Hacienda Pública Española/Review of Public Economics

Manuscript 2059

THE SINFUL SIDE OF TAXATION: IS IT POSSIBLE TO SATISFY THE GOVERNMENT HUNGER FOR REVENUES WHILE PROMOTING ECONOMIC GROWTH?

José Alves

The sinful side of taxation: is it possible to satisfy governments' hunger for revenues while promoting economic growth?

Abstract

This study evaluates both the linear and non-linear relationships between individual tax revenues and real *per capita* growth. The analysis is carried out by using panel data techniques to assess the short- and long-term effects of taxation on economic growth for all of the OECD countries during a period that comprises the years between 1980 and 2015. With the exception of taxes on individual income, we find evidence of non-linear relationships between other sources of taxation and economic growth, which consequently support the existence of optimisation in GDP terms for the threshold values between economic growth and revenue from tax components. In summary, the results provide a certain degree of support for the carry out of policies focused on raising certain taxes (expressed in percentage of GDP) without harmful consequences to economic growth.

Keywords: Economic Growth; Tax systems; Fiscal Policy; Optimal taxation

JEL: E62; H21; O47

1. Introduction

Few policy mechanisms have the economic and social impact that the tax phenomenon has. Taxation is indeed a crucial input for both individual and collective decision-making processes. It not only underpins several ideological and political economic perspectives, but it also minimizes the conflict between individual liberty and the imperative of the common good, through state financing (Musgrave, 1992). Furthermore, there are a variety of examples where one can observe the overall phenomena that has arisen from the themes regarding taxation, namely from the constant tension that exists between the appropriation of income and wealth generated by private economic agents through taxation, and the need to finance government expenditure (Alves, 2018). This tension gives rise to what might be describe as a problem of duality between micro and macro Economics . In fact, through a static perspective of reality a microeconomic point-of-view suggests that taxation is the deduction of income that has been obtained from individual effort, both by individuals and firms; on the other hand by re-examining the overall effect of taxation, *i.e.*, using a dynamic perspective, we might be able to better assess the true effects of taxation on economic agents in both the short and the long-term.

Optimal taxation is a recurring debate in Economics and its results have been revisited over time. Tax revenues are raised from the income and wealth of the private sector, and are redistributed and allocated through public spending. In addition, and irrespective of the nature of the level of efficiency of government expenditure, the funds raised by taxation are not taken out of the economy. Indeed, these financial resources are put into circulation and, consequently, they boost several aspects of an economy through both public consumption and investment. Therefore, according to Ramsey (1927) the concern of optimal taxation should be the raising of revenues to feed the ruler while, at the same time, minimizing the effects of deadweight loss derived from the expropriation of the income and wealth of the remaining economic agents. The seminal paper presented by Mirrlees (1971) develops a model to evaluate an optimal tax system over individual income, based on a static perspective of the economy. By neglecting the time-varying evolution of an economy the optimal information regarding the state of individuals taste as well as the administrative costs the government incurs in the process of levying taxes, are the main contribution of Mirrlees (1971) for the discussion regarding the skills distribution and income-leisure preferences of individuals for an optimal tax design. Furthermore, the joint optimal tax model developed in Chamley (1986)-Judd (1985) claims that capital taxes should be set to zero in the long-term, yet such claims were contradicted by the results obtained in the recent analysis carried out in Straub and Werning (2019). Other valuable contributions on optimal taxation could also be found in Werning (2007), Golosov et al. (2011), Farhi and Werning (2013) and Sargent et al. (2017), and others.

As discussed above, the financial resources obtained through taxation are constantly being reintroduced into the economic circuit by government spending, which, in turn, leads to the recognition of important results regarding economic competition, especially when governments attempt to correct market externalities through public policies. To be able to conduct these policies, notions exist of equality and efficiency, which naturally occur when public authorities have to make decisions on how to raise a tax. These concepts, which are usually concurrent, must be taken into consideration when public authorities decide how to raise taxes. In fact, as Okun (2015) refers, there is a need to transfer money from the richest strata society to the poorest one. However, the author is aware of the effects of the inefficiency that can occur from this process - due to the public administration costs produced by bureaucracy, as well as the incentives that can emerge from decreasing labour supply for the most fortunate individuals in society. Indeed, this latter group has more incentive to base their spending on tax-deductible expenditures. In this sense, and quoting Okun (2015, pp.95), "*High tax rates are followed by attempts of ingenious men to beat them as surely as snow is followed by little boys on sleds*". Therefore, we can expect these emerging inefficiencies to be somehow offset by what are assumed to be productive expenditures which can incentivise overall economic growth. Otherwise, it seems legitimate to admit that public authorities would not allow the deduction of such expenditures. Furthermore, and as highlighted in Berggren, Bjørnskov, and Lipka (2015), an institutional perspective needs to be considered when economists analyse the size of the tax burden produced by governments. In fact, the different degrees of sociological adherence to political regimes can influence the level of efficiency of governments, and can therefore explain the observed level of government tax burden across countries. As the authors mention, a higher perceived legitimacy is related with higher adherence to public policies and, in this sense, the tax burden has less impact; however, the same established legitimacy can alienate individuals from economic debate, and thus enable interest groups to have a greater influence in the political decision making process (which is the same observation as that made in Alves, 2018).

Through all of this reflection, we may wonder what the real effects of the overall economy and its dynamics are. Accordingly, we propose to study whether tax effects always have a linear impact on social life, or, whether, on the other hand, if there is evidence of the non-linear impact of tax revenues on economic development. In our empirical research, we evaluate linear and non-linear tax sources revenues and the effects they produce on both short- and long-term economic growth, for the period between the years of 1980 and 2015. We proceed to identify the optimal values of taxation that governments should consider when stimulating economic growth. To sum up, apart from providing new insights on this topic, we believe that this analysis also provides important clues for governments regarding optimal tax design.

Our results lead us to conclude on several tax-items' thresholds, both in short- and long-run, evidencing that there is a fiscal space to raise the revenues of some taxes in percentage of GDP and to promote short- and long-term growth. Moreover, we find that VAT revenues are at optimum level in the long-run. Indeed, the long-term thresholds found for this tax-item rounds the average value of 10.7% of GDP, while the mean values for the revenues raised in OECD countries is approximately 10.6%. However, we found a higher average maximizing *per capita* GDP growth threshold for this tax source of 14,5%. In addition, the differences between the short- and long-run results can be explained by the fact that short-run tax multipliers are usually smaller than those that can be found for the long-run, therefore justifying the differences found in the short- and long-run threshold results. In the overall, the set of results provided can be seen as an important path for fiscal authorities to try to improve, in an efficient way, their tax systems.

The rest of this empirical research is organised as follows: Section 2 provides a literature review of the related theoretical viewpoints and empirical studies on this topic; Section 3 presents the methodology, the data, and its sources; Section 4 highlights the empirical results, and; Section 5 summarises our conclusions.

2. Literature Review

The existing literature on the link between both short- and long-term tax composition effects on economic growth is quite abundant. However, and as reflected in Bergh and Henrekson (2011), the considerable amount of emergent literature has provided a set of different results regarding the role of the state, both for the analysis of the revenue and the spending sides. Notwithstanding the literature survey of these authors, which points to a negative impact on GDP growth of between 0.5% and 1% for each 10% increment in government size, they also conclude that higher tax burden countries show an above average economic growth. Their explanation relates to the collection of a larger amount of taxes together with a consequent set of policies which improve the general welfare of the population and therefore promote improved economic performance[1]. However, Dalena and Maggazzino (2012) have demonstrated the different paths of the trajectories of public finance for the Italian case for over more than a century. The authors conclude that while "*Tax-and-Spend*" and "*Spend-and-Tax*" arguments are present and adhere to liberal and interwar periods, respectively, the "*Fiscal Synchronization*" public finance argument is evident during the second-half of the twentieth century. However, and despite the public arguments these authors found, Maggazzino and Mutascu (2019) show that fiscal sustainability in the long-term seems to be ensured in Italy. In addition, Brady and Maggazzino (2018) provide new results for the fiscal sustainability paths for the EU28. Although they find three clusters of countries with regards having a balanced path for public finance, it seems that the PIIGS countries have the worst path, as in their case, government expenditure tend to grow faster than tax collection.

Several studies which analyse different timespans and country samples, usually for OECD countries, are unanimous regarding the negative effect of distortionary taxation's impact on economic growth (see Cashin, 1995, Kneller et al., 1999, Bleaney et al., 2001, and Gemmell et al., 2007). For instance, in an analysis of a sample of 14 EU countries for a period between 1990 and 2006, Benos (2009) found that distortionary taxation has a negative impact on economic growth rates, with capital, income, and wealth taxation all included. Furthermore, and in line with these conclusions, Acosta-Ormaechea and Yoo (2012) found that changing the tax composition in favour of income taxes is negatively related with long-term growth rates; this effect is even clear for social security contributions and personal income taxes. Contrary to similar studies, these authors' findings highlight that it is preferable to shift taxation from income to property taxes, rather than to change from income to consumption taxation. Furthermore, Arnold et al. (2011), when examining the required tax policy changes for a sustainable transition from short-term to the long-term economic growth for a set of 21 OECD countries, covering more than a 30 year time span, also reached similar conclusions – economic growth can be promoted by progressively moving towards consumption and property taxation, which is compensated by a reduction in income taxation.

Afonso and Furceri (2010) report that indirect tax revenues present negative and significant effects on growth for both EU and OECD countries between 1970 and 2004,

[1]In addition to this analysis, we recommend Forte and Magazzino (2011), who analyse the optimal government size for the EU27, covering the last four decades.

while direct taxes show no impact on economic performance, which evidences a lower degree of distortion when compared to indirect taxes. In addition to these results, the authors failed to find a concave relationship between taxes and growth. A similar result is also obtained in a previous study by Karras and Furceri (2009), where the authors address the tax-growth relationship for 19 European countries during a 39-year period (1965-2003). While they found that taxes represent a negative impact of a 0.5% to 1% increase in overall taxation, consumption taxes seem to be the most detrimental source of taxation for growth. Yet, Zimcík (2016) also evidences a negative correlation between production taxes and economic performance.

On the other hand, Fölster and Henrekson (2001) analysed the growth-tax linkage during the 1970-1995 period for a sub-sample of OECD countries and found results which failed to support that tax has an effect on growth. Although their results are robust under extreme bound analyses, when the authors consider other countries, such as Hong Kong, Singapore, and Taiwan, the conclusions show the significant negative impact of taxation on economic performance. Furthermore, and by decomposing tax revenues into several tax components for 155 countries during a 39-year period, Afonso and Jalles (2014) also evidence a non-significant effect of each tax component on growth. Tosun and Abizadeh (2005) evaluated the tax structure and its effects on growth for 24 OECD countries over the last two decades of the twentieth century, and found that those tax items which are most positively responsive to a change in GDP *per capita* are personal and property taxes, while taxes on payroll and goods and services decrease in importance. For a sample of 23 OECD countries during 5-year periods between 1970 and 2000, Angelopoulos et al. (2007) developed a competitive decentralised equilibrium model to study the growth-government revenues nexus, and concluded that capital and corporate income tax rates are positively related with growth. However, these results seem to be contradicted by Afonso and Alves (2015), who found that capital and profit taxation is detrimental to growth. The conclusion of the latter authors is corroborated by a previous study carried out by Arnold (2008), which assesses how tax structures influence growth dynamics for 21 OECD countries between 1971 and 2004. The author concludes that besides the fact that income taxes, in particular those levied on firms, are detrimental for growth, the priority should be to tax property and consumption since these sources of tax income are growth enhancing. De Witte and Moesen (2010) resort to a non-parametric data envelopment analysis to assess a concave relationship between growth and government size, computing an average value of 42% for the optimal tax burden for the whole economy.

Lastly, Xing's study (2012), which assesses the composition of tax revenues and *per capita* growth, found that several empirical papers on the relationship between taxation and economic growth present a non-robust econometric output under different heterogeneity hypotheses across the several samples of countries, both in the short and the long term.

Given the panoply of literature on the effects of taxation on several economic outcomes, as previously mentioned in this section, we can see that very few studies have been carried out on optimal levels of taxes, namely the levels of each tax component, and the existence of tax thresholds. Accordingly, our study aims to contribute to the above-mentioned literature with new insights regarding the link between taxation and economic growth.

3. Methodology and Data

In our analysis we consider a neoclassical growth model, represented by an aggregate production function of the type *Y=F(T)*, *i.e.*, the economic output is a function with a taxation structure represented, generically, by the set *T*, as expressed in Equation (1):

(1) $$g_{i,t} = \alpha_{i,t} + \beta_{0,i,t} y_{i,t-1} + \sum \beta_{n,i,t} \tau_{n,i,t} + \beta^{j}_{n,i,t} x^{j}_{i,t} + \nu_i + \eta_t + \varepsilon_{i,t}, j = 1,2, t = 1, \ldots, T, i = 1, \ldots, N$$

where $g_{i,t}$ is the growth rate of real GDP *per capita*, $y_{i,t-1}$ illustrates the one-lag real GDP *per capita*, $\tau_{n,i,t}$ represents the revenue of each tax item *n*, in tax to-GDP ratio, $x^{j}_{i,t}$ is an independent variable belonging to the first or second sets of control variables *j*, ν_i, and η_t are respectively the country and time-specific effects, $\varepsilon_{i,t}$, reflects an unobserved zero mean white noise-type column vector satisfying the standard assumptions, and, lastly, $\beta_{n,i,t}$ are the estimated coefficients used to assess the impact of each variable on growth, while *t* and *i* are the time and country indices, respectively.

In order to assess the possible non-linearity effects of tax items on economic performance, we then add an additional squared term for each tax item, as expressed in the following equation:

(2) $$g_{i,t} = \alpha_{i,t} + \beta_{0,i,t} y_{i,t-1} + \sum \beta_{1,n,i,t} \tau_t + \sum \beta_{2,n,i,t} \tau_t^2 + \beta_j x^{j}_{i,t} + \nu_i + \eta_t + \varepsilon_{i,t}, \ t = 1, \ldots, T, \ i = 1, \ldots, N$$

By deriving Equation (2), we obtain Equation (3), which represents the combined effect of increasing tax items revenues on economic growth:

$$(3) \qquad \frac{\partial g_{i,t}}{\partial(\tau_{n,i,t})} = \frac{\partial\left(\alpha_{i,t}+\beta_{0,i,t}y_{i,t-1}+\sum\beta_{1,n,i,t}\tau_{n,i,t}+\sum\beta_{2,n,i,t}\tau^{2}_{n,i,t}+\beta_i x^{j}_{i,t}+\nu_i+\eta_t+\varepsilon_{i,t}\right)}{\partial(\tau_{n,i,t})}$$

Each tax item threshold, $\tau^{*}_{n,i,t}$, is subsequently computed by equalising Equation (3) to zero, as shown in Equation (4),

$$(4) \qquad 0 = \beta_{1,n,i,t} + 2\beta_{2,n,i,t}\tau^{*}_{n,i,t} \Leftrightarrow \tau^{*}_{n,i,t} = \frac{-\beta_{1,n,i,t}}{2\beta_{2,n,i,t}}$$

Consequently, if the results evidence a significant negative signal for $\beta_{2,n,i,t}$, this means that there is a concave relationship between a specific tax item and economic performance, which implies a maximum value of taxation raised in an economy that promotes economic growth. In contrast, a positive significant coefficient leads to an inverse conclusion - where a positive $\beta_{2,n,i,t}$ means a convex relationship and, in economic terms, a specific tax item value that minimizes economic growth. Therefore, in the results section, when we obtain non-linear relations, we are able to retrieve these conclusions through the statistical significance of both linear and squared terms, and we proceed to highlight these coefficients as a way of differentiating between maximum and minimum optimal levels. In fact, we may expect positive impacts of taxes on growth. Those effects may not only arise from better redistribution of income and wealth among individuals, but also to force firms to improve their efficiency production degrees when facing higher tax rates, in order to guarantee the same level of percentage of profits. Lastly, being aware of the possible misleading interpretation of the results obtained from the debt squared-term, we follow Brambor et al. (2006), as this procedure allows us to confirm whether our estimations on tax-items thresholds can be claimed as being a true optimal tax threshold identification or not. By analysing the confidence intervals, we are able to ensure that our results are robust and that the non-linear results obtained effectively translate to a parabola effect between the identified tax-items thresholds and economic growth[2].

