The impact of tax incentives on economic activity of entrepreneurs

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Abstract

Based on existing evidence, we know little of how taxation of small business owners affect their economic activity. To shed new light on this topic, this paper studies the effect of two Finnish tax reforms in 1997 and 1998 on economic growth, employment and profit margins of small businesses. The reforms affected the income tax burden of business owners by changing the share of income taxed as capital income. The reforms applied only to unincorporated firms, leaving corporations out. Therefore we are able to use difference-in-differences strategy to estimate a causal impact of tax incentives on economic activity of small businesses. The change in incentives grew with the size of the firm, enabling us to study heterogeneous treatment effects. The results imply that lighter taxation leads to a modest increase in turnover and profit margin of firms, but does not affect employment.

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1 Introduction

Small businesses are seen as one key source of economic growth. For this reason, myriad economic policies have been devoted to promote this growth (Buss 2001). Various theories exist about which kind of activity in small businesses leads to economic growth and how this can be affected through taxation. One explanation is that taxation affects risk taking opportunities of entrepreneurs (Cullen and Gordon, 2007), and another is that taxation affects opportunities for maintaining external funds (Carpenter and Petersen, 2002). The puzzle is that major share of entry is made by firms that never grow very large. Therefore, from the perspective of economic growth, few firms that eventually grow large are important. This paper argues that one reason for small firm to grow larger relates to economic activity of entrepreneur. This activity can be promoted or hindered with taxation in a similar way than labor effort of employees. We establish this in a theoretical model and study empirically how much tax burden of entrepreneurs affects the output of their firms.

We are interested in determinants of real economic activity decisions of entrepreneurs. Earlier literature has established that the effect of tax system on effort of entrepreneurs is ambiguous (Carroll *et al.* 2001) and depend on type of entrepreneur and opportunities (Kanniainen *et al.* 2007). However, it is not clear how much and in what way real economic activity of entrepreneurs can be promoted through taxation. We build a simple theoretical model that answers this question. In the model it is essential that an entrepreneur can affect her own tax burden and consumption opportunities either through increasing effort or shifting assets from one period to another. The former is a real economic decision that entails utility cost, while the latter affects the timing of lifetime consumption opportunities. Shifting assets could also be seen as tax planning. We establish that in this environment more lenient income taxed income from firm can either increase or decrease effort exerted by an entrepreneur. The direction of this effect depends on how forward looking an entrepreneur is.

Empirically entrepreneurs and small businesses have turned out to be

elusive to analyze. The first problem is to identify the effect of taxation on behavior of small businesses. We contribute to this by being able to analyze two Finnish reforms that affected taxation of owners of unincorporated firm but left taxation of owners of corporations intact. In most of the cases the reforms we study reduced the marginal tax rates of the treated group. With these reforms we can apply a natural experimental approach that allows us to get rid of the severe endogeneity problems present in firm level data. We are able to allocate all changes in taxation to changes in turnover, profit margin and wage sums of firms. Furthermore, we can control for unobserved changes in these outcomes by comparing treated firms with similar control firms, which only differ in their legal form.

The second problem is how to observe actual economic activity. We have access to firm level tax record data that include output of firms. We argue that increase in output value of firm is first indication of economic activity that leads to economic growth. Thus we contribute by assessing how the changes in taxation affect the output of small businesses. We confirm our results by estimating the effect of the tax reforms on other outcomes, like profit margins, wage sums and number of employees, assets and input use. Real economic activity of an entrepreneur increases if output of her firm increases and there in no increase in input use at the same time.

The results indicate that decreasing marginal tax rate of an entrepreneur increases turnover from her firm. Our main specification that compares partnerships with companies indicates that 10 percent reduction in marginal tax rate leads to 2 percent increase in turnover. The result for smaller sole proprietors is zero. We also find that more lenient taxation led to a bigger increase in profit margin. This difference implies that part of the increased income from the firm is due to tax avoidance and part due to increased economic activity. Wage sums increase, but especially for partnerships there is no indication of employing more personnel. Thus it seems that the reforms did not increase labor demand.

Earlier literature has established that more progressive income taxation reduces the willingness to take risk, and thus would lead to less entrepreneurial activity (Kerr and Nanda 2009) and lower economic growth

(Cullen and Gordon 2007). Our results indicate that more progressive taxation might also reduce the entrepreneurial effort and affect economic growth in that way. Carroll et al. (2001) find a large elasticity on gross receipts from the firm. However, we do not find that elasticity. One reason for the difference is that we are able to control for many selection problems. Moreover, the result is significant only for part of the treated group.

Apart from changing their output, an entrepreneur could respond by tax planning. One indication of this kind of activity is that more firms choose legal forms that are more leniently taxed (Gordon and Mackie-Mason 1994). The deadweight loss resulting from taxation has been empirically studied by regressing tax differential of different legal forms on share of legal forms (Mackie-Mason and Gordon 1997, Goolsbee 1998b and 2004). We also study how tax reforms affect the switching of legal forms, as well as entry and exit behavior. We do find that more lenient taxation for partnerships made switching from partnerships to corporations significantly less common phenomenon. Still the number of firms that potentially switch their legal status is so small that taking into account the switching behavior does not affect our main results. Furthermore, we find that the reforms made entry more common and exit less common for the treated group.

We also contribute to literature studying policies that directly aim to boost employment. The 1997 reform added part of the wage sum to an imputed income rule, where capital income from firm is imputed. This feature of the reform made the impact of the reform stronger on firms that had higher wage sums. Earlier papers have analyzed policies where payroll taxes are reduced, which has a similar effect on firms than the 1997 reform wage sum rule. The results indicate that employment increased only very modestly, if at all (Korkeamäki and Uusitalo 2009). Bennmarker *et al.* (2009) found that wages increased as a result of payroll tax abolishing, but employment did not. This is in line with our result. In contrast, Duranton *et al.* (2011) find that increases in local tax rates can reduce labor demand of firms.

The rest of the paper proceeds as follows: section 2 presents the macroeconomic conditions at the time of the reforms, describes the institutional aspects of firm taxation and presents a theoretical model that describes how an

entrepreneur would respond to changes in tax incentives. Section 3 presents the econometric specification and discusses identification issues. Section 4 presents the data and descriptive statistics derived from them. Section 5 presents the results and robustness checks. Section 6 concludes the study.

2 Economic conditions and institutions

2.1 Macroeconomic situation surrounding the reforms

The mid 1990s were a period of economic growth in most developed countries. This is true for Finland as well, but the deep recession between 1991 and 1993 makes Finnish situation particular. However, the economy was already recovering from it in 1997, when the first reform we study took place.

The severity of recession and the subsequent growth can be seen from figure 1, where the development of Finnish GDP per capita and unemployment rate is compared with neighboring Sweden and the OECD average. The vertical line marks year 1997, when the first reform took place. In early 1990s in Finland GDP fell heavily and unemployment rose compared to other countries. Finland experienced a very deep recession. However, when the reforms of 1997 and 1998 targeting partnerships and sole proprietors took place, the Finnish economy had been already growing for few years. Note also that there is no visible deviation from the general time trends in Finland on 1997 or 8. This indicates that the reforms did not have significant and immediate macroeconomic consequences. This is not a concern for the current study, since the reforms were targeted to small part of Finnish economy. Moreover, significant macroeconomic effect would have weakened our identification strategy, since then the general equilibrium effects would have caused a concern, a feature that we could not control for.

