Tomas Bata University in Zlín
Faculty of Management and Economics

Doctoral Thesis

The Relationship Between Changes in Income Tax Rates and the Motivation to Work

Vztah mezi změnami sazeb daně z příjmů a motivace pracovat

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Full text of the doctoral thesis is available in the Library of TBU in Zlín.

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Many people have contributed to my dissertation. Before starting my acknowledgment, I would like to share a short story of my PhD application. I remember that I was in a camp in the mountain with my friends and in our rest time I was searching for scholarships for my PhD studies. After some searching, a very nice brochure of Tomas Bata University popped up in Google. It became more interesting when I checked the location of the university in YouTube. Immediately I called my sister to mail all of my documents to that university. I really remember Pavla Bartošova's help from the International Office in the Faculty of Management and Economics. She arranged everything in my submission. Her first email answering all of my questions on PhD studies motivated me more, and I started to look at the list of potential supervisors on the university's website.

When I applied for the PhD program at Tomas Bata University in Zlin, I needed to select one doctoral thesis topic title from the list. Among the titles, the most attractive one for me was a research topic about taxation. Only one professor was offering this topic, Associate Professor Bruce Dehning, Ph.D. from Chapman University, but at the same time affiliated with Tomas Bata University in Zlin. I wrote him an email that I want to be your student. It was a summer day (June) in 2014, when I got the email from him that he would be happy to work with me and be my principle supervisor. In Baku around 3:00 am, I read this email to my parents and I told them that there is a possibility of working with an American professor in Europe. Yes, this sentence worked, and I convinced them to go for a four-year adventure in Zlin. We did not sleep that night and we were discussing all of the future possibilities of my studies. After getting an acceptance letter from the faculty dean, prof. Dr. Ing. Drahomíra Pavelková, I moved to the Czech Republic from Azerbaijan.

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ABSTRACT

Taxes are related to wages in two ways. First, taxes directly reduce after-tax wages, which leads to direct economic effects, referred to in the economics literature as the income effect and the substitution effect. Second, there is a psychological effect. Taxes can have a psychological effect that can increase or decrease the motivation to work. In this paper, behavioural theories are developed and demonstrated and these show that workers at high and low levels of pay behave differently when tax rates change. One theory posits that to survive, workers must maintain a subsistence level of income. A change in taxes changes the minimum number of hours of work required to maintain this subsistence level of income. The second theory prescribes that the utility for leisure is not constant, but is an increasing function of income. This is due to the larger opportunity set of activities available at higher levels of income. The theories can be demonstrated by considering the changes in hours worked in reaction to changes in labour income tax rates. In countries with low wage rates, as labour income taxes increase, the motivation to work increases, because workers have to work more to maintain a minimum level of income. In countries with high wage rates, as labour income taxes increase, the motivation to work decreases, because workers have a high preference for leisure. The theories are tested using a time-series cross-section of data covering 15 countries for 50 years. The findings imply that wage levels and preferences for leisure/work can account for the differences in changes in hours worked in response to changes in tax rates.

ABSTRAKT

Daně souvisí se mzdami dvěma způsoby. Za prvé, daně přímo snižují konečnou výši platu, což je přímý ekonomický dopad, který je v ekonomické literatuře uveden jako důchodový a substituční efekt. Druhým je psychologický efekt. Výše daní může zvýšit nebo snížit motivaci pracovat. V této práci jsou vypracovány behaviorální teorie, které ukazují, jak se pracující chovají při změně daňové sazby při různých stupních výše platu. Jedna teorie předpokládá, že pracující musí mít pro přežití minimální příjem. Změna v daňové sazbě mění minimální počet hodin práce potřebný pro přežití či pro zachování životní úrovně. Druhá teorie předpokládá, že užitek z volného času není konstantní, ale je rostoucí funkcí příjmu. Toto je díky větší příležitosti pro volnočasové aktivity dostupných při vyšší úrovni příjmu. Za účelem prokázání těchto teorií jsou zvažovány změny počtu odpracovaných hodin ke změnám daňových sazeb z příjmu z pracovního poměru. V zemích s nízkými platy při zvyšování daňových sazeb z příjmu roste motivace pracovat, protože pracující musí pracovat více pro dosažení minimálního příjmu. V zemích s vysokými mzdami při zvyšování daňové sazby motivace k práci klesá, protože pracující mají vyšší preference týkající se volnočasových aktivit. Teorie jsou testovány použitím průřezu časových řad dat zahrnujících 15 zemí v průběhu 50 let. Zjištění naznačují, že změny úrovně mezd a preferencí pro volný čas/práci mohou představovat rozdíly mezi odpracovanými hodinami v reakci na změny daňových sazeb.

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LIST OF ABBREVIATIONS

BD	Benefit Duration
BRR	Benefit Replacement Rate
CESifo	Center for Economic Studies
CONTROLS	Control Variables
CT	Current Taxes on Income and Wealth
DICE	Database for Institutional Comparisons in Europe
EP	Employment Protection
EU11	European Union 11
EXP	Government consumption and expenditures
GAP	Output Gap
GDP	Gross domestic product
G-7	The Group of Seven
HHT	Taxes on Income and Profit
HOURS	Hours Worked
HP	Hodrick-Prescott
ICT	Information Communication Technology
INCOME	Average Income
IPS	Im, Pesaran, and Shin
LHD	Low and High Wages Dummy
LM	Lagrange Multiplier
LMID	Labor Market Institutions Database
PC	Personal Computer
OECD	The Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OSGOV	Operating Surplus
PCSE	Panel-Corrected Standard Errors
PMR	Product Market Regulation
PPP	Purchasing Power Parity
QLR	Quandt Likelihood Ratio
Q-Q	Quantile-Quantile
RO	Research Objective
RQ	Research Question
SNA	System of National Accounts
SS	Social Security Taxes
TAXES	Average Income Tax Rates
TAXSIM	Tax Simulation
TAUC	Consumption Tax Rate
TAUK	Capital Tax Rate
TD	Theory Dummy
TED	Total Economy Database
TPI	Taxes on Production and Imports

UD	Net Union Density
UK	United Kingdom
USA	United States of America
US	United States
VIF	Variance Inflation Factor
WID	World Wealth and Income Database

1. INTRODUCTION

1.1 Background

If the government raised the income tax rate and your net wages went down, what would you do? Would you work more hours to maintain your standard of living? On the other hand, perhaps you would work less, knowing that now giving up an hour of work is not forgoing as much income. This motivation to work comes from a combination of both needs and wants. In the classic economic sense, the needs are food, clothing, and shelter. Wants are luxury goods that make life pleasant and more enjoyable. Income taxes affect the ability to afford both needs and wants. Income taxes increase the cost of needs and wants, where the cost is the amount of work necessary to earn the amount necessary to pay for the needs and wants. Conversely, taxes decrease the opportunity cost of leisure. It is the balance and trade-offs between needs, wants, and leisure that cause people at different levels of income to react differently to taxes. This research examines how the labour supplied by workers at different levels of income is affected by taxes.

1.2 Research gap

The study of the relationship between income taxes and labour supply, or the motivation to work, has a history in economics going back almost 100 years. Yet despite this long history, the basic theories, the income effect and the substitution effect, remain unchanged since the 1920s (Knight, 1921; Pigou, 1920). The income effect and the substitution effect are used to explain how workers will react when tax rates are changed. The income effect refers to income taxes reducing after-tax wages, so individuals must work more to maintain the same level of income. The substitution effect means that when income taxes reduce after-tax wages people will work less because the opportunity cost of leisure decreases. These effects make opposite predictions, and little is known about the conditions under which one effect will apply or dominate the other. One explanation for the lack of applicability of economic theory comes from the argument that the effect of income taxes on the motivation to work is a psychological phenomenon (Lewis, 1982). The psychology-based perspective differs sharply from conventional economic approaches (Earl, 1990), because labourers face a complex trade-off between work and leisure (Brown et al., 1976). Therefore, the research gap comes from standard economic theory (income and substitution effects), because these economic explanations offer simple and easy to understand predictions, yet they do not explain which effect will apply to individuals in dissimilar conditions, particularly workers with low and high wages.

1.3 Research question

RQ: How does the relationship between income taxes and the motivation to work vary between workers at low and high wage rates?

1.4 Research objective

RO: Determine if the impact of income taxes on the motivation to work varies between workers at low and high wage rates.

1.5 The importance of the study

Every government periodically considers the impact of raising or lowering income taxes. Previous research has been unable to provide much guidance on the effect of tax rate changes due to the competing predictions of the income and substitution effect, and no clear theory for when each might apply. To overcome the limitation of previous research, two new behavioural theories are proposed, referred to as the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure. The Hierarchy of Pecuniary Needs is inspired by Humanistic Psychology, and uses the needs and wants of an individual to explain how they will react to tax rate changes at low and high wage rates. The Differing Utility of Leisure introduces the new idea that the utility of an hour of leisure varies depending on a worker's income level. This idea shows that the traditional approach of measuring the opportunity cost of leisure only considers half of the cost-benefit equation. When the benefit, or utility, of an hour of leisure is also considered, predictions regarding the reaction to tax rate changes become clearer.

1.6 The structure of the study

Following from the above, the rest of this research is organized as follows. Chapter 2 reviews the previous literature on income taxes and the motivation to work. Chapter 2 begins with a survey of the prior research in the field, including theoretical frameworks and empirical studies using a wide variety of methodologies. From this, it is shown that theoretical predictions and empirical work have been unable to determine conclusively how individuals will adjust their hours worked in response to tax rate changes. Chapter 3 provides theory development and hypothesis formulation. In this section, the gap of prior research is filled through the introduction of the two new theories, the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure. The first theory, the Hierarchy of Pecuniary Needs, shows that income level is an important factor when examining an individual's motivation to work. At low wage rates, the work/leisure decision is driven solely by the need to survive. When a worker is making only a subsistence level of income, an increase in income taxes causes the worker to increase their hours worked. For these workers the utility of an hour of leisure is almost irrelevant. Only when income levels rise above the subsistence level of income can a worker forgo an hour of work for an hour of leisure.

However, it is at this point that the theory of the Differing Utility of Leisure applies. Even when the opportunity to choose an hour of leisure arises, a worker at low wage rates might forgo that hour of leisure for an additional hour of labour because their utility from an hour of leisure is low. The opportunity set of activities available to workers with low wage rates is small when compared to the opportunity set of activities available to workers with high wage rates. Thus, at high wage rates, a worker might forgo an hour of work for leisure despite the higher opportunity cost of the leisure, due to the increased utility from an hour of leisure. This is an entirely new way to explain the work/leisure decision, considering both the cost and benefit of leisure at varying wage rates. Once the theories are developed, a simulation is used to show how workers will respond to tax rate changes depending on their income level, the cost of basic needs, their cultural or group preference for income or leisure, and their individual preference for income or leisure. Eight scenarios from the simulation are used to show how the two theories apply and that the results of the simulation match the theoretical predictions. Chapter 4 presents model specifications and data. The econometric model chosen to test the predictions of the theory and simulation is a first-differenced panel data model. This is primarily because the research question is about analysing changes in tax rates and changes in hours worked, which occur over time within each country. Data to test the hypothesis empirically using the econometric model is gathered from 15 countries over 50 years. Chapter 5 describes and analyses the main results of the study. In this section, the models are shown to meet all of the necessary econometric assumptions, and the results are fully and completely revealed, even when initial results do not fully support the theories developed. Although the empirical results are mixed, the theory is found to hold in about half of the countries. In addition to standard statistical tables, graphs are used to help clearly communicate the economic implications of the findings. Chapter 6 discusses the results of the study. Chapter 7 concludes with some policy implications of new behavioural theories and directions for future work. The results of the research provide motivation for further work, to refine the theoretical predictions and include new factors for when the theory is more likely to hold and when it is not.

2. LITERATURE REVIEW

2.1 Traditional theoretical and empirical archival approaches

Traditional economic research usually explains the impact of income taxes on the motivation to work in terms of after-tax wages, non-labour income, and various demographic characteristics. Traditional approaches discuss what is referred to here as “the motivation to work” using terms such as “work effort,” “incentive to work,” and “labour supply.” The assumption implicit in referring to these as “the motivation to work” is that individuals have some capability to control the quantity of work they supply during a year. In the discussion of control variables, the ease at which this is possible is discussed in further detail.

This review of traditional economic research begins with a discussion of theoretical models and predictions. In this context, the effect of taxation on the motivation to work refers to traditional studies that measure motives, behaviour, or actions. These traditional approaches refer to the choice between leisure and income when they measure the effect of income taxes on the motivation to work. Early theoretical studies in this area draw conflicting conclusions (Knight, 1921; Pigou, 1920; Robbins, 1930; Cooper, 1952). Their arguments suggest that income taxes can have a negative, positive, or no effect on the motivation to work. For example, drawing upon the work of Pigou (1920) and Knight (1921), Gilbert and Pfouts (1958) state that imposing taxes on a worker can cause them to exert either more or less effort.

In one of the first works in the area, Pigou (1920, p. 593) argues that taxes can have an incentivising effect, *"Since a part of his income is taken away, the last unit of income that is left to him will be desired more urgently than the last unit of income that would have been left to him if there had been no taxation. But the last unit of energy that he devotes to work will not affect him differently from what it did. Consequently, there will be a tendency for him to work a little harder… than he would have done otherwise."* Pigou (1920) believes that, except for low-income earners and possibly some portion of middle-income earners, taxation will not have any substantial effect on the work effort of the taxed person in the long run. On the other hand, Knight (1921, p. 117) says, *"…they will at a higher rate divide their time between wage-earning and non-industrial uses in such a way as to earn more money, indeed, but to work fewer hours…. We therefore draw our momentary supply line in terms of price with some downward slope."* Pigou (1920) and Knight (1921) base their arguments on the assumption of diminishing marginal utility of income (Gilbert and Pfouts, 1958). This assumes that imposing a tax that decreases a worker's net wage will always induce individuals to exert more work effort, and an increase in their net wage will always make them to exert less work effort. While this assumption is clear in the study of Pigou (1920), it is not clear in the study of Knight (1921). A criticism of the work of Knight (1921) is that he uses both working more hours per day and to work harder as having the same meaning. This makes it difficult to get a precise definition of work effort, because working more hours and exerting more effort in the same hours are completely different. Both Pigou (1920) and Knight (1921) assume the elasticity of demand for work effort is less than one. Robbins (1930) presented this less than or greater than unity assumption.

Knight (1921) argues that the prices of commodities composing real income are not altered. Robbins (1930) agrees with Knight's argument, but only if money price is considered, and not effort price. Robbins contends that effort prices should be used when considering the elasticity of demand for work effort, not money prices. Using effort prices instead of money prices, Robbins (1930) formulates a proposition showing that to exert more or less effort depends on the elasticity of demand for work effort. If the elasticity is greater than one, then workers will exert less effort. If it is less than one, then it is expected that workers will exert more effort. However, there is a disagreement among economists regarding the interpretation of Robbins' (1930) model. Similar to Knight (1921), it is difficult to know if he is discussing effort within the same hours or changing the number of hours worked (Falgueras-Sorauren, 2010). Using two pivotal concepts, the elasticity of the demand for income in terms of effort and the effort price per unit of income make it even harder to understand Robbins' model (Falgueras-Sorauren, 2010). Despite this lack of clarity, Robbins's (1930) work is accepted as the seminal work for the income and substitution effects. Hicks (1939) shows the same argument on income and substitution effects and connects his analysis with Robbins's (1930) work. Hicks (1939, p. 36-37) writes, *"Thus a fall in wages may sometimes make the wage-earner work less hard, sometimes harder; for, on the one hand, reduced piece-rates make the effort needed for a marginal unit of output seem less worthwhile, or would do so, if income were unchanged; but on the other, his income is reduced, and the urge to work harder in order to make up for the loss in income may counterbalance the first tendency."* Paish's (1941) approach is similar to Robbins's (1930), but he uses only demand for leisure in his analysis. According to this approach, after imposing taxes, both aggregate and marginal income decrease. The decrease in aggregate income will result in a lower demand for leisure, while a decrease in marginal income causes the opposite effect, because it reduces the cost of additional leisure. Paish (1941) notes that there are two opposing effects, each predicting a change in the opposite direction of the other. These two effects are the income effect and the substitution effect. The income effect will serve to increase the demand for work, while the substitution effect, the price effect at the margin, decreases the demand for work. Which effect will dominate can be determined only if the demand schedule for leisure is known at every income level.

Figure 2.1, from Brown (1969), illustrates the distinction between the income and substitution effects. While the horizontal axis shows income, the vertical axis (distance OA) represent the total number of hours available. Individuals' preferences between leisure and income are reflected with the indifference curves. By assuming a constant marginal tax rate in every income range along the OB distance, the net wage (e.g. gross wages minus taxes) can be shown by the slope of the line AB. When the indifference curves are tangent to the budget constraints, it means that an individual reaches the highest possible utility. It can be seen that at point P, the individual will be in equilibrium, where the I_3 indifference curve is tangent to the AB budget constraint. When an individual is at point P, he/she has H_1P income and OH_1 leisure (or AH_1 working hours). After the imposition of taxes, the new equilibrium point will be at R, where the I_1 indifference curve is tangent to the AC budget constraint. The movement from point P to point R can be separated into two movements. First, equilibrium switches from point P to point Q, a new equilibrium point, and then it switches from point Q to point R. The first movement is the income effect (working hours increase from AH_1 to AH_2) and the second movement is the substitution effect (working hours decrease from AH_2 to AH_3). In this case, taxes have a disincentive effect. However, the I_1' indifference curve can be tangent to the same AC budget constraint. This means that taxes now have an incentive effect. Because equilibrium switched from point R to point R', meaning that working hours increased from the previous AH_1 to AH_3. All of these movements are due to the increase/decrease in the relative price of leisure. As depicted above, the income effect leads to increased work effort and the substitution effect leads decreased work effort. Therefore, elementary economic theory cannot define which effect will dominate.

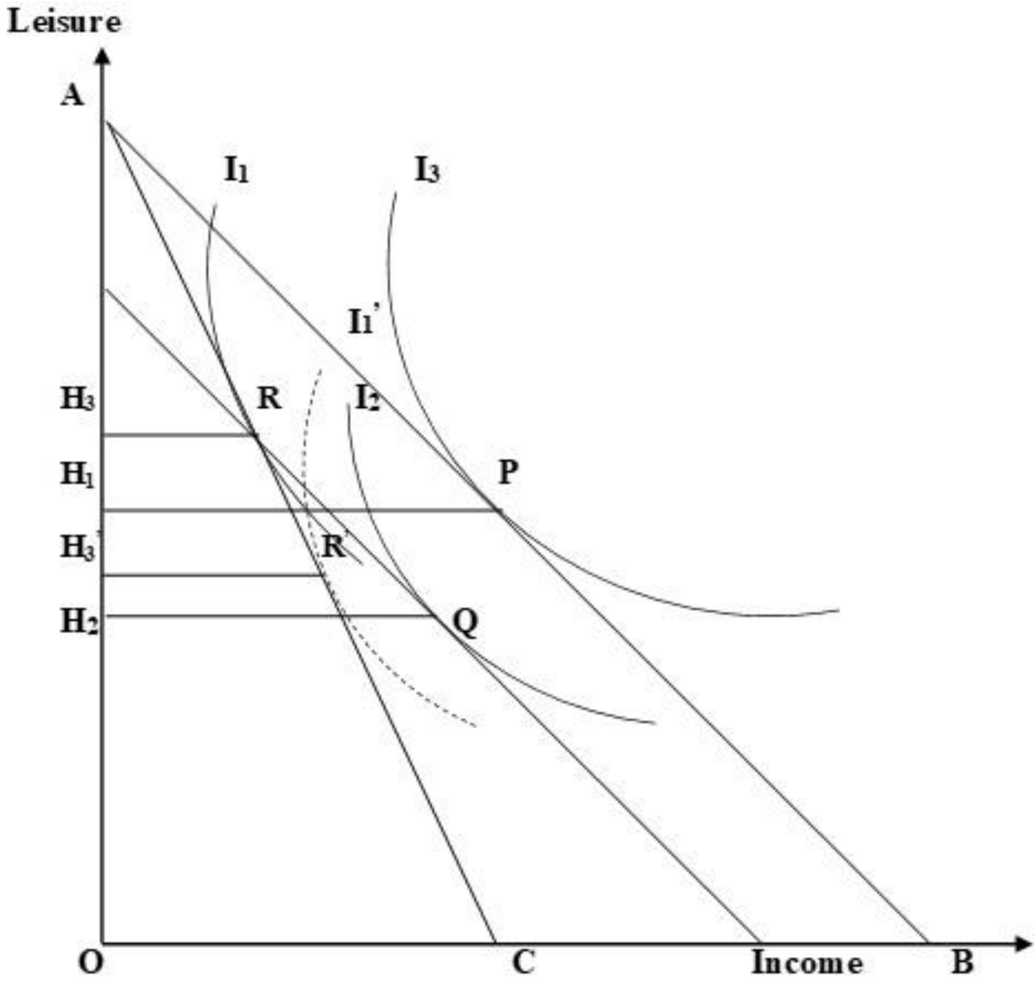


Fig. 2.1: Income and Substitution Effects

Source: Brown (1969)

Cooper (1952) objects to the traditional economic approach, because of the possibility that subjects have limited freedom of choice with respect to the willingness to work. If subjects have no control over the number of hours that they work, then perhaps testing the effect of taxation on the number of hours worked is unimportant. According to Cooper (1952), if this objection is true, then there is no need to test the influence of taxation on the "incentive" to work. He considers individuals to be free in their choices, and assumes in his analysis a simple utility equation that these individuals are rational and aware of the consequences of a given tax structure for them, and they are not motivated by patriotic feelings, or by a "money illusion." He concludes that the effect of increasing tax rates would depend on different income levels. The implication is that some individuals will choose to work more, while others will choose to work less. The analysis of Gilbert and Pfouts (1958) differs from Cooper (1952) by introducing the concept of unearned income in the analysis. Unearned income raises interesting possibilities in the study of taxes and the demand for work or leisure. They give an example of a worker that is a member of a family where both the husband and wife work. In that case, one spouse might assume the income of other as unearned income. Gilbert and Pfouts (1958) suggest empirical evidence is necessary to test if there is a negative relationship between the net wage rate (after imposition of taxes) and hours worked.

2.2 Survey studies

Early studies in this area were trying to explain the impact of taxes on the motivation to work using pure economic principles and assumptions (Knight, 1921; Pigou, 1920). Their findings were inconclusive, concluding that taxation can have a disincentive, incentive, or no effect on the motivation to work (Cooper, 1952; Robbins, 1930). Two fundamental assumptions of this work are that individuals have unlimited willpower, and optimally maximize their utility (Alm, 2010). Almost all of these studies start with a simple labour supply model with standard economic theory. This theory contains two well-known principles, the income and substitution effects, introduced in the previous section. They provide that the income and substitution effects work in opposite directions without being able to show which one dominates. Thus, theoretical view suffers to explain the relationship between taxes and the motivation to work, leading to the conclusion that empirical evidence is necessary to fully understand the relationship between taxes and the motivation to work (Hausman, 1985; Pencavel, 1986).

Research using survey methods followed the groundwork laid by theoretical studies based on traditional economic principles. These studies expanded the factors that explain the relationship between taxes and the motivation to work by introducing psychological explanations. The surveys measured individuals' perceived behaviours in the emerging field of the economic psychology of taxation (Lewis, 1982).

It should be noted that evidence from surveys of attitudes and perceived behaviour can suffer from potential problems such as respondents giving misleading information to interviewers, respondents' answers might reflect prejudices or misconceptions rather than their own true beliefs, respondents not understanding the questions, and removing one of these aforementioned problems can create other potential problems (Brown, 1983; James, 1992; Van Paridon, 1992; Moser and Kalton, 2017). Survey work in this area began in the early 1950s with the second report of the Royal Commission on the Taxation of Profits and Income (1954). The Royal Commission on the Taxation of Profits and Income (1954) conducted a survey of 1,429 industrial workers in England and Wales. The workers had the ability to change the amount of work they supplied because of overtime opportunities or work paid for on a piecework basis with some minimum guarantees. The Royal Commission found a disincentive influence of income taxation on the amount of labour supplied. After the Royal Commission survey, economists started to collect information from taxpayers more knowledgeable about the tax burden. In a review article by Villard (1952), the work of Sanders (1951) is analysed. Villard reports that Sanders (1951) conducted interviews with approximately 160 business executives in USA. Sanders found that despite income taxation, business executives work as much as possible. This is because the majority of the executives surveyed are salaried employees working direct supervision in a large corporation, and even there is no choice to change the number of clock hours of work, they do not admit to decrease work effort during such hours. Sanders concludes that non-financial incentives outweigh the financial disincentives of income taxes. According to Rosen (1976), the most influential of the survey studies is Break's (1957) survey of 306 solicitors and accountants in England who were either a partner or the owner or of their business. Break's subjects of solicitors and accountants had more flexibility in setting their hours and therefore to respond to high tax rates. These respondents did not mention high taxes as having a disincentive effect in their professional efforts. The policy implication of Break's (1957) study is that income taxes can be increased for middle- and high-income earners without affecting the number of hours that they work. Barlow et al. (1966) is similar to Break (1957) and with comparable findings. Barlow et al. (1966) surveyed 957 affluent Americans who had annual income of $10,000 or more. Around seven-eighths of the sample says that they did not shorten the amount of work they performed because of progressive income tax rates. The main group reporting a disincentive effect of taxes were people under 65 without dependent children, who had a chance to work more but did not. Barlow et al. (1966) suggest that there are other work-related motivations besides after-tax wages, such as a sense of belonging, a sense of power, social status, and the satisfaction of meeting self-imposed standards of performance. In their study, the work motives are divided into two groups: monetary income (after-tax wages) and nonmonetary (the aforementioned motives). The authors conclude that for high-income earners, nonmonetary incentives affect the motivation to work more than taxes.

Fields and Stanbury (1971) employ almost the same technique as Break (1957), surveying 285 solicitors and chartered accountants in the United Kingdom. Contrary to Break (1957), Fields and Stanbury (1971) find that taxes have a disincentive effect, drawing the conclusion that the disincentive effect of income taxation has increased over time. They suggest that future research with more comprehensive survey information can help economists to measure precisely the effect of taxation on the incentive to work. Using a large survey, Brown and Levin (1974) test the incentive and disincentive effects of income taxes on the amount of overtime worked by 2,139 respondents in United Kingdom. In their nation-wide survey, workers that are paid weekly responded to questions about taxation and work effort. They find a small effect of income taxes on the amount of overtime worked, but 75 percent of respondents claimed that taxation does not cause them to work more or less overtime. Strong conclusions cannot be drawn from their study, because they do not control for other factors that might affect work effort. Therefore, they do not know if their findings are due to economic, demographic, sociological, or psychological factors. Holland (1977) conducted a survey of 125 executives in the USA. Compared to prior studies, he directly attempted to test the substitution effect. His findings indicate that 15 percent of the sample would like to work harder if the marginal tax rate is set to zero. Calderwood and Webley (1992) use a survey to study 153 workers in south-west England. Using a hypothetical change in the tax rate, subjective estimate and assessment of reactions to 1988 UK tax changes, Calderwood and Webley (1992) provided that respondents showed significant ignorance of how taxation affects them. They conclude that for people in the United Kingdom, income taxes are not very salient and income taxes are a very small component of the motivation to work. Calderwood and Webley (1992) suggest that taxation can be more salient in countries where individuals are involved intensively in the tax assessment and collection process. Table 2.1 gives a general summary of the survey studies.

Table 2.1 Overview of survey studies regarding income tax and the motivation to work

Paper	**Sample**	**Hypothetical questions asked to measure the effect of taxes on work effort/incentive to work**	**Findings**
Sanders (1951)	160 business executives in USA	In the study, there was no effort to get a “scientific” sample and very few statistical results are presented. Author continued interviews until exact impressions and study mainly present these impressions.	Taxes do not affect executives because most of them own their business and this job requires steady attention
British Royal Commission on the Taxation of Profits and Income (1954)	1,429 industrial workers and supervisors (1,203 men and 226 women)	*“Would it be worth your while to earn more if it meant going on to a higher rate of tax?”* (Brown, 1983, p. 40)	73 percent of the men and 60 percent of the women claimed that taxation has a disincentive effect on work effort

Table 2.1 *(continued)*

Break (1957)	306 (solicitors and accountants)	*"Throughout the interview so far the influence of taxation on the respondent's incentives to work entered the discussion only if he introduced it himself. Leading questions were avoided until he had had full opportunity to express himself concerning his reasons for doing the amount of work he was doing. Those who had not mentioned taxation on their own initiative were then asked directly whether this had been a factor in any of their decisions to take on or refuse work"* (Break, 1957, p. 533)	18 percent experienced disincentive effects and 31 percent experienced incentive effects
Barlow et al. (1966)	957 (affluent Americans)	*"Has the income tax had any effect on how much work you (or your wife) do?"* (Barlow, 1966, p. 139)	12 percent of the total sample experienced disincentive effects
Fields and Stanbury (1971)	285 (solicitors and chartered accountants)	*"If taxes were lower (higher) would you work more or work less?"* (Fields and Stanbury, 1971, p. 442)	18.9 experienced disincentive and 11.2 incentive effects

Table 2.1 *(continued)*

Brown and Levin (1974)	2,139 weekly-paid workers	Respondents were asked to answer one of three statements: 1. "*Taxes has made me work more overtime*" 2. "*Doesn't apply/ Neither*" 3. "*Taxes has made me work less overtime*" (Brown and Levin, 1974, p. 835)	11 percent experienced disincentive effects, 15 percent incentive effects, and 74 percent claimed no effect
Holland (1977) *	125 US executives	-	15 percent experienced disincentive effects

Table 2.1 *(continued)*

Calderwood and Webley (1992)	153 workers	1. *"Now, please think carefully about the following situation. Suppose, that in what is commonly called a "mini-budget" speech, it is announced tomorrow that the rate of income tax you pay is to (rise/fall) by 5%. ... . Respondents then completed an open-ended question (What do you think you would do in response to this change in your income tax, and why?)"* 2. *"By how much would your rate of income tax have to change so that the change is just enough to affect your motivation to work?"* 3. *"For the assessment of reactions to the 1988 tax changes in Great Britain, respondents were simply asked ... (what they remembered about these changes and how they reacted to them)."* (Calderwood and Webley, 1992, p. 740)	Respondents reacted more to hypothetical tax increases than to tax decreases. Subjective estimates are in the same line with the hypothetical situation. Most of the respondents do not remember the 1988 UK tax changes.

Source: Own elaboration

*This study is not directly comparable to the other studies in the table. While the other studies test both the income and substitution effects, Holland (1977) separately tests the substitution effect.

2.3 Experimental evidence

In the economic literature on taxes, behavioural aspects seldom play a prominent role (Fochmann and Weimann, 2013). There are significant differences between theory and the experimental evidence of the behavioural aspects of taxes. A central assumption in economics is that individuals maximize their utility optimally and react to tax changes in the same way that they respond to price changes (Ramsey, 1927; Mirrlees, 1971; Atkinson and Stiglitz, 1976; Chetty et al., 2009). Each individual, called "economic man", is assumed to be rational, purely self-interested, and having unlimited willpower (Alm, 2010). The basis for the elementary economic theory is the income effect and the substitution effect. The income effect is the change in the level of an individual's income and how that impacts the decisions that individual makes regarding total consumption. The substitution effect is how individuals will change the mix of what they consume when faced with changes in prices. Experimental evidence of tax behaviour demonstrates that this elementary economic theory, the income and substitution effects, about the behaviour of individuals may not hold in reality. Considerable evidence from behavioural economics show that individuals do not always behave as the assumed "economic man".

Previous studies in experimental laboratories were trying to falsify the standard neoclassical economic theories of human behaviour (Swenson, 1988; Sillamaa, 1999a, 1999b, 1999c). However, most of them have their own approach to studying the relationship between taxes and the motivation to work. For example, in the experiments of Swenson (1988) and Sillamaa (1999a, 1999b, 1999c), a work-leisure decision is constructed in the laboratory by offering subjects newspapers and computer games they can use instead of working. This kind of experimental design is not the same as the work-leisure decision workers face outside of the laboratory. In real work-leisure decisions there are no time restrictions, the subjects are not students (they do not have the lower financial status that students have), and they must decide about both their work effort and the total time they spend working (Fochmann et al, 2010). Alm (2010) adds that much early work in experimental economics suffers from a lack of realism because the experimental procedures and design of work-leisure trade-offs were not reflective of real-world values.

In the studies by Swenson (1988) and Sillamaa (1999a, 1999b, 1999c), only the substitution effect between work and leisure is tested, because tax revenues are completely redistributed, removing the income effect entirely. This is related to the Lindbeck (1982) theorem, that if taxes on earned income are replaced with non-income related lump-sum taxes, then the motivation to work will increase. Swenson (1988) has mixed findings, including some general support for theorem proved by Lindbeck (1982) that taxes on earned income to finance transfer payments lead to a decline in the motivation to work. However, at the same time, his findings were partially contradictory to Lindbeck's theory, which might be because of some weaknesses in the experimental design (Sillamaa, 1999c). Sillamaa (1999c) replicates Swenson's experiment but corrects the flaws in the design and finds strong evidence for Lindbeck's (1982) theoretical prediction. Sillamaa uses this finding to assert the importance of experimental replication. In the same way, Sutter and Weck-Hanneman (2003), Ottone and Ponzano (2007), and Ottone and Ponzano (2011) confirms their experimental results.

Moreover, Sillamaa (1999b) tests another theorem presented by Phelps (1973), Sadka (1976), and Seade (1977), that marginal tax rates of zero percent can increase the motivation to work of top income earners. The literature on optimal taxes emerged in the 1970s and includes Mirrlees (1971), Atkinson and Stiglitz (2015), Tuomala (1984), and Kanbur and Tuomala (1994). The logic behind the idea of zero percent marginal tax rates is that if the top income earners are allowed to earn more, then they will have increased utility from working harder. This is because their work is more valuable if there are no taxes and the gain to society will be substantial. The experimental findings of Sillamaa (1999b) support the predictions of the optimal tax literature. Sillamaa (1999a) emphasizes the distinction between linear and non-linear tax functions and finds that tax flattening increases the motivation to work.

In the experimental literature, there are different foundational disciplines that examine the effect of taxes on the motivation to work. Therefore, it is important to take into consideration the different classifications of tax behaviour in the literature when analysing the effect of taxes on human behaviour. These include the perception of marginal tax rates, tax complexity, tax aversion in labour supply, taxation and incentives to work, tax salience, tax morale and fairness, and fiscal illusion. Each of these behavioural perceptions related to taxes is unique, and the foundational disciplines must be considered before comparing the results (Fochmann et al, 2010).

Unlike early studies in experimental economics, more recent research on tax framing and salience have shed new light on the tax behaviour field. For example, the earlier approaches of Sillamaa (1999a, 1999b) use neutral framing (only net wage rates), and did not mention explicit tax framing. A growing body of laboratory experimentation demonstrates that after income taxes are imposed, an individual's preference between leisure and work are not only the function of these income taxes (income or substitution effect), but also how they are applied and described (McCaffery and Baron, 2004; Gamage et al., 2010; Djanali and Sheehan-Connor, 2012; Houdek and Koblovsky, 2015). Evidence from field experiments indicates that individuals react less to taxes when they are hidden (Chetty et al., 2009; Finkelstein, 2009; Cabral and Hoxby, 2012; Jones, 2012). As might be expected, recent laboratory work finds that individuals respond more to taxes when they are more salient (Sausgruber and Tyran, 2005; Blumkin et al., 2012). Fochmann et al. (2013) find a contradictory view when compared to previous studies, that individuals with higher gross wages respond less to higher taxes because of a "net wage illusion." The "net wage illusion" is the belief by individuals that their net wage will be higher due to a higher gross wage. Weber and Schram (2017) report results similar to Fochmann et al. (2013). Contrary to the prior salience literature, Kessler and Norton (2016) hold subjects' net wages explicitly constant by using two designs, a decreasing gross wage and by introducing new taxes on labour income. They find that individuals react more to taxes on labour income than to an equivalent decrease in wages. However, as Fochmann et al. (2013) say, they cannot test the income effect in their analysis because the net wage (after-tax income) was held the same across conditions.

