NORGES HANDELSHØYSKOLE

Bergen, Autumn 2012

Thesis in Master of Science (MSc) in Economics and Business Administration
Specialisation: Economic Analysis

Advisor: Fil. Dr. Prof. Jonas Anderson

Income tax evasion: The conundrum of compliance

by John Houth Fjellseth

Abstract

This thesis consists of two parts. Part I constitute a review on income tax evasion literature. The focus is particularly on the economic and non-economic factors that relates to individuals' optimal tax reporting decision, and the determinants describing individuals' tax evasion behaviour. The starting point of the review is the theoretical paper by Allingham & Sandmo (1972) in which they compared the tax reporting decision to a gamble, and identified (albeit ambiguous) effects on individuals' tax evasion behaviour, by changes in the economic policy factors (tax rate, audit probability, and fine). Subsequent research has developed theory by improving, expanding, critiquing and challenging this first simplistic portfolio model. In this review I also visit principal-agent models, game theory models, dynamic stochastic inter-temporal models, and one recent framework considering behavioural economics. I also take a look at empirical research, particularly to investigate determinants which may allow tax authorities to identify tax evaders. I find that theory agrees on the importance of audit policies. Part II empirically explores a recently developed theory; the "slippery slope" framework. It aims is to validate the assumptions that high "trust in authorities" and high "power of authorities" are associated with high levels of tax compliance (and vice versa) by performing a cross-sectional study. I am unable to conclude on my main hypothesis. However, the salvaged results do provide support in the assumption of *trust*.

PDF, data set and R-project code available
http://is.gd/taxevasion

Preface

This thesis was carried out at Norwegian School of Economics (NHH) during the period August 2012 to December 2012.

I would like to thank my advisor Jonas Anderson for generously sharing his knowledge with me in the past semester. His comments and advice have been greatly appreciated.

I also thank Skatt vest for the research grant and the opportunity earlier this semester to present my findings for a highly interested audience. Their interest in tax research was inspiring.

Finally, I am particularly grateful towards my family who I always can rely on, and who have supported and bared with me over these past few months.

Bergen, December 2012

Table of Contents

Table of Figures

Introduction

"In recent years economists have devoted increasing attention to the study of individual tax evasion. Despite these efforts, our understanding of the reasons behind individual tax compliance behaviour remains limited. In fact, the puzzle of tax compliance is that most people continue to pay their taxes."

-- *Why do people pay taxes?* (Alm, McClelland, & Schulze, 1992)

The tax evasion literature appears to be topic in which no theoretical approach seems to get a proper foothold. In my search for the factors that explain tax compliance / tax evasion behaviour I find both theoretical and empirical research which provides conflicting, ambiguous, or undetermined results.

The reason the thesis is separated in two parts is twofold. Number one, I realised that my literature review deserved a decent summary of the factors and determinants of tax evasion, along with some final remarks. Number two, my empirical short study developed into an analysis which I believe may be independently read. I do, however, hope the reader will read and find enjoyable and useful information and discussions in both parts of the thesis.

Part I investigates theoretical research on the income tax evasion theory from the starting point provided by Allingham & Sandmo (1972) to Kirchler et al.(2008). It also reviews some of the key empirical research from the last 30 years.

Part II explores the tax compliance theory described as the "slippery slope" framework, introduced by Kirchler et al. (2008) and empirically tested by Kogler et al. (2012). The part seeks to empirically test the assumptions at the core of the framework.

PART I

The income tax gamble: Pay your share or pay the price

- A review on income tax evasion literature

1 Introduction

Consider the taxpayer's decision whether or not to report his or her[1] true income to the tax authorities. The decision to underreport income, i.e. illegally evade taxes, is in principle comparable to a gamble where there are two potential outcomes for the taxpayer; one successful and one unsuccessful[2]. In the successful outcome the individual's tax return is not audited and the "gain" of the lottery is the evaded taxes, in the unsuccessful outcome the return is audited and the "loss" is the fine imposed by the authorities. If we assume completely random probabilities of being audited, and observing that the expected fine for unsuccessful tax evasion is small compared to the expected gain of successfully evading taxes[3]. From a rational economic point of view, it seems a puzzle that not everyone would accept the gamble.

1.1 Purpose

The aim of this literature review is to collect, synthesise and compare the key theoretical models and frameworks on income tax evasion, and to supplement by looking into the development of subsequent and up-to-date research on the topic. This review specifically focuses on the factors that affect the decision to submit to- or refrain from tax evasion; in particular what analytical models and theories predict influence tax evasion behaviour, and whether or not empirical research supports their predictions. These factors are for convenience in discussion separated[4] into *economic* (i.e. policy instruments such as tax rates, audit policy, fine structure etc.) and *non-economic* (general education level, social norms, legal system, complexity of tax laws, etc.) factors. The *factors* are generally observed on a national level, and are often directly or indirectly controlled by the authorities. Additionally individuals exhibit characteristics which may indicate individual tax evasion behaviour. These descriptive variables (such

[1] In the following, unless referring to a specific person, the reader should read he/she for he and his/her for his.
[2] Readers whom object to the terminology "successful tax evasion" may note that in this introductory context the term is purely descriptive. It is not my intention to attribute moral or normative interpretations.
[3] In the United States , less than 1 per cent of tax returns are audited per year (Alm et al., 1992)
[4] See Figure 1: Economic and non-economic factors, and determinants of tax evasion.

as income level, age, education, personal norms and attitudes, etc.) are referred to as *determinants*.

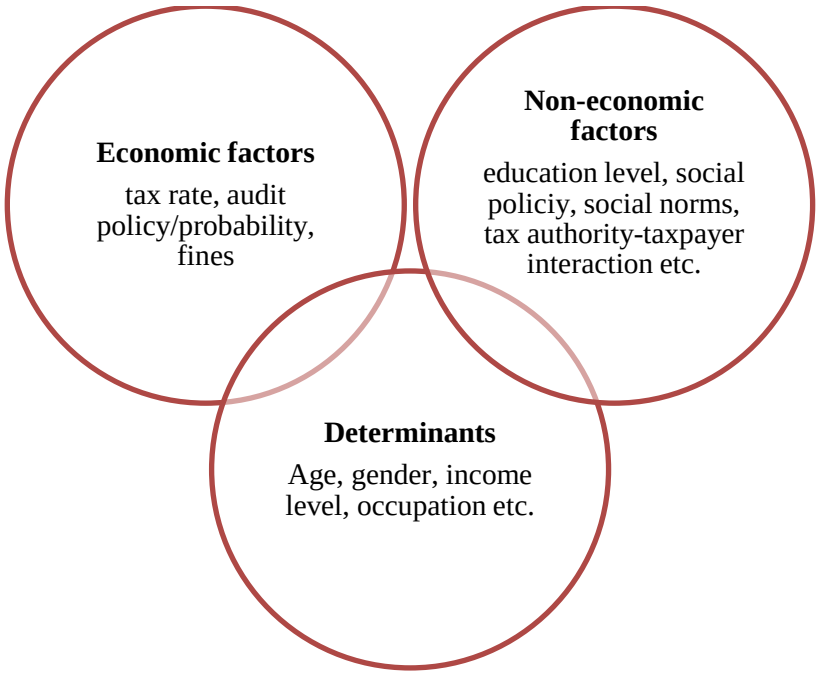

Figure 1: Economic and non-economic factors, and determinants of tax evasion

The reader should note that this review does not explore corporate taxation, value added taxes or indirect or direct taxes or customs other than individual income taxes. The focus of the review is the theoretical and empirical research concerning determinants of individual's tax compliance decisions, and the factors to enforce or incentivise tax compliance.

1.2 Structure

Chapter 2 introduces definitions of tax evasion and some related terminology. It introduces useful concepts related to tax evasion and measures of tax evasion. Chapter 3 introduces some of the major theories and models of income tax evasion with the economic factors of tax evasion in mind. Chapter 4 proceeds by introducing theory on income tax compliance with economic *and* non-economic factors of compliance in mind. Chapters 3 and 4 progress by presenting subsequent theories by reflecting on the

primary weaknesses of the prior topics. Chapter 5 presents some of the empirical research focusing on factors indicating individual's tax evasion. In Chapter 6 the assumptions of models, frameworks and empirical research are addressed, and Chapter 7 summarises key insights of the factors of tax evasion, and concludes Part I of this thesis by attempting a few final remarks.

2 Principles of tax evasion

2.1 Theory of taxation vs. theory of tax evasion

The "theory of *taxation*" springs from the field of "public economics" and focuses on topics such as the effects of taxes on economic efficiency and equity. One example is the theory on portfolio decisions of consumers, i.e. what effect does the introduction of taxes have on investments and consumption (Arrow, 1970; Musgrave, 1959). These theories focus on individual's altered behaviour by the introduction of taxes and should *not* be confused with the individual's decision to comply with taxation in itself. One might generally say that the "theory of *taxation*" focuses on *indirect costs* such as efficiency costs and tax wedges in relation to optimal taxation policies, and implicitly makes no presumptions extent of tax evasion. On the other hand "theory of *tax evasion*" investigates optimal tax policy with *direct costs* of taxation, (usually) not reflecting on optimal tax revenue or social policies. Sandmo (2004) separates the costs into

1. Indirect costs: Efficiency costs and tax wedges.
    a. Distortions of industry competition, increased prices, shifted demand etc.
2. Direct costs of tax collection
    a. Individuals (and firms) filling out forms, reviewing tax returns and being audited.
        i. Leading to people not starting businesses
        ii. Businesses shutting down due to increased costs
    b. Tax authorities pursuing tax evaders and financing audits etc.

2.2 Tax evasion and tax compliance

Theoretical literature on optimal income tax reporting applies a terminology which focuses on the underreporting of taxes; thus "tax evasion" is a term often used. On the other hand, recent empirical research and frameworks of tax reporting generally uses the term "tax compliance". This may on occasion, especially when comparing theories and results, cause some confusion. However, in this review implications from *tax evasion* and *tax non-compliance* are equivalent.

2.2.1 Definition of tax evasion

The *act* of tax evasion is by researchers defined as the illegal activity of not reporting taxable income to the tax authorities. Sandmo (2004) states that "When the taxpayer refrains from reporting income from labour or capital which is in principle taxable, he engages in illegal activity that makes him liable to administrative or legal action from the authorities". Kogler et al. (2012) defines tax evasion as "the deliberate act of breaking the law in order to reduce taxes. It involves acts of omission (e.g. failing to report certain revenues) or commission (e.g. false reporting of personal expenses as business expenses) and is liable to prosecution and fines".

The tax evasion *measure* refers to the amount of taxes that are hidden from tax authorities. See details on data measures and sources on page 12.

2.2.2 Definition of tax avoidance

On the other hand, there is tax avoidance which is in principal legal. Sandmo (2004) states that "avoidance is within the legal framework of the tax law. It consists in exploiting loopholes in the tax law in order to reduce one's tax liability; converting labour income into capital income that is taxed at a lower rate provides one class of examples of tax avoidance." The extent of tax avoidance is not subject to illumination in this review.

2.2.3 Definition of tax compliance

The *act* of tax compliance may be considered to be the opposite of tax evasion, thus a question of paying the appropriate amount of taxes legally imposed by authorities. However, in research which incorporates aspects of behavioural economics theory the

term compliance is given a moral interpretation. Kogler et al. (2012), for instance, defines intended tax compliance as "Citizens' disposition to pay taxes at a deliberate level", i.e. the extent of which the individual intends to pay his taxes.

Another use of the term tax compliance is to describe the amount of taxes raised relative to the real amount of taxes that *should* be raised given truthful reporting by the working individuals. This is in principle the opposite of the tax evasion measure.

2.3 Data sources in tax evasion research

Tax evasion is an illegal activity, thus it has proven challenging to collect reliable data for empirical research. However, measures and estimates of tax evasion have been developed, and they are an important part of empirical research of tax evasion.

2.3.1 Tax Gap approach

A commonly used *direct* approach used as an indicator of the magnitude of income tax evasion is the "(U.S.) Tax Gap". The Tax Gap is the "difference between taxes paid and taxes owed for all federal taxes and taxpayers" (Brown & Mazur, 2003), and was routinely measured by the Taxpayer Compliance Measurement Program (TCMP) run by the U.S Internal Revenue Service (IRS) until 1988. The Tax Gap consisted of three distinct types of compliance; payment compliance, filing compliance, and reporting compliance (Brown & Mazur, 2003). These three mutually exclusive and exhaustive measures together comprised a comprehensive picture of tax payer compliance. It provided a framework for analysis, by separating the problem into three sub-sets, since three categories of compliance are distinctively separated. The framework also allowed the researchers to focus on particular aspects of the tax compliance problems by focusing on filing-, reporting- or payment compliance in particular.

Other direct approaches are based on surveys, in which the individuals are granted tax evasion amnesty in return for their voluntary cooperation in revealing previous evaded taxes. However, a major problem with measuring tax evasion by voluntary revealed selection of individuals is that they might constitute a biased selection of evaders, and not represent the "average" tax evader.

2.3.2 Shadow economy approach

An important *indirect* method used to estimate the level of tax evasion is the use of proxies. A commonly used proxy of tax evasion has been developed by Schneider (2005). His estimates measure the shadow economy as a percentage of the "real" size of the gross domestic product (GDP) for a number of countries. This method incorporates multiple causes leading to the "shadow economy". It is based on statistical theory of unobserved variables, which considers multiple causes and multiple indicators[5] of tax evasion. The unobserved variables are indicated by using data from among others World Bank, OECD, and the International Labour Organization.

Other indirect approaches to measure tax evasion have looked for traces of evasion in for instance financial transactions, currency demand, consumption level, or even measured luminosity of geographical areas to estimate true level of economic activity[6].

[5]The method is called *Dynamic Multiple Indicators – Multiple Causes* (DYMIMIC).
[6]See Alm (2012) for a review on several tax compliance measures.

3 Traditional models of tax evasion

3.1 Allingham & Sandmo (1972) – It's just a silly gamble. Be rational!

In an extraordinary paper Allingham & Sandmo (1972) pioneered modern tax evasion theory. Their view on tax evasion theory differs from that time's contemporary taxation theory which primarily was concerned with public economics in relation to topics such as optimal taxation and risk-bearing (Arrow, 1970; Mossin, 1968; Musgrave, 1959). However, instead of finding an optimal tax rate policy from a public economic point of view, Allingham & Sandmo (1972) identify the effects of the economic factors; income level, tax rate, audit probability and penalty rate, on the choice of the individual's optimal tax reporting.