[2] For reasons of parsimony, we opt only for providing the set of the correspondent graphs with the confidence intervals of the non-linear analysis, in appendix. The remaining results are available upon request.

The model is estimated for the period between 1980 and 2015, for the following OECD countries: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), the Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Iceland (ISL), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), South Korea (KOR), Latvia (LVA), Luxembourg (LUX), Mexico (MEX), the Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Slovak Republic (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), the United Kingdom (GBR), and the United States (USA).

Our database is derived from several data sources. GDP is based on purchasing-power-parity *per capita* GDP (*realgdppc*), in thousands. Data on growth rate (*realgdppcgr*), general government structural balance in percentage of GDP (*capb*), general government gross debt-to-GDP ratio (*debt*), and share of total government expenditures in percentage of GDP (*totexp*) are taken from the World Economic Outlook of the International Monetary Fund. The financial information on taxes on income, profits and capital gains of individuals (*taxinc*), taxes on income, profits, and the capital gains of companies (*taxfirms*), social security contributions (*ssc*), taxes on payroll and workforce (*taxpayroll*), taxes on property (*taxprop*), taxes on goods and services (*taxvat*), gross fixed capital formation growth rate (*gfcfgr*), current account balance in percentage of GDP (*current*), long-term interest rates (*ltir*), average hours actually worked (*avg*). The unemployment rate as a percentage of active population (*unem*) had the *OECD.Stats* database as its source.

From the Government Finance Statistics, we used data on public spending, based on the classification of the functions of government, i.e., government expenditures on general public services (*pubser*), on defence (*def*), on public order & safety (*pubor*), on economic affairs (*eco*), on environment protection (env), on housing & community amenities (*hou*), on health (*hea*), on recreation, culture, & religion (*cul*), on education (*edu*), and on social protection (*socpro*).

In addition, the World Development Indicators (WDI) ate used to provide the data on the old age dependency ratio as a percentage of active population (*ageratioold*), total fertility rate (*fertility*), GDP percentage of household final consumption expenditure (*hconsggdp*), land area in squared km (*landarea*), and total life expectancy at birth in years (*lexpectancy*).

Lastly, population in millions (*pop*) and the total factor productivity at constant national prices (*rtfpna*) are based on Feenstra et al. (2015), while the liquid liabilities-to-GDP ratio (*llgdp*) information was collected from the International Financial Statistics (IFS) data of the International Monetary Fund. Table 1 presents the summary statistics for each variable used in our econometric specifications.

[Table 1]

To estimate the coefficients, we apply panel data techniques by using *(i)* OLS, *(ii)* OLS-Fixed Effects (FE) to deal with unobserved effects, *(iii)* Generalised Method of Moments (GMM) to deal with endogeneity problems, and lastly, *(iv)* Robust Least Squares (RLS) to retrieve robust results and to deal with possible outliers' observations. With the exception of RLS, we estimate the coefficient by resorting to white diagonal covariance matrix assumption, in order to assume a residual heteroscedasticity.

In complement to the application of each tax component, we use two sets of control variables: the first econometric specification includes $realgdppc_{-1}$, *gfcfgr*, *current*, *ltir*, *avg*, *unem*, *capb*, *debt* and *totexp* variables; the second econometric specification considers $realgdppc_{-1}$, *pubser*, *def*, *pubor*, *eco*, *env*, *hou*, *hea*, *cul*, *edu*, *socpro*, *llgdp*, *lpop*, *rtfpna*, *ageratioold*, *fertility*, *hconsggdp*, *landarea*, and *lexpectancy* variables.

Lastly, and in order to estimate both short- and long-term effects of taxation, we estimate Equations (1) and (2) by using annual growth rate and a 5-year average economic growth, respectively. However, it is important to mention that we only assess possible tax thresholds for each tax item when we obtain both statistical coefficients for both linear and square term items regressors, with a significant level of at least 10%.

4. Empirical Analysis

a. Short-term effects of taxation on economic growth

For both econometric specifications, as addressed in the previous section, estimations from Equations (1) to (8) are based on the first set of control variables, while the ones from Equations (9) to (16) are based on the second set.

[Table 2]

When the first set of control variables is used, the results presented in Table 2 show that there is always a β-convergence process through the negative and significant signal represented in the real *per capita* GDP. In addition, growth of investment (*gfcfgr*) and long-term interest rates evidence an expected signal for the economic growth dynamics when their coefficients are statistically significant. On the one hand, government expenditures seem to be detrimental for growth, which is consistent with Afonso and Jalles' (2016) findings, whilst on the other hand, both the structural budget balance and the government debt-to-GDP ratio appear to present an expected negative relationship with economic growth (see, for example, the conclusions presented in Afonso and Alves (2015)).

Looking in detail at the effects of the different tax sources' revenues on economic performance, based on the estimations without the square term (of Equations (1), (3), (5) and (7)), we conclude that only an increase in tax revenues from individual income presents a positive effect on growth, while the other tax sources fail to evidence consistent effects on economic growth. In fact, the econometric regressions show the effects on GDP of both positive and negative tax revenues, depending on the econometric technique under analysis.

Additionally, when we evaluate the existence of non-linear relationships between the several tax revenues and their impact on growth (estimations from Equations (2), (4), (6), and (8)), we achieve certain tax thresholds, especially when we conclude that there is an average maximum value of 5.82% for taxes levied on firms' income- which is the level of taxes that we suggest should be levied on firms to efficiently boost economic growth. The same conclusion is found for taxes levied on payroll and workforce, where we reach an average maximum of 1.86% of revenues over GDP for this tax item. Furthermore, we also obtain an average maximising GDP growth rate tax level of 11.37% for social security contributions (Equations (2), (6) and (8)), although it is important to mention that for this source of taxation, our results show a minimising effect on growth of 17.15%, which implies that raising social security revenues until attaining that value will reduce economic growth rates.

Moving now to Equations (9) to (16), which show the results of Equations (1) and (2) by using the second set of control variables as mentioned above, we are able to conclude that government spending, as a function of government, is generally negatively correlated to growth, as it is also evidenced in previous research. The same negative effect on growth is also found for life expectancy. In contrast to these results, an increment of monetary supply and of total factor productivity appears to improve real economic growth. Furthermore, an increase of household consumptions presents a negative impact on growth, although the statistical coefficients obtained show evidence of a marginal impact (which is less than 0.15% on economic growth per unit increase in household consumption).

When we evaluate possible tax-to-growth thresholds using the second set of control variables, we also obtain several optimising values. The results achieved show average growth-maximising values of 13.76% for social security contributions, while evidencing maximum values of 2.50% and 4.58% for taxes on payroll and property, respectively. Additionally, on average a threshold of 14.52% is found for taxes on goods and services. When compared to the results of previous research, we conclude that there are no significant differences between the regression results, using the first or the second set of control variables. The results are presented in Table 3.

[Table 3]

b. Long-term effects of taxation on economic growth

With regards to the long-term relationship between taxation structure and economic growth, we also compute our main equations using both sets of variables. However, in order to evaluate the taxation items impacts on long-term growth, we make use of the 5-year average economic growth rates. The long-term results are shown in Tables 4 and 5, for the first and second sets of control variables, respectively.

Regarding the first set of control variables with linear relationships of taxes with growth (Equations (1), (3), (5) and (7)), we verify that the positive impact of investment growth on long-run economic performance, is congruent with the findings highlighted in the short-term analysis. The same conclusions are reached for the impacts of government spending. However, and in accordance with the short-term results, government debt growth and fiscal consolidation through the structural budget balance, show in general a negative relation with *per capita* long-term growth. Nevertheless, the results show a positive link between certain tax items and growth, especially for social security contributions and taxes on payroll. For the remaining tax sources, the results obtained cannot be said to have a unique impact on growth, as different signals are obtained depending on the econometric specifications.

In the analysis of the possible non-linear impacts of taxation on economic performance (Equations (2), (4), (6) and (8)), we come to similar conclusions for the control variables' effect on *per capita* growth. With regards to the existence of taxation thresholds, we obtain maximum average values of 10.80% and 10.58% for the revenues from social security contributions and from taxes on goods and services, respectively. We also reach two optimal average values of maximum tax revenues for taxes on payroll and workforce (1.95%), while property taxes appear not to present a non-linear connection with economic growth.

For the long-term regressions, using the second set of control variables, we obtain the following optimal maximising tax items' revenues average threshold values: 7.61% for social security contributions; 3.08% for taxes on payroll; 3.87% for property taxation, and; 10.88% for consumption taxation.

Additionally, similar results for the long-term were obtained for the control variables' impact on real *per capita* GDP growth, when compared to those obtained for the short-term regressions. In particular, public spending by function evidences a negative impact for economic growth. Monetary supply seems to lose statistical significance when it comes to explaining long-term growth, whilst, at the same time, total factor productivity significance is maintained, although its impact on real growth is not as high in the long-term as in the short-term. Lastly, household consumption, fertility rate, old-age dependency ratio, and life expectancy all present the same conclusions as in the short-term analysis.

[Table 4]

[Table 5]

5. Conclusions

In our paper we have evaluated the relationship between revenues of tax sources as a percentage of GDP and real *per capita* economic growth. This study was carried out on both a short-term and long-term basis, and it also assessed possible non-linear relationships between taxation and growth. The analyses carried out for all the OECD countries between 1980 and 2015 used two sets of control variables in order to understand the impact of tax structure on GDP growth.

The results obtained in this study support the assessment that tax revenues-to-GDP thresholds exist, which translate into optimal maximising/minimising values for certain tax items' revenues in terms of GDP. In particular, and only for the short-term basis, we found optimal maximum values for taxes on firms, while social security contributions, taxes on payroll and workforce, taxes on property, and taxes on consumption present threshold values for both the short and the long-term. Furthermore, we conclude that there are no optimal threshold values for taxation of individual incomes in relation to economic growth.

Lastly, by comparing our results with the different values for the mean of each tax item presented in the summary statistics, we verify that the historical mean value for consumption taxes coincides with the threshold value registered for that same tax source in the long-term. In addition, we verify the existence of fiscal margin for raising certain tax revenues as a proportion of GDP, by confronting the threshold results obtained with average historic values. This would lead to a rise in government revenues, without jeopardising economic performance. This supposition is valid for taxes on firms, for social security contributions (albeit this is not valid for the second econometric specification in the long-term analysis), taxes on payroll and workforce, and also property taxes.

Furthermore, an additional hypothetical exercise can be made, whereby if we sum our results for the average threshold values with the average mean of the other tax components which do not display threshold values, we can then conclude that the proportion of taxation levied on GDP should be between 40.20% and 46.99% for the short-term perspective, and between 37.07% and 39.63% for the long-term perspective, depending on the results obtained for the first and second set of control variables employed in our analysis. Considering both this exercise and the mean values for total revenues (32.95%, based on OECD data), we conclude that, on average, there is fiscal margin to increase overall tax revenues as a proportion of GDP, and, consequently, to improve both the short and long-term real *per capita* economic growth (Table 6 summarises our main findings regarding average tax source threshold values).

However, we are aware that various differences regarding tax-items thresholds exist, which are due not only to tax sociology, *i.e.* from the sociological adherence to political process decision, but also to the intrinsic features of different tax systems. Future research should be aware of the progressive degree of tax systems, tax-deductions and, in general, of the specific details of tax incidence, in order to provide a deeper analysis of the effects of tax systems on economic growth along greater timespans.

[Table 6]

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Appendix

Table 1: Summary statistics of the variables set for economic growth regressions, 1980-2015.

	realgdppc	taxinc	taxfirms	ssc	taxpayroll	taxprop	taxvat
Mean	24.448	8.82	2.806	8.345	0.369	1.745	10.588
Std dev	14.313	4.635	1.5	4.981	0.728	1.003	3.046
Max	101.054	26.78	12.594	19.173	5.661	7.334	18.73
Min	2.184	0.873	0.261	0	0	0.074	2.979
Obs.	1195	1106	1106	1137	1137	1137	1137
Median	21.698	8.532	2.533	8.862	0	1.593	10.892
Skewness	1.426	1.14	2.045	-0.162	2.773	0.564	-0.36
Kurtosis	3.689	2.053	7.128	-1.085	9.192	0.075	-0.15
IQR	32.252	11.071	3.337	12.512	0.311	2.55	12.361
CV	0.585	0.526	0.534	0.597	1.976	0.575	0.288
Range	98.870	25.907	12.333	19.173	5.661	7.26	15.751

	gfcfgr	current	ltir	avg	unem	capb	debt
Mean	3.314	-0.578	6.211	1797.237	7.349	-2.588	55.728
Std dev	8.917	5.565	3.429	249.343	3.835	3.295	35.901
Max	45.119	16.467	22.498	2911	27.467	6.003	242.113
Min	-47.761	-23.201	-0.069	1361.7	1.854	-18.676	3.664
Obs.	1164	727	854	986	741	860	943
Median	3.214	-1.073	5.367	1783.9	6.776	-2.266	48.27
Skewness	-0.015	0.047	0.966	1.248	1.777	-0.878	1.565
Kurtosis	3.261	1.277	0.89	3.242	4.976	1.543	4.262
IQR	7.61	2.6	8.117	1906.75	8.839	-0.374	70.778
CV	2.691	-9.622	0.552	0.139	0.522	-1.273	0.644
Range	92.88	39.668	22.567	1549.3	25.613	24.679	238.449

	totexp	pubser	def	pubor	eco	env	hou
Mean	42.621	6.703	1.681	1.698	4.76	0.689	0.756
Std dev	9.657	2.274	1.333	0.44	1.763	0.346	0.44
Max	68.436	16.701	8.851	3.761	25.28	1.758	5.411
Min	14.244	2.98	0	0.815	1.307	-0.284	-0.083
Obs.	977	585	586	585	585	583	585
Median	43.202	6.287	1.376	1.643	4.475	0.681	0.696
Skewness	-0.404	0.972	2.623	0.777	4.755	0.21	2.935
Kurtosis	0.048	1.023	7.922	2.018	42.369	0.518	23.116
IQR	49.546	7.917	1.763	1.951	5.239	0.869	0.94
CV	0.227	0.339	0.793	0.259	0.37	0.502	0.582
Range	54.192	13.721	8.851	2.946	23.974	2.042	5.494

	hea	cul	edu	socpro	llgdp	pop	rtfpna
Mean	5.901	1.176	5.394	15.562	72.91	33.531	0.941
Std dev	1.686	0.57	1.08	4.708	48.689	52.235	0.123
Max	9.123	3.63	8.116	26.18	399.114	319.449	1.539
Min	0.379	0.248	3.021	5.44	6.865	0.228	0.472
Obs.	585	585	585	585	1139	1173	1173
Median	6.172	1.113	5.389	16.046	63.178	10.385	0.975
Skewness	-0.885	1.422	0.128	-0.001	2.933	3.186	-0.425
Kurtosis	0.638	3.829	-0.634	-0.82	11.78	11.883	1.632
IQR	7.076	1.413	6.221	19.054	82.569	46.492	1.014
CV	0.286	0.484	0.2	0.303	0.668	1.558	0.131
Range	8.744	3.381	5.095	20.74	392.249	319.221	1.067

	ageratioold	fertility	hconsggdp	landarea	lexpectancy
Mean	20.094	1.793	56.382	1014.986	76.316
Std dev	5.519	0.499	7.069	2412.040	3.934
Max	42.653	4.836	79.551	916.192	83.844
Min	6.641	1.076	29.918	2.590	58.692
Obs.	1260	1260	1174	1220	1260
Median	20.171	1.72	56.38	241.930	76.734

Skewness	-0.171	2.023	-0.233	2.834	-0.753
Kurtosis	0.473	6.207	0.8	6.313	0.91
IQR	23.766	1.96	60.858	410.340	79.185
CV	0.275	0.278	0.125	2.376	0.052
Range	36.011	3.76	49.633	9159.330	25.152

Notes: For reasons of parsimony, the results of *realgdppc* and *landarea* variables are expressed in thousands of USD and squared *km*, respectively.

