Freie Universität Berlin

The mutual impact of deferral labour taxation and capital income taxation on risk-taking behaviour

An experimental analysis

Nima Massarrat-Mashhadi

School of Business & Economics

Discussion Paper

FACTS

2013/1

The mutual impact of deferral labour taxation and capital income taxation on risk-taking behaviour- An experimental analysis

Nima Massarrat-Mashhadi*

February 19, 2013

Abstract

Does the timing of labour earnings taxation encroaches upon capital income taxation and individual risk-taking investment decisions, i.e. portfolio selection? This paper presents the results of a laboratory experiment that is, contrary to previous approaches, not restricted to the analysis of capital income taxation (fully taxable vs. tax-exempt investment earnings) and individual risk-taking, but adds other dimensions of taxation, i.e. deferral or immediate labour earnings taxation. Empirical findings support the view that tax framing effects affect tax burden visibility, changing individuals´ risk-taking propensity substantially. A tax system applying deferral taxation of labour earnings turns out to be more attractive to taxpayers with regard to risk-taking investment than immediate labour taxation with tax-exempt earnings from investment.

Keywords

Deferral labour taxation · Capital income taxation · Experimental tax research · Retirement accounts · Behavioural economics · Analysis of covariance

JEL classification

C91 · H24 · H31

* Freie Universität Berlin, Department of Finance, Accounting and Taxation, Garystraße 21, 14195 Berlin, Germany, e-mail: nima.massarrat@fu-berlin.de

1 Introduction

Tax policy has various, often conflicting objectives. A hands-on approach to tax policy is often equated with the isolated examination and modification of certain tax schemes in tax law. Economists and economic science have used to focus on a single component of a tax system, however, too readily forget to look at the bigger picture. Capital income taxation is a primary concern in tax policy, covered by heated debates over its divisive nature. The tax treatment of capital income is a substantial but no isolated feature of every income tax system and needs to be evaluated in a wider context considering other substantial tax system components, such as the taxation of labour earnings.[1] The basic view on the issue of income taxation is to define a taxpayer´s biography as his/her cumulative tax burden over time, resulting from labour and (subsequent) capital income taxation. When thinking about the chronological order of taxation of labour and capital income, two general methods emerge. The first, more widely-used approach separates the two dimensions. It starts with the generation of labour earnings and its immediate taxation, followed by the taxpayer´s net-of-tax investment decision and the subsequent taxation of income from capital. The second, alternative method defers the taxation of labour earnings. Here, the investment decision is based on gross labour earnings. Labour earnings taxation is shifted to the end and takes place at the same time as the taxation of the investment earnings[2].[3] For the latter, there are basically three main principles in taxation (with an arbitrary number of variations): (1) Earnings from investment are taxed in full at ordinary rates. (2) Earnings from investment are exempted from the income tax base and taxed at a schedular tax rate, which is typically lower than the ordinary income tax rate. (3) Earnings from investment are exempted from the tax base and not subject to income taxation at all.

In Germany, the Retirement Income Act of 2005 has established new regulatory changes affecting the tax treatment during the labour income (saving) phase and future pension income. Its main feature is the gradual transition to a deferral taxation of contributions to private pension plans. Since obviously policymakers are paying more and more attention to the deferral aspect of taxation, empirical evidence for behavioural responses to deferral taxation of labour earnings could be

[1] For the sake of simplicity, the term “capital income” is used to cover both the positive difference (gains) and the negative difference (losses).

[2] When using the term “investment earnings”, I only refer to earnings from financial investments by taxpayers. I do not examine investment earnings by corporations or investment in human capital assets.

[3] A well-known application of deferral labour earnings taxation is the tax treatment of taxpayer´s investments in private pension plans. US individual retirement accounts (IRA) and the 401(k) retirement plan benefit from deferral taxation, meaning the postponement of taxes on a portion of labour income and subsequent investment returns until the withdrawal..

helpful and valuable for not only new scientific insights but also for tax policy makers, designing (more) effective tax systems.

This paper addresses the question how different combinations of labour and capital income tax rules affect taxpayers´ allocation strategy, i.e. their risk-taking behaviour. The remaining part of this paper is organised as follow. The second section gives an overview of the development of (experimental) research in the field of risky investment and capital income taxation. It also outlines the contribution of this study to the existing literature. The following section sets out the hypothesis and describes the experimental design. Empirical results are presented in the fourth section. The fifth section is devoted to a discussion of the major findings and their implication for tax policy.

2 Previous Research

Pros and cons of capital income taxation have emerged in the theoretical public finance literature over the last decades.[4] There has been considerable scientific and political debate on the question of whether and how earnings from investment should be included in the income tax base. Pioneer theoretical contributions by Fisher (1897), (1906) and (1937), Ramsey (1927) and Seltzer (1950) have ignited the debate on how the taxation of capital income "[…] can be easily applied in practice while being, at the same time, sound in theory."[5] Research in this area is approached from different economic angles. It can be roughly divided into two parts of economic science, i.e. macroeconomic vs. microeconomic research. At the macro level, the mobility of capital, the welfare cost of capital income taxation, its proper measurement have been the subject of a long and lively debate led by economists such as Kaldor (1937), Harberger (1964a, 1964b, 1966), Levhari and Sheshinski (1972), Andrews (1974), Atkinson and Stiglitz (1976), Feldstein (1976), Atkinson and Sandmo (1980), Stiglitz (1983), Slemrod (1988), Auerbach (1992) and Kaplow (1994). They advocate the elimination or the reduction of capital income taxation to foster capital accumulation and economic growth.

On a micro level, a primary concern in tax policy and economic science is the effect of taxation on the demand for risky assets. Asea and Turnovsky (1997) emphasize that "it is central to one of the most challenging questions facing academics and policymakers […]."[6] Domar and Musgrave (1944) pioneered the analysis of taxation and its impact on taxpayers´ propensity to invest in risky

[4] Poterba (2001) gives a comprehensive overview of debates and developments in this research area and emphasises "the tax rules that apply to income from capital are the most complicated part of most modern income tax systems."

[5] Fisher (1906), p. 3.

[6] Asea and Turnovsky (1997), p. 56.

assets. Successive theoretical and empirical literature suggests a wide range of dimensions, illustrating how capital income taxation may affect individual investment behaviour and risk-taking. Using general expected utility maximisation or general equilibrium models, theoretical contributions investigate the demand for risky assets induced by income, wealth or different forms of taxation (e.g. Mossin (1968), Stiglitz (1969), Finn (1977), Fellingham and Wolson (1978), Schneider (1980), Mintz (1981), Bamberg and Richter (1984), Bulow and Summers (1984), Balcer and Judd (1987), Bamberg and Richter (1988) and Weisbach (2004)).

Panel data methods and laboratory experiments are widely used in empirical tax research to identify tax effects on individual risky investments. Although a clear and precise separation is not always possible and necessary, empirical research typically approaches the role of capital income taxation in (1) the realization of profits (Yitzhaki (1979), Slemrod (1989), Burman and Randolph (1994), Landsman and Shackelford (1995), Mariger (1995), Auerbach et al. (2000), Auerbach and Siegel (2000), Auten and Clotfelter (2000), Eichner and Sinai (2000), Jacob and Alstadsaeter (2012)) , (2) determining the set and shifting of assets owned by an individual (Butters and Thompson (1953), Elton and Gruber (1978), Agell and Edin (1990), Maki (1996), Poterba and Weisbenner (2001)) and (3) the amount invested in and the choice between risky assets. The current study addresses the latter by a laboratory experiment approach.

Experiment-based research questions aim to identify either aggregated dimensions, i.e. market transactions, the pricing of risky assets and equilibrium prices, or risky asset investment by individuals. It is straightforward to describe the most prominent papers of both research fields in greater detail, i.e. experimental designs, economic environments and main empirical findings. From an aggregate perspective, Davis and Swenson´s experiment (1993) approaches neoclassical predictions of investment behaviour. An artificial economy with sequential market transactions was utilised. Three types of economic agents (factor sellers, output producers, and output buyers) interact with each other to simulate market behaviour and price setting. The research question addressed is whether a capital investment friendly tax system is eligible to foster investment in depreciable assets. Davis and Swenson´s results imply that accelerated tax depreciation or investment tax credits are eligible to stimulate demand for investment assets. Anderson and Butler (1997) examine how preferential treatments of capital gains, i.e. lower tax rate and an unlimited capital loss deduction, drives the market prices of risky assets. They find that market prices of risky assets are both affected by the level of the preferential tax rate and the amount of risk. An unlimited deduction for capital losses has no significant impact on the risky tax-favoured asset´s price. Boylan and Frischmann (2006) designed a set of experimental markets to examine how the degree of tax rate visibility influences trading prices and quantities. Students volunteered to participate as buyers

and sellers. Their findings indicate that buyers facing high tax complexity systematically overpay the sellers for the risky assets compared to their counterparts in low-complexity markets.