There are other experimental studies that examine the effect of taxes on the motivation to work by extending the tax salience and price partitioning literature to a work effort context (Hayashi et al., 2013). These studies compare flat and progressive taxes (Pántya et al., 2016), and describe complex or non-complex taxes (Abeler and Jäger, 2015). Contrary to prior literature (e.g. Gamage et al., 2010; Sillamaa 1999c), Pántya et al. (2016) find a reverse relationship between progressive tax rates and work effort. They show that moving from a flat tax system to a progressive tax system significantly increases effort. Fochmann and Weimann (2013) also find a direct positive effect of progressive taxation on work effort. In their experimental design, they did not redistribute the tax revenues to individuals; the quantity of public goods that the subjects received was not associated with the taxes they paid. They offer two explanations for increased motivation to work due to progressive taxation, either individuals like to work for the government, or individuals get more utility from the production of public goods. In addition, it is worth noting that participants in the progressive taxation system work harder because of lower financial status in their experimental design. On the other hand, Pántya et al. (2016) report that having students in their experiments can cause this positive effect of progressive taxation on individual's work effort. Fochmann and Weimann (2013) state that individuals with lower financial status, such as students, work harder in progressive taxation (Pántya et al., 2016). Therefore, to check the robustness of these results, non-laboratory environments are needed, as was emphasized by Gamage et al. (2010).

Hayashi et al. (2013) integrate price description from the robust marketing literature into labour supply models. Partitioned pricing is a largely unexplored area in the tax behaviour literature. Hayashi et al. (2013) explain that individuals do not adjust their behaviour due to wage-framing effects. Compared to the anchoring hypothesis, their hypothesis has a contradictive view. According to the anchoring hypothesis, it can be supposed that individuals work more when wages are presented as a base price and minus a tax. Many researchers have stressed that individuals mainly "anchor" on the base price and they cannot adjust their behaviour to any surcharges. Put in different way, if individuals anchor on the base wage and underestimate the surcharges like taxes, then they should work more when they have higher base minus a tax than equivalently a lower base plus a bonus or tax credit. However, their findings with documenting partitioned pricing tell us that the motivation to work is reduced when there is a lower base plus a bonus or tax credit than when there is a higher base minus a tax. They recognize that the motivation to work is sensitive to wage framing, but on the other hand, their argument is that when they show all-inclusive wages in a salient way, the wage-framing effects disappear. This means that the wage-framing effects are not coming from deep preferences, but are more related to cognitive limitations, particularly with the responses to complexity.

Keser et al. (2015) use three different scenarios in their experimental design, the Leviathan scenario (Brennan and Buchanan, 1980), the redistribution situation, and a global public good. In the first, the Leviathan scenario, tax revenues are not distributed to taxpayers but are eaten up by bureaucracy. In the other extreme, the redistribution scenario, tax revenues are directly distributed to taxpayers. The global public good scenario refers to the intermediary situation, where there are no direct transfers from tax revenues to taxpayers. Surprisingly, participants show positive work effort at a 100% tax rate in the Leviathan scenario. However, their findings support the work of Laffer (1974) that individuals react to tax rates greater than 50% and reduce their motivation to work. As tax rates increase, individuals will try to withdraw work from the market or consume untaxed leisure (Levy-Garboua et al., 2009). Keser et al. (2015) relate their evidence to unfair taxation.

Levy-Garboua et al. (2009) indicate that the relationship between taxes and the motivation to work is related to both behaviour and emotion. Examining the relationship between taxes and work effort, they control for income and substitution effects by including work productivity level. Their findings show that the substitution effect dominates the income effect at both high and medium productivity levels. However, they state that the findings might be an artefact of the selectivity bias of their experimental design.

Additionally, it is conceivable that cultural, political, and moral reasons can affect work/leisure preferences (Kirchler, 1998, 2007; Hardisty et al., 2010; Sussman and Olivola, 2011). Recent experimental studies on tax behaviour show that income taxes can enhance the motivation to work (Rick et al., 2017). In a real-effort laboratory experiment, Rick et al. (2017) find that individuals react to income taxation with their own attitudes towards redistribution and government intervention. Individuals who prefer both of them think that taxes are motivating for their work effort, while everyone else finds income taxes demotivating. There is little or no research showing the variation of work effort due to changes in tax rates at different income levels, either inside or outside of laboratory conditions. Therefore, this study aims at filling this gap by examining the response to changing tax rates at different income levels. Table 2.2 gives an overview of experimental studies.

Table 2.2 Overview of experimental literature on taxes and labour supply

Paper	**Work measure**	**Tax rates**	**Experimental treatments**	**Findings**	**Sample**
Swenson (1988)	To press keys on a personal computer (PC)	Tax rates were 12%, 28%, 50%, 73%, or 87%	Three separate experiments	Negative relationship between marginal tax rates and labour supply	18 undergraduate business students
Sillamaa (1999a)	Number of correct letters typed in a period	- A non-linear tax system - A linear tax system - The no tax treatment	Five sessions	Labour supply is higher under the linear tax system	37 inexperienced subjects
Sillamaa (1999b)	Total number of letters typed or decoded in a period	Regressive and zero-tail regressive tax treatment	Four sessions	Work effort is higher under a zero top marginal tax rate	36 inexperienced subjects

Table 2.2 *(continued)*

Sillamaa (1999c)	Number of correct letters typed in a period	Tax rates were 12%, 28%, 50%, 73%, or 87%	Thirteen different sequences	Negative relationship between marginal tax rates and work effort	21 subjects
Fochmann and Weimann (2011)	To fold letters and put them into envelopes	Tax-free, 25 %, and 50 %	After tax rates, net wages were held the same	Work effort is higher under the tax treatment than no tax treatment	245 employed persons (no students)
Gamage et al. (2010)	To alphabetize words	- Flat tax - Progressive tax - Bonus - No tax	Four conditions with the same economic decision	The impact of taxes on labour/leisure decision depends on the framing of tax instruments	150 undergraduate students

Table 2.2 *(continued)*

Hayashi et al. (2013)	To alphabetize words	- No tax - Bonus - Excise tax - Income tax - Tax credit conditions	- Partitioned pricing - Anchoring hypothesis	Reject anchoring hypothesis and find that partitioned pricing reduces work effort	150 undergraduate students
Fochmann et al. (2013)	To fold letters and put them into envelopes	- Tax-free - 25 percent tax - 50 percent tax	After tax rates, net wages were held the same	Individuals work harder and longer when they are taxed	127 employed persons
Keser et al. (2015)	Decoding letters into numbers	Tax rates are changing from zero to 100 % in discrete five-percent steps	-Leviathan -Redistribution -Global public good	Labour supply curve falls as the tax rate increases, except in the Leviathan treatment	448 participants

Table 2.2 *(continued)*

Pántya et al. (2016)	The number of sliders adjusted correctly	Comparable flat and progressive tax systems that yield the same tax revenue	-Flat tax -Progressive tax -From flat to progressive tax -From progressive to flat tax	Higher work performance in a progressive tax system	191 participants (students)
Kessler and Norton (2016)	Typing strings of characters in a specific order into a text	- $0.02 treatment - Wage cut -Experimenter tax -Government tax	Meaning (of task) and Control treatments for four wage and tax treatments	A new tax on labour income decreases labour supply more than financially equivalent decrease in wages	325 subjects
Rick et al. (2017)	To count the number of zeros contained within a matrix of zeros and ones	Tax rates used in two experiments are 50% and 33%, respectively	- Tax condition (intervention and redistribution) - “Match” condition (no intervention and redistribution)	The effect of income taxes on the motivation to work depends on redistribution and government intervention	591 undergraduate students

Source: Own elaboration

2.4 The labour supply elasticity

The fourth methodology economists use to study the relationship between income taxes and the motivation to work are referred to as observational studies or natural experiments (Hausman, 1985; Pencavel, 1986; Killingsworth and Heckman, 1986; Blundell and MaCurdy, 1999; Meghir and Phillips, 2009; Keane, 2011; Saez et al., 2012; Manski, 2014). In this case, observational studies include cross-sectional, or between-country analysis, as well as within-country analysis. While survey based research in this area focuses primarily on the disincentive effects of income taxes on two economic groups, low-income and high income (Hausman, 1985), observational studies concentrate on other groups such as single parents and married women, and particularly women married to unemployed men (Dilnot and Duncan, 1992; Ermisch and Wright, 1995; Dilnot and Kell, 1987). Most observational studies find that men are less responsive to tax rate changes, while married women and single mothers respond strongly (Meghir and Phillips, 2009). Meghir and Phillips (2009, p. 204) note, *"Our conclusion is that hours of work do not respond particularly strongly to the financial incentives created by tax changes for men, but they are a little more responsive for married women and lone mothers."* James (1992) says that this conclusion is related to the traditional concept of 'breadwinners/carers' (a breadwinner husband with a wife concerned with caring for the family), and it is one of the primary reasons why empirical studies show that men are less responsive to tax changes than married women are. This finding has been supported by Saez et al. (2012). Saez et al. (2012, p. 1) write, *"With some exceptions, the profession has settled on a value for this elasticity close to zero for prime-age males, although for married women the responsiveness of labour force participation appears to be significant. Overall, though, the compensated elasticity of labour appears to be fairly small."* The review of Keane (2011) suggests a different view compared to conventional approaches, finding that the labour supply of men might be more elastic. Keane (2011, p. 1071) claims, *"This is especially true of papers that calculate "long run" elasticities−meaning some combination of fertility, marriage, work experience, and education are allowed to respond to wage changes, rather than being held fixed."* Manski (2014) argues that labour supply models examining taxes and labour supply in empirical studies may be an artefact of model specification. These models used assume that there are homogenous income-leisure preferences within broad demographic groups (Manski, 2014). However, he suggests that in reality individuals might have heterogeneous income-leisure preferences. As Manski (2014, p. 148) states, *"Some may increase work effort with net wage, others may decrease effort, and still others may exhibit a non-monotone wage–effort relationship. If so, estimates of models that assume monotonicity and homogeneity of labour supply can at most characterize the behaviour of an artificial "representative" person."* Based on these observational studies, it can be inferred that an appropriately chosen utilitymaximising model for certain groups in society can offer reliable behavioural insights on the relationship between income taxes and the motivation to work. However, there is a criticism from Alesina et al. (2005) for the divergence between within-country and cross-country estimates of the labour supply. They add that high marginal labour tax rates are correlated with many other factors that can depress working hours, such as generous welfare systems, workplace regulations, unemployment compensation programs, and powerful unions. Therefore, using between-country models does a better job of capturing the true effect of labour tax rates on labour supply. In the following section, the cross-country literature on taxes and hours worked will be discussed.

2.5 General equilibrium models and cross-country research

Income taxes and the motivation to work has been the topic of many studies that use macroeconomic approaches to explain the differences in hours worked between countries (Dalamagas and Kotsios, 2012). While some of the studies have employed cross-country research, other studies have adopted numerical experiments (quantitative macroeconomics), which is a calibration of a general equilibrium model. A growing literature in numerical experiments (quantitative macroeconomics) started with the contribution of Prescott (2004). Prescott (2004) constructed a representative agent neoclassical growth model with labour and consumption taxes to observe how individuals share their time between work and leisure. In the model, market work is considered to be work in the legal market for production that is taxed, whereas leisure includes ordinary leisure activities as well as home production and work activities in the shadow economy, which are not taxed. According to the neoclassical growth framework, economies are expected to work less efficiently when nonmarket activities dominates market activities. Such a model provides a quantitative tool for the explanation of the relationship between taxes and time devoted to market work. Predictions derived from the general equilibrium models were subsequently tested with cross-country research. The differences between the studies in these two areas can be inferred by comparing Table 2.3 with Table 2.4. While Table 2.3 gives a general summary of the general equilibrium models, Table 2.4 gives a general summary of the cross-country literature. One should take into consideration that these studies are mixed in the literature, interconnected to each other. Prescott (2002, 2004) tested the importance of effective marginal labour tax rates on labour supply for the major advanced industrial countries including all G-7 countries for the periods 1970-1974 and 1993-1996. His macro evidence is that welfare gains such as better retirement systems can be high if countries with high tax rates decrease their effective marginal tax rate on labour income. Prescott (2004) finds that asking people to save for retirement will not decrease the labour supply the same way that using tax revenue for retirement systems does. This concept is reinforced by many scholars (Davis and Henrekson, 2004; Ohanian et al., 2008). Nevertheless, the findings of Prescott (2004) have been criticized by other scholars because of a potential omitted variable bias (Alesina et al., 2005). Alesina et al. (2005) mentions that the calibration approach used in Prescott's 2004 study can have misleading results because this theoretical view does not include other factors that can affect working hours. First, it was acknowledged by Davis and Henrekson (2004), then confirmation for this criticism from Alesina et al. (2005) stimulated an emerging literature of cross-country studies on taxes and hours worked by incorporating other institutional and fiscal variables. Alesina et al. (2005) note that the omission of these country-specific factors can create bias in the results. The story favoured by Alesina et al. (2005) is that strong unions, generous benefit systems, and social democratic governments make taxes high, which eventually leads to less working hours. Even though the study of Prescott (2004) was not widely accepted by other scholars, his calibration approach with general equilibrium models has been applied to different countries to measure the effect of taxes on labour supplies. For example, Conesa and Kehoe (2005) find that 80 percent of the reduction in hours worked in Spain from 1970 to 2000 can be explained by the evolution of taxation. They test their model with France over the same period and the findings confirm their results. Contrary to Prescott (2004), Rogerson (2007) argues that taxes alone cannot explain the differences in hours worked across the US, Continental Europe, and Scandinavia. Adding Scandinavia to the G-7 countries examined previously, he finds that differences in the types of government expenditures can account for the elasticity of hours worked between countries. Ljungqvist and Sargent (2007) find that increasing unemployment benefits decrease hours worked in Europe. Silva (2008) proposes a model that predicts the relationship between hours worked and taxes for Portugal, the United Kingdom, France, Spain, and the United States for the periods 1970-1974, 1983-1986, 1993-1996, and 2000-2002. He concludes that taxes explain large differences in the number of hours worked. Applying Prescott's approach to Australia, Hallam and Weber (2008) show that increases in labour taxes temporarily decreased hours worked in the 1980s, but in the long-run there is little change. Using both a numerical experiment and a cross-country study, Ohanian et al. (2008) finds that a tax wedge explains much of the variation in hours worked across OECD countries for the periods 1956-2004. Koyuncu (2011) uses the progressivity of taxes to explain the relationship between taxes and labour supply. The progressivity of taxes is measured by dividing the marginal tax rate by the average tax rate. Koyuncu (2011) finds that a decline in the progressivity of taxes can cause increased working hours. His finding suggests that in the US people work more because the progressivity of taxes is less for the periods 1971-1974 and 1986-1989. On the other hand, German people work less because of the high progressivity of taxes for the same periods. The main criticism of his study for the findings of Prescott (2004) and Ohanian et al. (2008) is that their models do not consider individuals as heterogeneous. Koyuncu (2011) believes that individuals have heterogeneous time preference characteristics, which makes them to have different labour-leisure choices. Using a similar methodology to Conesa and Kehoe (2005), Dalton (2014) finds that the evolution of taxes can account for 76% of the decrease in the number of hours worked over the period 1970-2005 in Austria. Chen et al. (2015) present that labour taxes and unemployment benefits together account for around 75% of the reduction in the labour supply in Europe relative to the USA for the periods 1970-1973 and 2000-2003.

It can be seen from the latest general equilibrium models that they started to emphasize the importance of not only taxes but also other omitted variables such as the progressivity of taxes (Koyuncu, 2011) or unemployment benefits systems (Chen et al., 2015). Therefore, after Alesina et al. (2005), Faggio and Nickell (2007), Causa (2009) and Berger and Heylen (2011) started to measure the effect of taxes on hours worked in cross-country research to find answers that are more reliable. Faggio and Nickell (2007) find a contradictory view, especially when they apply the story of Alesina et al. (2005) to Sweden. Despite Sweden having strong unions, generous benefit systems, more social democratic governments, and high taxes, the employment rate, measured as hours worked, is very high. For this reason, Faggio and Nickell (2007, p. F416) say, *"Taxes are part of the story but much remains to be explained."* Causa (2009) approaches the story with different view, looking more closely at labour force heterogeneity, and finds that high marginal taxes can have a disincentive effect on female working hours, but there is no significant effect for male working hours. The study of Causa (2009) is in the same line with the labour supply elasticity literature, which is mentioned in the previous section. Using both a fiscal and labour and product market institution view, Berger and Heylen (2011) find support for the fiscal view that hours worked decreases when the labour tax rate increases. The labour and product market institutions have less of a role to play.

Table 2.3 Overview of general equilibrium models on taxes and hours worked

Paper	**Work measure**	**Tax measure and source**	**Countries**	**Findings**	**Period**
Prescott (2004)	Annual hours per employee	Average effective tax rates are calculated from Mendoza, Razin and Tesar (1994)	G-7 countries	Taxes alone can explain the differences in labour supply across countries	1970-74 and 1993-96
Conesa and Kehoe (2005)	Hours worked per week per working-age person.	Average effective marginal tax rates are calculated from Mendoza, Razin and Tesar (1994)	Spain and France	Decrease in hours worked can be explained by the evolution of taxes	1970-2003
Silva (2008)	Average actual annual hours worked divided by 52 to obtain the values in weekly hours	Average effective tax rates is calculated from Lucas (1990), Mendoza, Razin and Tesar (1994), and Prescott (2002, 2004)	Portugal, France, Spain, United Kingdom, and United States	As taxes increase, the number of hours worked decreases	1970-74, 1983-86, 1993-96, and 2000-02

Table 2.3 *(continued)*

Hallam and Weber (2008)	Weekly work hours per person aged 15-65	Effective marginal tax rates are calculated from Prescott (2004)	Australia	In the short-run taxes decrease work hours, but not in the long-run	1970-74 , 1986-88, 1993-96 and 2001-03
Ohanian et al. (2008)	Aggregate hours of work	Average effective tax rates are calculated from McDaniel (2007)	21 OECD countries	Negative relationship between taxes and hours of work	1956-2004
Koyuncu (2011)	Average weekly hours worked per person	Average tax rates and progressivity of taxes are calculated from NBER’s Tax Simulation (TAXSIM)	US and Germany	Tax progressivity is a better predictor of time use patterns than average level of taxes	1971-74 and 1986-89

Table 2.3 *(continued)*

Dalton (2014)	Aggregate hours worked per working-age person (annual)	Effective tax rates are calculated from Mendoza, Razin and Tesar (1994) and McDaniel (2007)	Austria	Evolution of hours worked can be explained by taxes	1970-2005
Chen et al. (2015)	Total number of hours worked over the year divided by the size of population aged 15-64	Average effective tax rate on labour income are calculated from McDaniel (2007)	US and EU-11	Taxes decrease hours worked	1970-73 and 2000-03

Source: Own elaboration

By approaching the work of Alesina et al. (2005) and follow-up studies from a different perspective explains why prior studies could not explain how high taxes increase working hours in some countries and decrease working hours in others. For example, previous studies used many different country groups such as Euro area, Nordic, Southern Europe, and Anglo-Saxon countries to find the answers for the relationship between taxes and hours worked, but most of them failed to give a clear picture. In addition, some researchers include home production in the number of hours worked in their models (Olovsson, 2009; Duernecker and Herrendorf, 2018). Following Reid (1934, p. 11), home production can be defined as *"those unpaid activities which are carried on, by and for the members, which activities might be replaced by market goods, or paid services, if circumstances such as income, market conditions, and personal inclinations permit the service being delegated to someone outside the household group."* These studies are not directly comparable to this research because unpaid home production and the untaxed or 'underground' sector of the economy, including tax avoidance and tax evasive activities, are not included in the measures of hours worked used in the empirical analysis. The primary objective of this analysis is to explain the 'work versus leisure' choice that workers make and the role that taxes play in their motivation to work. The main contribution to the literature is proposing and testing a new microeconomic labour supply model explaining the relationship between taxes and the motivation to work in a between-countries design. This differs from the aforementioned literature in the following ways: First, this study uses labour income tax rates, whereas most of the previous work uses the economic 'tax wedge' construct. Second, instead of examining the evolution of taxes, this study focuses on the change in hours worked due to changes in tax rates, while controlling for changes in wages and other factors found in previous research to affect the motivation to work.

Table 2.4 Overview of cross-country literature on taxes and hours worked

Paper	**Work measure**	**Tax rates**	**Experimental treatments**	**Findings**	**Sample**
Davis and Henrekson (2004)	Annual hours worked per employed person/Annual hours worked per adult of working age	Average personal tax rates are calculated from Nickell and Nunciata (2001) and Schneider (2002)	13 OECD countries	Taxes lead to less work time	1977, 1983, 1990 and 1995
Alesina et al. (2005)	Annual work hours per person 15-64	Marginal income tax rate (OECD)	18 OECD countries	Taxes lead to less work time	1960-1995
Faggio and Nickell (2007)	Average annual hours worked per person in employment	Marginal tax rates and average tax wedge (OECD)	17 OECD countries	Taxes cannot be the whole story	1981-1999

Table 2.4 *(continued)*

Causa (2008)	Annual average hours worked per person in employment	Average tax wedge for one earner family (Bassanini and Duval, 2006) and average of marginal tax wedges on a second earner (OECD)	21 OECD countries	Taxes decrease the working hours of females, but males are insensitive	1996-2003
Ohanian et al. (2008)	Aggregate hours of work	Average effective tax rates are calculated from McDaniel (2007)	21 OECD countries	Negative relationship between taxes and hours of work	1956-2004
Berger and Heylen (2011)	The employment rate in hours and average annual hours worked per employed person	Implicit labour tax rate is calculated from Martinez-Mongay (2000)	20 OECD countries	Hours worked fall when taxes increase	1970-2007

Source: Own elaboration

2.6 Other related literature

2.6.1 Subjective well-being literature

One possible explanation for the shortcomings of economic theory can be illustrated with the most debated topics from the subjective well-being literature about the relationship between income and happiness (Diener, 1984; Diener et al., 1985; Easterlin, 1974; Ferrer-i-Carbonell, 2005). All of the scenarios depicted above are based on two factors, level of income and a reference point. Imagine someone that earns money and wants to increase his/her happiness. However, money earned from market work by itself is not enough to make you happy, and cannot be the only primary goal in life. Not only income, but also other factors are considered together in the literature of subjective well-being and reference-dependent preferences. The four primary effects identified in this literature are, "comparison income" or "relative utility" (Easterlin, 1995; Ferrer-i-Carbonell, 2005); "past wage or consumption" (Easterlin, 2001); "the hedonic treadmill" (Brickman and Campbell, 1971) or "preference drift" (Van Praag, 1971); and "target income" (Camerer et al., 1997).

In the literature, "comparison income" or "relative utility" effect refer to a perspective where an individual's happiness does not depend on his/her income, but also on the comparison with the income of other people, who form the reference group (Ferrer-i-Carbonell, 2005). If people with relatively low wages have larger income in comparison with the income of a reference group, then even these low wage workers are happier. On the other hand, workers with high wages, but with income less than the income of a reference group are not happier, even if they have above average income (Ferrer-i-Carbonell, 2005).

According to the studies of Easterlin (1974, 1995, 2001), it is found that despite high income individuals being happier than low income individuals on average, an income increase does not increase the happiness or well-being of high income individuals. Easterlin (2001) notes that individuals judge their happiness based on material aspirations that they got at any particular point in time. For example, individuals tend to assess past lower income less favourably today compared to at the time they were earned. Because in the past at lower income they also had lower aspirations. Therefore, an individual's own situation in the past plays important role in their happiness.

The "hedonic treadmill" metaphor is explained by the stationary happiness of an individual despite getting some advance in economic condition (Brickman and Campbell, 1971). It is simply means that low income individuals will not be better off when they increase their income. The "preference drift" is known in the economics as an adaptation to higher income, meaning that an increase in income is positive event that leads to adaptation (Groot and Van Den Brink, 1999). Groot and Van Den Brink (1999) find that mainly preference drift happens in higher income individuals, especially adaptation to higher income that starts once basic needs are satisfied.

2.6.2 Reference-dependent preferences

Another possible explanation for the shortcomings of economic theory is connected with the "reference-dependent preferences" (reference point) literature, which was used by Camerer et al. (1997) to explain why individuals set daily income targets and tend to quit working for the day after reaching their daily target. The reference point has been treated as an unobserved latent-like variable in the literature. To examine this issue, Camerer et al. (1997) used cab drivers as subjects for their study. This is because the wages of cab drivers are relatively constant within days but uncorrelated across days. Camerer et al. (1997) found that there is a negative relationship between wages earned in the day and work duration in that day. Farber (2004, 2005) replicated the study of Camerer et al. (1997) but used a completely different econometric framework. Farber (2004) did not find the existence of a target income level and mentioned that most shifts end before drivers' target income levels are reached. In another study, Farber (2005) again find direct contrast to the findings of Camerer et al. (1997) and provides that the main differences between these studies is due to different empirical models and wage rates measurement issues.

Köszegi and Rabin (2006) expanded the Camerer et al. (1997) study and developed daily income targets for across days. Köszegi and Rabin (2006) found that the response of drivers to wage changes depends on if those changes are predictable. Drivers go to work and work more at a given realized wage if those predicted wages are high, but they work less when their wages are unpredictably high.

All studies on reference-dependent preferences are in the spirit of prospect theory developed by Kahneman and Tversky (1979) and Tversky and Kahneman (1991) (Crawford and Meng, 2011). An individual's preferences respond not only to wages, but also to a reference point. The reference point can be defined by past wage or consumption (Bowman et al., 1993), by social comparison (Duesenberry, 1949), or by expectations for the future (Camerer et al., 1997).

2.7 Control Variables

There are numerous factors besides income taxes that affect the motivation to work, including the level of social services and welfare available to workers, the amount of government intervention or planning in the economy, the quality of the legal system in place, the level of free markets in the economy, and the ability that workers have to determine the number of hours that they work, due to either legal or cultural factors. The variables that were used in the empirical tests to control for these factors are employment protection, net union density, benefit replacement rate, benefit duration, output gap, government consumption, product market regulation, and consumption and capital tax rates.

2.7.1 Employment protection (EP)

Employment protection is legislation for temporary and permanent work contracts. It disciplines employers for unfair practices and provides a guarantee for job loss and other benefits (Nicoletti and Scarpetta, 2005). The theoretical effect of employment protection regulations on employment are not clear. They affect companies' decisions on adjusting the workforce. It is costly for companies to fire employees, because eventually companies incur these costs. This means that employment protection supports employees for any dismissal situation. This can cause companies to offer lower pay, to cover the cost of terminating employees. On the other hand, employment protection helps employees through increased bargaining power, which allows them to demand higher pay from companies. Bargaining for higher wages can lead companies to decrease hiring rates, and ultimately this process increases the time in job seeking for employees, or they spend more time unemployed before finding new job (Bassanini and Duval, 2006). However, declining labour market turnover makes the incidence of unemployment costlier. Therefore, after some periods of high income, claims are moderated in the market (Berger and Heylen, 2011). Consequently, employment protection leads to increased work effort. Theoretical and empirical evidence on the effect of employment protection on the labour supply remains inconclusive (Berger and Heylen, 2011). Nicoletti and Scarpetta (2005), and Faggio and Nickell (2007) found a negative association between employment protection and labour supply. Other studies found the opposite or an insignificant effect (Nickell et al., 2005; Bassanini and Duval, 2006; Estevão, 2007).

2.7.2 Net union density (UD)

Trade union density is a measure of the share of the total workers that are members of a trade union. Earle and Pencavel (1990) note that early literature on the theory of labour contracts was focused on wages and the number of workers employed, and they disregarded working hours. Blanchflower (1996) shares the same thought, that a relatively small number of studies have been done on the effects of unionism on the number of hours worked and employment growth (e.g. Freeman and Kleiner, 1990; Leonard, 1992; Lalonde et al., 1996; Blanchflower et al., 1991; Long, 1993). Economists have emphasized four outcomes of unionism for employees: (1) higher wages and other compensation, (2) shorter hours and fewer days of work, (3) better working conditions, and (4) better treatment by employers (Boal, 2017). It should be noted that union density, the proportion of employees in unions, is the most common variable used to measure unionism (Baker et al., 2002). Oswald (1985) says that strong trade unions can cause less labour supply because of their monopolization power on labour supply, thus forcing wages above market-clearing levels. Boal and Pencavel (1994) note the same pattern, that unionization can push wages up, causing companies to reduce labour demand, which eventually decreases employment or working hours, or both. This theoretical view can be seen in the early works of Slichter (1941) and Lewis (1966).

Nickell (1997) points out that union density is only a rough measure of the impact of unions. In some countries, administrative extension of wage agreements can determine the wages of employees that are not explicitly part of the union. Nickell (1997) gives examples from Spain and France, that while only 10 percent of employees are union members, 70 percent of all employees' wages are determined by union bargaining. Therefore, some studies use a "union coverage index" that indicates the share of employees' wages that are actually determined by union bargaining (Nickell, 1997). However, Koeniger et al. (2007) state that union density is used more often than the union coverage index, because union coverage is measured less frequently and exhibits less variability.

High unionization in one sector can have a spillover effect on non-union sectors (Blanchard and Kiyotaki, 1987). This mechanism is connected with the "insider-outsider" hypothesis. Examining the behaviour of economic agents, the inside-outsider hypothesis states that some individuals, the insiders, have more privileged positions than others, the outsiders (Lindbeck and Snower, 1984). Scarpetta (1996) finds that unemployed youths are "outsiders" and increased union density has a negative effect on youth employment. Scarpetta (1996, p. 64) notes, *"In the case of youth unemployment, the results provide further support to the insider-outsider thesis, whereby young workers and new entrants into the labour market are particularly affected by the strong position of insiders…."* The importance of trade union density in research on taxes and hours worked has been supported by cross-country analysis (Alesina et al., 2005; Huberman and Minns, 2007; Berger and Heylen, 2011). Alesina et al. (2005) find that there is a negative relationship between union density and hours worked per working-age person. Surprisingly, some studies find a positive relationship between union density and labour supply, contrary to theoretical predictions (Burgoon and Baxandal, 2004; Bowles and Park, 2005; Bassanini and Duval, 2006; Faggio and Nickell, 2007; Causa, 2009). Faggio and Nickell (2007) explain the positive effect of union density on hours worked with the study of Koeniger et al. (2007), that if the negative effect of wage inequality is taken into account, then the positive effect of union density on hours worked is eliminated. It can be seen from these prior studies that the effect of union density on labour supply is highly ambiguous.

2.7.3 Benefit Replacement Rate (BRR) and Benefit Duration (BD)

The unemployment benefit system has two components. While the benefit replacement rate measures benefit entitlement, benefit duration is the length of time of benefit entitlement. Both of them are generally assumed to reduce labour supply. Berger and Heylen (2011) find a negative effect of benefit replacement rate on hours worked. Similar to the benefit replacement rate, there is strong evidence that a high benefit duration also has a positive impact on unemployment, or a negative effect on employment (Scarpetta, 1996; Nickell, 1997; Elmeskov et al., 1998; Bassanini and Duval, 2006). Layard et al. (1991) find that both higher benefit durations and replacement rates increase unemployment. These effects are due to two mechanisms. First, they decrease the motivation for workers to go out and find new jobs because it reduces the fear of unemployment, which leads to lower employment. Second, it lowers the economic cost of unemployment, which leads to higher wage claims from employees, and eventually reduces labour demand and employment (Bassanini and Duval, 2006; Estevão, 2007; Nickell et al., 2005; Nicoletti and Scarpetta, 2005). Madsen (2004) touches upon another view that replacement rate increases the risk of financial disincentives, especially for low-income earners in the Danish labour market. Higher replacement rates can create a poverty trap, which is the mechanism that makes individuals poorer, and thus they cannot escape from below the poverty line. For example, Madsen (2004) provides that while the replacement rate in Danish labour market is around 70 percent for an average production worker, it is around 90 percent for the low-income groups. Although high benefit replacement rates might appear to make unemployed persons less likely to seek jobs, they do not, because of the aforementioned poverty trap issue. Madsen (2004) says that while this view is theoretically plausible, it is hard to get verification for theoretical view using empirical models.

2.7.4 Output gap (GAP)

Output gap is a measure of the current state of the economy, either above or below the normal production of the economy at full capacity. The proportional difference between actual and trend output indicates the gap variable (Elmeskov et al., 1998). If the output gap is positive then the economy is in expansion, while the output gap is negative then the economy is in recession. Therefore, increases in output gap are expected to influence labour supply positively. The trend in output is estimated by applying the Hodrick-Prescott (1997) filter (HP filter) to GDP (Elmeskov et al., 1998).

Output gap is related to business cycles, and understanding the effect of business cycles on hours worked has been a primary goal in business cycle research (Kydland and Prescott, 1982; Hansen, 1985). As Scarpetta (1996, p. 50) says, *"At any point in time, countries can differ in their relative position in the business cycle and in the amplitude of the cycle around the long-run trend."* Business cycles are one of the reasons countries have varying hours worked over time. In business cycles research, output gap is measured to test the effects of institutional factors on the unemployment rate (Scarpetta, 1996). The effect of output gap on both unemployment and employment rates has been examined by Bassanini and Duval (2006). According to their study, output gap has a positive effect on employment rate, while it has negative effect on unemployment rate. Their finding supports the economic predictions (Bassanini and Duval, 2006).

In the empirical literature, while Causa (2009) finds an insignificant relationship between output gap and hours worked, Berger and Heylen (2011) find a positive relationship between output gap and hours worked. The result of Berger and Heylen (2011) is in the same line with economic prediction that increases in the output gap affects labour supply positively.

2.7.5 Government consumption and expenditures (EXP)

Government Consumption as a Percentage of GDP consists of all government expenditures, including imputed expenditures, and those incurred by the general government on both individual consumption goods and services, and collective consumption services. The composition of government expenditures and its key role on the macroeconomic consequences of national economies has been emphasized by Dhont and Heylen (2009). Berger and Heylen (2011) note that different compositions of government expenditures have various effects on labour supplies.

It can be argued that specific items of government expenditures such as education, public infrastructure, childcare subsidies, and others can have different effects on the labour supply. All of these government expenditures can be classified for employees as either useful government consumption (productive expenditures) or non-useful government consumption (non-employment benefits) (Berger and Heylen, 2011). Useful government consumption means that government expenditures finance mainly productive expenditures. On the other hand, non-useful government consumption means that government expenditures finance non-employment benefits. While the effect of non-useful government consumption on employment is clear (it has negative effect on the labour supply), the impact of useful government consumption is mixed. There is a belief that if taxes are collected to finance non-employment benefits (non-useful government consumption for employees), then these expenditures on non-employment benefits will cause a reduction in working hours because of less of a utility gain from being employed. To put it in a different way, if governments supply transfer programs, in which individuals receive benefits but do not produce any valuable services, then it will decrease the labour supply. Traditional unemployment benefits, early retirement benefits, and disability benefits can be considered non-employment benefits, which help individuals who are not working (Berger and Heylen, 2011). It can be seen from the aforementioned discussion that the effect of non-useful of government consumption on the labour supply is straightforward. Useful government consumption for employees has a negative effect on employment by eliminating the income effect (Berger and Heylen, 2011). Despite some useful government consumptions that generally reduce the labour supply, other useful government consumptions can increase working hours. For example, Rogerson (2007) finds that childcare subsidies have a positive effect on the labour supply. Dhont and Heylen (2009) find that in the Nordic countries people work more than the core Euro area because of a higher share of productive government expenditures and lower non-employment benefits. In their study, the productive government expenditures include education spending, active labour market expenditures, R&D expenditures, and public investment. The main reason for the positive effect of these productive expenditures on the labour supply is that these expenditures increase the productivity of labour and wages, therefore leading to a higher return to working. Carbonari et al. (2017) find a positive relationship between the productive type of government expenditures (i.e. the public ICT capital services) and hours worked by younger members of the labour supply.

