

# ELASTICITY OF TAXABLE INCOME. A CASE STUDY FOR THE CZECH REPUBLIC

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## Abstract

Elasticity of taxable income has increasingly become an important subject matter for economists in recent times. This study provides an estimate for the Czech Republic by exploiting panel data for corporate income tax rates between 2004 and 2009. The severity of the tax evasion and avoidance issue in this country triggers a question about the existence of the elasticity itself. The uniqueness of this study also stems from its focus on proportional tax rates while other influential studies examine this subject for progressive taxation. The result of this research supports a hypothesis about indifference between taxable income decision and the size of the tax rate; about fifty percent of the observations in the sample are not subject to taxation. The high level of tax avoidance could explain such an outcome intensifying the necessity to fight this fiscal policy phenomenon.

**Key words:** taxable income, elasticity, corporate income tax, Czech Republic

**JEL classification:** H21, C23

## Introduction

Elasticity of taxable income has become a significant indicator for fiscal policies. It measures the responsiveness of an individual's taxable income to a percentage change in the tax rate. Its appeal rests in its responsiveness to show to what degree an individuals' behaviour concerning tax avoidance alters in the presence of tax reforms. While individuals and corporations are subject to taxation, there always exist legal ways to minimise taxable income and, by doing so, partially evade taxation. Corporations and higher-income class individuals, who can afford to pay more for tax consulting, are the most pervasive entities of this problem. They can also modify their tax-deductible expenses or look for a tax haven and reshape their entrepreneurial plan accordingly to achieve the same goal. Although one might imply that these entities should be the main subject of criticism, it is the legal system that enables them to follow such a strategy. Vague terms in tax laws and their abundant complexity, often created to help politicians to maximise their personal utilities, is the main source of such a dilemma.

The aim of this paper is to examine the existence of taxable income elasticity of corporate income tax (CIT) for the Czech economy. The model will follow tax reforms between the years 2004 and 2009. This period is especially interesting as it was accompanied by almost steady decreases in the corporate income tax rate. During the whole period, the tax rate was dropping incrementally, therefore the regression analysis will also examine whether the rational expectations theory could be correct for Czech businessmen. Such a result would correspond to no association between taxable income and tax rates, as

individuals would have already incorporated the effect into their behaviour. Particularly, the present study will provide estimates for the overall elasticity of taxable income via regression analysis.

This paper proceeds as follows. First, the literature review summarises the preceding literature concerning this topic as well as applicability of its results to the current study. Then, data collection and their descriptive statistics are presented. After that, the formulation of a regression model with an explanation of the methodology takes place. In the fourth section, one can find results of the regression model along with their interpretation as well as the limitations of the model. The fifth section offers a conclusion.

## Literature review

While the literature concerning elasticity of taxable income has been numerous, there is a lack of papers questioning the elasticity of taxable income in respect to the corporate tax rate. One such example is a paper by Devereux, Liu, Loretz [2014], which measures the effect for the United Kingdom between 2001 and 2009. According to their results, the taxable income of companies with annual profits around 300,000 pounds is much less sensitive to changes in tax rates than in the case of low-income companies. The authors explain such a result by higher possibilities of evasion for low-income companies, which are not subject to auditing.

The deficiency of studies regarding the elasticity for proportional tax rate has led me to follow other authors' models. The present article is mostly based on Gruber and Saez's [2002] influential study. These authors attempt to investigate the true effect of tax rate changes during the series of tax reforms in the 1980s on taxable income via collection of long series of panel data. Their overall taxable income elasticity amounts to 0.4, which is lower compared to previous works such as Feldstein [1995], whose result was 0.8, Navratil [1995] with the same estimate of 0.8, Auten and Carroll [1997] with a taxable income estimate of 0.75, or Lindsey [1987] with a median estimate of 1.6. Sillamaa and Veall [2001] reveals even lower elasticity of taxable income for Canada amounting to 0.25, and Bakos et al. [2008] suggest statistically significant tax price elasticity of only 0.06. Gruber and Saez [2002] discover different values of elasticity for various income groups; particularly high-income groups are connected with higher elasticity of taxable income. They use taxable income as well as a broader definition of income as the outcome variable. However, the response in terms of income elasticity is much smaller for the broader definition of income. While their study was conducted for the United States with its progressive income taxation rates, this paper attempts to reveal the true causal effect of tax rate changes on taxable income in a country with proportional taxation for corporate income tax; therefore their 2SLS model will be simplified to OLS. The study by Mattika [2014] also employs a proportional tax rate but as an instrument variable to measure the effect of a progressive tax rate on taxable income for Finland. As a consequence, following their outcome, namely the larger value of elasticity of taxable income rather than elasticity of the broad definition of income, the model in this paper focuses only on taxable income.