Swenson´s study (1989) has ignited the experimental analysis of taxation and its influence on individual investment decisions. 56 students served as buyers and sellers and participated in four separate markets sequentially. Swenson compares the tax induced demand for a riskless and a risky asset in different tax environments, i.e. no taxes, proportional taxes, progressive taxes with a limited loss offset, and proportional taxes with a tax credit. His findings are in line with predictions from theory, revealing that progressive (proportional) taxes decrease (increase) the demand for risky assets. Eliminating the tax credit, proportional taxes cause no significant increase in demand, contradicting the theory. King and Wallin (1990) designed two laboratory experiments for 60 student volunteers to examine the effect of income tax rate structures on the level of risky asset investment. Using a slightly different economic environment (no taxes, proportional taxes, progressive taxes), their results confirm that a progressive tax system reduces the holdings of risky assets, whereas investment decisions are merely distinguishable between the proportional tax and the no tax scenario. Meade´s examination (1990) addresses the lock-in effect caused by capital gains taxation. The 64 students participating in her study were required to choose between six investment options. Her main findings support the hypothesis that the deferral aspect of capital gains taxation induces a lock-in effect and hampers new risky investments. Meade concluded that the taxation of capital gains upon realisation does no help to foster the tax policy goal of promoting risky investments.

Conducting a repeated-measure experiment, Meade (1995) tested how different tax systems affect saving and risk-taking behaviour. Risk-taking behaviour is measured by the relative amount invested in the riskier of two assets available. In her experiment, 90 undergraduate students were assigned to different tax regimes, i.e. income and consumption tax regimes. Her between-subjects design included two groups and three treatments to analyse both income tax and consumption tax systems as well as future tax rate (un)certainty. Providing empirical support for previous analytical work, her experimental findings suggest that taxpayers rethink their risk-sharing arrangement, when the structure of a tax regime changes. Results indicate that the composition of a tax regime can have significant and multidimensional effects on taxpayer´s propensity to deal with risk. She finds that income (consumption) taxes encourage (discourage) risk-taking behaviour when the tax rate is known. Meade identifies different effects of future and present tax rate (un)certainty within the two tax regimes. When present and future tax rates are uncertain, risk-taking declines significantly with dissimilar extent for both tax systems. When these tax rates are certain, the consumption tax regime is neutral with respect to risk-taking.

Apart from these studies, the perception of taxation and the influence of tax framing on tax perception have been found to explain empirical observations deviating from theoretical predictions (Lewis (1978), Fujii and Hawley (1988), Rupert and Fischer (1995), Sausgruber and Tyran (2005), Chetty et al. (2009)). Tax framing effects are a useful tool to explain why individual behaviour deviates, when net-of-tax outcomes are described or presented differently. Cullis et al. (2006) emphasize that "the same underlying process can be framed very differently, so that individuals confronted with the same information cast in different forms (e.g. as a potential gain or loss, a decision tree or in words, etc.) can be induced to systematically alter their choices."[7] The resulting lower degree of tax system salience and/or taxpayers´ awareness of their true tax burden are assigned substantial explanatory power to rationalize irrational taxpayer behaviour.

This way of thinking has been incorporated in several experimental settings dealing with the analysis of capital income taxation and individual risk-taking. De Bartolome (1995) tested whether the average or marginal tax rate are used by taxpayers, when being confronted with risky investments. His findings indicate that the presentation of the tax schedule is of substantial importance for individual decision-making. The experimental set-up by Fochmann et al. (2012) models three tax treatments to examine the effect of various loss deduction rules. In each treatment (no taxation, proportional income taxation without loss deduction and proportional income taxation with capped or partial loss deduction), the two investment alternatives generate identical expected after-tax payoffs. Comparing the number of risk seeking and risk averse investors, Fochmann et al. found no significant difference in the case of without taxation. The same was true for the proportional income taxation without loss deduction rules. The introduction of a capped or partial loss deduction rule produced a substantial and significant perception bias towards risk seeking investment behaviour. Fochmann et al. concluded that the loss deduction rules in income taxation are overestimated by taxpayers, leading to an increased willingness to take risk.

Labour taxation usually precedes capital income taxation and taxpayers´ decision to take risk. This paper provides a promising approach on how to identify the extent to which taxpayers´ risky investment choices between two assets are affected, when different tax rules are applied to known labour earnings and uncertain future earnings from investment. It contributes to the empirical experiment-based literature and complements previous research in three ways.

First, contrary to previous experimental approaches, the analysis does not only cover capital income taxation but the coexistence of labour and capital income taxation within a tax system and offers a more realistic set-up. At least to my knowledge, there has not been yet an experimental approach,

[7] Cullis et al. (2006), p. 305.

combining deferral taxation of gross labour earnings with (preferential) capital income taxation in a real effort experiment. The addition of labour income taxation as an essential component of the overall taxation process offers the unique opportunity to control for different dimensions of taxation, affecting taxpayers´ investment behaviour. The student participants of the laboratory experiment were required to carry out a real effort task where real money had to be earned and could be invested in two different risky assets afterwards, modelling the often neglected labour component in experimental analysis. Contrary to other studies, participants were not endowed with exogenous or artificial money or investment points. This approach is eligible to simulate a more realistic economic environment in the laboratory experiment.

Second, opposing previous approaches by Swenson (1989) as well as King and Wallin (1990), risk-taking propensity is not measured by the relative or absolute risky asset holdings but by the overall portfolio variance, resulting from the relative demand for the two risky assets. This measure is more elaborate than the absolute or relative amount invested in the riskier asset. It accounts directly for the interdependence between the relative demands for the two risky assets and their impact on the overall portfolio variance, to which the taxpayer selects to be exposed. This approach can be considered a substantial methodological improvement.

Third, on the one hand the results confirm the appealing aspect of increased liquidity, resulting from deferral taxation of labour income. On the other hand they provide strong empirical evidence for the existence of tax framing effects, when income tax systems are realigned without changing the overall strain on the taxpayer. Deferral labour income taxation turns out to encroach upon the individual investment decision, i.e. the demand for portfolios with a higher variance ceteris paribus increases.

Empirical findings which are closer to individual behaviour in reality enable tax policymakers to discuss in greater detail the role and usefulness of deferral taxation in behavioural economics. This study provides helpful findings on risk-taking behaviour. It analyzes whether theoretical and empirical results derived from immediate labour taxation frameworks are still valid or need to be rethought, when the taxation of labour earnings is also considered or changes. The paper focuses on the joint impact of immediate and deferral taxation of taxpayers´ labour earnings and capital income taxation on risk-taking behaviour. This approach departs from previous, mostly theoretical work on tax-deferred investment opportunities through the use of a promising experimental research design. It broadens current empirical research by adding another dimension, i. e. tax-induced individual investment decisions after a real effort task. The experiment draws attention to the individual decision of private risk-taking, when different tax systems apply to the taxation of labour earnings

and investment earnings. To my knowledge, this paper also presents the first experimental investigation approaching the identification of a perception bias resulting from deferral earnings taxation and its "abnormal" consequences on individual risk-taking behaviour. By providing new insights into the effects of deferral taxation on microeconomic investment behaviour, the study advances the political and scientific debate on the appropriateness of different income tax systems, featuring a different degree of salience and net-of-tax visibility.

3 Methodology

3.1 Hypotheses

Economic theory does not provide any imperturbable axiomatic picture of how capital income taxation and individual risk-taking of investors are related. Describing their utility functions by plausible combinations of the related measures of absolute and relative risk aversion, most analytical contributions assert that the level of risky investment will increase when a proportional income tax applies to earnings from investment.[8] However, the seminal paper by Domar and Musgrave (1944) indicates that analytical precision blurs when an asymmetric treatment of profits and losses applies. Schneider´s (1980) critical voice reinforces the indeterminateness of taxation and individual risk-taking. He argues that "the effects of progressive taxation in general and of proportional taxation (except under very restrictive conditions) cannot be predicted […]". Previous approaches have produced rather ambiguous results, often challenging pure rational theoretical predictions. It is revealed that the empirical implementation of a tax system, assumptions about economic agents and their more or less comprehensive knowledge of the tax system are crucial for a possible discrepancy between theory and reality.