Table 2: Linear and non-linear short-term impact results of taxation structure on economic growth dynamics for Equation (1).

	OLS		OLS-FE		GMM		RLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(\text{realgdppc}_{-1})$	-0.000**	-0.000***	-0.000***	-0.000***	-0.000	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	0.097	0.037	-0.017	0.221	-0.008	-0.176	0.159***	0.134*
	(0.063)	(0.122)	(0.146)	(0.250)	(0.077)	(0.165)	(0.043)	(0.081)
taxinc^2		0.004		-0.012		0.007		0.003
		(0.004)		(0.009)		(0.004)		(0.003)
taxfirms	0.063	0.557***	-0.337**	0.318	-0.010	0.173	0.085	0.631***
	(0.080)	(0.200)	(0.163)	(0.312)	(0.087)	(0.315)	(0.06)	(0.170)
taxfirms^2		-0.050***		-0.058***		-0.016		-0.052***
		(0.017)		(0.020)		(0.029)		(0.015)
ssc	0.173***	0.655***	-0.903***	-2.950**	0.095	0.525***	0.241***	0.647***
	(0.059)	(0.108)	(0.205)	(1.258)	(0.064)	(0.124)	(0.036)	(0.082)
ssc^2		-0.03***		0.086*		-0.027***		-0.024***
		(0.006)		(0.052)		(0.006)		(0.005)
taxpayroll	0.042	1.006***	-0.711**	0.496	-0.052	0.587	0.111	0.974***
	(0.118)	(0.276)	(0.356)	(0.540)	(0.127)	(0.382)	(0.103)	(0.270)
taxpayroll^2		-0.283***		-0.266***		-0.157		-0.252***
		(0.076)		(0.096)		(0.105)		(0.081)
taxprop	0.103	0.111	-0.685*	-2.196	0.058	0.449	0.156*	-0.335
	(0.115)	(0.473)	(0.374)	(1.576)	(0.122)	(0.601)	(0.092)	(0.388)
taxprop^2		-0.062		0.321		-0.114		0.065
		(0.099)		(0.288)		(0.120)		(0.087)
taxvat	0.097	0.272	-0.783***	-1.862	0.067	-0.124	0.109**	-0.033
	(0.082)	(0.250)	(0.294)	(1.132)	(0.096)	(0.357)	(0.050)	(0.184)
taxvat^2		-0.009		0.048		0.008		0.008
		(0.013)		(0.043)		(0.018)		(0.009)
gfcfgr	0.302***	0.295***	0.181***	0.182***	0.347***	0.327***	0.282***	0.275***
	(0.028)	(0.029)	(0.031)	(0.029)	(0.050)	(0.050)	(0.011)	(0.010)
current	-0.019	-0.039	-0.098**	-0.071	-0.059	-0.089	0.029	0.006
	(0.037)	(0.042)	(0.043)	(0.048)	(0.049)	(0.055)	(0.018)	(0.018)
ltir	0.007	0.047	-0.269***	-0.258**	-0.017	0.027	-0.012	0.039
	(0.059)	(0.065)	(0.104)	(0.111)	(0.097)	(0.113)	(0.041)	(0.043)
avg	0.000	-0.001	-0.006***	-0.009***	0.000	-0.002	0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
unem	0.013	0.002	-0.084*	-0.084*	0.016	0.006	0.011	0.023
	(0.036)	(0.039)	(0.045)	(0.045)	(0.043)	(0.048)	(0.025)	(0.025)
capb	-0.068	-0.051	0.082	0.042	0.060	0.118	-0.099**	-0.091**
	(0.065)	(0.074)	(0.075)	(0.071)	(0.092)	(0.115)	(0.040)	(0.040)
debt	-0.007*	-0.006	0.023***	0.033***	-0.003	-0.005	-0.008***	-0.008***
	(0.004)	(0.004)	(0.009)	(0.011)	(0.005)	(0.006)	(0.003)	(0.003)
totexp	-0.103*	-0.120*	-0.091	-0.085	-0.033	-0.027	-0.135***	-0.163***
	(0.057)	(0.061)	(0.069)	(0.069)	(0.068)	(0.083)	(0.030)	(0.030)

Tax thresholds

taxinc	-	-	-	-	-	-	-	-
taxfirms	-	5.57%	-	-	-	-	-	6.07%
ssc	-	10.92%	-	**17.15%**	-	-	-	13.48%
taxpayroll	-	1.78%	-	-	-	-	-	1.93%
taxprop	-	-	-	-	-	-	-	-
taxvat	-	-	-	-	-	-	-	-
R^2	0.63	0.651	0.834	0.844	0.624	0.641	0.462	0.476
DW-statistic	1.432	1.492	1.518	1.554	1.472	1.507	n.a.	n.a.
Obs.	525	525	525	525	491	491	525	525

Notes: *, ** and *** represent statistical significance at levels of 10%, 5%, and 1%, respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards to the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

Table 3: Linear and non-linear short-term impact results of taxation structure on economic growth dynamics for Equation (2).

	OLS		OLS-FE		GMM		RLS	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
$\ln(\text{realgdppc}_{-1})$	-0.000***	-0.000***	-0.001***	-0.001***	-0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	0.307***	0.279**	0.177	0.075	-0.002	0.153	0.189***	0.110
	(0.08)	(0.136)	(0.129)	(0.298)	(0.114)	(0.186)	(0.064)	(0.117)
taxinc^2		0.003		0.002		-0.003		0.005
		(0.005)		(0.010)		(0.007)		(0.005)
taxfirms	0.172**	0.304	0.237	0.373	-0.081	-0.693	0.069	0.338
	(0.087)	(0.265)	(0.153)	(0.375)	(0.138)	(0.501)	(0.091)	(0.267)
taxfirms^2		-0.022		-0.014		0.052		-0.031
		(0.021)		(0.026)		(0.043)		(0.024)
ssc	0.374***	0.989***	-0.452*	-0.365	0.192	0.592**	0.283***	0.750***
	(0.078)	(0.199)	(0.241)	(0.839)	(0.120)	(0.273)	(0.060)	(0.184)
ssc^2		-0.035***		-0.004		-0.022		-0.028***
		(0.010)		(0.031)		(0.014)		(0.009)
taxpayroll	0.492***	1.490***	-0.394	0.601	0.136	0.176	0.294*	0.904**
	(0.176)	(0.451)	(0.359)	(0.801)	(0.205)	(0.583)	(0.153)	(0.440)
taxpayroll^2		-0.298**		-0.245*		0.036		-0.180
		(0.138)		(0.138)		(0.184)		(0.134)
taxprop	0.838***	1.748***	-0.008	-0.921	1.212***	1.858	0.523***	0.734
	(0.229)	(0.503)	(0.185)	(0.908)	(0.385)	(1.331)	(0.176)	(0.456)
taxprop^2		-0.191**		0.112		-0.156		-0.057
		(0.074)		(0.113)		(0.317)		(0.081)
taxvat	0.394***	1.006***	0.127	1.341*	0.390**	0.436	0.286***	0.844***
	(0.138)	(0.383)	(0.185)	(0.686)	(0.197)	(0.677)	(0.090)	(0.321)
taxvat^2		-0.027		-0.048*		0.000		-0.028**
		(0.018)		(0.028)		(0.032)		(0.014)
pubser	-0.514***	-0.589***	-0.325**	-0.369***	-0.417***	-0.490***	-0.464***	-0.489***
	(0.085)	(0.082)	(0.127)	(0.138)	(0.157)	(0.147)	(0.068)	(0.071)
def	-0.271	-0.395*	0.018	0.055	-0.156	-0.189	-0.207	-0.349**
	(0.188)	(0.211)	(0.369)	(0.388)	(0.254)	(0.274)	(0.143)	(0.157)
pubor	-1.083**	-1.600***	0.658	0.693	-1.277*	-1.379*	-0.638	-1.069**
	(0.496)	(0.542)	(0.828)	(0.868)	(0.741)	(0.792)	(0.422)	(0.456)
eco	-0.186	-0.175	0.015	0.014	-0.601	-0.717	-0.145**	-0.109
	(0.137)	(0.129)	(0.058)	(0.054)	(0.465)	(0.515)	(0.067)	(0.068)
env	-1.728***	-1.242*	-1.233	-1.171	-1.905**	-0.997	-1.842***	-1.303**
	(0.646)	(0.692)	(0.909)	(0.942)	(0.967)	(1.168)	(0.470)	(0.506)
hou	-0.444	-0.574	0.281	0.300	-0.350	-0.085	-0.354	-0.457
	(0.433)	(0.453)	(0.318)	(0.331)	(0.795)	(0.962)	(0.274)	(0.280)
hea	-0.224*	-0.177	0.390*	0.401*	0.108	0.142	-0.226**	-0.176
	(0.125)	(0.129)	(0.230)	(0.230)	(0.197)	(0.239)	(0.105)	(0.110)
cul	-1.255***	-0.983**	0.016	0.400	-1.084**	-1.132*	-0.754**	-0.491
	(0.435)	(0.457)	(0.693)	(0.756)	(0.537)	(0.637)	(0.341)	(0.370)
edu	-0.281	-0.439**	-1.072**	-1.126**	0.035	-0.162	-0.227	-0.315*
	(0.190)	(0.207)	(0.441)	(0.435)	(0.281)	(0.399)	(0.177)	(0.191)

socpro	-0.343***	-0.311***	-0.597***	-0.595***	-0.136	-0.086	-0.240***	-0.204***
	(0.071)	(0.076)	(0.144)	(0.152)	(0.090)	(0.119)	(0.051)	(0.058)
llgdp	0.011**	0.009	0.037***	0.037***	0.004	0.008	0.008**	0.006
	(0.005)	(0.005)	(0.012)	(0.012)	(0.007)	(0.009)	(0.004)	(0.005)
ln(pop)	-0.264	-0.267	17.701***	16.495***	-0.452	-0.624	-0.254	-0.234
	(0.217)	(0.223)	(4.657)	(5.217)	(0.368)	(0.468)	(0.155)	(0.165)
rtfpna	7.767***	7.326***	10.797***	9.666***	-3.100	-1.415	8.489***	7.472***
	(2.318)	(2.305)	(2.859)	(3.086)	(3.415)	(3.452)	(1.708)	(1.818)
ageratioold	-0.079	-0.079	0.166*	0.105	-0.184**	-0.215**	-0.018	-0.014
	(0.062)	(0.064)	(0.098)	(0.103)	(0.080)	(0.089)	(0.038)	(0.039)
fertility	-0.802	-0.743	-7.314***	-6.709***	-3.567***	-3.417***	-0.011	0.391
	(0.846)	(0.876)	(1.419)	(1.482)	(1.139)	(1.252)	(0.618)	(0.650)
hconsggdp	-0.060	-0.051	-0.147*	-0.116	-0.090	-0.080	-0.085**	-0.070*
	(0.043)	(0.044)	(0.085)	(0.088)	(0.070)	(0.085)	(0.035)	(0.036)
landarea	0.000	0.000**	0.000	0.000	0.000	0.000*	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lexpectancy	-0.258**	-0.288**	-0.837***	-0.744**	-0.072	-0.032	-0.302***	-0.338***
	(0.109)	(0.117)	(0.316)	(0.328)	(0.144)	(0.163)	(0.066)	(0.073)
Tax thresholds								
taxinc	-	-	-	-	-	-	-	-
taxfirms	-	-	-	-	-	-	-	-
ssc	-	14.13%	-	-	-	-	-	13.39%
taxpayroll	-	2.50%	-	-	-	-	-	-
taxprop	-	4.58%	-	-	-	-	-	-
taxvat	-	-	-	13.97%	-	-	-	15.07%
R^2	0.392	0.411	0.798	0.801	0.285	0.271	0.305	0.313
DW-statistic	1.273	1.263	1.195	1.212	1.386	1.403	n.a.	n.a.
Obs.	536	536	536	536	500	500	536	536

Notes: *, ** and *** represent statistical significance at levels of 10%, 5%, and 1% respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards to the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

Table 4: Linear and non-linear long-term impact results of taxation structure on economic growth dynamics for Equation (1).