The Allingham & Sandmo (A-S) model is a picture of the taxpayer at the moment he is filling his income report. The question he is asking himself is; how much of my income should I report to the tax authorities? The taxpayer is assumed to have complete information about his income level, tax rate, probability of audit, and fine rate, and wants to maximise his expected utility. The trade-off is between the "safe" net income after taxes, and the "risky" fine on the unreported share of the income if audited, thus the choice is a decision under uncertainty.

In the model actual income, W, is exogenously given and is known by the taxpayer but not by the tax authorities. Tax is levied at a rate, θ, on decleared income, X, which is the taxpayer's decision variable. The taxpayer will be subject to an audit with probability, p, and fined by the tax authorities on the unreported income, $W - X$, at a rate, π, (which obviously is higher than θ).

The taxpayer choose to report income, X, to maximise the expected utility

$$f(\mathrm{X}) = \mathrm{E}[\mathrm{U}] = (1-\mathrm{p})\mathrm{U}(\mathbf{W} - \boldsymbol{\theta}\mathbf{X}) + \mathrm{pU}\big(\mathbf{W} - \boldsymbol{\theta}\mathbf{X} - \boldsymbol{\pi}(\mathbf{W} - \mathbf{X})\big)$$

where

W：(exogenous)income

X： amount of declared income,

p：(exogenous) probability of audit

θ： proportional income tax rate

π： penalty rate

If the tax evasion is not detected by the authorities the net income of the taxpayer is

$$(\mathrm{W} - \theta\mathrm{X}) = \mathrm{Y}$$

On the other hand, if the tax evasion is detected his net income is

$$\big(\mathrm{W} - \theta\mathrm{X} - \pi(\mathrm{W} - \mathrm{X})\big) = \mathrm{Z}$$

If the individual chooses to report all his income, there is no uncertainty regarding a penalty (a penalty which in case of an audit is zero). If he chooses to report only some or no income, a fine on the unreported income is enforced if he is audited. This means that depending on the taxpayer's true income level and risk aversion, and depending on the tax authority's probability of audit and impose evasion penalties; there is potentially room for the taxpayer to increase his expected utility level by disclosing less than his true income. The optimal portfolio approach assesses the two alternatives (one certain, one uncertain) to optimally find the reporting decision[7].

[7] Recall that for this study the results of interest are the changes in taxpayer's reporting behavior by changes in the parameters. Not the optimal income reporting decision in itself.

The first order condition for an interior maximum of $f(X)$ can be written as

$$-\theta(1-p)U'(Y)-(\theta-\pi)pU'(Z)=0$$

which yields the optimal[8] amount of declared income

$$X^*(\theta,\pi,p)$$

The partial derivatives of $X(\theta,\pi,p)$ are of particular interest as they show the effects on the amount of tax evasion by small changes in the authorities economic policy parameters. Assuming decreasing absolute risk aversion with income[9], the A-S model shows the effects of changes in tax rate, penalty rate and the probability of audit

1. A change in tax rate, $\frac{\partial X}{\partial \theta}$
    a. A higher tax rate has an ambiguous effect. The *income effect* is positive; i.e. higher taxes make the taxpayer poorer and therefore less willing to take the risk of evading taxes. This indicates that increasing taxes increases compliance. On the other hand there is a negative *substitution effect*; i.e. the increase in tax rate reduces the difference between the tax rate and the penalty rate. Thus makes tax evasion more attractive, thus decreasing tax compliance. Which of the income- or the substitution effect is bigger is not obvious from the model.
2. A change in penalty rate,
    a. The derivative is positive, $\frac{\partial X}{\partial \pi}>0$; a higher penalty rate will always increase tax compliance, since it increases the expected penalty.

[8] An asterisk sign (*) denotes the optimal solution of the function. The same function without the asterisk denotes a general solution.

[9] The A-S model makes use of the Arrow-Pratt risk aversion measures. The absolute and the relative risk aversion functions are defined as $R_A(Y)=-\frac{U''(Y)}{U'(Y)}$, and $R_R(Y)=-\frac{U''(Y)Y}{U'(Y)}$, respectively. See Arrow (1970) for discussion on these measures.

3. A change in probability of audit
    a. This derivative is also positive, $\frac{\partial X}{\partial p}>0$; an increase in the probability of detection will lead to a larger portion of income being declared since the risk of evasion becomes greater.

Based on these results the tax authorities should in theory be able to enforce high compliance by administering a high penalty rate, combined with a high probability of audit. The results however rely on strict assumptions, some of which already indicated above, the remaining assumptions and practical implications are discussed along with the assumptions on the remaining theoretical models in Chapter 5.

A clarification of the model has been presented by Yitzhaki (1974). He follows the same portfolio theory framework. However, he is able to remove the ambiguity of tax rate changes by implementing one feature; he imposes the linear penalty, F, on the evaded taxes, $\theta(W-X)$, instead of imposing a penalty rate on unreported income.

$$g(X) = E[U] = (1-p)U(W-\theta X) + pU\big(W-\theta X - \mathbf{F\theta}(\mathbf{W}-\mathbf{X})\big)$$

where

$F:$ fine (on evaded taxes) > 1

In contrast to the A-S model, the ordinary tax rate and the penalty rate increase proportionally with θ in the Yitzhaki model. I.e., in the Yitzhaki model an increase in the tax rate also increases the penalty for evading taxes, thus the substitution effect disappears and the income effect prevails. The income effect is still positive, thus an increase in tax rate, increases tax compliance.

3.2 Cowell (1985) - What about leisure time?

Allingham & Sandmo (1972) and Yitzhaki (1974) show that changes in tax rate, probability of audit and penalty rate have *identifiable* effects on the tax compliance decision when income is exogenous to the model. Cowell (1985) on the other hand shows that if total income is *endogenous* to the model, their simple conclusions are unlikely to be robust. In particular, the effects of policy factors on tax evasion may even be completely indeterminate.

The complexity of the tax compliance decision increases if the individual is allowed to choose between leisure and work, and in addition being able to supply his labour in two job markets; "on the books" (legal) and "off the books" (illegal). The difficulty with his model is that there are two problems being solved simultaneously:

1. How much leisure time shall the individual sacrifice?
2. How shall the individual allocate his working hours amongst "on the books" and "of the books" activities?

The two questions complicate the analysis as the individual is optimising not only how much income to generate, he may also take two jobs associated with different wages and risk. The solution is to maximise the utility assuming the person is an amoral expected utility maximising individual. He seeks to maximise

$$\mathrm{h}(\mathrm{h}_0, \mathrm{h}_1) = \mathrm{EU}(\mathrm{c_i}, [\mathbf{1} - \mathbf{H}])$$

subject to choices of h_0 and h_1

$$\begin{aligned} \mathrm{c}_\alpha &= \mathrm{B} + (1-\theta)\mathrm{W_o h_0} + \mathrm{W_1 h_1} \\ \mathrm{c}_\beta &= \mathrm{B} + (1-\theta)\mathrm{W_o h_0} + (1-\pi)\mathrm{W_1 h_1} \end{aligned} \qquad with\ prob. \begin{cases} 1-p, \\ p, \end{cases}$$

where

$\mathbf{1} - \mathbf{H} = 1 - \mathrm{h}_0 - \mathrm{h}_1$: leisure time

h_0 : "on the books" legal work

h_1 : "off the books" illegal work

$\mathrm{c_i}$: is consumption if successful (α) or unsuccesful (β)evasion

$(1-\theta)\mathrm{W}_0$: After tax wage rate

W_1 : Wage rate off the books

B : Lump sum grant (fixed tax deductible)

π : Penalty rate

p : Probability of audit

The total amount of hours available are normalised to unity. The individual may decide the amount of leisure to give up, thus choosing total work load, H. He may also split the total work amount into legal, h_0 and illegal h_1 work. This makes it is possible for the

individual to substitute across two margins; leisure/work (i.e. amount of consumption), and risk/no risk (i.e. legal/illegal work). This makes the model more realistic than the earlier A-S and Yitzhaki models; however, it makes the workings of the model more complex. In principle the individual's optimal labour supply h_0 and $h_1$is provided by the following expressions.

$$h_0 = h_0\big((1-\theta)W_0\,, \pi, W_1, B, p\big)$$
$$h_1 = h_1\big((1-\theta)W_0\,, \pi, W_1, B, p\big)$$

However, the comparative results by Cowell (1985) are cumbersome, and the responses on the individual's utility by changing policy parameters do not provide determinate effects. I.e. it is not possible to determine unambiguous predictions on the effects of changes in the economic factors when simultaneously solving the model for leisure and work, and legal- and illegal work. The reason is that there are two states of nature, leisure and work, and there are two labour market decision variables h_0 and h_1. Thus, there are four decision variables in total, which are restricted by only two constraints.

Cowell (1985) therefore simplifies the problem by introducing *functional separability*[10] to the problem. Functional separability is a condition which separates the taxpayer's decision into two stages, i.e. instead of simultaneously solving the entire model in one step; the labour supply is determined by separating the decision on *amount of leisure* from the decision on the allocation on *legal- and illegal* work. In practice it means a two-step approach where the individuals first choose how much leisure time to give up, and second to allocate the supply of labour between legal- and illegal work.

The introduction of *functional separability* allows Cowell (1985) to determine effects on tax reporting. He finds that higher tax rate increases tax evasion, higher penalty rate decreases tax evasion, and higher probability of detection decreases tax evasion.

[10]The *functional sepearability* condition means in practice that the individual first determines optimal amount of leisure, and then decides on how to allocate the work hours between legal and illegal activities. The condition is analogous to the Drèze-Modigliani condition (Drèze & Modigliani, 1972) of separating the consumption decision from the portfolio choices.

However the two last conclusions depend on the labour supply curve being forward rising[11]. The results also rely, as in the A-S and Yitzhaki model, on strict assumptions on individual rational behaviour, risk aversion, and complete information. A major problem with the functional separability assumption is discussed in Chapter 5.

3.3 Levaggi & Menoncin (2012) – It's a matter of time. One more bet!

Inter-temporal versions of the portfolio models are proposed by Levaggi & Menoncin (2012). They construct dynamic versions of the A-S and Yitzhaki models, using stochastic differential equations, to investigate the tax rate effect on tax evasion. In this model Levaggi & Menoncin are able to resolve the ambiguous results in the A-S model of the increase in tax rates on tax evasion. Levaggi & Menoncin (2012) are able to clarify that if the fines are imposed on evaded income, an increase in tax rate increases tax evasion. On the other hand if fines are imposed on evaded taxes, they confirm the negative relationship between tax rates and tax evasion (the Yitzhaki result).

The model considers all income as capital income such that

$$y(t) = Ak(t)$$

This function measures the income $y(t)$ as a linear production function where A is some technology parameter, and $k(t)$ is the accumulated capital.

[11] Forward rising labour supply is when an increase in real wage rate increases supply of labour. For an individual this implies that an increase in wage rate increases his hours of work, rather than increasing leisure.

The model consists of the optimisation problem, where the individual maximises utility by choosing optimal consumption and tax evasion

$$\max_{e(t),c(t)} E_0\left[\int_0^{\infty} e^{-\rho t}\ln c(t)dt\right]$$

where

ρ (rho): consumer's discount rate

t : time instant

$e(t)$: measures the fraction of income evaded

$c(t)$: intertemporal consumption

And the state variable (capital) follows the equation

$$dk(t) = \Big(\big(1-\tau+\tau e(t)\big)y(t) - c(t)\Big)\,dt - \eta(t)e(t)y(t)d\Pi(t)$$

where

$k(t)$: capital

$y(t)$: income produced by the linear production function $Ak(t)$

τ : tax rate

$\eta(t)$: fine

$d\Pi(t)$: the risk process related to being audited (stochastic process)

The first term, $\Big(\big(1-\tau+\tau e(t)\big)y(t) - c(t)\Big)\,dt$, measures the net income after tax and consumption, plus evasion in the instant, *t*. The second term, $\eta(t)e(t)y(t)d\Pi(t)$ is a risk process which measures the expected value of the fine on evaded income, in the instant, *t*. The risk related to audit is introduced through a Poisson jump process. The intensity of the process $d\Pi(t)$ whose expected value and variance are given by

$$\mathbb{E}_t[d\Pi(t)] = \mathbb{V}ar_t[d\Pi(t)] = \lambda dt$$

where

λ : intencity of the process (audit intecity)

The model by Levaggi & Menoncin (2012) results in the following functional expression for optimal amount of tax evasion

$$e^*(t) = \frac{\tau - \eta(\tau)\lambda}{\tau\,\eta(\tau)A}$$

If a constant fee is paid on the evaded *income* as in A-S model (i.e. $\eta(\tau) = s$) the optimal tax evasion is a positive function of the tax rate. The characteristic ambiguity of A-S model is resolved and for the inter-temporal model the relationship between tax rate and tax evasion is positive; an increase in tax rate increases tax evasion. If, on the other hand, a constant fee rate is paid on the evaded *taxes* ($\eta(\tau) = s\tau$) as in Yitzhaki (1974) the optimal tax evasion is a negative function of tax rate; an increase in tax rate decreases tax evasion.

It becomes apparent that optimal portfolio theory and closely related research are able to find identifiable results in terms of policy factors impact on tax evasion, and based on the theories presented it makes sense for governments to actively utilise and be aware of consequences of tax rates, audit probabilities, and penalty rates to encourage and enforce tax compliance, and detect and sanction tax evasion. These intermediary conclusions are unfortunately based on several strong and restrictive assumptions discussed in Chapter 5.

3.4 Reinganum & Wilde (1985) – Don't bet on it!

The paper by Reinganum & Wilde (1985) represents a different theoretical view on the topic of tax evasion. They intriguingly state that "one of the most interesting features of modern systems of income taxation is their essentially voluntary nature"[12] Reinganum & Wilde (1985) constructs a principal-agent framework where the tax authority (principal) and the taxpayer (agent) strategically interact to maximise their respective utility. They find that this approach produces higher levels of tax compliance than do portfolio theory.

[12] As an interesting side note it may be observed that Reinganum and Wilde (1985) argues and writes their paper keeping a positive compliance focus, rather than the negative and onerous evasion view.

