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Taxation of income and economic growth: An empirical analysis of 25 rich OECD countries

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Abstract

Several empirical papers have studied the effect of government size, typically measured as government expenditures, on economic growth. There is no consensus on the direction of this impact, even though more recent studies tend to find a negative relationship between the general level of government expenditures and economic growth. This negative relationship is explained by the distortions that raising tax revenues cause on economic activities. There are, however, several ways to raise tax revenues that likely have different distortionary effects and, hence, may impact economic growth differently. This paper analyses how taxation of income influences economic growth. More precisely we study how statutory tax rates on corporate and personal income affect economic growth by using panel data from 1975 till 2010 for 25 rich OECD countries. We find that both taxation of corporate and personal income negatively influence economic growth. The correlation between corporate income taxation and economic growth is more robust, however.

JEL classification: H21 ; H24 ; H25 ; O40

Keywords: Economic growth, taxation of corporate income, taxation of personal income

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1. Introduction

There is a vast literature on how taxation distorts individuals' and firms' decisions concerning for example how much labor individuals supply, how hard they work, how and where investments are made, and where firms choose to locate. There is also a sizable literature documenting the overall effect of government size on economic growth. Though the results are scattered, recent literature tends to find that government size, typically measured as total government expenditures as a fraction of GDP, is negatively correlated with economic growth in rich economies (see e.g., Fölster & Henrekson (2001), Romero-Avila & Strauch (2008), and Bergh & Karlsson (2010)).

The reason government expenditures are thought to influence economic growth negatively is due to the distortionary effect of taxation. Studies analyzing the correlation between overall government expenditures and economic growth are, hence, using an indirect way to study how taxation affects economic growth. Several studies have analyzed the direct link between taxation of typically personal income and economic growth (see e.g., Koester & Kormendi (1989), Plosser (1992), Slemrod (1995), Padovano & Galli (2001) and (2002)). The results from this literature are equally scattered, however.

It is likely that not only the aggregated total tax burden but also the disaggregated structure of taxation matters for economic growth. Some taxes are thought to be more distortionary than others as different taxes have more or less stable tax bases. For instance, high corporate tax rates are often assumed to be more harmful for economic activities than taxation of property. Hence, various taxes have different effects on the *level* of economic activity. Whether this effect carries over to also impact the *growth rate* is less clear however. A study by Easterly (1993) supports this by providing empirical evidence that distortions are negatively correlated with growth.

With tax competition countries worldwide are reforming their tax systems to become more competitive. In order to design desirable tax systems information about different taxes' harmfulness is of great importance. More recently studies have turned to investigate the structure of taxation and economic growth. For instance, a few papers have examined the link between tax structure, based on tax measures from tax revenues, and economic growth (e.g., Widmalm (2001), Arnold (2008), and OECD (2010)). The results from these studies are mixed and, hence, hard to draw policy implications from. Moreover, a shortcoming of these studies is that they all use backward looking average tax measures based on tax revenues. As distortions from taxation to a large degree are influenced by forward looking marginal tax

rates it may be more fruitful to analyze the link between marginal tax rates and economic growth. An exception to the use of average tax revenue based measures is a study by Lee & Gordon (2005). They estimate the impact statutory corporate and personal income tax rates and the value added tax rate have on GDP per capita growth using panel data from in 70 countries. Of these taxes, they find that only corporate tax rates negatively and statistically significantly influence economic growth.

Given that intensified tax competition and increased demand for public services have made it more important to raise taxes in efficient ways there is surely more need for knowledge about how different types of taxes influence economic growth.[1] This paper further examines the correlation between income taxation and economic growth by studying how taxation of corporate and top personal income impact economic growth in 25 rich OECD countries during the period 1975 to 2010. We use standard growth estimation techniques with country and year fixed effects to determine the effect of income tax rates on GDP per capita growth. Unlike Lee & Gordon we also analyze the impact taxation of dividends and employers' social security contributions have on economic growth. Consistent with Lee & Gordon (2005) we find robust support for corporate tax rates impacting growth negatively. However, we find support for a non-linear relationship between tax rates and economic growth. Though we also find a negative correlation between personal income taxes – both on incomes from labor and from dividends - and economic growth, this relationship is less robust.