2.7.6 Product market regulation (PMR)

Product market regulation (PMR) is the regulation policies that promote or inhibit competition of the products in the market. Blanchard and Giavazzi (2003) provide that removing product market regulation can increase output and decrease unemployment. Therefore, deregulation is defined as reducing and redistributing rents, which leads economic players to adapt this new distribution (Blanchard and Giavazzi, 2003). Product market deregulation is assumed to increase labour supply (Berger and Heylen, 2011). It helps new firms to enter the market and reduce the power of incumbent firms. Having a competitive environment in the market decreases wage claims at the firm level and increases real wages because of lower aggregate prices (Blanchard and Giavazzi, 2003, Berger and Heylen, 2011). Other empirical works support the assumption that product market regulation increases labour supply (Bassanini and Duval, 2006; Nicoletti and Scarpetta, 2005).

2.7.7 Consumption (TAUC) and capital tax rate (TAUK)

Higher tax rates on consumption affects the motivation to work, but its effect is very small compared to labour income tax rates. Blumkin et al. (2012) find that individuals underestimate the cost derived from consumption taxes when they make labour-leisure choices. Compared to labour tax rates, the consumption tax base is much broader including pensioners, beneficiaries, and capital-income earners (Pestel and Sommer, 2013). Pestel and Sommer (2013) note that while only a part of the population is subject to labour taxation, everyone pays consumption taxes. Therefore, consumption taxes have a negative effect on remaining unemployed, because in each consumed product paying taxes makes the leisure time costlier to unemployed persons. Capital tax rates do not affect the motivation to work directly. Capital tax rates negative effect on employment is indirect, and comes from physical capital formation and labour productivity (Berger and Heylen, 2011). For instance, in economics, three inputs such as physical capital (or just capital), natural resources (including land), and labour are the primary factors of production (Samuelson and Nordhaus, 2009). First, higher capital tax rates affect capital accumulation by significantly reducing business fixed investment (Feldstein, 1987). This happens because taxes increase the cost of capital for business owners, reducing demand for capital. Second, a lower demand for capital leads to lower labour productivity and lower real wages (Hassett and Mathur, 2006). This happens because the tax burden is shifted from business owners to labourers in the form of lower wages, which eventually decrease labour supply.

2.8 Some critical remarks

To test theory in this research requires a few conditions. First, there must be changes in tax rates. A change in tax rates is required for the taxpayers to react to and change their hours worked. The change in tax rates can be thought of as a sort of "natural experiment" to which workers' reactions can be gauged. However, tax rates within a country change infrequently, making it difficult to collect more than a few data points on how workers react, even with a long time series. In addition, tax reform is often accompanied by other structural or macroeconomic changes. These confounding events make it difficult to determine if the change in hours worked is due to the tax rate changes or other factors.

One condition that is required to test theory in this paper is the ability of workers to adjust the number of hours that they work. If this is limited due to the influence of unions, for example, then even if tax rates changes workers might not change the number of hours that they work. The additional control variables tested in the model vary between countries, but not within country. In order to test the influence of control variables on the reaction to tax rate changes, a between-countries design must be used. In summary, using a between-country design instead of a within-country design has the advantages of more tax rate changes, the ability to rule out most confounding events and other factors, and to test which control variables mitigate or intensify workers' reactions to tax rate changes. However, one advantage of testing within country is that country-specific variables are held constant. When testing between countries there are cultural differences and structural factors such as legal systems, social programs, and other control variables that add complexity to the natural experiment that exists when countries change their tax rates. An advantage of a within-country design is that almost all country-specific factors are eliminated. This might allow the reaction to tax rate changes to be isolated and free from alternative explanations. Between the two possible designs, this study uses the between-countries methodology due to the ability to test the control variables, which are of great interest.

In addition to the above reasons, when the disparity in income worldwide is observed, it is difficult to test the effect of tax rate changes on workers with different income levels within one country. Although there is some variance in wages within country, it is small compared to the between-country variance in wages. One criticism of previous research, particularly survey studies, is that they focus almost exclusively on the short run (Van Paridon, 1992). Dalamagas and Kotsios (2012) provide that a tax-induced decrease in the motivation to work is less in the short run than it is in the long run.

There has been significant criticism of experimental approaches to testing the relationship between taxes and the motivation to work (Swenson, 1988; Rupert and Fischer, 1995; Sillamaa, 1999a, b, c; Gamage et al., 2010; Djanali and Sheehan-Connor, 2012; Hayashi et al., 2013; Fochmann and Weimann, 2013; Keser et al., 2015; Rick et al., 2017; Kessler and Norton, 2016; Pántya et al., 2016). For example, in experiments the designs used do not allow researchers to observe the impact of potential taxes on the motivation to work. Experimental research often suffers from a lack of external validity (Kirchler, 2007). Moreover, as discussed above, the experimental research on the effect of income taxes on the motivation to work has shown conflicting results. For example, while Djanali and Sheehan-Connor (2012) show the positive effects between income tax and motivation to work, Kessler and Norton (2016) find a negative association.

Unlike previous research in this area, the theory was first developed and demonstrated using a simulation. After this proof-of-concept, empirical tests were performed to confirm that workers' reactions to tax rate changes depend on wage level and other factors. The results show the trade-offs between the income effect and the substitution effect, and how they depend on income level.

3. THEORY DEVELOPMENT AND HYPOTHESIS FORMULATION

3.1 The Hierarchy of Pecuniary Needs

Previous empirical research has found that increasing taxes reduces the motivation to work (Prescott, 2004; Davis and Henrekson, 2004; Ohanian et al., 2008; Manski, 2014). However, the opposite effect, that increasing taxes will cause workers to increase the number of hours that they work, was proposed in the early twentieth century by Pigou (1920) and Knight (1921). The Hierarchy of Pecuniary Needs, developed here, builds on Maslow's Hierarchy of Needs (Maslow, 1943) and demonstrates theoretically why increasing taxes can increase the motivation to work.

Although Maslow's Hierarchy of Needs has been criticized (Kaur, 2013) and difficult to prove empirically (Graham and Messner, 1998), the logic it conveys can be applied to the motivation to work. Any individual's basic needs, both psychological and physical, must be satisfied in order for that individual to survive. A minimum amount of nutrition and protection from the elements, plus the will to survive, are necessary. For these, an individual must exert effort. Once the basic needs are satisfied for an individual, then other needs can be pursued, such as providing basic needs for family members, or pursuing pleasurable activities such as hobbies or leisure. To the extent that these needs have a cost, they affect the motivation to work. This hierarchy can be imagined as an economic parallel to the psychological hierarchy of needs in the humanistic approach to psychology. This is the Hierarchy of Pecuniary Needs, as shown in Figure 3.1.

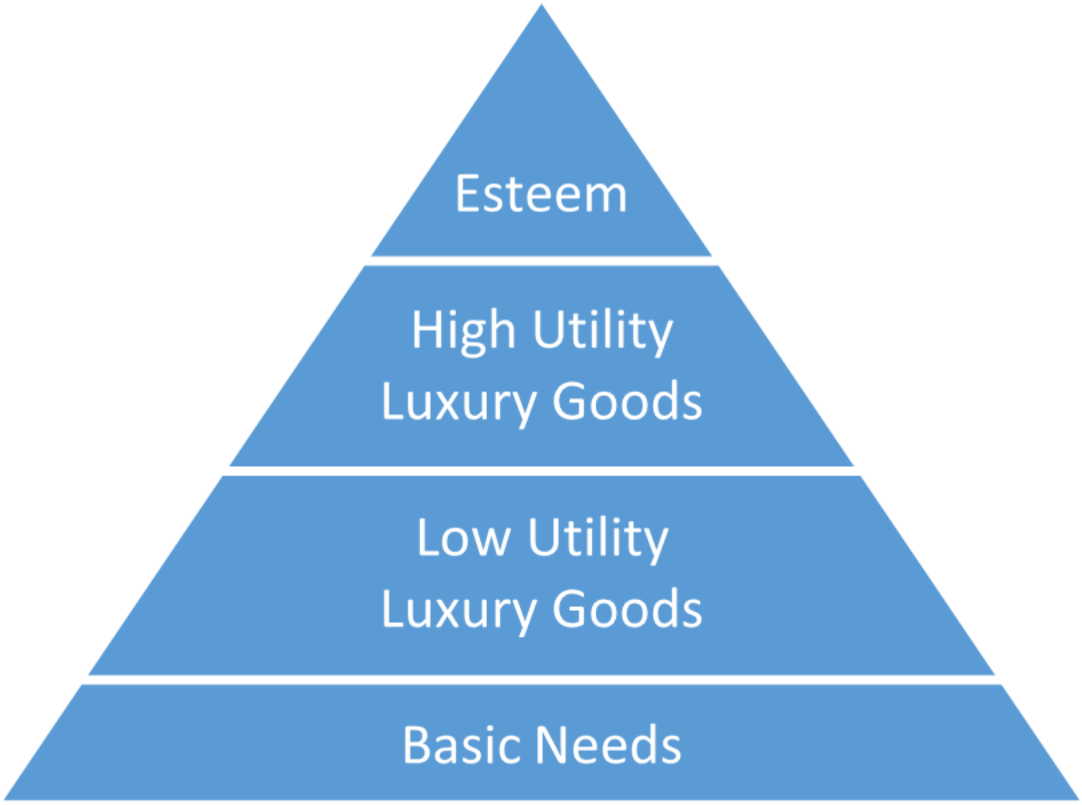


Fig. 3.1: Hierarchy of Pecuniary Needs
Source: Own elaboration

As shown in Figure 3.1, the Hierarchy of Pecuniary Needs has "Basic Needs" as its base. This is the cost of the goods and services needed to survive, both from a physical and psychological perspective. The line between Basic Needs and Low Utility Luxury Goods is the subsistence level of income. After a worker pays for basic needs, they can start to pay for luxury goods, or "wants". The least expensive of these are the low utility luxury goods, which have a ready supply and low demand, keeping them affordable. Higher utility luxury goods are in lower supply and higher demand, making them less affordable. After luxury goods are acquired, income has utility for individuals due to the esteem it provides, or the "Veblen Effect" (Veblen, 1899) discussed in the literature review. This includes both self-esteem and the respect and admiration of others. In the sections that follow, a framework is developed that allows predictions based on the economic model, but extended to explain which effect will apply to individuals in different circumstances.

Based on the Hierarchy of Pecuniary Needs presented above, the number of hours that a person will work is the maximum of two functions:

1. The number of hours worked needed to pay for the cost of basic "survival" needs, the subsistence level of income. The minimum number of hours that an individual must work in a period, h_1, is the subsistence level of income for the period divided by the hourly wage rate. The slope of this function

between wages and hours worked is negative. The number of hours required to work to pay for subsistence level of income decreases as pay increases.
2. The second function is based on an individual's preference for income and leisure. Workers prefer more of both, but they must choose between them, because an hour of work is one less hour of leisure, and vice versa. Workers will choose the number of hours of work, h_2, which maximizes their utility. This trade-off means that the slope of the function is positive, the number of hours worked increases as pay increases. This reflects the increasing opportunity cost of leisure as wages increase.

These two functions combine to form a complex model where each individual has a unique subsistence level, a unique preference function for work and leisure, and a unique wage rate. Non-wage income and government subsidies or social programs are not explicitly part of the model, but implicitly reduce the number of hours necessary to cover basic needs. The subsistence level of income is equal to the gross cost of basic needs minus net non-wage income and government transfers.

The number of hours per week necessary to cover each worker's basic needs, h_1, is calculated along with the number of "optimal" hours, h_2, given each individual's work/leisure preference. The actual number of hours worked, h_3, is the greater of these two amounts. That is because even if a worker has 100% preference for leisure, there is a minimum quantity of hours that they will work to pay for basic needs. These functions can be described generally as follows:

$$h_1 = \frac{Basic\ Needs}{w} \tag{3.1}$$

$$h_2 = maxU(w * h, T - h) \tag{3.2}$$

where:

h = work hours per period
w = hourly after-tax wage
Basic Needs = minimum subsistence level per period
U is a utility function
T = total hours per period
T – h = leisure hours per period

The actual hours worked, h_3, is the maximum of h1 and h2.

$$h_3 = max\{h_1, h_2\} \tag{3.3}$$

This theory can be used to demonstrate numerous situations. For example, it is possible that (3.1) and (3.2) do not intersect. Consider two groups of workers, a group with low wages and a group with high wages. Although the terms "low" and "high" are relative, they can be defined for the purposes of the theory of the Hierarchy of Pecuniary Needs. Low wages are defined as wages close to the subsistence level of income. For workers with low wages the work-leisure decision is impacted at the margin by the potential for falling below the subsistence level of income. High wages are defined as wages far above the subsistence level of income. For workers with high wages the work-leisure decision is not impacted at the margin by the potential for falling below the subsistence level of income.

For the hypothetical group of workers at very low wages, $h_1 > h_2$, because workers are at the subsistence level of income, working only to cover their basic needs. In this case $h_3 = h_1$. In this example, increasing taxes, which decreases net wages, will cause these workers to work more hours to cover their basic needs. On the other hand, in a hypothetical group of workers earning high wages, $h_1 < h_2$. Workers are working many hours more than enough to cover their basic needs. In this case $h_3 = h_2$. When taxes increase, everyone works less because they now prefer the lower cost of leisure. Thus, h_3 might be downward sloping for groups of workers with high wages and upward sloping for groups of workers with low wages.

3.1.1 Simulation

In order to demonstrate this model, a simulation was constructed in Excel, where taxes, the subsistence level of income, wage rate, and preference functions are set differently for each person using random variables. The simulation modelled in Excel allows the variables in the functions to be changed to demonstrate different scenarios.

The primary variable of interest is taxes, and whether changing tax rates increases or decreases the motivation to work. Taxes make the opportunity cost of leisure lower, because after-tax wages decrease. Labourers do not have to give up as much income in order to have an hour of leisure. Increasing the tax rate has a similar effect as lowering the labourer's preference for work.

In the simulation, each individual's utility function, the preference for work or leisure, is a combination of two variables. The first is the scenario preference for income, which is the same for all individuals. The slope of the preference function for income varies from 1 to 5, as depicted below:

$$1 \leq \alpha \leq 5 \tag{3.4}$$

The values of 1 and 5 are arbitrary endpoints in a monotonic function to demonstrate the preference for income over leisure, where income becomes more preferred as the value increases. Thus, an individual with a value of $\alpha = 1$ has a high preference for leisure, and an individual with a value of $\alpha = 5$ has a high preference for income. These values can be chosen to represent cultural or country-specific factors that determine overall preference for work or leisure in an economy (Moriconi and Peri 2015; Mocan and Pogorelova, 2015).

The second variable that determines the preference for work/leisure in the simulation is a random variable for each individual, setting the individual's variation from the overall preference for work/leisure. This variable adds realism to the simulation, because even in a culture where average preference for leisure is high or low, individuals' preferences within that group will vary around the average.

To demonstrate a scenario in an economy where workers have a high preference for leisure, the preference function slope (preference for income) value is set low. For example, a value of 1 means that labourers always work enough to cover their basic needs, but wages must be high for them to work more than that because they prefer leisure. This results in a mostly downward sloping curve, as wages go up workers work less because they make enough to cover their basic needs and they prefer leisure to work.

A high value for the preference function slope (preference for income), means that workers have a high preference for income and a low preference for leisure. When the preference for income is high, for example 5, labourers are willing to give up leisure in order to work, so the slope is mostly positive. As wages go up, workers are quick to forgo leisure for more work because they have a high preference for income.

3.1.2 Scenarios 1-2 Low Wages

Using the simulation developed in Excel, different scenarios are demonstrated. The first two scenarios are for groups of workers with low wages and the second two for groups of workers with high wages. For each pair of wage groups, the preference for work/leisure is varied between high preference for leisure and high preference for income. Thus the first four scenarios have the combinations of low wages and low preference for income, low wages and high preference for income, high wages and low preference for income, high wages and high preference for income. In all scenarios the tax rate changes from 0% to 30% to show the impact of taxes on hours worked.

Scenario 1 demonstrates how workers with low wages and with a high preference for leisure ($\alpha = 1$) respond to taxes. In this case, workers always work to cover their basic needs, but little more because they prefer leisure. As shown in Figure 3.2, as pay increases the number of hours worked decreases because fewer hours are necessary to pay for basic needs. When taxes of 30% are applied, the effect is to decrease net pay. As shown in Figures 3.3 and 3.4, after taxes workers must increase their hours in order to cover basic needs.

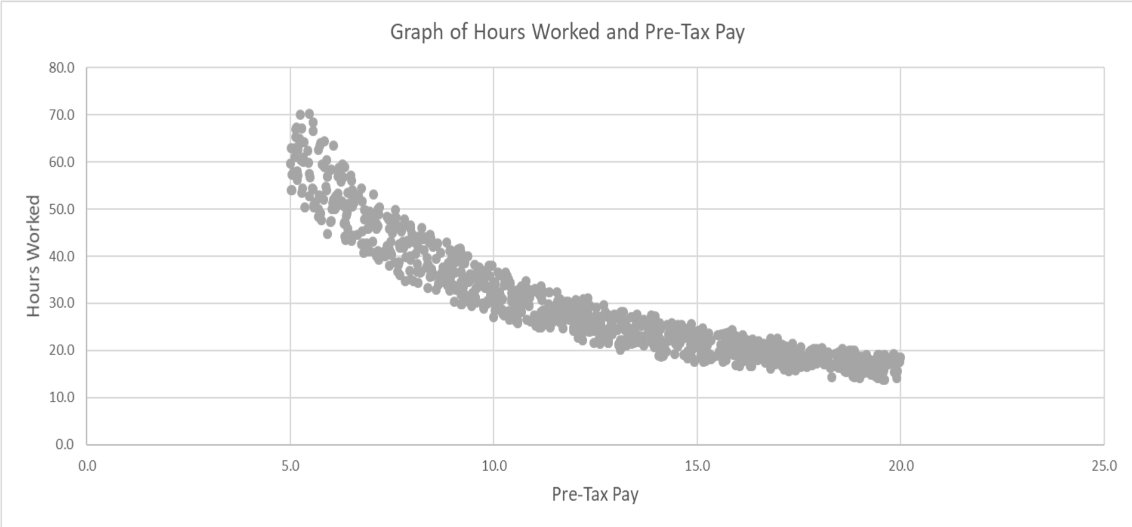


Fig. 3.2: Graph of Hours Worked and Pre-Tax Pay
Scenario 1, Low Wages, Taxes = 30%,
Utility Function Value = 1 (High Preference for Leisure)

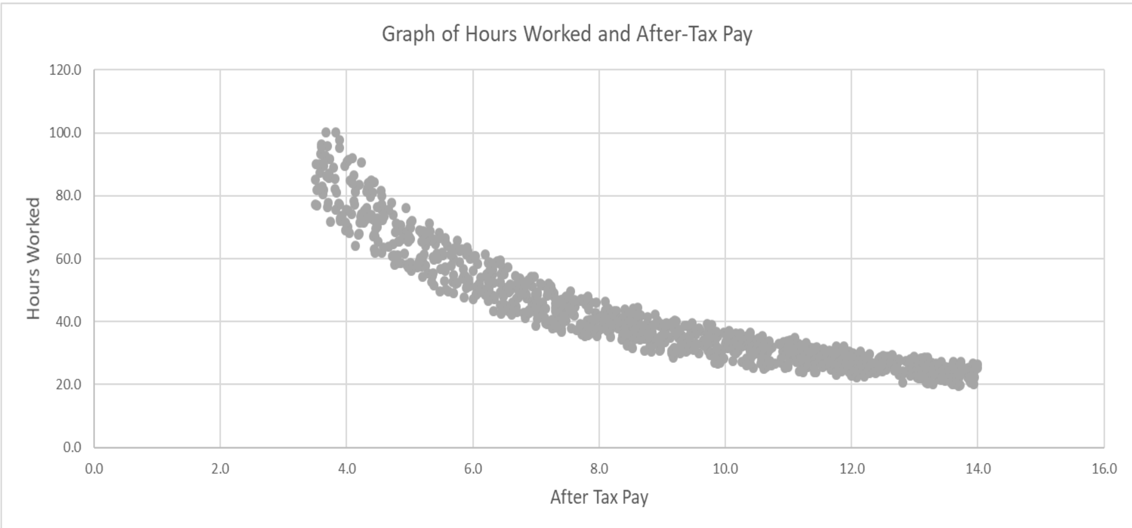


Fig. 3.3: Graph of Hours Worked and After-Tax Pay
Scenario 1, Low Wages, Taxes = 30%,
Utility Function Value = 1 (High Preference for Leisure)

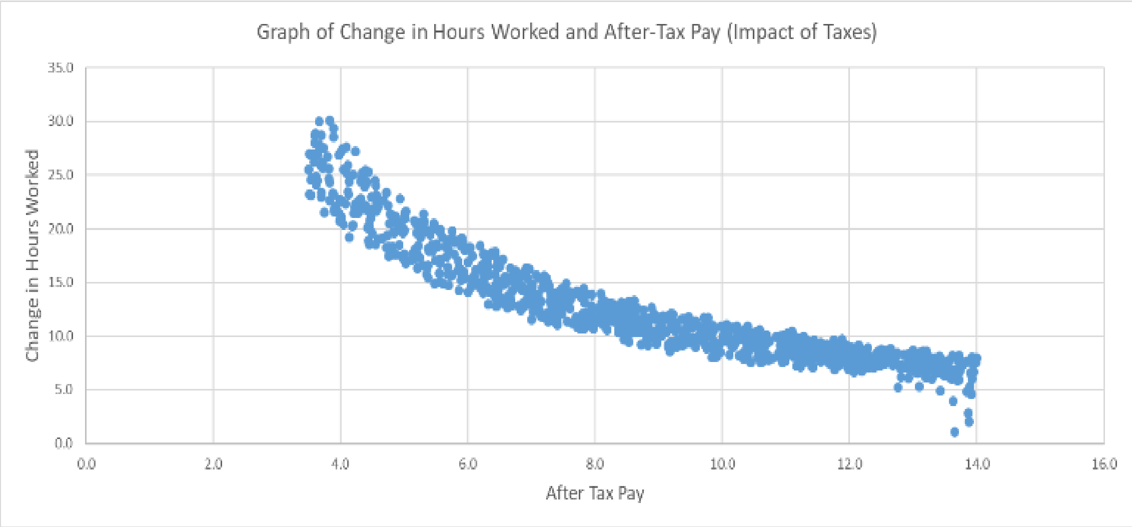


Fig. 3.4: Graph of Change in Hours Worked and After-Tax Pay Scenario 1, Low Wages, Taxes = 30%, Utility Function Value = 1 (High Preference for Leisure)

Scenario 2 shows how workers with low wages and with a high preference for income ($\alpha = 5$) respond to taxes. In this scenario, workers always work enough to cover their basic needs, and if their wage is high enough they forgo leisure to work because of their preference for income. As shown in Figure 3.5, as pay increases the number of hours worked initially decreases, because fewer hours are necessary to pay for basic needs. However, as wages increase an inflection point is reached where workers start to increase their hours due to their preference for income.

When taxes of 30% are applied, the effect is to decrease net pay. This changes the inflection point and fewer workers are willing to work more than just the minimum amount required to cover their basic needs (see Figure 3.6). The workers with the lowest wages must all increase their hours to cover their basic needs, and after taxes, even some workers towards the high end of the wage scale must increase their hours. However, due to the now lower cost of leisure, even many workers with a high preference for income decrease their hours (see Figure 3.7).

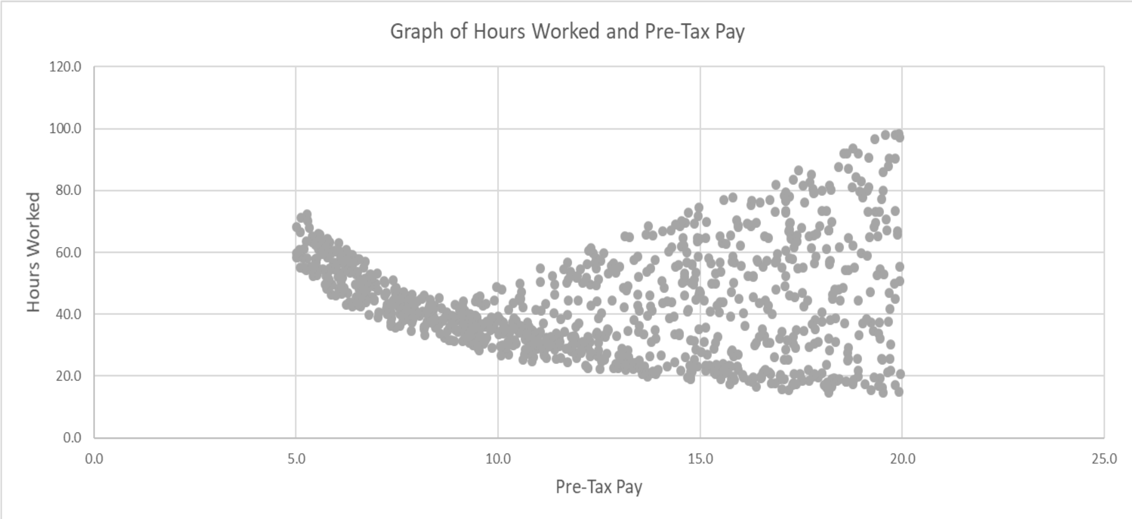


Fig. 3.5: Graph of Hours Worked and Pre-Tax Pay
Scenario 2, Low Wages, Taxes = 30%,
Utility Function Value = 5 (High Preference for Income)

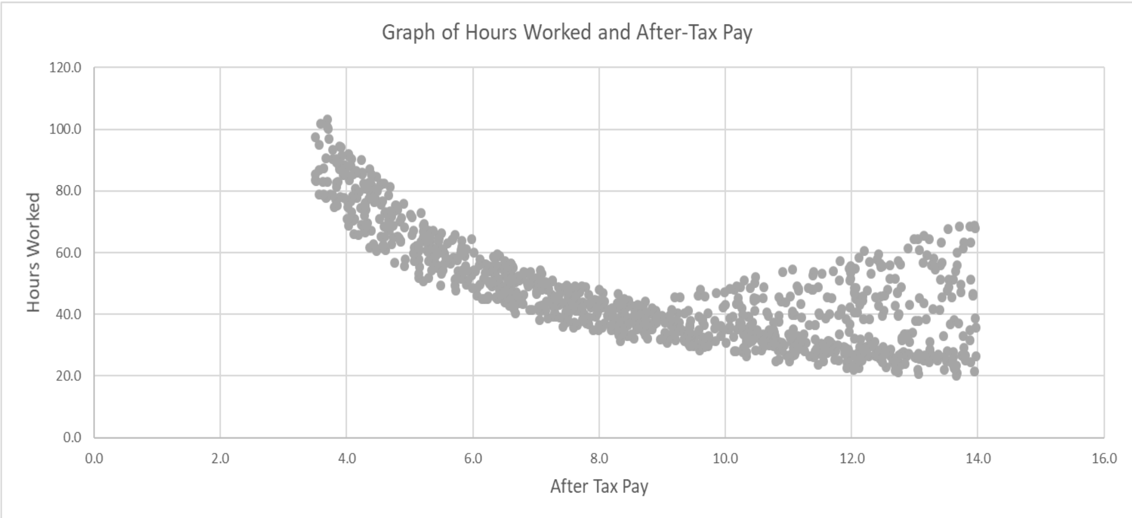


Fig. 3.6: Graph of Hours Worked and After-Tax Pay
Scenario 2, Low Wages, Taxes = 30%,
Utility Function Value = 5 (High Preference for Income)

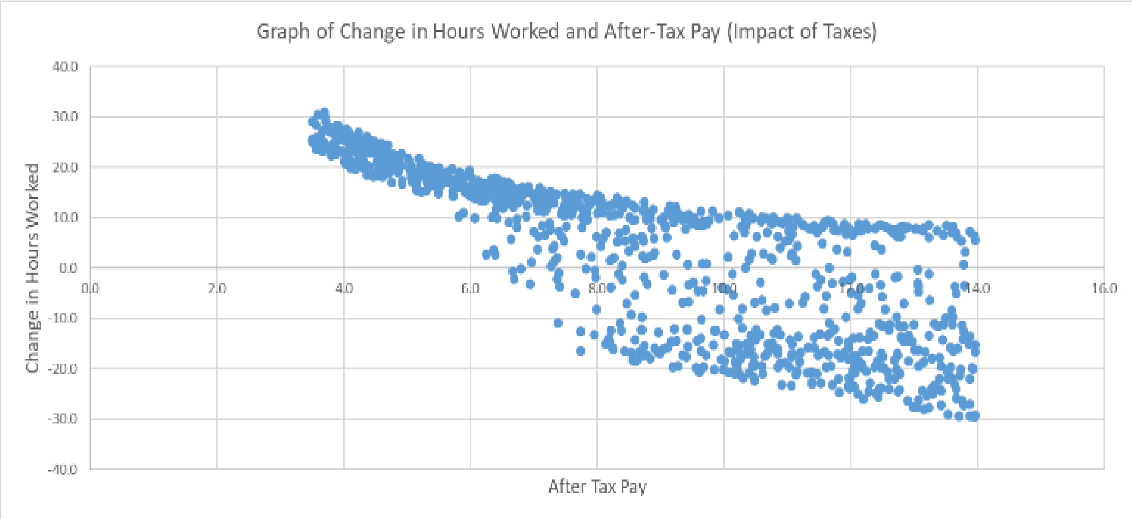


Fig. 3.7: Graph of Change in Hours Worked and After-Tax Pay
Scenario 2, Low Wages, Taxes = 30%,
Utility Function Value = 5 (High Preference for Income)

3.1.3 Examining four individual subjects from Scenario 1 and Scenario 2.

In scenarios 1 and 2 the impact of the subsistence level of income is high. Workers' decisions to increase or decrease their hours is primarily based on the number of hours required to pay for basic needs, and the preference for income or leisure only applies to a few of the highest paid workers that are above the subsistence level of income both before taxes and after taxes. A way to show this in more detail is to examine four individual subjects from the simulation, and show how the subsistence level of income plays such an important role in determining the number of hours worked for workers with low wages, and whether it increases or decreases due to taxes (see Table 3.1 and Table 3.2).

Each of the four subjects in the example comes directly from the simulation performed in Excel. Each subject is shown under two conditions, with a high or low preference for income ($\alpha = 1$ and $\alpha = 5$). This is also a good way to demonstrate the simulation in more detail. For each subject a random variable is used to determine the subject's innate preference for income. This is because even within the scenarios comparing high and low overall preference for income, there are individual differences between subjects within each scenario. In the four subjects being analysed, this preference varies from .49 to .93. The number itself has no meaning, other than higher numbers mean the subject has more preference for income. Subject 1's value of 0.84 is greater than subject 2's value of .59, so subject 1 has a higher preference for income. Within each group of 1,000 subjects in each scenario, an overall slope of the utility for income (α) was set from 1 to 5. In the four scenarios illustrated above, the endpoint values of 1 and 5 were chosen to emphasize the impact of the utility for income on the decision to work more or less hours. For subjects 1-4 shown below, two columns, side-by-side for each subject, show the values of the relevant variables when the utility function slope is 1 or 5 for that subject.

After utility is determined, each subject is randomly assigned a cost of basic needs. The sum of these divided by the worker's pay rate is the minimum number of hours that each subject must work to survive. Because wages and the subsistence level of income are randomly determined (within specified ranges), the minimum number of hours that each subject must work is different for each worker. In the four example subjects shown (see Tables 3.1 and 3.2), the low is 17.3 hours per period to pay for the cost of basic needs, and a high of 33.3 hours per period to pay for the cost of basic needs. The number of hours that each subject would prefer to work given their wage and preference for work/leisure is referred to in the simulation as the "optimal hours." This is how many hours each worker would work if the subsistence level of income is not considered. However, each worker must work at least enough hours to pay for basic needs, so the actual number of hours worked is whichever number is greater, the maximum between the hours required for basic needs and the optimal hours due to the subject's utility for income.

When taxes are applied, it changes the wage and the variables dependent upon wages, but nothing else. Therefore, the number of hours required to work to pay for basic needs increases, the number of "optimal hours" decreases, and the change in actual hours worked, increases or decreases depending on each subject's individual situation.

Table 3.1 Examining Subjects 1 and 2 from Scenarios 1 and 2 in the Simulation

Subject Number	**1**	**1**	**2**	**2**
Utility Random Variable	0.84	0.84	0.59	0.59
Utility Function Slope (α)	5	1	5	1
Cost of Food (F)	57	57	60	60
Cost of Clothing (C)	11	11	10	10
Cost of Shelter (S)	257	257	257	257
Total Cost of Basic Needs (F+C+S)	325	325	327	327
Pay per Hour	11.7	11.7	18.9	18.9
Min Hours (F+C+S)/Pay Rate	27.9	27.9	17.3	17.3
Optimal Hours	48.8	9.8	56.0	11.2
Max (Higher of Min or Optimal Hours)	**48.8**	**27.9**	**56.0**	**17.3**
Taxes = 30%				
Cost of Food (F)	57	57	60	60
Cost of Clothing (C)	11	11	10	10
Cost of Shelter (S)	257	257	257	257
Total Cost of Basic Needs (F+C+S)	325	325	327	327
Pay per Hour (after taxes)	8.2	8.2	13.3	13.3
Min Hours (F+C+S)/Pay Rate	39.8	39.8	24.7	24.7
Optimal Hours	34.1	6.8	39.2	7.8
Max (Higher of Min or Optimal Hours)	**39.8**	**39.8**	**39.2**	**24.7**
Change in Hours	**-8.9**	**12.0**	**-16.8**	**7.4**
Change in Min Hours	12.0	12.0	7.4	7.4
Change in Optimal Hours	-14.6	-2.9	-16.8	-3.4

Source: Own elaboration

Before taxes, subject 1 must work 27.9 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 48.8 hours, and does work 48.8 hours, the greater of 27.9 and 48.8. However, when the utility function for income is low, the subject prefers leisure and only wants to work 9.8 hours. When the utility function for income is low, the subject works 27.9 hours, the greater of 27.9 and 9.8.

After taxes of 30%, subject 1 must work 39.8 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 34.1 hours. However, when the utility function for income is low, the subject prefers leisure and only wants to work 6.8 hours. When the utility function for income is high, the subject works 39.8 hours, the greater of 39.8 and 34.1. When the utility function for income is low, the subject works 39.8 hours, the greater of 39.8 and 6.8.

The effect of taxes is to decrease the number of hours worked when the preference for income is high, and increase the number of hours worked when the preference for income is low. This is due to the decrease in after-tax wages. When the preference for income is high, the pre-tax wage is very attractive and the subject works more than the subsistence level of income to maximize their preference. When the preference for income is low, the pre-tax wage is unattractive and the subject works only enough to pay for basic needs, and spends the remainder of their time in leisure. After taxes are applied, the preference for income is still high, but the after-tax wage is not attractive and the subject works only enough to pay for their basic needs. When the preference for income is low, the after-tax wage is very unattractive and the subject works only enough to pay for basic needs.

This is a very important result, and deserves additional discussion. It seems intuitive that when the preference for income is high, taxes have a large impact and the individual works less. However, it might seem counterintuitive that when the preference for leisure is high that the individual works more after taxes. This emphasizes the impact of the subsistence level of income. Because the individual prefers leisure, their optimal number of hours is always below the number of hours of work required to pay for basic needs, both before and after taxes. Thus, the preference for income or leisure has no impact on the individual's decision-making, it is solely based on the number of hours required to pay for basic needs. Because taxes decrease net pay, the worker has to work more hours after taxes than before taxes.

Subject 2 is in a similar situation as subject 1. Before taxes, subject 2 must work 17.3 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 56.0 hours. However, when the utility function for income is low, the subject prefers leisure and only wants to work 11.2 hours. When the utility function for income is high, the subject works 56.0 hours, the greater of 17.3 and 56.0. When the utility function for income is low, the subject works 17.3 hours, the greater of 17.3 and 11.2.

After taxes of 30%, subject 2 must work 24.7 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 39.2 hours. However, when the utility function for income is low, the subject prefers leisure and only wants to work 7.8 hours. When the utility function for income is high, the subject works 39.2 hours, the greater of 24.7 and 39.2. When the utility function for income is low, the subject works 24.7 hours, the greater of 24.7 and 7.8.