2.2 The institutional background and reforms

The income tax system in Finland for income from firms is a variant of imputed income method (Boadway and Bruce, 1984) or similarly a variant of

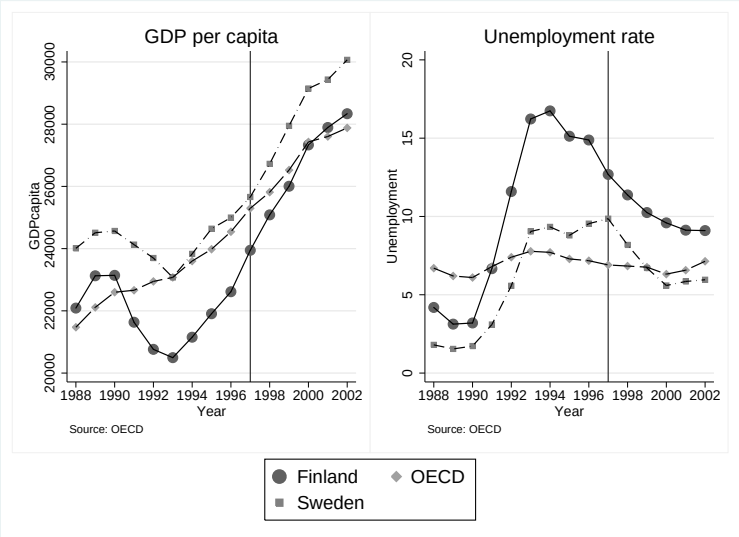


Figure 1: GDP per capita and unemployment in Finland, Sweden and OECD average over time.

comprehensive business income tax (Auerbach *et al.* 2010). It is called Dual Income Tax (DIT) system and has been in place since 1993 in Finland (Kanniainen et al. 2007). In DIT income from a company is taxed as a part of personal income, which is different from an allowance for corporate equity (ACE) system. Income from firm is split into capital and earned income by a predetermined rule (Lindhe et al. 2004). The split is made according to a fixed share of net assets of previous year. The earned income tax is progressive with highest marginal tax rates being over 60 % and capital income tax proportional 28 % in 1997. Therefore when total income is high enough, earned income is substantially more heavily taxed than capital income.

The reforms in 1997 and 1998 affected the income split rule from unincorporated firms. The 1997 reform had been planned for a while, but the details were changed last minute (HE 105/1996). It was only in September 1996 that the government announced that there is going to be a new tax rule, where part of the wage sum is added to the net assets of the firm. Thus the firms did not have time to anticipate this reform. The law was passed in last weeks of 1996 and there was not much discussion about it in Finnish newspapers prior to the end of 1996.

In 1996, prior to the reform, a sum of 15 % of net assets of previous year was considered as capital income. This changed in 1997 to 18 % of net assets. Even larger change was that 30 % of the wage sum of previous year was added to net assets. Therefore marginal tax rate declined for all entrepreneurs who had an unincorporated firm and who had enough income so that their earned income tax rate was higher than capital income tax rate. The splitting rule can be presented as a formula as follows:

$$CI = p(A + xWL)$$

where CI is capital income, A assets and WL wage sum. The 1997 reform increased p from .15 to .18 and x from 0 to 0.3.

The 1998 reform ended a transit rule where long term debt had been added to the asset side of net assets (ITL 1992). Therefore the 1998 reform reduced the net assets of an affected firm, contrary to the 1997 reform. As a result the tax burden increased for firms that had any long term debts and whose earned income tax rate was higher than capital income tax rate. The transit rule was created in a law that took effect from the beginning of 1993. This is the same law that created the DIT system for unincorporated firms, and concequently for all income earned in Finland.

The total marginal tax rate for the total income from the firm is defined as the marginal increase in tax from marginal increase in income. It depends on how much is splitted into capital income and also on how high is the marginal tax rate on earned income. The latter depends on the total earned income of the taxpayer. Figure 2 presents four different scenarios of total marginal tax rate and how this changes in the dual reforms. The dip in the marginal income tax schedules occurs when the earned income tax rate is kicking in, which is lower than capital income tax rate for the lowest incomes. The total marginal tax rate features two polar cases depending on the size of net assets. It is possible that some firms have so much net assets that they only pay capital income taxes. On the other hand, if they do not have positive net assets, they only pay taxes according to earned income tax schedule. Neither of these polar cases are interesting for our analysis here, since we are

interested in cases where marginal tax schedule shifted due to a change in imputed capital income.

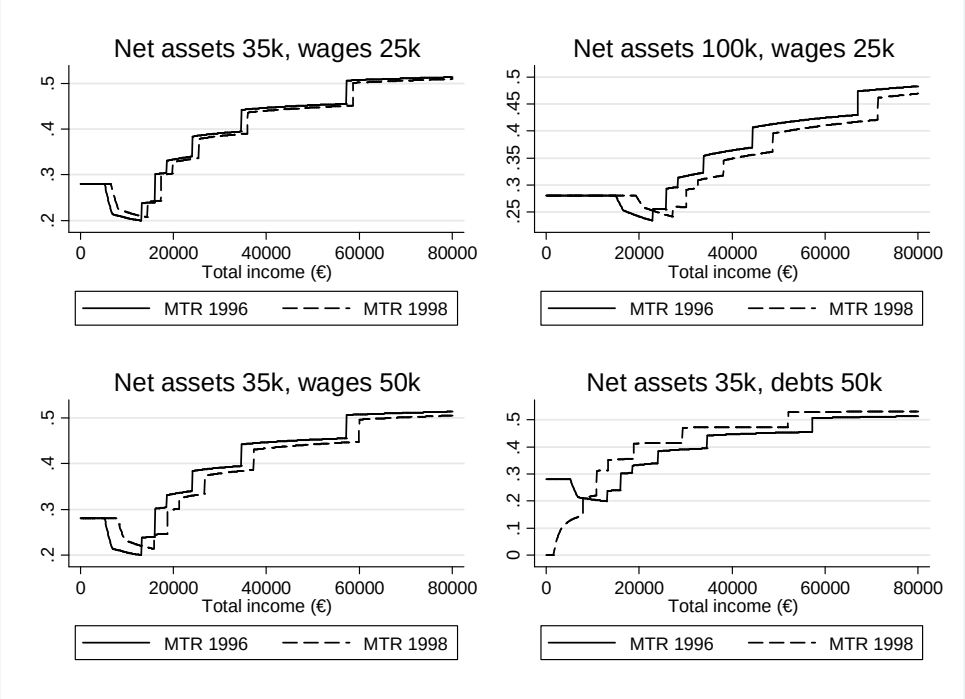


Figure 2: Marginal tax rates before and after the two reforms

Note: Each panel shows marginal tax rate schedule of total income from unincorporated company before and after the two reforms in 1997 and 1998. Figure presents four different combinations that affect the splitting rule between capital and earned income.

The two reforms affected the marginal income schedule depending on the size of net assets, wages and long term debts in the firm. It is evident that the 1997 reform, which affected imputed income rule in favor of capital income, eased the tax burden of everyone high enough in the marginal tax schedule. On the contrary, for those having low income, the reform increased the marginal tax rate. On the contrary, those that had high enough long term debts and high income, experienced an increase in marginal tax rates.

At the time of the reforms, firms could not choose how the income split was made. However, they could engage in tax planning by altering their net assets, or after the 1997 reform, by increasing their wage sum. Firms can

naturally choose their legal form, thus they could switch to less taxed legal forms. In Finland, prior to the 1997 reform, it was thought that corporated firms were tax favored. Part of the motivation for the 1997 reform was to restore the tax neutrality across legal forms of firms.