Reinganum & Wilde (1985) focus on an "audit cut-off" policy, in which the tax paying agent triggers an audit if he reports income that is *too low* (according to a set limit); in contrast he is not audited if reported income is *sufficiently high*. Depending on their reported income the individuals thus faces different probability of being audited

$$p(X) = \begin{cases} 1 & if\ X < i \\ 0 & if\ X \geq i \end{cases}$$

where

i : audit trigger amount

i $\in [0, \infty)$

It is important to note that Reinganum & Wilde (1985) model the tax compliance decision by assuming that individual income, W, is a random variable. This means that some individuals will realise real income higher than the trigger amount, i, and some will realise income below the trigger amount. This means that the individual's tax liability is still a function of reported income, however, it is modelled as a lump sum payment, T. In optimum the trigger amount equals the lump sum tax, $i = T$. I.e. the individuals are prompted to pay T, or if the income of the individual less than T, he will pay all of his income, W. The taxpayer's income after tax will be

$$Y(W, X) = \begin{cases} W - \min(X, T) & if\ i \leq X \leq W \\ W - \min(T, W) & if\ i > X = W \\ W - \min(T + F, W) & if\ X < \min(i, W) \end{cases}$$

where

W : (randomly realised)income

X : amount of declared income,

T : lump sum tax

F : lump sum fine

The model by Reinganum & Wilde (1985) shows that the audit cut-off policy produces complete tax compliance. Additionally, they argue that the principal-agent model dominates prior non- principal-agent theory for proportional, as well as lump-sum taxes as well. However, their results were established under fairly strong assumptions. In

particular, they assumed risk-neutrality for the agent and that the principal desires to maximise net expected revenue.

In terms of the government's policy instruments the results are interesting. It shows that if the tax authorities are able to commit to their cut-off strategy (by performing audits on *everyone* who reports below the audit trigger amount, and discovering all tax evasion if performing audits) there exists an equilibrium in which there is no tax evasion. If that is the case then the a change in the lump sum tax or the lump sum fine will not impact tax evasion at all, because the audit policy does not change and tax evasion will still be non-existent. In principle the tax authority can raise as much taxes as they like.

3.5 Bayer (2006) – Fool me once, shame on you. Fool me twice…

Bayer (2006) constructs a model of tax evasion, where the tax authority is assumed not to commit beforehand to an audit strategy. The reasons the tax authority may be assumed to behave in such a way are two-fold according to Bayer (2006); first, a credible commitment requires that the taxpayers know the audit strategies that the tax authority will use. Bayer (2006) argues that the apparent secrecy surrounding authorities' audit strategies shows that the taxpayers do not know the strategy. Second, Bayer (2006) argues that even if taxpayers knew, they do not necessarily believe the commitment attempts by the tax authorities.

In his tax-evasion model the tax authority and taxpayers are able to invest in detection and concealment respectively. The taxpayers may have multiple income sources (for instance they have several employers, or are self-employed with multiple customers). The introduction of multiple income sources is an improvement to other models where income is homogenous, such as in portfolio models. The taxpayer maximises income net of tax liability, resources invested in concealment, moral cost of evasion, and expected fines.

The taxpayer is assumed to be risk neutral, and the tax authority is assumed to maximise tax revenue plus expected fines net of detection costs, and is also risk neutral.

$$EU = \sum_{i=1}^{n} Y_i - T(d_i) - F(Y_i, d_i) * p(e_i, a_i) - C(e_i) - \phi\theta$$

$$ER = \sum_{i=1}^{N} T(d_i) + F(Y_i, d_i) * p(e_i, a_i) - K(a_i)$$

where

N：number of income sources (in nature)

n：number of individual's income sources

i ：income source identificator

Y_i：Amount of income from source i

$T(d_i)$：Tax liability for an income declaration

$F(Y_i, d_i)$：fine (if true income is verified)

d_i：Income decleared for i

$p(e_i, a_i)$： Verification probability

e_i：Investment (effort) in reducing verification probability

a_i：Detection effort (tax inspector can exert different levels of effort)

ϕ：Indicator variable for evasion

$\theta \in \{\theta_l, \theta_h\}$: moral cost

$K(a_i)$：detection costs

Nature determines the amount of income Y_i from source *i*. After observing the actual income generated by the possible sources the taxpayer has to file a tax return. He observes his tax liability $T(d_i)$, and separately declares to the tax authorities the income for each of his multiple sources, d_i. The taxpayers are assumed to differ in their attitudes towards tax evasion. These attitudes are captured by different moral costs of evasion, θ. The taxpayer also has the possibility to invest some of his resources, e_i in order to reduce the probabilities of being verified as a tax evader.

The tax authority observes a tax declaration and chooses its detecting efforts, a_i. The declaration pattern over different income sources reveals some information to the authority about the likelihood of facing an evader. The tax inspector can even get more valuable information if he adopts a sequential auditing strategy. I.e. he audits one income source, and then decides whether or not to audit another one belonging to the same taxpayer. He can use the information gained from previous audits when deciding over detection efforts for sources that are not yet audited.

Bayer (2006) shows that when comparing sequential auditing of income sources to a strategy where the tax authority audits all sources of the taxpayer at the same time, the first approach yields better results (for the tax authority) since auditing one source may reveal valuable information about the taxpayer and his likely behaviour for other sources. Under simultaneous audits the environment is favourable for evasion if the taxes liabilities are high, if concealment is cheap, and if fines are low. Bayer finds that sequential auditing has the edge over simultaneous auditing from the auditor's point of view. Under the sequential auditing regime the beliefs of the remaining income sources may be different after the first audit. In the case of evasion in the first audit, the perceived probability that the remaining income sources contain evasion is increased.

Bayer (2006) concludes that sequential audits discourage evasion. He notes that this is confirmed by a widely observed audit pattern in reality, namely that tax inspectors sequentially routinely check with a consecutive full-scale audit if suspicion of evasion arises from these checks. In terms of theory Bayer (2006) shows that a tax inspector prefers to audit source by source until he finds evidence for evasion to conduct a full-scale audit.

3.6 Alm, Bahl & Murray (1993)– Hold on! Audits aren't random.

At this point it is necessary to take a brief look at some empirical research. The analytical models of tax evasion are all critically depending on the assumption that the

likelihood of being audited is random[13]. Alm et al. (1993) however, find evidence that both the taxpayers and tax authority interact strategically to achieve their respective ends. The interaction between the taxpayers and the tax authority constitute a game-theoretical, sequential equilibrium model of the tax compliance game where the outcome of the game is a compliance strategy for the individual, as well as an audit strategy for the tax authority.

Alm et al. (1993) uses a game-theoretical model to structure the taxpayer – tax authority interaction in an effort to estimate a model of audit selection and income tax underreporting behaviour in Jamaica. The steps may be described as

1. The individual taxpayer first observes his true income, and files a tax return with reported income, credit, and tax information, knowing that the items reported on the return may influence the probability of audit.
2. The tax authority then decides who to audit on the basis of the items reported on the return.

For their analysis they used two data sets generated in connection with a comprehensive tax reform in the country[14]. The first set contained observations on audited Jamaican taxpayers, in which the information was detailed enough to make direct estimates of the amount of individual taxpayers' income tax evasion, i.e. identify the tax evaders. The second data set contained detailed information on 932 tax returns of a random sample of non-audited individuals. This enabled Alm et al. (1993) to investigate the tax authorities selection process, as well as patterns of individual's tax evasion behaviour.

Alm et al. (1993) constructed a hypothetical model in which they treated the tax authority and the taxpayers as strategic players. Then they tested if there existed significant determinant factors which revealed patterns in the audit selection process of

[13]Note: The a priori likelihood of being audited in the cut-off model (Reinganum & Wilde, 1985) is also random. I.e. prior to the realization of individuals' income level.
[14] According to Alm et al. (1993) the first set contained 148 audited tax return for self-employed taxpayers from years 1980 to 1982,

the tax authority, and if there existed patterns among the individual's tax evasion behaviour.

The observations collected in the data set represented equilibrium, where it was assumed that both the taxpayer and the agency must behave optimally, given the response of the other. Alm et al. (1993) presents several estimation methods in their effort to reveal strategic interaction between the tax authority and the taxpayers. All of which have in common that they employ different versions of the probit[15] regression model to compare the determinants describing the confirmed tax evaders, with the determinants describing the taxpayers selected for audits. The procedure therefore allowed estimation of the major factors that may determine individual tax evasion behaviour and tax authority audit selection.

Alm et al. (1993) show evidence in the empirical relevance of the sequential equilibrium model of the tax compliance game. The results supported the systematic nature of the tax agency's behaviour. In particular they found that the tax agency systematically uses information reported by the taxpayers to select returns for audit. Consequently they (Alm et al., 1993) note that it should *not* be assumed that the behaviour of the agency is *not* strategically given or exogenous to the compliance process, nor that it can be assumed that the behaviour of the taxpayer has no effect on the probability if audits. The results also found that economic factors play a large role in the individual's compliance decision. In general, the probability and the level of underreporting were positively related to the marginal tax rate and income, and negatively related to marginal payroll tax benefits. It is also argued that opportunities for evasion, as measured by the number income sources, affect tax evasion. Generally the paper shows that understanding tax compliance - and devising policies to combat it - requires recognition of the strategic nature of the compliance game.

---

[15] Probit is similar to multiple regression in that the dependent variable (a proportion) is predicted from a set of variables analysis focus on proportions if cases in two or more categories of the dependent variable. It produces an estimate of the probability that the dependent variable is equal to 1 given a set of predictor variables.

3.7 Feinstein (1991) – Audits are imperfect!

Another interesting study in terms of evasion detection is an empirical study by Feinstein (1991). He models econometrically the relationship between information provided on tax return, and taxpayers' decision to evade. He finds that, "the likelihood and magnitude of tax evasion increases with taxpayer income and the marginal tax rate". He also finds that self-employed tax payers are much more likely to evade than the average tax payer, and that married people and individuals under the age of 65 is more likely to evade. In other words; there may exist several determinant factors which indicate tax evasion behaviour. Another point made by Feinstein (1991) is that detection when the tax authority is performing audits is imperfect. This is an interesting discovery[16], since most analytical tax evasion theory makes the assumption that given an audit all evaded taxes are detected[17].

[16] This may appear obvious to the reader, however in terms of criticism of analytical models of tax evasion, the finding that audit selections are not random is an important result.
[17] An estimate of the average detection rate of tax examiners is approximately 50% (Feinstein, 1991).

4 Modern framework of tax compliance

4.1 Kirchler, Hoelzl and Wahl (2008) – Compliance in three dimensions.

Kirchler, Hoelzl and Wahl (2008) suggest a new theoretical framework to analyse the tax compliance behaviour; the "slippery slope" framework[18]. The framework is presented as an operational tool to investigate the interaction between the taxpayers and authorities by integrating economic and psychological factors assumed to relate to tax compliance. Particularly, Kirchler et al. (2008) attempt to describe the tax compliance decision, when no longer assuming that all taxpayers are explicitly trying to rationally avoid paying taxes. Thus they incorporate the observation that a majority of taxpayers take the legitimacy of the tax system for granted and pay their taxes without considering the possibility to evade.

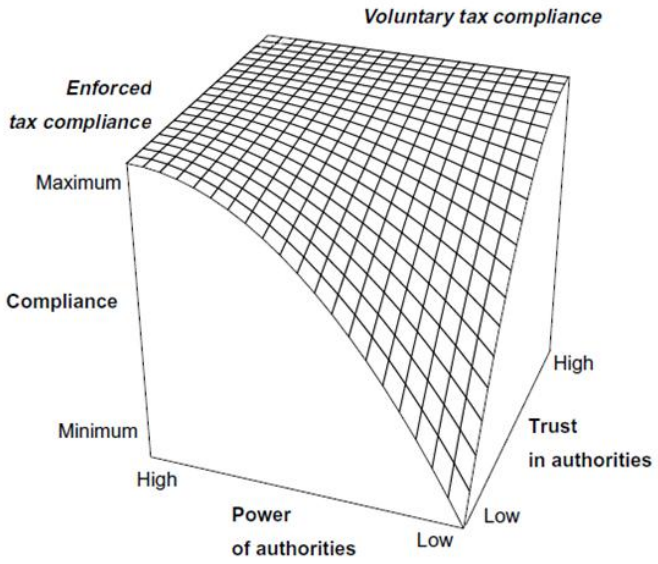

Figure 2: The dimensions of tax comliance[19]

[18] A suggested visual interpretation of the "slippery slope" framework:
Imagine a funnel or an upside down cone where the top is wide and the bottom is narrow. Along the upper edges economic and non-economic factors of compliance are placed. The center bottom *is* tax compliance. Depending on the number and intensity of the factors, the taxpayer slides into taxpaying compliance at the bottom of the cone.

[19] Figure by Kirchler et al. (2008) p. 212

The "slippery slope" framework illustrated by Figure 2, introduces two main dimensions which are assumed to influence tax compliance behaviour. The taxpayers' perceptions of the dimensions are assumed to determine the extent of compliance. The dimensions are "trust in authorities" and "power of authorities".

1. Trust in authorities

   Kirchler et al. (2008) defines trust in authorities as "the general opinion [of individuals and social groups] that the tax authorities are benevolent and work beneficially for the common good" whereas

2. Power of authorities

   Refers to the perception of "authorities' capacity to detect and punish evasion" (Kirchler et al., 2008), for example by conducting frequent and thorough tax audits.

According to Kirchler et al. (2008) the general idea is that the tax climate in a society can vary on a continuum between an antagonistic climate and a synergistic climate. The antagonistic climate is characterised by a "cops and robbers" – attitude, i.e. the authorities and taxpayers work against each other; in a synergistic climate, they work together. In the antagonistic climate taxpayers feel persecuted by the authorities and feel the right to evade. Kirchler et al. (2008) argue that in such a climate social distance is likely to be large, with little respect and little positive feelings towards the regulatory authorities on behalf of individuals and groups. Voluntary compliance is likely to be low, and individuals are likely to resort to "rational" weighing of the costs and benefits of evading, and only complying when forced to do so.

Kirchler et al. (2008) characterise the synergistic climate by the idea that authorities perform a service to the community, and are a part of the same community the individual taxpayer belong to. In the synergistic climate the authorities communicate a "service and clients" – attitude. The taxpayers act on the basis of the perceived fairness of the system and comply voluntarily. The authorities in the "service and client" – approach motivate taxpayers by means of trust to comply voluntarily, with a decreased need for cost-intensive audits. The taxpayers in a synergetic climate consider their tax

share as a fair contribution to the public good. Factors that are suggested to contribute to trust are subjective tax knowledge, participation, positive attitudes towards taxes, favourable norms on the personal, social, and national level, perceived fairness in distributional, procedural, and retributive terms, and a considerate use of power. It is assumed that authorities aim for transparent procedures and for respectful and supportive treatment of taxpayers. In such a climate, individuals are less likely to consider the chances of evading, and more likely to contribute their share out of a sense of obligation.