	OLS		OLS-FE		GMM		RLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln(realgdppc_{-1})$	-0.000***	-0.000***	-0.000***	-0.000***	-0.000**	0.000**	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	0.035	-0.007	-0.203***	-0.302*	0.058	-0.029	0.073***	-0.020
	(0.043)	(0.072)	(0.078)	(0.178)	(0.062)	(0.109)	(0.027)	(0.052)
taxinc^2		0.002		0.003		0.005*		0.004**
		(0.002)		(0.006)		(0.003)		(0.002)
taxfirms	-0.009	0.113	0.043	0.394***	0.002	0.458**	0.028	0.180*
	(0.041)	(0.119)	(0.073)	(0.148)	(0.054)	(0.186)	(0.037)	(0.107)
taxfirms^2		-0.017*		-0.029***		-0.049***		-0.015
		(0.010)		(0.009)		(0.018)		(0.010)
ssc	0.078*	0.385***	-0.170	0.103	0.107	0.497***	0.142***	0.373***
	(0.041)	(0.064)	(0.120)	(0.498)	(0.054)	(0.087)	(0.022)	(0.052)
ssc^2		-0.020***		-0.014		-0.024***		-0.015***
		(0.003)		(0.021)		(0.004)		(0.003)
taxpayroll	0.023	0.506***	0.219	0.470	0.091	0.683**	0.115*	0.381**
	(0.070)	(0.184)	(0.151)	(0.322)	(0.094)	(0.265)	(0.063)	(0.171)
taxpayroll^2		-0.141***		-0.082		-0.162**		-0.066
		(0.048)		(0.058)		(0.070)		(0.051)
taxprop	0.060	0.469	-0.726***	-1.766**	-0.026	-0.057	0.196***	0.445*
	(0.076)	(0.290)	(0.272)	(0.846)	(0.088)	(0.378)	(0.057)	(0.245)
taxprop^2		-0.138**		0.232		-0.042		-0.076
		(0.065)		(0.142)		(0.080)		(0.055)
taxvat	-0.006	0.499***	-0.406***	-0.852***	0.018	0.378**	0.060*	0.256**
	(0.056)	(0.152)	(0.119)	(0.324)	(0.071)	(0.181)	(0.031)	(0.117)
taxvat^2		-0.026***		0.022		-0.018**		-0.011*
		(0.007)		(0.014)		(0.008)		(0.006)
gfcfgr	0.044***	0.040***	0.031***	0.029***	0.094***	0.079***	0.023***	0.021***
	(0.012)	(0.011)	(0.009)	(0.009)	(0.028)	(0.026)	(0.007)	(0.007)
current	0.024	0.010	-0.027	-0.027	-0.020	-0.033	0.020*	0.000
	(0.015)	(0.017)	(0.020)	(0.021)	(0.022)	(0.025)	(0.011)	(0.012)
ltir	-0.006	0.003	-0.091*	-0.098*	0.074	0.149*	0.058**	0.080***
	(0.045)	(0.049)	(0.052)	(0.054)	(0.073)	(0.082)	(0.025)	(0.027)
avg	0.001**	0.000	-0.001	0.000	0.000	-0.001	0.001***	0.000
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
unem	0.002	-0.026	-0.110***	-0.104***	0.005	-0.010	-0.008	-0.026
	(0.029)	(0.028)	(0.036)	(0.037)	(0.035)	(0.037)	(0.015)	(0.016)
capb	-0.084**	-0.059	0.073	0.066	-0.075	-0.065	-0.066***	-0.041
	(0.037)	(0.039)	(0.048)	(0.047)	(0.070)	(0.080)	(0.025)	(0.026)
debt	-0.018***	-0.016***	0.016***	0.020***	-0.012***	-0.011**	-0.015***	-0.015***
	(0.003)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.002)	(0.002)
totexp	-0.036	-0.037	0.024	0.020	-0.069	-0.091	-0.077***	-0.071***
	(0.041)	(0.042)	(0.048)	(0.046)	(0.056)	(0.061)	(0.018)	(0.019)
Tax thresholds								
taxinc	-	-	-	-	-	-	-	-

taxfirms	-	-	-	6.79%	-	4.67%	-	-
ssc	-	9.63%	-	-	-	10.35%	-	12.43%
taxpayroll	-	1.79%	-	-	-	2.11%	-	-
taxprop	-	-	-	-	-	-	-	-
taxvat	-	9.60%	-	-	-	10.50%	-	11.64%
R^2	0.390	0.440	0.781	0.788	0.288	0.343	0.338	0.359
DW-statistic	0.433	0.472	0.804	0.848	0.749	0.770	n.a.	n.a.
Obs.	525	525	525	525	491	491	525	525

Notes: *, ** and *** represent statistical significance at levels of 10%, 5%, and 1% respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards to the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

Table 5: Linear and non-linear long-term impact results of taxation structure on economic growth dynamics for Equation (2).

	OLS		OLS-FE		GMM		RLS	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
$\ln(realgdppc_{-1})$	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
taxinc	-0.042	-0.030	0.108	0.075	-0.033	-0.087	-0.001	-0.008
	(0.031)	(0.058)	(0.068)	(0.160)	(0.048)	(0.085)	(0.028)	(0.049)
$taxinc^2$		0.000		-0.001		0.003		-0.001
		(0.002)		(0.006)		(0.003)		(0.002)
taxfirms	-0.022	0.102	0.169**	0.312*	-0.020	0.065	-0.012	-0.095
	(0.049)	(0.128)	(0.072)	(0.173)	(0.070)	(0.200)	(0.040)	(0.111)
$taxfirms^2$		-0.020**		-0.012		-0.014		-0.009
		(0.010)		(0.012)		(0.017)		(0.010)
ssc	-0.023	0.225***	-0.059	0.471	-0.014	0.324***	0.048*	0.308***
	(0.031)	(0.078)	(0.115)	(0.492)	(0.053)	(0.106)	(0.027)	(0.076)
ssc^2		-0.016***		-0.023		-0.020***		-0.020***
		(0.004)		(0.019)		(0.005)		(0.004)
taxpayroll	0.063	0.138	0.428**	1.047**	0.099	0.484**	0.103	0.028
	(0.056)	(0.165)	(0.193)	(0.405)	(0.065)	(0.234)	(0.067)	(0.183)
$taxpayroll^2$		-0.024		-0.170**		-0.107		0.018
		(0.048)		(0.076)		(0.073)		(0.056)
taxprop	0.275***	0.774***	-0.149	-1.142	0.438**	1.195**	0.251***	0.988***
	(0.094)	(0.245)	(0.155)	(0.697)	(0.184)	(0.505)	(0.078)	(0.190)
$taxprop^2$		-0.102***		0.130		-0.194		-0.125***
		(0.039)		(0.082)		(0.118)		(0.034)
taxvat	-0.129**	0.470***	0.089	0.702**	-0.064	0.642**	-0.011	0.466***
	(0.056)	(0.161)	(0.093)	(0.339)	(0.071)	(0.292)	(0.040)	(0.133)
$taxvat^2$		-0.027***		-0.024*		-0.032**		-0.023***
		(0.007)		(0.014)		(0.013)		(0.006)
pubser	-0.129***	-0.164***	-0.063	-0.111	-0.167**	-0.206***	-0.142***	-0.183***
	(0.040)	(0.039)	(0.069)	(0.071)	(0.076)	(0.074)	(0.030)	(0.030)
def	-0.106	-0.127	0.160	0.197	-0.101	-0.199*	0.027	-0.046
	(0.080)	(0.084)	(0.184)	(0.198)	(0.115)	(0.113)	(0.063)	(0.065)
pubor	0.059	-0.403*	-0.089	-0.087	-0.015	-0.487	-0.392**	-0.574***
	(0.214)	(0.207)	(0.407)	(0.408)	(0.288)	(0.311)	(0.186)	(0.189)
eco	0.004	0.012	0.076	0.075	0.117	0.156	-0.059**	0.046
	(0.059)	(0.054)	(0.057)	(0.051)	(0.270)	(0.269)	(0.030)	(0.028)
env	-1.740***	-1.428***	-2.512***	-2.423***	-2.193***	-1.801***	-1.026***	-0.642***
	(0.278)	(0.286)	(0.448)	(0.458)	(0.504)	(0.525)	(0.207)	(0.210)
hou	0.039	-0.101	0.007	0.039	0.136	-0.227	0.121	0.124
	(0.148)	(0.164)	(0.157)	(0.166)	(0.472)	(0.487)	(0.121)	(0.117)
hea	0.148**	0.165**	0.152	0.168	0.081	0.110	-0.005	0.135***
	(0.062)	(0.069)	(0.149)	(0.166)	(0.102)	(0.118)	(0.046)	(0.046)
cul	-0.304	-0.087	0.685*	0.946***	-0.409	-0.234	-0.011	-0.350**
	(0.238)	(0.248)	(0.358)	(0.356)	(0.269)	(0.296)	(0.150)	(0.154)
edu	-0.185**	-0.216**	0.103	0.046	-0.266**	-0.273	-0.121	-0.254***
	(0.083)	(0.088)	(0.199)	(0.204)	(0.119)	(0.169)	(0.078)	(0.079)
socpro	-0.008	0.018	-0.277***	-0.280***	-0.024	-0.012	-0.026	0.048**

	(0.028)	(0.030)	(0.081)	(0.083)	(0.038)	(0.042)	(0.022)	(0.024)
llgdp	0.001	-0.000	0.007	0.006	0.002	0.002	0.001	-0.003
	(0.002)	(0.002)	(0.006)	(0.006)	(0.003)	(0.003)	(0.002)	(0.002)
$\ln(pop)$	-0.223**	-0.187*	11.093***	9.345***	-0.184	-0.103	-0.162**	-0.282***
	(0.099)	(0.108)	(2.465)	(2.689)	(0.174)	(0.216)	(0.068)	(0.069)
rtfpna	-0.001	-0.364	4.635***	3.597**	-0.796	-1.320	1.041	0.808
	(1.047)	(1.076)	(1.558)	(1.617)	(1.322)	(1.370)	(0.753)	(0.756)
ageratioold	-0.079***	-0.077***	0.109**	0.066	-0.078***	-0.073***	-0.076***	-0.113***
	(0.019)	(0.020)	(0.052)	(0.055)	(0.024)	(0.028)	(0.017)	(0.016)
fertility	-0.191	-0.338	-2.388***	-2.184***	-0.264	-0.056	-0.607**	-0.538**
	(0.334)	(0.357)	(0.716)	(0.758)	(0.445)	(0.471)	(0.273)	(0.270)
hconsggdp	-0.103***	-0.104***	-0.078*	-0.057	-0.105***	-0.094**	-0.053***	-0.084***
	(0.022)	(0.022)	(0.044)	(0.045)	(0.037)	(0.038)	(0.016)	(0.015)
landarea	-0.000**	0.000	-0.000	-0.000	-0.000**	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lexpectancy	-0.244***	-0.280***	-0.251	-0.205	-0.220***	-0.269***	-0.215***	-0.226***
	(0.033)	(0.036)	(0.189)	(0.193)	(0.041)	(0.050)	(0.029)	(0.030)
Tax thresholds								
taxinc	-	-	-	-	-	-	-	-
taxfirms	-	-	-	-	-	-	-	-
ssc	-	7.03%	-	-	-	8.10%	-	7.70%
taxpayroll	-	-	-	3.08%	-	-	-	-
taxprop	-	3.79%	-	-	-	-	-	3.95%
taxvat	-	8.72%	-	25.07%	-	10.03%	-	10.13%
R^2	0.636	0.662	0.796	0.803	0.631	0.649	0.475	0.509
DW-statistic	0.537	0.570	0.808	0.839	0.545	0.598	n.a.	n.a.
Obs.	536	536	536	536	500	500	536	536

Notes: *, ** and *** represent statistical significance at levels of 10%, 5%, and 1% respectively. The robust standard errors are in brackets. The White diagonal covariance matrix is used to assume residual heteroskedasticity, with the exception of the RLS technique. The DW-statistic used is the Durbin-Watson statistic. The non-bold and bold values express, respectively, maximum and minimum optimal tax items levels. With regards to the use of instrumental variables in GMM, we make use of the same explanatory variables, which are one-period lagged.

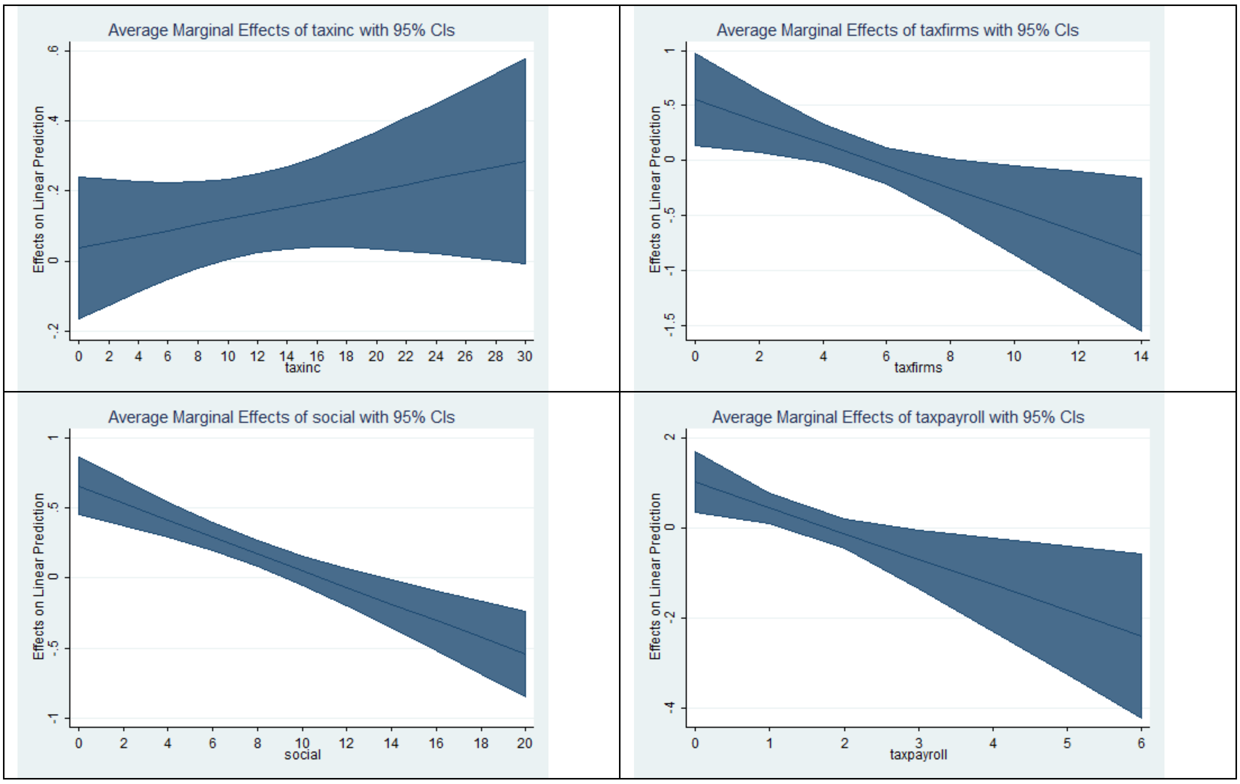
Table 6: Summary of tax items threshold values for real GDP growth rate *per capita*.

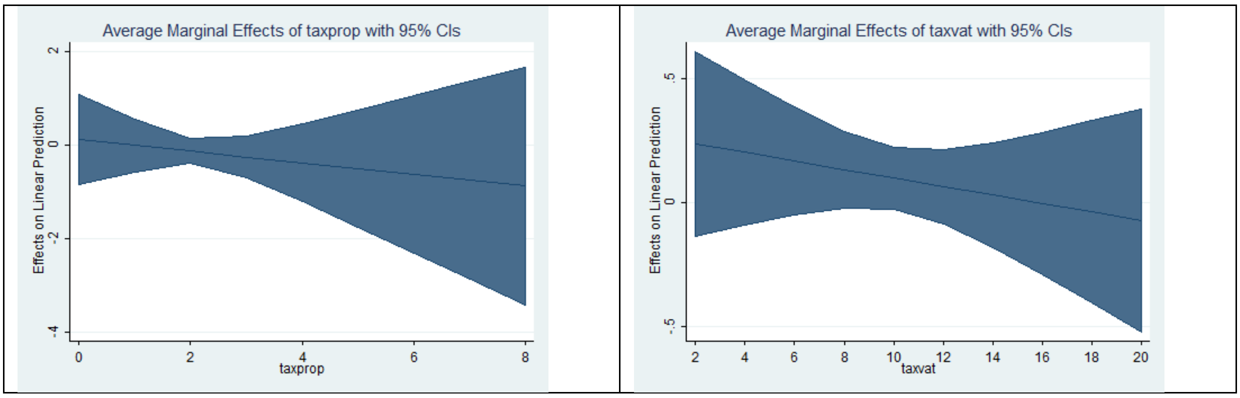
	(1)		(2)		
	Short-term	Long-term	Short-term	Long-term	**Mean**
taxinc	-	-	-	-	8.82%
taxfirms	*5.82%*	*5.73%*	-	-	2.81%
ssc	**17.15%**/*11.37%*	*10.80%*	*13.76%*	*7.61%*	8.35%
taxpayroll	*1.86%*	*1.95%*	2.50%	3.08%	0.37%
taxprop	-	-	4.58%	*3.87%*	1.75%
taxvat	-	*10.58%*	*14.52%*	*10.88%*	10.59%

Notes: The non-bold and bold values presented in the short-term and long-term columns express maximum and minimum optimum levels, respectively. The values expressed in *italics* represent average values.