2.3 Model of entrepreneurial choices

We investigate the effects of the 1997 and 1998 tax reforms with a theoretical model. The idea of the model is to focus on the choices an entrepreneur makes in imputed income method tax system, as Kanniainen *et al.* (2007) did. Carroll et al. (2001) also focused on changes in entrepreneurial effort decisions as a response to changes in tax system, as we do. The distinction with our model from earlier literature is that we let entrepreneurs to affect their own tax rate through tax planning on top of effort level choice.

We employ a two period model, since the tax system affects and depends on time dependent decisions, like saving. The model will highlight how time preference, alternative return to savings and tax rules together affect the effort and saving choices of an entrepreneur. The model abstracts from the details of tax system, since the idea is to focus behavior of an entrepreneur in a world of imputed income method tax system. However, we retain enough structure from the actual Finnish tax structure in the model, so that theoretical predictions can be linked with empirical analysis below.

In the model there is an utility maximizing entrepreneur. She produces income by exerting effort in a firm. Entrepreneur enjoys utility from consumption and dislikes effort. There are two periods. In the first period the entrepreneur makes relevant production choices and may transfer negative or positive income to the second period either within firm or from own consumption. In the second period world ends and the entrepreneur enjoys the consumption from savings and exogenous income and assets. The idea of this model is to look at the effect of the special tax rule, that allows taxes to be affected by income transfers within a firm, on the choices of the entrepreneur.

An inter-temporal utility function is written into separable utility form

$$u(c_1) + h(e_1) + \delta u(c_2)$$

where $c_1$and e_1 refer to consumption and effort in period 1 and c_2 consumption in period 2. The utility function has following properties: $u_c > 0$, $u_{cc} < 0$, $h_e < 0$ and $h_{ee} < 0$. The discount rate is $0 < \delta < 1$.

The entrepreneur has a firm that produces income y_i in period $i = 1, 2$. In the first period the entrepreneur produces income in the firm using effort. The production function is proportional in effort and is denoted ne_1, $n > 1$. In the second period the entrepreneur earns only exogenous income Y. The entrepreneur can also transfer income from period 1 to period 2 using two different income transfers. The first is to transfer amount of m income within firm. This also reduces the exogenous assets A already in the firm. Income transfer m captures the possibility to increase net assets A within firm over time. The net assets A left in firm are consumed in the second period. The second method to transfer income is to save or dissave amount R from private consumption with interest rate $r > 0$. The incomes from the firm for the two periods are denoted as follows:

$$y_1 = ne_1 - m$$

$$y_2 = Y + m$$

The entrepreneur consumes the income from the firm, but needs to pay taxes from that income. The periodic budget constraints are written as follow:

$$c_1 = y_1 - T_1(y_1, \mu(A - m)) - R$$

$$c_2 = y_2 - T_2(y_2, \mu(A + m)) + rR + A$$

The tax functions and their effect on endogenous variables are the focus of this model. The periodic tax function T_i in period i depends on two arguments; income y_i and net assets within firm $\mu(A - m)$. The special tax

rule is affected by exogenous assets A, that an entrepreneur can affect through an income transfer m from period 1 to period 2. This transfer is multiplied by a parameter μ that reflects the share of net assets used to calculate the share of income liable to capital income tax. We denote $T(y, \mu(A-m)) = T(y, A)$ to simplify the notation. The more income is transferred within firm, the smaller is tax burden due to the special tax rule ($\frac{\partial T}{\partial m} = T_m < 0$) and this relationship is constant in income ($T_{mm} = 0$)[1]. We also assume $T_\mu < 0$ and $T_{\mu\mu} < 0$. This special tax rule captures the fact that increasing net assets in the firm reduces the marginal income tax rate. This is line with imputed income method that allows as a function of assets larger share of profits being taxed at lower capital income tax rate. Finally note that the special tax rule is not affected by savings from private consumption R, which is again similar to the actual tax reform.

We insert the for the consumptions in the utility function from the periodic budget constraints and get as the inter-temporal objective function:

$$\begin{aligned} U &= u_1\left(ne_1 - m - T_1\left(ne_1 - m, A\right) - R\right) + h(e_1) \\ &+ \delta u_2\left(Y + m - T_2\left(Y + m, A\right) + rR + A\right) \end{aligned}$$

We first present conditions from FOCs for tax rates and m. Inserting from 3 to 4, it follows:

$$r\left(1 - T_{1y} - T_{1m}\right) = 1 - T_{2y} - T_{2m}$$

This condition reveals that the net of tax rates in the two periods are linked by the interest rate. Without the special tax rule that induces the terms T_{im}, the interest rate would equal the ratio of marginal tax rates in the two periods.

We are interested in the effect of parameter μ, that reflects the significance of special tax rule, on the choice variables effort and savings within firm. The

[1]The main results are qualitatively the same even with $T_{mm} > 0$. They are not presented here, since this assumption introduces complicated terms without adding anything interesting to the model.

second order condition and derivation of the following results is presented in the Appendix 6. By utilizing Cramer's rule we get the following results:

$$\frac{\partial e_1^*}{\partial \mu} \gtreqless 0 \Rightarrow \frac{T_{1\mu}}{T_{2\mu}} \gtreqless \delta r \frac{u_{2cc}}{u_{1cc}}$$

and

$$\frac{\partial m^*}{\partial \mu} \gtreqless 0 \Rightarrow \frac{T_{1\mu}}{T_{2\mu}} \gtreqless \delta r \frac{u_{2cc}}{u_{1cc}}$$

These results imply that the special tax rule increase effort and savings within firm when an entrepreneur is relatively patient. This is because the effect is positive when the marginal effect of special rule on tax rate is larger in period one than in period two and when second derivative of utility is smaller in period two than in period one. With the assumed concave functional forms these conditions are fulfilled when there is more income in period two than in period one and higher savings within firm. The kind of entrepreneur that cares more about future consumption than present has higher income in second period.

Therefore this model predicts that a tax reform that increases the imputed capital income increases effort and thus economic growth for some of the firms. They are those firms that are relatively forward looking. If some entrepreneurs care more about the present than the future, this kind of reform could decrease effort and economic growth, and also net assets of the firm. The intuition for this is that the reform makes the first period taxation lighter and the entrepreneur wants to consume this extra income immediately and need to exert less effort as a consequence. This is similar than income effect dominating substitution effect result.

3 Econometric specification

3.1 Treatment and control groups

As described in the institutional setting section 2.2 the tax reforms were designed for partnerships and sole proprietors. Therefore, the firms with these

legal forms comprise the treatment group. Corporations comprise the control group. The reforms affected the marginal tax rate structure of income from unincorporated firms while it remained constant for corporated firms. Therefore we can analyze the effects of marginal tax rates on firm level outcomes by comparing the changes in taxes and outcomes between these two groups before and after the reform.