According to the framework, tax compliance can be fostered either via boosting trust in authorities or by increasing the enforcement of power of authorities. However, the quality of compliance is different in the two cases. Increasing tax honesty via enhancing trust in the authorities leads to voluntary compliance, while raising power of authorities induce enforced compliance. In the framework, it is argued that the subjective tax knowledge and participation in the use of taxes is positively related with trust, whereas poor understanding and misunderstanding are positively correlated with distrust. Thus, higher knowledge leads to higher compliance. Increasing taxpayers' literacy by simplification of the tax laws will increase trust in authorities and will therefore lead to increased voluntary tax compliance. Power of authorities refers to the perception of authorities' capacity to detect and punish evasion. Knowledge about tax officers having conducted a large number of tax audits and detected several cases of fraud can make authorities appear effective and powerful. Kirchler et al. (2008) also recognise the interconnectedness of power and trust. They note it would be difficult to identify clear relationship between them, and it is more likely that they form a reciprocal relationship. For example, when authorities increase their level of auditing, the new level of monitoring could be interpreted as a signal that the authorities distrust the honest taxpayers, on the other hand it may be interpreted as an effort to bring justice through enforcing power.

Within the framework, the impact of the tax rate would depend on the degree of trust. When trust is low, a high tax rate could be seen as an unfair treatment of taxpayers, as an attempt at taking from the taxpayers what is rightly theirs. When trust is high, the

same level of tax rate would be interpreted by taxpayers as an appropriate contribution to the community, which in turn again profits each individual. In the first case, the tax rate would be interpreted as the wielding of power by some remote office; in the second case, as a joint agreement within the community. Whether or not the different factors increase or decrease the level of tax evasion depends on which dimension is investigated.

4.2 Kogler et al. (2012) – Eastern Europeans support the "slippery slope"!

Kogler et al. (2012) investigated the "slippery slope" framework in an empirical observational study. The aim of the study by Kogler et al. (2012) was to find confirmation of the general validity of the main assumptions of the "slippery slope" framework within different cultural and economic settings. Specifically the following hypothesis where constructed in order to test the main assumptions of the slippery slope framework

1. High perceived *trust* compared to low level perceived trust in authorities leads to
    a. a higher level of intended tax compliance
    b. a higher level of voluntary compliance, and
    c. a lower level of tax evasion in the form of strategic taxpaying.
2. High perceived *power* compared to low perceived *power* of authorities results in
    a. Higher intended tax compliance
    b. Higher enforced compliance, and
    c. Lower tax evasion in the form of strategic taxpaying.

The countries selected for the study was Austria, Hungary, Romania, and Russia. The reasons for the authors selecting these countries were their differences with regard to the fiscal system, the estimated levels of shadow economy, and the extent of corruption. As an indicator of *trust* their study used the Austrian, Hungarian, Romanian and Russian scores from Transparency International Corruption Perception Index (2011), while the World Wide Governance Indicators (Kaufmann, Kraay, & Mastruzzi, 2010) was used to indicate *power* of the authorities.

The hypotheses were tested by performing a lab experiment with students from Russia, Austria, Hungary and Romania. 1319 student from four universities in the four countries where participating in the experiment. They were all asked questions describing their level of intended tax compliance in a make-believe country. The study (Kogler et al., 2012) revealed strong effect for both dimensions of trust and power. The authors found that the manipulation of trust in authorities and power of authorities proved to be successful, and that the manipulation of trust also had an impact on perceived power, just as the manipulation of power had an effect on perceived trust.

Kogler et al. (2012) found evidence to support the assumptions of the "slippery slope" framework and show that both trust and power are important determinants of tax compliance in different economic conditions and tax climates. In terms of government policy Kogler et al. (2012) suggest that governments should try to gain their citizens' trust by enhancing fair procedures and service-oriented behaviour. As a consequence, citizens may comply voluntarily even in cases where detection by authorities is rather unlikely. Kogler et al. (2012) found the highest tax compliance and the lowest level of tax evasion in the condition of high trust in authorities and high power of authorities (in Austria). The participants in the group of low trust and low power showed the lowest intention to comply and the highest intention to evade taxes.

5 Empirical research on tax evasion determinants

A literature review by Jackson and Milliron (1986) established 14 key determinants of tax evasion. These included age, gender, education and occupation status (described as "demographic" determinants), income level, income source, marginal tax rates, sanctions and probability of detection ("economic" determinants), and complexity, fairness, revenue authority initiated contact, compliant peers and ethics or tax morale ("behavioural" determinants). Since then multiple studies to identify key determinants of individual's tax evasion decision have been performed. This section provides a look into some of the important empirical studies.

5.1 Empirical studies: Determinants of tax evasion matter, but which?

The questionnaire survey by Porcano (1988) is a comprehensive analysis on individual's attitudes towards tax evasion. He finds gender to be significant, and proposes that future policy should place greater enforcement and detection efforts on single and male taxpayers. He also found that non-evaders tended to be more honest[20] than evaders. Self-employed or individuals with a second job "off the books", thus opportunity to evade tended to do so. Further Porcano (1988) finds that tax evaders believed that tax evasion was more prevalent than non-evaders did, and that attitudes towards engaging in future evasion was influenced by gender; males appeared to be more apt to evade in the future, and single (unmarried) individuals tended to previously have been evading taxes, however found that the tax rate had no effect on evasion and underreporting.

Riahi-Belkaoui (2004) considered the relationship between selected determinants of tax morale and tax evasion, employing data from 30 countries. He found empirical evidence to show that tax evasion across countries was negatively related to the level of economic freedom, the level of importance of the equity market, the effectiveness of competition laws and high moral norms.

[20] Whether or not the person was considered honest depended on the respondents' answers to relevant questions in the questionnaire

Some researchers (Spicer & Hero, 1985) have questioned whether or not the taxpayers make the burdensome calculations necessary to determine an optimal level of tax evasion. In a laboratory study Spicer & Hero (1985) set up a multiple round game experiment in which student participants were given a small income and prompted to decide on how much of the income they would report. The students were taxed on that amount. The participants were also provided with deceptive information regarding other groups of students who had supposedly taken part in a prior game. Spicer and Hero (1985) found that the amount of taxes evaded was positively and significantly related to the individual's tax evasion decision in earlier rounds of the game. The number of audits had a significant and negative effect in tax evasion in the last round. Gender did have an effect, according to Spicer and Hero (1985) "men tended to evade more taxes than women". The results also showed that the individual's experience of being audited lowered levels of tax evasion in subsequent rounds. Spicer and Hero (1985) found that the amount of taxes evaded was not affected significantly by the information provided regarding evasion in fictional games by student peers. However, the reason might be that the subjects in the experiment did not know how the other members of their group actually behaved since the perceptions were formed upon deceptive information provided by the researchers about group compliance rates in experiments that were not in fact run. Also, subjects in their experiments were not able to affect the behaviour of other group members by their own compliance decisions, since there was no group tax fund and there was no interaction among the group members.

Wallschutzky (1984) performed an Australian nationwide questionnaire mail survey. The group consisted of identified evaders, and a random control group of individuals. The study looked to explain tax evasion in by two dimensions; the respondents' basic predisposition towards the state, and how tax evasion was likely to be influenced by control systems. Wallschutzky (1984) found that both evaders and non-evaders thought in general that tax rates were too high and quality of Government services was too low and/or too expensive. However Wallschutzky (1984) notes that those who evaded tax expressed opinions such as, they "did not get value for their tax dollar", "tax rates were too high", "Government did not spend taxpayer's money wisely", that the "burden of

taxes fell disproportionality on low income and salary earners", that the "rich avoided taxes by employing tax specialists", and that the "other aspects of the tax system caused inequalities". However the control group from the general population did not differ significantly from responses. He also suggests that treatment by tax authorities, being punished for evasion in particular causes resentment which in turn increases motivations to cheat.

A controlled experiment by Alm et al. (1992) investigated the impact of the effects of probability of being audited, by performing laboratory experiments with voluntary participating students. The students were provided with a small income and were asked to report income for taxation. The probability of being audited and the fine for evading taxes were stated and known to the students prior to making the reporting decision. The game was multiple rounds, and in some of the rounds of the game a social multiplier was introduced to incentivise group compliance. The social multiplier distributed an additional even income to the group based on the total income reported by the group. The results in Alm et al. (1992) suggest that tax compliance occurs because some individuals are oversensitive, or overweight the probability that they face. The study showed that there was some compliance there was no chance of detection, on the other hand there was some evasion when the expected value of the evasion gamble was negative. The study also suggests that compliance occurs because individuals value the public good that are financed by the tax payments.

Arguably one of the most comprehensive empirical studies on tax evasion of recent times is the one by Richardson (2006). The cross-sectional study is a detailed empirical analysis of proposed key determinants of tax evasion. The study expands the work of Riahi-Belkaoui (2004) and systematically investigates many of the key determinants of tax evasion identified by Jackson and Milliron (1986). Richardson (2006) estimates several ordinary least squares (OLS) regressions, based on a data set obtained from among other OECD, World Economic Forum and World Bank.

The base regression model is defined as

$$\begin{aligned}\mathrm{TEVA_i} = \alpha_i &+ \beta_1 \mathrm{AGE_i} + \beta_2 \mathrm{GENDER_i} + \beta_3 \mathrm{EDUCATION_i} + \beta_4 \mathrm{LILEVEL_i} \\ &+ \beta_5 \mathrm{HILEVEL_i} + \beta_6 \mathrm{AISOURCE_i} + \beta_7 \mathrm{SISOURCE_i} \\ &+ \beta_8 \mathrm{MARGINALTAXRATE_i} + \beta_9 \mathrm{FAIR_i} + \beta_{10} \mathrm{COMPLEXITY_i} \\ &+ \beta_{11} \mathrm{SELFASSESSMENTSYSTEM_i} + \beta_{12} \mathrm{MORALE_i} + \varepsilon_i\end{aligned}$$

where the dependent variable TEVA is *tax evasion* as measured using subjective survey ratings[21]. For country *i* the variables describe the percentage of the population greater than 65 years of age, the percentage of the population that is female, the general education score, the proportion of household income going to the lowest 20% of households, the proportion of household income going to the highest 20%, the percentage of employment in the agricultural sector, the percentage of employment in the services sector, the top marginal income tax rate for individuals, the fairness score, the complexity score, the dummy variable represented by 1 if the country *i* has a self-assessment tax system, the tax morale score, and the error term, respectively.

Richardson (2006) did find significant determinant variables of tax evasion. First of all that *complexity* was the most important positively related determinant of tax evasion. Other important determinants which were negatively related to tax evasion were found to be *education*, *percentage of employment in service sector*, the *fairness score* of the country and *tax moral*. Among the insignificant determinants was age, gender and marginal tax rate. Richardson (2006) found that the results supported the view that non-economic determinants have the strongest impact on tax evasion.

[21] See *Appendix A* in Richardson (2006) for detailed description on dependent and independent variables, p156.

6 The reality of research: Assumptions and implications

The theoretical models of tax evasion provide fundamental and useful groundwork for the development of subsequent tax evasion research. However, their predictions on tax evasion behaviour need to be interpreted cautiously with their respective assumptions in mind. First of all, the portfolio models of tax evasion, such as the A-S model and Yitzhaki model, rely on the assumptions that taxpayers exhibit rational behaviour, act risk averse and maximise individual utility. The study by Alm et al. (1992) finds contrary evidence to indicate that some individuals are not cheating even if the audit probability is zero; in fact, on the other hand with regard to rational behaviour, some individuals demonstrate risk-seeking behaviour by making non-positive expected value reporting decisions. Alm et al. (1992) also finds that individuals in general overweight the probability of being audited and the associated penalty of being caught cheating. This finding is in conflict with another critical assumption in portfolio theory; namely that taxpayers have access to complete information when making the decision on tax reporting. Even if individuals are explicitly informed about their own true income, the penalty rate, and the probability distribution of being audited, individual's subjective perception does not represent the factual information.

Another portfolio theory assumption is that the individual's decision to evade is independent and unaffected of other individuals' decisions regarding tax evasion. The study by Porcano (1988) contradicts this as he finds indications that tax evaders often confirmed that they knew, or knew of, other tax evaders. In terms of portfolio theory assumptions it may also be noted that those models abstract from the fact that tax evasion in some cases lead to non-economic penalties such as jail, prohibitions on personal activity, loss of social recognition etc. The portfolio models also abstract from the fact that audits are costly to carry out. From the tax authority's point of view that means there are limits on the capacity of doing audits, and thus how high the probability of being audited can be in reality. It may not be feasible to audit all of the population, in addition it is highly unlikely that the probabilities of audits are in fact completely random and exogenously given. This is discussed in a different study by Alm et al.

(1993) where he shows that the audit selection process is not random, and argues that there exists strategic interaction between the taxpayers and the tax authority.

The theoretical model by Cowell (1985) exhibits the same weaknesses in terms of the assumptions as other portfolio theory. In addition, some interesting notes were made in an essay by Schroyen (1994). His essay argue that the *functional separability* (Drèze & Modigliani[22]) assumption that leads to a manageable procedure to solve the Cowell model is unlikely to hold in reality when a *lump sum penalty* is present. The reason may be too extensive to discuss in detail in this review, however the argument is that the Drèze & Modigliani assumption critically depends on the absence of a lump sum fine part. This is not likely to be envisioned in reality, as fines often consist of lump sum and linear parts, thus the conclusion is that the separability assumption does not obtain. The implications for the model by Cowell (1985) is that his clear cut results, under the separability assumption, on the economic factors' effect on tax evasion are not valid, and that the ambiguous general solution leaves the factors' effects on tax evasion undetermined.