The paper is organized as follow. The next section gives a brief motivation of the paper. Section 3 reviews previous literature while section 4 describes the method and section 5 the data. Section 6 presents the results and finally section 7 concludes the paper.

2. Motivation

Economic researchers have tried to explain and model growth for centuries. More recently, researchers have typically employed either the neoclassical growth model developed by Robert Solow in the 1950s or the endogenous growth models developed by Paul Romer and Robert Lucas in the 1980s to explain and model economic growth. As taxes have no permanent effects on per capita GDP growth, regardless of the distortionary effects of the tax system, in the neoclassical model we assume that the endogenous growth model better explains growth.

[1]Several papers have analyzed the relationship between tax structure and economic growth indirectly by studying how taxes affect total factor productivity.

There are several reasons to expect both corporate and personal income taxation to impact economic growth. Starting with corporate tax rates, taxation of corporate income lowers the return on innovations and reduces the amount spent on research and development which impact growth negatively. In addition, corporate taxation discourages investments both domestically and internationally by reducing foreign direct investment, and hence hampers economic growth.

Taxation of personal labor income may influence economic growth by affecting human capital investments, through supply of labor, and work effort. Flat income taxes do not influence education decisions as the government shares equally in the forgone earnings and the future return from education (Trostel, 1993). Progressive income taxes discourage education, however, as taxes saved while in school are less than taxes paid on future returns to education (Heckman et al., 1998). An extensive literature has found that incentives and compensation policies matter for individuals' effort (see e.g., Ehrenberg, 1990, and Prendergast, 1996, for reviews). This literature indicates that there is a positive relationship between wages and work effort. This suggests that higher taxes, that lower net return, increase production costs and lower efficiency. Similar results have been found in the tax response literature, with several studies revealing that especially high-income earners respond to lower net-returns by reducing effort rather than reducing hours worked (see e.g., Gruber & Saez, 2002).

In addition, taxation of both corporate and personal labor income taxation may affect entrepreneurial activity, which enhances economic growth by creating new ideas and promoting technological change. The impact of corporate and personal income taxation on entrepreneurship has recently been receiving attention; the correlation between them is not clear-cut as there are several ways through which taxes can affect the amount of entrepreneurial risk-taking. Obviously, the impact of the two income taxes depends on how entrepreneurial income is taxed in individual countries. In countries where entrepreneurial income is taxed at lower rates than personal income, high personal income tax rates encourage individuals to become entrepreneurs (self-employed) in order to avoid highly taxed personal income.

The treatment of losses may also influence entrepreneurial activity. The classical Domar and Musgrave (1944) result suggests that higher taxes encourage risk-taking as the government, by allowing loss offsetting, shares the risk with the entrepreneur. This finding is also in line with results from Myles (2009), who finds high statutory tax rates on labor income to encourage risk-taking if losses can be written off against other income. Progressive taxation,

however, discourages risk-taking as losses push entrepreneurs into low tax brackets reducing the value of the loss offset, while profits push entrepreneurs into high marginal tax brackets reducing the net profit for the entrepreneurs. Gentry & Hubbard (2000) suggest that the larger the tax wedge is between being successful and unsuccessful the lower is the amount of risk-taking. In addition, tax avoidance and evasion are much easier for entrepreneurs (self-employed) to undertake than for employees supporting a positive relationship between personal income taxes and entrepreneurship.