Most previous empirical studies consider capital income taxation and individual risk-taking in isolation by neglecting and/or eliminating other aspects of an income tax system such as its salience, taxpayer´s imperfect rationality, psychological effects and (mis)perceptions. The question whether the design of a proportional income tax system, comprising alternative tax rules for labour and capital income, dis- or encourage risk-taking has not been answered yet. Four different tax systems are used in the analysis of individual investment behaviour. The tax systems discriminate between the taxation of labour earnings and investment earnings. Table 1 depicts two (possible) dimensions of income taxation and their coexistence within an income tax system, creating four different tax regimes.

[8] A comprehensive illustration is given by King and Wallin (1990, p. 28).

Tax systems	Immediate or deferral taxation of gross labour earnings	Are earnings from investment subject to taxation?
A	Immediate	Yes
B	Immediate	No
C	Deferral	Yes
D	Deferral	No

Table 1 – Tax system structure

Experiments offer the unique opportunity of empirical tests to explore the genuine driving force of taxation on investment behaviour and shed light on the puzzling issue of taxation and risk-taking. The approach chosen in the laboratory experiment is not restricted to the analysis of capital income taxation only, but expands the economic environment by another dimension, i.e. the taxation of labour. Most analytical and empirical work has implicitly only addressed the relation between capital income taxation and individual risk-taking, ruling out the aspect of labour taxation. The combination of labour and capital income taxation is a more elaborate experimental set-up, challenging and complicating analytical rigor and precise empirical evidence.

There are four hypotheses to be tested, addressing taxpayers´ risk-taking behaviour. The term "risk-taking behaviour" is used to describe the individual decision of a taxpayer to choose between two assets, bearing a different amount of risk. The degree of individual risk-taking is measured by the overall portfolio variance, which depends on the relative amounts invested in the two assets. Participants had complete freedom, when deciding about their disposable earnings and their allocation strategy. They were allowed to invest in just one or both assets or nothing at all. Taxpayer *i* is more risk-taking than taxpayer *j*, if the portfolio variance selected by *i* is higher than the portfolio variance chosen by *j*.

When thinking about deferral taxation, a prominent argument is the appealing (main) effect of increased liquidity, resulting from the postponement of labour income taxation. It can be regarded as a tax incentive to stimulate individual risk-taking propensity. This effect should be observable for both scenarios where deferral taxation of labour earnings ceteris paribus applies. The first research hypothesis addresses the attribute of increased liquidity and can be stated as:

H_1: *In a tax system with deferral taxation of labour earnings (tax systems C and D), taxpayers select a riskier portfolio than in a tax system with immediate labour taxation (A and B).*

The second research hypothesis deals with another part of taxation, i.e. the influence of capital income taxation on risk-taking behaviour. In my experimental setting, capital income is either fully taxable or tax-exempt. The tax treatment implies a consistent treatment of positive and negative investment earnings within a tax system, meaning a complete or no loss offset in the case of a negative outcome. When earnings from investment are subject to taxation, the Treasury absorbs part of the investor's risk and can be regarded as a partial insurance against losses. Proportional capital income taxation with a homogeneous treatment of positive and negative earnings reduces positive and negative outcomes by the same percentage, leaving the relation between risk and yield unchanged. Although a complete loss offset alleviates the reduction in yield, an investor seeks to be compensated for reduced earnings from investment and is attracted by more risk in terms of portfolio variance. According to King and Wallin (1990, p. 28.), symmetric (capital income) taxation reduces the dispersion of the investment earnings and increases the attractivity of the riskier asset to the risk-averse investor. They postulate that taxpayers seek more risk, when there is a proportional tax on capital income than when there is no tax.[9] To put it simple: Does a change in capital income taxation induce an increase in risk-seeking investment behaviour? The second hypothesis tests these considerations and can be stated as:

H_2: *In tax systems with immediate labour taxation (A and B): The switch from tax exempt to fully taxable capital income reduces investor's risk and yield by the same amount. To compensate for tax-induced lower earnings from investment, investors will seek more risk and select a portfolio with a higher variance.*

The third and fourth research hypothesis addresses possible tax framing effects on individual risk-taking. First, changing the tax rules for labour earnings from immediate to deferral taxation could be perceived as a complication in the process of overall income taxation. It might offset the assumed increase in the selected portfolio variance, resulting from the change of the tax rules for capital income. The third hypothesis equals:

[9] King and Wallin (1990, p. 29).

H_3: *Tax systems with deferral labour taxation (C and D) complicate determining the exact degree of risk-sharing between the investor and the Treasury. A tax system concealing the full extent of risk-sharing prevents taxpayers from selecting a portfolio with more risk, when the taxation of capital income is changed.*

The overall net-of-tax earnings resulting from the combination of deferral labour taxation with taxable earnings from investment (tax system B) are identical to those subject to immediate labour taxation with tax-exempt earnings from investment (tax system C). Let y denote the gross labour earnings, s the tax rate applied to labour and investment earnings and r the return on investment, then the overall strain on the taxpayer within both tax systems is identical[10] and can be stated as:

$$(y \bullet (1+r)) \bullet (1-s) = y \bullet (1-s) \bullet (1+r).$$

When tax framing effects are ruled out, it is reasonable to expect no statistically significant difference between individual risk-taking behaviour in terms of the chosen portfolio variance between taxpayers within both tax systems. Changing capital income taxation and labour taxation´s point of time are mechanism of tax framing. The description and presentation of tax system components are assumed to weaken tax system salience and can alter taxpayer´s behaviour. One possible explanation is that the lower degree of tax system salience causes a positively biased perception. It makes taxpayers believe that they benefit more from lower tax burden by deferral taxation than by tax-exempt investment earnings. It is assumed that the deferral aspect of labour earnings taxation is more confusing to taxpayers than tax-exemption of investment earnings. This way of thinking implies that deferral labour taxation conceals the true tax burden on labour earnings, disappearing from taxpayers´ awareness. This perceived decrease of overall taxation results in a portfolio with a higher variance relative demand for a portfolio with a higher degree of risk. The fourth research hypothesis can be stated as:

H_4: *Comparing two tax systems putting an equal strain on the taxpayer´s overall earnings but presenting it differently, investors will show different risk-taking behaviour in terms of portfolio selection.*

[10] This identity is created within the defined experimental microcosm. The tax rate is invariant over time and certain and known to the taxpayers in the present and future.

3.2 The Experimental Setting

Experimental research in economics is widely accepted as an empirical method to approach the analysis of tax policy.[11] The advantages of experimental research is to provide control and knowledge of the economic environment, while producing only low costs to gather evidence on how tax incentives may affect individual and aggregate taxpayer behaviour.[12]

Instead of providing an exogenous financial endowment, which is to be invested in risky assets, the idea is to let the participants work for their earnings to derive a more realistic investment decision afterwards. A total of 96 students mostly enrolled in undergraduate business courses volunteered in the real effort experiment. The experiment took place in five runs between April 2011 and June 2011. Participants were randomly assigned to one of the five runs with no more than 25 volunteers each. Every single experiment run consisted of two parts, i.e. the real effort part and the investment part. The subjects had not been informed of the second part before the experiment started. The procedure of each run was identical. Before beginning the task, the subjects were given detailed instructions, e.g. as to how to use the computer to do the work, how the work task was rewarded, how to end the experiment. Once all instructions had been read, questions were answered. No working time restrictions were set.[13] Each individual was allowed to quit working whenever they wanted. They were required to make a real work-leisure decision, deciding not only on their individual work effort but also on their total working time. The cash payment depended on the individual work-effort, i. e. the total amount of work, and was received at the end of the task. The participants also received a sheet of paper informing them of the tax rate (60%) applied to their earnings. The individual task was to digitise solution sheets of a multiple choice exam. Each solution sheet that was digitised correctly was rewarded with a gross payment of EUR 0.30. The gross wage ranged from EUR 0.30 to 52.80 with a mean of EUR 19.05 for an average time commitment of 103.32 minutes and 70.58 digitised solution sheets. When concluding the working part, participants were asked to complete a post-experiment questionnaire to gather information about their personal background. While their overall earnings before taxes were calculated, the subjects were told about the second part of the experiment. It took place in a separate lecture room where further instructions and information were handed out to each participant: (1) The gross amount of money a subject earned, (2) The one-period investment decision between two assets (3)

[11] Alm (2010) surveys and assesses the development of behavioural economics. In particular, he discusses the metho dologies, applications and limitations of experimental economics.

[12] See Davis and Swenson (1988, p. 41.)

[13] Only four out of 96 students were willing to work more than the maximum working time of three hours.

The particular tax system applied to labour earnings and the earnings resulting from the investment in the risky assets.