Principal-agent models and portfolio models share some assumptions, especially with respect to rationality of individuals' behaviour. However, there are some differences; Reinganum & Wilde (1985) assume risk neutral taxpayers, which is a very strict assumption. It implies that, for instance, the taxpayers are indifferent between receiving a fixed value amount, and a risky amount with the equivalent expected value. Another weakness of the principal-agent model is its implication that all audited taxpayers is found to have reported honestly. The reason that they all report honestly is that the tax authority is assumed to be able to commit to their strategy and detect all tax evaders. Recall from Reinganum & Wilde (1985), where the only individuals being audited were the ones that paid less than the lump sum tax (since they reported below the trigger amount), and the individuals that did pay tax paid the same fixed amount. Given the assumption that all evaded taxes is discovered in an audit, this leads to the property of

[22] See Drèze & Modigliani (1972) for functional separability (in consumption and portfolio decisions)

the principal-agent model, that it results in total tax compliance. This property is unrealistic as Feinstein (1991) shows empirically that detection is imperfect, i.e. that the tax authorities' examiners are unable to detect all evaded taxes all the time.

In the game-theoretic model by Bayer (2006), he assumes rational behaviour and that taxpayers maximise utility. The game-theoretic model generates considerably more realistic predictions on tax compliance than the principal-agent model, since some of the taxpayers are found to comply, and some are found to evade. In the sequential equilibrium of the game-theoretic model by Bayer (2006), many audited taxpayers are found to have reported dishonestly. This reporting pattern is more consistent with empirical observations than the results provided in earlier models of tax evasion.

The "slippery slope" framework (Kirchler et al., 2008) introduced two new assumptions to tax reporting theory, namely that "trust in authorities" induce voluntary tax compliance, and that "power of authorities" enables enforcement of tax compliance. Empirical research prior to the "slippery slope" on determinants of tax compliance (Porcano, 1988; Richardson, 2006; Wallschutzky, 1984) have found that normative and behavioural factors contribute significantly to the tax compliance decision. In particular Richardson (2006) argues that non-economic determinants are significantly affecting tax compliance. Recent studies (Kogler et al., 2012) have tested the "slippery slope" framework and found empirical support in the assumptions that *trust in authorities* and *power of authorities* are positively related to voluntary- and enforced tax compliance respectively. However, it may be noted that not much empirical testing have been performed on this particular framework.

Finally, empirical studies are also subject to several limitations. The limitations of the studies are primarily related to the unavailability of data. In particular the problem is to acquire accurate information, or convince participants to respond to experiments thoroughly and truthfully. Studies may be biased from omitting relevant variables in their models. Another common issue is the sample size, and sample selection. The study by Richardson (2006) consists of a data set with 45 countries observed in the sample, and the investigation by Kogler et al. (2012) collected experimental data in four

countries. The empirical research would benefit from larger and more detailed empirical studies of tax evasion.

7 Conclusions

I have in this review investigated the theoretical and empirical literature of tax evasion starting from the analytical models developed in the 1970s, via introductions to principal-agent, and game theoretical models, into the present modern frameworks which incorporate economic and psychological factors of tax compliance. The emphasis of the review has been to provide the reader with a thorough, yet non-intimidating summary of key literature on factors of tax evasion. The factors have for convenience been separated into "economic factors", "non-economic factors" and "determinants".

In this chapter I present key factors, determinants and final remarks.

7.1 Economic factors of tax compliance

Tax rate

Researchers do not agree on the effects of an increase in tax rate; Alm et al. (1992) finds that higher taxes increases tax evasion, on the other hand, the analytical result by Yitzhaki (1974) predicts the opposite. Porcano (1988) finds that the tax rate had no effect on evasion and underreporting, and Allingham & Sandmo (1972) and Cowell (1985) provide ambiguous and undetermined effects respectively. The research leaves the impression that the income tax rate is *not* the vital parameter in the taxpayers' tax reporting decision.

Audit policy

The audit policy is important, and arguably the least controversial factor of tax compliance. Analytical models (Allingham & Sandmo, 1972; Reinganum & Wilde, 1985; Yitzhaki, 1974) find that increasing the probability of audits reduces the extent of tax evasion, as do empirical studies which focus on perceived audit probabilities (Alm et al., 1992). However, studies (Alm et al., 1993) show that the probabilities are in reality not random since there exist a strategic relationship between taxpayers and the

tax authority, thus the audit selection process is biased toward individuals who exhibit certain characteristic determinants. It may be possible to argue that performing *random* audits may increase the taxpayers' perceived risk of being exposed as a tax evader, since then everyone is in principle eligible for audit; on the other hand, based on the literature, the most effective and realistic approach in terms of detection, seems to be to conduct a strategic selection of taxpayers for audit.

Fines and penalties

Analytical models (Allingham & Sandmo, 1972; Cowell, 1985; Yitzhaki, 1974) show that increasing fines decreases tax evasion. Empirical research (Alm et al., 1992) supports the analytical models in this regard. Recently developed theory (Kirchler et al., 2008) argues that fines that are too low could be perceived as an indicator that the authorities are weak and unable to control the tax evaders, thus undermining trust among honest taxpayers. On the other hand fines that are inappropriate because a taxpayer involuntary made a mistake, or fines that appear as unreasonably high, would undermine the perception of fairness, thus reduce voluntary compliance. Over all, theory leaves the impression that it is not the extent or severity of fines that are of decisive importance, it is the existence and enforcement that is the primary concern.

7.2 Non-economic factors of tax compliance

Complexity of tax system, and taxpayer – tax authority interaction

Empirical studies (Richardson, 2006) find significant positive relationship between the perceived complexity of the tax system and tax evasion. In recent research (Kirchler et al., 2008; Kogler et al., 2012) it is argued that the tax authorities might induce voluntary tax compliance by attempting to form a "synergistic" relationship with the taxpayers. Thus if the tax authorities present a service minded mentality, e.g. by providing taxpayers with appropriate help in tax reporting situations, compliance should benefit. In general simplifying tax regulations, or increasing tax literacy (or even general education) may also increase tax compliance.

Attitudes, norms and morals

Empirical research (Riahi-Belkaoui, 2004) finds that high moral code of the taxpayers in a country is positively related to tax compliance Another empirical study (Richardson, 2006) shows that tax moral and perceptions of fairness is positively related to compliance, and some studies (Alm et al., 1992) argue that tax compliance occur due to the appreciation of public goods. Attitudes towards the authorities have been investigated (Wallschutzky, 1984) and it is argued that feelings of resentment is associated with tax evasion. Empirical studies find that tax evaders more often than non-evaders claim to know about other tax evaders (Porcano, 1988). The reviewed literature indicates that if the tax revenue is spent on popular public goods, then tax compliance should be positively affected. Additionally tax authorities may expect positive effects on tax compliance by ensuring that the authorities and its representatives acts in accordance to the citizens' perceptions of what is morally good.

7.3 Determinant factors

Age, gender and marriage

Age and gender are two commonly used variables in empirical research, and according to some studies (Feinstein, 1991) the age of taxpayers is one of the most important determinants of tax evasion. Porcano (1988) found that males did show significant positive attitudes towards future prospects of tax evasion. The same study also found that singles evaded more than non-single. The results appear to confirm some popular common beliefs, however it is worth noting that some studies (Richardson, 2006) does not find gender or age to be significant.

Income, income sources and occupation

Feinstein (1991) finds that the likelihood of tax evasion increase with income. The analytical models (Allingham & Sandmo, 1972; Yitzhaki, 1974) reviewed depend on very specific assumptions on risk aversion when determining the effects by income, thus they provide in practice indeterminate results. However, other empirical studies find relationships in an income-related variable, namely *opportunity*. Studies (Porcano, 1988) find that the number of opportunities the individual has to evade, is positively

related to tax evasion. Thus if the individual has several employers or is self-employed, his opportunities for evasion are larger than for instance for those employed in only one fulltime job.

7.4 Final remarks

This literature on income tax evasion theory has collected factors which are proposed by theoretical and empirical research to affect individuals' tax evasion/tax compliance decisions. The factors and determinants of tax evasion, and their effects are not often agreed upon by researchers; however there is a general theoretical and empirical consensus that the tax authority's audit selection policy is highly important. The optimal audit strategy is not specifically investigated in this review. However, based on the observation that audits are costly, and that they are imperfect in terms of detection; it seems likely that the optimal audit strategy should involve a non-random selection process to maximise the chances of identifying evaders. In addition this non-random selection process would benefit from detailed information on relevant tax evasion determinants to separate potential evaders from assumed non-evaders.

PART II

The “slippery slope” framework

- An empirical study of a modern tax compliance framework

1 Introduction

This Part II of my thesis investigates a recently developed theoretical tax compliance framework, namely the "slippery slope" framework, introduced by Kirchler, Hoelzl and Wahl (2008). The objective of this brief study is to test the assumptions at the core of the "slippery slope" framework by looking for support of the hypotheses

a) High/low trust in authorities induce high/low tax compliance by taxpayers
b) High/low power of authorities induce high/low tax compliance by taxpayers

The framework attempts to integrate economic and psychological factors to explain the tax compliance decision. Instead of viewing the tax reporting decision as merely a competition between taxpayers and tax authority, the framework incorporates behavioural economic theory and seeks to explain the reciprocal relationship between tax authorities and taxpayers.[23]

The "slippery slope" framework is challenging to test as there is very little empirical guidance provided. Recently some studies have explored the framework; Kogler et al. (2012) performed an experimental study, in which the results did find support in validity in the assumptions of the framework, and a short paper (Lisi, 2012) has tested observational data and found support in the hypothesis that both trust in- and power of authorities are necessary to guarantee a high level of tax compliance.

I am unable to find strong evidence to support both assumptions in this study. However, I believe the reason for this may relate to information redundancy and ambiguity in the variables *trust* and *power*. In the Conclusion I argue that I may still find support in the assumption that *trust in authorities* may induce tax compliance.

[23] Readers may find Part I Chapter 4 useful to better understand the "slippery slope" framework.

2 Data

The dataset consists of cross-sectional data on 31 European and 5 highly developed non-European countries for year 2011 (see Table 1). The data set is collected and compiled from different sources for this study specifically. The dependent variable measures the level of tax evasion. However, the hidden nature of tax evasion implies that an accurate measure on the dependent variable does not exist in reality; therefore this study employs the estimated variable *shadow* as a proxy for tax evasion. *Shadow* is a measure of the shadow economy as a percentage of the true gross domestic product (GDP) in the selected countries measured by Schneider (2005). "True GDP" is referring to the sum of the officially reported GDP plus the estimated size of the shadow economy.

Australia	Cyprus	Germany	Latvia	Norway	Slovakia
Austria	Czech Republic	Greece	Lithuania	Poland	Sweden
Belgium	Denmark	Hungary	Luxemburg	Portugal	Switzerland
Bulgaria	Estonia	Ireland	Malta	Romania	Turkey
Canada	Finland	Italy	Netherlands	Slovenia	United Kingdom
Croatia	France	Japan	New Zealand	Spain	United States

Table 1: The observed countries in this study

The independent variables are the indicators *trust* and *power* which measure "trust in authorities" and "power of authorities" respectively. In order to capture the crucial interplay of trust and power an interaction term, defined by *trust* multiplied by *power*, is constructed and named *interaction*. Further descriptions of the variables are provided in Appendix A.1 page 60.

For illustration the variables *shadow*, *trust*, *power* and *interaction* is plotted as a preliminary attempt to describe the dataset.

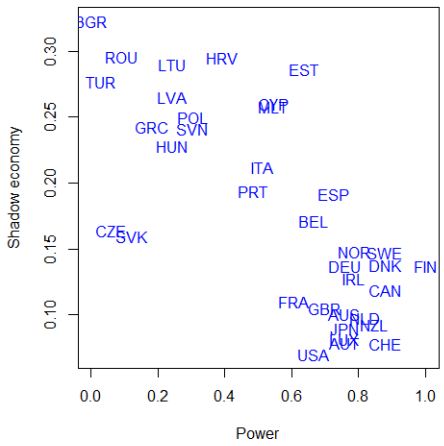

Figure 3: Plot of shadow economy vs. power variable

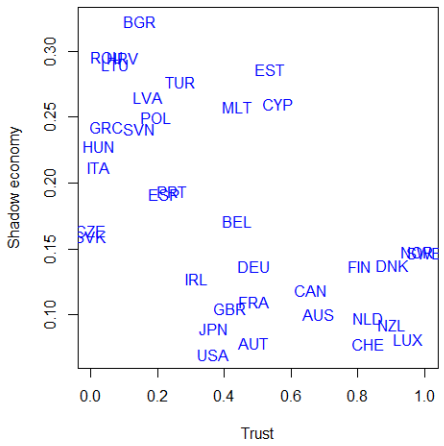

Figure 4: Plot of shadow economy vs. trust variable

Figure 3 shows the plotted observations in the dimensions of shadow economy (of GDP) and power of authorities (from low to high). The plotted countries indicate that low power is associated with a large shadow economy, and high power is associated with a small shadow economy. Figure 4 shows the plotted observations in the dimensions of shadow economy and trust in authorities. The plot indicates that low trust is associated with a large shadow economy, and that high trust is associated with a small shadow economy. However the observations are quite dispersed.

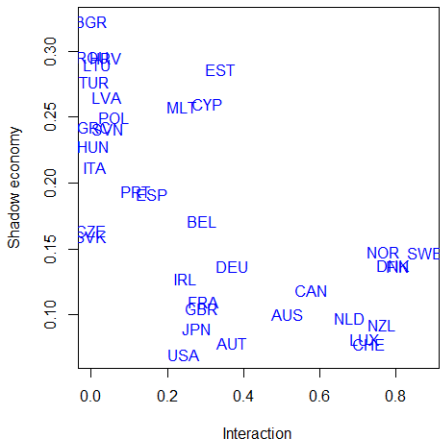

Figure 5: Plot of shadow economy vs. interaction variable

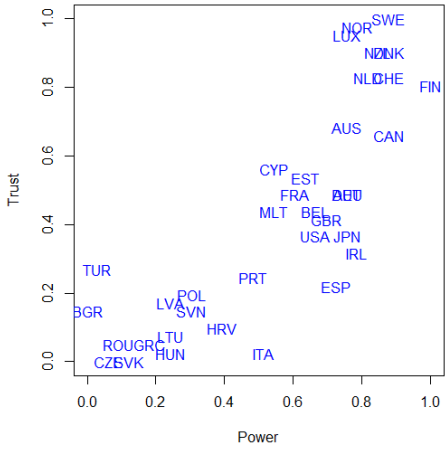

Figure 6: Plot of variables trust vs. power

In Figure 5 the shadow economy is plotted against the interaction variable. There appears to be somewhat of a decreasing relationship between the variables. Finally Figure 6 shows the plotted values of the variables power and trust. The plotted variables indicate that there is a positive relationship between the dimensions trust and power.