3.2 Difference in difference

We apply difference-in-differences (DD) approach with continuous treatment to find out the causal effect marginal tax rates have on the treated: unincorporated firms. Basic DD approach just compares treatment and control groups before and after the reform. Since we have rich variation in marginal tax rates due to the reforms, we regress the change in marginal tax rates on changes in outcomes. The model is a DD approach with continuous treatment; the change in marginal tax rate for control group is zero. We will estimate the following equation:

$$\triangle lny_{it} = \alpha_i + \epsilon \triangle lnMTR(I_{96})_{it} + \beta_2 X_{it} + \upsilon_t + \nu_{it} \tag{1}$$

where y represents an outcome of firm i in year t. The main outcome is logarithmic turnover, since it is a key variable describing output of a firm. Other outcomes are wage bill, profit and investment. The main explanatory variable is change in log marginal income tax rate, which coefficient ϵ can be interpreted directly as an elasticity with respect to marginal tax rate. X contains a list of control variables coming from account data of the firm. α_i indicates that we utilize fixed-effects specification to control for firm-specific effects. Therefore, with the differential specification that we utilize, this includes firm specific trends. Furthermore, υ_t indicates that we include year fixed effects to control for flexible time trends that is common to all firms. ν_{it} is the residual error term.

The observed marginal tax rates are endogenous, since they depend directly on income. To solve this problem, we utilize changes in imputed marginal tax rates that do not depend on behavior of the firm. We rather

use changes in tax law arising from the two reforms. We apply to past (from year 1996) income and other determinants of marginal tax rates the tax laws of different years (1997 and 1998), as Gruber and Saez (2002) did.

Equation 1 identifies the effect of taxes on outcome variables provided that treatment and control groups would have behaved over time in similar way in the absence of the reforms [2]. Since the estimated equation is in difference form, and it is estimated using fixed-effects procedure, we can control for across firms time trends. This means that we do not need all firms to develop in the same direction before the reforms, we only need their behavior to stay similar than before the reform in the absence of the reform. When there are changes in these trends that occur at the time of tax reforms, we assign these changes to tax variable. If we did not have the corporations in the control group, the method we use would not be possible, since the taxation of all firms with similar observable characteristics would have changed in the same way and we could not separate the changes in outcome from general time trends.

3.3 Potential identification problems and solutions

We apply DD strategy and thus the normal DD assumption need to apply; control group should represent the counterfactual. Since we can control for observed time trends of firms, this assumption is most likely violated if there are other unobserved shocks than the tax reforms at the same time. In principle the only difference between treated and untreated firms is the legal form. As a consequence they are observationally part of the same economy, face the same fluctuations coming from the global economy and changes in market conditions like demand for their products. Even so, there could be differences between these groups and changes in conditions they face. One is international trade. If control group e.g. has a lot of international customers and subsidiaries abroad and treatment group has not, the groups could experience different shocks coming from international trade. To eliminate this

[2] Our approach differs from elasticity of taxable income literature in that we can compare firms with similar income instead of comparing e.g. rich firms with poor firms. (Gruber and Saez 2002, Saez 2003, Kopczuk 2005 and Pirttilä and Selin 2011).

potential problem, we exclude from our sample large corporations that have international activity like subsidiaries abroad.

To further convince that our approach works, we present a preview on our data. Figure 3 describes coefficients from a DD estimation that mimicks the main estimation approach. DD estimation compares the growth rate of turnover in the two groups over time. The plot is from coefficients of interaction of year dummies and a treatment group dummy in fixed effects regression on change in log turnover. The figure demonstrates that at first partnerships in the treatment group grew slower than corporations in control group. Then at the time of the 1997 reform this changed so that the two groups grew at the same phase. The dramatic change in the treatment group occuring at the time of 1997 reform, but not elsewere, indicates that the identification assumptions work. It is reassuring that apart from the change in 1997, the relative growth rates stay constant.

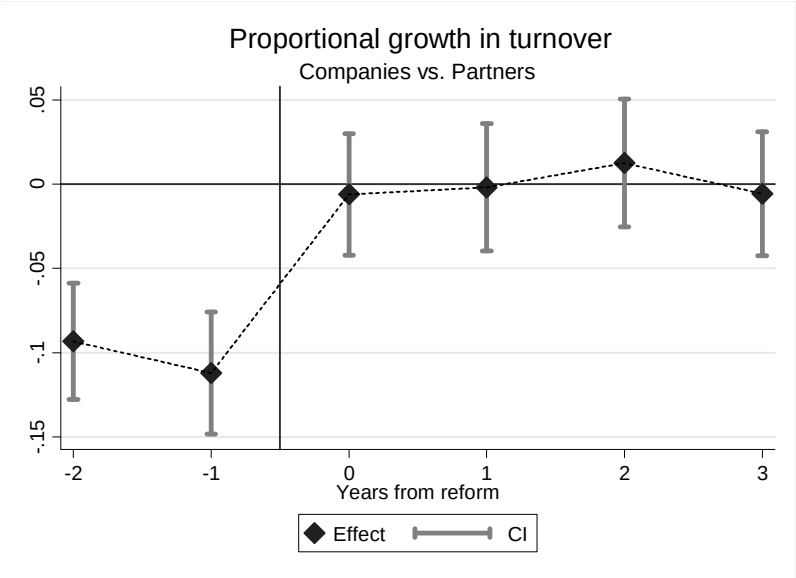


Figure 3: Turnover relative to 1997 reform between treatment and control groups

Note: Figure compares proportional change in turnover between partnerships in treatment group and companies in the control group. The effects are from fixed effect regression where change in logarithmic turnover is regressed against interaction between year and treatment group indicators. The confidence intervals are 95 % interval from robust standard errors.

Potential problems are selection into exit, selective entry or switching legal form. We can account for these potential selection biases by modeling how the entry, exit and switching decisions depend on changes in the average tax rates. These are of interest by themselves, since these extensive margin responses are potential channels of responding even if they do not affect the responses along the intensive margin of adjusting output size marginally. We take a prediction of these extensive margin effects and include it in the main intensive margin regression as Carroll *et al.* (2001) did for exiting firms. If this extra term affected the marginal tax rate variable in the main regression, it would indicate that the extensive margin decisions are driving the result.

We impute the marginal tax rates for each year according to tax law of that year and 1996 income and net assets information from each firm as explained above. This might lead to measurement error, if we make a mistake in imputing process. Standard solution for this in elasticity of taxable income literature (Gruber and Saez, 2001) is to instrument the actual tax rate with the imputed tax rate and use variation from this to explain the changes in outcomes. We present also these instrumented results after the main DD results as a robustness check. DD estimates are the main estimates, because they are more transparent due to clear source of identifying variation used there. Furthermore, we perform standard DD estimates using just indicator of treatment group instead of marginal tax rate variable to convince that measurement error in tax variable is not driving the results.

4 Data description

We perform the estimations on comprehensive tax record panel data for years 1994 to 2000. The data come from the Finnish Tax Administration and they include every firm liable to taxation in Finland. The data set contains information on the financial statements and tax records of Finnish businesses, as well as information on taxation of business owners.

The data contains all important tax information for our analysis. We observe income from the firm, net assets, wage bill and long term debts that influence the marginal tax rates. In addition, for partnerships we observe

income of the firm owner earned from other sources than the firm. The most relevant outcome for our analysis in the data is turnover of the firm. This variable captures how much output the firm made and therefore is a good indication of economic activity of the firm.

4.1 Descriptive statistics

Table 1 presents descriptive statistics of the three most interesting outcome variables: turnover, profits and wage bills pooled between years 1996 and 1998. Table is for main estimation sample that is restricted by firms needing to have both earned and capital income in 1996. Table is divided according to legal form of the firm. Partnerships and sole proprietors are in treatment group and corporations in control group. It is evident that sole proprietors make the largest fraction of the data but they are smallest in value of measured variables. There are comparable fraction of partnerships and corporations, latter including on average largest firms.