Both assets (X and Y) are designed with an identical expected value but a different amount of risk (mean preserving spread), each featuring three possible outcomes which are distributed with equal probabilities. The outcomes of both assets are stochastically independent. X is the less risky asset with only non-negative outcomes. The range of possible outcomes is more spread for Y than for X, leading to a higher variance. Asset Y also involves the possibility of a loss with a probability of $\frac{1}{3}$, which has important implications with regard to the taxation of profits and losses resulting from investment. Assuming risk-averse investors, the lowest variance possible (Var(r)= 0.048) can be obtained by allocating an relative amount of 80% to asset X and 20% to Y, meaning a reduction in variance by one fifth through asset diversification. It is also controlled for a possible "erroneous" demand of taxpayers for the portfolio with the lowest variance. The need to combine the two assets to obtain the portfolio with the lowest variance might not be obvious to taxpayers. Therefore, all investors (n=22), who decided invest in asset X only, selecting a portfolio variance of 0.06, are assigned a "corrected" portfolio variance of 0.048.[14]

	Possible outcomes and probability distributions							
Asset	r(up)	p(up)	r(medium)	p(medium)	r(down)	p(down)	EV(r)	Var(r)
X	0.6	1/3	0.3	1/3	0	1/3	0.3	0.06
Y	0.9	1/3	0.3	1/3	-0.3	1/3	0.3	0.24

Table 2 – Available assets

Four different tax systems were to be tested, differing in two dimensions from each other. Each participant was randomly assigned to one tax system, i.e. one tax treatment, on the basis of which their individual investment decision was to be made. Labour earnings are either subject to immediate or deferral taxation, meaning that labour earnings are subject to taxation before or after the investment. Depending on the particular tax system, gross labour earnings (m) or net earnings ($n = m \bullet (1 - s)$) are the maximum amount available for investment. Moreover, tax systems A & C raise taxes on the earnings from on investment, whereas they are tax-exempt in tax systems B & D.

[14] The empirical analysis is done with both the original portfolio variances and the adjusted variances.

Tax systems	Immediate or deferral taxation of gross labour earnings?	Maximum amount to be invested	Earnings from investment are subject to taxation?	Net-of-tax amount after labour and capital income taxation
A (n=24)	Immediate	$n = m \bullet (1-s)$	Yes	$n \bullet (1 + r \bullet (1-s))$
B (n=24)	Immediate	$n = m \bullet (1-s)$	No	$m \bullet (1-s) \bullet (1+r)$
C (n=24)	Deferral	m	Yes	$m \bullet (1-s) \bullet (1+r)$
D (n=24)	Deferral	m	No	$m \bullet ((1-s)+r)$

Table 3 – Tax systems and maximal amount to be invested

Under their assigned tax system, each subject had to decide how to allocate their earnings to the two assets.[15] When choosing between two risky assets with an identical expected return but a different amount of risk, participants are implicitly required to weigh the advantage of a possible greater return against the disadvantage of a possible negative return. Regarding the net-of-tax amount, the following ranking order for positive outcomes can be derived: $D \succ C \sim B \succ A$.

The experimental design is to analyse how the willingness of taxpayers to bear more risk can be manipulated by tax policy, not only by capital income taxation but also by labour income taxation. After the subjects had determined the proportions to invest in the two assets X and Y, the outcome of each asset was determined individually by rolling a dice twice. The subjects completed another ex post questionnaire. It included additional questions referring to their investment decision-making. They were paid privately and left. The subject pay averaged 10.47 euros, requiring a total time involvement of 113.78 minutes.

[15] Although investors were assumed to maximise their wealth, participants were also allowed not to invest their earnings.

4 Empirical findings

4.1 Group-specific analysis

The empirical strategy is based on three steps. The first step aims to identify the effect of increased initial liquidity on risk-taking behaviour, provided by deferral labour income taxation. The second step is a group comparison to identify, whether the change in capital income taxation is perceived differently, when immediate or deferral taxation of labour earnings apply. Third, the research question whether the demand for riskier portfolios is influenced by tax framing, i.e. redesigning the process of income taxation without changing the overall strain on the taxpayers, is addressed.

Tax system	Subjects	No. of subjects investing only in risky asset X	No. of subjects investing in X and Y	No. of subjects investing only in riskier asset Y	No. of subjects investing neither in X nor in Y
A	24	13	7	3	1
B	24	6	12	5	1
C	24	0	15	9	0
D	24	3	11	10	0
Total	**96**	**22**	**45**	**27**	**2**

Table 4 – Tax systems and investment behaviour

Table 3 and 4 present group-specific investment decisions. Table 3 indicates that the number of individuals investing in only one or both assets differs substantially between the four groups. Table 4 depicts the mean portfolio variance for taxpayers, who underlie different tax treatments, revealing that risk-taking behaviour is not equal across the tax systems. Under tax system D (deferral taxation of labour earnings and tax-exempt earnings from investment) individuals select a portfolio with an average variance of 0.163, whereas individuals only select a portfolio with a mean variance of 0.083 under a tax system with immediate labour taxation and taxable earnings from investment.

Mean portfolio variance chosen by taxpayers, underlying different tax treatments		Earnings from investment are subject to taxation	
		Yes	**No**
Gross labour earnings are subject to immediate taxation	**Yes**	A: 0.083	B: 0.102
	No	C: 0.148	D: 0.164

Table 5 – Tax systems and mean portfolio variance

Testing statistical significance, I initially perform different two-sample proportion t-tests. A two-sample proportion t-test is helpful to determine whether differences between two proportions of independent samples are statistically significant. I conduct pairwise comparisons of different tax systems to test H_1 –H_4.

With respect to hypothesis H_1 comparing tax systems with immediate labour taxation (A and B) with those with deferral labour taxation (C to D)), the equality of means can be rejected on a 1% level of significance (p-value <0.001). Averaging the respective portfolio variances for A and B (0.093) as well as C and D (0.156), the absolute difference turns out to be statistically significant positive (>0) with a p-value of 0.035, meaning a relative increase in portfolio variance of almost 68%. The appealing effect of increased liquidity due to labour income tax postponement is found to be empirically verified. A tax system providing an initial increased investment amount make investors select riskier portfolios. This result indicates that tax systems with deferral labour taxation can be regarded as an incentive to induce taxpayers´ willingness to select riskier portfolios.

H_2 addresses the long-time issue in theoretical as well as empirical work, asserting that risk-averse individuals will show more willingness to take risk, when a proportional tax on capital income is in effect compared to an environment with capital income taxation. Despite the analytical predictions of increased risk-taking behaviour, the level of mean portfolio variance selected by taxpayers under tax systems A and B does not differ significantly from each other (p-value=0.491). Imposing a tax on investment earnings does not increase the demand for a riskier portfolio and opposes theoretical rigor. This result is in line with the implications of experimental studies by Swenson (1989), King and Wallin (1990) and Fochmann et al. (2012), who also found only little (or none) empirical support for a positive impact of capital income taxation on individual risk-taking.

Hypotheses H_3 –H_4 address tax framing effects. First of all, H_3 refers to H_2 and cannot be tested without referring to the empirical test results for H_2. Since in the case with immediate labour income taxation there is no empirical support for a positive effect of capital income taxation on risk-

taking behaviour, testing H_3 can neither confirm nor reject the existence of tax framing effects. Even in tax systems with the standard approach of immediate labour income taxation, the assumed relationship between a proportional capital income tax and individual risk-taking propensity is not empirically observable. When there is deferral taxation of labour earnings, the imposition of a capital income tax does not lead to less risk seeking by taxpayers, i.e. the selection of portfolios with a lower overall variance. In the case with deferral labour taxation, there is also no statistically significant difference (p-value= 0.362) between individual risk-taking propensity (in tax systems C and D). Modelling the dimension of labour taxation, theoretical predictions about capital income taxation and risk-taking are contradicted or at least found to be empirically not verifiable in the chosen experimental setting. The lack of empirical support is a strong hint how careful analytical findings must be interpreted and transferred to reality.

With respect to hypothesis H_4, tax framing effects are prominent. The equality of means for tax systems B and C can be rejected on a 5% level of significance. Moreover, the difference between the mean portfolio variances in tax system B and C is positive (>0) on a 5% level of significance (p-value <0.026). This finding provides clear empirical evidence that tax framing causes a substantial perception bias with regard to a tax system´s overall tax burden. Although the information given is the same, i. e. overall tax burden remains constant, the introduction of deferral taxation and elimination of capital income taxation produces significantly different investment behaviour. Even with eliminating economic complexity in the laboratory, the group comparison challenges the view that taxpayers are capable to determine their overall tax burden, when different tax rules apply to different components in the process of income taxation. Tax framing appears to be one source for taxpayers´ lack of unanimous risk-taking behaviour. It is reasonable to assume that tax system salience is strongly affected by the realignment of tax rules. The result implies that tax framing conceals the overall tax burden, generating a deviation from a pure rational perspective regarding risk-taking behaviour.