The main difference in the papers addressing this question (such as Gruber and Saez's [2002] explanation) is whether they control for the mean reversion and income distribution problems. The mean reversion problem can make individuals with high income appear as low-income individuals in the next period; alternations in the size of income distribution

over the years as well as inside income distribution changes shift the population to become subject to different tax rates for various years, in the scenario with progressive taxation. In the end, there might appear an endogenous problem as policy-makers modify tax rates according to variations in income distribution. The self-selection problem should not be a problem in the scenario with proportional taxation where everybody is subject to taxes, therefore nobody can “pre-select” themselves to different tax rates. On the other hand, the present paper is enhanced with other variables of interest such as an incorporation of lagged variables recommended by Golsbee [1997] or Giertz [2010].

Giertz [2010] examines not only taxable income elasticity but also short and long responses of individuals’ behaviour measured by income to changes in tax rates. They focus on the 1990s reforms in the United States using panel data. Interesting is their result of higher long-period responses over three years in comparison to short-term ones. For the long-term responses, they find estimates of 0.78 to 1.46, and for the short-period responses an estimate of 0.43. This paper will also attempt to distinguish between short and long-term responses by incorporating lagged tax rate variables such as Giertz [2010] proposes.

It is also worth noting that there is a high chance of a weak link between taxable income and changes in tax rates. If changes in tax rates are perfectly predictable, the rational expectations theory suggests that such an effect could already be internalised, leaving the taxable income irresponsive. In such a scenario, the businesses’ supply would also remain unmodified. For this reason, Lucas, Stokey and Barro cited in Sargent [2014] suggest that governments should follow a “tax-smoothing” policy without abrupt alterations in marginal tax rates. According to these authors, such a policy would result in a minimal negative effect on supply.

Next, there are other authors revealing low responsiveness of taxable income to variations in tax rate. For example, Mattika [2014] discovers very low elasticity of taxable income in a range between 0 and 0.2. The elasticity of taxable income even lacks statistical significance, especially for the three-year model.

Tax evasion along with tax avoidance represent the number-one problem for the tax system in the Czech Republic. In the Czech Republic, tax evasion results in a yearly loss of 150 billion crowns.<sup>1</sup> PwC estimates the distance from the Czech Republic’s best potential performance in paying taxes to assimilate to such countries as Mozambique, Iran or other Islamic republics.<sup>2</sup> A significant part of the Czech deficit stems from tax evasion and the government’s inability to stop tax avoidance. Moreover, tax avoidance has been viewed as a moral and legal way of escaping taxation [Salih, 2010]. In an extreme case, high tax avoidance or evasion resulting in non-existing obligation of paying taxes could render individual companies irresponsive to changes in tax rates. Then, policy ideas such as a reduction to the tax rate to stop tax evasion in accordance with the Laffer curve [Marek, 2010] would appear hopeless.

Understanding of the country specific for this case study appears crucial. Due to the degree of tax evasion and general perception of tax avoidance, the chief hypothesis in this paper is not of the scope of taxable income elasticity but of its actual existence.

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1 [www.czech.cz](http://www.czech.cz)

2 [www.pwc.com](http://www.pwc.com)

## Data analysis

To obtain the apparent elasticity, panel data have been collected consisting of twenty companies between 2004 and 2009; altogether, the dataset consists of 120 observations. While the data selection comprises only a fragment of all company data in the Czech Republic, they incorporate all clients of companies subject to the corporate income tax rate, differing in size and location within the economy. Full access to the database of the Stereo software in an unnamed Czech company enables me to obtain detailed data and provide a thorough analysis.

Table 1 presents the corporate income tax rate in the Czech Republic for particular years.

**Table 1 | The evolution of the corporate income tax rate in percentage**

Year	2004	2005	2006	2007	2008	2009
CIT rate	28	26	24	24	21	20

*Source: calculated by the author*

Table 2 shows the summary statistics for particular variables of interest. The values for the taxable income variable are in thousands, as presented in the particular models.

