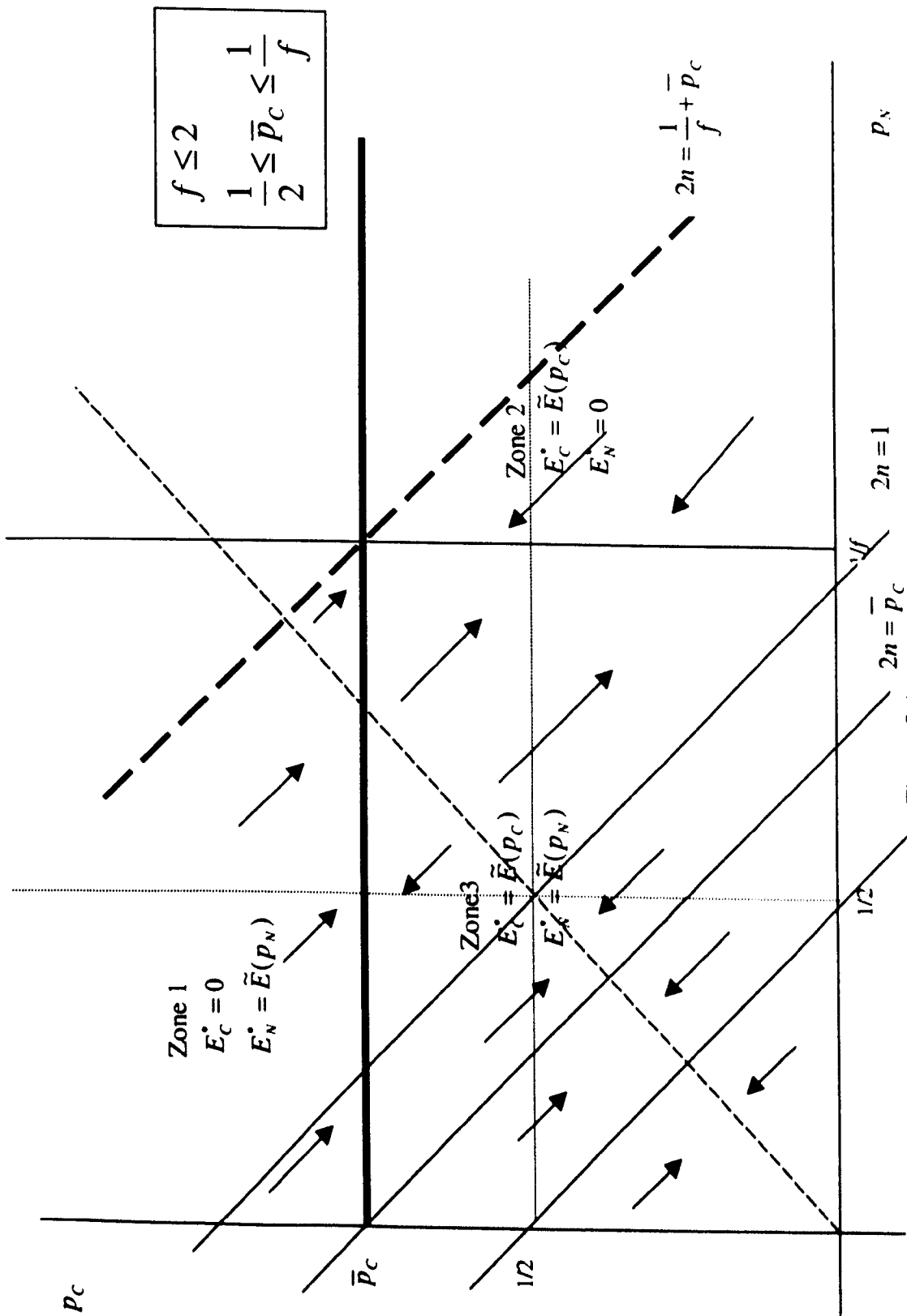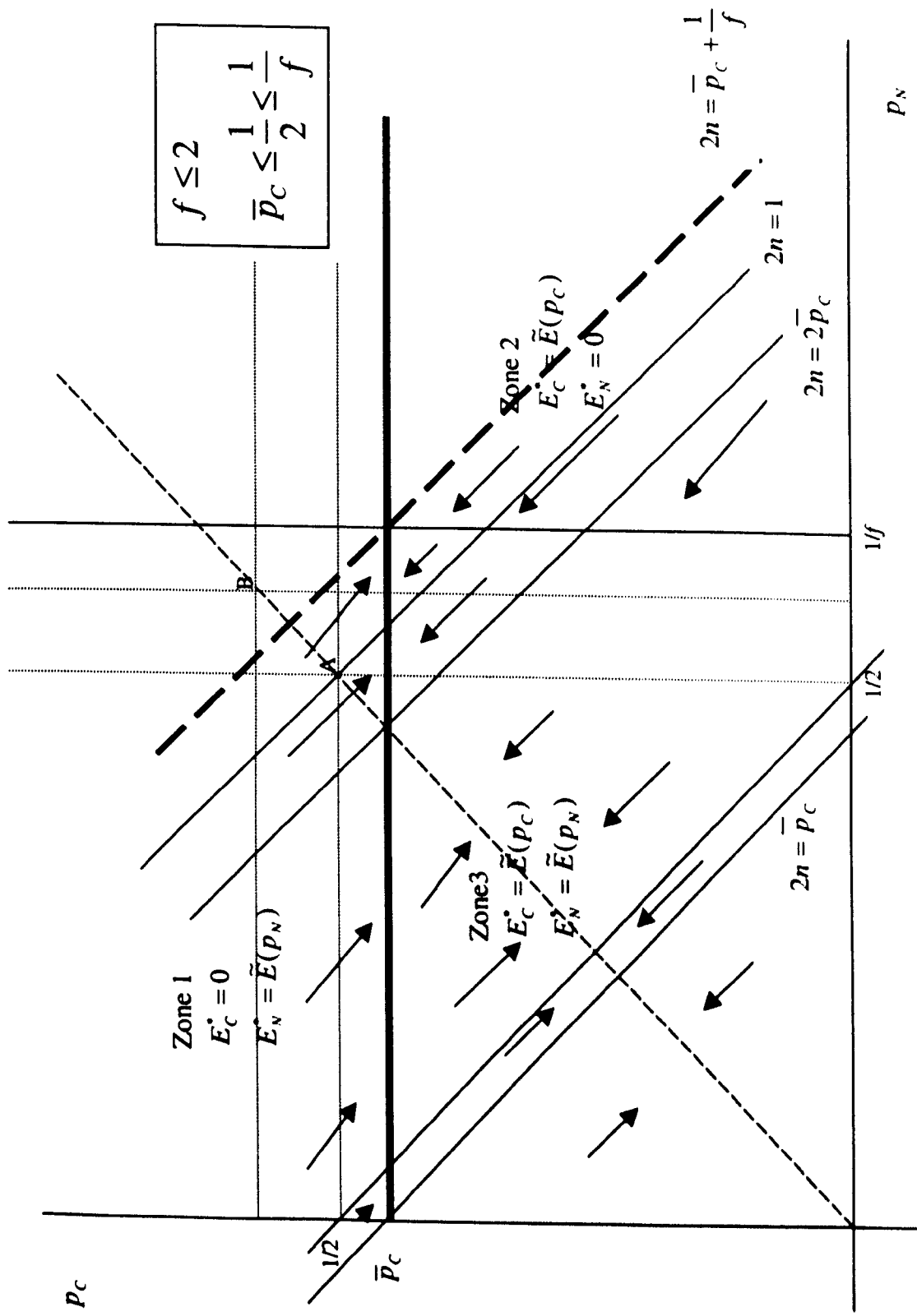