Overall, the empirical testing provides strong evidence that the introduction of deferral taxation challenges the traditional view how capital income taxation and risk-taking investment behaviour are (supposed to be) related. On the one hand, multidimensionality of taxation softens empirical evidence by tax framing effects, lowering tax system salience and concealing tax burden visibility. On the other hand, my results indicate that the replacement of immediate by deferral labour taxation turns out to be a powerful tax policy instrument to foster investment in riskier assets. In line with previous findings there is no empirical evidence that capital income taxation fosters individual risk-taking behaviour as analytical work asserts.

4.2 ANOVA/ ANCOVA

The analysis of variance (ANOVA) offers a more profound testing of hypotheses. It allows comparing the means of populations, which are classified in two (or more) different ways. The two-way ANOVA contains two independent categorical variables or so called factors. In the experiment these factors are the "labour income taxation" and "capital income taxation" upon which four treatments are formed. The underlying between-subjects design is based on the idea that each combination of these factors is applied to a completely new group of subjects. Participants are only part of one of the four treatment groups. The dependent variable in two-way ANOVA is the selected portfolio variance, resulting from the allocation of disposable earnings to assets X and Y. The exploration via a boxplot graphic reveals group-specific patterns in the data. Figure 1 depicts statistics about the investment behaviour across the tax systems and visualises its intra- and intergroup dispersion, indicating remarkable differences between the four treatments.

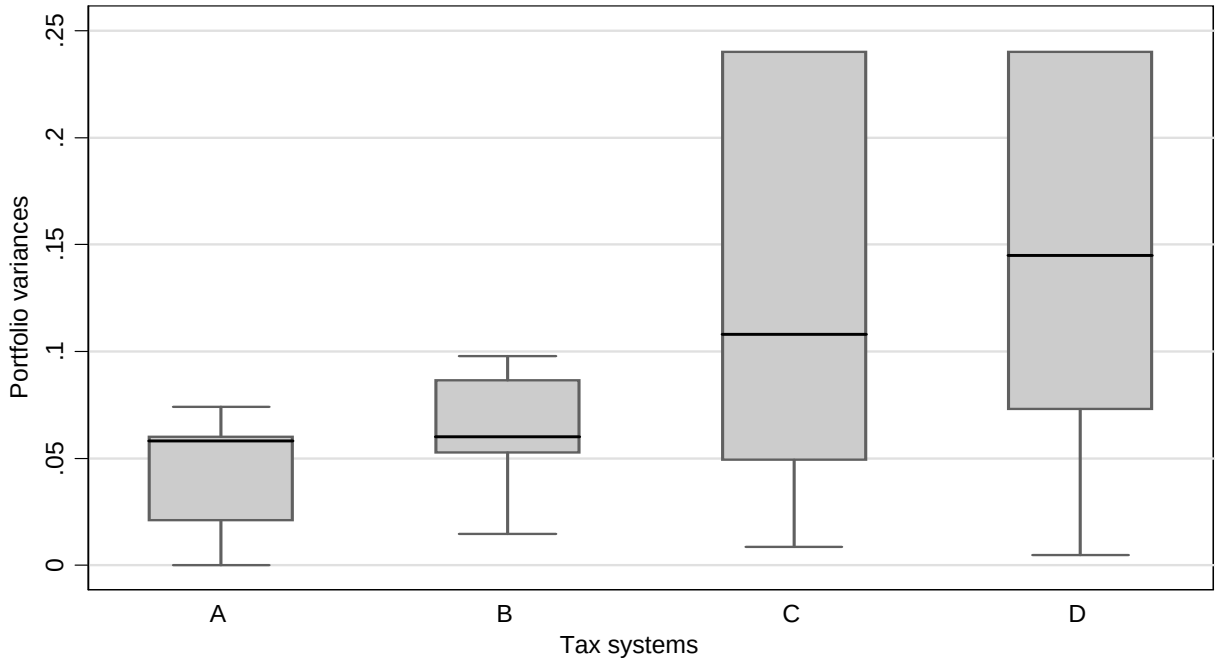

Figure 1 – Tax systems and selected portfolio variance

When controlling for other explanatory quantitative variables, the statistic tool is often called the analysis of covariance (ANCOVA). It combines elements from regression and analysis of variance. ANCOVA includes categorical and continuous variables and allows for the identification of a possible interdependency. The ANCOVA basic estimation equation is specified as:

$$\text{var}_i = \beta_0 + \beta_1 def + \beta_2 citax + \gamma_k' X_{ik} + \varepsilon_i \text{ with } X_{ik} = \left\{ \begin{array}{l} disposable\ earnings \\ disposable\ earnings \bullet def \\ risk\ attitude \\ age \\ gender \end{array} \right\}.$$

The dependent variable is the selected portfolio variance, denoted by var_i. It is continuous with only non-negative outcomes within a possible range of 0.00 to 0.24. β_0 is the unknown intercept, β_1 is the unknown parameter for the factor "labour income taxation" with two levels (deferral taxation and immediate taxation). Its abbreviation is *def* and equals 1 for deferral labour income taxation and 0 for immediate labour income taxation. β_2 is the unknown regression coefficient for the binary factor *citax*, indicating whether capital income is tax-exempt ($citax = 0$) or taxable ($citax = 1$). The base category is a tax system with immediate labour taxation and tax-exempt earnings from investment, i.e. tax system B. Following the principle of parameter parsimony, the model includes five unknown parameters, given by row vector γ_k'. They refer to socio-demographic characteristics contained in column vector X_i for the i-th observation. The metric variable *disposable earnings* is included as a regressor to control for a possible level effect of the underlying gross labour income on the portfolio variance as the dependent variable. An interaction between disposable earnings and the factor "labour income taxation" is also included to account for a possible interdependence between the aforementioned level effect and the increased liquidity, resulting from the postponement of labour income taxation. Self-estimated personal *risk attitude* with values ranging from 1 to 10 is also included as a regressor.[16] The variable *age* is measured in years and metric; gender is binary and equals 1 for male respondents and 0 for female respondents. The latter is the base category.

Estimation results are presented in Table 5 containing the point estimate and the standard error of each covariate. In general, most coefficients are found to be not statistically significant. However, the results of ANCOVA indicate a statistically significant and pronounced main effect of the labour

[16] The questionnaire contains questions on personal risk attitudes. On a scale from 1 (risk averse) to 10 (risk seeking), participants are asked to assess their risk-taking propensity. An indirect query of personal risk preferences via Arrow Pratt measure could also have been a valuable alternative. See Huang and Litzenberger (1988) for further information. Since the measurement of (self-estimated) personal risk attitudes might be problematic, the basic equation was also estimated without the self-estimated risk attitude as a regressor. Estimations results were not significantly different in size and direction.

income tax treatment. The estimated coefficient for the factor "labour taxation" ($\hat{\beta}_1 = 0.065$) is highly significant with a p-value of 0.025, whereas the factor "capital income taxation" ($\hat{\beta}_2 = -0.017$) is neither economically nor statistically significant on a reasonable level of confidence.

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.065*	0.028	0.025	0.008 - 0.122
citax				
0	(base)			
1	-0.017	0.016	0.285	-0.050 - 0.014
disposable earnings	-0.003	0.002	0.125	-0.007 - 0.001
disposable earnings•def	0.001	0.002	0.671	-0.003 - 0.005
risk attitude	0.021	0.016	0.189	-0.011 - 0.053
age	0.001	0.002	0.451	-0.002 - 0.005
gender				
0	(base)			
1	0.027	0.016	0.095	-0.005 - 0.060
constant	0.080	0.051	0.117	-0.020 - 0.181

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.186, Root MSE= 0.0776

Table 6 – ANCOVA estimates for basic equation

The findings provide empirical evidence that the tax treatments are perceived differently. They are not equally eligible to increase taxpayers´ risk-taking propensity, i.e. favouring portfolios with a higher overall variance. ANCOVA identifies deferral labour income taxation to be a powerful/effective tax incentive to induce more risk-seeking. The change of labour income taxation make taxpayers alters their investment allocation between the risky assets fundamentally. On basis of immediate labour taxation (as the base category), the taxation of capital income does not affect taxpayer´s portfolio selection. Although this result is not in line with most analytical work, similar results have been often found in previous studies. The result´s value value for tax policy design

cannot be underestimated. It heats up the academic and political debate whether the taxation of capital income can be considered as an incentive to foster riskier investment behaviour. Proponents of capital income taxation often argue that the Treasury absorbs part of the investor's risk and can be regarded as a partial insurance against possible losses, fostering risk-taking behaviour by taxpayers. Controlling for the dimension of labour income taxation, the hypothesis, that risk-sharing between the investor and the Treasury is appealing and increases individual risk-taking propensity, is clearly not empirically supported.