Taxation of dividend income may also influence growth via its impact on investment and firm behavior. Indeed, Bush's aim with his "Jobs and Growth Tax Relief Reconciliation Act" of 2003, where double taxation of dividends were eliminated, was to boost economic growth. However, within the academic community there is no consensus about the impact taxation of dividends has on firm behavior and, hence, on economic performance. Instead there are two views, the old and new, with conflicting implications. According to the old view, taxation of dividends is distortionary and reduces available amount of equity capital for firms. According to the new view, taxation of dividends does not influence the marginal cost of capital and consequently has no impact on investment decisions. Double taxation of dividends can, hence, be regarded as a lump-sum tax. The reason for this is that firms can finance their activities through retained earnings and thus avoid double taxation. In addition, many argue that in small open economies taxation of dividends is irrelevant for firms' finances as foreign investments are perfect substitutes for domestic investments; even though taxation of dividends lowers domestic savings it does not impact the amount of investment as domestic capital is replaced by foreign. Recently, this view has been questioned as taxation of dividends may reduce available new capital and harm firm start-ups for those without access to international capital markets, and firms with no gain to reinvest. Given the lack of theoretical consensus several empirical studies have investigated the role of dividend taxation. Several of these support the old view (e.g., Poterba and Summers (1985), Gentry (1994), Zodrow (1991), Gerardi et al. (1990), and McKenzie & Thomson (1996)) while others find support for the new view (Auerbach & Hassett (2002) and Lindhe (2002)). As there clearly is no consensus on this matter we find it of great interest to analyze the empirical implications of dividend taxation on economic growth.

Apart from the more direct ways that income taxation influences economic growth there are several indirect ways through which taxation can influence economic growth both

positively and negatively. For example, various tax incentives for research and development and small firm creation may enhance economic growth.

3. Previous empirical literature

There is an extensive literature examining the relationship between government expenditures and economic growth. Many of these studies tend to find a negative relationship between size of government, typically measured as total government or government consumption expenditures, and economic growth (e.g., Barro (1991), Fölster & Henrekson (2001), (2006), Romero-Avila & Strauch (2008), Bergh & Karlsson (2010)), while others dispute this negative relationship (e.g., Ram (1986), Devaranjan et al. (1996), and Agell et al. (2006)) or are unable to demonstrate a statistically significant correlation (e.g., Kormendi & Meguire (1985), Levine & Renelt (1992), and Easterly & Rebelo (1993)). The lack of consensus here may not be surprising as the overall size of the government has two contrasting effects. A larger size means higher taxes that impose larger distortions in the economy, but higher levels of public spending may also boost economic growth as part of the spending is growth enhancing.

While these papers look at government size as a proxy for overall level of taxation, several papers have tried to determine the direct link between taxation and growth. A majority of these focuses on how taxation of personal income affects economic growth and uses various measures to capture the tax burden of income taxation. The results from these studies are, if possible, even more scattered and found to be sensitive to use of tax measure and included variables.

For example, Plosser (1992), on the one hand, finds tax burdens measured as the share of revenues from income and profit taxes to GDP to be negatively correlated with GDP growth. Koester & Kormendi (1989), on the other hand, detect no statistically significant relationship between taxes and economic growth. They construct measures of average and marginal personal income tax rates by regressing tax revenues on GDP, and then use these measures in a growth regression. Neither tax rates seem to have a negative impact on the growth rate, though the marginal tax rate has a negative effect on the level of activity. Padovano & Galli (2001) construct similar tax measures but include a slope dummy in addition to allow for changes in tax rates over time. Contrary to Koester & Kormendi, they observe these tax rates to negatively and statistically significantly impact growth. In a later paper, Padovano & Galli (2002), confirm the negative correlation between marginal tax rates and economic growth but find average taxes to have an insignificant impact.

Easterly & Rebelo (1993) detect, by using a wide set of different marginal income tax rates little evidence for a robust correlation between these marginal tax rates and economic growth in developing countries. An unstable or non-existing relationship is also in line with work from Mendoza, Milesi-Ferretti & Asea (1997), where tax rate variables turn insignificant in growth regressions when initial income is included, and Slemrod (1995) who demonstrates that the relationship between tax rates and growth is sensitive to specification and countries included.

Contrary to these findings are results from e.g., Leibfritz, Thornton & Bibbee's (1997) who obtain a negative correlation between both average and marginal tax rates and economic growth, and Dowrick (1993) who find personal income taxes to have a negative effect on growth.

Some studies have analyzed the link between growth and the tax structure rather than the level of taxation. Kneller at al. (1999), for example, study the tax structure by dividing taxes into distortionary and non-distortionary taxes (measured as tax revenue as a share of GDP) and expenditures into productive and non-productive. Their results lend support to distortionary taxes reducing growth and productive spending enhancing growth. This result is later confirmed in a study by Gemell et al. (2006).