The most important explanatory variable in our analysis is imputed MTR. Imputed MTR is calculated exploiting variation due to the reform in imputed net assets and total income of owners. As described in 2.2 wage sum affects the net assets 1997 onwards and long term debts affect the net assets 1998 onwards. Imputed net asset is calculated using 1996 firm level net assets, wage bill and long term debts but using different tax rate schedules for each year. We observe all of these variables in the data. By using these imputed net assets and total income of owners we calculate the imputed MTRs for every firm for each year in the data. The measure of imputed MTR is the weighted average of marginal tax rates on earned and capital income marginal tax rates. The weights are the share of income earned as a capital and labor income. However, for sole proprietor owners we have only total income from the firm and not other income from other sources which can affect the calculated MTRs. Thus, the imputed MTRs for sole proprietors is only a proxy for the MTRs. For partnership owners we observe also income from other sources than from the firm. Later on we use this variation to estimate the effect of the reform on the activity of the entrepreneurs. The statistics

Firm type	Statistics	Turnover	Wages	Profits	Imputed net assets	Imputed MTR
Partnership	Mean	235478	24436	24335	26454	0,379
	N	161830	202295	202295	24422	102437
	SD	668617	81510	248589	67287	0,075
	No. Firms	53812	53812	53812	53812	53812
Sole	Mean	63440	3895	13309	6750	0,247
proprietors	N	659419	802343	802343	106666	590513
	SD	220737	42343	21818	21102	0,148
	No. Firms	159104	159104	159104	159104	159104
Corporations	Mean	435453	76156	41084	45188	0,302
	N	386213	388083	388083	51749	250956
	SD	968182	196308	293986	428557	0,156
	No. Firms	71625	71625	71625	71625	71625
Total	No. Firms	284541	284541	284541	284541	284541

Table 1: Descriptive statistics

of imputed net assets and marginal tax rates are in table 1 and changes in those variables are presented in table 2.

Table 2 shows the changes in the main variables between years 1996 and 1998 for partnerships and sole proprietors. It seems obvious that in terms of economic activity both legal forms have increased. As can be predicted the mean of imputed MTR has decreased after the reforms due to the increase of imputed net assets. For partnerships the mean increase in imputed net assets is relatively large and it directly affects the imputed MTRs. However, for sole proprietorships the mean change in imputed MTR is very low. This is mainly because sole proprietorhip firms are very small in size and many of them do not have wage expenses or long term debt at all.

Figure 4 describes how the imputed net assets changed proportionally due to the reforms from 1996 to 1998. The net assets are imputed using financial information from 1996 and applying tax laws in different years, same as our main explanatory variable. The variation in net assets arises due to the inclusion of wages and exclusion of long term debts into the net assets. As figure shows, the reforms induced a lot of variation in net assets,

Firm type	Statistics	△Turnover	△Wages	△Profits	△Imputed MTR	△Imputed net assets
Partnership	Mean	8721	2075	1300	-0,017	11576
	N	13173	13173	13173	13173	13173
	SD	243004	30644	20933	0,025	39039
Sole	Mean	3514	49	1152	-0,001	2245
proprietors	N	67344	67344	67344	67344	67344
	SD	71399	124977	11231	0,017	16873

Table 2: Changes in main variables before and after the reforms

both increases and decreases. Evidently most of the firms did face an increase in their net assets. Total marginal tax rates decreased for firms which net assets increased and that had higher marginal tax rate on earned income than on capital income (see 2).

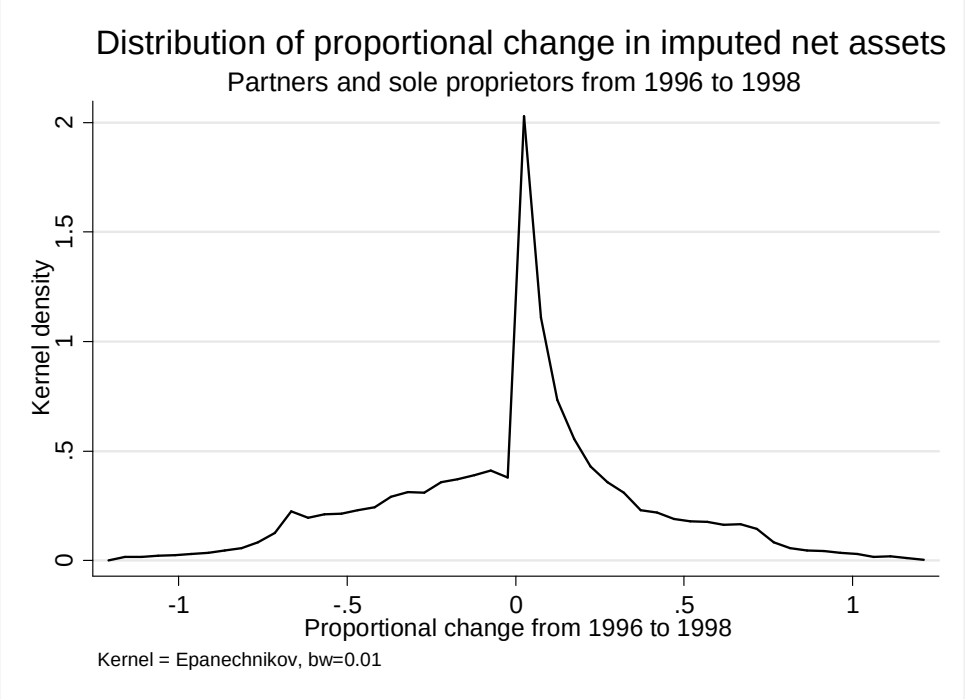


Figure 4: Distribution of proportional change in imputed net assets

Note: Figure shows the distribution of change in logarithmic imputed net assets from 1996 to 1998 due to the double reform. Values of underlying net assets, wages and debts are taken from 1996 and imputed according to reformed rules for each firm.

5 Results

We are interested in finding the effect of the reforms first on change rate of output of firms and then on other outcomes. We perform estimations by applying the natural experimental method described in section 3 on firm level data described in section 4. All outcomes are in change of logarithmic form, since we are interested in the change rate of outcomes. The main explanatory variable is change of log of imputed marginal tax rate. Thus the point estimates can be interpreted as an elasticity of outcome with respect to marginal tax rate.

Table 3 presents the main estimation results on turnover. Column (1) presents the differences-in-differences (DD) result where the explanatory variable is a DD dummy. A positive coefficient indicates that the turnover started to grow faster in unincorporated firms after the reform than in corporated firms and before the reform. Columns (2) through (4) present specifications that use the imputed tax variable as an explanatory variable and the sample is restricted to include only those firms that have both capital and labor income in 1996. The different columns are estimated for different samples of firms: in column (2) all firms are in the sample and in column (3) only sole proprietors are in the treatment group. The latter estimate is positive, but not statistically significant. This result indicates that sole proprietors seem to have disregarded the reform completely. There is a doubt, however, that some of the sole proprietors are just side businesses and therefore do not represent the total economic activity of their owners. Moreover, it is not clear how good control group corporations are for these small firms. Our main estimation result is in column (4), where partnerships in the treatment group are compared with corporations. Partnerships resemble corporations in their size and in that they both have employees. The coefficient on tax variable is -0.17, which is also the estimated elasticity of turnover with respect to marginal tax rate.[3] The results are very robust for controlling with various covariates.

[3]We also perfomed estimates with net of tax rate as outcome. It produces elasticities that are close to 0.2 for the main estimation group.