From a fiscal point of view, the beauty of deferral taxation is the postponement of taxation, whereas the exemption of investment earnings means forgone tax revenues. From a fiscal point of view, deferral labour income taxation kills two birds with one stone: it is perceived as an appealing incentive to make taxpayers demand riskier portfolios while securing the overall income tax revenues in the long-run. If German tax policy aims to foster risk-seeking investment behaviour on income tax revenue- friendly basis, the ANCOVA estimation implies a strong and distinct preference for deferral labour taxation.

Surprisingly, the point estimates for *disposable earnings* ($\hat{\gamma}_1 = -0.003$) and the interaction term between *disposable earnings* and *def* ($\hat{\gamma}_2 = 0.001$) do not reveal a significant effect on the subject´s demand for riskier portfolios. The implications are clear: First, there is no level effect of disposable earnings on portfolio selection, meaning that taxpayers, who earned a greater amount of gross labour earnings, cannot be statistically distinguished from taxpayers with less gross labour earnings regarding their risk-taking behaviour. The insignificant interaction term implies that the level effect cannot be induced within tax systems where deferral labour income taxation applies. To put it non-technical: Taxpayers with a greater amount of gross labour income do not demand riskier portfolios, even if the taxation of their labour income is postponed.

Predicting the variance of the selected portfolio with ANCOVA is intuitive. A participant (base categories for both factors) in a tax system with immediate labour income taxation and tax-exempt capital income (tax system B) is expected to select a portfolio with a variance of 0.080. Assuming that the factor "labour income taxation" (variable *def*) changes its level from zero to one, the predicted portfolio variance increases by 0.065 (in absolute terms), meaning almost a doubling of portfolio variance. Controlling for the influence of the taxpayer´s gender, the ANCOVA indicates that a male participant selects a portfolio variance with 0.107 compared to a female participant. In relative terms, this increase slightly exceeds one fourth.

To test whether the interaction of both factors might be significant, an interaction term is added to the above estimation equation. This specification produces no statistically significant result for the

interaction of both tax incentives. Reducing the number of model parameters, several other specifications are also estimated but do not represent a statistically significant interaction. Even the modelling of portfolio variance (the response variable) as a function of *def* , *citax* and their interaction does not produce statistically significant results (See Table A1-A5 in the Appendix for further details). Assuming risk-averse investors, it is also controlled for a possible "erroneous" demand of taxpayers for the portfolio with the lowest variance. When deciding about the investment of disposable earnings, the portfolio with a lowest variance possible (0.048) can be obtained by the allocating a relative amount of 80% to asset X and the other 20% to asset Y, whereas the complete investment in asset X means a portfolio variance of 0.06. Since this fact not be obvious to taxpayers, all investors (n=22) with selected portfolio variance of 0.06 are assigned a "corrected" portfolio variance of 0.048. Neither the two-sample proportion t-test nor the ANCOVA have produced deviating results with regard to significance and direction of the estimated parameters.[17]

Summing up, ANCOVA is a more powerful statistical tool than two-sample proportion t-tests. It allows for the estimation of the impact that categorical variables may have on the demand for riskier portfolios while also controlling for socio-demographic (continuous) explanatory variables. The preferred specification only exhibits a substantial positive influence of one of the main variables of interests on taxpayers´ risk-taking investment behaviour. An alternative tax treatment of labour earnings turns out to increase taxpayers´ willingness to take risk when they have to make investment decisions.

5 Summary and Conclusions

This study addresses the question as to how different tax systems applied to taxpayers´ labour and investment earnings affect the allocation strategy, i.e. the risk-taking behaviour displayed by taxpayers. At the core of the experimental analysis are four different designs of a tax system, affecting of individual investment behaviour. The tax systems discriminate between the taxation of labour earnings and investment earnings. The experimental approach combines a real effort task where real money had to be earned with a subsequent investment decision between two risky assets. On basis of a real effort experiment, it is a promising and new approach to model and analyse four different tax systems featuring deferral taxation of gross earnings in connection with capital income taxation. The addition of another income taxation dimension creates a more realistic economic environment in the laboratory allows deriving more reasonable behavioural responses than in

[17] The two samples proportion tests and ANCOVA estimation results on basis of the adjusted portfolio variances are given in the Appendix (A6-A11).

previous studies. Although the limitations of experimental tax research are well known and sometimes hamper the generalizability of the laboratory results to the field, empirical tax research finds its justification in making tax policy recommendations. The implications of this study are clear:

(1) The postponement of taxes on investment or other earnings appears to be an attractive incentive to taxpayers´ and lives up to its promise. A primary concern of tax policymakers is the impact of tax-deferred contributions on pension plans. My findings provide strong empirical support for tax deferral as proper measure to increase these contributions. (2) The study also provides grist to the mills of the opponents of a preferential tax treatment of investment earnings. Its much vaunted positive externality of influencing taxpayers´ propensity to undertake risky investments has not been empirically verified in the laboratory environment, when immediate or deferral labour income taxation applies. (3) The balancing act between budget consolidation and setting incentives for private investment requires a careful weighing up of different tax policy measures. The ANCOVA estimates indicate that deferral taxation of earnings is a powerful tax incentive in fostering risk-taking behaviour. With regard to income tax revenues, deferral taxation puts less pressure on the public budget than the exemption of capital gains from taxation, providing additional strong arguments for expanding the application of deferral taxation in modern tax systems.

Future experimental tax research should focus on the sample size and its composition. Although student participants are widely accepted and easily available, a more representative choice of participants would shed more light on the results´ validity and improve their transferability to reality. Several measures obtained from the same subject would be helpful in many ways. First, repeated decision-making in laboratory experiments is useful to identify participants´ learning effects and their (in)consistency in decision-making. Second, repeated decision-making creates more data on individual (investment) behaviour. This additional information paves the way for more elaborate statistical procedures accounting for experimental designs with repeated measures. Third, varying the degree of deferral taxation of gross earnings can be implemented in a repeated-measure design, examining not only heterogeneous responsiveness between subjects but also the subject´s inner responsiveness under a number of different tax treatments.

Appendix

Table A1. ANOVA only including tax treatments as factors

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.058***	0.016	<0.001	0.026 - 0.091
citax				
0	(base)			
1	-0.016	0.016	0.314	-0.049 - 0.016
constant	0.086***	0.014	<0.001	0.058 - 0.114

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.105, Root MSE= 0.081

Table A2. ANOVA including tax treatments as factors and their interaction

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.059*	0.023	0.012	0.013 - 0.105
citax				
0	(base)			
1	-0.015	0.023	0.497	-0.062 - 0.0393
def•cgf	-0.001	0.033	0.957	-0.067 - 0.064
constant	0.085***	0.016	<0.001	0.053 - 0.117

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.096, Root MSE= 0.082

Table A3. ANCOVA basic specification including interaction term of factors

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.067*	0.033	0.047	0.001 - 0.134
citax				
0	(base)			
1	- 0.015	0.023	0.517	-0.061 - 0.031
def •exempt	- 0.004	0.032	0.885	-0.070 - 0.060
disposable earnings	0.032	0.002	0.127	-0.007 - 0.000
disposable earnings•def	<0.001	0.002	0.697	-0.003 - 0.005
risk attitude	0.021	0.016	0.189	-0.054- 0.010
age	0.001	0.001	0.447	- 0.002 - 0.005
gender				
0	(base)			
1	0.027	0.016	0.106	-0.005 - 0.060
constant	0.078	0.052	0.133	-0.024 - 0.182

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.177, Root MSE= 0.078

Table A4. ANCOVA excluding risk attitude, age, gender and interaction term

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.066*	0.028	0.023	0.009 - 0.124
citax				
0	(base)			
1	-0.023	0.016	0.143	-0.055 - 0.008
disposable earnings	0.003	0.002	0.112	-0.007 – 0.000
disposable earnings•def	<0.001	0.002	0.706	-0.003 – 0.005
constant	0.122***	0.022	0.001	0.077 - 0.167

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.162, Root MSE= 0.078

Table A5. ANCOVA including interaction term of factors and excluding risk attitude, age and gender

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.068*	0.033	0.046	0.001 - 0.136
citax				
0	(base)			
1	-0.022	0.022	0.333	-0.067 - 0.023
def•cgf	0.003	0.032	0.919	-0.066 - 0.062
disposable earnings	0.003	0.002	0.113	-0.007 - 0.000
disposable earnings•def	0.001	0.002	0.709	-0.003 - 0.05
constant	0.121***	0.024	<0.001	0.073 - 0.169