Turning to the literature including corporate tax rates, the literature becomes less extensive even though there are a growing number of studies showing interest in the overall structure of taxation and economic growth. While Dowrick (1993) found personal income taxes to have a negative impact on economic growth his results indicates no such relationship for corporate tax rates and economic growth. This is consistent with Widmalm's study (2001) that investigates the effect of tax structure, defined as the proportion of tax revenues stemming from taxes on personal income, corporate income, property taxes, taxes on goods and services, and taxes on wages, and a measure for tax progressivity on GDP growth. Her results reveal a negative correlation between the proportion of tax revenues from personal income taxes and economic growth, while no such correlation is found for the proportion of corporate tax revenues. This may seem surprising as the corporate tax rate is commonly thought to be more distortionary than taxation of personal income.

Arnold (2008) use annual panel data for 21 OECD countries to study the link between tax structure and economic growth. His tax measures are also based on tax revenues obtained from different taxes. Unlike previous studies Arnold use annual data and the estimations are based on a standard empirical model and a government budget constraint enabling evaluation of revenue-neutral changes in the tax structure. The results indicate that a stronger reliance on

income taxes imply significantly lower levels of GDP per capita than the use of taxes on consumption and property. Among the income taxes, he finds corporate income taxes to be associated with lower levels of GDP per capita than personal income taxes.

In addition, Lee & Gordon (2005) analyze whether taxation of household versus corporate income differ in how they influence economic growth. Unlike above mentioned studies using tax revenue based tax measures, Lee & Gordon use top statutory tax rates on corporate and personal income to measure the tax effect. They do this on a sample of 70 countries during the time period 1970 to 1997. Results show a significant negative correlation between statutory corporate tax rates and growth but no significant correlation between top statutory personal income tax rates and growth. When they restrict the sample, by including an OECD-dummy, the corporate tax rate effect on growth for the OECD countries becomes nearly zero, suggesting that the corporate taxation is less harmful to growth in more developed countries than in less developed countries.

Above studies are all based on cross-sectional data for a number of different countries. Engen & Skinner (1996) alert to the problems with cross-country studies and instead propose the use a bottom-up approach that estimates the effect of taxation on labor supply, investment, and productivity, respectively, and then sums these individual effects up to obtain the overall effect. Doing this suggest that both average and marginal tax rates hamper economic growth. Several other papers have studied the impact of taxes on growth components. Schwellnus & Arnold (2008) and Vartia (2008), for example, study the impact of corporate income taxes on the productivity of firms and industries using a large data set of firms and industries across OECD countries. Both papers find a negative effect of corporate income taxes on productivity, and hence indirect evidence of corporate taxes harming growth.

Moreover, industry-level evidence from OECD countries (OECD, 2010) suggests a negative relationship between top marginal tax rates on personal income and long-run levels of total factor productivity, especially in countries with high entry level rates, suggesting that high top statutory personal income tax rates hurt firm entry. This is also consistent with results from Sweden, showing that high marginal tax rates on personal income retard firm start-ups (see Hansson (2010)). In addition, research by Gentry & Hubbard (2000) points to a negative relationship between the progressivity in the personal income tax schedule and entrepreneurial risk-taking.

Similarly, there is a sizable literature documenting a negative relationship between corporate tax rates and FDI (see e.g., De Mooij & Ederveen, 2006 and Feld & Heckemeyer, 2011). Several papers have established a negative link between labor taxes and FDI as well

(Hajkova et al. (2006), Hansson & Olofsdotter (2011)). Hajkova et al. (2006) even find the impact of labor taxes on FDI to be substantially larger than that of cross-border effective average and marginal corporate tax rates.

After reviewing the literature, it seems fair to conclude that the empirical evidence of a relationship between both the level of taxation and the structure, respectively, and economic growth is weak, and that there is a need for further research to clarify this relationship.