The effect of taxes is to decrease the number of hours worked when the preference for income is high, and increase the number of hours worked when the preference for income is low. This is due to the decreased after-tax wages. When the preference for income is high, the pre-tax wage is very attractive and the subject works more than the subsistence level of income to maximize their preference. When the preference for income is low, the pre-tax wage is unattractive and the subject works only enough to pay for basic needs, and spends the remainder of their time in leisure. After taxes are applied, the preference for income is still high, but the after-tax wage is not attractive and the subject works only enough to pay for their basic needs. When the preference for income is low, the after-tax wage is very unattractive and the subject works only enough to pay for basic needs.

Table 3.2 Examining Subjects 3 and 4 from Scenarios 1 and 2 in the Simulation

Subject Number	**3**	**3**	**4**	**4**
Utility Random Variable	0.93	0.93	0.49	0.49
Utility Function Slope (α)	5	1	5	1
Cost of Food (F)	63	63	66	66
Cost of Clothing (C)	15	15	10	10
Cost of Shelter (S)	208	208	273	273
Total Cost of Basic Needs (F+C+S)	286	286	349	349
Pay per Hour	8.6	8.6	12.6	12.6
Min Hours (F+C+S)/Pay Rate	33.3	33.3	27.8	27.8
Optimal Hours	40.1	8.0	31.1	6.2
Max (Higher of Min or Optimal Hours)	**40.1**	**33.3**	**31.1**	**27.8**
Taxes = 30%				
Cost of Food (F)	63	63	66	66
Cost of Clothing (C)	15	15	10	10
Cost of Shelter (S)	208	208	273	273
Total Cost of Basic Needs (F+C+S)	286	286	349	349
Pay per Hour (after taxes)	6.0	6.0	8.8	8.8
Min Hours (F+C+S)/Pay Rate	47.6	47.6	39.7	39.7
Optimal Hours	28.1	5.6	21.8	4.4
Max (Higher of Min or Optimal Hours)	**47.6**	**47.6**	**39.7**	**39.7**
Change in Hours	**7.5**	**14.3**	**8.6**	**11.9**
Change in Min Hours	14.3	14.3	11.9	11.9
Change in Optimal Hours	-12.0	-2.4	-9.3	-1.9

Source: Own elaboration

As shown in Table 3.2, before taxes, subject 3 must work 33.3 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 40.1 hours. However, when the utility function for income is low, the subject prefers leisure and only wants to work 8.0 hours. When the utility function for income is high, the subject works 40.1 hours, the greater of 33.3 and 40.1. When the utility function for income is low, the subject works 33.3 hours, the greater of 33.3 and 8.0.

After taxes of 30%, subject 3 must work 47.6 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 28.1 hours. However, when the utility function for income is low, the subject prefers leisure and only wants to work 5.6 hours. When the utility function for income is high, the subject works 47.6 hours, the greater of 47.6 and 28.1. When the utility function for income is low, the subject works 47.6 hours, the greater of 47.6 and 5.6.

The effect of taxes is to increase the number of hours worked when the overall preference for income is both high and low. This is due to the subject's high individual preference for income. When the preference for income is high, the pre-tax wage is very attractive and the subject works more than the subsistence level of income to maximize their preference. When the preference for income is low, the pre-tax wage is unattractive and the subject works only enough to pay for basic needs, and spends the remainder of their time in leisure. After taxes are applied, the preference for income is still high, and the after-tax wage is not as attractive, but the subject must increase their hours to pay for their basic needs. When the preference for income is low, the after-tax wage is unattractive and the subject works only enough to pay for basic needs, which is more hours after taxes than before taxes.

As shown in Table 3.2, before taxes, subject 4 must work 27.8 hours for basic needs. When the utility function for income is high, the subject wants to work 31.1 hours. However, when the utility function for income is low, the subject prefers leisure and only wants to work 6.2 hours. When the utility function for income is high, the subject works 31.1 hours, the greater of 27.8 and 31.1. When the utility function for income is low, the subject works 27.8 hours, the greater of 27.8 and 6.2.

After taxes of 30%, subject 4 must work 39.7 hours for basic needs. When the utility function for income is high, the subject wants to work 21.8 hours. However, when the utility function for income is low, the subject prefers leisure and only wants to work 4.4 hours. When the utility function for income is high, the subject works 39.7 hours, the greater of 39.7 and 21.8. When the utility function for income is low, the subject works 39.7 hours, the greater of 39.7 and 4.4.

The effect of taxes is to increase the number of hours worked when the preference for income is both high and low. This is due to the subject's low wages. When the preference for income is high, the subject works slightly more than the subsistence level of income to maximize their preference. When the preference for income is low, the pre-tax wage is unattractive and the subject works only enough to pay for basic needs, and spends the remainder of their time in leisure. After taxes are applied, the after-tax wage is not as attractive, but the subject has to increase their hours to pay for their basic needs. When the preference for income is low, the after-tax wage is very unattractive and the subject works only enough to pay for basic needs, which is more hours after taxes than before taxes.

Unlike subjects 1 and 2, subjects 3 and 4 increase their hours after taxes irrespective of their preference for income, high or low. Because their wage is low, the determinant of their hours is primarily the cost of basic needs. Their preference for income or leisure is mostly irrelevant, because after taxes they must always work enough hours to pay for basic needs, and their optimal hours is always less than this quantity of hours.

3.1.4 Scenarios 3-4 High Wages

Scenarios 3 and 4 can be used to show how workers with high wages, well above the subsistence level of income, react to taxes. The primary difference in the theory of the Hierarchy of Pecuniary Needs is between high and low wage groups. For workers with low wages the cost to buy basic necessities such as food, clothing, and shelter, requires a substantial number of hours in the workweek, while for workers with high wages it requires a minimal number of hours. In order to demonstrate an extreme example, the simulation was changed so that the cost of basic needs was insignificant. To do this, each cost was divided by a factor that reduced the cost relative to wages. In scenarios 3 and 4, this factor was set to 100, and nothing else was changed compared to scenarios 1 and 2.

In scenario 3, workers have a high preference for leisure. As pay increases, the opportunity cost of leisure increases, so more workers forgo leisure for income. In this case, the slope of the hours/pay graph is positive (see Figure 3.8). This is true even after taxes of 30%, but the number of hours worked decreases due to the new lower cost of leisure (see Figure 3.9). Essentially every worker in the high wage scenarios decreases the number of hours worked when taxes are applied (see Figure 3.10).

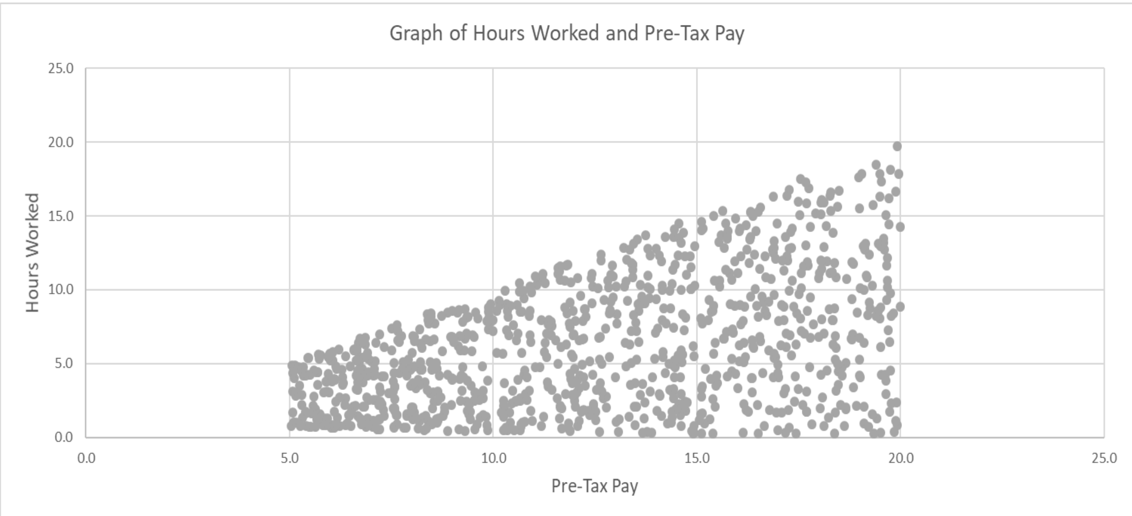


Fig. 3.8: Graph of Hours Worked and Pre-Tax Pay
Scenario 3, High Wages, Taxes = 30%,
Utility Function Value = 1 (High Preference for Leisure)

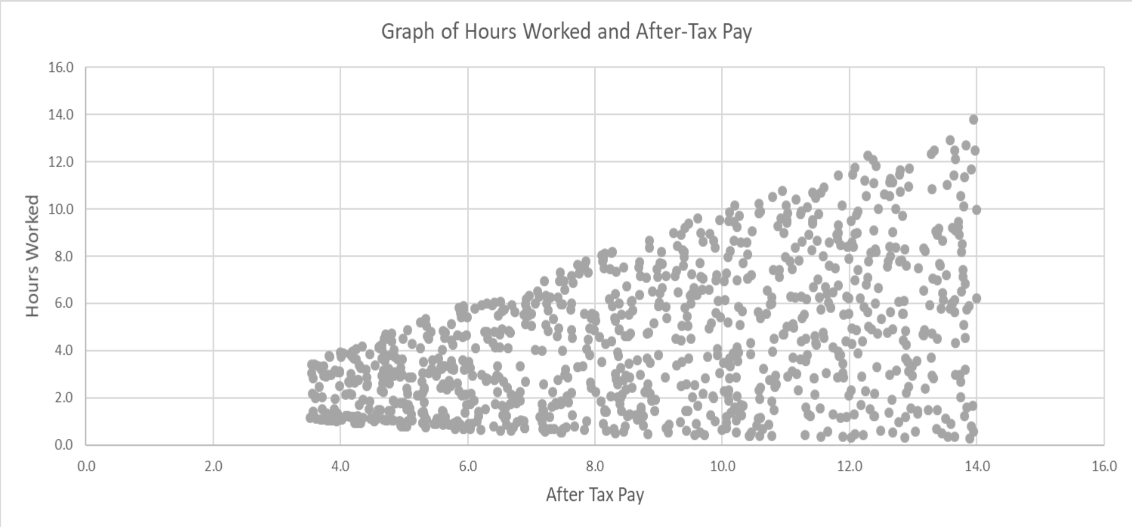


Fig. 3.9: Graph of Hours Worked and After-Tax Pay
Scenario 3, High Wages, Taxes = 30%,
Utility Function Value = 1 (High Preference for Leisure)

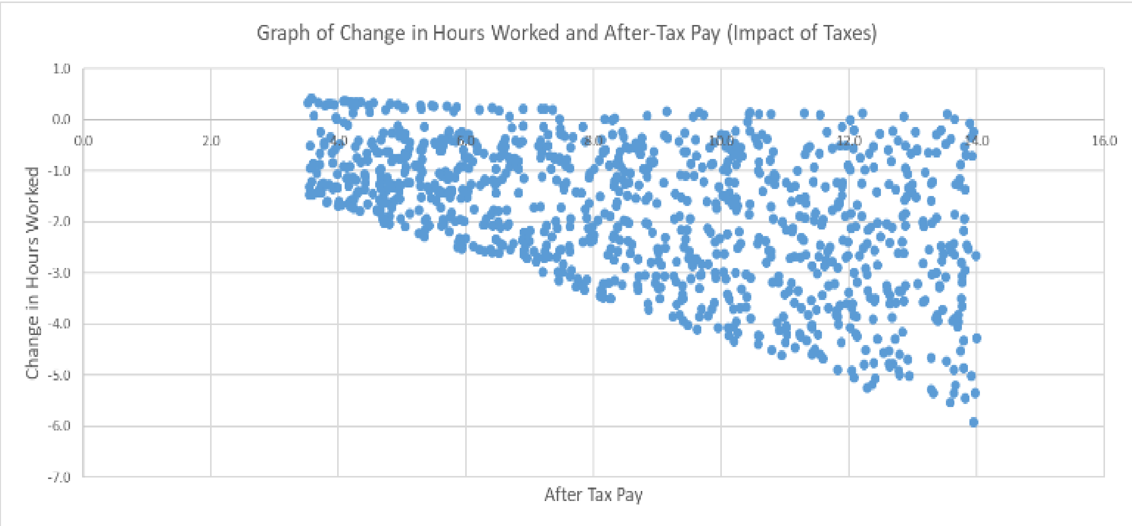


Fig. 3.10: Graph of Change in Hours Worked and After-Tax Pay
Scenario 3, High Wages, Taxes = 30%,
Utility Function Value = 1 (High Preference for Leisure)

In scenario 4, workers have a high preference for income. As pay increases, more workers forgo leisure for income, so the slope of the hours/pay graph is positive (see Figure 3.11). This is true even after taxes of 30%, but the number of hours worked decreases due to the new lower cost of leisure (see Figure 3.12). The key difference between scenario 3 and scenario 4 is the quantity of hours worked between the scenarios, not the impact of taxes. In scenario 3 workers prefer leisure, so even at the highest wages the number of hours worked is low. In scenario 4, because of the high preference for income, the total number of hours worked is much greater than in scenario 3. Correspondingly, the decrease in the number of hours worked after taxes is much greater in scenario 4 than in scenario 3 (see Figure 3.13).

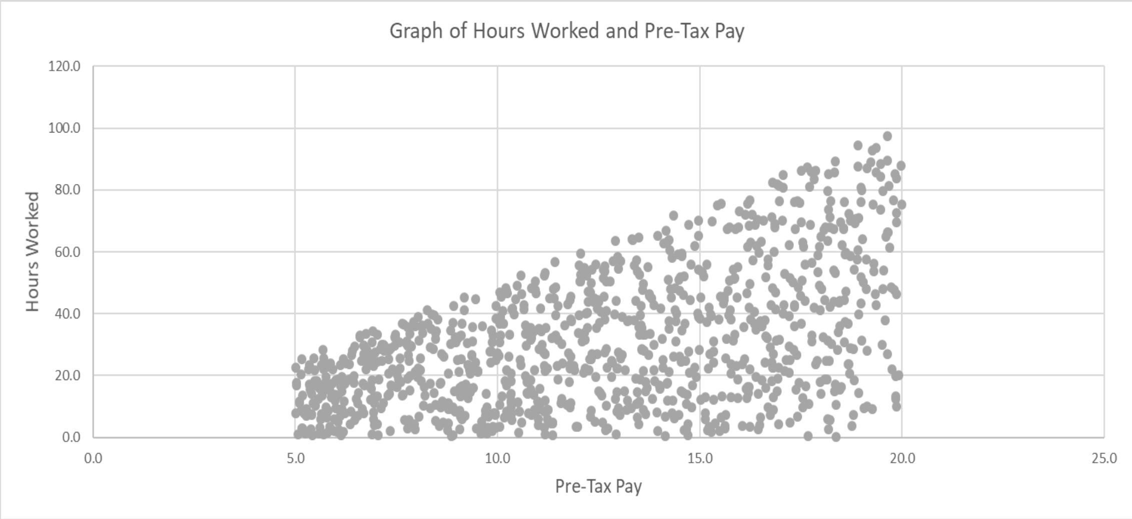


Fig. 3.11: Graph of Hours Worked and Pre-Tax Pay
Scenario 4, High Wages, Taxes = 30%,
Utility Function Value = 5 (High Preference for Income)

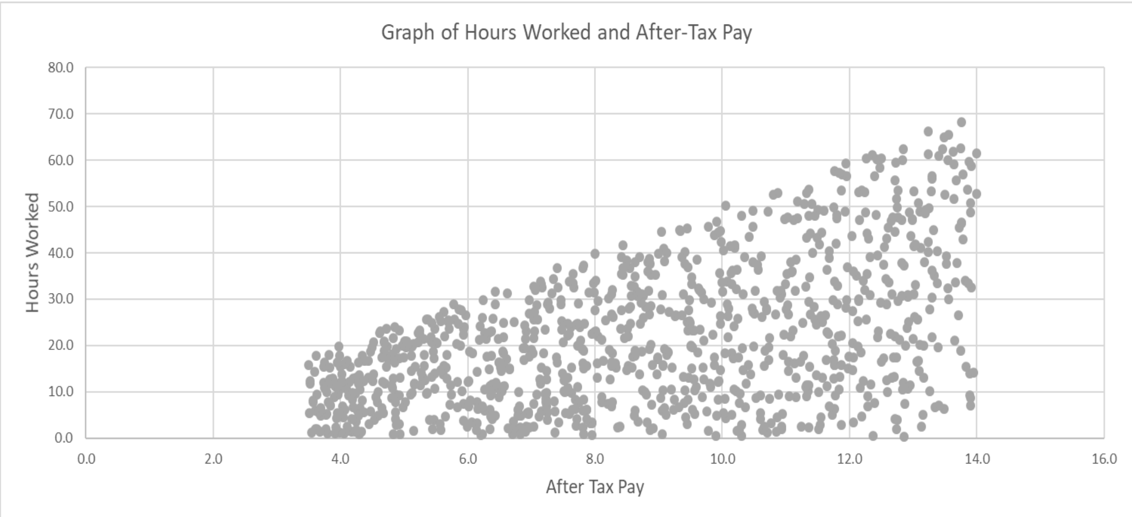


Fig. 3.12: Graph of Hours Worked and After-Tax Pay
Scenario 4, High Wages, Taxes = 30%,
Utility Function Value = 5 (High Preference for Income)

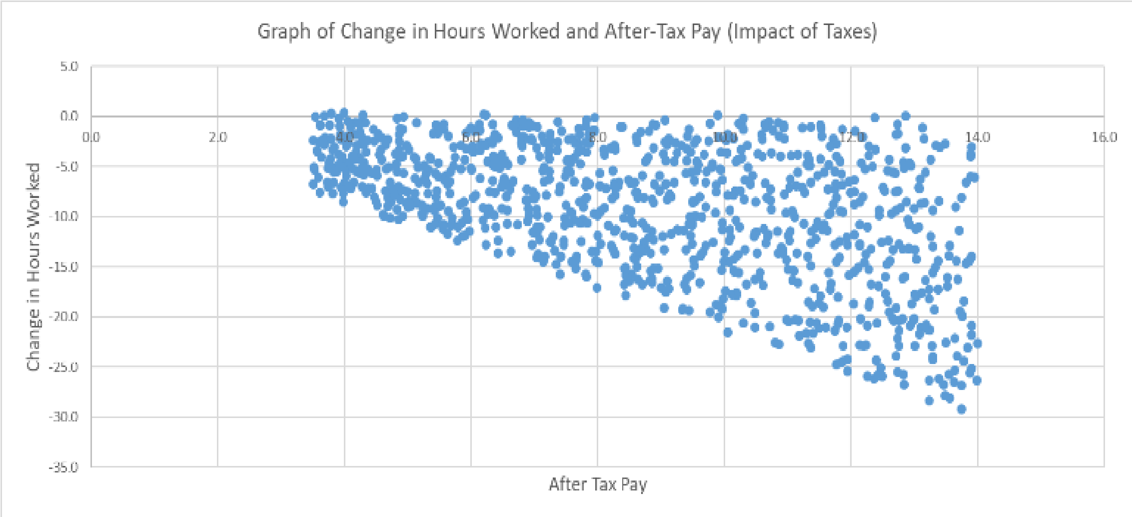


Fig. 3.13: Graph of Change in Hours Worked and After-Tax Pay Scenario 4, High Wages, Taxes = 30%, Utility Function Value = 5 (High Preference for Income)

3.1.5 Examining four individual subjects from Scenario 3 and Scenario 4.

In scenarios 3 and 4 the impact of the subsistence level of income is negligible. Workers' decisions to increase or decrease their hours are primarily based on their preference for income or leisure, because they are well above the subsistence level of income both before taxes and after taxes. A way to show this in more detail is to examine four individual subjects from Scenarios 3 and 4 (see Table 3.3 and Table 3.4).

Table 3.3 Examining Subjects 1 and 2 from Scenarios 3 and 4 in the Simulation

Subject Number	**1**	**1**	**2**	**2**
Utility Random Variable	0.30	0.30	0.16	0.16
Utility Function Slope (α)	5	1	5	1
Cost of Food (F)	0.55	0.55	0.57	0.57
Cost of Clothing (C)	0.17	0.17	0.11	0.11
Cost of Shelter (S)	2.55	2.55	2.99	2.99
Total Cost of Basic Needs (F+C+S)	3.27	3.27	3.67	3.67
Pay per Hour	16.64	16.64	9.29	9.29
Min Hours (F+C+S)/Pay Rate	0.20	0.20	0.40	0.40
Optimal Hours	24.64	4.93	7.42	1.48
Max (Higher of Min or Optimal Hours)	**24.64**	**4.93**	**7.42**	**1.48**
Taxes = 30%				
Cost of Food (F)	0.55	0.55	0.57	0.57
Cost of Clothing (C)	0.17	0.17	0.11	0.11
Cost of Shelter (S)	2.55	2.55	2.99	2.99
Total Cost of Basic Needs (F+C+S)	3.27	3.27	3.67	3.67
Pay per Hour (after taxes)	11.65	11.65	6.50	6.50
Min Hours (F+C+S)/Pay Rate	0.28	0.28	0.56	0.56
Optimal Hours	17.25	3.45	5.19	1.04
Max (Higher of Min or Optimal Hours)	**17.25**	**3.45**	**5.19**	**1.04**
Change in Hours	**-7.39**	**-1.48**	**-2.22**	**-0.44**
Change in Min Hours	0.08	0.08	0.17	0.17
Change in Optimal Hours	-7.39	-1.48	-2.22	-0.44

Source: Own elaboration

As shown in Table 3.3, before taxes, subject 1 must work .20 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 24.64 hours, and does work 24.64 hours, the greater of .20 and 24.64. When the utility function for income is low, the subject prefers leisure and only wants to work 4.93 hours. Therefore, when the utility function for income is low, the subject works 4.93 hours, the greater of .20 and 4.93. After taxes of 30%, subject 1 must work .28 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 17.25 hours, and does work 17.25 hours, the greater of .28 and 17.25. When the utility function for income is low, the subject prefers leisure and only wants to work 3.45 hours. Therefore, when the utility function for income is low, the subject works 3.45 hours, the greater of .28 and 3.45.

Before taxes, subject 2 must work .40 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 7.42 hours, and does work 7.42 hours, the greater of .40 and 7.42. When the utility function for income is low, the subject prefers leisure and only wants to work 1.48 hours. Therefore, when the utility function for income is low, the subject works 1.48 hours, the greater of .40 and 1.48. After taxes of 30%, subject 1 must work .56 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 5.19 hours, and does work 5.19 hours, the greater of .56 and 5.19. When the utility function for income is low, the subject prefers leisure and only wants to work 1.04 hours. Therefore, when the utility function for income is low, the subject works 1.04 hours, the greater of .56 and 1.04.

Table 3.4 Examining Subjects 3 and 4 from Scenarios 3 and 4 in the Simulation

Subject Number	**3**	**3**	**4**	**4**
Utility Random Variable	0.84	0.84	0.95	0.95
Utility Function Slope (α)	5	1	5	1
Cost of Food (F)	0.52	0.52	0.72	0.72
Cost of Clothing (C)	0.10	0.10	0.10	0.10
Cost of Shelter (S)	2.38	2.38	2.62	2.62
Total Cost of Basic Needs (F+C+S)	3.00	3.00	3.44	3.44
Pay per Hour	8.86	8.86	10.36	10.36
Min Hours (F+C+S)/Pay Rate	0.34	0.34	0.33	0.33
Optimal Hours	37.06	7.41	49.31	9.86
Max (Higher of Min or Optimal Hours)	**37.06**	**7.41**	**49.31**	**9.86**
Taxes = 30%				
Cost of Food (F)	0.52	0.52	0.72	0.72
Cost of Clothing (C)	0.10	0.10	0.10	0.10
Cost of Shelter (S)	2.38	2.38	2.62	2.62
Total Cost of Basic Needs (F+C+S)	3.00	3.00	3.44	3.44
Pay per Hour (after taxes)	6.20	6.20	7.25	7.25
Min Hours (F+C+S)/Pay Rate	0.48	0.48	0.47	0.47
Optimal Hours	25.94	5.19	34.52	6.90
Max (Higher of Min or Optimal Hours)	**25.94**	**5.19**	**34.52**	**6.90**
Change in Hours	**-11.12**	**-2.22**	**-14.79**	**-2.96**
Change in Min Hours	0.15	0.15	0.14	0.14
Change in Optimal Hours	-11.12	-2.22	-14.79	-2.96

Source: Own elaboration

As shown in Table 3.4, before taxes, subject 3 must work .40 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 37.06 hours, and does work 37.06 hours, the greater of .40 and 37.06. When the utility function for income is low, the subject prefers leisure and only wants to work 7.41 hours. Therefore, when the utility function for income is low, the subject works 7.41 hours, the greater of .40 and 7.41. After taxes of 30%, subject 1 must work .48 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 25.94 hours, and does work 25.94 hours, the greater of .48 and 25.94. When the utility function for income is low, the subject prefers leisure and only wants to work 5.19 hours. Therefore, when the utility function for income is low, the subject works 5.19 hours, the greater of .48 and 5.19.

Before taxes, subject 4 must work .33 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 49.31 hours, and does work 49.31 hours, the greater of .33 and 49.31. When the utility function for income is low, the subject prefers leisure and only wants to work 9.86 hours. Therefore, when the utility function for income is low, the subject works 9.86 hours, the greater of .33 and 9.86. After taxes of 30%, subject 1 must work .47 hours to pay for basic needs. When the utility function for income is high, the subject wants to work 34.52 hours, and does work 34.52 hours, the greater of .47 and 34.52. When the utility function for income is low, the subject prefers leisure and only wants to work 6.90 hours. Therefore, when the utility function for income is low, the subject works 6.90 hours, the greater of .47 and 6.90.

In the scenarios with high wages, the effect of taxes is to decrease the number of hours worked. This is due to the decrease in after-tax wages. After taxes are applied, the preference for income is still high, but the after-tax wage is not as attractive and the subject works less, due to the low cost of leisure.

A thorough review of the literature reveals that little is known about the effect of tax rate changes on labourers' motivation to work at different wage rates. This research tries to remove some of this ambiguity. The predictions are grounded in the simulation model and extend it to test how workers change their hours worked in response to tax rate changes. Very simply, the reaction is primarily dependent upon worker's wages, high or low. This leads to a curvilinear function, convex to the origin, with after-tax wages on the x-axis and change in hours supplied on the y-axis. This curvilinear relation is due to the difference in slopes that low and high income workers have in the relation between taxes and hours worked. As shown in the simulation, the cost of basic needs plays a key factor in determining the number of hours worked at low wages, where workers have income that is close to the subsistence level. The cost of basic needs plays a negligible role at high wage rates, where workers have income that is well above the subsistence level. Except for when wages are extremely low, motivation to work increases with wages, but at a diminishing rate. This is because the utility of a dollar earned decreases when wages are very high. That is why both theories (economic and psychological) are appealing in determining the differences of the motivation to work between labourers at different wage rates. Building this new behavioural theory on the psychology of taxation shows an alternative view to the economists' traditional income and substitution effects.

3.2 Differing Utility of Leisure

Imagine it is your day off. You wake up early, enjoy a leisurely breakfast of eggs, toast, and coffee, sitting outside on your patio enjoying the sunshine and listening to the birds sing. After breakfast, you get in your car and drive to the beach for the day, or for a hike in the mountains. You have a picnic lunch with wine and cheese, and then dinner at a white tablecloth restaurant with fresh food imported from around the world.

Alternatively, imagine it is your day off, but from a different perspective. You wake up early to the sounds of your neighbours screaming and dogs barking. Breakfast is cold cereal eaten standing at the sink looking out the window at the wall of the building next door. You walk to the nearest park, overgrown with weeds, and homeless people sleeping in the protected areas around the trees. The noise of traffic and airplanes overhead makes it hard to relax. For lunch you grab a fast-food hamburger and eat it next to a table of rowdy teenagers. Dinner is pizza in front of the television.

In each scenario above, the quantity of leisure time both individuals take is the same. However, one could argue that the individual in the first scenario received greater utility from their day of leisure than the individual in the second scenario. This is the advantage that wealth provides, an increased utility from leisure, and therefore a higher preference for leisure. If the utility from leisure is low for a worker with low wages, then they might prefer work more than someone with a much higher wage, despite the traditional measure of the "cost" of leisure as being the opportunity cost, which is equal to the net wage. This effect is previously untested in the literature, and can be demonstrated with the simulation presented earlier.

In order to demonstrate this effect, a change was made to the simulation, where the likelihood of a preference for income or leisure is correlated with the workers' wages. Utility is still randomly determined, but the higher a worker's wage, the more likely it is that the utility for leisure will be high. This reflects the larger opportunity set for leisure that high-wage earners enjoy compared to low wage earners. The impact of this change on the graphs presented earlier is interesting.

3.2.1 Scenarios 5-6 Low Wages

First, consider scenarios 5 and 6, workers with low wages, where the subsistence level of income sets a minimum number of hours that workers must work in order to survive. This is similar to scenarios 1 and 2 presented previously, except the preference for work/leisure is changed. In scenario 5, the overall preference for work/leisure, the utility function value, is set to $\alpha = 2.5$, the middle value. In scenario 5 all but the highest wage earners with a high utility for leisure increase their hours when taxes are introduced. This is because most workers are working just enough hours to pay for basic needs, and when taxes reduce net wages they must increase their hours (see Figure 3.14, Figure 3.15, and Figure

3.16).

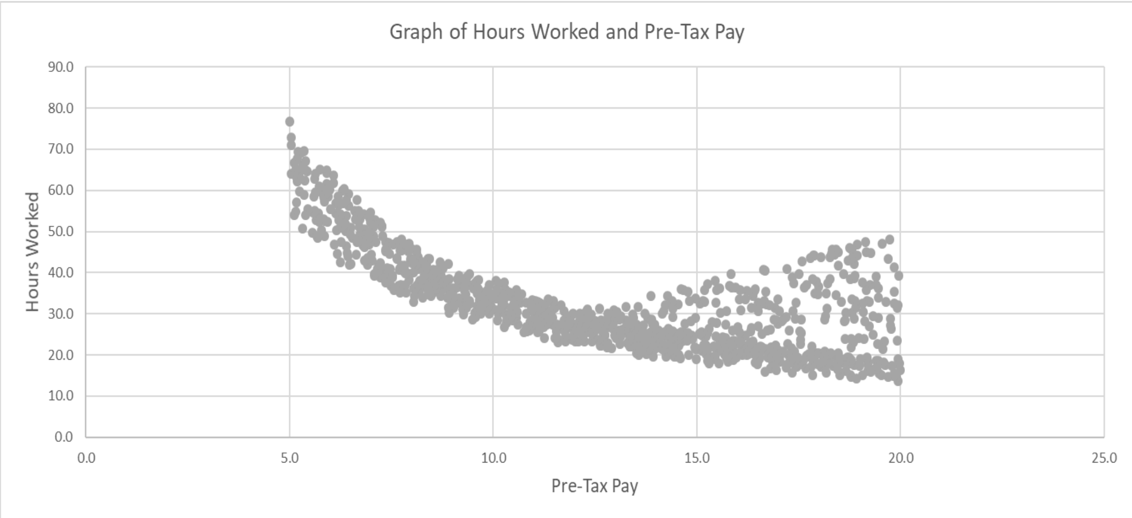


Fig. 3.14: Graph of Hours Worked and Pre-Tax Pay
Scenario 5, Low Wages, Taxes = 30%,
Utility Function Value = 2.5

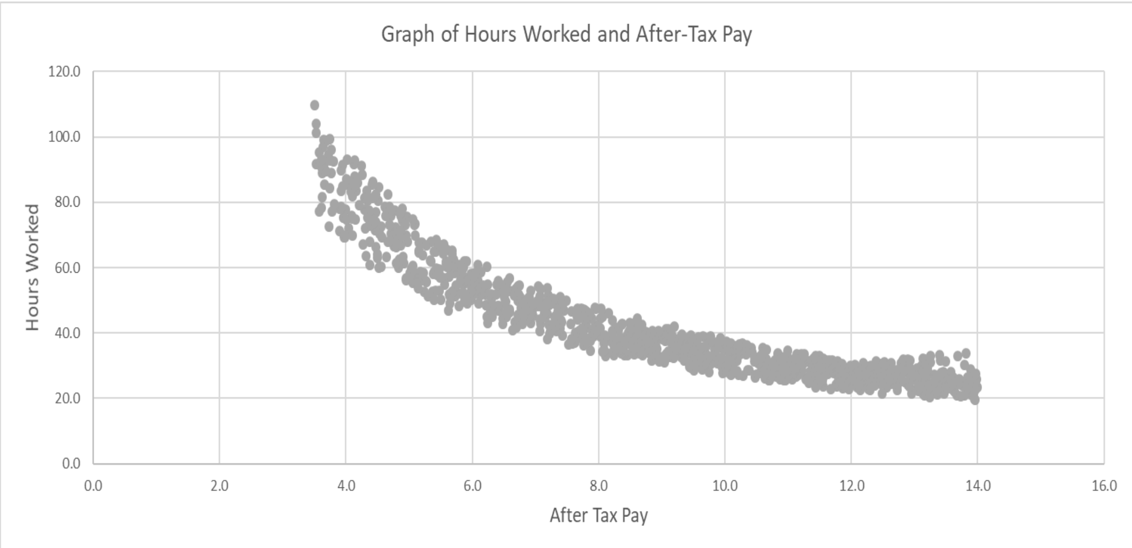


Fig. 3.15: Graph of Hours Worked and After-Tax Pay
Scenario 5, Low Wages, Taxes = 30%,
Utility Function Value = 2.5

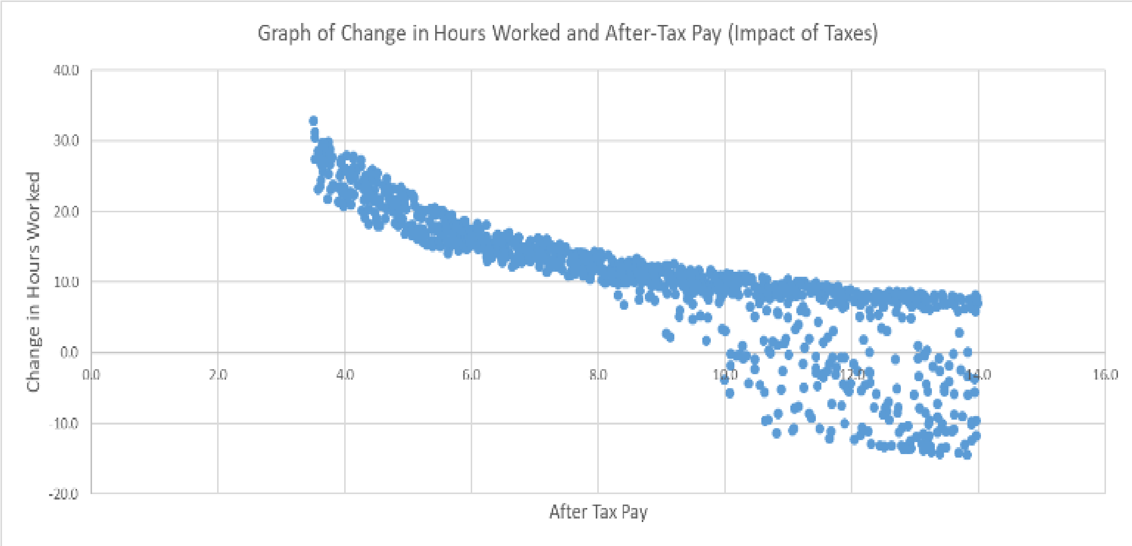


Fig. 3.16: Graph of Change in Hours Worked and After-Tax Pay
Scenario 5, Low Wages, Taxes = 30%,
Utility Function Value = 2.5

In scenario 6, the simulation is changed, and the utility for leisure is not set by random variance around the overall preference for work/leisure, but is correlated with the workers' wages. This reflects that as wages increase, the opportunity set for leisure activities increases, which increases the utility of an hour of leisure. The change in the graphs in scenario 6 before and after taxes is minimal. Almost all workers increase their hours after taxes, both to pay for basic needs and because of the low utility for leisure at low wage rates (see Figure 3.17, Figure 3.18, and Figure 3.19).