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.152, Root MSE= 0.079

Table A6. Two sample proportion tests with adjusted portfolio variance

Hypothesis	Tax systems	Means	95% Conf. interval	P-values
1	A and B vs. C and D	0.074 vs. 0.136	0.053 – 0.096 vs. 0.110 – 0.162	H1a: difference ≠0 p-value: <0.001 H1b: difference<0 p-value: 0.002
2	A vs. B	0.127 vs. 0.144	0.088 – 0.166 vs. 0.108 – 0.181	H1a: difference ≠0 p-value: 0.510 H1b: difference<0 p-value: 0.255
3	C vs. D	0.065 vs. 0.089	0.036 – 0.095 vs. 0.055 – 0.124	H1a: difference ≠0 p-value: 0.275 H1b: difference<0 p-value: 0.137
4	B and C	0.089 vs. 0.127	0.088 – 0.166 vs. 0.055 vs. 0.124	H1a: difference ≠0 p-value: 0.139 H1b: difference<0 p-value: 0.0699

Table A7. ANOVA only including tax treatments as factors

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.061***	0.016	<0.001	0.028 - 0.094
citax				
0	(base)			
1	-0.017	0.016	0.307	-0.050 - 0.015
constant	0.082***	0.014	<0.001	0.054 - 0.111

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.115, Root MSE= 0.082

Table A8. ANOVA including tax treatments as factors and their interaction

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.061**	0.023	0.010	0.015 - 0.108
citax				
0	(base)			
1	-0.017	0.023	0.468	-0.063 - 0.029
def•cgf	-0.001	0.033	0.998	-0.066 - 0.066
constant	0.082***	0.016	<0.001	0.053 - 0.115

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.105, Root MSE= 0.082

Table A9. ANCOVA basic specification including interaction term of factors

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.071*	0.034	0.037	0.004 - 0.139
citax				
0	(base)			
1	- 0.016	0.023	0.492	-0.063 - 0.030
def•citax	- 0.003	0.033	0.926	-0.069 - 0.063
disposable earnings	0.029	0.002	0.161	-0.007 - 0.001
disposable earnings•def	<0.001	0.002	0.749	-0.003 - 0.005
risk attitude	0.021	0.016	0.192	-0.054- 0.011
age	0.001	0.001	0.464	- 0.002 - 0.005
gender				
0	(base)			
1	0.027	0.016	0.11	-0.005 - 0.061
constant	0.074	0.052	0.160	-0.030 - 0.179

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.179, Root MSE= 0.079

Table A10. ANCOVA excluding risk attitude, age, gender and interaction term

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.071*	0.029	0.016	0.013 - 0.123
citax				
0	(base)			
1	-0.024	0.016	0.143	-0.056 - 0.008
disposable earnings	0.003	0.002	0.144	-0.007 – 0.001
disposable earnings•def	<0.001	0.002	0.780	-0.003 – 0.005
constant	0.116***	0.022	0.001	0.071 - 0.162

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.166, Root MSE= 0.079

Table A11. ANCOVA including interaction term of factors and excluding risk attitude, age and gender

Covariate	Coefficient	Standard error	P-value	95% Conf. interval
def				
0	(base)			
1	0.072*	0.034	0.037	0.004 - 0.141
citax				
0	(base)			
1	-0.023	0.023	0.317	-0.067 - 0.022
def •citax	0.001	0.032	0.960	-0.066 - 0.063
disposable earnings	0.003	0.002	0.146	-0.007 - 0.001
disposable earnings•def	<0.001	0.002	0.782	-0.003 - 0.05
constant	0.116***	0.024	<0.001	0.067 - 0.164

Note: Asterisks denote the respective significance level at 95% (*), 99% (**) and 99.9 (***). The Adj. R^2 is 0.156, Root MSE= 0.080

References

Ahsan, S. M. (1990): Risk-Taking, Savings and Taxation. A Re-Examination of Theory and Policy. *The Canadian Journal of Economics*, 23 (2), 408-433.

Agell, J., Edin, P. A. (1990): Marginal Taxes and the Asset Portfolios of Swedish Households. *Scandinavian Journal of Economics*, 92 (1), 47-64.

Alm, J. (2010): Testing Behavioural Public Economics Theories in the Laboratory. *National Tax Journal*. 64 (4), 635 – 658.

Anderson, S. E., Butler, J. B. (1997): Experimental Evidence on the Effects of Tax Incentives on Risky Security Prices. *The Journal of the American Taxation Association*, 19 (1), 58-76.

Andrews, W. D. (1974): A Consumption-Type or Cash Flow Personal Income Tax. *Harvard Law Review*, 87 (6), 1113-1188.

Asea, P. K., Turnovsky, S. J. (1998): Capital Income Taxation and Risk-Taking in a Small Open Economy. *Journal of Public Economics*, 68 (1), 55-90.

Atkinson, A. B., Stiglitz, J. E. (1976): The Design of Tax Structure: Direct versus Indirect Taxation. *Journal of Public Economics*, 6 (1)-(2), 55-75.

Auerbach, A. J., Burman, L. E., Siegel, J. M. (2000): Capital Gains Taxation and Tax Avoidance: New Evidence from Panel Data in Slemrod, J. (ed.): Does Atlas Shrug? New York: Russell Sage Foundation.

Auerbach, A. J., Siegel, J. M. (2000): Capital Gains Realizations of the Rich and Sophisticated. *American Economic Review*, 90 (2), 276-282.

Auten, G. E., Clotfelter, C. T. (1982): Permanent vs. Transitory Tax Effects and the Realization of Capital Gains. *Quarterly Journal of Economics*, 97 (4), 613-632.

Bamberg, G., Richter, W. F. (1984): The effect of progressive taxation on risk-taking. *The Journal of Economics*, 44 (2), 93 – 102.

Bamberg, G., Richter, W. F. (1988): Decision-theoretic analysis of envisaged income tax reforms for FRG and USA, *Annals of Operations Research, 16 (1), 105 – 116.*

Balcer, Y., Judd, K. L. (1987): Effects of Capital Gains Taxation on Life-Cycle Investment and Portfolio Management. *Journal of Finance*. 32 (3), 743-758.

Bulow, J. I., Summers, L. H. (1984): The Taxation of Risky Assets. *Journal of Political Economy*, 92 (1), 20-39.

Burman, L. E., Randolph, W. C. (1984): Measuring Permanent Responses to Capital Gains Tax Changes in Panel Data. *American Economic Review*, 84 (4), 794-809.

Butters, J. K., Thompson, L. E. (1953): Effects of Taxation on the Investment Policies and Capacities of Individuals. *Journal of Finance*, 8 (2), 137-151.

Chetty, R., Looney, A., Kroft, K. (2009): Salience and Taxation: Theory and Evidence. *The American Economic Review*, 99, 1145 – 1177.

Cullis, J., Jones, P., Lewis, A. (2006): Tax framing, Instrumentality and individual differences: Are there two different cultures? *Journal of Economic Psychology*, 27, 304 – 320.

Davis, J. S., Swenson, C. W. (1988): The Role of Experimental Economics in Tax Policy Research. *Journal of the American Taxation Association*, 10 (1), 40-59.

Davis, J. S., Swenson, C. W. (1993): Experimental Evidence on Tax Incentives and the Demand for Capital Investments. *The Accounting Review*, 68 (3), 482-514.

Domar, E., Musgrave, R. (1944): Proportional Income Taxation and Risk-Taking. *The Quarterly Journal of Economics*, 58 (3), 388 – 422.

Eichner, M., Sinai, T. (2000): Capital Gains Tax Realizations and Tax Rates: New Evidence from Time Series. *National Tax Journal*, 53 (3), 663-681.

Elton, E. J., Gruber, M. J. (1978): Taxes and Portfolio Composition. *Journal of Financial Economics*, 6 (4), 399-410.

Feldstein, M. S. (1976): On the Theory of Tax Reform. *Journal of Public Economics*, 6 (1)-(2), 77-104

Feldstein, M. S. (1978): The Welfare Cost of Capital Income Taxation. *Journal of Political Economy*, 86 (2), 29-51.

Fellingham, J. C., Wolfson, M. A. (1978): The Effects of Alternative Income Tax Structures on Risk-Taking in Capital Markets. *National Tax Journal*. 31 (4), 339-348.

Finn, T. J. (1977): A Simple Note on Taxation and Risk-Taking. *Economica*, 44 (175), 283-287.

Fisher, I. (1897): The Role of Capital in Economic Theory. *Economic Journal*, 7 (28), 511-537.