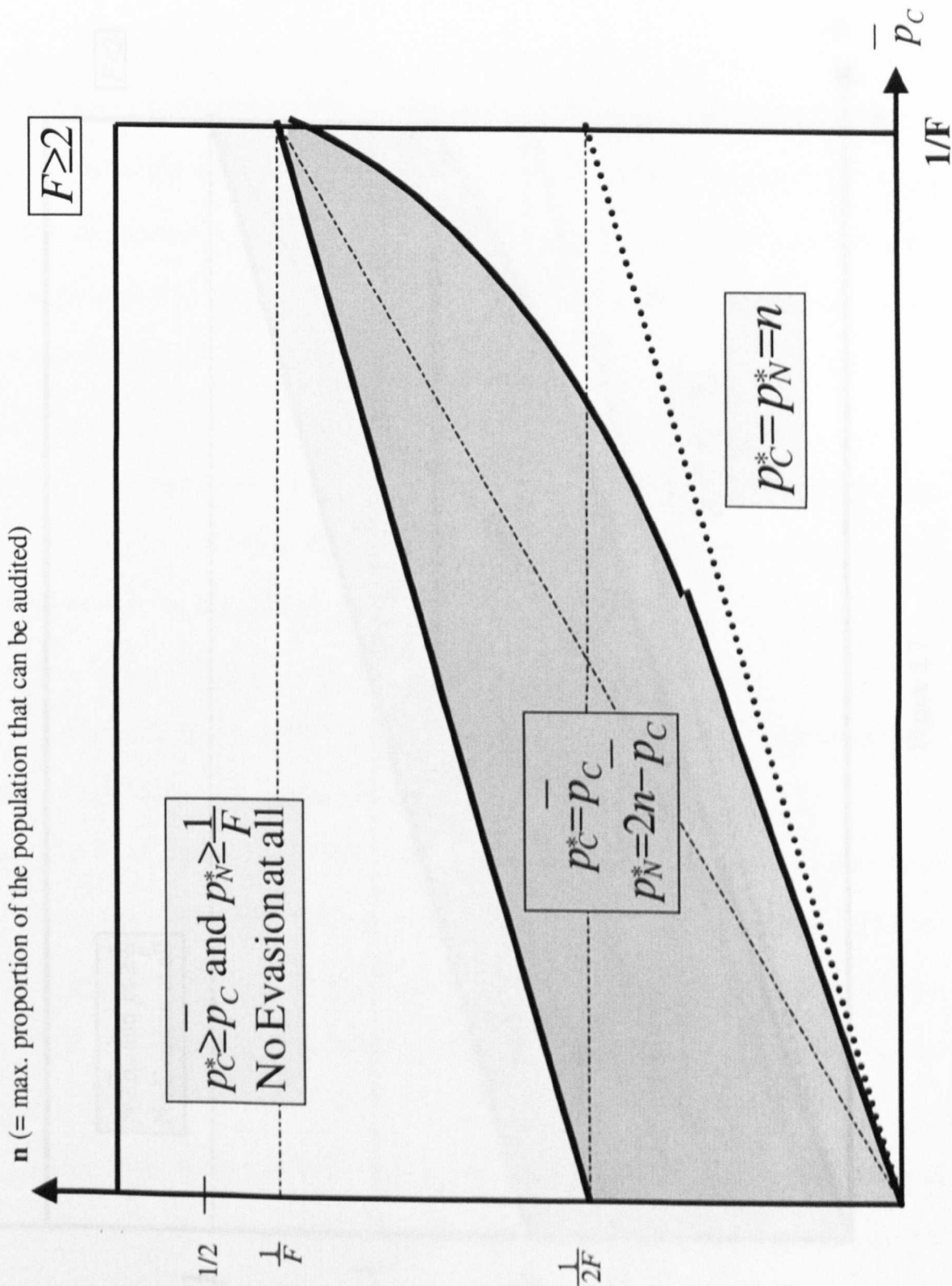
Zone 1
$E_c^* = 0$
$E_N^* = \tilde{E}(p_N)$