Table 2 shows the correlation matrix of the variables. The table confirms the observations from Figure 3, Figure 4 and Figure 5 that there appears to be negative relationships between the size of the shadow economy, and the independent variables *power, trust* and *interaction*.

	Shadow	Trust	Power	Interaction
Shadow	1.000	-0.598	-0.735	-0.653
Trust	-0.598	1.000	0.817	0.977
Power	-0.735	0.817	1.000	0.852
Interaction	-0.653	0.977	0.852	1

Table 2: Correlation matrix of dependent and independent variables

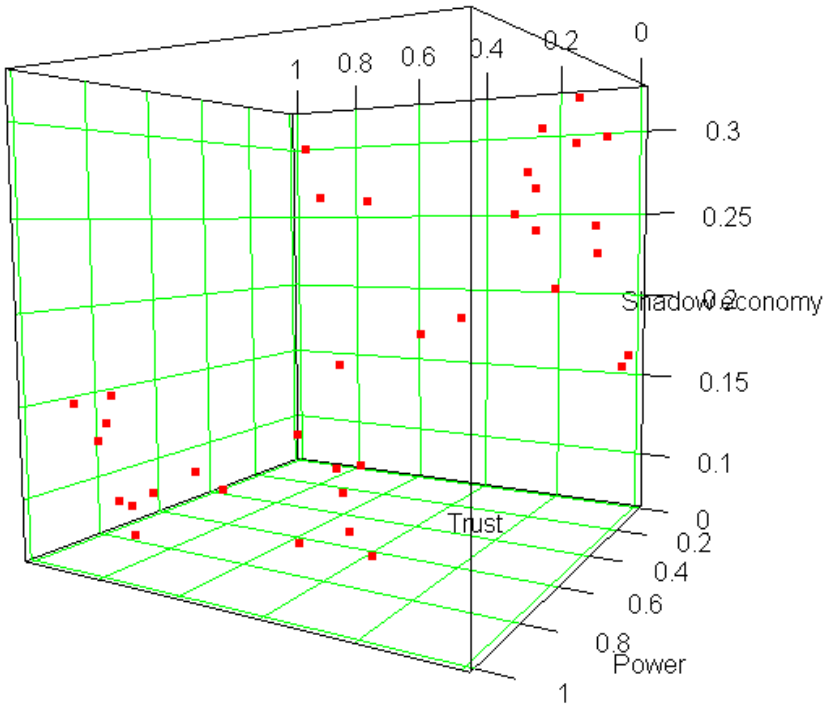

Figure 7: 3-dimensional plot of shadow vs. trust and power

Figure 7 shows a three dimensional chart of the observations in the dataset. The red plots represent each observation. On the vertical axis is the value of the assumed dependent variable *shadow*. The horizontal axis across represents the variable *trust*, ranging from low values on the left to high values on the right. The *power* variable is represented by the depth dimension, from low on the far side to high values on the readers close side. The observant reader may be able to visualise a pattern of the observations as they appear to trend from the bottom left corner in the front (high *power* and high *trust*) to the top right corner in the back (low *power* and low *trust*). This indicates a pattern in size of the shadow economy shifting from small to higher, along the path from *high power/high trust* to *low power/low trust* respectively.

2 Model and results

The analysis is performed using ordinary least squares (OLS) regression, and the robustness analysis is performed on additional model specifications and principal component analysis (PCA).

In the base Model (1) the relationship between the dependent variable *shadow* and the independent variables *trust* and *power* is investigated, excluding the potential interaction. The base model is specified as

$$shadow_i = \alpha + \beta_1 Trust_i + \beta_2 Power_i + \varepsilon_i \quad (1)$$

The coefficients of *trust* and *power* are estimated using OLS for all countries, *i*. The results are provided in Table 3. The estimated coefficients in Model (1) indicate that the coefficient of *power*, β_2, is highly significant. This shows that an increase in the indicator for power of authorities leads to a decrease in *shadow*. The coefficient of trust, β_1, does not show statistical significance and the effect remains undetermined for now.

	α_i	β_1	β_2	γ_1	Adj. R^2
(1)	0.2875 ***	0.0013	-0.1967 **		0.5118
(2)	0.2648 ***	0.1635	-0.163 *	-0.2093	0.5210
(3)	0.2327 ***			-0.1733 ***	0.4091
(4)	0.2874 ***		-0.1955 ***		0.5262
(5)	0.2408 ***	-0.1454 ***			0.3391
	Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

Table 3: Results from OLS regressions

$$shadow_i = \alpha + \beta_1 Trust_i + \beta_2 Power_i + \gamma_1 Interaction_i + \varepsilon_i \quad (2)$$

$$shadow_i = \alpha + \gamma_1 Interaction_i + \varepsilon_i \quad (3)$$

$$shadow_i = \alpha + \beta_2 Power_i + \varepsilon_i \quad (4)$$

$$shadow_i = a_i + \beta_1 Trust_i + \varepsilon_i \quad (5)$$

Model (2) supplements the base model with the *interaction* variable. Table 3 reports the coefficients and it appears that the introduction of the interaction variable in the

regression has had a diminishing effect on the coefficient of *power*, however still significant. On the other hand, the coefficient γ_1 is in itself is not significant with respect to *shadow*. In model (3) as the sole independent variable, γ_1 is significantly negative with respect to *shadow*.

Turning to model (4) the estimated coefficient β_2 is negative and highly significant in itself. This supports the results from the base model that an increase in *power* leads to a decrease in *shadow*. The final model specification, model (5) estimates the coefficient of *trust*. The coefficient $\beta_1$appears also to be negative and highly significant. This result is interesting and somewhat confusing, since β_1 did not produce significant effect on *shadow* in any of the other model specifications. For some reason the variable *power* assumes a larger part of the explanatory effect that does the variable *trust* even though both appear to be related to *shadow*.

So far the analysis indicates conflicting effects by *trust in authorities* and *power of authorities* on tax compliance. It appears that *power* is a greater predictor of tax compliance than is *trust*, however the conclusion is drawn into question as there appears to be issues in the relationships between the independent variables in the dataset. The robustness analysis will take a closer look at possible explanations, in particular why the variable *trust* loses significance on *shadow* in Model (1) and Model (2).

3 Robustness

The observation that the significance of the independent variable *trust* is lost in cohesion with *power* indicates that there is some relationship between the variables that needs to be examined. A principal component analysis (PCA) provides a useful addition to the analysis by separating the "independent" *variables* into independent *components* instead. The interested reader is referred to Appendix A.2 page 61 to find a step-by-step guide on the PCA analysis. The results and key points are provided in the current chapter.

Figure 8 shows a plot of the mean scaled observations of *trust* and *power,* along with the fitted principal components. The red line (bottom left to top right) shows the first principal component, the green line (top left to bottom right) show the second principal component. Observe that the first principal component accounts for the most variation in the data, in fact it accounts for 91% of the total variance. This indicates that there exist redundancies in the variables *trust* and *power*; in particular they may be providing some of the same information.

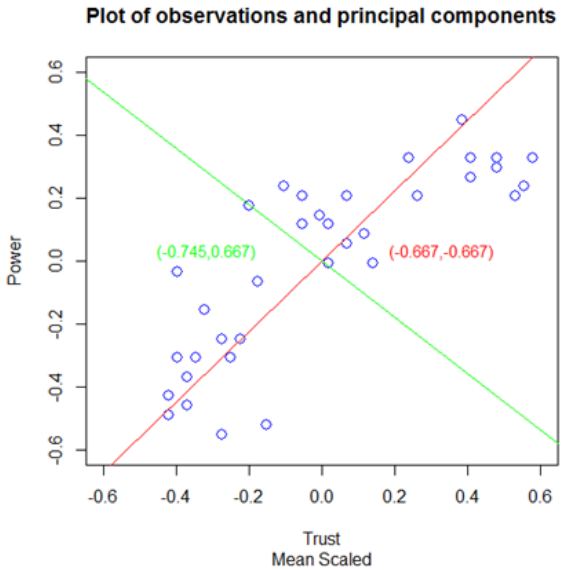

Figure 8: The mean scaled observations and the principal components

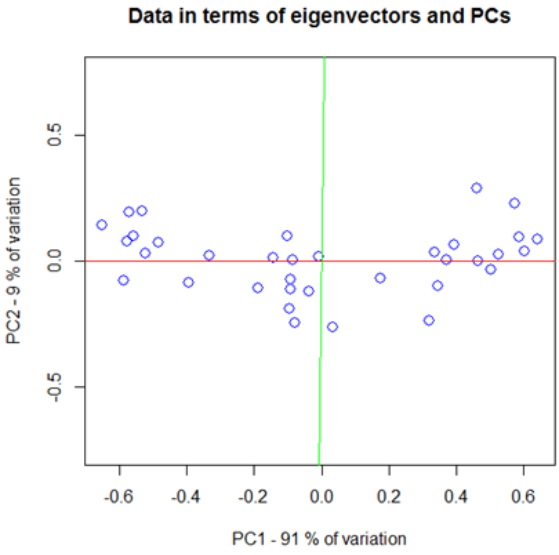

Figure 9: The scores plotted along with orthogonal trend lines

Figure 9 illustrates the new data set after having rotated the observations such that they are represented by the new variables (PC1 and PC2). The red (horizontal) and green

(vertical) lines in this figure show that the variables are now orthogonal to each other, i.e. PC1 and PC2 are uncorrelated.

In Figure 10 the plotted scores (with country labels) and the variables, presented as vectors are provided.

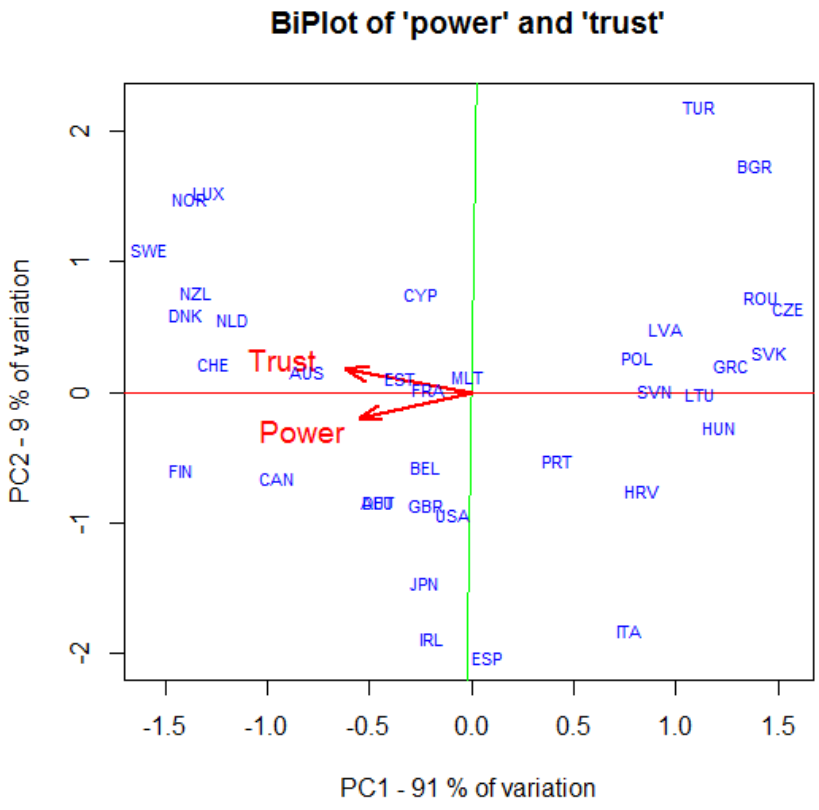

Figure 10: Biplot of the variables and the scores

The directions of the vectors indicate that the variables *power* and *trust* are positively correlated; a small angle between the vectors indicate high positive correlation (on the other hand, vectors in opposite direction would indicate negatively correlation).

The plotted scores' distance from the centre indicates the original observations' value in *trust* and *power* relative to the mean values. I.e. in this case scores close to the centre of the plot exhibit average values in the variables *trust* and *power*. For instance Malta (MLT) [0.4390, 0.5454] and France [0.4878, 0.6060] are observed with quite average variable levels [*trust*, *power*]. Another feature of the biplot is that the score's proximity

to the trajectory of the vectors indicates which of the variables that dominate the observation. It can be verified by checking the values of Finland. The scores are quite high for *trust* and *power* [0.804, 1.00]. If observing Denmark, they have high values [0.902, 0.878], however they are higher in *trust* and *lower* in power, relative to Finland. This is consistent with their proximity to the respective vectors, as well as their relatively large distance from the mean. On the other side of the figure, if comparing Finland and Denmark with Greece [0.0487, 0.1818] and Hungary [0.0243, 0.2424], it is possible to observe that they both rank lower than Finland and Denmark in both variables, and Greece rank higher (lower) than Hungary in *trust* (*power*).

An interesting pattern is observed along the green vertical line. Ireland [0.3170, 0.7878] and Spain (ESP) [0.2195, 0.7272] exhibit somewhat similar values at the bottom centre with moderately low *trust* and moderately high *power*. The reason is not clear, however, a possible reason might be that these levels of high *power* and low *trust* indicate some resentment towards the authorities. On the other hand there are no observations plotted on the top centre. This indicates that the sample does not contain countries ranked with moderately high *trust* and moderately low *power*. One hypothesis is that *trust* is depending on a certain amount of *power*, in other words that in absence of "power of authority", "trust in authorities" cannot get a foothold. On the other hand, it may simply be attributed to a gap in the dataset

When comparing the biplot in Figure 10 with the three countries with least amount of estimated shadow economy (Table 4 p.57), it may be observed that USA has the lowest *shadow* which is quite surprising since USA does not rank among the highest countries in either *trust* or *power*. The two next countries are Switzerland (CHE) and Austria, which both have, as anticipated, relatively high values in *trust* and *power*. Bulgaria, Romania (ROU) and Croatia (HRV) are the bottom three countries in terms of the size of the shadow economy. They are observed surprisingly dispersed in Figure 10. Intuitively, if one were to believe in the "slippery slope" framework, the observed countries with similar size of the shadow economy should appear in clustered areas of the biplot.