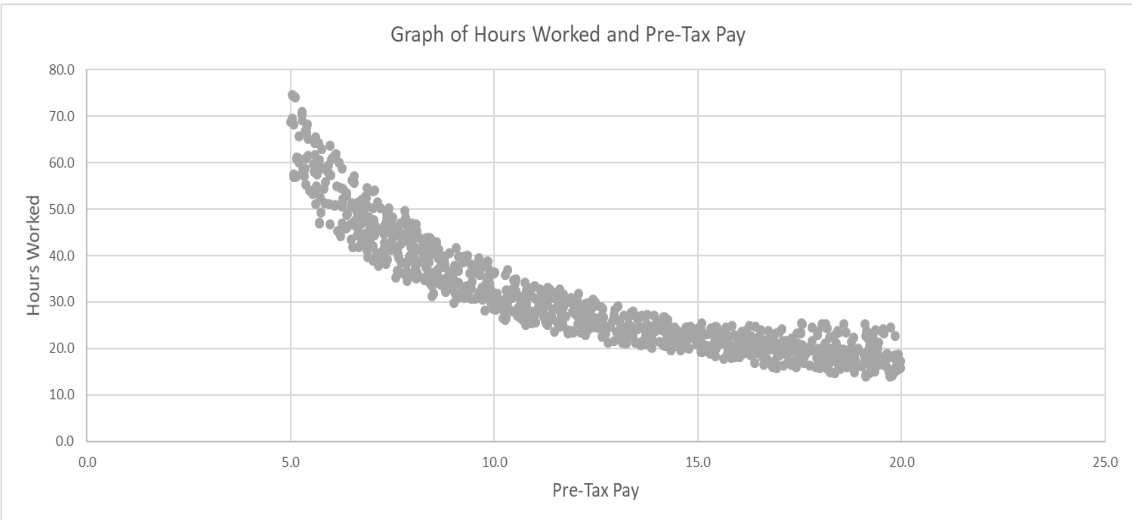


Fig. 3.17: Graph of Hours Worked and Pre-Tax Pay
Scenario 6, Low Wages, Taxes = 30%,
Utility Function Value Correlated with Income (Increased Preference for Leisure with Increased Income)

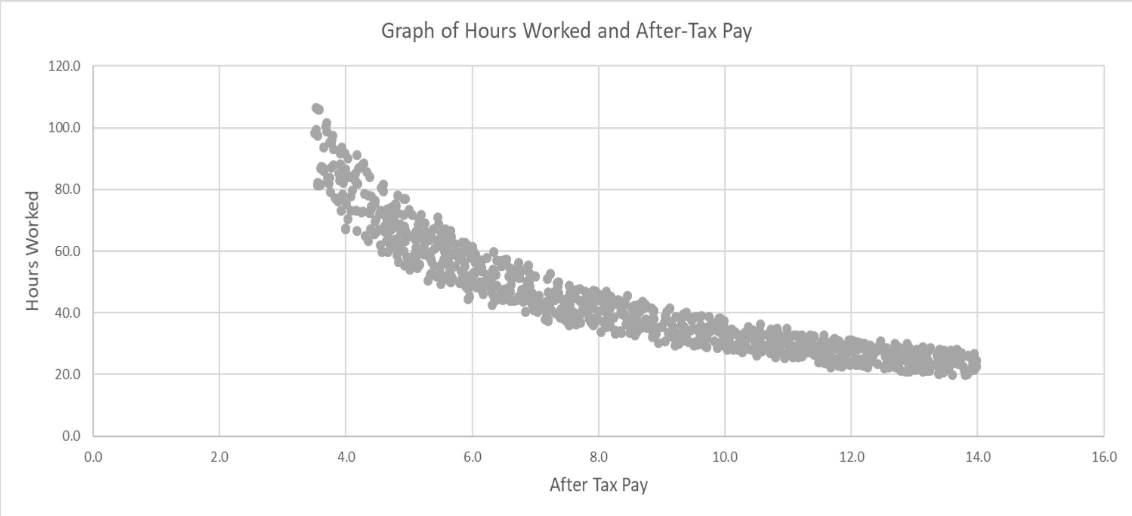


Fig. 3.18: Graph of Hours Worked and After-Tax Pay
Scenario 6, Low Wages, Taxes = 30%,
Utility Function Value Correlated with Income (Increased Preference for Leisure with Increased Income)

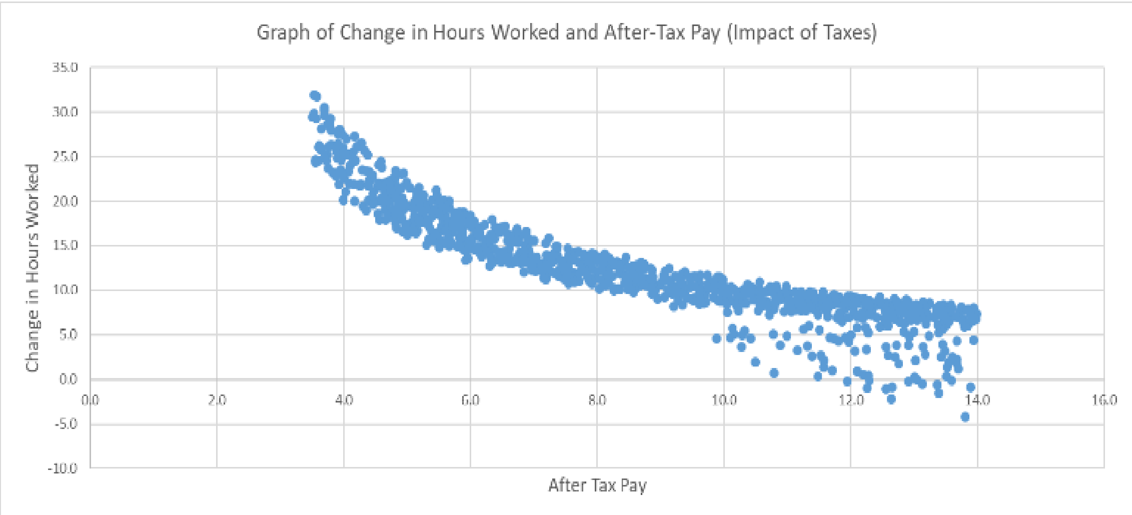


Fig. 3.19: Graph of Change in Hours Worked and After-Tax Pay
Scenario 6, Low Wages, Taxes = 30%,
Utility Function Value Correlated with Income (Increased Preference for Leisure with Increased Income)

3.2.2 Scenarios 7-8 High Wages

Scenarios 7 and 8 compare a similar situation as the low wage scenarios 5 and 6, except for workers with high wages. For these workers, the subsistence level of income is not a factor. In scenario 7, the overall preference for work/leisure, the utility function value, is set to $\alpha = 2.5$, the middle value. In scenario 7 almost all workers decrease their hours after taxes are imposed. This is because after taxes, the cost of leisure has decreased (see Figure 3.20, Figure 3.21, and Figure 3.22).

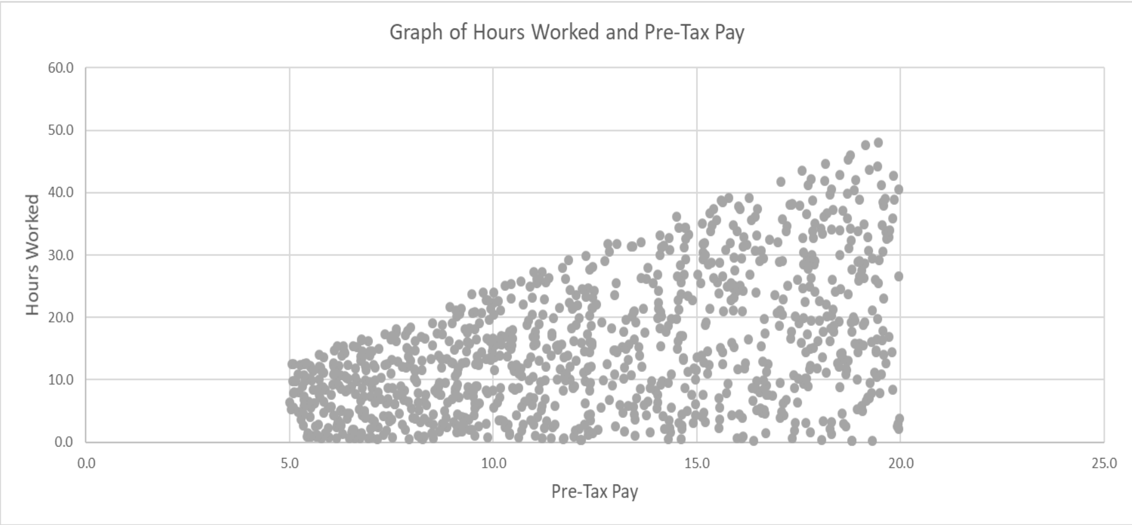


Fig. 3.20: Graph of Hours Worked and Pre-Tax Pay
Scenario 7, High Wages, Taxes = 30%,
Utility Function Value = 2.5

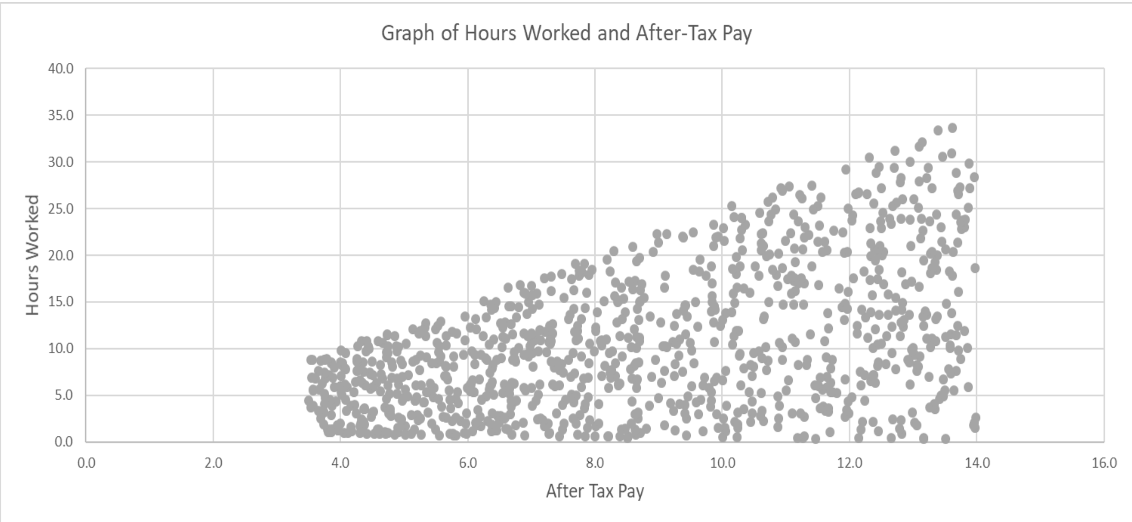


Fig. 3.21: Graph of Hours Worked and After-Tax Pay
Scenario 7, High Wages, Taxes = 30%,
Utility Function Value = 2.5

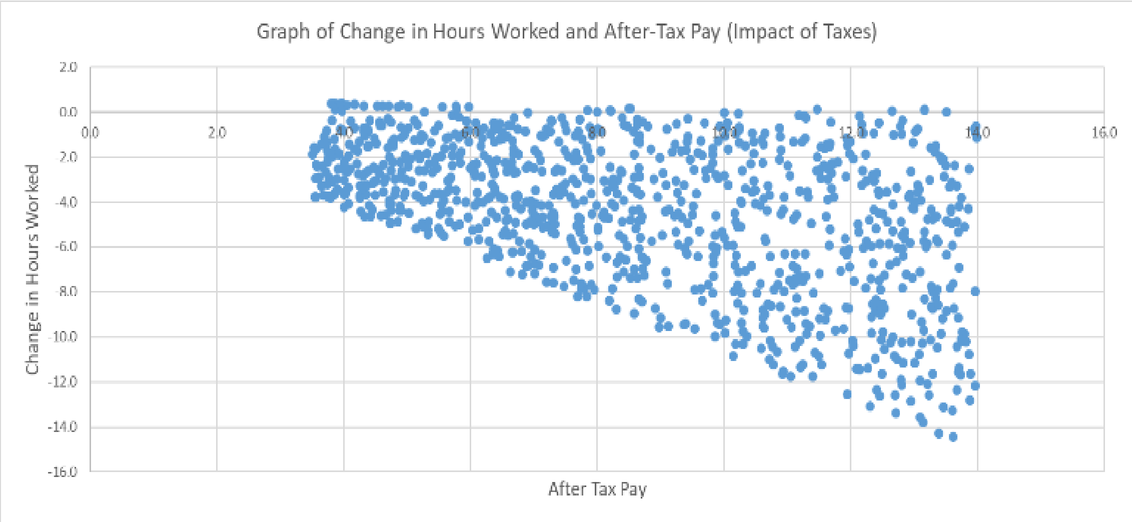


Fig. 3.22: Graph of Change in Hours Worked and After-Tax Pay Scenario 7, High Wages, Taxes = 30%, Utility Function Value = 2.5

In scenario 8, the simulation is changed as it was in scenario 6, and the utility for leisure is not purely random, but is correlated with the workers' wages. This reflects that as wages increase, the opportunity set for leisure activities increases, which increases the utility of an hour of leisure. Scenario 8 is where the largest impact of the change in the simulation can be seen. On average, as wages increase, so does the utility for leisure. This has an interesting effect. Because the utility for leisure is low for the lowest paid workers, no one works the minimum number of hours necessary to pay for basic needs (near zero in some cases). All of the lowest paid workers choose work over leisure due to the low utility for leisure when wages are low. As wages increase the number of hours worked increases initially, but then starts to decrease. The initial increase is due to the increased opportunity cost of leisure, as measured by the pay rate. However, as wages increase, so does the utility for leisure. The highest wage earners have the highest utility for leisure, and begin to forgo work for leisure even as wages increase. This leads to an inverted U shape, a concave function between pay and hours worked.

As shown in scenario 8, after taxes are introduced all workers decrease their hours. However, unlike in scenario 7, the function is not linear with respect to wages, but has more of a U shape. The lowest wage earners all decrease their wages a similar amount, but the variance is large for the highest wage earners. This is due to competing effects. First, the cost of leisure has decreased, encouraging workers to forgo work for leisure. However, the second effect is in the opposite direction. Leisure now has a lower utility because of lower wages, which give workers a smaller opportunity set of leisure activities, encouraging workers to forgo leisure for work (see Figure 3.23, Figure 3.24, and Figure 3.25).

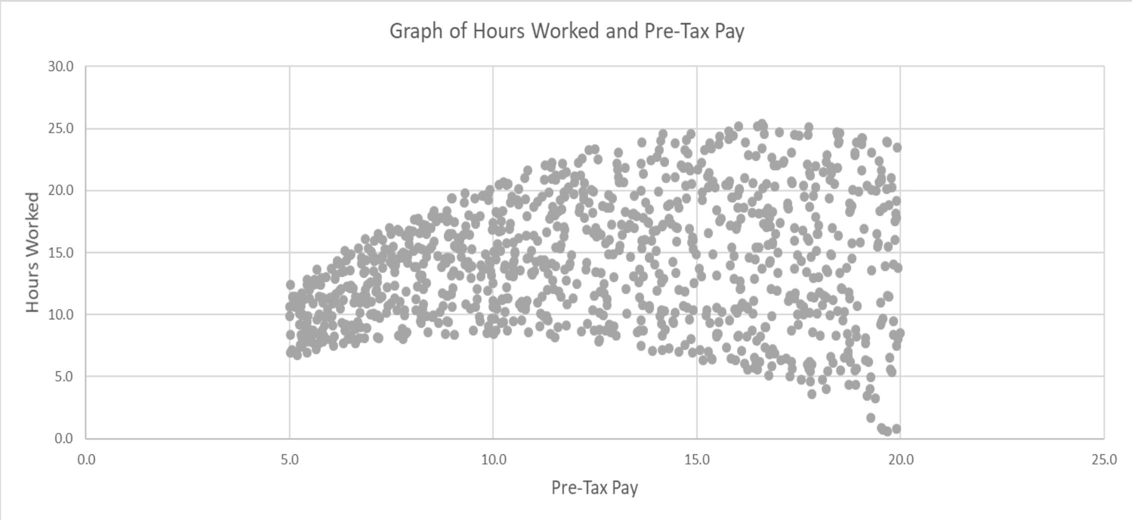


Fig. 3.23: Graph of Hours Worked and Pre-Tax Pay
Scenario 8, High Wages, Taxes = 30%,
Utility Function Value Correlated with Income (Increased Preference for Leisure with Increased Income)

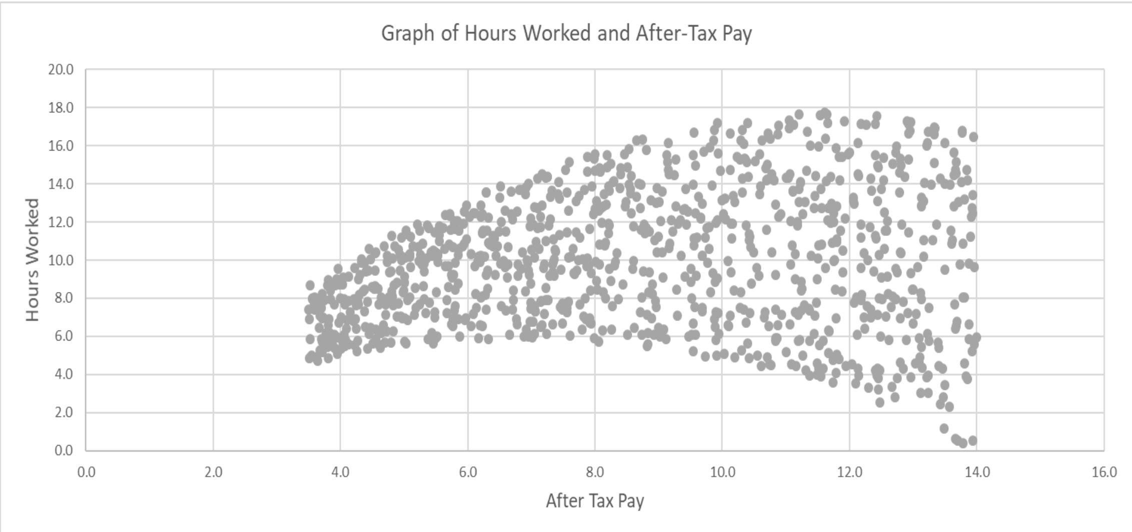


Fig. 3.24: Graph of Hours Worked and After-Tax Pay
Scenario 8, High Wages, Taxes = 30%,
Utility Function Value Correlated with Income (Increased Preference for Leisure with Increased Income)

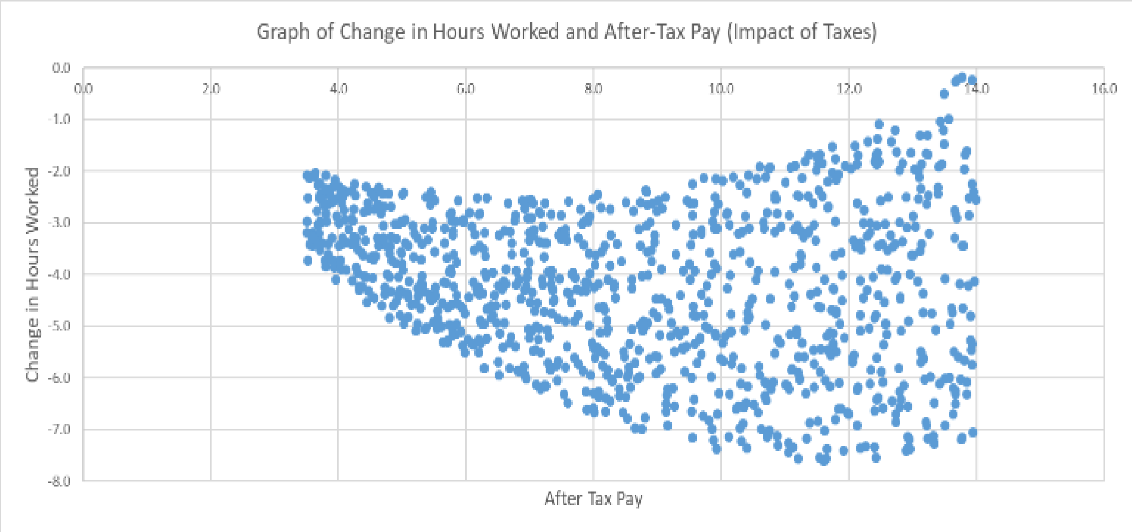


Fig. 3.25: Graph of Change in Hours Worked and After-Tax Pay
Scenario 8, High Wages, Taxes = 30%,
Utility Function Value Correlated with Income (Increased Preference for Leisure with Increased Income)

3.2.3 Hypothesis Development

The Differing Utility of Leisure makes similar predictions as the Hierarchy of Pecuniary Needs. However, where the Hierarchy of Pecuniary Needs requires some workers to have low wages for the slope between changes in taxes and changes in hours to vary between workers with different wages, the Differing Utility of Leisure predicts that even if all workers are above the subsistence level of income, the slope between changes in taxes and changes in hours will vary between workers with different wages.

The key question for reference-dependent preferences is, what determines the reference point? Kirchler et al. (2009) point out that taxpayers could adopt different reference points to assess their decision outcomes. The new behavioural theories presented here (Hierarchy of Pecuniary Needs and Differing Utility of Leisure) explain how the process works. It can be seen from the scenarios for low and high wages that there are no stable patterns for all scenarios. The explanation for the changing patterns for low wage groups and high wage groups is associated with individual's preferences for leisure. At low wages the preference is almost irrelevant to the decision to work more or less, because workers must work more to maintain a subsistence level of income. At higher wages the individual's preference for leisure is important in the decision to work more or less, but it varies with wages. The scenarios from the simulation contribute to the literature by combining explicit reference points (the Hierarchy of Pecuniary Needs) with a utility function that varies with wages (Differing Utility of Leisure) to predict inflection points and downward/upward slopes in the relationship between after-tax pay (the impact of taxes) and the motivation to work.

The problems of neoclassical theories of labour supply are not only mentioned within the subjective well-being and reference-dependent preferences literature, but also in cross-country research of taxes and labour supply. For instance, the simulation model can also answer the question raised from Blanchard (2004) regarding what causes the changes in the labour/leisure trade-off, is it "preferences" or "distortions"? Blanchard (2004) defines "preference" as a choice of choosing leisure over income as productivity increases, and defines "distortions" as higher taxes on work, an increase in the minimum wage, or forced early retirement programs. Again, the Hierarchy of Pecuniary Needs and Differing Utility of Leisure theories apply here. Because while the Hierarchy of Pecuniary Needs includes one of these distortions (especially, taxes on work), the Differing Utility of Leisure contains "preferences". Following from the above discussions, it is hypothesized that:

Hypothesis: *The relationship between income taxes and the motivation to work varies between income levels. When wages are low, hours increase as income taxes increase, and when wages are high, hours decrease as income taxes increase.*

4. METHODOLOGY AND DATA

4.1 METHODOLOGY

4.1.1 Model specification

To study the relationship between income taxes and the motivation to work requires a model with change in hours worked as the dependent variable and changes in tax rates as the independent variable. Because the theory predicts that the reaction will differ between high and low income groups, a between-country design is used. Countries will be split into high and low groups based on the average income in the countries. This split will be represented in the model as a dummy variable, with the hypothesis test being the interaction between the change in tax rates and the dummy variable. Letting *t* index time (years) and *i* index countries, the baseline model estimated is based on the following equation by first differencing:

$$\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \beta_3 LHD + \beta_4 \Delta TAXES_{it} * LHD + \varepsilon_{it} \quad (4.1)$$

Where $\Delta HOURS_{it}$ is the changes in hours worked; $\beta_0$is the intercept for time periods; $\Delta TAXES_{it}$is the changes in income tax rate; $\Delta INCOME_{it}$ is the changes in average income; *LHD* is a dummy variable coded "1" if the average income is above the median and coded "0" if the average income is below the median; and $\Delta TAXES_{it} \times LHD$ is an interaction term.

To test the hypotheses regarding the relationship between income taxes and the motivation to work using a between-country design, the regression analysis used is based on first difference methodology with time effects (including year dummies) and standard errors clustered by country. All regressions are robust to heteroscedasticity, autocorrelation, and cross-sectional dependence. In the dataset, T=60 and N=15, therefore dummy variables for each time period will be suppressed. The methodology applied to the current analysis is appropriate for natural experiments of exogenous events such as changing taxes or other government policies, and changes in the environment such as individuals, families, firms, or cities (Wooldridge, 2015). Triest (1998) notes that research on the behavioural effects of taxation need to find a way to distinguish the effect of tax changes from other changes in the economic environment that coincide with tax changes.

4.2 Data

This section presents the data used in the empirical tests for hours worked, average income, and income tax rates, as well as other control variables across countries. The dependent variable in the models is the motivation to work, measured by the number of hours worked. The key explanatory variables are average income and tax rates. Control variables used in the models are employment protection, net union density, benefit replacement rate, benefit duration, output gap, government consumption, product market regulation, consumption tax rates, and capital tax rates.

The data necessary for these variables comes from a variety of sources, as outlined below. Many of them are available for long periods and several countries. However, a few variables constrain the number of years and number of countries used. Most of the control variables are available beginning in 1960, so this is the first year used in the empirical tests. Tax rates estimated by several researchers were considered for use in the analysis. The tax rates calculated by McDaniel (2007, 2017) provide the longest time series, beginning in 1950, whereas those calculated by Mendoza et al. (1994) begin in 1965 and the rates calculated by Martinez-Mongay (2000) begin in 1970. Because the McDaniel tax rates are available in 1960, matching the control variables, they were selected for use in the analysis. The McDaniel tax rates also have the advantage of being available for 15 countries (see Table 4.1 for a list of countries), whereas the rates from Mendoza et al. (1994) are only available from seven countries, and the Martinez-Mongay (2000) tax rates are only available from 12 countries. Therefore, the dataset used to examine the relationship between income taxes and the motivation to work consists of a sample that includes 15 OECD countries, for the period from 1960 to 2010.

Table 4.1 Countries included in the analysis

Australia	France	Spain
Austria	Germany	Sweden
Belgium	Italy	Switzerland
Canada	Japan	United Kingdom
Finland	Netherlands	United States

Source: Own elaboration

The dependent variable used in all regression models is the average annual hours worked. The hours worked data are taken from independent and publicly available sources. The data sources are The Conference Board Total Economy Database, Labor Market Institutions Database, OECD Labour Statistics Database, World and Wealth Income Database, DICE Database, Groningen Growth, and World Bank online database.

4.2.1 Motivation to work

Prior studies divide the motivation to work between extensive and intensive margins (Heckman, 1993; Immervoll and Barber, 2005; Faggio and Nickell, 2007; Causa, 2009). This distinction has long been recognized in the labour supply literature, and it is very important for the design of any income-tax system (Christl et al., 2017). The extensive margin considers how many people work in an economy, the participation rates to work or not to work. The intensive margin refers to the way in which workers allocate their time between paid work, unpaid or home work, and leisure. The difference between extensive and intensive margins can be thought of simply as the first choice a worker makes, to work or not to work, and the second choice, how much to work.

In the empirical tests, the motivation to work is measured along the intensive margin. The motivation to work is measured as the average annual hours worked per worker. For all 15 countries this data comes from The Conference Board Total Economy Database (hereafter TED), May 2017. The estimation of working hours involves serious measurement and international comparability problems (Ypma and Van Ark, 2006; Bick, Brüggemann and Fuchs-Schündeln, 2016). This is compounded by the fact that there are two databases of working hours to choose from, each with a different measurement method. While the first choice is labour force survey based estimates, the second one is national accounts based estimates. Some scholarly papers prefer to use labour force survey based estimates (Bick, Brüggemann and Fuchs-Schündeln, 2016; Bick, Fuchs-Schündeln and Lagakos, 2018). Labour force survey based estimates can be good from a socio-economic perspective, but they are not good from productivity analysis perspective (De Vries and Erumban, 2017). The advantage of the labour force survey based estimates from a socio-economic perspective is due to the existence of an age threshold. However, this is not common for national accounts based estimates because it incorporates everyone included in the nation's GDP (De Vries and Erumban, 2017). The advantage of the national accounts based estimates of working hours is that it is harmonious with other indicators derived from national accounts (De Vries and Erumban, 2017). This assures that output measures are consistent with working hours. Therefore, the measure of working hours used in the empirical tests come from TED, due to the preference for national accounts based estimates. In addition, the hours worked from TED are good for international comparison because the series are adjusted to consider most sources of between-country variation in hours worked such as contracted length of the workweek, statutory holidays, paid vacation and sick days, and days lost due to strikes (Ohanian and Raffo, 2012). Interpolation was not required in the TED data, as there are no missing values.

4.2.2 Average income

In standard economic theory, economists start with a simple static scenario to test the effect of income taxes on the motivation to work (Manski, 2014). It means that any deduction in average income after imposition of a proportional tax rate can show us the response of the motivation to work to the income tax rate. The average income plays an important role in explaining the monotonic and non-monotonic relationship with the motivation to work. For all 15 countries, average income comes from the World and Wealth Income Database (hereafter WID) (2017). In some countries, average income for the entire population data is consistent with the macroeconomic national accounts. Based on the national accounts concept, WID adjusted new aggregate national income, which helps to show the internationally comparable series of income, independent from the fiscal legislation of the given country/year (Blanchet and Chancel, 2016). The data has no missing values, and therefore interpolation was not required.

Alvaredo et al. (2017) mention three different income concepts, such as "taxable income" (post-deductions income), "fiscal income" (pre-deductions income), and "national income." Despite "fiscal income" being broader and more homogenous than "taxable income," it is not broad enough and not homogenous over time and across countries (Alvaredo et al, 2017). The main problem with the "fiscal income" and "taxable income" concepts is that they are not defined in the same manner for all countries and for all years. Alvaredo et al. (2017) note that although the "national income" concept they provide is not perfectly satisfactory, their aim is to estimate income concepts that are independent from the tax system and legislation of the given country/year. For this reason, "national income" is used in the empirical tests.

There are two methods to convert national currency of economic indicators into a common currency, exchange rate conversion, and purchasing power parities (PPPs). Exchange rate conversation is considered inadequate because of inefficiency in reflecting purchasing power differences across countries (De Vries and Erumban, 2017). PPPs are important to understand the market size or real standards of living of a country. Therefore, PPPs are considered as better at capturing the 'true' value of what products and services a dollar can buy in a country (De Vries and Erumban, 2017). WID convert the local currencies into a common currency by using both methods (Blanchet and Chancel, 2016). In the empirical tests, the common currency values computed by PPPs are employed because of the aforementioned advantages of PPPs over exchange rate conversion. The measure of average national income is depicted below:

$$Natinal\ income = Gross\ domestic\ product - Fixed\ capital + \\ +Net\ foreign\ income \tag{4.2}$$

Where gross domestic product is the sum of goods and services that are produced in the territory of a given country during a given year; fixed capital is the capital used in the production processes; and net foreign income is the income earned by residents in the rest of the world. Despite the fact that average national income has many limitations, it is the only income definition internationally agreed upon (established by the United Nations System of National Accounts, see SNA 2008).

Based on the average income variable, the workers in each country were divided into low and high income groups based on the average income in the countries over the 50 year sample period. The low and high income classification is shown in Table 4.2

Table 4.2 Low/High Income Classification

Low	Avg. Income		High	Avg. Income
Belgium	25.806		Australia	26.852
Finland	22.311		Austria	26.059
France	25.060		Canada	27.503
Italy	24.447		Germany	27.538
Japan	21.346		Netherlands	30.890
Spain	19.718		Sweden	25.951
United Kingdom	25.128		Switzerland	40.151
Median	25.951		United States	34.703

Source: Own elaboration

Note: Average income shown is the PPP average income over the period 1960-2010.

4.2.3 Average income tax rates

Income tax rates used in the empirical tests refer to the average tax series. To use internationally comparable tax rates requires national account statistics, similar to the average hours worked and income measures discussed in the previous sections. Mendoza et al. (1994) used aggregate tax revenues and national account statistics to calculate average tax rates for the first time. Using aggregate tax revenues and national account statistics, the average tax rate on labour income was calculated and subsequently updated by McDaniel (2007). The average tax rate on labour contains both average payroll tax rate and the tax rate on household income. Tax indicators from McDaniel (2007, 2017) have been extensively used in many scholarly works (Ohanian et al., 2007; Ohanian et al., 2008; Dalton, 2014; Mocan and Pogorelova, 2015; Chen et al., 2015; Duernecker and Herrendorf, 2018). The advantage of McDaniel's tax rates is that they are comparable across time and years for a large set of countries. The disadvantage of these tax rates is that they are average tax rates. Normally, traditional economic theory assumes that the proper tax rates used on making marginal decisions by individuals are the marginal tax rates (Arrazola et al., 2000). However, in the empirical tests, change in tax rates is used, not the actual tax rates. As long as the change in average tax rates and change in marginal tax rates is positively correlated, then the measured reaction will be unbiased. Ohanian et al. (2007) show that the correlation between average and marginal tax rates is stable over time for 21 OECD countries. Using average tax rates might add noise to the data, which will cause a loss of power in the statistical tests, so any significant results are likely stronger than the measured reaction.

The literature on tax perception brings up another issue to consider when choosing what tax rates to use in the empirical tests. The issue is the difference between actual and perceived tax rates. Individuals will react to perceived tax rates, not actual tax rates. Blaufus et al. (2015) says that for measuring, analysing, and explaining the reaction of individuals to taxation, perceived tax features are more appropriate. To evaluate the relationship between taxes and the motivation to work, scholars should take into consideration both actual and perceived tax rates (Rosen, 1976; Fuji and Hawley, 1988; De Bartolome, 1995).

Tax researchers discuss two distinct groups of tax features, actual ("objective") and perceived ("subjective") (Blaufus et al., 2015; Lewis, 1982; Kirchler, 2007). These studies stress the importance of taxes on individual decision making, but they do not mention which tax rates (average or marginal) are relevant. The heterogeneity in perception (some individuals might use average tax rates and some marginal tax rates) makes it difficult to test which tax rates are relevant for the individual decision maker using data collected by survey or interviews. De Bartolome (1995) suggests that it is incorrect to assume marginal tax rates are used in individual decision making. Therefore, De Bartolome (1995) used experiments to avoid these difficulties. Two experiments, a main and a control, were used in De Bartolome's study. The main experiment reflected a tax table that is used by most U.S. filers in preparing their tax returns, and the marginal taxes were not explicitly shown. These tax tables in the main experiment show only the total taxes related with each level of taxable income. However, in the control experiment, De Bartolome (1995) presented subjects with a tax table that explicitly showed the marginal tax rate. In De Bartolome's experiments, individuals assume the average tax rate 'as if' it is the marginal tax rate.

Moreover, collecting accurate data for marginal tax rates across countries is practically impossible. There are several reasons why the marginal tax rates are not applicable at the national or international level. First, marginal tax rates are only simple and quantifiable at a microeconomic level. Second, marginal tax rates require data on tax revenues and income distribution consistent with the income tax schedules, yet there is limited information available for these. Finally, it is difficult to accurately measure marginal tax rates at an international level, because of the differences in the structure of tax systems (Mendoza et al., 1994).

In the present study, three different tax rates will be compared. The first is the Mendoza et al. (1994) tax rate discussed above. The second is the implicit tax rates on employed persons from Martinez-Mongay (2000), which are calculated based on Mendoza et al. (1994). The third are the tax rates developed by McDaniel (2007), discussed previously. Figure 4.1 shows plots of tax rates calculated by the three methodologies, Mendoza et al. (1994), Martinez-Mongay (2000), and McDaniel (2007). The graphs make it easy to compare the tax rates and pick the appropriate one for the empirical tests. The graphs show the correlation between the time series for each country and that the tax rates are similar, but McDaniel has more countries and years. As shown in Figure 4.1, while the McDaniel tax rate is available for all 15 countries, Mendoza and Martinez-Mongay tax rates are available only for 7 and 12 countries, respectively. This is the first advantage of the McDaniel tax rate. In addition, while the McDaniel tax rate covers the time period from 1950 to 2015 for all 15 countries, Martinez-Mongay only covers the time period from 1970 to 2001 for 12 countries. The Mendoza tax rates cover different years for each country or group of countries. The Mendoza tax rates are available from 1965 to 1996 for Canada, Germany, Japan, United Kingdom, and United States, and are available from 1980 to 1996 for Italy, and from 1970 to 1996 for France. It can be seen that the McDaniel tax rate is the most recently updated tax rate and covers more years. This is the second advantage of the McDaniel tax rates. Because of these two advantages of the McDaniel tax rates, they were used in the empirical tests.