Zone 2
$E_c^* = \tilde{E}(p_c)$
$E_N^* = 0$

Zone 3
$E_c^* = \tilde{E}(p_c)$
$E_N^* = \tilde{E}(p_N)$

$2n = \frac{1}{f} + \overline{p}_c$

$2n = 2\overline{p}_c$

$2n = \frac{1}{f}$

$2n = \overline{p}_c$

p_N

p_c

1/2

$\overline{p}_c$

1/2

1/f

Figure 5.3

Figure 5.4

$f \leq 2$

$\dfrac{1}{2} \leq \bar{p}_c \leq \dfrac{1}{f}$

Zone 1
$E_c^* = 0$
$E_N^* = \tilde{E}(p_N)$

Zone 2
$E_c^* = \tilde{E}(p_c)$
$E_N^* = 0$

Zone 3
$E_c^* = \tilde{E}(p_c)$
$E_N^* = \tilde{E}(p_N)$

$2n = \dfrac{1}{f} + \bar{p}_c$

$2n = 1$

$2n = \bar{p}_c$

p_c

$\bar{p}_c$

$1/2$

$1/f$

$1/2$

p_N

277

Figure 5.5

n (= max. proportion of the population that can be audited)

$F \geq 2$

$\overline{p_C^*} \geq p_C$ and $p_N^* \geq \frac{1}{F}$
No Evasion at all

$\overline{p_C^*} = p_C$
$p_N^* = 2m - p_C$

$p_C^* = p_N^* = n$

$\frac{1}{2}$

$\frac{1}{F}$

$\frac{1}{2F}$

$1/F$

$\overline{p_C}$

Figure 5.6

Figure 5.7

$F < 2$

$\bar{p_C} \geq p_C$ and $p_N^* \geq \dfrac{1}{F}$
No Evasion at all

$\bar{p_C} = p_C$
$p_N^* = 2n - p_C$

$p_C^* = p_N^* = n$

$\mathbf{n}$ (= max. proportion of the population that can be audited)