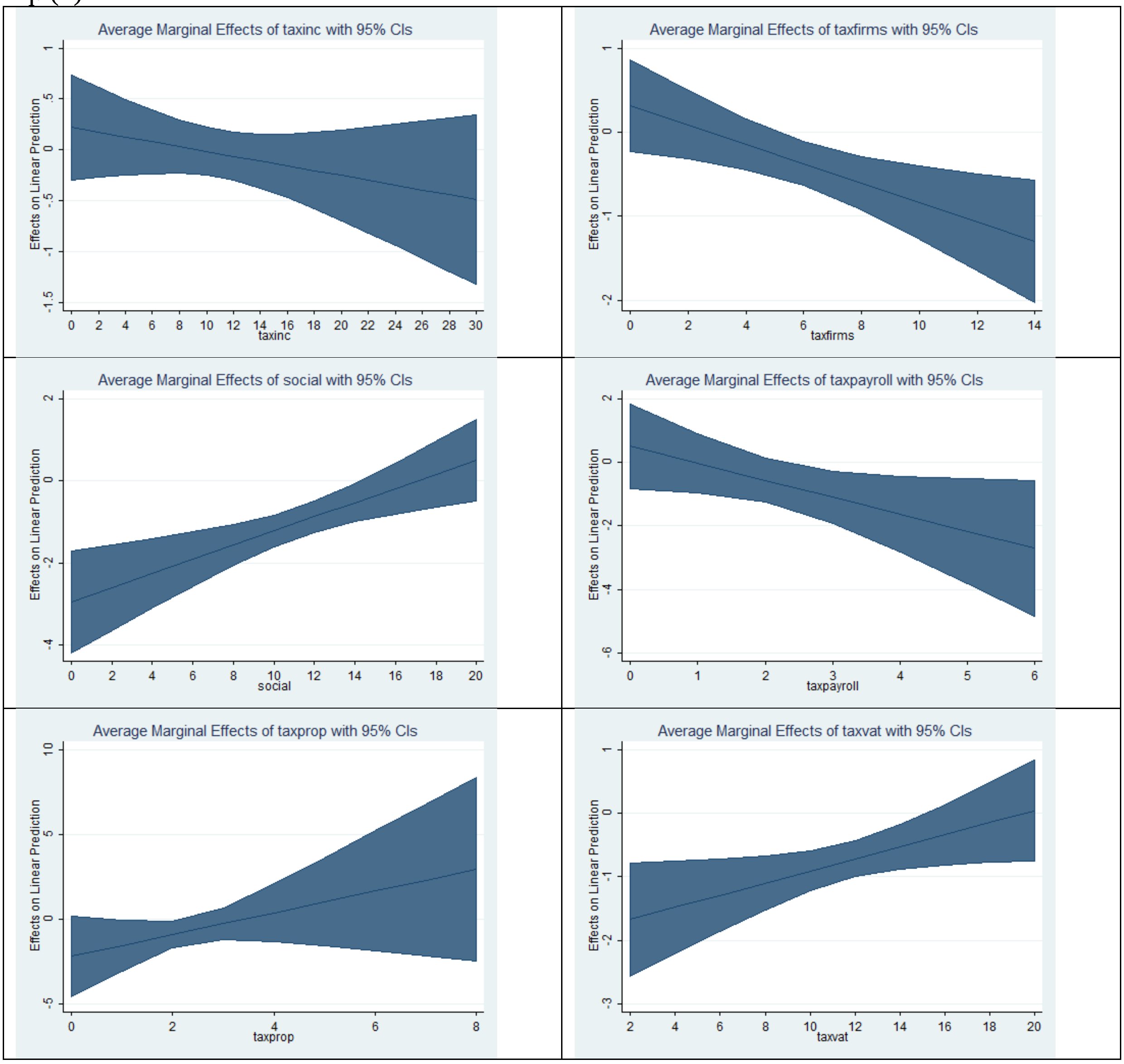
Graphs with the confidence intervals of the non-linear analysis

Short-term analysis




Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

Eq. (4)


Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll
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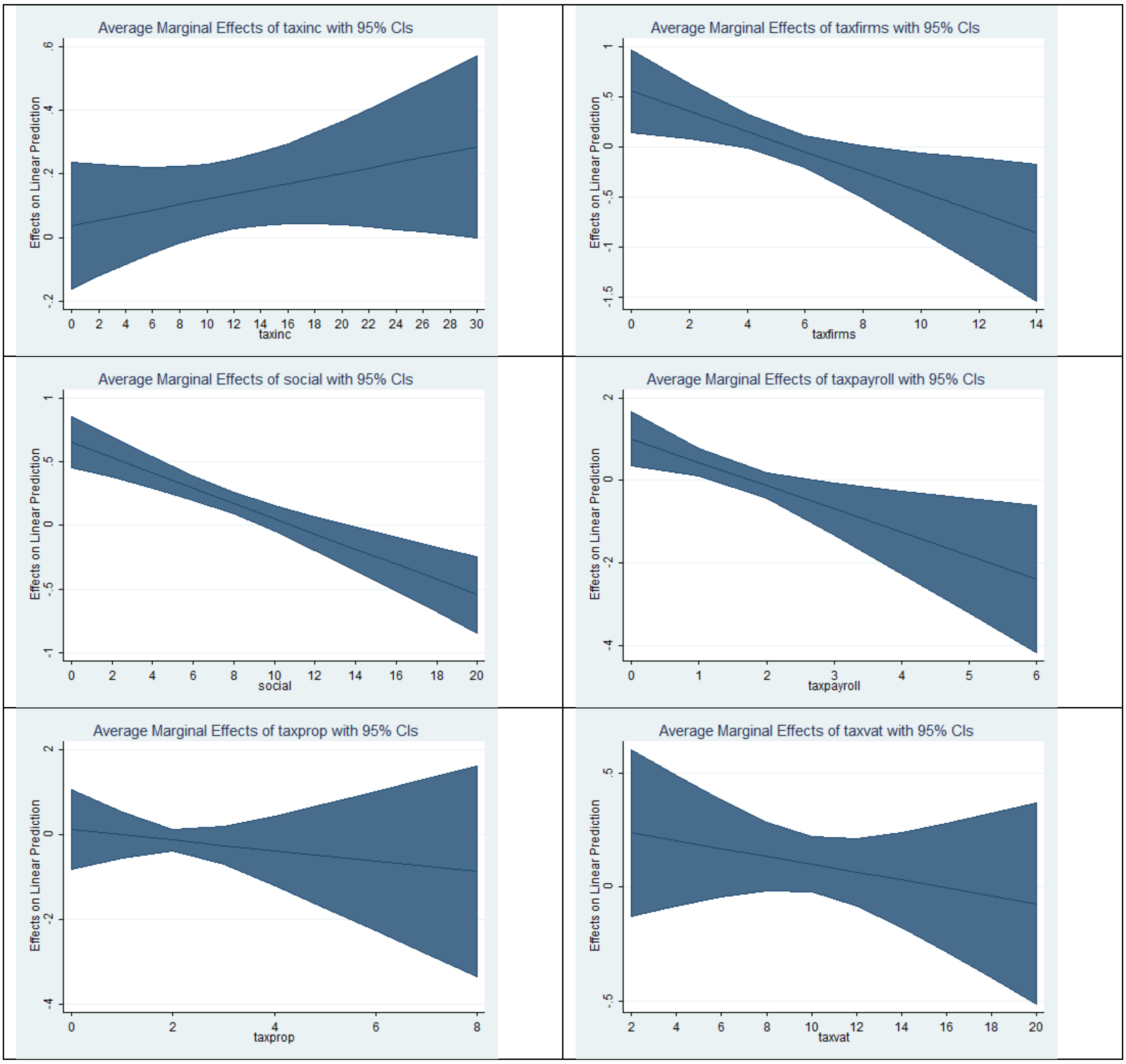
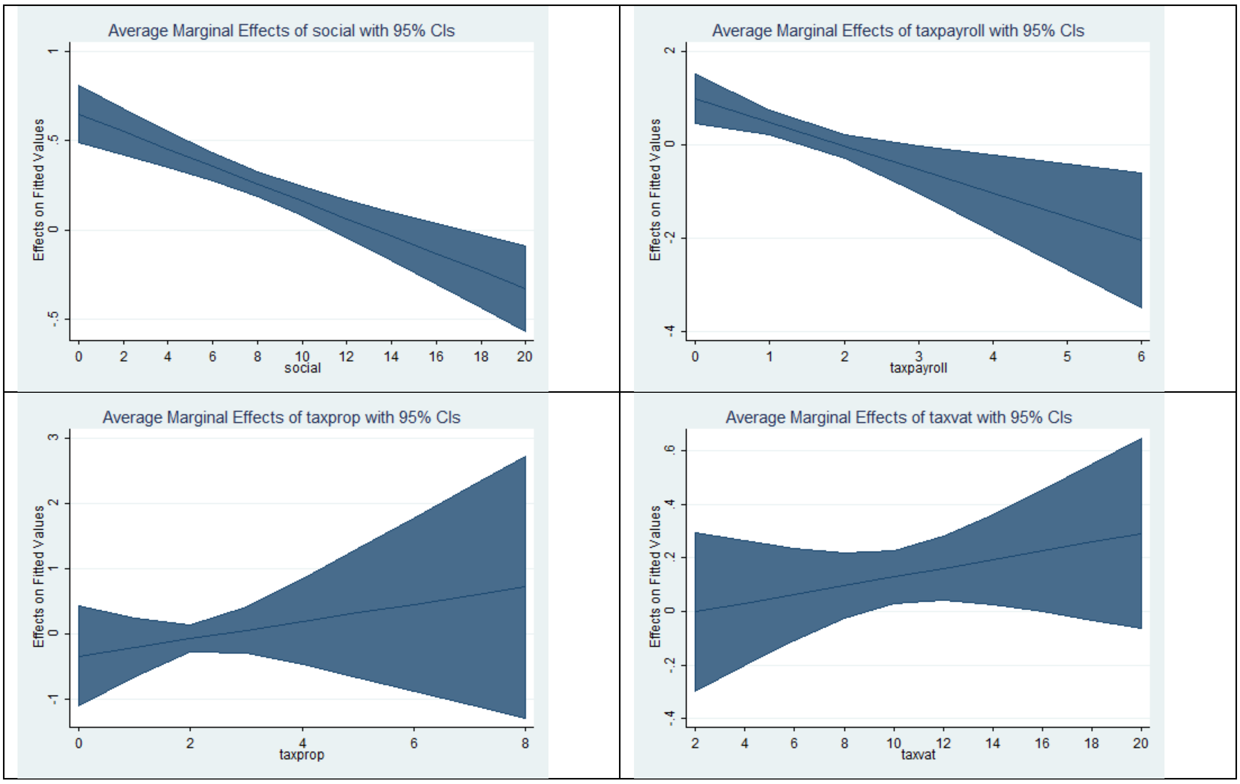
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

Eq. (6)

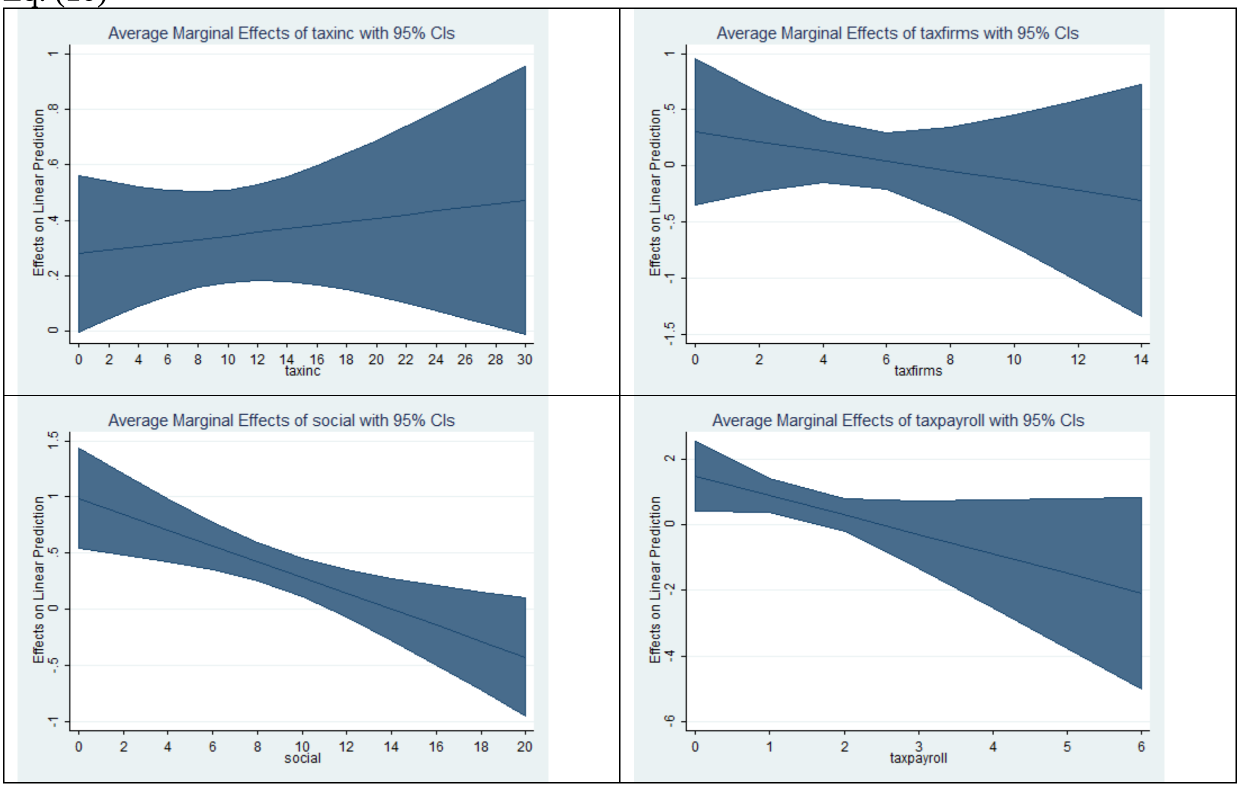

Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

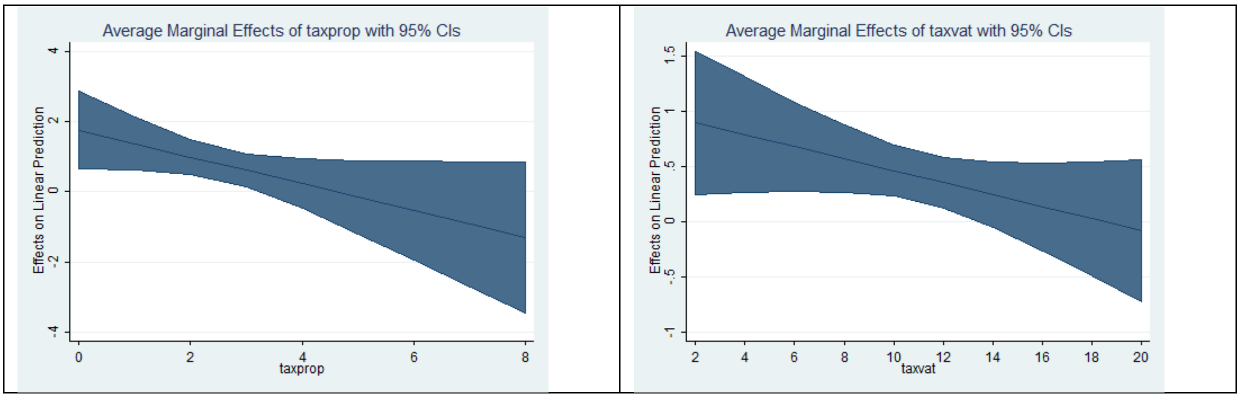
Eq. (8)