McDaniel (2007) uses national account publications to calculate the tax rates from 1950-1965 and uses OECD Revenue Statistics for the years after 1965. McDaniel indicates that to compute the labour income tax rates, first labour income tax revenues and labour income should be calculated. Two sources are necessary to calculate labour income tax revenues, household income taxes and social security taxes. To derive the household income tax rate (τ^{inc}), the following formula is used:

$$\tau^{inc} = \frac{HHT}{GDP-(TPI-Sub)} \tag{4.3}$$

The abbreviations used in Equation 4.3 are: HHT is taxes on income and profits (from household accounts); GDP is Gross Domestic Product; TPI is taxes on production and imports; and Sub is Subsidies

Then McDaniel (2007) divides income into two different payments – capital and labour income. Using θ as a share of income attributed to capital, she finds the share attributed to labour with the remaining $(1-\theta)$ share. Therefore, the total household income tax rate on labour income is measured by

$$HHT_L = \tau^{inc}(1-\theta)(GDP-(TPI-Sub)) \tag{4.4}$$

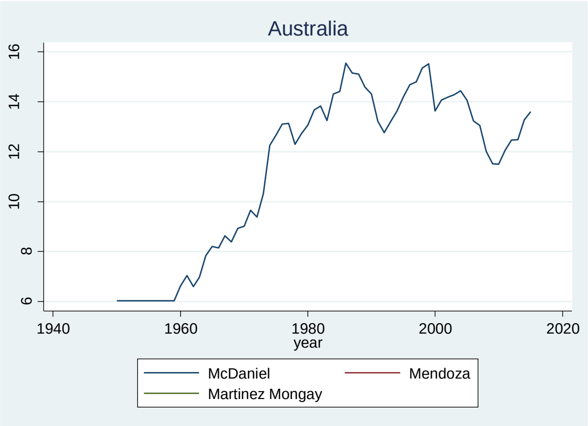
The abbreviations used in Equation 4.4 are: GDP is Gross Domestic Product; TPI is taxes on production and imports; and Sub is Subsidies

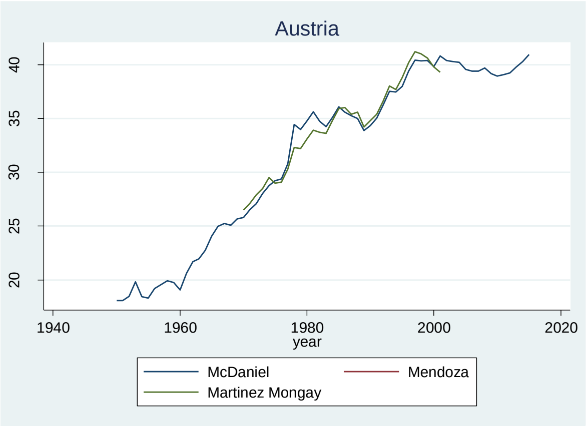
By adding the second source – social security taxes, SS, average tax rate on labour income (τ^h) is calculated by using following formula:

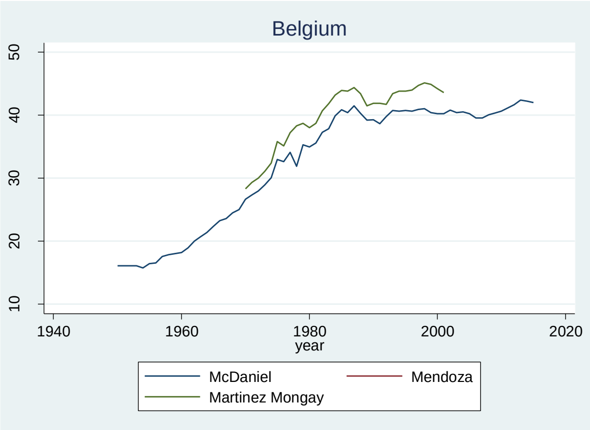
$$\tau^h = \frac{SS+HHT_L}{(1-\theta)(GDP-(TPI-Sub))} \tag{4.5}$$

The abbreviations used in Equation 4.5 are: SS is actual social contributions, receivable (from government accounts); GDP is Gross Domestic Product; TPI is taxes on production and imports; and Sub is Subsidies

Interpolation was not required in the McDaniel tax rate data, as there are no missing values.



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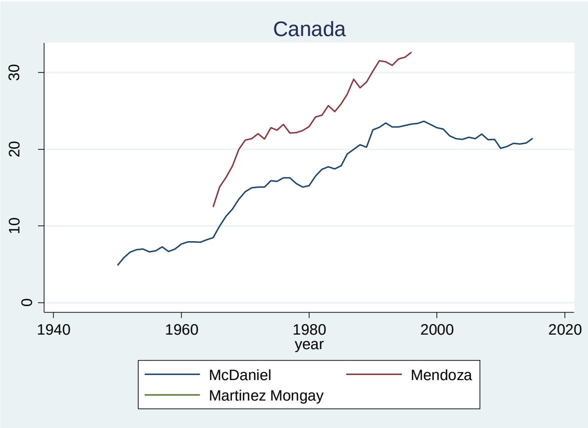
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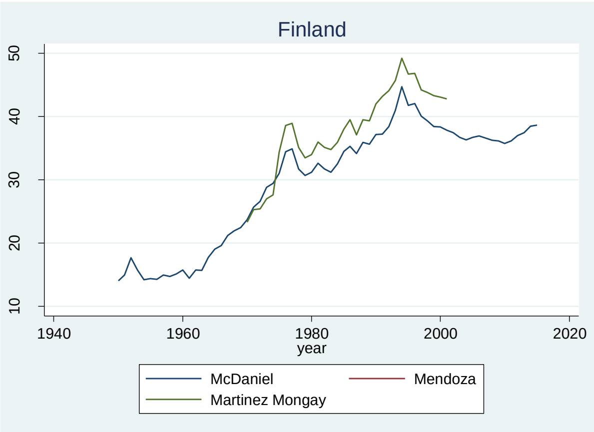
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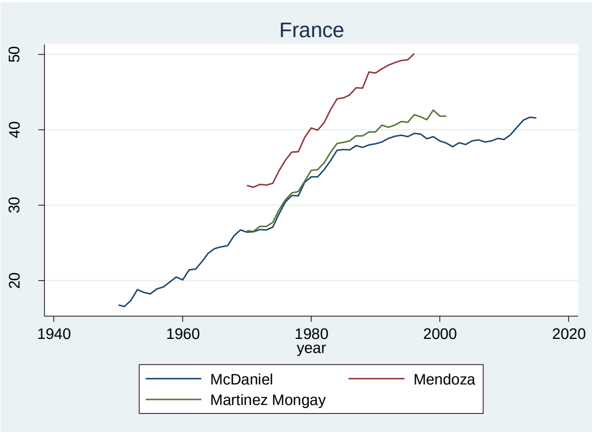
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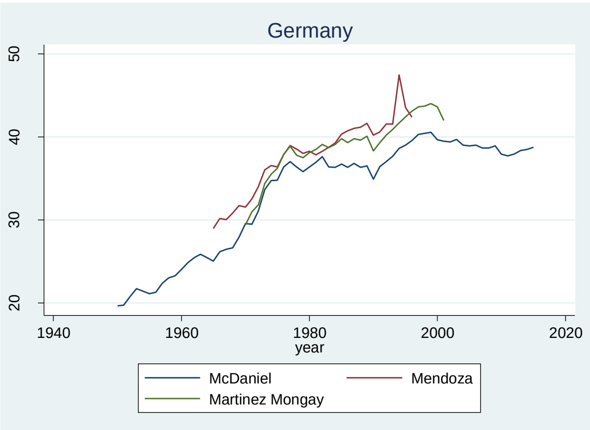
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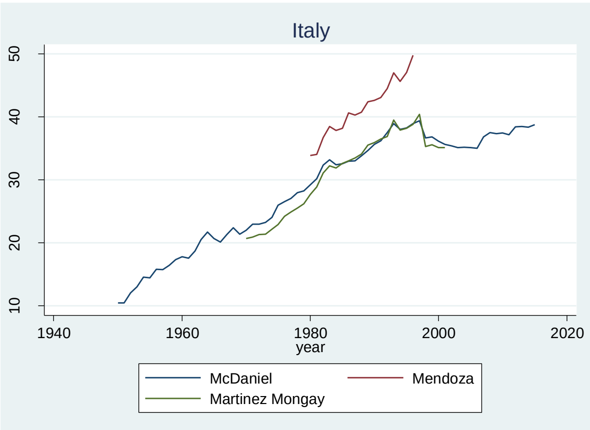
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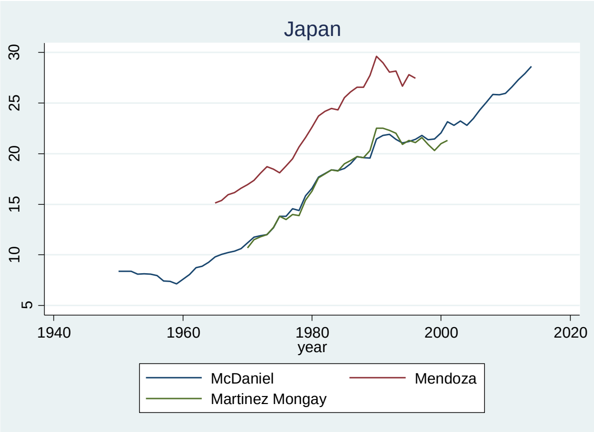
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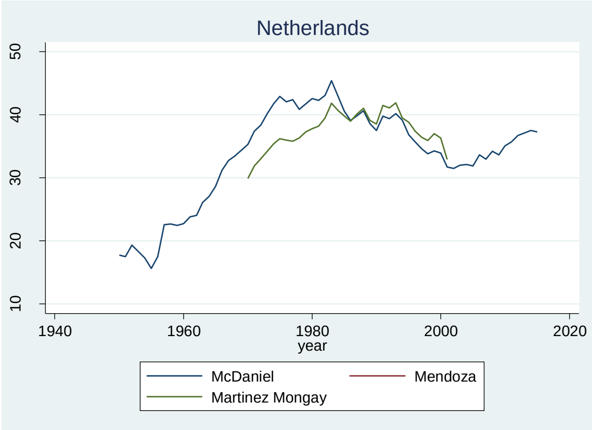
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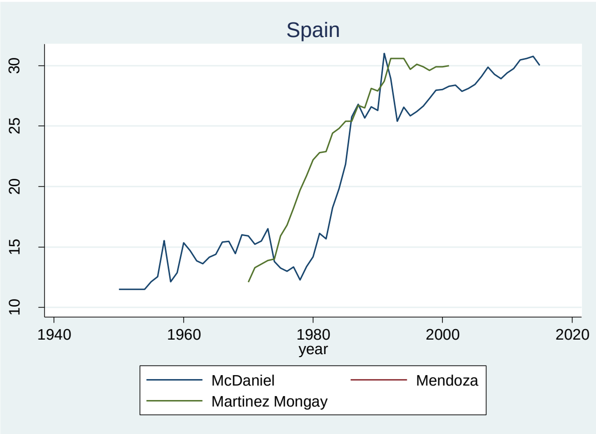
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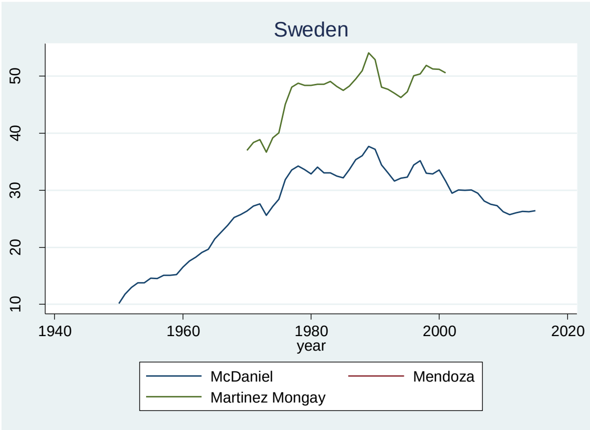
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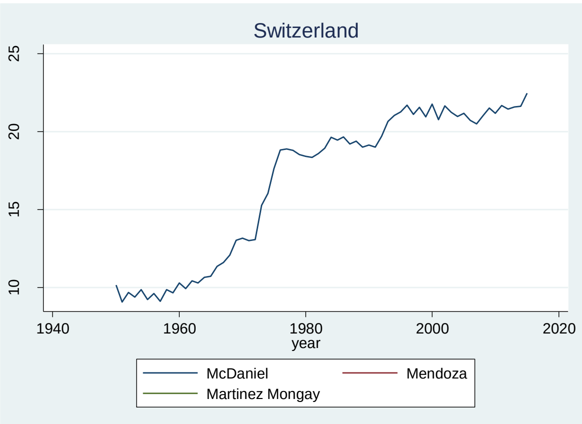
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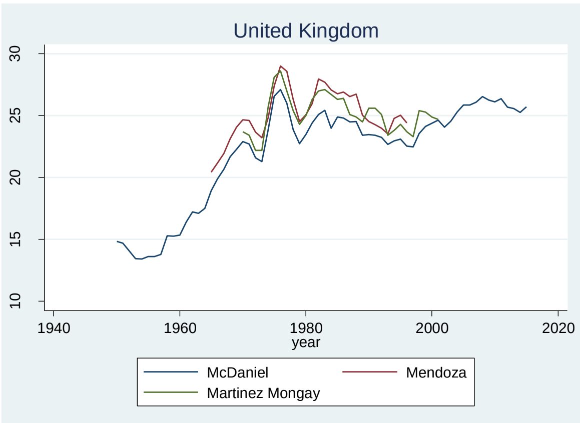
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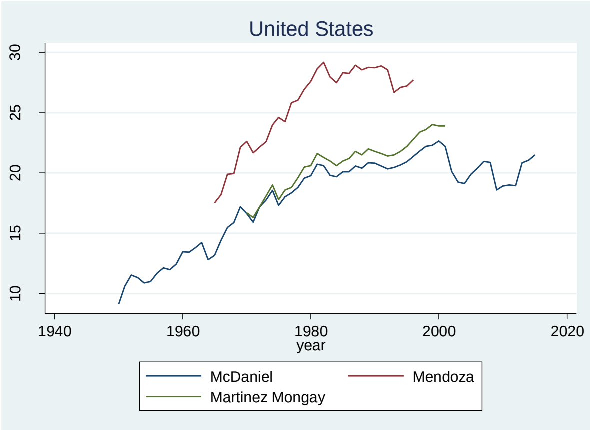

Fig. 4.1: Average labour income tax rates
Source: Own elaboration

4.2.4 Employment Protection

The employment protection variable is range increasing with {0.2} and shows the strictness of employment protection legislation. From 1960 to 1998, data is from the Labor Market Institutions Database (hereafter LMID) by Nickell and Nunziata (2001). For all countries, from 1999 to 2010, data on employment protection is missing, and for replacing these missing values, a linear interpolation method is used.

4.2.5 Net Union Density

Trade union density rate is the percentage of workers affiliated with a trade union. Net union density was originally used by LMID by Nickell and Nunziata (2001) and covers the period from 1960 to 1998. For all 15 countries, from 1960 to 1998 data is from Nickell and Nunziata (2001). For the other years, 1999 to 2010, data on net union density is retrieved from the DICE database (2013b) provided by CESifo. Data in 2010 for Belgium, Spain, and Switzerland is missing. Data in 2009 and 2010 for France is missing. To maximize the number of available observations, interpolation methods were used to replace missing values. In Stata, the `ipolate` command is used to implement linearly interpolated values. The method is used here conforms to the method used in the DICE database provided by CESifo. In the DICE database, a linear interpolation method is used to maximize the number of available years for each country. Therefore, the approach used is the same as CESifo to replace missing values.

4.2.6 Benefit Replacement Rate

Benefit replacement rate is the OECD summary measure of benefit entitlements (Martin, 1996). Whiteford (1995) asserts that the benefit replacement rate is a consistent measure of benefit levels in different countries. The calculation of benefit replacement rate is based on average wage levels. OECD devoted much time to measure comparable data on net and gross benefit replacement (not adjusted for the effects of taxation) for cross-country studies (Martin, 1996). While in early literature the benefit replacement rate was used as a measure of benefit generosity (Aldrich, 1982), in more recent literature it is starting to be used as a measure of the work disincentive effect of unemployment benefit systems (Saunders et al., 1989; Bradbury et al., 1991). This measure is calculated by expressing nine replacement rates as an average. Table 4.3 shows the list of these nine replacement rates. These replacement rates are not adjusted for taxation, because they are gross replacement rates. Three family and income situations, such as a single person, a married person with a dependent spouse, and a married person with a spouse in work, are calculated for the first year, second and third year, and fourth and fifth year, respectively. Then the OECD summary measure of benefit entitlements can be calculated with the following equation

$$Overall\ average = \frac{(brr1 + brr2 + brr3)}{9} \quad (4.6)$$

Table 4.3 Replacement rates used in the measurement of average benefit replacement rate

First year (brr1)			**Second and third year (brr2)**			**Fourth and fifth year (brr3)**		
Single (1)	With dependent spouse (2)	With spouse in work (3)	Single (4)	With dependent spouse (5)	With spouse in work (6)	Single (7)	With dependent spouse (8)	With spouse in work (9)

Source: Martin (1996)

For 14 countries (excluding Sweden), from 1960 to 1999, data is from LMID by Nickell and Nunziata (2001). For Sweden, data on benefit replacement rates are available from 1960 to 1995 from Nickell and Nunziata (2001). For Sweden from 1996 to 2003, and the 14 other countries from 2000 to 2003, data comes from the DICE Database (2013a). Original data are available only for odd years, so even years are obtained by linear interpolation. For years after 2004, a linear interpolation method is used to replace the missing values.

4.2.7 Benefit Duration

Benefit duration is the ratio of average to initial unemployment benefit net replacement rate. The benefit duration index is constructed by using the following equation:

$$bd = 0.6 * \frac{brr2}{brr1} + 0.4 * \frac{brr3}{brr1} \tag{4.7}$$

Where *bd* is benefit duration, *brr1* is the unemployment benefit replacement rate received during the first year of unemployment, *brr2* is the replacement rate received during the second and third year of unemployment, *brr3* is the replacement rate received during the fourth and fifth year of unemployment. Benefit duration is originally credited to LMID by Nickell and Nunziata (2001) and covers the period from 1960 to 1995. The rest of the data, from 1996 to 2010, is taken from DICE Database (2013a) provided by CESifo. The benefit duration data from 1960 to 1972 for Austria and from 1960 to 1970 for Finland are missing from the datasets. As discussed above, a linear interpolation method is used to replace missing values.

4.2.8 Output Gap

Output gap is measured by the following equation:

$$Output\ Gap = \frac{Actual\ GDP - Potential\ GDP}{Potential\ GDP} \tag{4.8}$$

Output Gap data is from LMID by Nickell and Nunziata (2001) for all 15 countries. Data for Australia and Finland is missing from 1960 to 1974 and from 2001 to 2010. Data for Austria and Netherlands is missing from 1960 to 1971 and from 2001 to 2010. Data for Belgium, Canada, and France is missing from 1960 to 1970 and from 2001 to 2010. Data for Germany is missing from 1960 to 1965 and from 2001 to 2010. Data for Italy is missing 1960 to 1962 and from 2001 to 2010. Data for Japan and United Kingdom is missing from 1960 to 1969 and from 2001 to 2010. Data for Sweden is missing from 1960 to 1966 and from 2001 to 2010. Data for Spain and Switzerland is missing from 1960 to 1977 and from 2001 to 2010. Data for United States is missing from 1960 to 1963 and from 2001 to 2010. Wherever possible, missing data from 2001 to 2010 is filled by using data from OECD (2017a). Remaining missing data for each country is replaced by employing a linear interpolation method.

4.2.9 Government Consumption

Government consumption is measured as a percentage of GDP. Data is taken from DICE Database (2013). Data for Canada is missing for only 1960. Data for Switzerland is missing from 1960 to 1964. Data for Germany is missing from 1960 to 1990. Again, a linear interpolation method has been employed to replace the missing values.

4.2.10 Product Market Regulation

Product Market Regulation is an OECD summary indicator of regulatory impediments to product market competition in seven nonmanufacturing industries such as telecoms, electricity, gas, post, rail, air passenger transport, and road freight. The OECD summary indicator for product market regulation is collected from OECD.Stat, Public Sector, Taxation and Market Regulation data set (2017b). Data is available for 14 countries from 1975 to 2010, except United States. Data for United States is available only for 3 years including 1998, 2003 and 2008. Again linear interpolation method was used to replace the missing values.

4.2.11 Consumption tax rate

Consumption taxes used in the analysis are based on property taxes paid by households (the services provided by owner occupied housing), excise taxes (including taxes on sugar, alcohol, tobacco, and other consumption goods) and taxes on specific services (entertainment, insurance, restaurant meals and casinos). McDaniel (2007) calculated average consumption tax rates. Updated values were made available on her website (McDaniel, 2017). There are no missing values in the average consumption tax rate data and it is measured as:

$$\tau^c = \frac{TPI_C}{C - TPI_C} \tag{4.9}$$

Where, C denotes household final consumption expenditure; TPI_C indicates taxes on production and imports.

4.2.12 Capital tax rate

McDaniel (2007) calculated the proxy for the average tax rate on capital income according to the formula shown in equation 4.10:

$$\tau^k = \frac{HHT_C + CT + \mu TPI}{\theta\left(GDP - (TPI - Sub)\right) - OSGOV} \tag{4.10}$$

Where HHT is taxes on income and profits (from household accounts); CT is current taxes on income and wealth, payable (from corporate accounts); μ is average share of TPI over time; TPI is taxes on production and imports; θ is share of income attributed to capital; GDP is Gross Domestic Product; Sub is Subsidies; and OSGOV is Operating surplus, net + consumption of fixed capital.

Updated average capital tax rate values were made available on her website (McDaniel, 2017). There are no missing values.

4.2.13 Tests of model assumptions

The model used in the analysis is a linear panel data model. Compared with other models, panel data models are attractive because they contain more information, which increases the precision in their estimation (Hoechle, 2007). Hoechle (2007) notes that one should take into consideration cross-sectional dependence in the estimation of panel models, because ignoring it can lead to biased empirical results. Therefore, Hoechle (2007) argues that most empirical studies show that their models are robust for heteroscedasticity and autocorrelation, but cross-sectional or "spatial" dependence has been largely ignored in many of them. The logic behind the idea of cross-sectional or "spatial" dependence is that even in panel datasets that have been randomly selected, there can be mutual dependence between the cross-sectional units (for example, individuals or firms) because of social norms and psychological behaviour patterns (Hoechle, 2007). This problem has been emphasized mainly by a growing body of panel-data literature (Robertson and Symons, 2000; Pesaran, 2004; Anselin, 2001; Baltagi, 2008). Therefore, Hoechle (2007, p. 3) says, *"… assuming that the residuals of a panel model are correlated within but uncorrelated between groups of individuals often imposes an artificial and inappropriate constraint on empirical models."* As Petersen (2009) mentions, recent articles published in the leading finance journals still fail to adjust standard errors appropriately. To reduce this problem, OLS coefficient estimates with panel-corrected standard errors (PCSEs), as suggested by Beck and Katz (1995), are used in the empirical tests. By relying on large-*T* asymptotics, Beck and Katz (1995) demonstrate that the contemporaneous correlation between groups of individuals can be corrected with the PCSE estimator. Beck and Katz (1995) provide that their PCSE method is imprecise if the ratio *T/N* is small. It means that if the number of panels, *N*, is large compared to the number of time periods, *T*, then the PCSE estimator will have poor results. Because the ratio *T/N* is not small in the dataset used in the analysis, it is appropriate to use the PCSE method.

Finally, adjusted prediction and marginal effects will be calculated. As Williams (2012) mentions, most researchers and journals emphasize the necessity of using sign and statistical significance of effects, but the substantive and practical significance of findings are often ignored. Additionally, Long and Freese (2006) note the importance of using results by computing predicted and expected values.

4.2.13.1 Unit root tests

This section illustrates the time series properties of the data used in the empirical tests. As per Berger and Heylen (2011), most of the studies in the literature ignore tests of the stationarity of the labour market variables, which leads to spurious regression problems. To check for nonstationary of the model variables, three panel unit-root tests are performed, Breitung (Breitung 2001; Breitung and Das, 2005), Im, Pesaran, and Shin (2003) (hereafter IPS) and the Hadri Lagrange Multiplier (Hadri 2000) (hereafter Hadri LM). By employing all three panel unit-root tests, more reliable and robust results are achieved. It should be noted that the unit-root tests of model variables are examined including panel-specific means (fixed effects) and time trends. While the Breitung test assumes a common unit-root process (allowing for the same autoregressive parameters), the IPS test assumes panel-specific unit-root processes (allowing for panel-specific autoregressive parameters) in panel datasets. Hadri LM is different from the other two tests, therefore common and panel-specific unit-root processes are not applicable here, as illustrated below in the description of the common and panel autoregressive parameters process.

The following equation can be used to demonstrate that simple panel data share a common autoregressive parameter:

$$y_{it} = \rho_i \, y_{i,t-1} + z'_{it}\gamma_i + \epsilon_{it} \tag{4.11}$$

Where $i=1,\dots,N$ denotes panels; $t=1,\dots,T_i$ denotes time; y_{it} is the variable is being tested; and ϵ_{it} is a stationary error term. The panel specific means and a time trend are denoted with the z_{it} term. By default, without a trend, $z_{it} = 1$, meaning that $z'_{it}\gamma_i$ shows panel-specific means (fixed effects). By using a trend, $z'_{it} = (1, t)$, meaning that $z'_{it}\gamma_i$ shows panel-specific means and linear time trends. In Stata, the `xtunitroot` command is used to employ all of the unit root tests.

The null hypothesis $H_0\colon \rho_i = 1$ for all i versus the alternative $H_a\colon \rho_i < 1$ is used in the panel unit-root tests. To show the panel specific unit process, equation (4.11) is often formulated as

$$\Delta y_{it} = \varphi_i \, y_{i,t-1} + z'_{it}\gamma_i + \epsilon_{it} \tag{4.12}$$

It means that the null hypothesis is $H_0\colon \varphi_i = 0$ for all i versus the alternative $H_a\colon \varphi_i < 0$. The Hadri LM test is not consistent with equations (4.11) and (4.12) depicted above, because it does not refer to the parameter ρ_i in (4.11) and φ_i in (4.12). While Breitung and IPS have the null hypothesis that all the panels contain a unit root, Hadri LM has the null hypothesis that all the panels are stationary. Therefore, in the Breitung test, $\rho_i = p$ for all i, meaning that all panels share a common autoregressive parameter. Im, et al. (2003) emphasize that cultural, institutional, and other factors can make common autoregressive parameter assumptions very weak for panel datasets. For this reason, the IPS test uses a panel-specific autoregressive parameter.

The panel dataset used in the empirical tests is balanced, meaning that it has the same T time periods for each N of cross-sectional unit. Therefore, $T_i = T$ for all i. Panel unit root tests differ in their assumptions, especially in the number of panels, N, and the number of time periods, T. All of the tests used are based on sequential limit theory, which is denoted $(T, N) \rightarrow \text{seq } \infty$. This means that first, the number of time periods goes to infinity, and then the number of panels goes to infinity. The tests chosen work best when T is "large" and N is "moderate". The large T and moderate N of the panel data used in the empirical tests were the criteria for choosing these unit root tests for the analysis.

4.2.13.2 Model econometric assumptions

In this section, seven assumptions for the pooled OLS using first differences model will be presented. The first assumption can be provided before regressing the first-differenced equation. It means that for each *i*, the model can be measured

$$y_{it} = \beta_1 x_{it1} + \cdots + \beta_k x_{itk} + \alpha_i + \varepsilon_{it} \tag{4.13}$$

Where $\beta_j$are the estimation parameters and α_i denotes unobserved effects. It should be noted that the advantage of the first-differenced equation is that it removes the errors that do not vary over time (α_i). Therefore, the error term ε_{it} in the first-differenced equation is idiosyncratic error, which is called time-varying error.

The second assumption is that the sample used in the empirical tests is a random sample from the cross section. In order for the model to meet the second assumption, the population model is defined as the 15 countries described above over the period 1960-2010 used in the empirical tests. From this population it is assumed that an i.i.d. sample (independent and identically distributed) was drawn from the population. This assumption allows for temporal correlation, but random sampling in the cross section dimension. This also allows for unrestricted dependence in the time-series dimension (Wooldridge, 2002).

The third assumption to be checked is the presence of the multicollinearity. The presence of multicollinearity will be tested using variance inflation factors (VIF) (Chatterjee and Hadi, 2012). If the explanatory variables are highly correlated, then the estimated standard errors of the fitted coefficients can be inflated. There are different thresholds for acceptable levels of VIF in the literature, but the most commonly accepted value for the maximum level of VIF is 10 (e.g., Hair et al., 1995; Kennedy, 1998; Marquardt, 1970; Neter et al., 1989). In accordance with prior literature, this rule will be applied to the current analysis.

The fourth assumption is strict exogeneity, meaning that idiosyncratic errors are not correlated with the explanatory variables. Put in a different way, holding this assumption allows ruling out the cases where future explanatory variables react to current changes in the idiosyncratic errors (Wooldridge, 2002). Wooldridge (2002) proposes a regression-based F-test on strict exogeneity. As the first difference model used in the empirical tests covers more than two time periods, strict exogeneity can be tested by $H_0: \gamma = 0$ in the following equation:

$$\Delta y_t = \Delta x_t \beta + w_t \gamma + \Delta u_t \qquad t = 2, \dots, T \tag{4.14}$$

Where w_t denotes the subset of x_t.

It is simply including all of the explanatory variables in the first-differenced equation with the subsets and carrying out an F-test. In Stata, the `test` command will be implemented to get the results of the F-test. If the p-values are above 0.10, then strict exogeneity cannot be rejected, meaning that differencing has already solved the endogeneity concern (Felbermayr and Jung, 2009).

The fifth assumption is that the differenced errors are homoscedastic. If the variance of the errors in the regression is dependent on the values of the independent variables, then heteroscedasticity exists, and the differenced errors are not homoscedastic. The Breusch-Pagan test for heteroscedasticity is performed in Stata by the `estat hettest` post regression command (Breusch and Pagan 1979; Cook and Weisberg, 1983). If the null is rejected in the Breusch-Pagan test, then there is evidence of heteroscedasticity. This means the violation of the assumption that the differenced errors are homoscedastic and regression analysis is not appropriate to use in the empirical tests. Therefore, homoscedasticity is an important assumption in the regression analysis.

The sixth assumption is that the differenced errors are serially uncorrelated. Serial correlation causes the results to be less efficient (Drukker, 2003). To identify serial correlation in the idiosyncratic error term, the Wooldridge (2002) test can be applied. It is the preferred test because it requires very few assumptions and is easy to implement. Drukker (2003) discusses the Wooldridge (2002) test and states that while having few assumptions can make the test less powerful than other highly parameterized tests, it is more robust. This makes it more attractive to use. Either the results will show that there is or is not serial correlation in the baseline model. Nevertheless, first-order autocorrelation for robustness is used in the empirical tests. As per Drukker (2003), the `xtserial` command in Stata is employed to implement the Wooldridge test for serial correlation in panel data.

The last assumption is the normality of the error term. This test is used to define whether the dataset is well modelled with the normal distribution. Using the Stata command `sktest`, the classic Jarque-Bera test (Jarque and Bera, 1987) will be implemented. Moreover, diagnostic plots will be employed to show graphically any violations in the assumption. First, histograms will be used, and then quantile-quantile plots will be employed, which are more useful than histograms. The Stata command for histogram is `histogram`, and for quantile-quantile plots (hereafter Q-Q plot) it is `qnorm` (Cox, 2005). A Q-Q plot shows the differences between observed and expected quantiles (Cox, 2007). These plots do not report test statistics that can be gauged for significance, but instead give a more clearly graphical assessment in the testing of the normality of error terms (Cox, 2005).

5. RESULTS

The results of the empirical tests are presented in this section, beginning with presentation of descriptive statistics and univariate tests, then tests of the regression model econometric assumptions, and finally the results of the first differences panel data model with and without the control variables.

5.1 Descriptive Statistics

Table 5.1 and 5.2 contain descriptive statistics of all variables, with original and Winsorized values. All variables were Winsorized at 5% of each tail of the distribution to control for outliers and influential observations.

Table 5.1 Summary statistics (original values)

Variable	Obs	Mean	Std. Dev.	Min	Max
ΔHOURS	750	-8.495243	16.81097	-98.145	78.3265
ΔTAXES	750	.0028933	.0106918	-.04	.05
ΔINCOME	750	.4474914	.9035118	-7.297832	6.469626
TD	765	.4666667	.499214	0	1
LHD	765	.5333333	.499214	0	1
TD*LHD	765	.1333333	.340157	0	1
ΔTAXES*TD	750	.0012533	.0067594	-.04	.05
ΔTAXES*LHD	750	.0012667	.0078109	-.03	.05
ΔTAXES*TD*LHD	750	.0001467	.0030753	-.02	.02
ΔEP	750	.0049377	.0356332	-.3716184	.2400001
ΔUD	750	-.0014442	.0129727	-.1679814	.065
ΔBD	750	.0153563	.0742812	-.2227055	.8142453
ΔBRR	750	.0047731	.0287603	-.091875	.18375
ΔGAP	750	-.0549845	1.913354	-9.261699	4.797097
ΔEXP	750	.0061473	.6044483	-1.716691	2.74866
ΔPMR	750	-.0645053	.1281674	-.9614763	.1108452
ΔTAUC	750	.0009276	.0095003	-.0551372	.0618257
ΔTAUK	750	.000872	.0151957	-.0815732	.0804831

Source: Own elaboration

Notes: Observations are by country for each year from 1961 to 2010. *HOURS* is annual hours worked per worker. *INCOME* indicates average annual income (in thousands of euros adjusted to PPP). *TAXES* is the average tax rate on labour income (annually, percent). *EP, UD, BRR, BD, GAP, EXP, PMR, TAUC* and *TAUK* are employment protection (range), net union density (percent), benefit replacement rate (percent), benefit duration (ratio), output gap (measured by the gross domestic product, GDP), government consumption (percent), product market regulation (summary indicator), and consumption and capital tax rates (percent), respectively.

Table 5.2 Summary statistics (Winsorized values)

Variable	Obs	Mean	Std. Dev.	Min	Max
ΔHOURS	750	-8.322377	14.01896	-36.9522	15.2194
ΔTAXES	750	.00316	.0088006	-.01	.02
ΔINCOME	750	.4623759	.6263248	-.978003	1.489545
TD	765	.4666667	.499214	0	1
LHD	765	.5333333	.499214	0	1
TD*LHD	765	.1333333	.340157	0	1
ΔTAXES*TD	750	.00132	.0056362	-.01	.02
ΔTAXES*LHD	750	.0014667	.0066363	-.01	.02
ΔTAXES*TD*LHD	750	.0001867	.002871	-.01	.02
ΔEP	750	.0033614	.0169978	-.0200001	.0630303
ΔUD	750	-.0013441	.0084655	-.0161812	.018
ΔBD	750	.0103468	.0361981	-.021878	.1397436
ΔBRR	750	.0030783	.0164809	-.0225	.0495313
ΔGAP	750	-.040255	1.731169	-3.836365	2.338828
ΔEXP	750	-.0029519	.5206094	-.975158	1.021963
ΔPMR	750	-.0571128	.0987795	-.3397379	.0007143
ΔTAUC	750	.0008837	.0068493	-.0129605	.0148209
ΔTAUK	750	.0009813	.0125322	-.0265822	.0230132

Source: Own elaboration

Notes: Observations are by country for each year from 1961 to 2010. *HOURS* is annual hours worked per worker. *INCOME* indicates average annual income (in thousands of euros adjusted to PPP). *TAXES* is the average tax rate on labour income (annually, percent). *EP*, *UD*, *BRR*, *BD*, *GAP*, *EXP*, *PMR*, *TAUC* and *TAUK* are employment protection (range), net union density (percent), benefit replacement rate (percent), benefit duration (ratio), output gap (measured by the gross domestic product, GDP), government consumption (percent), product market regulation (summary indicator), and consumption and capital tax rates (percent), respectively. Dummy variables and interaction terms are not included in the Winsorizing process. The interaction terms are calculated after Winsorizing the Δ*TAXES* variable.