Fisher, I. (1937): Income in Theory and Income Taxation in Practice. *Econometrica*, 5 (1), 1-55.

Fisher, I. (1906): Nature of Capital and Income. New York: MacMillan.

Fochmann, M., Kiesewetter, D., Sadrieh, A. (2012): Investment behaviour and the biased perception of limited loss deduction in income taxation. *Journal of Economic Behaviour & Organization*, 81 (1), 230 – 242.

Fujii, E. T., Hawley, C. B. (1988): On the Accuracy of Tax Perceptions. *Review of Economics and Statistics*, 70, 344 – 347.

Harberger, A. C. (1964a): Taxation, Resource Allocation and Welfare. In *The Role of Direct and Indirect Taxes in the Federal Revenue System*. New Jersey: Princeton University Press.

Harberger, A. C. (1964b): The Measurement of Waste. *American Economic Review*, 54 (3), 58-76

Harberger, A. C. (1966): Efficiency Effects of Taxes on Income from Capital. In *Effects of Corporation Income Tax*. Detroit: Wayne State University Press.

Huang, C., Litzenberger, R. (1988): Foundations of Financial Economics. Prentice-Halle, Inc.

Kaldor, N. (1955): An Expenditure Tax. London: Allen & Unwin.

Kaplow, L. (1994): Taxation and Risk-Taking: A General Equilibrium Perspective. *National Tax Journal*, 47 (4), 789-798.

King, R. R., Wallin, D. E. (1990): Individual Risk Taking and Income Taxes: An Experimental Examination. *The Journal of the American Taxation Association*, 12 (1), 26-38.

Landsman, W. R., Shackelford, D. A. (1995): The Lock-In Effect of Capital Gains Taxes: Evidence from RJR Nabisco Leverage Buyout. *National Tax Journal*, 48 (2), 245-259.

Levari, D., Sheshinski, E. (1972): Lifetime Excess Burden of a Tax. *Journal of Political Economy*, 80 (1), 139-147.

Lewis, A. (1978): Perceptions of Tax Rates. *British Tax Review*, 6, 358 – 366.

Maki, D. (1996): Portfolio Shuffling and Tax Reform. *National Tax Journal*, 49 (3), 317-329.

Meade, J. A. (1990): The Impact of Different Capital Gains Systems on the Lock-In Effect and New Risky Investment Decisions. *The Accounting Review*, 65 (2), 406-431.

Meade, J. A. (1995): The Effects of Income and Consumption Tax Systems and Future Tax Rate Uncertainty on Proportional Savings and Risk-Taking. *The Accounting Review*, 70 (4), 635-653.

Mariger, R. P. (1995): Taxes, Capital Gains Realizations, and Revenues: A Critical Review and Some New Results. *National Tax Journal*, 48 (3), 447-462.

Mintz, J. M. (1981): Some Additional Results on Investment, Risk Taking, and Full Loss Offset Corporate Taxation with Interest Deductibility. *The Quartely Journal of Economics*, 96 (4), 631- 642.

Mossin, J. (1968): Taxation and Risk-Taking: An expected utility approach. *Economica*, 35 (137), 74-82.

Poterba, J. M. (2001): Taxation, Risk-Taking and Household Portfolio Behaviour. NBER Working Paper 8340, available at: www.nber.org/papers/w8340

Poterba, J. M., Weisbenner, S. (2001): Capital Gains Tax Rules, Tax Loss Trading, and Turn-of-the-Year Returns, *Journal of Finance,* 56 (1), 353-368.

Ramsey, F. P. (1927): A Contribution to the Theory of Taxation. *The Economic Journal*, 37 (145), 47-61.

Rupert, T. J., Fischer, C. M. (1995): An Empirical Investigation of Taxpayer Awareness of Marginal Tax Rates. *Journal of the American Taxation Association*, 17, 83 – 99.

Sandmo, A. (1989): Differential Taxation and the Encouragement of Risk-Taking. *Economics Letters*, 31 (1), 55-59

Sausgruber, R., Tyran, J. R. (2005): Testing the Mill Hypothesis of Fiscal Illusion. *Public Choice*, 122, 39 – 68.

Schneider, D. (1980): The Effects of Progressive and Proportional Income Taxation on. Risk-Taking. *National Tax Journal*, 33 (1), 67 – 75.

Slemrod, J. (1989): Rank Reversals and the Tax Elasticity of Capital Gains Realizations. *National Tax Journal*, 42 (4), 503-507.

Stiglitz, J. E. (1969): The Effects of Income, Wealth and Capital Gains Taxation on Risk-Taking. *Quarterly Journal of Economics*, 83 (2), 263-283.

Stiglitz, J. E. (1983): Some Aspects of the Taxation of Capital Gains. *Journal of Public Economics*, 21 (2), 257-294.

Swenson, C. W. (1989): Tax Systems and the Demand for Risky Assets: Some Experimental Market Evidence. *The Journal of the American Taxation Association*, 11 (1), 54-76.

Weisbach, D. (2004): Taxation and Risk-Taking with Multiple Tax Rates. *National Tax Journal*, 57 (2), 229-243.

Yitzhaki, S. (1979): An Empirical Test of the Lock-in-Effect of the Capital Gains Tax. *The Review of Economics and Statistics*, 61 (4), 626-629.

Diskussionsbeiträge
des Fachbereichs Wirtschaftswissenschaft
der Freien Universität Berlin

2012

2012/1 SCHULARICK, Moritz
Public Debt and Financial Crisis in the Twentieth Century
Economics

2012/2 NEHER, Frank
Preferences for Redistribution around the World
Economics

2012/3 BOCHOVE, Christiaan van / Lars BOERNER / Daniel QUINT
Anglo-Dutch Premium Auctions in Eighteenth-Century Amsterdam
Economics

2012/4 FOSSEN, Frank / Martin SIMMLER
Differential taxation and firms' financial leverage – Evidence from the introduction of a flat tax on interest income
Economics

2012/5 KÖNIG, Jan / Christoph SKUPNIK
Labor market integration of migrants: Hidden costs and benefits in two-tier welfare states
Economics

2012/6 CLUDIUS, Johanna / Martin BEZNOSKA / Viktor STEINER
Distributional Effects of the European Emissions Trading System and the Role of Revenue Recycling
Economics

2012/7 BRANDT, Thiemo / Rudi K. F. BRESSER
Gaining Insight into Membership Strategy: Competitive Advantage by Shaping Institutions
Strategic Management

2012/8 AMBROSIUS, Christian
Are Remittances a 'Catalyst' for Financial Access? Evidence from Mexican Household Data
Economics

2012/9 AMBROSIUS, Christian
Are Remittances a Substitute for Credit? Carrying the Financial Burden of Health Shocks in National and Transnational Households
Economics

2012/10 FRITZ, Barbara / André BIANCARELI / Laurissa MÜHLICH
Regional Payment Systems: A Comparative Perspective on Europe and the Developing World
Economics

2012/11 FOSSEN, Frank M.
Risk Attitudes and Private Business Equity
Economics

2012/12 HETSCHKO, Clemens / Dominic QUINT / Marius THYE
Nationale Schuldenbremsen für die Länder der Europäischen Union : Taugt das deutsche Modell als Vorbild?
Economics

2012/13 ARONSSON, Thomas / Ronnie SCHÖB
Adaptation, Anticipation-Bias and Optimal Income Taxation
Economics

2012/14 BEZNOSKA, Martin / Viktor STEINER
Does Consumption Decline at Retirement? : Evidence from Repeated Cross-Section Data from Germany
Economics

2012/15 PÜSCHEL, Julia
Task dependence of U.S. service offshoring patterns
Economics

2012/16 SCHULARICK, Moritz / Paul WACHTEL
The Making of America´s Imbalances
Economics

2012/17 HATTENDORFF, Christian
Do Natural Resource Sectors Rely Less on External Finance than Manufacturing Sectors?
Economics

2012/18 BÖNKE, Timm / Sebastian EICHFELDER / Stephen UTZ
Uneven Treatment of Family Life? : Horizontal Equity in the U.S. Tax and Transfer System
Economics

2012/19 FOSSEN, Frank M. / Tobias J.M. BÜTTNER
The returns to education for opportunity entrepreneurs, necessity entrepreneurs, and paid employees
Economics

2012/20 BARTELS, Charlotte
Long-term Participation Tax Rates
Economics

2012/21 BETTENDORF, Timo / Wenjuan CHEN
Are There Bubbles in the Sterling-dollar Exchange Rate? : New Evidence from Sequential ADF Tests
Economics

2012/22 MASSARRAT-MASHHADI, Nima und Clive WERDT
Estimating Dynamic Income Responses to Tax Changes: Evidence from Germany
FACTS