	Country	Code	2011	Trust	Power
1	United States	USA	7 %	0.3659	0.6667
2	Switzerland	CHE	8 %	0.8293	0.8788
3	Austria	AUT	8 %	0.4878	0.7576
4	Luxemburg	LUX	8 %	0.9512	0.7576
5	Japan	JPN	9 %	0.3659	0.7576
32	Estonia	EST	29 %	0.5366	0.6364
33	Lithuania	LTU	29 %	0.0732	0.2424
34	Croatia	HRV	30 %	0.0976	0.3939
35	Romania	ROU	30 %	0.0488	0.0909
36	Bulgaria	BGR	32 %	0.1463	0.0000

Table 4: Top and bottom sample shadow economies of *true* GDP

Finally, the effect of removing the second principal component from the analysis is investigated to see if this leads to interpretable OLS results. Figure 11 illustrates the one-dimensionality resulting from dropping the second principal component.

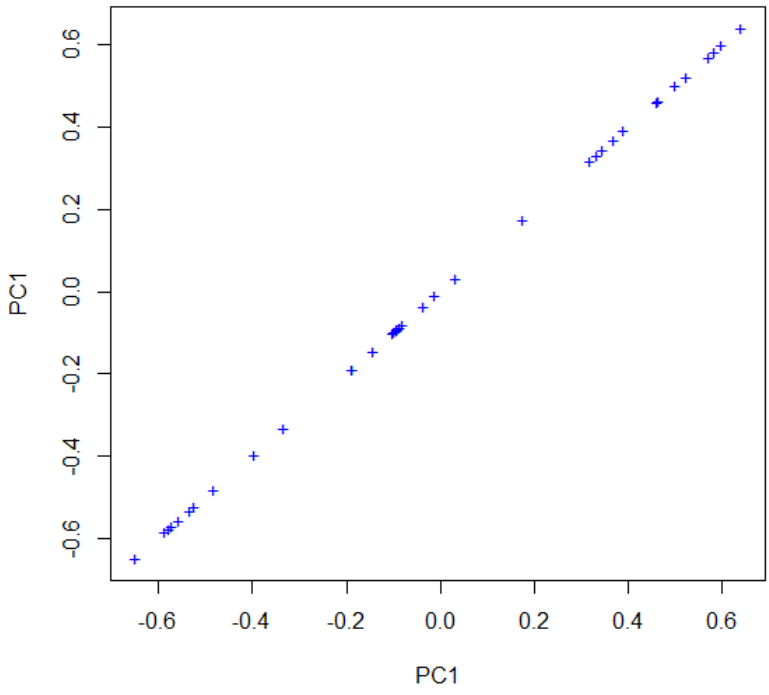

Figure 11: The data interms of the first principal component

The analysis is conducted by regressing the first principal component, *PC1*, on the dependent variable *shadow*.

$$shadow_i = \alpha + \delta_1 PC1_i + \varepsilon_i \qquad (6)$$

The results are provided in Table 5.

	α	δ_1	Adj. R^2
(6)	0.1796 ***	0.1302 ***	0.4631
	Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1		

Table 5: Results from first principal components regression

The results show that the first principal component is positive and significantly related to *shadow*. The significance of δ_1 suggests that the original dataset with variables *trust* and *power* contains redundant information, i.e. they exhibit common variation. This leads to the problem that the coefficient of *power* absorbs the majority of the amount of the explanatory effect, since it fits the independent variable better than *trust*. This means that *trust* loses its explanatory effect, even if it does have an impact on *shadow*. The models (1), (2), and (5) are unable to recognize the impact of trust due to the dominance of *power*.

So how can we explain this result? We take a look at the original variables *trust* and *power* to see if there are similarities between the variables which may explain the redundant variance. The intention was to capture the level of "trust in authorities" by measuring how citizens perceived and trusted the decisions made by politicians. *Power* was intended to measure "power of authorities" as the perception by citizens that criminal action was detected and punished. A detailed look at the two measures reveals that the variables are closer related than originally assumed. The argument can be made that the variable *power* is in fact also a measure of "trust in authorities". The reason is that *power* in this study actually measures the general perception that the citizens can count on the police authority to keep the society safe. However, in this setting a more appropriate measure of *power* would have been the perception of the police as an

enforcer of government interests. To illustrate, there is a difference between trusting in the power of the police, and fearing the power of the police.

Another possible explanation may be that the observation sample consists of countries that are too similar, or that the sample size is too small. This may affect the variability and the importance of the variables trust and power.

4 Conclusions

The validity of the assumptions in the "slippery slope" framework have proven difficult to test empirically. The main challenge identified in this study has been to find appropriate measures of the dimensions "trust in authorities" and "power of authorities".

If we accept the argument that the variables *trust* and *power* are in fact both measuring the trust dimension, and that *shadow* is an appropriate proxy for tax evasion. It follows from the model specifications that "trust in authorities" are significantly and positively affecting tax compliance. The findings, in particular model (5) do support the hypothesis

a) high/low trust in authorities induce high/low tax compliance by taxpayers

However to fully explore the assumptions of the "slippery slope" framework, new and clearer measures of trust and power needs to be examined.

Hypothesis b) remains unexamined as the validity of the variable *power* is drawn into question.

APPENDIX

A.1 Definitions of variables

Name	Definition and source
Shadow	Country level tax evasion measures are estimated as the size of the *shadow economy* relative to the true GDP of the country for the year 2011 (Schneider, 2011) .
Trust	The indicator of trust in authorities is based on World Economic Forum (2011) – "The Global Competitiveness Report 2011–2012" (WEF, 2011). Executive leaders were asked to respond to the following question: *How would you rate the level of public trust in the ethical standards of politicians in your country? [1 = very low; 7 = very high]* The "trust" variable is normalised to fit the interval between 0 (low) and 1 (high).
Power	The indicator of power of authorities is measured as a normalised variable between 0 and 1. Based on World Economic Forum (2011) – "The Global Competitiveness Report 2011–2012" (WEF, 2011). Executive leaders were asked to respond to the following question: *To what extent can police services be relied upon to enforce law and order in your country? [1 = cannot be relied upon at all; 7 = can be completely relied upon]* The "power" variable is normalised to fit the interval between 0 (low) and 1 (high).
Interaction	The interaction term is given by multiplying trust*power

A.2 Principal Components Analysis

This section provides a brief introduction to Principal Components Analysis[24]. The concepts are applied to the dataset in Part II.

A2.1 What is Principal Components Analysis?

Principal components analysis is applied to the variables *trust* and power. We know that they exhibit correlation, and we have observed that the variables are significant in relation with *shadow* separately; however, the coefficient of *trust* loses significance when the OLS model is introduced with *power*. Principal components are a new set of variables, which are linear combinations of the original observations. The principal components have two properties that are desirable in terms of analysis. First, because the principal components are orthogonal, they can be used instead of the original variables in situations where having orthogonal variables is desirable (e.g., regression). Second, because the of the decreasing variance property, much of the variance (information in the original set of variables) tends to be concentrated in the first few principal components. This implies that we can drop the last few principal components without losing much information. PCA is therefore considered as a dimension-reduction technique.

A2.2 Finding the Principal Components

The following procedure has been applied on the variables *trust* and *power* to extract the principal components. The two first steps are straight forward.

[24] This appendix is based on concepts of PCA by Tabachnick & Fidell (2013) and Tong, Kumar, & Huang (2011)

In the first step the variables *trust* and *power* have been mean scaled, i.e. both trust and power variables are centred such that the expected mean of both variables is zero. Note that this is just a transformation, and does not affect the relationship between the observations. Figure 12 shows the original observations, whereas Figure 13 shows the transformed observations.

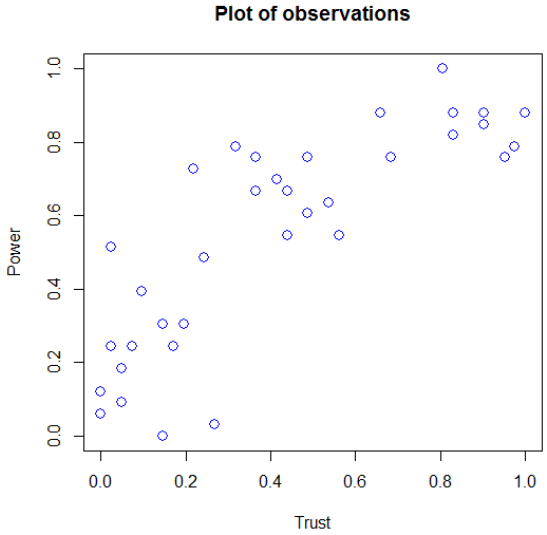

Figure 12: Power vs. trust

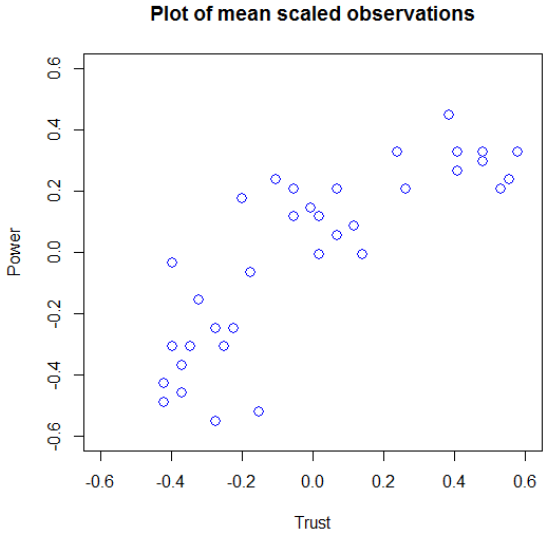

Figure 13: Mean power vs. mean trust

In step two the variance-covariance matrix between the variables trust and power is calculated

$$A = \begin{bmatrix} 0.1025 & 0.0765 \\ 0.0765 & 0.0855 \end{bmatrix}$$

In step three the eigenvalues λ_i for the $i = [1,2]$ variables are calculated. The covariance matrix allows for obtaining the eigenvalues and eigenvectors.

The eigenvalues is the set of values that satisfy the following condition

$$\begin{vmatrix} 0.1025 - \lambda & 0.0765 \\ 0.0765 & 0.0855 - \lambda \end{vmatrix} = 0.00876 - 0.188\lambda + \lambda^2 - 0{,}00585 = 0$$

If we solve for λ we find the resulting eigenvalues

$$\lambda_1 = 0.01702$$
$$\lambda_2 = 0.17098$$

In step four the eigenvectors are found. In PCA the eigenvectors of unit length (i.e. 1) are called *loadings*. The loadings represent the direction of the principal components.

Formally an eigenvector is a vector (x) that satisfies the following condition

$$A\,\boldsymbol{x} = \lambda \boldsymbol{x}$$

Thus, in our case the matrix A is a variance-covariance matrix with two dimensions, thus we identify two vectors specified by x_1 and x_2.

For $\boldsymbol{\lambda = 0.1710}$

$$Ax = \begin{bmatrix} 0.1025 & 0.0765 \\ 0.0765 & 0.0855 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = 0.1710 \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

which is equivalent to

$$0.1025x_1 + 0.0765x_2 = 0.1710x_1$$
$$0.0765x_1 + 0.0855x_2 = 0.1710x_2$$
$$\Rightarrow\ x_1 = 1.11678x_2$$

For $\boldsymbol{\lambda = 0.0171}$,

$$Ax = \begin{bmatrix} 0.1025 & 0.0765 \\ 0.0765 & 0.0855 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = 0.0171 \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

which is equivalent to

$$0.1025x_1 + 0.0765x_2 = 0.0171x_1$$
$$0.0765x_1 + 0.0855x_2 = 0.0171x_2$$
$$\Rightarrow x_1 = 0.89578x_2$$

Then we find the eigenvector of unit length, i.e. $x_1^2 + x_2^2 = 1$

$$\textbf{For } \boldsymbol{\lambda = 0.1710, x_1 = 1.11678x_2}$$

$$x_1 = \pm 0.74488$$

$$x_2 = \pm 0.66708$$

$$\textbf{For } \boldsymbol{\lambda = 0.0171, x_1 = 0.89578x_2}$$

$$x_1 = \pm 0.74488$$

$$x_2 = \mp 0.66708$$

This provides the following eigenvectors (loadings)

$$\begin{bmatrix} -0.74488 & 0.66708 \\ -0.66708 & -0.74488 \end{bmatrix}$$

The eigenvectors *are* the *principal components*, and from observing Figure 14 we can see to what extent the variables contribute. We see that the red eigenvector (bottom left to top right) represents the direction of maximum variation; this is the *first principal component*, $PC1$. The green line (top left to bottom right), orthogonal to the first principal component, is the *second principal component*, $PC2$. (The principal components are by construction orthogonal to each other, there is a 90 degree angle between the slopes of the eigenvectors).

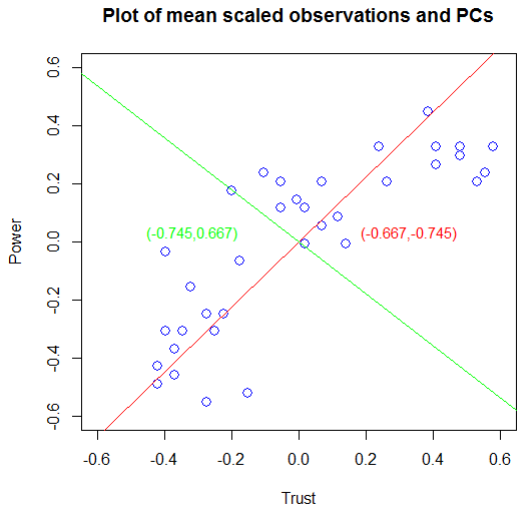

Figure 14: Scaled observations and Principal Components

In step five, the original observations are transformed by rotating the mean scaled variables with the factor loadings, the result on the RHS below is known as the *scores*.

$$[\,\textbf{Trust}\quad\textbf{Power}\,]\,[\quad\textbf{Eigenvectors}\quad]=[\textbf{PC1 scores PC2 scores}]$$

$$\begin{bmatrix} trust_1 & power_1 \\ trust_{1+j} & power_{1+j} \\ \vdots & \vdots \\ trust_n & power_n \end{bmatrix} \begin{bmatrix} -0.74488 & 0.66708 \\ -0.66708 & -0.74488 \end{bmatrix} = \begin{bmatrix} PC1_1 & PC2_1 \\ PC1_{1+j} & PC2_{1+j} \\ \vdots & \vdots \\ PC1_n & PC2_n \end{bmatrix}$$

We may plot the scores in terms of the principal components.