Like Lee & Gordon (1995), our study analyzes how taxation of corporate and personal income impact economic growth. We also use marginal tax rates on corporate and personal income as our tax measures rather than measures based on tax revenues. Economic theory predicts marginal tax rates to matter for the distortions introduced to individuals' and firms' choices. This as they influence decisions concerning among others the amount of investments to undertake, additional income to earn, and entrepreneurial effort, and are, hence, the relevant tax rates for economic growth. Average tax rates, on the other hand, influence the discrete decisions whether to invest or work at all. Additionally, average rates are more correlated with government expenditures than marginal rates, and may hence effect economic growth positively, while marginal tax rates should, according to theory, be negatively correlated with growth. The difficulty lies in determining what marginal tax rate to use as different rates apply to different levels of income (due to various rates but also due to exemptions, credits, and depreciation allowances). To avoid some of these issues we choose to use the top marginal tax rate on both personal and corporate income.

Unlike Lee & Gordon (2005) we focus on the rich OECD countries as the effect of taxation on economic growth likely vary greatly between rich and developing countries. In addition, we also study the effect of shareholders' taxation of dividends and employer paid social security contributions on economic growth. Whether social security contributions should be considered a tax or a fee for current and future benefits have been debated. If it is a tax it is likely to have the same impact as taxation of labor income. Either way, we find it to be of interest to study whether social security contributions impact economic growth and if so to what extent. Another difference is that we allow for non-linearity in the tax effect. Up to a certain level tax rates may stimulate growth as the revenues generated are spent in productive ways enhancing the functioning of the economy. Above a certain level, the negative effects in terms of larger distortions caused by higher tax rates may outweigh the positive effects from spending the revenues.

4. Empirical method

We estimate the effect of tax rates on economic growth using fixed effects regression, a standard approach within the literature capable of accounting for many unobservable factors that may be confounded with the functioning of the tax system. The fixed effects estimator may remedy the problem of omitted variable bias as long as these are constant over time. Factors such as national culture, legal-political institutional infrastructure, and government efficiency are factors that have been found to influence growth and are likely to be correlated with tax rates. Omitting such factors would lead to biased estimates.

The regression model can be written as:

$$g_{it} = X'_{it0}\beta + Z'_{it}\gamma + \mu_i + \delta_t + \varepsilon_{it} \qquad (1)$$

To obtain elasticities we estimate (1) in logarithmic form. The dependent variable, g_{it}, denotes the average 4-year per capita GDP growth rate for country *i* at time period *t*. X_{it0} is a vector of measures of our tax rates in the initial year. t_0 indexes the initial value in the start of each period. X_{it0} hence measures tax rates on corporate and personal income and is our variable of interest. We also include the tax level squared to allow for non-linear tax effects. Z_{it} is a vector of explanatory variables including the variables initial income, national investment, unemployment, dependency ratio, government expenditures, tax revenues, openness (exports and imports as a fraction of GDP), growth of the labor force, inflation rate, and national savings.

The μ_i terms are fixed country effects (i.e., unmeasured shocks). These terms account for time-invariant determinants of economic growth that vary among the countries in our sample. If μ_i were correlated with X_{it0} in equation (1), then estimators that failed to include the country-specific fixed effects would yield inconsistent estimates of the effect of taxation on economic growth.

The δ_t terms are sample-wide period effects. These terms account for trends that affect the economic growth in each of the countries similarly, such as business cycles and the oil shocks in the 1970s. Tax rates are likely affected by these events and a model failing to account for such trends would confound those trends with the effects of changing tax rates.

The terms β and γ are parameters to be estimated. The ε_{it} terms are idiosyncratic disturbance terms that vary by country and time period, and are assumed to be independently and identically distributed with mean zero and variance σ_ε^2.

Studies on taxes and growth may suffer from several statistical problems. One of them is the endogeneity problem. Tax rates may both influence economic growth and be influenced by economic growth. High taxes may cause lower growth rates, but periods of low growth rates may require raised tax rates in order to finance increased expenses on, for example, higher unemployment rates. To mitigate this problem we use 4-year averages for per capita GDP growth and the other explanatory variables. The tax rate variables take on the initial values in each 4-year period however. In addition, we use an instrument variable technique. We follow Lee & Gordon (2005) and use the weighted tax rates in the other countries in the sample as instruments. The weights are the inverse of the distance between the country in question and all other countries in the sample.