Table 5.3 presents Pearson and Spearman correlations between the main variables of interest. These univariate tests have little meaning, because the variables are aggregated over 15 countries and 60 years. They are included here for completeness, but trying to draw meaningful conclusions, economic or otherwise, is not possible. According to the Pearson correlations, ΔHOURS is negatively correlated with ΔTAXES ($r=-0.11$; $p<0.01$), but positively correlated with ΔINCOME ($r=0.27$; $p<0.01$). ΔHOURS is positively correlated with interaction terms such as TD*LHD ($r=0.09$; $p=0.010$) and ΔTAXES*TD*LHD ($r=0.08$; $p=0.026$). Among the control variables, while ΔHOURS is negatively correlated with ΔEP ($r=-0.16$; $p<0.01$), ΔUD ($r=-0.21$; $p<0.01$), ΔEXP ($r=-0.36$;

p<0.01) and ΔPMR r=-0.14; p<0.01), it is positively correlated with ΔGAP (r=0.29; p<0.01) and ΔTAUC (r=0.09; p=0.019).

According to the Spearman correlations, ΔHOURS again negatively correlated with ΔTAXES (r=-0.10; p<0.01) and positively correlated with ΔINCOME (r=0.26; p<0.01). ΔHOURS is positively correlated with interaction terms such as TD*LHD (r=0.09; p=0.012) and ΔTAXES*TD*LHD (r=0.09; p=0.015). Among the control variables, while ΔHOURS is negatively correlated with ΔEP (r=-0.13; p<0.001), ΔUD (r=-0.20; p<0.01), ΔBD (r=-0.07; p=0.04), ΔEXP (r=-0.36; p<0.01) and ΔPMR (r=-0.17; p<0.01), it is positively correlated with ΔGAP (r=0.26; p<0.01).

Table 5.3 Correlation Table

Pearson correlations below the diagonal, Spearman correlations above the diagonal. Correlations significant at p≤.05 are in bold.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
ΔHOURS	**1**	**1.000**	**-0.103**	**0.264**	0.039	0.013	**0.092**	-0.061	-0.047	**0.089**	**-0.132**	**-0.205**	**-0.075**	-0.040	**0.261**	**-0.357**	**-0.174**	0.070	0.054
ΔTAXES	**2**	**-0.110**	**1.000**	-0.044	-0.029	-0.044	-0.072	**0.600**	**0.713**	**0.319**	**0.073**	**0.119**	**0.095**	-0.003	-0.050	**0.126**	**0.201**	**0.128**	**0.349**
ΔINCOME	**3**	**0.271**	-0.032	**1.000**	-0.027	0.038	0.018	0.022	0.038	**0.113**	**0.077**	**-0.157**	-0.043	0.012	**0.599**	**-0.542**	-0.009	0.012	**0.116**
TD	**4**	0.032	-0.035	-0.011	**1.000**	**-0.464**	**0.419**	**0.254**	**-0.134**	0.065	**0.083**	-0.004	-0.063	-0.059	-0.021	-0.023	0.009	-0.068	0.000
LHD	**5**	0.021	-0.050	0.014	**-0.464**	**1.000**	**0.367**	**-0.176**	**0.200**	0.057	-0.011	**-0.139**	0.071	**0.077**	**0.135**	0.024	0.016	0.022	-0.044
TD*LHD	**6**	**0.095**	**-0.078**	0.008	**0.419**	**0.367**	**1.000**	0.022	0.013	**0.155**	-0.021	**-0.082**	-0.015	0.033	0.059	-0.038	-0.045	-0.061	-0.033
ΔTAXES*TD	**7**	-0.070	**0.591**	0.026	**0.251**	**-0.184**	0.006	**1.000**	**0.207**	**0.533**	**0.088**	0.035	0.008	-0.048	0.037	0.040	**0.137**	0.056	**0.211**
ΔTAXES*LHD	**8**	-0.065	**0.711**	0.037	**-0.150**	**0.207**	-0.004	**0.169**	**1.000**	**0.459**	0.068	0.025	**0.107**	0.028	0.049	0.046	**0.118**	**0.074**	**0.277**
ΔTAXES*TD*LHD	**9**	**0.082**	**0.304**	**0.109**	0.070	0.061	**0.166**	**0.496**	**0.420**	**1.000**	-0.003	-0.025	0.047	-0.005	**0.112**	**-0.074**	0.004	0.023	**0.171**
ΔEP	**10**	**-0.161**	**0.113**	**0.073**	0.033	0.000	**-0.078**	**0.091**	**0.107**	-0.013	**1.000**	0.068	-0.025	0.002	0.068	0.069	**0.289**	-0.052	-0.003
ΔUD	**11**	**-0.206**	**0.150**	**-0.157**	-0.017	**-0.155**	**-0.077**	0.054	0.053	-0.003	**0.118**	**1.000**	-0.014	0.065	**-0.180**	**0.164**	**0.202**	-0.064	-0.020
ΔBD	**12**	-0.039	**0.121**	-0.001	**-0.124**	0.019	-0.052	-0.005	**0.086**	-0.010	-0.055	-0.006	**1.000**	-0.049	**-0.104**	0.045	0.038	0.019	-0.036
ΔBRR	**13**	-0.064	**0.073**	-0.003	**-0.092**	0.031	-0.023	-0.027	**0.079**	0.008	0.057	**0.113**	**0.090**	**1.000**	-0.022	-0.019	-0.002	-0.022	-0.017
ΔGAP	**14**	**0.294**	**-0.072**	**0.607**	0.005	**0.134**	0.058	0.025	0.048	**0.102**	0.058	**-0.218**	**-0.132**	-0.017	**1.000**	**-0.464**	0.045	0.044	**0.105**
ΔEXP	**15**	**-0.356**	**0.126**	**-0.551**	-0.032	0.032	-0.036	0.049	0.059	-0.060	**0.131**	**0.180**	-0.005	-0.004	**-0.488**	**1.000**	**0.145**	-0.059	-0.043
ΔPMR	**16**	**-0.145**	**0.134**	0.015	0.011	0.070	**0.106**	**0.087**	**0.087**	0.028	**0.203**	**0.159**	0.019	0.031	-0.017	**0.096**	**1.000**	-0.016	0.037
ΔTAUC	**17**	**0.086**	**0.107**	0.043	-0.058	0.020	-0.049	0.042	0.071	0.015	-0.055	**-0.092**	0.071	-0.004	-0.004	-0.070	-0.017	**1.000**	**0.130**
ΔTAUK	**18**	0.060	**0.337**	**0.146**	-0.012	-0.031	-0.038	**0.208**	**0.268**	**0.186**	0.014	-0.013	0.002	0.020	**0.130**	-0.055	0.009	**0.112**	**1.000**

Source: Own elaboration

5.2 Tests of econometric assumptions

5.2.1 Unit root test results

Table 5.4 and 5.5 contain the panel unit-root test results for all model variables, shown with a constant, and with a constant and trend. While Table 5.4 contains the series in levels, Table 5.5 shows them in first differences. The variables *TD*, *LHD*, and the interaction terms are not included in the unit-root tests. Both IPS and Breitung unit-root tests in levels and first differences generally rejected the null hypothesis that all series contain unit roots at a 1% significance level, except *EP* in levels. Contrary to IPS and Breitung, the Hadri LM test gives conflicting results and reveals weak stationarity in levels. Therefore, in levels, the null hypothesis is rejected that the series are stationary at a 1% significance level and accept that the variables except *TAXES*, *TAUC*, and *TAUK* contain a unit root. While *TAXES* rejects the existence of stationarity at 5% in constant, it cannot reject the existence of stationarity when the series is de-trended. *TAUC* and *TAUK* cannot reject the existence of stationarity when the series is constant and de-trended. However, in first differences, Hadri LM cannot reject the null hypothesis that the series are stationary, and therefore, it is accepted that all of the model variables are stationary. The overall assessment of the unit root tests is that the first differences of the model variables overcome the non-stationary issue.

Table 5.4 Panel unit-root test results (levels)

	IPS	Breitung	Hadri LM
Panel A: Constant			
HOURS	-13.6834***	-11.8290***	4.8955***
TAXES	-16.7679***	-14.2446***	1.8667**
INCOME	-14.1682***	-13.8378***	3.6247***
EP	-1.1579	-5.4108***	35.0407***
UD	-11.5110***	-10.6924***	11.1006***
BD	-10.0109***	-5.9530***	40.1047***
BRR	-10.0923***	-8.6779***	4.0635***
GAP	-10.5553***	-7.7009***	28.4301***
EXP	-12.3714***	-7.8526***	17.1627***
PMR	-13.6271***	-12.7503***	4.2709***
TAUC	-15.0454***	-13.2319 ***	0.7134
TAUK	-16.7831***	-15.1259 ***	-1.8099
Panel B: Constant and Trend			
HOURS	-14.1441***	-12.1711***	5.4316***
TAXES	-17.0770***	-13.9882***	0.4260
INCOME	-14.7056***	-8.9474***	2.5826***
EP	-4.4799***	-3.5051***	32.3858***
UD	-12.2419***	-10.9746***	9.9117***
BD	-11.3986***	-8.7213***	26.3970***
BRR	-10.2853***	-10.8055***	7.1762***
GAP	-12.0378***	-10.5706***	11.2337***
EXP	-13.7094***	-9.7057***	4.9456***
PMR	-13.7421***	-8.8259***	6.1218***
TAUC	-15.3972***	-10.5992***	1.1051
TAUK	-16.9155***	-12.7707***	-1.4688

Source: Own elaboration

Note: ***, **, * indicates the rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.

Table 5.5 Panel unit-root test results (first order differences)

Panel A: Constant			
	IPS	Breitung	Hadri LM
ΔHOURS	-19.4630***	-13.2739***	-3.7805
ΔTAXES	-21.0077***	-18.5737***	-3.8825
ΔINCOME	-20.1988***	-16.6169***	-3.7947
ΔEP	-19.0214***	-20.8676***	-3.0814
ΔUD	-20.0094***	-14.8951***	-3.6714
ΔBD	-18.2546***	-20.3339***	-3.2632
ΔBRR	-17.0132***	-18.5255***	-3.5468
ΔGAP	-18.5514***	-20.6011***	-3.4151
ΔEXP	-19.5368***	-12.0445***	-3.4608
ΔPMR	-19.9793***	-21.8071***	-3.8198
ΔTAUC	-19.9702***	-15.8140***	-3.6970
ΔTAUK	-21.0574 ***	-16.4218***	-3.8038
Panel B: Constant and Trend			
ΔHOURS	-19.4511***	-14.2847***	-4.7842
ΔTAXES	-21.0065***	-18.1338***	-4.9567
ΔINCOME	-20.1913***	-14.1690***	-4.6512
ΔEP	-19.0511***	-20.5843***	-2.9259
ΔUD	-20.0248***	-17.7859***	-4.5812
ΔBD	-18.2989***	-15.1513***	-4.2595
ΔBRR	-17.0248***	-18.6609***	-3.8517
ΔGAP	-18.5941***	-18.7773***	-4.3701
ΔEXP	-19.5475***	-15.5492***	-4.4280
ΔPMR	-20.0016***	-18.2822 ***	-4.8338
ΔTAUC	-19.9681***	-14.4203***	-4.5728
ΔTAUK	-21.0424***	-12.4655***	-5.0243

Source: Own elaboration

Note: ***, **, * indicates the rejection of the null hypothesis at the 1%, 5%, and 10% significance levels, respectively.

5.2.2 Other econometric assumptions

5.2.2.1 Multicollinearity

Table 5.6 presents that there is no VIF greater than 10, the mean VIF is 2.22. As per previous research (Hair et al., 1995; Kennedy, 1998; Marquardt, 1970; Neter et al., 1989), multicollinearity is not a problem when the VIF are all less than 10.

Table 5.6 Diagnostic for multicollinearity: 1961-2010

	(1) ΔHOURS b/t	VIF
ΔTAXES	294.8**	6.73
	(3.15)	
ΔINCOME	2.524	2.33
	(1.73)	
TD	0.134	3.26
	(0.13)	
LHD	-0.743	3.11
	(-0.58)	
TD*LHD	2.884	2.78
	(1.89)	
ΔTAXES*TD	-582.1***	4.31
	(-4.59)	
ΔTAXES*LHD	-411.3***	4.96
	(-7.04)	
ΔTAXES*TD*LHD	904.3***	2.45
	(4.24)	
ΔEP	-31.30	1.38
	(-0.77)	
ΔUD	-138.5*	1.40
	(-2.17)	
ΔBD	-7.389	1.42
	(-0.48)	
ΔBRR	-28.57	1.12
	(-0.92)	
ΔGAP	0.954*	2.23
	(2.16)	
ΔEXP	-4.427**	1.90
	(-3.45)	
ΔPMR	-8.240	1.73
	(-1.30)	
ΔTAUC	35.14	1.17
	(0.50)	
ΔTAUK	37.25	1.39
	(0.58)	
Constant	-4.608	
	(-1.49)	
Observations	750	
Mean VIF	2.22	

Source: Own elaboration

5.2.2.2 Strict exogeneity

The results of regression-based F-test for strict exogeneity shows that p-value is above 0.1 ($F = 1.51, p = 0.123$), which means that the test fails to reject the null and accepts that the first difference method solved the endogeneity concern.

5.2.2.3 Homoscedasticity

The outcome of the Breusch-Pagan test is as follows, $\chi^2(1) = 9.43$ and Prob. > $\chi^2 = 0.0021$.

According to the test statistic of 9.34 with a p-value of 0.0022, one can see that homoscedasticity assumption is violated. In the analysis, a large chi-square indicates that heteroscedasticity is present. Moreover, the p-value is very small. Therefore, the null hypothesis is rejected, and it is accepted that the variance is not homogenous. When heteroscedasticity is present, using robust standard errors is more reliable. Therefore, standard errors in the expanded model are robust to heteroscedasticity.

5.2.2.4 Serial correlation

The Wooldridge test indicates that the null hypothesis of no serial correlation is strongly rejected in the expanded model ($F = 16.035, p = 0.00$). Nevertheless, the expanded model is tested by assuming first-order autocorrelation for robustness.

5.2.2.5 Normality

The outcome of the Jarque-Bera normality test is as follows,
$\chi^2(2) = 1.357$ and Prob. > $\chi^2 = 0.5073$

According to the test statistic of 1.357 with a p-value of 0.5073, one can see that normality assumption is not violated. The p-value is not significant; therefore, the null hypothesis cannot be rejected and it should be accepted that the data is not affected with non-normality. Most of the time, researcher refer to graphical illustration on the normality assumption. In the histogram, the y-axis is labelled as frequency, which means that each bin contains the number of observations. Based upon the histogram, it is illustrated that residuals are a normally distributed, bell-shaped distribution (see Figure 5.1). The Q-Q plot shows that the data points do not seriously deviate from the origin with a unit slope. It means that the residuals are normally distributed (see Figure 5.2).

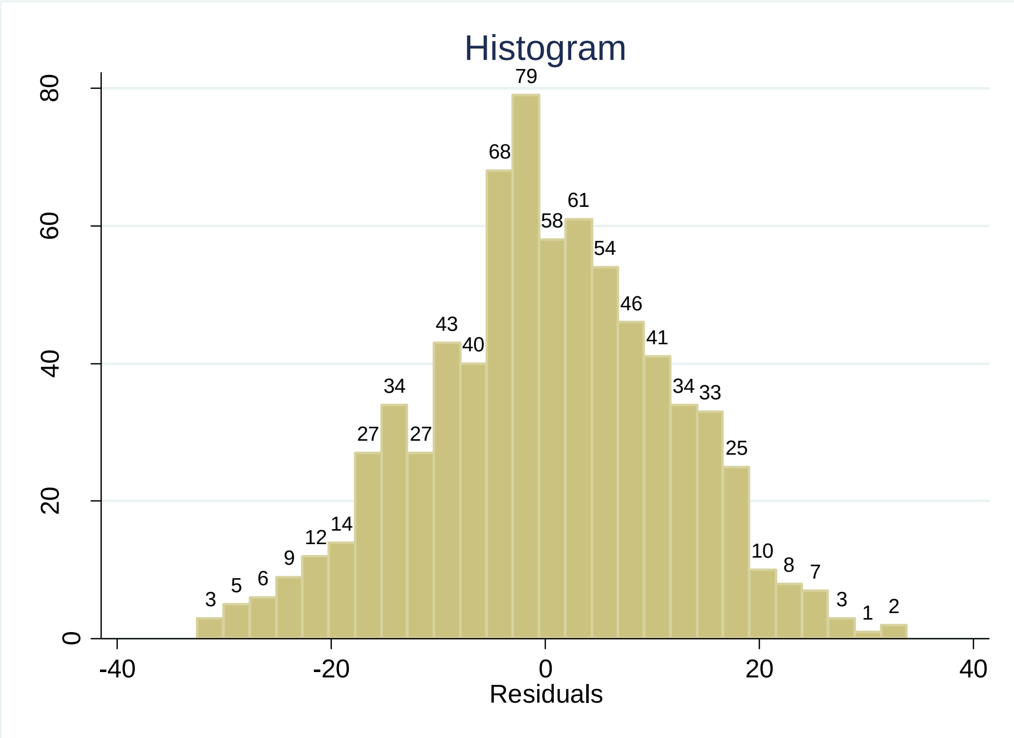

Fig. 5.1: Histogram
Source: Own elaboration

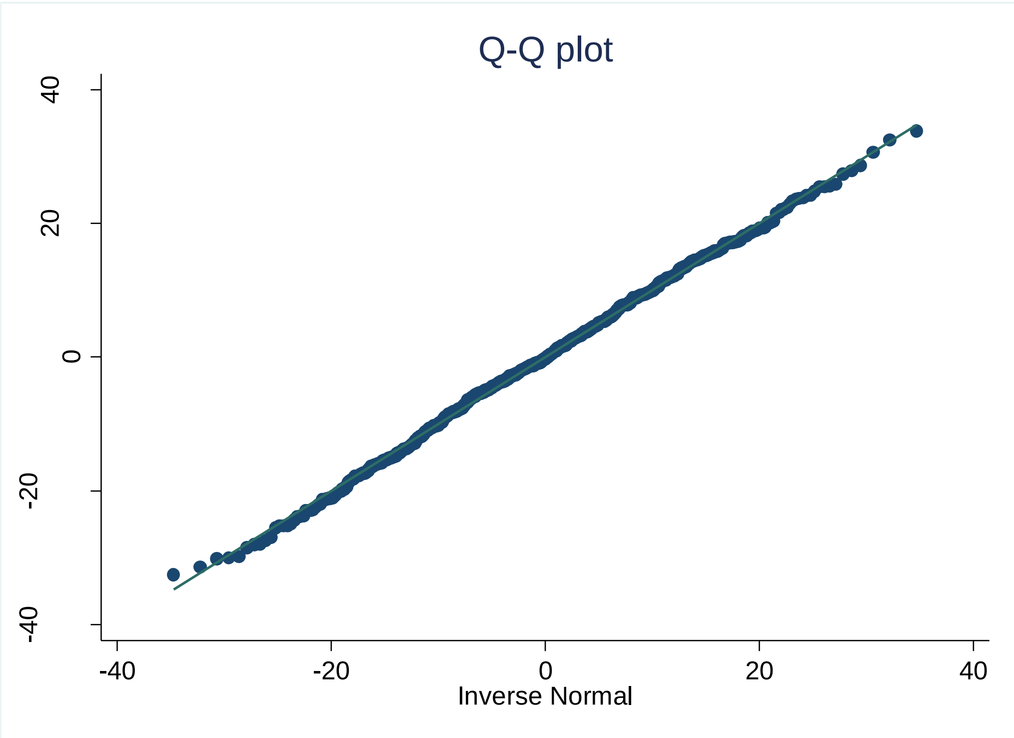

Fig. 5.2: Quantile-Quantile plot
Source: Own elaboration

5.3 Baseline Model Results

Table 5.7 presents the results of the baseline model. As shown in the methodology section, the baseline model is used to test the hypothesis through the interaction term between the change in taxes and the dummy variable for high and low wage groups. The dependent variable in the model is the change in average hours worked. The only two variables in the model that are significant are the constant term and the coefficient on the change in average annual income. Both results are as expected. The coefficient on the constant term is negative, indicating that the long-term trend is a decline in hours worked. This has been true in general worldwide for the past 100 years, and has been documented numerous times in the labour economics literature. The second significant variable is the change in income, where the coefficient is positive. This is likely an artefact of the relationship between hours and income, that as hours increase, so does income. The positive coefficient reflects this dynamic. In the baseline model there is no significant effect of $\Delta TAXES$ $(\beta = -69.72, p = 0.378)$, or the interaction between taxes and the low/high wage dummy variable, ΔTAXES*LHD $(\beta = -2.208, p = 0.983)$. Thus, theory that there would be a significant difference in the reaction to a tax rate change between high and low wage groups does not hold. There is no significant difference in the reaction to a tax rate change between low and high wage workers.

Table 5.7 Baseline Model

	1961-2010
ΔTAXES	-69.72
	(0.378)
ΔINCOME	4.978***
	(0.000)
LHD	0.465
	(0.662)
ΔTAXES*LHD	-2.208
	(0.983)
Constant	-15.24***
	(0.000)
Observations	750
R^2	0.251

Source: Own elaboration

Note: Standard errors are robust to heteroscedasticity, cross-sectional dependence, and serial correlation. Year dummies are included in the model, but not reported in the table. P-values are in parentheses.

* p<0.05

** p<0.01

*** p<0.001

One possibility for the lack of results in the baseline model that theory predicts is that there are other factors that determine the motivation and/or ability to work. By adding the $CONTROLS_{it}$ variables, the baseline model becomes the overall model with nine control variables.

$$\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \beta_3 LHD + \beta_4 \Delta TAXES_{it} * LHD + CONTROLS_{it} + \varepsilon_{it} \tag{5.1}$$

Table 5.8 Baseline Model (with control variables)

	1961-2010
ΔTAXES	-46.44
	(0.566)
ΔINCOME	2.431*
	(0.021)
LHD	-0.0295
	(0.978)
ΔTAXES*LHD	-21.76
	(0.829)
ΔEP	-55.40
	(0.170)
ΔUD	-123.1*
	(0.046)
ΔBD	1.642
	(0.917)
ΔBRR	-28.04
	(0.362)
ΔGAP	1.087**
	(0.008)
ΔEXP	-3.604**
	(0.003)
ΔPMR	-4.059
	(0.492)
ΔTAUC	23.54
	(0.730)
ΔTAUK	31.04
	(0.423)
Constant	-14.52***
	(0.000)
Observations	750
R^2	0.284

Source: Own elaboration

Note: Standard errors are robust to heteroscedasticity, cross-sectional dependence, and serial correlation. Year dummies are included in the model, but not reported in the table. P-values are in parentheses.

* p<0.05

** p<0.01

*** p<0.001

Table 5.8 shows the results from the overall model with control variables. The results in the overall model are similar to the baseline model. The only variables in the model that are significant are the constant term and the coefficient on the change in average annual income, plus the three control variables, change in union density, change in output gap, and change in government expenditures. The negative coefficient on the change in union density means that as union density changes, the number of hours worked moves in the opposite direction. Therefore, an increase in union density decreases the number of hours worked. The positive coefficient on the change in output gap means that as output gap changes, the number of hours worked moves in the same direction. Therefore, an increase in output gap increases the number of hours worked. The negative coefficient on the change in government expenditures means that as government expenditures changes, the number of hours worked moves in the opposite direction. Therefore, an increase in government expenditures decreases the number of hours worked.

In the overall model there is no significant effect of $\Delta TAXES$ ($\beta = -42.53, p = 0.420$), or the interaction between taxes and the low/high wage dummy variable, ΔTAXES*LHD ($\beta = -21.76, p = 0.829$). Thus, theory that there would be a significant difference in the reaction to a tax rate change between high and low wage groups does not hold. The results from the overall model warrant further investigation. Therefore, each country will be examined separately to determine in which countries, if any, theory holds, and in which countries it does not.

The first way to examine individual countries is to examine the largest tax increase and tax decrease for each country and see how the average hours worked changed in that country. This is shown in Figure 5.3, which plots changes in hours worked against changes in average labour income tax rates.

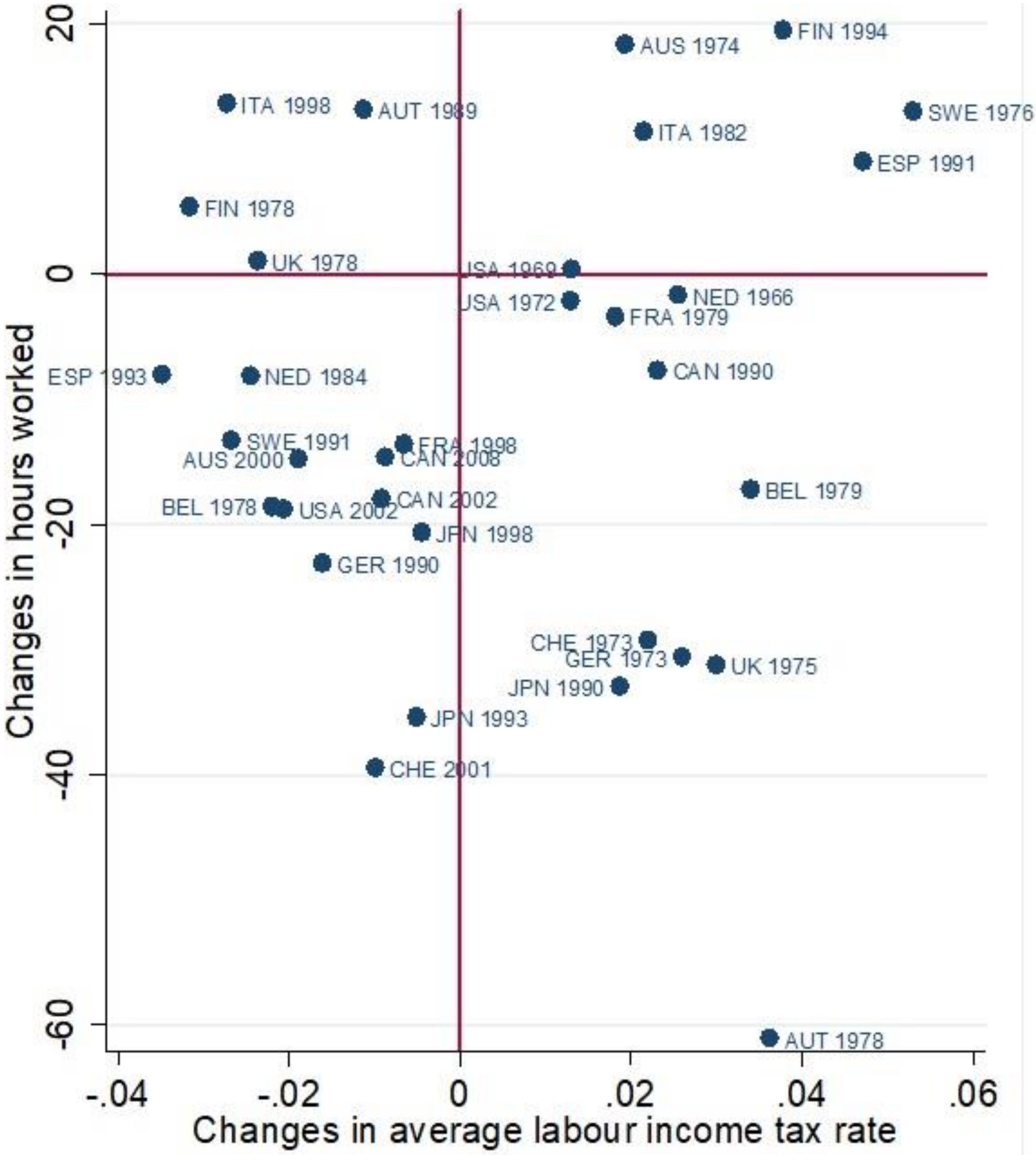

Fig. 5.3: Changes in taxes and hours worked

Note: For each country, the largest tax rate increase and largest tax rate decrease were selected, including ties for the largest tax rate decrease in USA, Japan, and Canada.

Based on Figure 5.3, no pattern can be discerned to explain why the results from the baseline and overall models do not match theory. However, there are some interesting results. For example, Sweden faced the largest tax rate increase in the entire sample in 1976, and reacted by increasing their hours worked. When tax rates decreased in 1991 they reduced their hours worked. Because no conclusions can be drawn from Figure 5.3, regression will be performed at the individual country level instead of in a pooled cross-section. For the individual country analysis, a variant of the baseline model will be used. This simple model is the same as the baseline model, except that there is no dummy variable for wages, and no related interaction term.

$$\Delta HOURS_t = \beta_0 + \beta_1 \Delta TAXES_t + \beta_2 \Delta INCOME_t + \varepsilon_t \tag{5.2}$$

Tables 5.9 and 5.10 show 15 results from the individual country analysis using the simple model. Theory predicts that for high wage workers, as taxes increase the number of hours worked decreases, and for low wage workers, as taxes increase the number of hours worked increases. Likewise, theory predicts that for high wage workers, as taxes decrease the number of hours worked increases, and for low wage workers as taxes decrease the number of hours worked decreases.

Table 5.9 Individual country analysis, low wage group

	BEL	FIN	FRA	ITA	JPN	ESP	UK
ΔTAXES	-295.7	116.0	-23.55	112.5	-468.9	-272.2	-643.6**
	(0.205)	(0.444)	(0.941)	(0.633)	(0.125)	(0.181)	(0.002)
ΔINCOME	5.207	2.741	3.939	2.040	14.65***	3.756	11.27***
	(0.152)	(0.223)	(0.454)	(0.592)	(0.000)	(0.344)	(0.001)
Constant	-10.81***	-10.16***	-14.21***	-8.497**	-11.81***	-8.688**	-11.40***
	(0.001)	(0.000)	(0.000)	(0.003)	(0.000)	(0.002)	(0.000)
Observations	50	50	50	50	50	50	50
R^2	0.0882	0.0351	0.0124	0.00913	0.274	0.0539	0.413

Source: Own elaboration
* p<0.05; ** p<0.01; *** p<0.001

Table 5.10 Individual country analysis, high wage group

	AUS	AUT	CAN	GER	NED	SWE	CHE	USA
ΔTAXES	75.45	-23.12	-250.3	-228.1	-157.5	-451.3*	-140.6	197.6
	(0.764)	(0.917)	(0.263)	(0.279)	(0.361)	(0.027)	(0.574)	(0.301)
ΔINCOME	2.554	14.85***	5.384	10.29**	1.202	2.905	3.270	12.63***
	(0.509)	(0.000)	(0.070)	(0.001)	(0.639)	(0.333)	(0.135)	(0.000)
Constant	-6.966**	-15.54***	-10.52***	-19.21***	-8.404***	-5.503	-9.306***	-11.28***
	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.056)	(0.000)	(0.000)
Observations	50	50	50	50	50	50	50	50
R^2	0.0154	0.250	0.0936	0.235	0.0216	0.106	0.0616	0.548

Source: Own elaboration
* p<0.05; ** p<0.01; *** p<0.001

Theory only holds for two low wage countries, Italy and Finland. In these two countries, when taxes increase, so do the hours worked. While in the other countries (Belgium, France, Japan, Spain, UK) ΔTAXES is negative (hours go down when taxes go up), contrary to what theory predicts. However, with the exception of the United Kingdom, none of the coefficients is significantly different from zero. As predicted by theory, in the high wage countries of Sweden, Canada, Germany, Netherlands, Switzerland, and Austria, the coefficient on ΔTAXES is negative (hours go down when taxes go up). In the other high wages countries, Australia and United States, the coefficient on ΔTAXES is positive (hours go up when taxes go up). However, except for Sweden, none of the coefficients are significantly different from zero. This lack of significance could be due to the low power of the tests. In order to increase the power of the tests, the data will be pooled with a dummy variable, *TD*, coded zero in the countries where theory was found to hold at the country-level, and coded one in the remaining countries, where theory did not hold. Interaction terms are added for the new dummy variable, so theory can be tested between high and low wage groups, where theory holds and where it does not. As in the previous models, *LHD* is dummy variable to distinguish between low and high wages. The resulting expanded model is:

$$\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \beta_3 TD + \beta_4 LHD + \beta_5\, TD * LHD + \beta_6 \Delta TAXES_{it} * TD + \beta_7\, \Delta TAXES_{it} * LHD + \beta_8 \Delta TAXES_{it} * TD * LHD + \varepsilon_{it} \qquad (5.3)$$

The results from the expanded model are shown in Table 5.11.

Table 5.11 Expanded model (without control variables)

	1961-2010
ΔTAXES	240.4*
	(0.027)
ΔINCOME	5.123***
	(0.000)
TD	0.701
	(0.691)
LHD	-0.0328
	(0.983)
TD*LHD	2.831
	(0.246)
ΔTAXES*TD	-512.5***
	(0.001)
ΔTAXES*LHD	-349.6**
	(0.008)
ΔTAXES*TD*LHD	757.4***
	(0.001)
Constant	-15.04***
	(0.000)
Observations	750
R^2	0.270

Source: Own elaboration

Note: Standard errors are robust to heteroscedasticity, -sectional dependence, and serial correlation. Year dummies are included in the model, but not reported in the table. P-values are in parentheses.

* p<0.05

** p<0.01

*** p<0.001

To discuss the results of the expanded model, versions of the model are presented in Table 5.12 with different values for the dummy variables and interactions substituted into the model. Panel A shows the full equations and Panel B only the resulting coefficients.

Table 5.12 Panel A: Results of the expanded model by level of the dummy variables.