$\dfrac{1}{F}$

$\dfrac{1}{2}$

$\dfrac{1}{2F}$

$1/F$

$\bar{p_C}$

280

General Conclusion

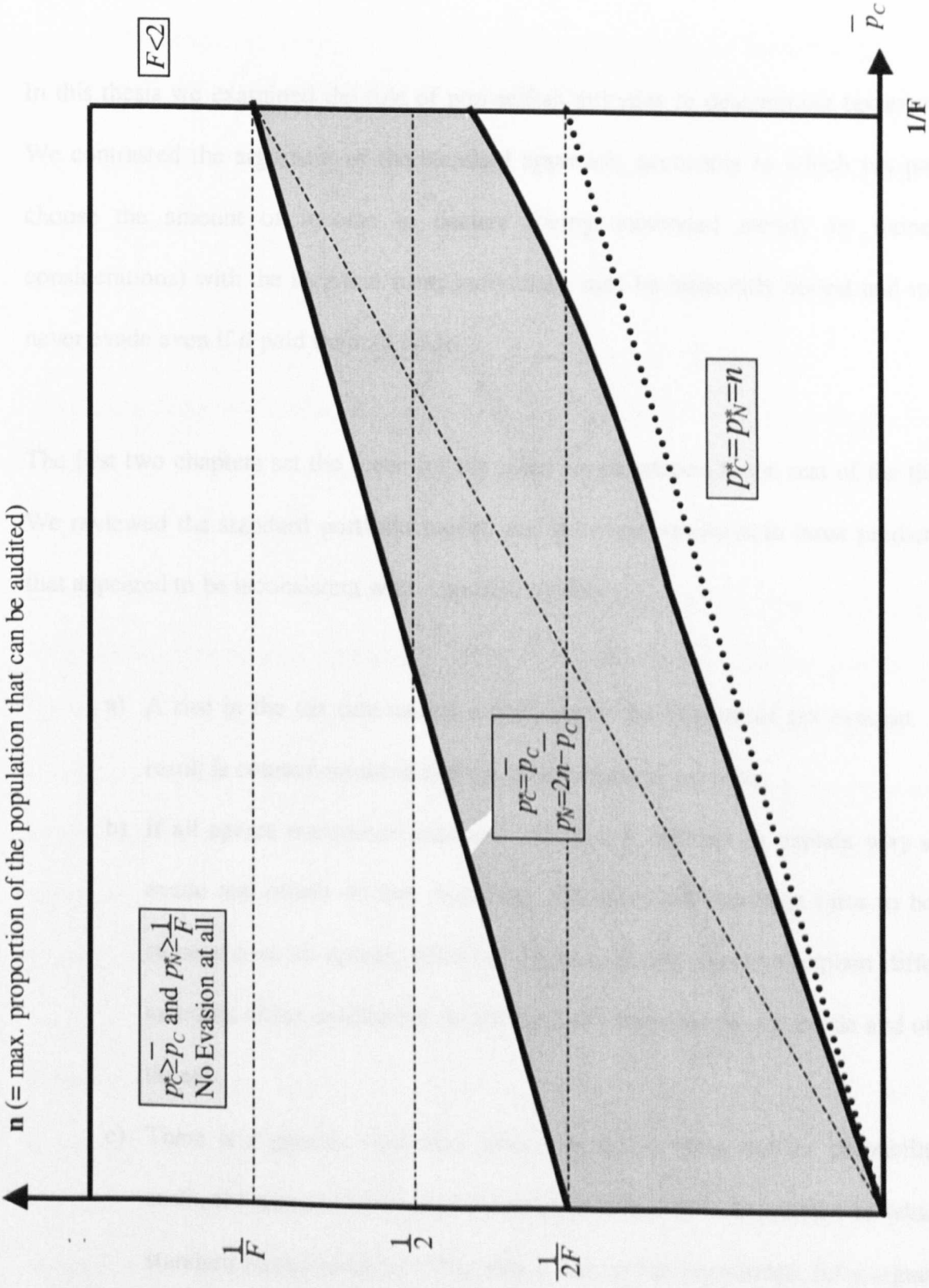In this thesis we examined the role of non-selfish attitudes in determining tax evasion. We contrasted the argument of the standard approach, according to which tax payers choose the amount of income to declare (being motivated merely by monetary considerations) with the idea that some individuals may be inherently honest and would never evade even if it paid them to do so.