**Table 2 | Summary statistics**

	Mean	S. D.	Max	Min
Taxable income	333.44	630.642	2533	-983
Tax rate	23.833	2.734	28	20
Number of observations	120			

*Source: calculated by the author*

The data present two phenomena worth mentioning. Out of a hundred and twenty observations over different firms and periods, forty-four observations across units and time periods stand for zero taxation, and about fifty percent of the observations of taxable income turn up negative. Due to the significant amount of negative or zero value observations, omission of such cases would result in a crucial bias, reducing the validity of the potential interpretation. For that reason, the model in this paper aims to include all the data and rather modify the standard model as presented by various authors. Nevertheless, such a result of the data analysis complicates the analysis of the elasticity of taxable income as the next part examines in more depth.

This data analysis supports the prior intuition about a serious tax evasion and avoidance problem, which intensifies the questioning about any existence of taxable income elasticity for the sample of Czech companies.

## Methodology

In terms of the methodology, the models in this study correspond to the models by authors in the literature review with certain modifications to account for specific characteristics pertaining to the question of interest in this paper. As in the previous papers, the regression models present taxable income as the outcome variable and marginal tax rates as exogenous ones.

Data in this model are in a panel form. Besides their utilisation in most of the authors' papers examining elasticity of taxable income, the rationale behind opting panel data is the ability to analyse policy issues more thoroughly as the same companies are followed over time as the changes in the tax rate occur. This enables me to examine these firms' behavioural response after the tax policy is altered, but also to include the possibility of its anticipation by individual companies.

The presence of various companies with zero or negative values of taxable income necessitates a modification to the models in this paper in respect of the papers by authors noted in the literature review. In particular, the first model is a linear regression model, while the next one takes the form of a linear probability model to examine the companies' behaviour in connection with tax avoidance in the presence of different tax rates. The outcome variable in the prior case will take on a non-logarithmic form, instead of using the ratio of taxable incomes in two different periods as other authors examining behavioural responses to progressive taxation suggest; this outcome variable is a single taxable income variable in the time  $t$ . While such an adjustment diverges from the papers by American authors, it should not reduce the validity of the following conclusion.

The first model will be a linear regression model further modified for the linear probability model. As already discussed, linearity of the models becomes a reasonable simplification as Czech tax rates are not progressive in contrast to other papers. Correlation between the error term and tax rates for different income levels should not be a threat. Also, the self-selection problem should not affect the regression since individuals cannot pre-select themselves for particular tax rates, as all individuals are taxed by the same percentage.

Besides the literature review, the reason for the selection of particular models also follows statistical examination. The ADF test allows me to reject the null hypothesis of the existence of a unit root for individual variables of interest in the form of the panel data according to all available tests: Levin, Lin and Chu [2002]; Im, Pesaran and Shin [2003], and the Fisher Type Test using the ADF and the  $d$  PP test [Maddala and Wu, 1999; Choi, 2001] at a 1-percent level of statistical significance. A linear model estimated by pooled OLS seems to be an appropriate technique from this point of view.

As already mentioned, the endogeneity problem should not be an issue in this model as the taxation is not progressive but rather proportional. However, the potential existence of significant serial correlation of errors for individual firms over time due to the panel structure of data necessitates a correction of the standard errors. The least squares dummy variable (LSDV) model, which is pooled OLS including a set of  $N-1$  dummy variables, offers an estimator numerically identical to the fixed effect model estimator which accounts for this common panel data problem. Testing for fixed effects with an F test for individual effects provides a model with a  $p$ -value =  $1.069\text{e-}13$ , a model including the fixed effect such as the LSDV is then a better option in comparison to a regular OLS model. The F test for fixed effects also rejects the null hypothesis about indifference between applying

regular OLS or the fixed effect method to the second model with a binary dependent variable; the p-value in this case is 0.0004. Finally, the LSDV method offers an estimate identical to that of the fixed effect model [Torres-Reyna, 2011].

The fixed effect method along with the random effect method have also been compared to verify the accuracy of the application of pooled OLS incorporating the fixed effect. (See Schmidheiny and Basel, 2001, for a fixed and random effect method estimation in the program “R”.) According to the p-value of the Hausman test for the exogeneity of the unobserved error component, one cannot reject the null hypothesis about asymptotic equivalence between suitability of the fixed effect or the random effect method but also the pooled OLS as long as standard error correction takes place [Cameron and Trivedi, 2009]. Finally, running the regression with the use of all the random effect and fixed effect methods or the LSDV method (whose results appear identical) in the program R yields almost identical estimates for both models in this paper.