5. Data

We focus on the rich OECD countries and our dataset is a panel of 25 OECD member countries. The dataset contains OECD data from 1970 to 2010 on GDP per capita and its growth rate, the general government tax revenue and expenditure as shares of GDP, national investment as a share of GDP, national savings as a share of GDP, the unemployment rate, the dependency ratio, exports and imports as a share of GDP (openness), and the growth of the labor force.

Data on the various statutory tax rates come from the European Tax Handbook of the International Bureau of Fiscal Documentation (IBFD), the World Tax Database from the Office of Tax Policy Research (OTPR) at the University of Michigan, and OECD Tax Database. Data on the corporate tax rate range from 1970 to 2010, while data on the top marginal tax rate on personal income cover the period from 1975 to 2010. Employers' social security rates range from 1981 to 2010 and refer to the top rate in cases where employers' social security contributions are differentiated. The top tax rate shareholders face on distributed profits range from 1981 to 2011. Is should be noted that this rate refers to the top tax rate on dividends and include taxation at both corporate and shareholder level (when applicable). Table 1 shows a summary description of the variables. The Appendix contains a variable description with sources and a list of the OECD member countries included in the study.

Figures 1 and 2 illustrate the development for corporate income tax rates and the top marginal tax rates on personal income (figure 1) and shareholders' top tax rate on distributed dividends and employers' social security contribution (figure 2). The average corporate tax

rate (blue line in figure 1) increases with nearly 10 percentage points from 1970 to 1980, where the average corporate tax rate amounts to approximately 45 percent. The subsequent 30-year period is characterized by a general decline, ending with a tax rate of about 26 percent in 2009. The mean top marginal tax rate on personal labor income (green line in figure 1) peaks at 70 percent in the late 70s and decreases quite rapidly during the next ten years; in 1990 the rate is below 50 percent. In later years the tax rate has remained above 45 percent except for the last couple of years in the period.

Turning to figure 2 and the top tax rate on dividends (red line), this rate also shows a remarkable decline. In the early1980s the average rate for the sample is 76 percent. The rate then steadily declines to around 44 percent in 2011. Contrary to the development of the other tax rate employers' social security contribution rate (green line) has increased fairly steadily since the early 1980s. The average employer social security contributions starts out just under 14 percent in the early 1980s and then reaches a peak over 18 percent during the first half of the 2000s, thereafter the average rate declines a little to 17 percent in 2009.

6. Results

Table 2 reports the results from the regression of the corporate tax rates and GDP per capita growth. In column (1) only the level of the corporate tax rate, the fixed effects, and a constant are included as explanatory variables. The corporate tax rate variable has a negative, although insignificant coefficient. In the next column, (2), we allow for non-linearity by adding the corporate tax rate variable squared. Interestingly, the level of the corporate tax rate now turns positive (although still insignificant) while the squared term is negative and statistically significant at the 10 percent significance level. In columns (3) to (5) additional economic explanatory variables are included. Including additional explanatory variables strengthens the results. The level of the corporate tax rate has a positive and in most specifications statistically significant impact while the squared term has a negative and statistically negative effect on economic growth. This suggests that low levels of corporate tax rates have a positive influence while higher rates hamper economic growth. The magnitude of the coefficients is fairly stable across the different specifications.

Turning to the other explanatory variables, initial per capita income has a negative and statistically significant impact on GDP per capita growth, supporting the catching-up hypothesis. Two other explanatory variables are consistently significant across the different specifications, namely, government expenditures and openness. This result is consistent with Bergh & Karlsson (2010), who also find government expenditures and openness to

statistically significantly influence growth. Government expenditures have a negative and statistically significant effect on GDP per capita growth; with an elasticity of around -0.07, implying that a one percent increase in government expenditures lowers GDP per capita growth by -0.07 percent. Openness has a positive impact on GDP per capital growth; a one percent increase in openness (measured as the sum of exports and imports as a share of GDP) raises economic growth by approximately 0.02 percent. The last column (6) in table 2 reports the results from the IV estimations. The estimation results are weak; nothing is statistically significant and the instruments poor.