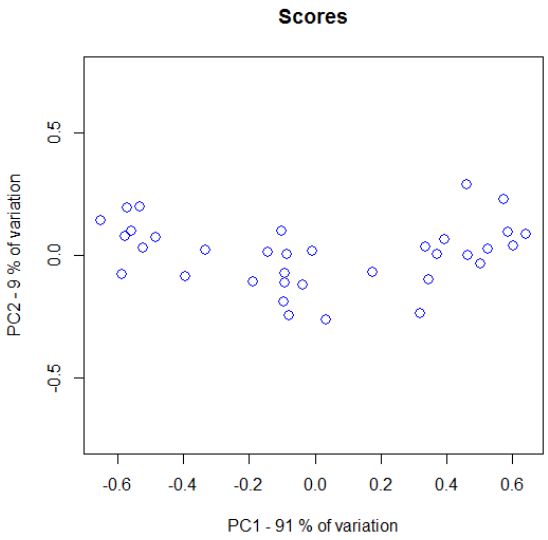

Figure 15: Plotted Scores

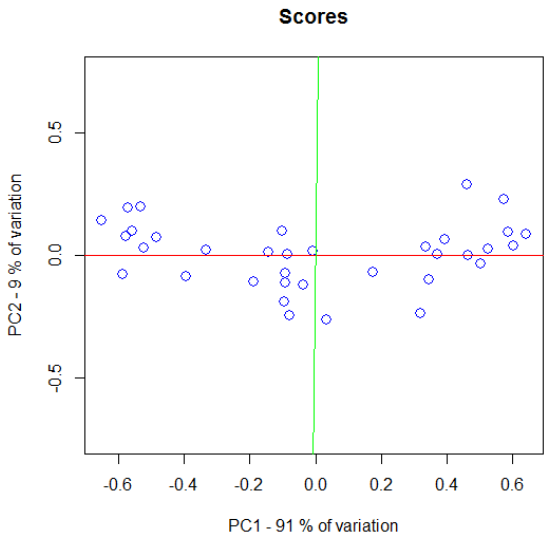

Figure 16: Plotted scores and principal components

And now we note they purpose of PCA; we have constructed new variables that are uncorrelated. We can verify this property by calculating the correlation between the first- and the second principal component

$$cor(PC1, PC2) = 0$$

We also collect the variances of the principal components and see to what extent they account for the total variance of the dataset.

$$\mathbb{V}\text{ar}[\text{PC1}] = 0.1710$$
$$\mathbb{V}\text{ar}[\text{PC2}] = 0.0171$$
$$\mathbb{V}\text{ar}[\text{PC1}] + \mathbb{V}\text{ar}[\text{PC2}] = 0.1880$$

As a side note we also observe that the variance equals the sum of the eigenvectors

$$\lambda_1 + \lambda_2 = 0.01702 + 0.17098 = 0.1880$$

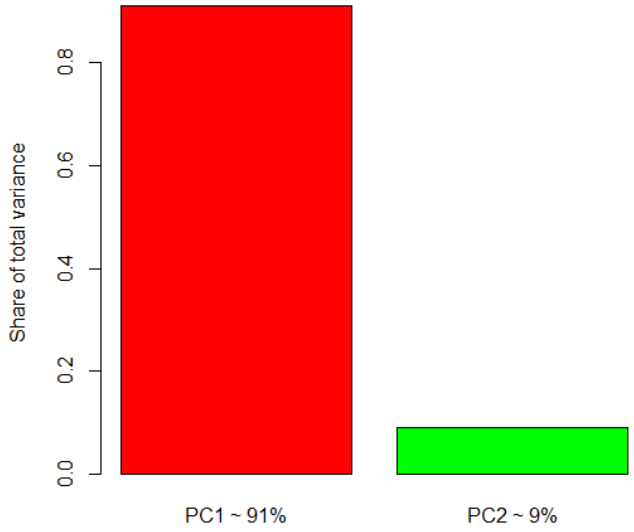

Figure 17: Barplot of the amount of variances in the principal components

If we compare the variances we find that the first principal component has 91% of the total variation, and the second principal component has 9% of the total variation. Figure 17 illustrates the variance.

A2.3 Analysing the Principal Components

There are two interesting applications of the principal components relevant to this study.

A2.3.1 Interpreting the Biplot

A biplot is in reality a combination of two plots. It shows the variables (trust and power) as vectors and the scores as plots. The biplot in Figure 18 plots the scores with country labels, Figure 19 biplot is an automatically created plot.

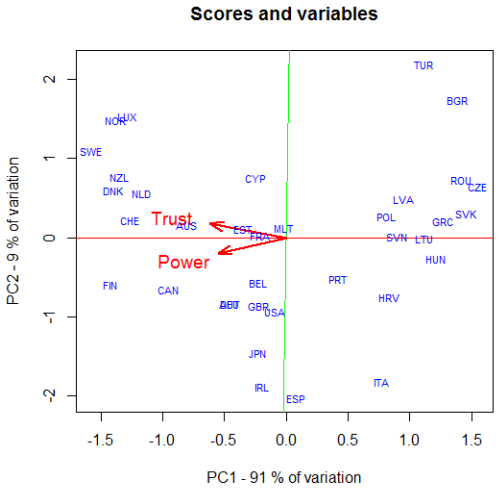

Figure 18: Manually biplot (with country identifiers)

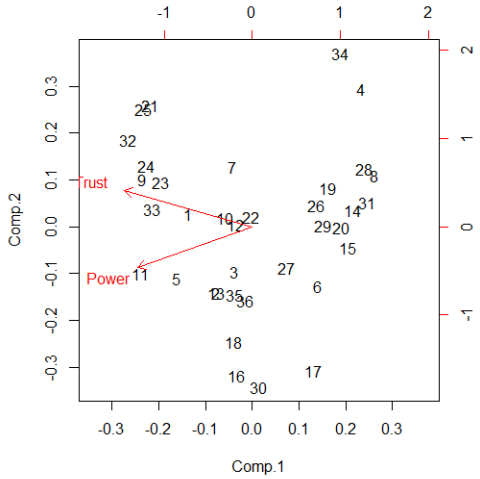

Figure 19: Auto-generated biplot

In terms of interpretation the angle of the vectors indicate the extent of correlation between the variables. If they were to point in the same direction the variables would be perfectly positively correlated. If the arrows were to point in opposite directions the variables would have been negatively correlated.

We observe by comparing the plotted scores that (in this case) the countries on the left (right) of the green vertical line are increasingly high (low) in trust as they plotted closer towards the edge of the figure. On the other hand, the scores below (above) the red horizontal line are increasingly high (low) in power as they are plotted closer towards the edge of the figure.

Further intuition and insights from the biplot is provided in Part II Chapter 3

A2.3.2 Reducing dimensionality

The other application is to reduce the dimensionality of the data. We recall that the variance of the first principal component is larger than the second principal component. Thus, we can drop the second principal component without losing too much information, and use the first principal component in for instance regression analysis with the dependent variable *shadow*. This means we rotate the data and disregards the variablility associated with the second principal component.

$$[\,\mathbf{Trust} \quad \mathbf{Power}\,]\,[\mathbf{PC1\ eigenvector}] = [\mathbf{PC1\ scores}]$$

$$\begin{bmatrix} trust_1 & power_1 \\ trust_{1+j} & power_{1+j} \\ \vdots & \vdots \\ trust_n & power_n \end{bmatrix} \begin{bmatrix} -0.74488 \\ -0.66708 \end{bmatrix} = \begin{bmatrix} PC1_1 \\ PC1_{1+j} \\ \vdots \\ PC1_n \end{bmatrix}$$

The data is now one-dimensional and represents the majority of the variance of the variables *trust* and *power*. We accept the loss of variability information because it provided a minority of the explanatory effect. Figure 20 illustrates the one-dimensionality resulting from dropping PC2.

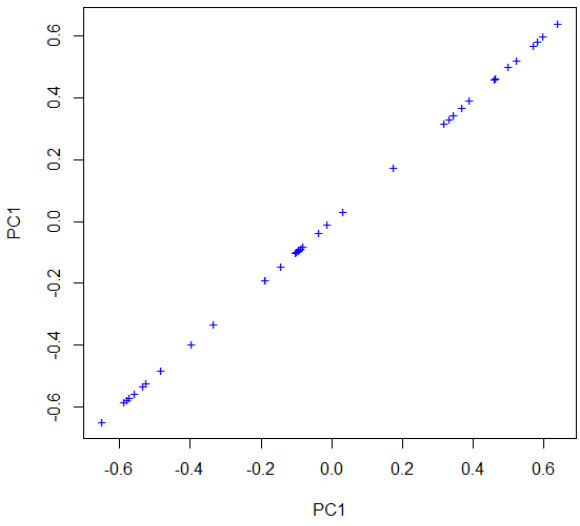

Figure 20: The dataset represented in 1 dimension

The resulting dataset is used to estimate the relationship with the dependent variable *shadow*. This is explored, and the results are discussed in the Part II Chapter 3.

References

Allingham, M. G., & Sandmo, A. (1972). Income tax evasion: a theoretical analysis. *Journal of Public Economics, 1*(3–4), 323-338. doi: 10.1016/0047-2727(72)90010-2

Alm, J. (2012). Measuring, Explaining, and Controlling Tax Evasion: Lessons from Theory, Experiments, and Field Studies: Tulane University, Department of Economics.

Alm, J., Bahl, R., & Murray, M. N. (1993). Audit selection and income tax underreporting in the tax compliance game. *Journal of Development Economics, 42*(1), 1-33. doi: 10.1016/0304-3878(93)90070-4

Alm, J., McClelland, G. H., & Schulze, W. D. (1992). Why do people pay taxes? *Journal of Public Economics, 48*(1), 21-38. doi: 10.1016/0047-2727(92)90040-M

Arrow, K. J. (1970). Essays in the theory of risk-bearing: North Holland.

Bayer, R.-C. (2006). Finding Out Who The Crooks Are — Tax Evasion With Sequential Auditing. *The Singapore Economic Review (SER), 51*(02), 195-227.

Brown, R. E., & Mazur, M. J. (2003). IRS's Comprehensive Approach to Compliance Measurement.

Cowell, F. A. (1985). Tax evasion with labour income. *Journal of Public Economics*(26), 19-34.

Drèze, J. H., & Modigliani, F. (1972). Consumption decisions under uncertainty. *Journal of Economic Theory, 5*(3), 308-335. doi: http://dx.doi.org/10.1016/0022-0531(72)90044-0

Feinstein, J. S. (1991). An Econometric Analysis of Income Tax Evasion and Its Detection. *The RAND Journal of Economics, 22*(1), 14-35. doi: 10.2307/2601005

Jackson, B. R., & Milliron, V. C. (1986). Tax compliance research: Findings, problems and prospects. *Journal of Accounting Literature*(5), 125–165.

Kaufmann, D., Kraay, A., & Mastruzzi, M. (2010). The Worldwide Governance Indicators: Methodology and Analytical Issues.

Kirchler, E., Hoelzl, E., & Wahl, I. (2008). Enforced versus voluntary tax compliance: The “slippery slope” framework. *Journal of Economic Psychology, 29*(2), 210-225. doi: 10.1016/j.joep.2007.05.004

Kogler, C., Batrancea, L., Nichita, A., Pántya, J., Belianin, A., & Kirchler, E. (2012). Trust and Power as Determinants of Tax Compliance: Testing the Assumptions of the Slippery Slope Framework in Austria, Hungary, Romania and Russia. *Journal of Economic Psychology*(0). doi: 10.1016/j.joep.2012.09.010

Levaggi, R., & Menoncin, F. (2012). Tax audits, fines and optimal tax evasion in a dynamic context. *Economics Letters, 117*(1), 318-321. doi: 10.1016/j.econlet.2012.05.043

Lisi, G. (2012). Testing the slippery slope framework *Economics Bulletin* (Vol. 32, pp. 1369-1377): University of Cassino.

Mossin, J. (1968). Taxation and Risk-Taking: An Expected Utility Approach. *Economica, 35*(137), 74-82.

Musgrave, R. A. (1959). Chapter 14 Adjustments in Investments *The Theory of Public Finance*.

Porcano, T. M. (1988). Correlates of tax evasion. *Journal of Economic Psychology*(9), 47-67.

Reinganum, J. F., & Wilde, L. L. (1985). Income tax compliance in a principal-agent framework. *Journal of Public Economics, 26*(1), 1-18. doi: 10.1016/0047-2727(85)90035-0

Riahi-Belkaoiu, A. (2004). Relationship between tax compliance internationally and selected determinants of tax morale. *Journal of International Accounting, Auditing and Taxation*(13), 135–143.

Riahi-Belkaoui, A. (2004). Relationship between tax compliance internationally and selected determinants of tax morale. *Journal of International Accounting, Auditing and Taxation*(13), 135–143.

Richardson, G. (2006). Determinants of tax evasion: A cross-country investigation. *Journal of International Accounting, Auditing and Taxation, 15*(2), 150-169. doi: 10.1016/j.intaccaudtax.2006.08.005

Sandmo, A. (2004). *The theory of tax evasion: A retrospective view*.

Schneider, F. (2005). Shadow economies around the world: What do we really know? *European Journal of Political Economy, 21*(4), 598-642.

Schneider, F. (2011). *Size and Development of the Shadow Economy of 31 European and 5 other OECD Countries from 2003 to 2012: Some New Facts*.

Schroyen, F. (1994). The Comparative Statics of Tax Evasion with Elastic Labour Supply *Essays on redistributive taxation when monitoring is costly* (pp. (2)1-55). Katholieke Universiteit Leuven.

Spicer, M. W., & Hero, R. E. (1985). Tax evasion and heuristics: A research note. *Journal of Public Economics, 26*(2), 263-267. doi: 10.1016/0047-2727(85)90009-X

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Boston: Pearson.

Tong, H., Kumar, T. K., & Huang, Y. (2011). *Developing econometrics*. Chichester: Wiley.

Wallschutzky, I. G. (1984). Possible causes of tax evasion. *Journal of Economic Psychology*(5), 371-384.

WEF. (2011). The Global Competitiveness Report 2011–2012. In K. Schwab (Ed.).

Yitzhaki, S. (1974). Income tax evasion: A theoretical analysis. *Journal of Public Economics, 3*(2), 201-202. doi: 10.1016/0047-2727(74)90037-1