The Breusch-Pagan Lagrange multiplier test reveals no need to use a fixed time effect given its p-value 0.679 for the first and 0.124 for the second model. On the other hand, the Breusch-Pagan Lagrange multiplier test for random effects suggests a significant difference across units, so-called panel effect, with the p-value  $< 2.2\text{e-}16$  and  $= 7.208\text{e-}05$  for the first and second models, respectively, which excludes the possibility to use regular OLS. Also for this reason, the LSDV method accounting for the fixed effect is applied.

## Hypotheses

Hypothesis 0:

Taxable income is independent of tax rate changes.

Hypothesis 1:

Non( $H_0$ ). Taxable income is dependent on tax rate changes.

## Models and results

This part of the paper is concerned with the regression models, which statistically examine the relationship between taxable income and tax rates.

### Model 1

Another version of the linear probability model for the present analysis is:

$$y_{i,t} = \beta_0 \log \frac{(1 - \tau_{t+1})}{(1 - \tau_t)} + \beta_1 \log \frac{(1 - \tau_t)}{(1 - \tau_{t-1})} + \beta_2 \log \frac{(1 - \tau_{t+2})}{(1 - \tau_{t+1})} + \delta_i + \varepsilon_{i,t}$$

Where “t” denotes the year of interest, “i” the unit of observation, tau represents the marginal tax rate and the variable “y” stands for the real taxable income.

The delta captures fixed effects for individual companies; it incorporates all the characteristics observed and unobserved for the firms, which are fixed over time. This dummy variable regression model should give us the same estimators of the parameters such as time-demeaned data according to Wooldridge [2006, pp. 490]. The fixed effect variable should enable me to discover a clearer effect of the tax rate on taxable income.

The first three variables correspond to the prior studies (see the Literature Review for more details). Inclusion of a beta 1 and beta 2 reflects the research of Golsbee [1997], where beta 2 incorporates potential behavioural responses of anticipation of tax rate changes for individuals. Beta 0 reflects short-term responses to tax rate changes, and beta 0 together with beta 2 reflect long-term responses. Beta 1 then reflects a delayed response to a tax rate reform. The wider understanding of elasticity of taxable income should consist of all of these beta parameters. This explanation follows the study of Giertz [2010, pp. 414].

A fixed time effect variable is not present in this model following the suggestion of the Breusch-Pagan Lagrange multiplier test, which reveals no need to use a fixed time effect with the p-value of 0.679. On the other hand, an inclusion of the fixed effect variable for individual companies seems crucial following the F test for a fixed effect with the p-value of 1.069e-13, or the Breusch-Pagan Lagrange multiplier test revealing a panel effect in the model as argued in the methodology part above. These tests support the use of the least squares dummy variable method.

Table 3 in the Appendix depicts the outcome of this model with the use of the least squares dummy variable method in the program R. The variables correspond to the previous equation, where “LogTaxR1” represents the ratio of tax rates in the years  $t+1$  and  $t$  in the logarithm, the variable “LogTaxR” is the ratio of tax rates between the years  $t$  and  $t-1$  in the logarithm and the variable “LogTaxR2” is the ratio of tax rates between the years  $t+2$  and  $t+1$  in the logarithm. Finally, the variable “DF” reflects the fixed effect of the firms.

There is no evidence for a cross-sectional dependence; residuals across entities appear uncorrelated; the Pasaran CD test has been implemented leading to a p-value of 0.6. Wooldridge’s test for serial correlation in “short” fixed effect panels suggests the problem of serial correlation providing a p-value of 0.0001. Next, the Breusch Pagan test suggests the existence of a heteroskedasticity providing a p-value = 8.674e-09. Arellano’s [1987] method controls for heteroskedasticity, along with the serial correlation, and provides the same conclusion of the model as the coefficients without such a treatment (see Table 3 column (3)) [see Vogelsang, 2012].

This model so far seems to incline to the null hypothesis about non-existence of a relationship between various tax rates and taxable income for the sample of companies in the Czech Republic. Since this result certainly originates from the existence of almost fifty percent of observations with negative taxable income, I reformulate the research question in the next models not to ask about the relationship between the value of taxable income and variations in tax rates but rather to examine whether individual companies base their decisions about tax avoidance or evasion (mathematically about the sign of taxable income) dependent on the evolution of tax rates.