	(1)	(2)	(3)	(4)
△lnMTR		-0.029	0.038	-0.173***
		(0.045)	(0.092)	(0.051)
DD	0.074***			
	(0.007)			
N	702,472	641,070	572,562	263,967
R^2	0.024	0.026	0.025	0.034
N of firms	159,856	144,044	128,146	56,355
Groups	S, P, C	S, P, C	S, C	P, C

Note: Fixed effects regressions using as outcome change in log of turnover and applying robust standard errors. Column (1) is on a DD indicator comparing all unincorporated with corporated firms before and after the reform. Columns (2) - (4) use the imputed tax variable as main explanatory variable. Column (2) includes the whole estimation sample, column (3) excludes partnerships and column (4) sole proprietors. All estimations are performed with a comprehensive set of control variables including year dummies, trend for net assets, other income, rent expenses, purchasing expenses and fixed expenses.

Table 3: Main estimation results

To check against potential identification problems discussed in section 3, we present various robustness checks in table 4. The robustness checks include the same specification as in the main estimates. Columns (1) and (2) are instrumental variables regressions, where observed marginal tax rates are instrumented with imputed marginal tax rates. The first stage is strong indicating that the instruments are also strong. The second stage result on turnover are very close to main estimation results in table 3. Thus it seems that measurement errors in tax variable do not cause concern for our strategy.

Column (3) controls for exit and entry. Column (4) also controls for legal form switching behavior and includes linear trend for exit and entry of treatment firms. These spesifications are done by regressing interactions of year summies and industry codes against probabilities in case of exit or entry and against probability of switching legal form in case of switching. Predicted values from these first stage regressions are then included in the main estimations[4]. We find that mostly our main results are unaffected in

[4]The standard errors of these predicted values have not been corrected and are probably too large compared to the correct standard errors but as we use these variables as controls we are not per se interested in the significancy of these variables.

	(1)	(2)	(3)	(4)	(5)	(6)
△lnMTR	-0.204***	-0.023	-0.174**	-0.162***	-0.002	0.030***
	(0.052)	(0.043)	(0.051)	(0.051)	(0.090)	(0.010)
1st stage	0.997***	1.082***				
	(0.028)	(0.015)				
Exit			-0.918***	-0.735***		
			(0.137)	(0.230)		
Entry			0.262	-0.399*		
			(0.163)	(0.231)		
Switch				3.306**		
				(1.115)		
N	200,265	570,264	263,946	263,946	109,667	302,682
R^2	-0.005	0.023	0.034	0.035	0.027	0.017
N of firms	40,208	120,832	56,345	56,345	49,029	123,949
F test	1100.17	2385.33				
Groups	P, C	S, P, C	P, C	P, C	P, C	S, P, C

Note: Fixed effects regressions using as outcome change in log of turnover and applying robust standard errors. Columns (1) and (2) presents instrumental variable estimates where actual marginal tax rate is instrumented by the imputed marginal tax rate. Column (3) presents the main estimates added with a control for exit and entry of firms. Column (4) adds a control for switching legal form to main estimates. Columns (5) and (6) presents a placebo estimate where reform is pretended to have happened in 1999. Otherwise same specifications as in main estimates are used.

Table 4: Robustness of the results

these checks, although coefficient in column (4) is slightly closer to zero.

Columns (5) and (6) present a placebo result where the reform is pretended to have happened in 1999 instead of 1997. This is achieved by moving the actual imputed tax variables forward in the data. We find no effect when comparing partnerships and companies and small positive correlation for the whole sample. We have the same conclusion from these as from figure 3, that there are no changes between treatment and control groups in other than reform year. Thus, unobserved shocks do not seem to be driving our main results.

After documenting how marginal tax rates affect turnover of unincorporated firms, we are interested in seeing which other outcomes are affected by the reform. Table 5 presents results on profit, wage sum, number of employ-

ees, investment and assets from similar specifications as our main estimation results in table 3. The results imply that profits increased due to more lenient taxation. This result is close to elasticity of taxable income, but the outcome does not contain other income than income from the firm. The estimated elasticity is -0.37, which is higher in absolute value than the tax elasticity of turnover. If the profit elasticity had been smaller than turnover elasticity, it could have indicated that the turnover result came from increased costs due to higher price level for inputs. Now that the profit elasticity is larger, it seems that entrepreneurs responded to lower marginal tax rate by increasing both output of the firm and also by reducing costs or doing other tax planning.

Wage sum and number of employees are estimated only against DD indicator variables. This standard DD type of analysis was thought to suit better for these outcomes since it is not clear how marginal tax rates should affect wage sums that partly determine marginal tax rate. We find positive effect for wage sums in treatment groups indicating that the reform that mostly made taxation more lenient for these groups have increased wage sums. On the other hand, the number of employees result is negative for sole proprietors and zero for partnerships. These results imply that labor demand did not increase as aresult of the reforms. The positive wage sum effect may arise from higher salaries to employees or from entrepreneurs paying more wages to themselves.

Results on investments are negative on assets positive, but neither is significant. Investment here is real investment to machines and equipments. The negative result supports the view that firms wanted to grow more rapidly as a result of the reform. The result is so weak that too much can not be concluded from that. The positiv ecoefficient of assets indicate that little bit more assets were left in the firm, which is indication of tax planning. The result goes to the direction predicted by theoretical model, that when an entrepreneur wants to increase effort, she also wants to increase future assets. Again the result is statistically insignificant, though.

Table 6 presents results on turnover divided by the marginal tax rate in 1996. The group in the first column had marginal tax rate below 30% and

	Profit	Wage sum	Employment	Invest	Assets
△lnMTR	-0.366***			-0.430	0.023
	(0.068)			(0.265)	(0.040)
DD proprietors		0.075***	-0.067***		
		(0.012)	(0.010)		
DD partners		0.158***	-0.006		
		(0.012)	(0.009)		
N	206,031	346,933	298,422	141,382	221,359
R^2	0.051	0.020	0.021	0.002	0.034
N of firms	51,932	87,524	75,470	43,365	53,990
Groups	P, C	S, P, C	S, P, C	P, C	P, C
X	Yes	Yes	Yes	Yes	Yes

Note:Results are from fixed effects regressions of change in log marginal tax rate on change in log profit, wage sum, number of employees, investment and assets. All models are estimated with a comprehensive set of control variables that include year dummies, trend for net assets, other income, rent expenses, purchasing expenses and fixed expenses. Robust standard errors are used throughout.

Table 5: Other outcomes

the marginal tax rates in 1996 are increasing when moving towards right in the table. For the lowest marginal tax rate group the reforms did not reduce the marginal tax burden. Consequently, it is not surprising that we find no effect on their turnover. It is interesting to observe how the effect increases when we move up in the prior reform marginal tax rates. The higher the marginal tax rate the higher was the income prior to reforms. Therefore the more tax rates were reduced on average as a result of the 1997 reform. The increasing elasticity with bigger change in tax incentives result can be interpreted as a tax salience effect; larger changes in tax incentives are more salient. The difference in groups also introduces potential mean reversion problem, so that the results should be interpreted cautiously. The reason for this is that higher income firms in one year are more likely to be decreasing in the future than the rest of firms. However, our identification strategy should mitigate this problem. We are each time able to control with companies that had just as high marginal tax rate before the reform, but did not face changes in the tax system due to reforms.

	TO1	TO2	TO3	TO4
△lnMTR	0.136	-0.191**	-0.436***	-0.899***
	(0.173)	(0.082)	(0.167)	(0.276)
N	65,066	54,680	28,915	51,938
R^2	0.027	0.036	0.035	0.059
N of firms	13,409	11,250	6,024	10,909

Note: Fixed effects regressions on change of log turnover. Tax variable is log of the imputed marginal tax rate. The results are according to marginal tax rate in 1996. TO1 indicates a group that had lowest marginal tax rate (below 30 %) and TO4 a group that had highest marginal tax rate.