Average Marginal Effects of taxinc with 95% CIs
Effects on Fitted Values
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Fitted Values
taxfirms

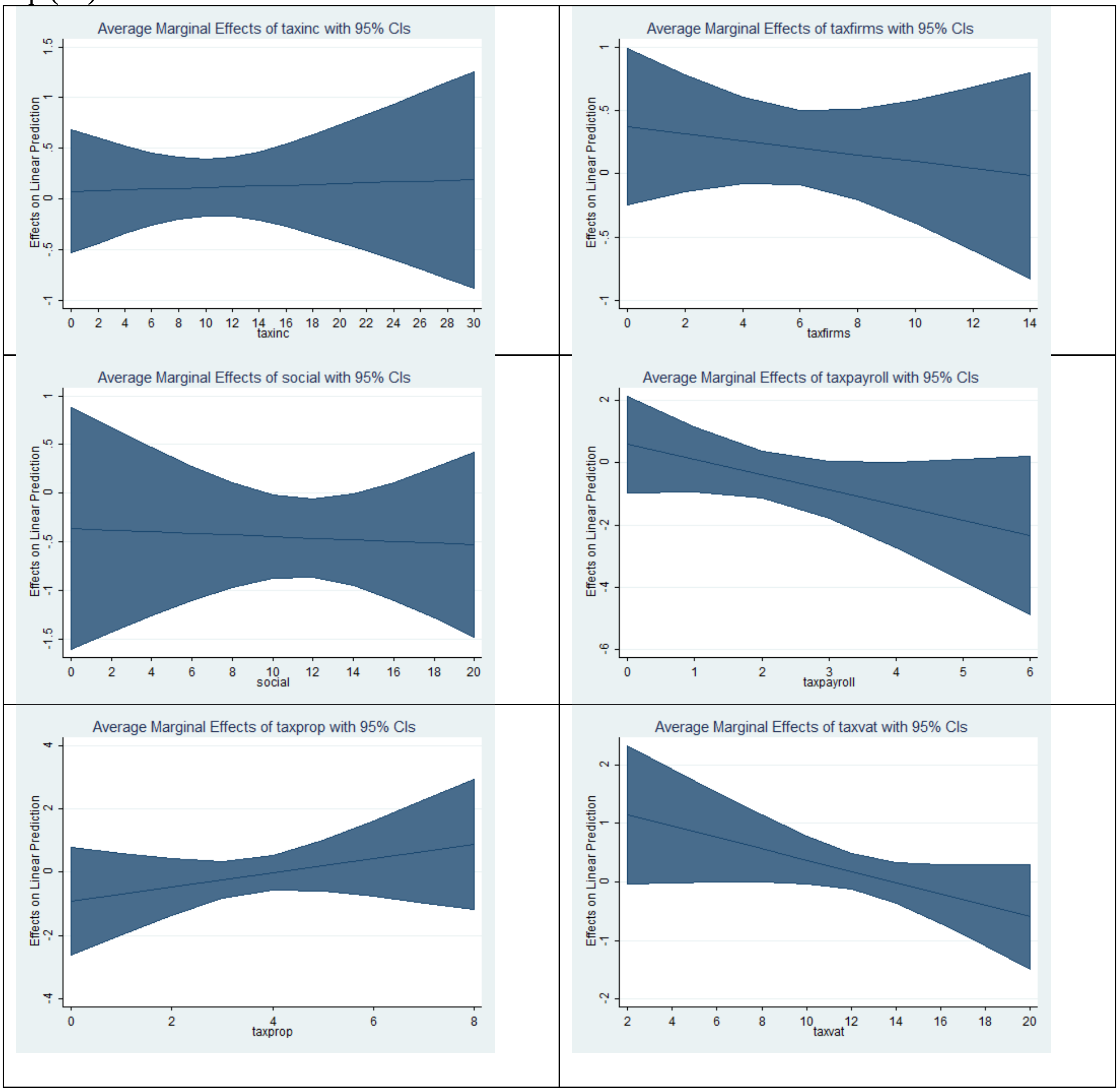

Average Marginal Effects of social with 95% CIs
Effects on Fitted Values
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Fitted Values
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Fitted Values
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Fitted Values
taxvat

Eq. (10)

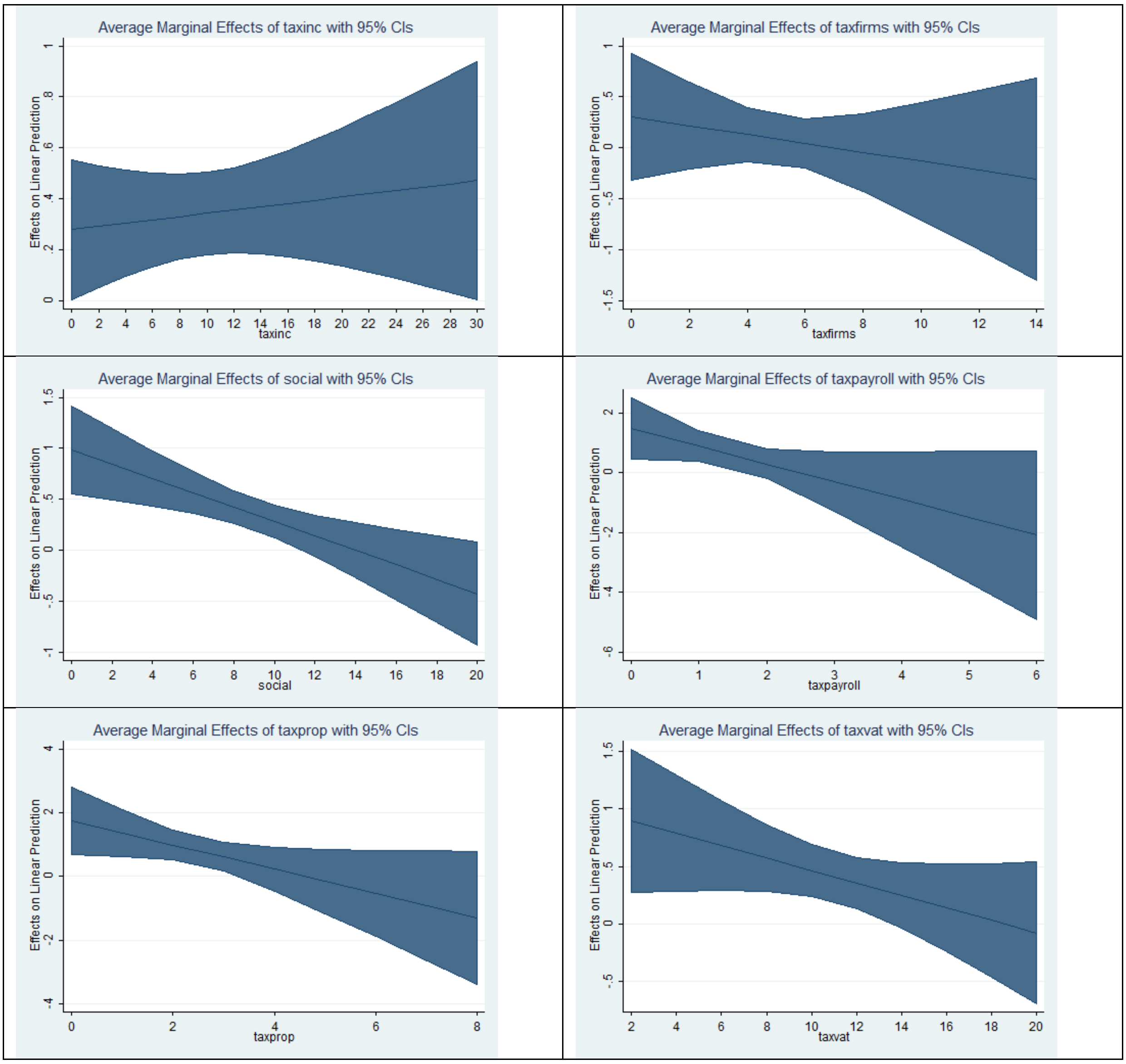

Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll


Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

Eq. (12)

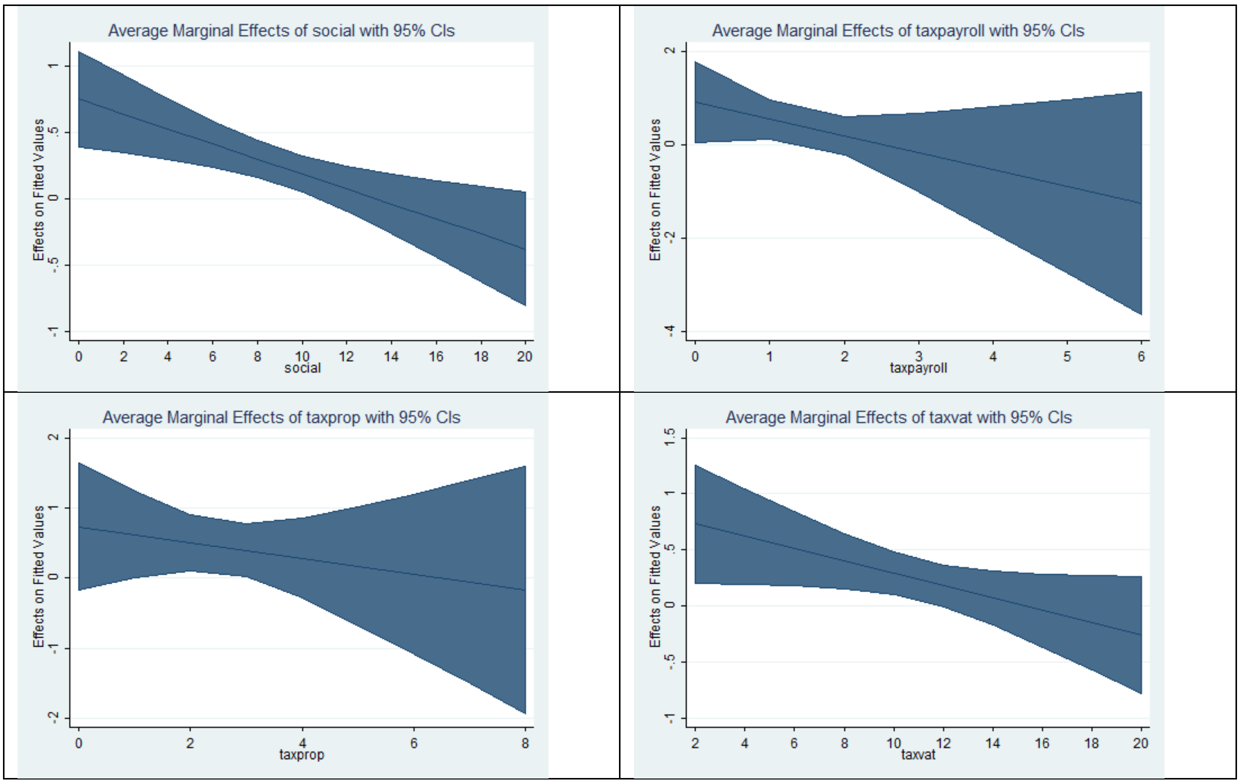

Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

Eq. (14)


Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

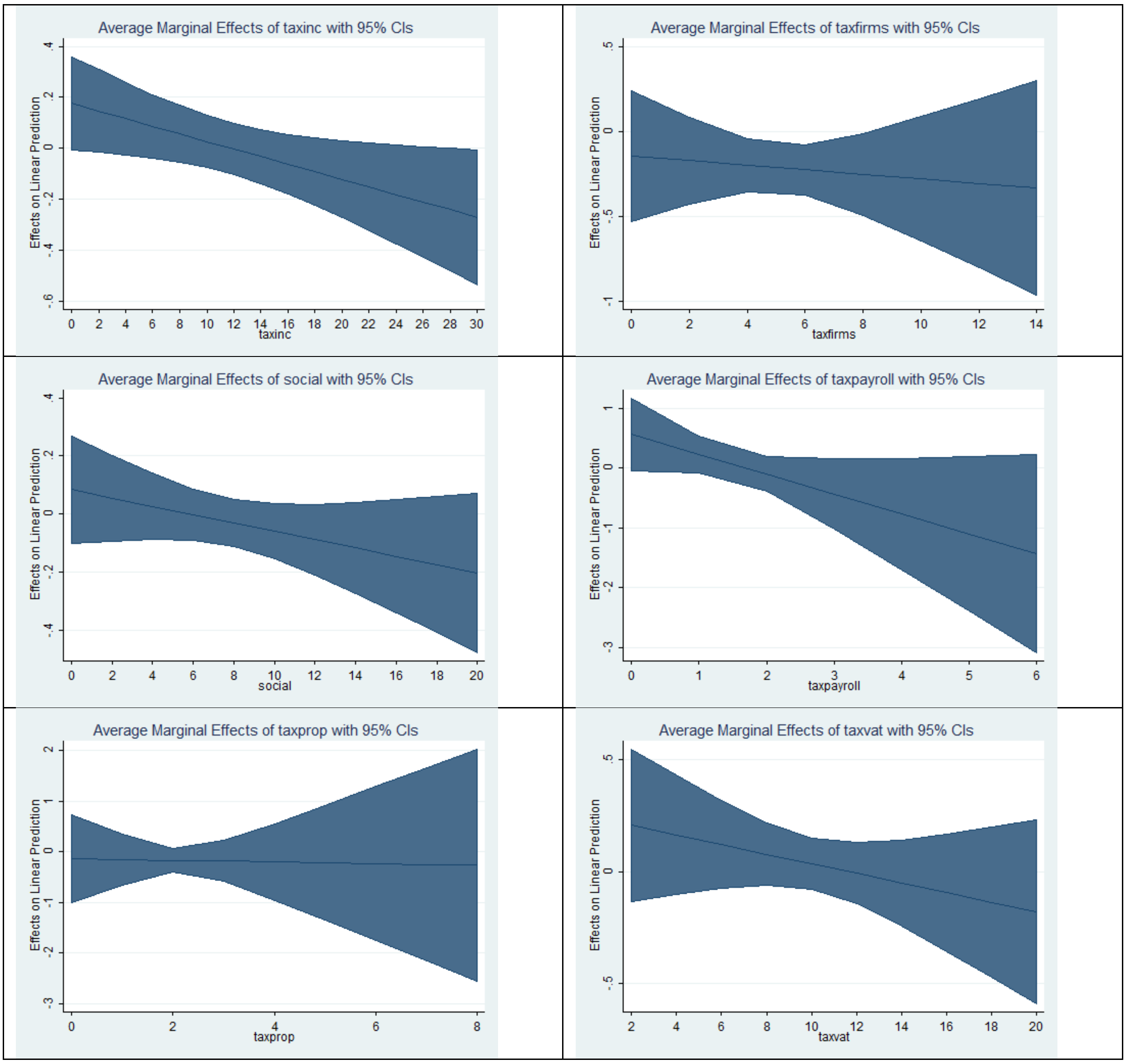
Eq. (16)