The first two chapters set the scene for the ideas we developed in the rest of the thesis. We reviewed the standard portfolio model, and drew our attention to three predictions that appeared to be inconsistent with empirical evidence:

a) A rise in the tax rate causes a decrease in the amount of tax evasion. This result is counter-intuitive and has little empirical support.

b) If all agents maximised expected utility, it is difficult to explain why some evade and others do not. Assuming fine rates and detection rates to be the same across all agents, different degrees of risk aversion explain different amounts of tax evaded but do not explain why some people evade and others do not.

c) There is a general view that, given actual fine rates and the probability of audit, the amount of evasion undertaken is too low, in relation to what the standard model predicts. This idea is not, to our knowledge, fully argued, in that it is unclear exactly how much evasion the standard model does predict.

Also it is unclear how large empirical estimates of evasion actually are in the context of the portfolio model. Actual evasion must be compared with the amount of income that an agent is able to hide from the tax authority.

We considered the economic literature on the role of morals in tax evasion together with some empirical evidence. In particular, we focused on the Myles and Naylor model which considers tax compliance as a social custom, and on Bordignon's analysis, which examines the role of fairness considerations in deterring tax evasion.

In Myles and Naylor's model the issue of the effect of an increase in the tax rate on tax evasion is not completely resolved. It is possible to get an increase in tax evasion after an increase in the tax rate, but this will occur only because those who were previously honest start to evade, i.e. more people become evaders. Existing evaders would still *decrease* tax evasion after an increase in the tax rate, as in the Yitzhaki model. Hence the Myles and Naylor analysis offers only a partial resolution to this puzzling prediction. Bordignon's analysis is more satisfactory in this respect: in his model people can end up evading more, when the tax rises, even when they were previously evading. This happens when individuals perceive the increase in the tax rate as unfair and consequently are prepared to evade more than previously.

Hence the puzzling prediction concerning the effect of a change in the tax rate is not completely resolved by the models on social interactions.

We also pointed out that the argument that some people are inherently honest is vulnerable to evolutionary forces. Once we allow preferences to change and selfish

attitudes to be present in the social environment, altruistic behaviour can be undermined by an increased tendency to "selfishness". Furthermore the simple arguments we gave suggested some difficulties in explaining how "honest" and "utility maximising" individuals could coexist in equilibrium. This general argument is not new to economics, having appeared as long back as 1959 in Tullock's famous paper on voting.

The argument that some people may be inherently honest and not evade even if it would pay to do so is not completely satisfactory. In the models we considered people are assumed to be motivated by non-selfish considerations, some sort of predisposition to altruistic behaviour seems to be taken as given, rather than explained. There has been a large amount of literature that suggests some form of "altruism" motivates economic decisions. However the models and evidence that point in this direction suggest that the stability of altruistic or co-operative behaviour relies on some form of reciprocity. This argument for altruism is weaker in the context of tax evasion, however. Tax evasion is by its nature a hidden activity and individuals cannot observe each other. Moreover a single taxpayer can be reciprocal only with an anonymous group. Hence reciprocity considerations and punishment of cheaters are likely to be a lot less effective than in many of the cases studied.

In the light of this, the question of why individuals should consider tax compliance as part of a social custom remains an open question.

Empirical evidence on this issue is rather thin, in that most of empirical studies do not consider this question directly. From the studies we discussed, the evidence on the role

of morals is not compelling. More compelling is the role of opportunities and costs of evasion in determining tax compliance. Curiously this issue has been neglected by the literature in the standard portfolio model. Here the only cost for evading is the fine, which is incurred only in case of detection.

We explored the idea that costs or opportunities rather than willingness to evade might determine evaders' behaviour: some people may not evade simply because it is too costly or because they do not have the opportunity to do so.

By introducing a minor modification to the standard approach, to allow for a cost element in evasion, we get some different results. In particular we show that it is possible to predict an increase in tax evasion after an increase in the tax rate, without relying on any particular psychological motivation. It is also possible to get a mixed outcome of evaders and non-evaders, even if individuals have the same income and face the same probability of detection. Typically, evaders are less risk averse than non-evaders. Different degrees of risk aversion lead to different choices on whether or not to evade. This was not a characteristic of the standard model.

In Chapter 5 we analysed the optimal audit policy when taxpayers have different opportunities to evade. The analysis can be extended in various ways:

1) by considering different sizes for the two groups of tax payers;

2) by allowing individuals to choose the group to which they belong. This pursues the idea developed by Cowell (1985).

3) The choice of the tax rate could be endogenised, to allow more interaction among the taxpayer, the tax authority and tax enforcement agency. This would obviously require an explicit social welfare based approach.

4) It is also possible that the government could directly affect evasion by controlling the cost of compliance. In particular it could be interesting to examine how much of the compliance cost should be borne by the government and how much by the individual.

These are directions for possible future research.

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