Table 3 presents corresponding results for the top marginal tax rate on personal labor income. Again, column (1) only includes the top marginal tax rate, a constant, and the fixed effects. Surprisingly, the top marginal tax rate on personal labor income has a positive and statistically significant impact on GDP per capita growth. Allowing for non-linearity and including additional economic explanatory variables result in the same pattern for marginal tax rates on personal income as for corporate tax rates. Namely, that up to a certain tax level the relationship between marginal tax rates on personal income and growth is positive, while above this level the relationship turns negative. The other explanatory variables have the same impact on per capita GDP growth as in table 2. The results from the IV regression, presented in the last column (6), are again weak.

Table 4 shows the results for regressions including both statutory marginal tax rates on corporate and personal labor income. When including both income tax rates only the corporate tax rate has a statistically significant impact on economic growth. The significance level and magnitude for the corporate tax rate variables are similar to those in table 2. For the tax rates on personal income, the coefficients have the same sign as before but are no longer significant. This is in line with results from Myles (2009), who claims that tax regressions deliver better results when each form of tax is included separately (Myles, 2009).

Estimation results for shareholders' top marginal tax rates on dividends and employers' social security contributions are presented in table 5. Columns (1) to (3) show the results for dividend taxation, starting with the specification including only the dividend tax in level and squared, a constant term, and fixed effects. The dividend tax has a negative and statistically significant effect on economic growth, but this effect diminishes as the squared term is positive and significant. Including additional explanatory variables in column (2) does not alter the result but makes the coefficient more statistically significant. Finally, in column (3) tax rates on corporate and labor income are added. The dividend tax has the same impact as before, and consistently with results from table 4 the corporate tax rate has a statistically

significant impact on economic growth while taxation of labor income does not. Contrary to the corporate and labor income tax rate, the dividend tax has an immediate negative impact on economic growth although at a diminishing rate.

Table 5 also presents regression results from the employers' social security contributions. This "tax" has a negative impact when additional explanatory variables are included (column (5)) but this result vanishes when other income tax rates are incorporated (column (6)).

Many previous studies on taxation and economic growth have used 5-years averages. Theory gives no guidance to the choice of period length, however. In order to compare our results with previous work, and to check whether the period length influences the results we rerun our estimations based on 5-years rather than 4-years averages. The results from doing this are presented in table 6. The first column reports the result from the regressions using the corporate tax rate, the following column reports the results from the marginal tax rate on personal income, and the third column shows the estimation results when both income taxes are included. The fourth and fifth columns report the results for the dividend taxation in isolation and with the other two income taxes.[2] The results for the corporate tax rate are robust and basically unchanged by the choice of period length. The impacts of the labor and dividend tax rates on economic growth are not upheld though. The coefficients have the same sign as before but are not significant in any of the specifications. An additional difference is that openness is no longer significant.

As there is no guidance to the right period length, we, in addition, follow Arnold (2008) and use annual data to investigate the impact of income taxes on economic growth. To avoid endogeneity and to account for taxes taking time to affect growth we lag the tax rates two and four years, respectively. Table 7a reports the resulting estimation results for the tax variables. The first three columns show the results for the corporate tax, the following three show results for the personal income tax, and finally the last three columns report the result for both tax rates. Again, the results for the corporate tax rate are robust and similar to previous results. The results for the personal income tax are, however, sensitive to the choice of lag and only statistically significant when no lags are used. Table 7b shows the corresponding results for the dividend tax and employers' social security. The results for these two taxes are also sensitive to length of lag and in most specifications insignificant.

[2] Results from the employers' social security contributions are not reported in the table in order to preserve space. The employers' social security contributions impacts on growth are insignificant however, both in isolation and with the other taxes.

7. Conclusions

Intensified competition between countries and increasing demand for publicly financed services pressure countries' tax systems to be designed in efficient ways. In order to design efficient tax systems it is crucial to know how distortive and harmful different taxes are to economic growth. This paper aims to provide some insights into the relationship between taxation of different sources of income and economic growth. We do so by study the correlation between statutory tax rates on corporate and personal income and economic growth in 25 rich OECD countries during the period 1975 to 2010.