Average Marginal Effects of taxinc with 95% CIs
Effects on Fitted Values
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Fitted Values
taxfirms

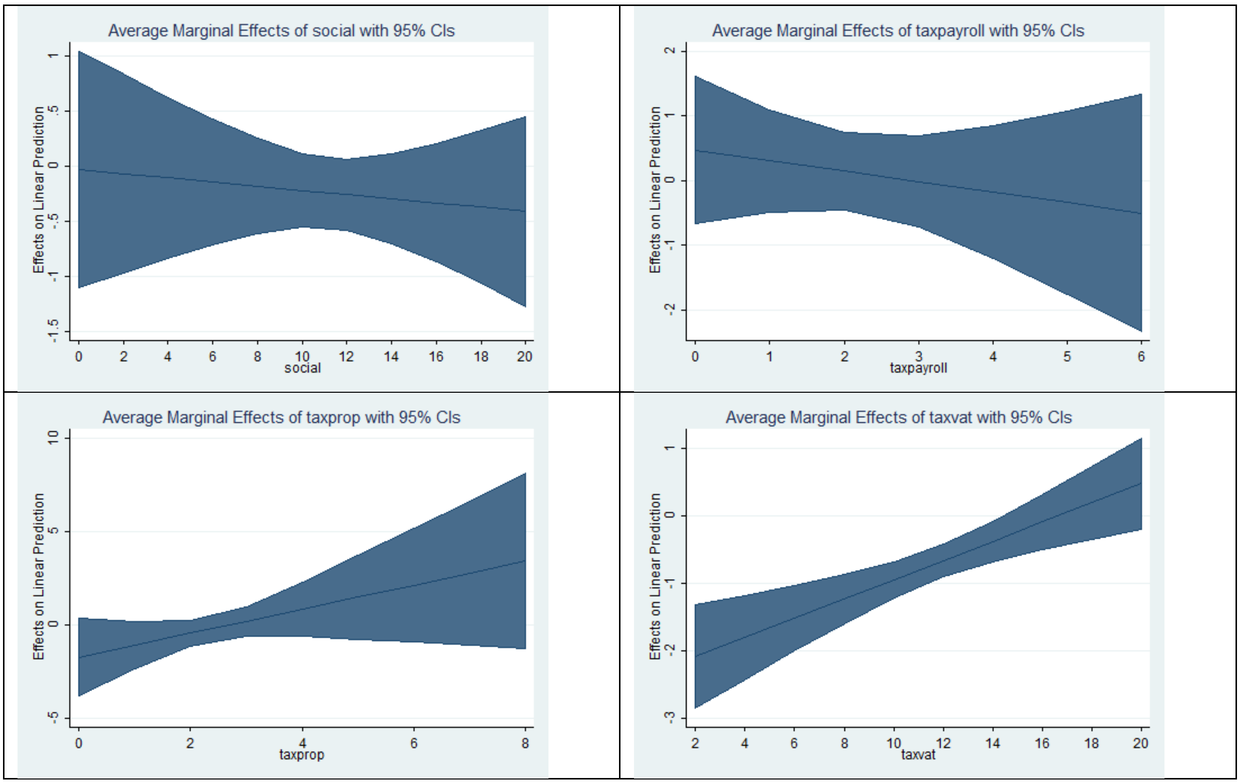

Average Marginal Effects of social with 95% CIs
Effects on Fitted Values
-1
-.5
0
.5
1
0
2
4
6
8
10
12
14
16
18
20
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Fitted Values
-4
-2
0
2
0
1
2
3
4
5
6
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Fitted Values
-2
-1
0
1
2
0
2
4
6
8
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Fitted Values
-1
-.5
0
.5
1
1.5
2
4
6
8
10
12
14
16
18
20
taxvat

Long-term analysis

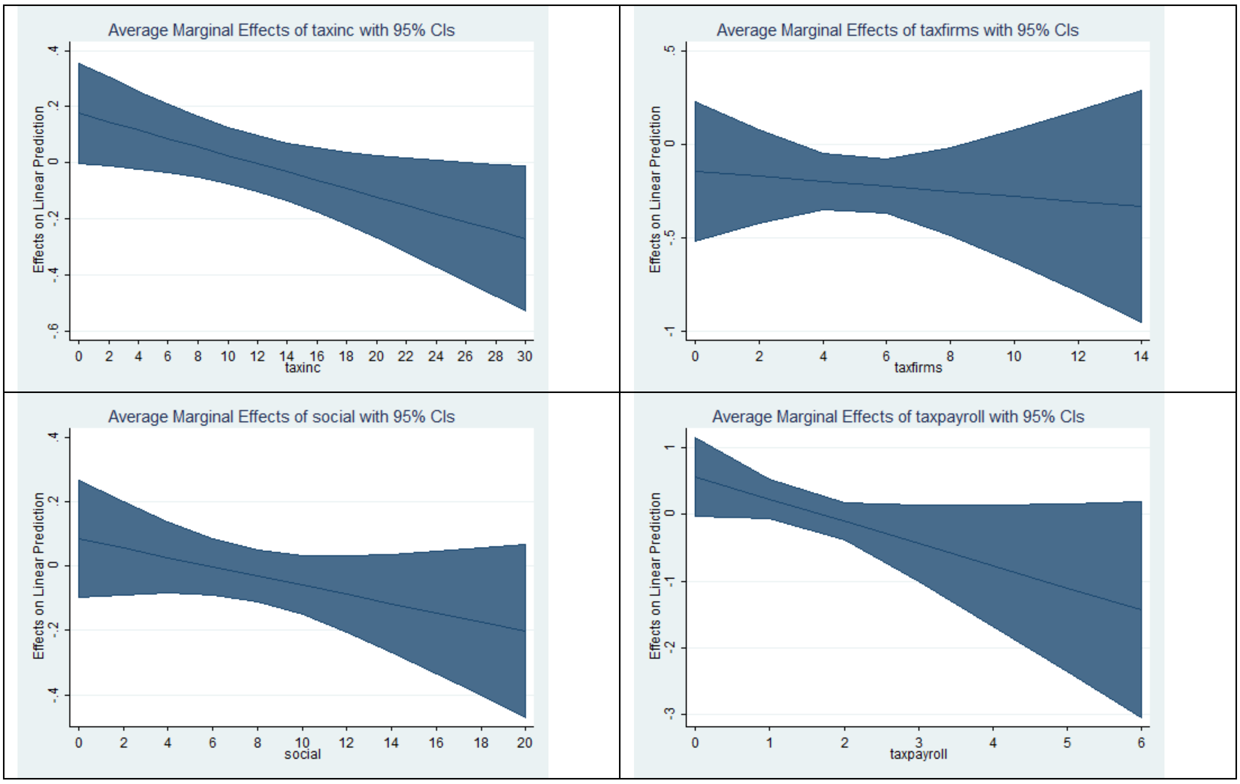
Eq. (2)

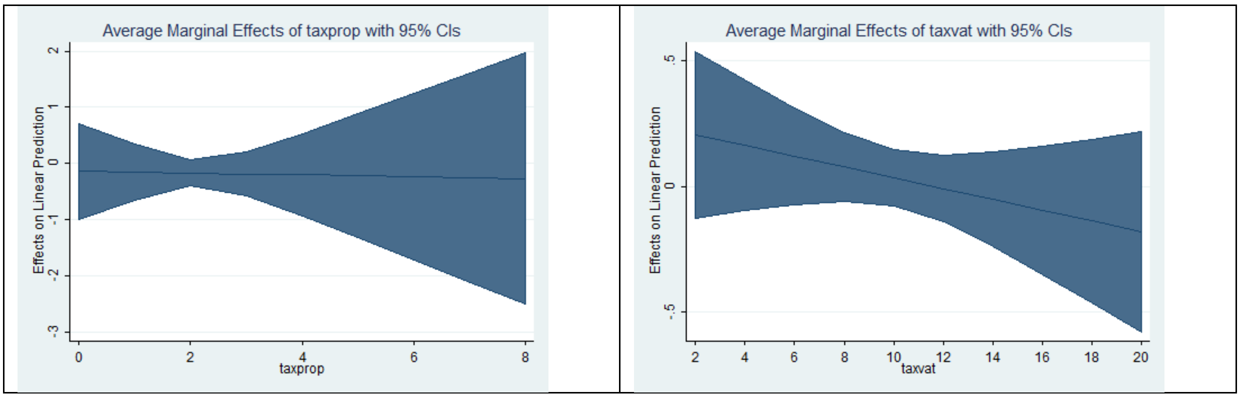


Eq. (4)

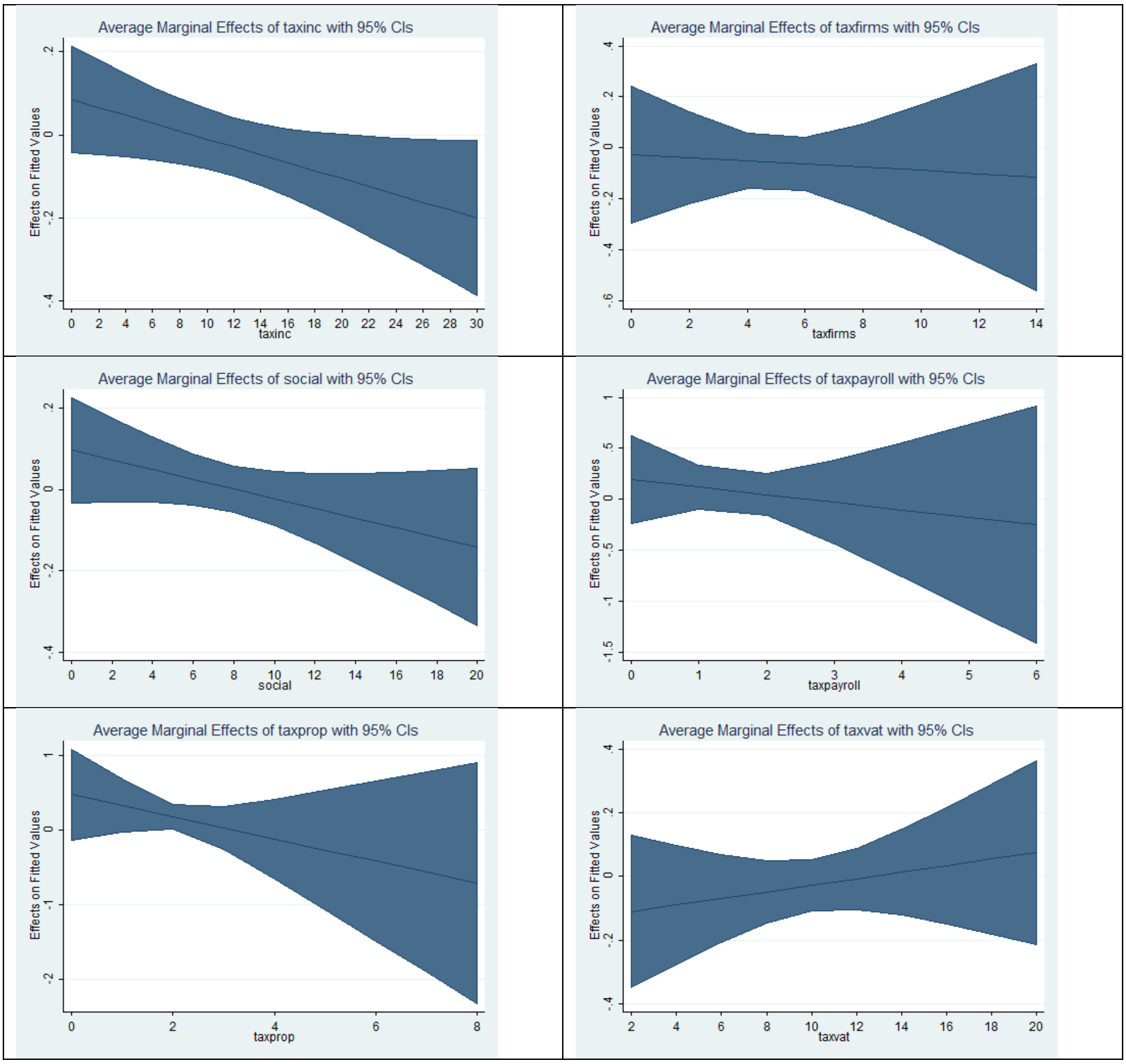

Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

Eq. (6)