Table 6: Results divided by pre-reform size

Table 5 presents the results on exit, entry and switching legal form. The results for exit and entry in columns (1) through (6) are done with a DD indicator for different estimation samples. Overall pattern of the results is that the reforms made exiting less rare and entry more common. The only deviation of this general pattern is the positive exit result for sole proprietors. The coefficient is zero in economic terms, though. The exit result for partnerships stands out, the reforms reduced exit probability by more than 7 percent for them. Column (7) presents the switching result from partnerships to corporations only. We do not observe switching from sole proprietors to other legal forms. The estimation is done by regressing an indicator of switching against indicator of after the reform. The result indicates that switching probability reduced by 2 percent due to the reforms.

6 Conclusion

Understanding determinants of entrepreneurial choices was the main goal in this paper. Surprisingly few studies have offered credible empirical analysis on how economic activity of entrepreneurs depends on their tax incentives. We studied entrepreneurial choises both by theoretical model and by analysing empirically tax reforms that altered the income tax rates of entrepreneurs.

Theoretical model presented stipulation on how effort decisions and sav-

	(1) exit	(2) entry	(3) exit	(4) entry	(5) exit	(6) entry	(7) switch_YS
Effect	-0.016***	0.034***	0.002***	0.037***	-0.072***	0.026***	-0.021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Observations	2,389,692	2,389,692	1,987,998	1,987,998	1,157,040	1,157,040	439,488
R-squared	0.001	0.001	0.000	0.001	0.008	0.001	0.011
Number of pan	398,282	398,282	331,333	331,333	192,840	192,840	73,248
Groups	S, P, C	S, P, C	S, C	S, C	P, C	P, C	P
Robust standard errors in parentheses							
*** p<0.01, ** p<0.05, * p<0.1							

Note: Fixed effects regressions on indicators for exiting or entering the sample and switching from partnership to company in column (7). Regressions do not include additional controls, since these are not observed for non-surviving firms. In Columns (1) - (6) explanatory variable is an interaction term of after and treatment indicators. In column (7) explanatory variable is after indicator

Figure 5: Results: exit, entry and switching

ing decisions could be affected in imputed income method (Boadway and Brice 1994) tax system. The question is interesting, since an entrepreneur can affect her income tax rates through saving within firm. On the other hand an entrepreneur can excert more effort within firm that then produces more output. Our theoretical model predicted that decreasing marginal tax rate through increasing imputed income part increases effort decisions only if the entrepreneur is sufficiently patient.

This prediction was then studied using empirical data and tax reforms affecting tax incentives. Two Finnish tax reforms affecting only owners of unincorporated firms provided exogenous variation in tax burden of entrepreneurs. The main result supports the theory. Economic activity of larger firms seem to have increased due to more lenient taxation. The elasticity of turnover with respect to marginal tax rate was -0.2 for this group. Small sole proprietors did not react to the reform, which had negligible impact on their marginal tax rates. The owners of small firms could be seen as impatient. These main estimation results passed various robustness checks making them more credible.

Taking entry and exit decisions into account do not change the main

estimation results. Interestingly, the reforms influenced legal form switching decisions; less firms switched from partnerships to corporations after the reform. This was expected since the reform made the taxation of partnerships more lenient. However, the number of switchers is small and controlling for them does not influence our main results.

Entrepreneurs reacted to tax incentives by increasing their profit margin. Profit margin is the income from firm. The elasticity of this income with respect to tax rate is .37, higher than the output elasticity. This indicates that the entrepreneurs have engaged in tax planning by reducing costs or increasing other aspects of income than output. The results for wage sum and number of employees indicate that more lenient income taxation for an entrepreneur did not affect labor demand, but increased wage sums modestly. We did not find significant effects on investments and assets. All these point estimates indicate that entrepreneurs mostly reacted through affecting their own effort and through tax planning, but not through changing input use.

The divided sample results revealed that those with higher marginal tax rates prior to reform and consequently faced a larger change in their tax burden due to the reforms responded more. This is intriguing result indicating that there could be optimization frictions present. With larger change in tax incentives the entrepreneurs respond evidently more.

Our results suggest that economic activity of entrepreneurs in their firms can indeed be promoted by providing them better tax incentives. However, we interpret the elasticity of output with respect to income taxation, 0.2, to be relatively small. As a result, it is possible that reducing the tax burden in this way may turn out to be relatively costly way of increasing output in firms. However, the changes in the tax code were dependent on the size of the firm and we found higher elasticity for those with higher marginal tax burden before the reform. Also, we did not find the elasticity estimate deviating from zero for sole proprietorhips but their income tax changes due to reform were small. This suggests the elasticity to be heterogenous depending on the legal form and size of the firm. In conclusion. there could be some firms, which economic activity could be promoted with well targeted tax incentives.

Another margin for adjustement is exit, entry and switching behaviour.

These are extensive margin decisions, whereas marginally changing output is intensive margin decision. Some of the earlier literature studying tax incentives of small firms has focused on this extensive margin (Gordon and Mackie-Mason 1994, Gordon and Cullen 2007, Goolsbee 1998b). We found that the exit of firms descreased and entry increased as a response to the reforms. However, these extensive margin responses were relatively small compared to intensive margin response. Nevertheless, they could be additional responses that affect the economic growth.

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Appendix: First order conditions and Cramer's rule derivations

Take the inter-temporal objective function:

$$\begin{aligned} U &= u_1\left(ne_1 - m - T_1\left(ne_1 - m, A\right) - R\right) + h(e_1) \\ &+ \delta u_2\left(Y + m - T_2\left(Y + m, A\right) + rR + A\right) \end{aligned}$$

Next we take first order conditions with respect to e_1, R and m:

$$\frac{\partial U}{\partial e_1} = u_{1c} n \left(1 - T_{1y}\right) + h_e = 0 \tag{2}$$

$$\frac{\partial U}{\partial R} = -u_{1c} + \delta u_{2c} r = 0 \tag{3}$$

$$\begin{aligned} \frac{\partial U}{\partial m} &= -u_{1c}(1 - T_{1y} - T_{1m}) + & (4)\\ & \quad \delta u_{2c} \left(1 - T_{2y} - T_{2m}\right) = 0 & (5) \end{aligned}$$

We take the second order conditions form the first order conditions

$$\frac{\partial^2 U}{\partial e_1 \partial e_1} = -u_{1c} n^2 T_{1yy} + u_{1cc} \left(n \left(1 - T_{1y}\right)\right)^2 + h_{ee} < 0$$

$$\frac{\partial^2 U}{\partial e_1 \partial m} = \frac{\partial^2 U}{\partial m \partial e_1} = -u_{1cc} \left(n \left(1 - T_{1y}\right)\right) \left(1 - T_{1y} - T_{1m}\right) + u_{1c} n T_{1yy} > 0$$

$$\frac{\partial^2 U}{\partial R \partial R} = u_{1cc} + \delta u_{2cc} r^2 < 0$$

$$\frac{\partial^2 U}{\partial e_1 \partial R} = \frac{\partial^2 U}{\partial R \partial e_1} = -u_{1cc} n \left(1 - T_{1y}\right) > 0$$

$$\frac{\partial^2 U}{\partial m \partial m} = u_{1cc}(1 - T_{1y} - T_{1m})^2 + \delta u_{2cc}(1 - T_{2y} - T_{2m})^2 + u_{1c} \left(-T_{1yy}\right) + \delta u_{2c} \left(-T_{2yy}\right) < 0$$

$$\frac{\partial^2 U}{\partial R \partial m} = \frac{\partial^2 U}{\partial m \partial R} = u_{1cc} \left(1 - T_{1y} - T_{1m}\right) + \delta r u_{2cc}(1 - T_{2y} - T_{2m}) < 0$$