	LHD = 0	LHD = 1
TD = 0	Substituting in 0, 0 for the dummy variables: $\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \varepsilon_{it}$ Substituting in the estimated coefficients: $\Delta HOURS_{it} = -15.04 + 240.4 * \Delta TAXES_{it} + 5.123 * \Delta INCOME_{it} + \varepsilon_{it}$	Substituting in 1, 0 for the dummy variables: $\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \beta_4 + \beta_7 \Delta TAXES_{it} + \varepsilon_{it}$ Substituting in the estimated coefficients: $\Delta HOURS_{it} = -15.04 + 240.4 * \Delta TAXES_{it} + 5.123 * \Delta INCOME_{it} - 0.0328 - 349.6 * \Delta TAXES_{it} + \varepsilon_{it}$ Grouping together like terms: $\Delta HOURS_{it} = -15.07 - 109.2 * \Delta TAXES_{it} + 5.123 * \Delta INCOME_{it} + \varepsilon_{it}$
TD = 1	Substituting in 0, 1 for the dummy variables: $\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \beta_3 + \beta_6 \Delta TAXES_{it} + \varepsilon_{it}$ Substituting in the estimated coefficients: $\Delta HOURS_{it} = -15.04 + 240.4 * \Delta TAXES_{it} + 5.123 * \Delta INCOME_{it} + 0.701 - 512.5 * \Delta TAXES_{it} + \varepsilon_{it}$ Grouping together like terms: $\Delta HOURS_{it} = -14.34 - 272.1 * \Delta TAXES_{it} + 5.123 * \Delta INCOME_{it} + \varepsilon_{it}$	Substituting in 1, 1 for the dummy variables: $\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \beta_3 + \beta_4 + \beta_5 + \beta_6 \Delta TAXES_{it} + \beta_7 \Delta TAXES_{it} + \beta_8 \Delta TAXES_{it} + \varepsilon_{it}$ Substituting in the estimated coefficients: $\Delta HOURS_{it} = -15.04 + 240.4 * \Delta TAXES_{it} + 5.123 * \Delta INCOME_{it} + 0.701 - 0.0328 + 2.831 - 512.5 * \Delta TAXES_{it} - 349.6 * \Delta TAXES_{it} + 757.4 * \Delta TAXES_{it} + \varepsilon_{it}$ Grouping together like terms: $\Delta HOURS_{it} = -12.94 + 135.7 * \Delta TAXES_{it} + 5.123 * \Delta INCOME_{it} + \varepsilon_{it}$

Source: Own elaboration

Table 5.12 Panel B: Coefficients of the expanded model by level of the dummy variables

$\Delta HOURS_{it} =$	Low Wages	High Wages
Country where theory worked	$\text{Intercept} = -15.04$ $\Delta\text{TAXES}_{\text{it}} = 240.4$ $\Delta\text{INCOME}_{\text{it}} = 5.123$	$\text{Intercept} = -15.07$ $\Delta\text{TAXES}_{\text{it}} = -109.2$ $\Delta\text{INCOME}_{\text{it}} = 5\ .123$
Country where theory did not work	$\text{Intercept} = -14.34$ $\Delta\text{TAXES}_{\text{it}} = -272.1$ $\Delta\text{INCOME}_{\text{it}} = 5.123$	$\text{Intercept} = -12.94$ $\Delta\text{TAXES}_{\text{it}} = 135.7$ $\Delta\text{INCOME}_{\text{it}} = 5.123$

Source: Own elaboration

Due to the numerous dummy variables and interaction terms, interpreting the results of the expanded model is difficult. However, there are four distinct groups, low and high wage groups where theory worked, and low and high wage groups where it did not. The intercept in all four equations is negative and significant, denoting the long-term trend over time in the decrease in the number of hours worked. Similarly, the coefficient on the change in income is positive, due to the mechanical relationship between the number of hours worked and income. When the dummy variables are both zero, the resulting equation is for workers with low wages where theory works. For the low wage workers where theory works, the coefficient on the change in taxes is positive and significant, as predicted by theory. When the dummy variables on LHD = 1 and TD = 0, the resulting equation is for high wage workers where theory works. For high wage workers where theory works, the coefficient on the change in taxes is negative, as predicted by theory. As shown by the interaction term between the LHD dummy variable and the change in taxes (*ΔTAXES*), the difference in the reaction between high and low wage workers is significant. This is an important finding, that the workers with low wages and high wages behave significantly different in adjusting the number of hours worked as a reaction to a change in tax rates. Unfortunately, this difference is limited to a subset of the countries studied, and further investigation is necessary to determine why theory applies to some countries and not others.

In the subset of countries identified in the individual country analysis as countries where theory does not work, the reaction to tax rate changes is exactly the opposite of what is predicted by theory presented earlier. For the low wage group, the average number of hours worked decreases when there is a tax rate increase, and for the high wage group, the average number of hours worked increases when there is a tax rate increase.

In order to test theory in the presence of other factors that affect the motivation to work, an expanded model with control variables is used to test the previous results.

$$\Delta HOURS_{it} = \beta_0 + \beta_1 \Delta TAXES_{it} + \beta_2 \Delta INCOME_{it} + \beta_3 TD + \beta_4 LHD + \beta_5 TD * LHD + \beta_6 \Delta TAXES_{it} * TD + \beta_7 \Delta TAXES_{it} * LHD + \beta_8 \Delta TAXES_{it} * TD * LHD + CONTROLS_{it} + \varepsilon_{it} \quad (5.4)$$

The results of the expanded model with controls variables are shown in Table 5.13. The results are essentially unchanged after adding the control variables to the model. For workers with low wages where theory works, the coefficient on the change in taxes is positive and significant, as predicted by theory. As shown by the interaction term between the LHD dummy variable and the change in taxes (ΔTAXES), the difference in the reaction between high and low wage workers is statistically significant.

Table 5.13 Final Expanded Model (with control variables)

	1961-2010
ΔTAXES	277.3*
	(0.013)
ΔINCOME	2.487*
	(0.018)
TD	-0.0908
	(0.957)
LHD	-1.041
	(0.479)
TD*LHD	3.243
	(0.151)
ΔTAXES*TD	-527.5***
	(0.001)
ΔTAXES*LHD	-376.1**
	(0.004)
ΔTAXES*TD*LHD	754.6***
	(0.001)
ΔEP	-34.91
	(0.375)
ΔUD	-127.4*
	(0.037)
ΔBD	0.277
	(0.986)
ΔBRR	-30.37
	(0.311)
ΔGAP	1.175**
	(0.003)
ΔEXP	-3.519**
	(0.003)
ΔPMR	-5.012
	(0.394)
ΔTAUC	25.48
	(0.709)
ΔTAUK	21.67
	(0.576)
Constant	-13.59***
	(0.000)
Observations	750
R^2	0.304

Source: Own elaboration

Note: Standard errors are robust to heteroscedasticity, cross-sectional dependence, and serial correlation. Year dummies are included in the model, but not reported in the table. P-values are in parentheses.

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

In the expanded model with control variables, three control variables have coefficients that are significantly different from zero, change in union density, change in output gap, and change in government expenditures. The negative coefficient on the change in union density ($\beta = -127.4, p = 0.037$) means that as union density changes, the number of hours worked moves in the opposite direction. Therefore, an increase in union density decreases the number of hours worked. The positive coefficient on the change in output gap ($\beta = 1.175, p = 0.003$) means that as the output gap changes, the number of hours worked moves in the same direction. Therefore, an increase in the output gap increases the number of hours worked. The negative coefficient on the change in government expenditures ($\beta = -3.519, p = 0.003$) means that as government expenditures changes, the number of hours worked moves in the opposite direction. Therefore, an increase in government expenditures decreases the number of hours worked.

5.4 Marginal effects

To calculate the marginal effects for each group of workers (high and low wage groups where theory worked, and high and low wage groups where it did not), the following equations were used, based on Panel A of Table 5.14.

TD = 0; LHD = 0 (Poor)
ΔHOURS = –15.04 + 5.123*ΔINCOME +240.4*ΔTAXES + e (5.5)

TD = 0; LHD = 1 (Rich)
ΔHOURS = –15.04 + 5.123*ΔINCOME + 240.4*ΔTAXES – .0033*LHD – 349.6*LHD*ΔTAXES + e (5.6)

TD = 1; LHD = 0 (Poor)
ΔHOURS = –15.04 + 5.123*ΔINCOME +240.4*ΔTAXES – 0.701*TD – 512.5*TD*ΔTAXES + e (5.7)

TD = 1; LHD = 1 (Rich)
ΔHOURS = –15.04 + 5.123*ΔINCOME + 240.4*ΔTAXES – 0.701*TD – 0.033*LHD + 2.831*TD*LHD – 349.6*LHD*ΔTAXES – 512.5*TD*ΔTAXES + 757.4*TD*LHD*ΔTAXES + e (5.8)

To see the difference in change in hours worked between countries, five scenarios were constructed. The first was a steady–state scenario, where the change in taxes was assumed the mean change in income and taxes for all countries and all years. The mean change in income was 0.462 and the mean change in tax rates was 0.3%. Substituting these into equations 5.5 through 5.8 results in the following marginal effects (see Table 5.14).

Table 5.14 Marginal effects for a change in tax rates of 0.3%.

	Low Wages	**High Wages**
TD = 0	**–11.970**	**–13.023**
TD = 1	**–12.764**	**–8.776**

Source: Own elaboration

For each type of country, in the average year, the number of hours worked decreases. This reflects the long–term trend of the number of hours worked declining over time.

The same technique can be used to calculate the reaction to hypothetical tax rate changes. For example, a 10% increase in tax rates above the 0.3% average, but holding the change in income constant at the grand mean of 0.462. In this hypothetical scenario, for workers with low wages where theory was shown to hold at the individual country level, the average number of hours worked increases by 12.07. However, for the same scenario but for workers with high wages, the average number of hours decreases by 23.943 (see Table 5.15). This scenario reflects the situation where a tax increase for low wage workers causes after–tax wages to decrease, causing the average worker to increase their hours in order to maintain a subsistence level of income. However, in a rich country in the same scenario workers decrease the number of hours that they work due to a new lower cost of leisure.

Table 5.15 Marginal effects for a change in tax rates of 10.3%.

	Low Wages	**High Wages**
TD = 0	**12.070**	**–23.943**
TD = 1	**–39.974**	**4.794**

Source: Own elaboration

Applying the same technique to five scenarios allows for graphs that demonstrate the marginal effects. The graphs are based on the data points from five hypothetical scenarios outlined below, as shown in Table 5.16.

Table 5.16 Marginal effects used in graph 1 and graph 2.

	Low Wages	High Wages
TD = 0	–36.010	–2.103
TD = 1	14.446	–22.346

	Low Wages	High Wages
TD = 0	–23.990	–7.563
TD = 1	0.841	–15.561

	Low Wages	High Wages
TD = 0	–11.970	–13.023
TD = 1	–12.764	–8.776

	Low Wages	High Wages
TD = 0	0.050	–18.483
TD = 1	–26.369	–1.991

	Low Wages	High Wages
TD = 0	12.070	–23.943
TD = 1	–39.974	4.794

Source: Own elaboration

Figure 5.4 and Figure 5.5 are helpful because they clearly show the differences between workers with low and high wages, in those countries where theory worked and those where it did not. It is interesting to note that the slope of the line is steeper for workers with low wages in both groups, where theory worked and where it did not. This matches previous research that found that workers with high wages are less sensitive to tax rate changes (e.g. Sanders, 1951; Break, 1957; Barlow et al., 1966).

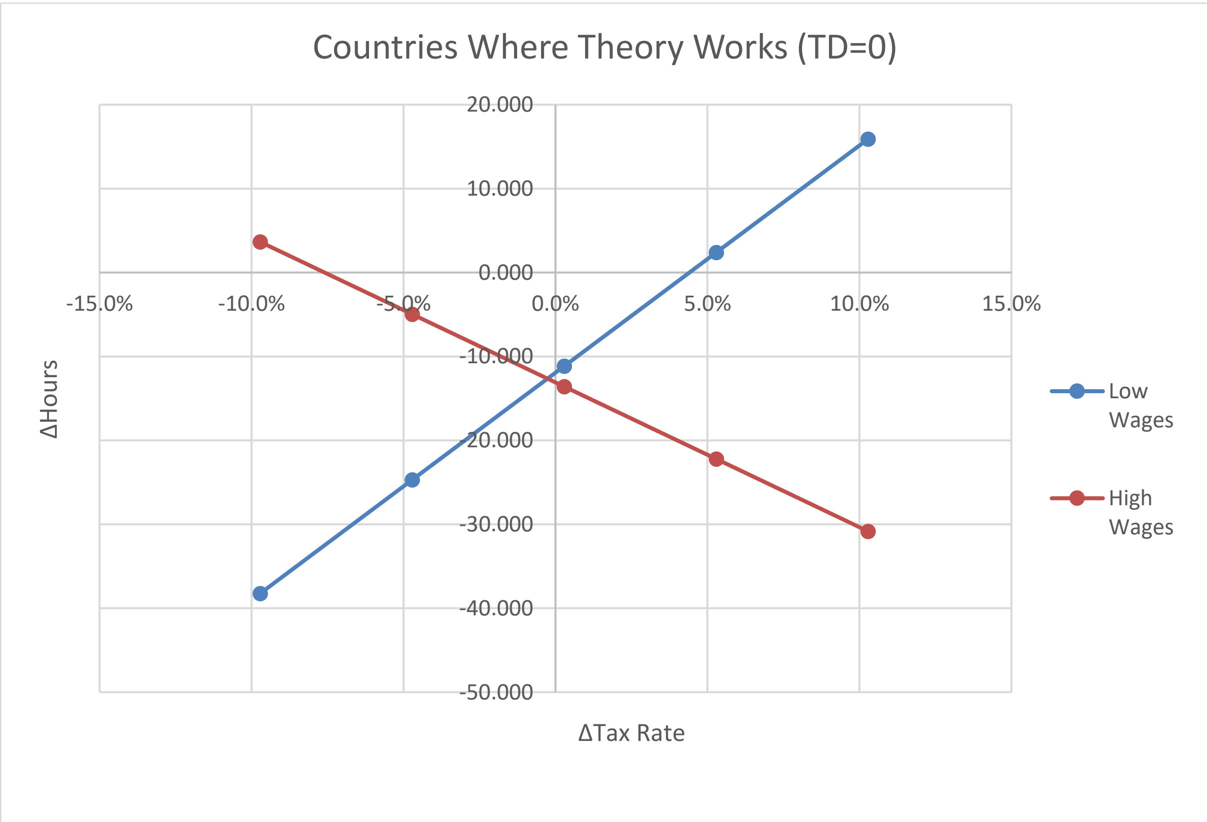

Fig. 5.4: Theory worked
Source: Own elaboration

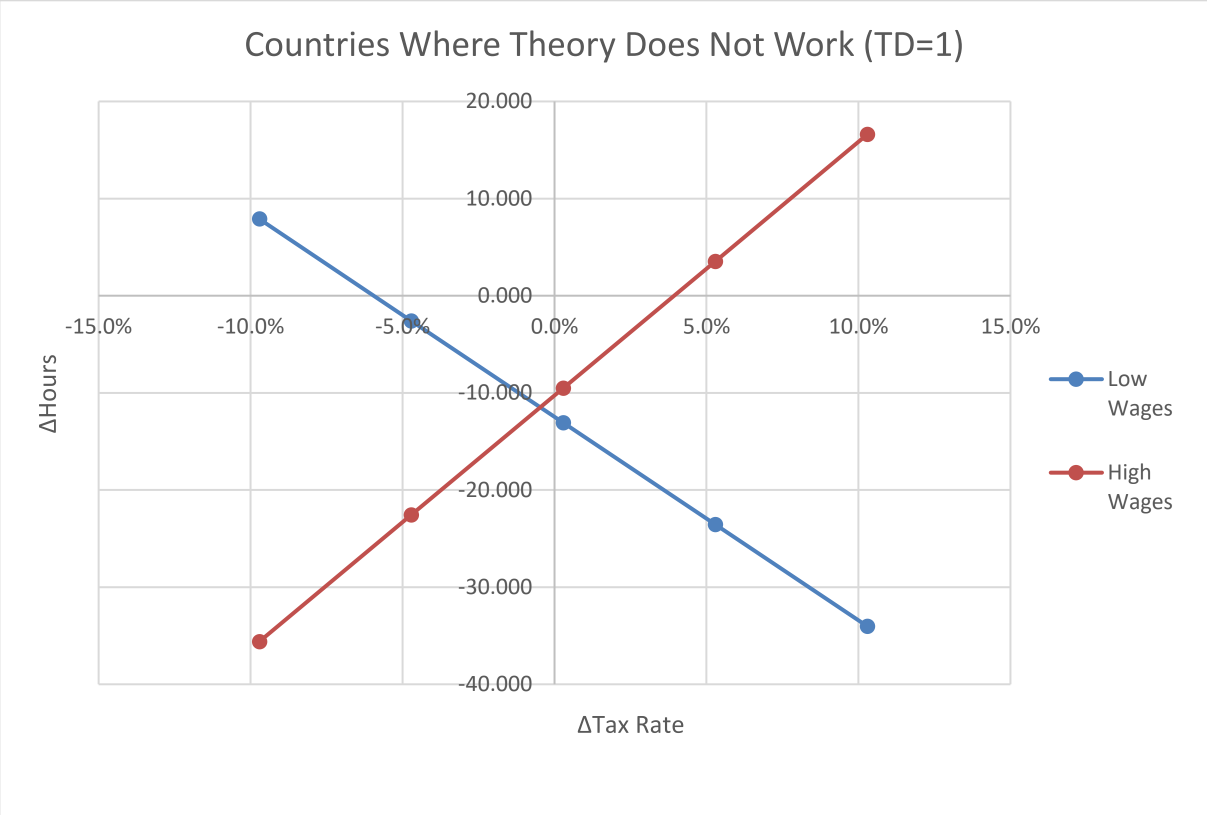

Fig. 5.5: Theory did not work
Source: Own elaboration

6. DISCUSSION

6.1 Analysis

Using data from publicly available sources, this research uses a first differences panel data methodology to examine how changes in taxes affect work-leisure preferences. This contributes to the research on "income taxes and the motivation to work," which has gained considerable attention in the literature, and has been recently investigated in the emerging field of economic psychology. Two novel behavioural theories are presented (Hierarchy of Pecuniary Needs and Differing Utility of Leisure) and demonstrated through simulation scenarios that show new and different patterns in several aspects of the relationship between income taxes and the motivation to work, compared to previous studies. These new behavioural theories explain why the reaction to tax rate changes differs between workers with high and low wage rates. This is applied to the study of the change in hours worked in response to tax rate changes between high and low wage workers. The analysis covers the period 1960 to 2010 in 15 OECD countries.

The primary finding is that theory works well in about half of the countries. For the low wage workers in this group, the average worker increases their hours when tax rates go up and decrease their hours when tax rates decrease. This matches theory proposed, that low wage workers must increase their hours when tax rates increase, to maintain a subsistence level of income. For the high wage workers, when tax rates go up the workers work less because the cost of leisure decreases, and workers with high wages have a very high utility from leisure due to a large opportunity set their wealth provides. These findings are similar to previous research using cross-country general equilibrium models, that taxes have a negative effect on the labour supply in wealthy countries (e.g. Prescott, 2004; Davis and Henrekson, 2004; Ohanian et al., 2008).

In the other group of countries where the new behavioural theories did not work, the findings were the opposite. For the low wage workers in this group, the average worker decreases their hours when tax rates go up and increase their hours when tax rates decrease. This matches previous theory that says that when tax rates increase workers will choose leisure due to the new lower cost of leisure. However, for the high wage workers within this group the average worker increases their hours when tax rates go up and decrease their hours when tax rates decrease. This is explained by the income effect in traditional economic research (e.g. Pigou, 1920; Robbins, 1930; Hicks, 1939, 1946), and matches some of the developing theories on reference groups, that wealthy individuals might judge themselves against even wealthier individuals (e.g. Groot and Van Den Brink, 1999; Ferrer-i-Carbonell, 2005), and when tax rates go up they increase their hours to try to stay as close to this reference group as possible. The finding that workers with high wages increase their working hours when tax rates increase in the same line with prior survey studies such as Sanders (1951), Break (1957), and Barlow, et al. (1966). Experimental evidence provided by Fochmann et al. (2013) also supports this idea, but they give an alternative explanation for why higher income people work more under higher taxes. They provide that it is because of a “net wage illusion” (when individuals work more they assume that their gross wage is higher and therefore their net wage will also be higher). Moreover, the best example for this finding is the cross-country study of Faggio and Nickell (2007). They find that in a wealthy country like Sweden, people work more under higher taxes, and provide that taxes are just one part of the story, but there is a much that remains to be explained. It is likely that the remaining part of the story can be explained with “Veblen effects” (Easterlin, 1974; Hirsch, 1976; Scitovsky, 1976; Layard, 1980; Cole et al., 1995; Bagwell and Bernheim, 1996; Frank, 1997; Frey and Stutzer, 2003; Ferrer-i-Carbonell, 2005; Bertrand and Morse, 2016; Oh et al., 2012) as well as the developing theories on reference groups.

In the final expanded model with control variables, three control variables were significant, change in union density, change in output gap, and change in government expenditures. The effect of union density is negative, in line with theoretical predictions (e.g. Slichter, 1941; Lewis, 1966; Oswald, 1985; Boal and Pencavel, 1994) and empirical finding (e.g. Alesina et al., 2005). But, as mentioned in the literature review section, some of the empirical studies have found a positive relationship between union density and hours worked (e.g. Burgoon and Baxandal, 2004; Bowles and Park, 2005; Bassanini and Duval, 2006; Faggio and Nickell, 2007; Causa, 2009), and the most pervasive story for this finding in these studies is that they are missing wage inequality. However, the econometric model proposed and used here removes within-country wage inequality by dividing workers into high and low wage groups. Therefore, the effect of the union density is negative in the current analysis.

The second significant control variable was government consumption. The effect of government consumption on the motivation to work is negative. As government consumption increases the number of hours worked decreases. This is consistent with previous findings, supporting the idea that individuals consider government expenditures as non-useful government consumption (e.g. Dhont and Heylen, 2009; Berger and Heylen, 2011). This result is believed to hold when the proxy variable for general government consumption contains more "non-employment benefits" rather than "productive expenditures". It is useful to examine this result from an equity-efficiency trade-off. Non-useful government consumption mainly refers to traditional welfare programs, which redistribute tax revenues from high-income earners toward low income-earners. Traditional welfare programs mainly support low-income earners and these programs have been criticized for keeping low-income earners out of the labour force (Brewer et al., 2010). In addition, high-income earners do not want to work more because these traditional welfare programs do not produce valuable services for them. In general, average workers in both wage groups reduce their motivation to work due to the aforementioned issues.

The third significant control variable was output gap. Theory says that increases in output gap positively affect the labour supply. The results of the output gap are in line with theoretical prediction and previous empirical findings (Bassanini and Duval, 2006; Berger and Heylen, 2011).

6.2 Contribution to science and practice

The motivation for this research came from the opportunity to contribute to both science and practice. Economic psychology is a growing field due to its ability to explain behaviour where simple "rational man" arguments fall short (Alm and Sheffrin, 2017). The complex psychological effects of taxes on behaviour make it a good field for applying relatively new techniques and ideas. The primary contributions of this work come from the new theories developed, the simulation model developed to demonstrate the theories, and the opportunities for future research presented by the results.

In order to explain the relationship between changes in income taxes rates and changes in the number of hours worked, two original theories were developed, the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure. Although both predict similar reactions for groups of workers with low and high wages, they are subtly different. The Hierarchy of Pecuniary Needs primarily applies between low wage workers near the subsistence level of income and high wage workers clearly above it. Whereas the Differing Utility of Leisure applies to any workers at any two distinct wage levels, one higher than the other. In order to demonstrate the theories and the differences between them, a novel simulation was developed.

The simulation used to demonstrate the theories is unique in this line of research. Only by showing dynamically how the variables interact for 1,000 hypothetical workers does the intuition behind the theories become clearly evident. The benefits of the simulation are that it shows what could happen if the theory is true, presents the results in a graph that is clear and easy to understand, it is easy to change to demonstrate a wide variety of scenarios, as was done in the theoretical development section of the paper.

The third contribution of this work is advancing and testing new theory, as prescribed by the scientific method (e.g. McLelland, 2006, Proulx, 2004). Advancements in science occur by going through stages to reach tentative conclusions. This process is summarized in Figure 6.1.

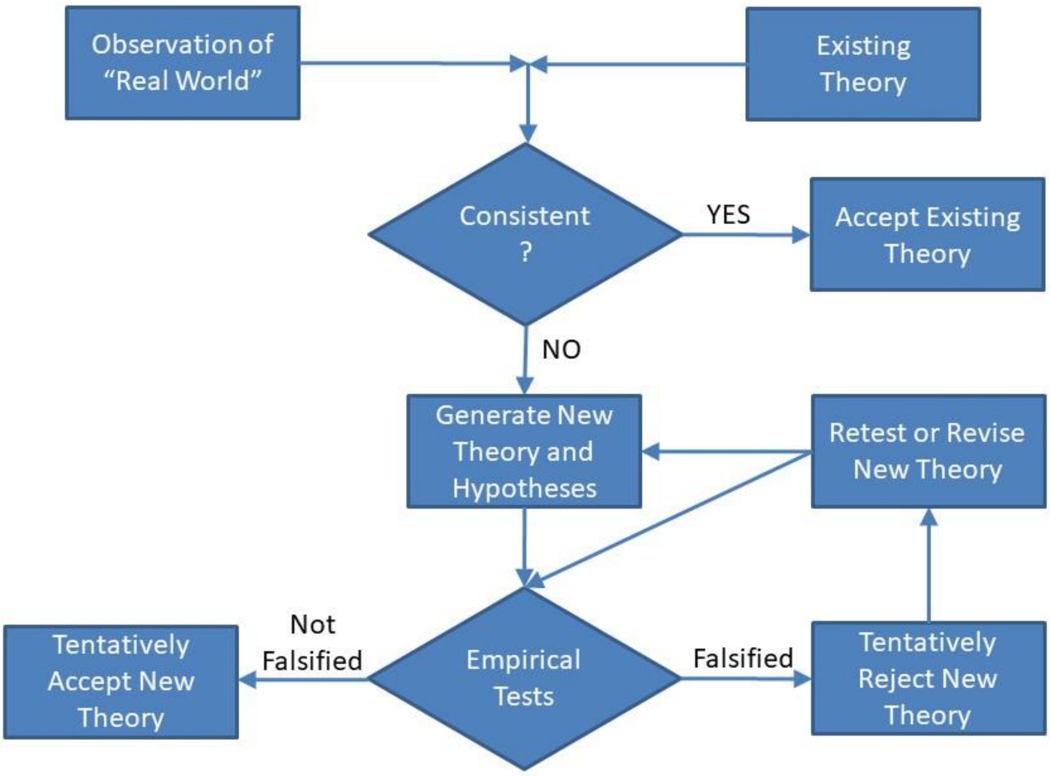

Fig. 6.1: The Scientific Method
Source: Dehning, (2010)

After completing the empirical tests with Baseline Model, it was not possible to reject the null hypothesis that the reaction to income tax rate changes was different for low and high wage groups. At this point, it was clear that the theory needed to be retested, and/or revised and new tests performed. Simple retesting would be difficult, due to the limited tax rate data available. However, testing could be performed on a subset of the data, to see if there were conditions under which the theory held. Therefore, the individual country analysis was performed, and the subsequent expanded model developed. The encouraging results of the empirical tests using the expanded model provide motivation for subsequent research, revising the existing theory, and new empirical tests.

The next step in the research between income taxes and the motivation to work will focus on developing theory regarding under what conditions the theory is most likely to hold, and when it might not hold. Or when the effects predicted by the theory will be small and therefore not detectable using standard econometric methods. For example, some countries changed more dramatically than others during the 50 year sample period. It is possible that using average income over the entire 50 years was too simple of a classification method for high and low wage groups, and shorter time periods with changing low/high income classification will lead to more reliable results. There are also several factors that vary by country that might limit the applicability of the new theories proposed. For example, in countries with strong collective bargaining, individual workers are less able to adjust the number of hours that they work in response to tax rate changes. Similarly, in countries with broad social welfare programs, workers' decisions might not be impacted by the cost of basic needs. In these countries, the Hierarchy of Pecuniary Needs would not apply. There are also cultural differences between countries that lead to different average utility from leisure that is unrelated to income level, as predicted by the Differing Utility of Leisure. This would also weaken the empirical tests and the ability to detect a difference between the reactions of low and high wage groups.

Revising the theory will require an extensive examination of the structural, economic, and cultural factors that might influence the applicability of the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure. Once the most likely factors are identified, variables will be created to represent the factors, and tested to see if they can discriminate between the two groups of countries, the ones where the theory worked and those where it did not. It is possible that this will lead to revision of the existing theory or perhaps entirely new theory. Either way, new empirical tests will be necessary to try to test the new or revised theory.

Although the empirical results of the baseline model are discouraging, it is not without optimism that additional research proceeds. In almost half the countries the theory does appear to work, and perhaps there is a systematic way to classify these countries. If so, then the results should allow policymakers to examine the characteristics of their own country to understand better the reaction workers have to changes in tax rates.

One of the main policy implications of the results is that if governments consider labour supply responses and their effect on economic productivity, then they should definitely rely on labour income taxes (fiscal policy) and the differing utility of leisure (societal preferences) as well as institutional factors. It should be possible to measure the motivation to work by properly disentangling “institutional factors,” “fiscal policy,” and “societal preference.”

The results of this research stream will also help policymakers in setting tax policy, to understand better the potential impacts on the labour force. Increasing tax rates can result in less tax revenue if workers decrease their hours worked to more than offset the effects of the tax increase. The potential even exists that tax revenue can increase when tax rates are decreased due to increased output by labourers.

6.3 Limitations of the research

As any empirical study that uses archival data, there are some limitations. First, the sample covers 50 years, during which there were numerous periods of economic growth and contraction, changes in labour laws, changes in technology, development of robots and automation that displaced large portions of the workforce, globalization, etc. The sample also only covers 15 countries. Any conclusions drawn are limited to those countries during the time period examined. In addition, the present analysis cannot disentangle labour demand from labour supply.

There are numerous cultural factors that affect the motivation to work and the work-leisure trade-off. Although country-specific factors were included for structural differences between countries, no variables based on culture or sociological factors were included that might explain cross-country differences in the reaction to changes in tax rates. Including these variables might increase the power of the tests, and help explain the finding that theory presented only worked in about half of the sample countries.

Despite the fact that the evidence supports the new behavioural theories, there are still several challenges. The model does not intend to estimate labour supply at the extensive margin. Moreover, the motivation to work is identified with market hours in the analysis and thus it is not possible to find the distribution of work between home production and market.

It is less straightforward to make policy conclusions from the results of the current study regarding specific socio-economic characteristics and heterogeneous work-leisure preferences. Individual work-leisure preferences may only be expressed by using time-use survey data. Because the data used is measured at the country-level, individual preferences are lost. However, one should also keep in mind that time-use surveys are not available for countries in the same years, which precludes their use in between-country research. This is the reason why country level data is used, particularly national accounts based estimates.

Another limitation of the current study is that the classification of high and low wages does not switch from 0 to 1 or from 1 to 0 over time. The dummy variable used to distinguish high and low wages is considered fixed, meaning that it has no temporal variation. This same issue exists for the dummy variable that is used to discriminate between the countries where theory works and those countries where it does not. Theory dummy variable does not change from 0 to 1 or from 1 to 0 over time. This is a limitation, because it is possible the ordering of average wages changed during the 1960-2010 period.

7. CONCLUSION

7.1 Synopsis

The motivation behind this work was to improve upon the economic theories of the income and substitution effect, which have been found to be incomplete in their ability to predict how workers will adjust their hours worked in response to changes in income tax rates. Based on almost 100 years of previous research in economics and psychology, two new behavioural theories were developed, the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure. Based on these two theories and a simulation designed to demonstrate them, predictions were formulated that in groups of low wage workers, changes in hours worked would be positively correlated with changes in tax rates. An increase in income tax rates would cause workers to increase the number of hours worked, and a decrease in income tax rates would cause workers to decrease the number of hours worked. Oppositely, in groups of high wage workers, changes in hours worked would be negatively correlated with changes in tax rates. An increase in income tax rates would cause workers to decrease the number of hours worked, and a decrease in income tax rates would cause workers to increase the number of hours worked.

To test the theory, data was gathered for 15 OECD countries for the period 1960-2010. This included data on income tax rates, hours worked, income levels, and several other variables that are believed to influence the relationship between income taxes and hours worked. A first differences panel data econometric model was used in empirical tests to assess whether the changes in hours worked as a response to changes in tax rates, was different for high and low wage workers.

The empirical results were mixed. The initial empirical tests using a baseline model failed to confirm the predictions made by the theories and demonstrated using a simulation. However, subsequent analysis shows the possibility of the theory being country-specific rather than being broadly applicable, and demonstrates that further research is necessary.

7.2 Further research

Although there was no significant difference in the reaction between the high and low wage groups, further testing led to encouraging prospects for future research. The theory was found to hold individually for about half of the countries in the sample, and when pooled together the difference between the low and high wage groups was statistically significant in these countries. However, this result alone is not adequate to confirm the new theories developed, because in half the countries the new theories clearly did not work. What this finding does, however, is provide motivation for further research, to try and determine under what conditions the theory holds and when it does not. If there are systematic differences that can be used to determine if workers are likely to behave as predicted by the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure, then the theory can be revised to include the modifications.

The new behavioural theories presented provide a broad foundation for additional future research. First, although theory presented was found to hold for a variety of low and high wage groups, it did not hold in the broad sample. The possibilities presented by exploring this finding are numerous. There are possible methodological extensions, such as searching for non-linearity in the data, or using the Quandt Likelihood Ratio (hereafter QLR) test to define if there is temporal variation in the wage groups over time. The QLR test is a modified version of Chow test. While the Chow test is appropriate when the structural breaks are known, the QLR test defines unknown structural break points.

It is also important in future research to examine periods of economic growth and contraction, breaking the sample down into smaller time periods, and reclassifying workers into high and low wage groups as they change at different rates over time. There are additional tests of theory, including measuring the utility of leisure for workers within a country and seeing if it varies between high and low wage earners, examining the impact of culture on the utility of leisure, and searching for the inflection points predicted by theory of the Differing Utility of Leisure.

As micro level data becomes available, numerous additional questions can be asked about the relationship between taxes and the motivation to work. The main possible extension to the current study can be done by introducing labour force heterogeneity. For example, the impact of age and gender, households with one instead of two working parents, and others. Moreover, by incorporating labour demand into the analysis, a more comprehensive model can be provided. Laboratory experiments might be used to compare the psychological impact on motivation for similar after-tax wages but different tax rates. For example, do two workers making the same after-tax wage behave differently when one is faced with a 10 percent tax rate and the other a 50 percent tax rate? How does it change based on the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure? Can students be used in laboratory experiments that they are under subsistence level of income and employees that they are above subsistence level of income?

McDaniel (2017) updated her data for 38 countries, but for fewer years. In the current study, 15 countries were selected because of the longer time series. Future research can examine the models based on the Hierarchy of Pecuniary Needs and the Differing Utility of Leisure for all 38 countries. Despite having data until 2016 for the dependent variable (hours worked) and explanatory variables (average labour income taxes and average national income), the time period used ends in 2010, because most of the control variables included into the model are available until that time. In addition, a better understanding can be obtained by looking more closely at interaction terms among the control variables. Moreover, there are few macroeconomic shocks in the current study, such as tax rates and output gap. By incorporating additional macroeconomic variables, for example oil price, future research can also test the models in resource-rich and non-resource-rich countries.

In any scientific endeavour, theory is constantly being tested and revised as new information and results are discovered. The two new theories presented here were empirically tested for the first time. Therefore, no results can be considered good or bad. The results simply give the researchers information on whether the theory is closer to being confirmed, or whether it needs further testing or revision. It is with this thought in mind that research in this area will enthusiastically continue.

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2. Nadirov, O., Dehning B., Aliyev K., & Iskandarova M. (2017). Who reacts to income tax changes? The relationship between income tax and motivation to work: The case of Azerbaijan. *Scientific Papers of the University of Pardubice, Series D*. No. 40.
3. Aliu, F., Knapkova, A., Aliyev, K., & Nadirov, O. (2016). Factors affecting interest rate risk: The case of Kosovo. *Proceedings of the 6th EACO International Scientific Conference.* 2017, pp 1-15. ISBN 978-80-905405-2-1
4. Aliyev, K., Dehning, B., & Nadirov, O. (2016). Modelling the Impact of Fiscal Policy on Non-Oil GDP in a Resource Rich Country: Evidence from Azerbaijan. *Acta Universitatis Agriculturaeet Silviculturae Mendelianae Brunensis*, *64*(6), 1869-1878.
5. Dehning, B., Aliyev K., & Nadirov, O. (2016). Modelling ‘Productivity’ of Budget Expenditure Items Before-and-After the Oil Boom in a Resource Rich Country: Evidence From Azerbaijan. *International Journal of Economic Research*, Vol. 13, No. 3, 2016, pp. 991-1023.
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10. Nadirov, O., &Aliyev, K. (2015). Informality, Tax Evasion and the Quality of Business Environment: Evidence from South Caucasian Countries. *European Journal of Business Science and Technology*, *1*(2), 114-127.
11. Nadirov, O., &Aliyev, K. (2015, February). Do high corporate income tax rates demotivate entrepreneurs? The case of Azerbaijan. In *Conference Proceedings of MEKON 2015 Selected Papers*.
12. Yusifov, P. S., Nadirov, O., Hasanov, U., Ismayilov, T., & Bakhishli, I. Tax reform in Azerbaijan: effectiveness and efficiency. *Caucasus and Central Asia in the globalization process". IV international congress*.

13. Suleymanov, E., & Nadirov, O. (2014). Türkiye Örneğinde Enflasyonla Ekonomik Büyüme Arasında İlişki (The Relationship between Inflation and Economic Growth in the Case of Turkey). *Journal of Qafqaz University-Economics and Administration*, *2*(2).

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The Relationship Between Changes in Income Tax Rates and the Motivation to Work

Vztah mezi změnami sazeb daně z příjmů a motivace pracovat

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