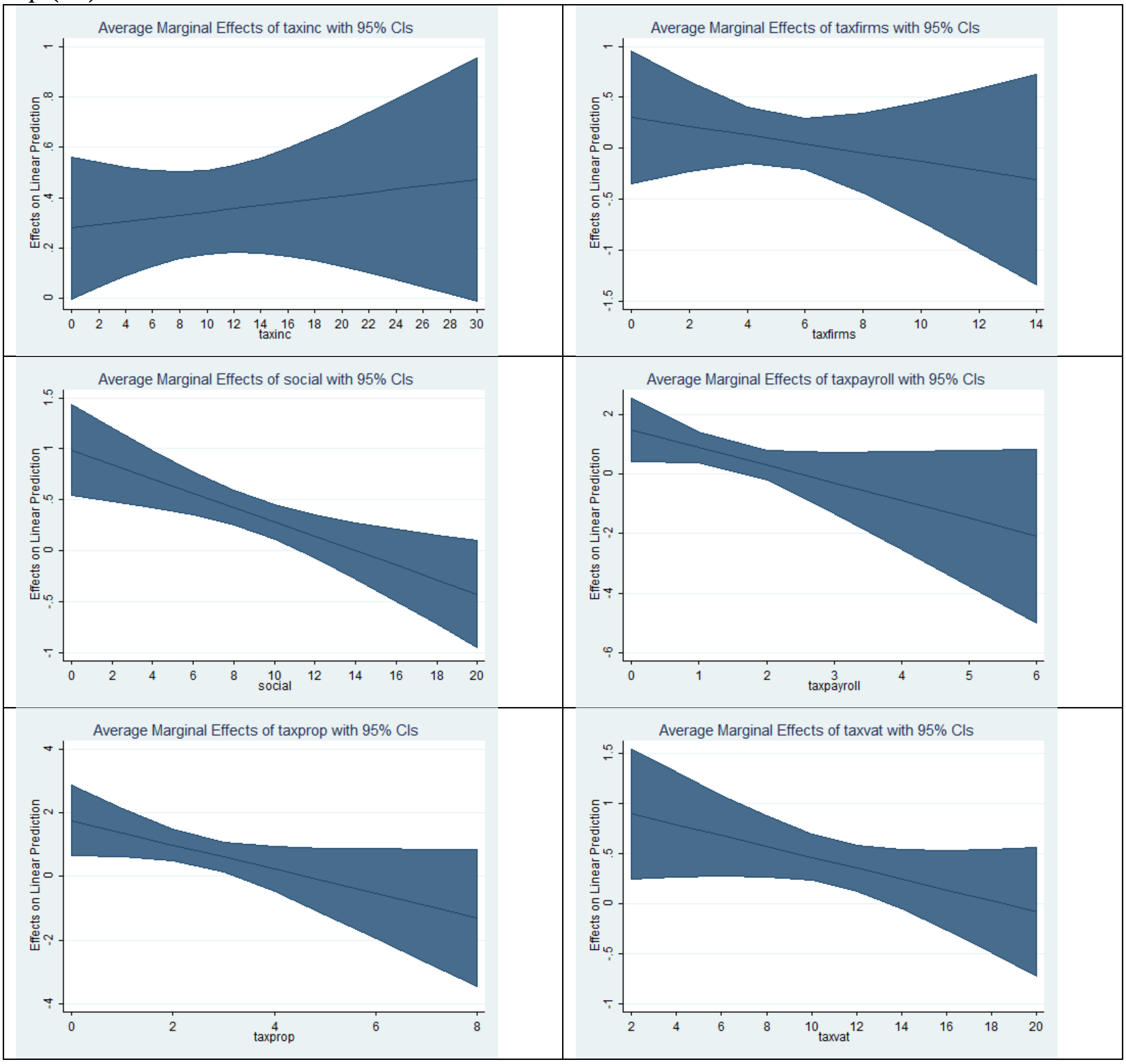

Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll


Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

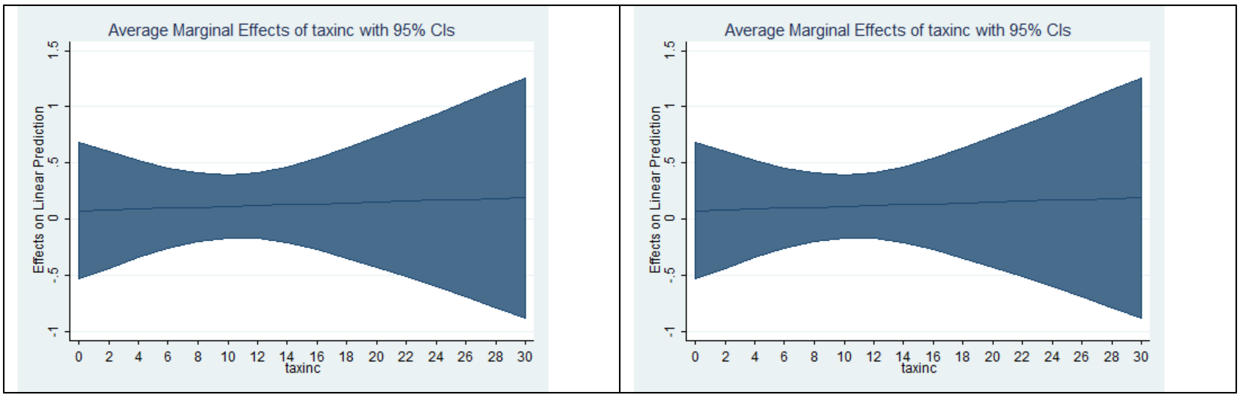
Eq. (8)

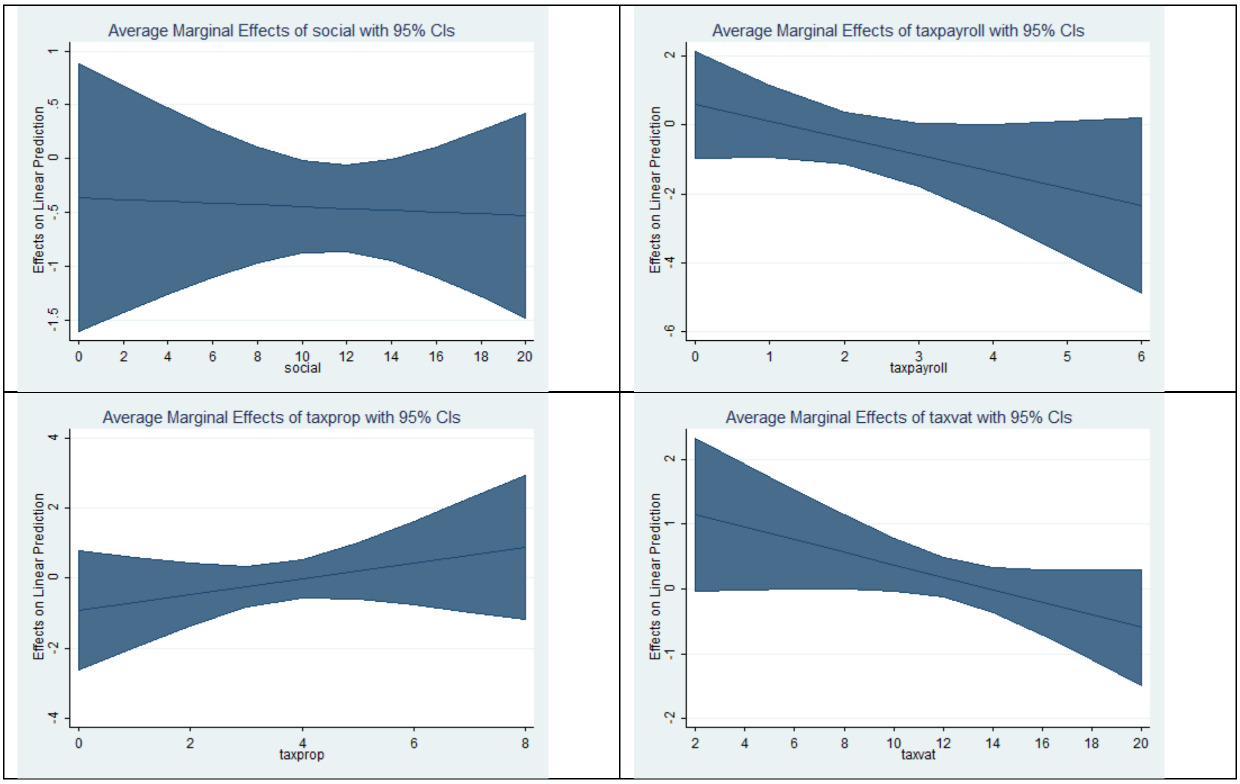

Average Marginal Effects of taxinc with 95% CIs
Effects on Fitted Values
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Fitted Values
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Fitted Values
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Fitted Values
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Fitted Values
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Fitted Values
taxvat

Eq. (10)

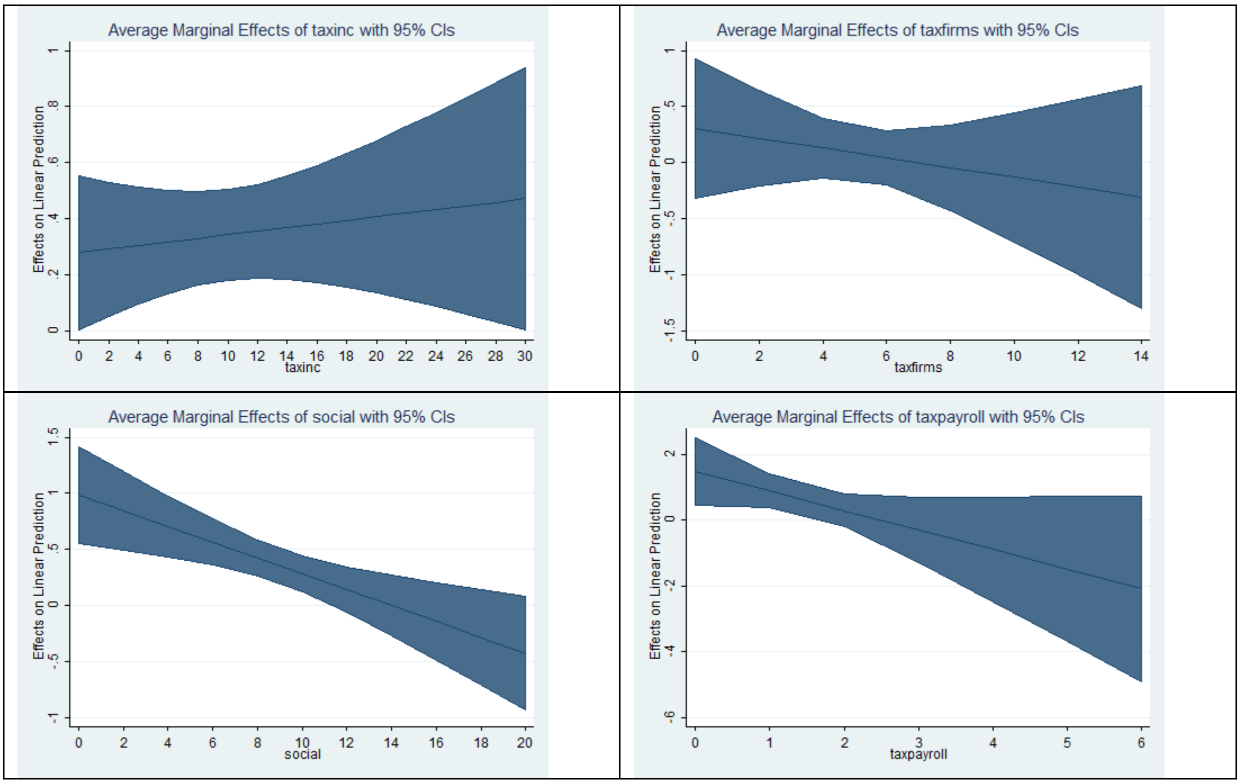

Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

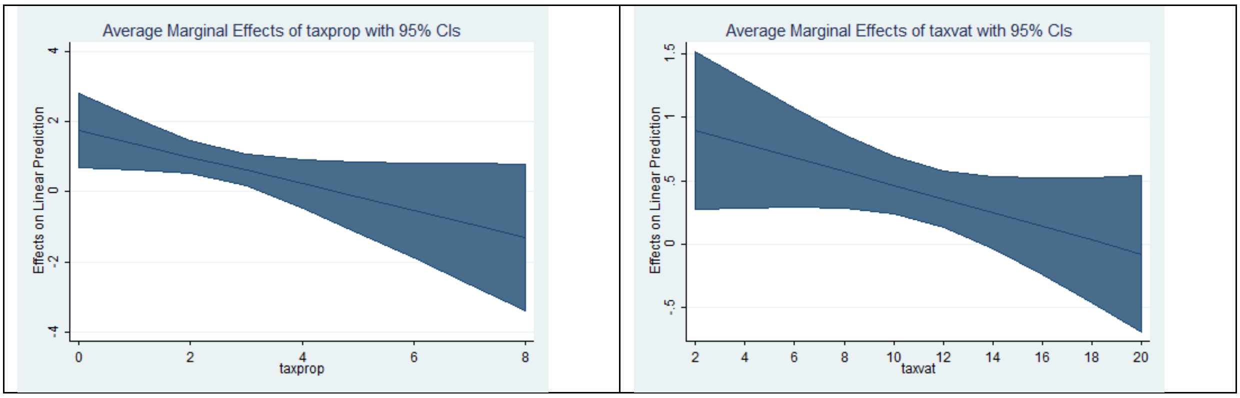
Eq. (12)


Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc

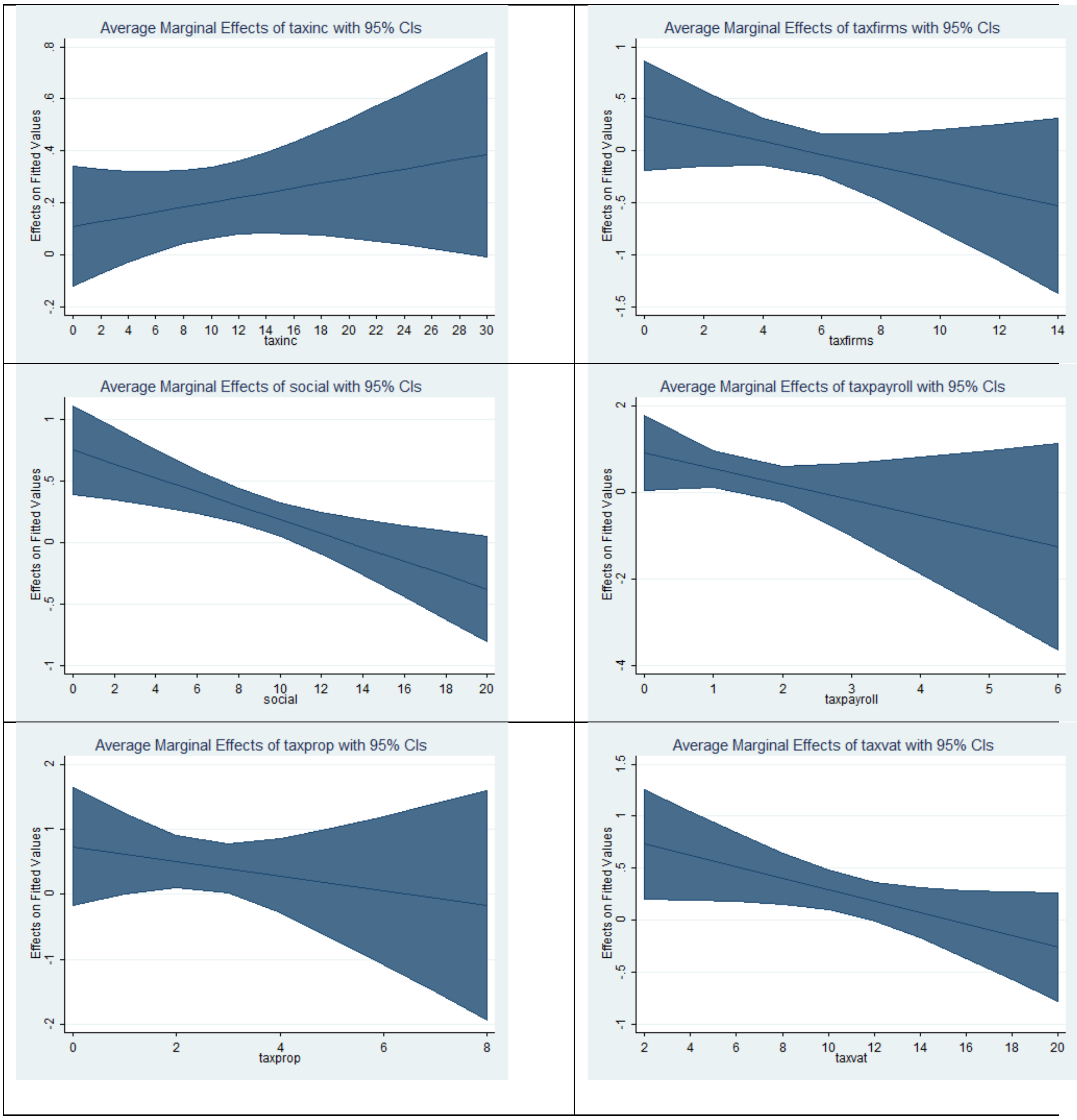

Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

Eq. (14)


Average Marginal Effects of taxinc with 95% CIs
Effects on Linear Prediction
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Linear Prediction
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Linear Prediction
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Linear Prediction
taxpayroll


Average Marginal Effects of taxprop with 95% CIs
Effects on Linear Prediction
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Linear Prediction
taxvat

Eq. (16)


Average Marginal Effects of taxinc with 95% CIs
Effects on Fitted Values
taxinc
Average Marginal Effects of taxfirms with 95% CIs
Effects on Fitted Values
taxfirms
Average Marginal Effects of social with 95% CIs
Effects on Fitted Values
social
Average Marginal Effects of taxpayroll with 95% CIs
Effects on Fitted Values
taxpayroll
Average Marginal Effects of taxprop with 95% CIs
Effects on Fitted Values
taxprop
Average Marginal Effects of taxvat with 95% CIs
Effects on Fitted Values
taxvat