In sum, the question of the sensitivity of taxable income in response to changes in tax rates might seem biased towards companies with negative taxable income, as they are indifferent to the absolute value of already negative income. The next model then seeks to reveal a probability with which a company reveals a negative taxable income in response to changes in tax rates. In case the sign of firms’ taxable income follows changes in tax rates, the particular parameters should appear significant. Again, such models should help to question the hypothesis about the existence of taxable income elasticity for the Czech Republic, namely whether the companies’ reduction of taxable income below zero follows changes in tax rates.

## Model 2

The regression model appears as follows:

$$D_{i,t} = \beta_0 \log \frac{(1 - \tau_{t+1})}{(1 - \tau_t)} + \beta_1 \log \frac{(1 - \tau_t)}{(1 - \tau_{t-1})} + \beta_2 \log \frac{(1 - \tau_{t+2})}{(1 - \tau_{t+1})} + \delta_i + \varepsilon_{i,t}$$

This model assimilates to the previous one, except that the dependent variable is a dummy variable “D” with the value of 1 in case the firm’s taxable income appears zero or negative. Such a model with a binary dependent variable is called a “linear probability model”. The least squares dummy variable method exploiting fixed effects has also been selected for this model after the F test for fixed effects does not reject the null hypothesis about indifference between applying regular OLS or the fixed effect method; the p-value in this case was 0.0004. Given the p-values for the F-test for individual effects as well as the Breusch Pagan Lagrange multiplier test, the model does need to include a fixed time effects variable.

This model 2 is also tested in the software R. The results of the examination are presented in Table 3 in the Appendix.

The signs of the variables presented in Table 3 in the Appendix seem intuitive; with an increase in the tax rate, the taxable income decreases. However, no variable appears statistically significant in this model. The R-squared reflecting the merit to which the outcome variable is explained by the regressors amounts to 55.87 percent. The results are in accordance with the conclusion of the previous model. The probability of individual companies reporting zero or negative taxable income seems unresponsive to increases in the tax rate.

Verification of the model is as follows. There is no evidence for a cross-sectional dependence; residuals across entities appear uncorrelated; the Pasaran CD test has been implemented leading to a p-value of 0.36. Wooldridge’s test for serial correlation in “short” fixed effect panels suggests no problem of serial correlation providing a p-value of 0.865 (for more details on serial correlation, see Croissant, 2008). At the 95-percent level of statistical significance, one cannot reject the null hypothesis about homoskedasticity using the Breusch-Pagan test.

In sum, the signs of the variables for tax rates correspond to one’s intuition; however, given their statistical insignificance, no conclusion about the size of their effect on taxable income can be clearly made. Only some of the dummy variables reflecting the fixed effect appear statistically significant. Therefore, there is no apparent link between tax rates and taxable income. Behavioural responses of anticipation of tax rate changes for individuals following Golsbee [1997] or Giertz [2010] do not appear to be significant either. The outcome variable is explained by the independent variables by 71.23 percent. The result supports the conclusion of the previous outcome. Individual companies! behaviour regarding their taxable income does not respond to changes in tax rates.

## Discussion of results

The outcomes of the above models do not reject the null hypothesis concerning the non-existence of elasticity of taxable income for the sample of firms in the Czech Republic. This conclusion confirms the idea in the literature review. Companies following rational



expectations theory could internalise changes of tax rate a priori, keeping their taxable income irresponsive.

A more possible interpretation stems from the severe problem of tax avoidance or evasion in this country, which could explain companies' apathy to alterations in the tax rates. Among the sample of companies, about fifty percent of the observations report negative taxable income, as they are not subject to taxation; the tax rate does not seem to be of a concern. The data, along with the results of this study, point out the acuteness of the tax avoidance problem. While Western economists question the size of the elasticity of taxable income to reveal the merit to which individuals attempt to affect their taxable income and thus avoid taxation, companies from the sample for the Czech Republic avoid taxation to the extreme where a rise in the tax rate does not worry them anymore.