The sign of determinant H need to be negative for the second order conditions of this model to be fulfilled

$$H = \begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial e_1} & \frac{\partial^2 U}{\partial e_1 \partial R} & \frac{\partial^2 U}{\partial e_1 \partial m} \\ \frac{\partial^2 U}{\partial R \partial e_1} & \frac{\partial^2 U}{\partial R \partial R} & \frac{\partial^2 U}{\partial R \partial m} \\ \frac{\partial^2 U}{\partial m \partial e_1} & \frac{\partial^2 U}{\partial m \partial R} & \frac{\partial^2 U}{\partial m \partial m} \end{vmatrix}$$

We insert to the second order conditions the arbitrage condition derived from first order conditions that $r\left(1-\tau\right)=1-\tau+T_A(A)$. With a little bit of manipulation, we get the following signs for the terms of determinant H:

$$\begin{aligned} H \;=\; & \underbrace{\frac{\partial^2 U}{\partial e_1 \partial e_1}}_{-}\underbrace{\begin{vmatrix} \frac{\partial^2 U}{\partial R \partial R} & \frac{\partial^2 U}{\partial R \partial m} \\ \frac{\partial^2 U}{\partial m \partial R} & \frac{\partial^2 U}{\partial m \partial m} \end{vmatrix}}_{+} - \underbrace{\frac{\partial^2 U}{\partial R \partial e_1}}_{+}\underbrace{\begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial R} & \frac{\partial^2 U}{\partial e_1 \partial m} \\ \frac{\partial^2 U}{\partial m \partial R} & \frac{\partial^2 U}{\partial m \partial m} \end{vmatrix}}_{+} \\ + \; & \underbrace{\frac{\partial^2 U}{\partial m \partial e_1}}_{+}\underbrace{\begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial R} & \frac{\partial^2 U}{\partial e_1 \partial m} \\ \frac{\partial^2 U}{\partial R \partial R} & \frac{\partial^2 U}{\partial R \partial m} \end{vmatrix}}_{+} < 0 \end{aligned}$$

Note that the sign of the first line appears ambiguous. However, the sign of H determinant is negative, as long as the following condition is fulfilled from the second square since the first to terms dominate the second square determinant

$$\frac{\left(1+\frac{1}{r}\frac{T_{2yy}}{T_{1yy}}\right)\left(1-T_{1y}\right)}{\left(1-T_{1y}-T_{1m}\right)} < 1+\delta r^2 \frac{u_{2cc}}{u_{1cc}}$$

two terms in absolute value.

Now that we have the sign of the H determinant, we derive the effects the parameters of the model has on endogenous choice variables using the Cramer's rule. First we write down the effect a parameter μhas on first order conditions.

$$U_{R\mu} = u_{1cc}T_{1\mu} - \delta u_{2cc} r T_{2\mu}$$

$$U_{m\mu} = u_{1cc}T_{1\mu}\left(1-T_{1y}-T_{1m}\right) - \delta\left(u_{2cc}\left(1-T_{2y}-T_{2m}\right)T_{2\mu}\right)$$

Here we have assumed that $T_{ym}, T_{mm}=0$ and $T_m<0$, the special tax rule affects tax function in a negative and linear way. Utilizing a condition from FOC it follows that $U_{R\mu}\left(1-T_{1y}-T_{1m}\right) = \left(1-T_{1y}-T_{1m}\right)\left(u_{1cc}T_{1\mu}-\delta u_{2cc}rT_{2\mu}\right) = U_{m\mu}$. The effect on changing μ on optimal effort is:

$$\frac{\partial e_1^*}{\partial \mu} = \frac{\begin{vmatrix} 0 & \frac{\partial^2 U}{\partial e_1 \partial R} & \frac{\partial^2 U}{\partial e_1 \partial m} \\ -U_{R\mu} & \frac{\partial^2 U}{\partial R \partial R} & \frac{\partial^2 U}{\partial R \partial m} \\ -U_{m\mu} & \frac{\partial^2 U}{\partial m \partial R} & \frac{\partial^2 U}{\partial m \partial m} \end{vmatrix}}{H}$$

$$\frac{\partial e_1^*}{\partial \mu} = U_{R\mu} \begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial R} & \frac{\partial^2 U}{\partial e_1 \partial m} \\ \frac{\partial^2 U}{\partial m \partial R} & \frac{\partial^2 U}{\partial m \partial m} \end{vmatrix} - U_{m\mu} \begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial R} & \frac{\partial^2 U}{\partial e_1 \partial m} \\ \frac{\partial^2 U}{\partial R \partial R} & \frac{\partial^2 U}{\partial R \partial m} \end{vmatrix}$$

This complicated calculation is manipulated into:

$$\begin{array}{l} (u_{1cc} T_{1\mu} - \delta u_{2cc} r T_{2\mu}) \\ \left(\frac{\left(u_{1cc} \left(1 - T_{1y}\right) \left(T_{1yy} + \frac{1}{r} T_{2yy} \right) \right)}{\left(1 - T_{1y} - T_{1m}\right)} \right) \end{array}$$

where the second line is always negative. Therefore the effect of special tax rule on effort is determined by the first term. The effect is positive as long as

$$\frac{\partial e_1^*}{\partial \mu} \gtrless 0 \Longleftrightarrow \frac{T_{1\mu}}{T_{2\mu}} \gtrless \delta r \frac{u_{2cc}}{u_{1cc}}$$

Similar calculation is done for m. The Cramer's rule produces following determinant, which sign need to be determined:

$$\frac{\partial m^*}{\partial \mu} = \frac{\begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial e_1} & \frac{\partial^2 U}{\partial e_1 \partial R} & 0 \\ \frac{\partial^2 U}{\partial R \partial e_1} & \frac{\partial^2 U}{\partial R \partial R} & -U_{R\mu} \\ \frac{\partial^2 U}{\partial m \partial e_1} & \frac{\partial^2 U}{\partial m \partial R} & -U_{m\mu} \end{vmatrix}}{H}$$

$$\frac{\partial m^*}{\partial \mu} = U_{R\mu} \begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial e_1} & \frac{\partial^2 U}{\partial e_1 \partial R} \\ \frac{\partial^2 U}{\partial m \partial e_1} & \frac{\partial^2 U}{\partial m \partial R} \end{vmatrix} - U_{m\mu} \begin{vmatrix} \frac{\partial^2 U}{\partial e_1 \partial e_1} & \frac{\partial^2 U}{\partial e_1 \partial R} \\ \frac{\partial^2 U}{\partial R \partial e_1} & \frac{\partial^2 U}{\partial R \partial R} \end{vmatrix}$$

The effect of special tax rule on m^* turns out to depend on the same condition as on e^*:

$$\frac{\partial m^*}{\partial \mu} \gtrless 0 \Longleftrightarrow \frac{T_{1\mu}}{T_{2\mu}} \gtrless \delta r \frac{u_{2cc}}{u_{1cc}}$$