Fiscal policy decision-makers should consider the result of this analysis and perhaps increase the sample size to evaluate its generality for the whole country. If it shows to be realistic for most taxpayers in this country, necessary changes in policies should follow. The famous idea of a flat tax as proposed by Hall and Rabushka (2007) could be one possibility to deal with this phenomenon, without opportunities for tax deductions and exemptions to limit the harmful tax avoidance. Simplification to the tax law could also improve the situation so that individual companies would not have so much space for discretion. Finally, the complexity of the tax system ranks the Czech Republic among the worst of the EU & EFTA countries; even though there have been noticeable improvements on the administration and process side, the average time for corporate income tax compliance was 94 hours in 2014.<sup>3</sup>

## Conclusion

In conclusion, the results of the models reject the null hypothesis about the existence of elasticity of taxable income for the sample of firms in the Czech Republic. This outcome is supported by two types of econometric models with and without dummy variable capturing the firms' fixed effect. To control for the data problem due to the large amount of taxable incomes with negative values, the linear probability model is also applied, which also supports the null hypothesis. The behaviour of entrepreneurs does not seem to be sensitive to changes in the tax rates. This result is in a sharp contrast with results of American authors, which support the idea of existence of elasticity for the US and rather differ in its size, as the literature review summarises.

The explanation of the results might correspond to entrepreneurs' anticipation of the changes in tax rates for an interval preceding two periods.

In respect to the theory of rational expectations, also suggested in the introduction, such an effect could already be internalised, leaving data on taxable income without jumps in response to alterations in tax rates. As the literature review suggests, Lucas, Stokey and Barro cited in Sargent [2014] view such a result as positive, demanding governments to follow a "tax-smoothing" policy without abrupt alterations in marginal tax rates. According to these authors, such a policy would result in a minimum negative effect on supply.

Another, more intuitive explanation could originate from particular companies' severe tax avoidance, resulting in zero or negative taxable income values. Then, not being

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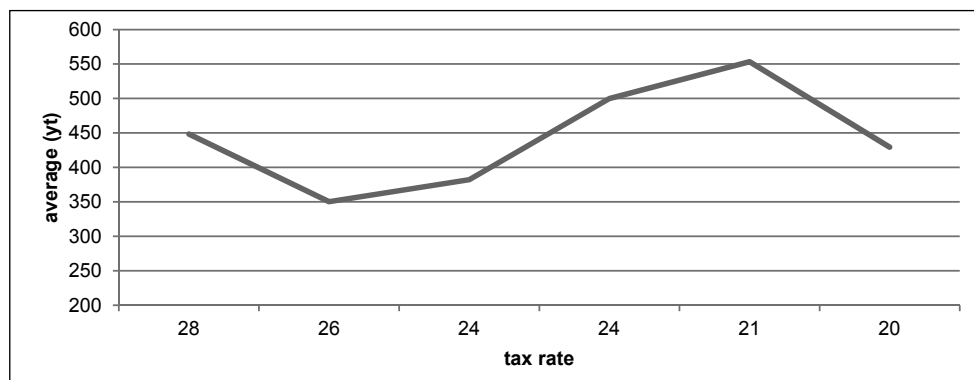
3 [www.pwc.com](http://www.pwc.com)

subject to taxation, these companies do not react to the fiscal policy. The significance of this conclusion rests in the extreme to which Czech companies avoid their tax obligation in comparison to Western countries, where an elasticity of taxable income is present. While individuals' behaviour reflects alterations in the tax rate in the last case, individual companies in the country of interest do not even worry about its dimension.

Further research could concentrate merely on data consisting of only positive taxable income values. Increasing the sample could also help to evaluate the results of this study.

## Appendix

**Chart 2 | Evolution of averages of taxable income**



Source: calculated by the author

**Table 3 | Elasticity of taxable income estimates**

Dependent variable	Model (1) Taxable income	Model (2) Binary variable	Model (3) Taxable income- Arellano
LogTaxR1	-2,090.482 [0.473]	1.895 [0.502]	-2,090.482 [0.463]
LogTaxR	-181.799 [0.943]	0.66 [0.788]	-181.799 [0.931]
LogTaxR2	-2405.913 [0.255]	1.959 [0.338]	-2405.913 [0.246]
+ FE			
R2	0.712	0.559	
F-Statistic	10.44	5.338	
p-value	< 2.2E-16	2.10E-09	
p-value in [ ]	0 (***), 0.001 (**), 0.01 (*), 0.05 ( ' )		

Source: calculated by the author

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