Unlike many previous studies we allow for taxes having a non-linear effect on economic growth. The reason for this is that higher rates may be more distortionary and hence impact growth negatively while lower rates may generate revenues that are spent in productive ways. We find empirical support for a non-linear relationship. Both low taxation of corporate and personal labor income enhance growth while higher rates retard growth. While the result for taxation of personal income is less stable, the results for the corporate tax rate are robust across specifications and choice of included variables. In addition, we find support for taxation of dividends having a negative impact on economic growth even though this result is also less robust than that for the corporate tax rate. The results from this paper hence suggest that taxation of corporate income has a robust harmful impact on economic growth, a result that is consistent with more recent research (see e.g., OECD (2010)).

Table 1. Variable description, all variables are 4-year averages, unless stated otherwise

Variable	Obs	Mean	Std Dev	Min	Max	Description
Growth of GDP per capita	980	6.309	2.889	-0.029	14.359	Average annual growth rate of GDP per capita
Initial income per capita	980	16749.5	11530.7	1239.3	78523.3	GDP per capita for the initial year of each subperiod, current prices
Tax revenues	980	34.022	8.146	10.511	51.259	General government tax revenues as a share of GDP, current prices
Government expenditures	640	44.803	7.731	25.95	71.72	General government expenditures as a share of GDP, current prices
Investment	960	0.228	0.039	0.165	0.372	National investment as share of GDP, current prices
Unemployment	816	6.925	3.768	0.787	22.275	Unemployment as share of labor force
Dependency ratio	1000	34.351	2.628	26.292	45.820	Population aged 0-15 and >65 as share of total population
Openness	980	0.682	0.430	0.103	3.138	Exports and imports of goods and services as share of GDP
Labor force growth	804	0.003	0.007	-0.025	0.031	Average annual growth rate of the labor force
Corporate tax rate	860	36.155	9.616	3	56	Top statutory corporate tax rate, for the initial year of each subperiod
Top marginal tax rate on personal income	672	53.129	12.664	11.5	85	Top marginal tax rate on labor income, for the initial year of each subperiod
Top marginal tax rate on distributed dividends	650	54.521	14.555	26.2	93.67	Top marginal tax rate on dividends incl. taxation at both corporate and shareholder level, for the initial year of each subperiod
Employers' social security contribution	718	16.084	13.890	0	48.26	Employers' maximal social security contribution rate, for the initial year of each subperiod

Table 2.Estimation results for the corporate tax rate

GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6) (IV)
Corporate tax rate	-0.00292	0.165	0.208**	0.208**	0.162*	31.64
	(0.00984)	(0.0997)	(0.0898)	(0.0910)	(0.0939)	(2,531)
Corporate tax rate^2		-0.0252*	-0.0307**	-0.0306**	-0.0238*	-4.745
		(0.0147)	(0.0130)	(0.0131)	(0.0134)	(382.2)
Initial per capita income			-0.0593***	-0.0584***	-0.0821***	1.674
			(0.0183)	(0.0177)	(0.0218)	(131.5)
Investment			0.0274	0.0281	0.0103	0.210
			(0.0204)	(0.0204)	(0.0222)	(8.831)
Unemployment			0.00475	0.00456	-0.00165	0.232
			(0.00652)	(0.00756)	(0.00704)	(19.68)
Dependency ratio			-0.0506	-0.0517	-0.0883*	-3.653
			(0.0430)	(0.0446)	(0.0470)	(272.0)
Government expenditures			-0.0741***	-0.0728***	-0.0817***	1.036
			(0.0236)	(0.0244)	(0.0276)	(84.20)
Tax revenues			0.0268	0.0242	0.0297	1.378
			(0.0277)	(0.0286)	(0.0280)	(121.5)
Openness			0.0256**	0.0248**	0.0175*	-0.319
			(0.0105)	(0.0111)	(0.00959)	(34.73)
Labor force growth			-0.00136	-0.00140	-0.00109	0.0330
			(0.00176)	(0.00178)	(0.00186)	(3.011)
Inflation				-0.00110		0.0789
				(0.00409)		(7.665)
Savings					-0.00561	
					(0.0115)	
Constant	0.0994**	-0.175	0.670*	0.672*	1.072**	-62.00
	(0.0363)	(0.168)	(0.352)	(0.355)	(0.390)	(5,045)
Observations	188	188	135	134	127	134
R-squared	0.630	0.645	0.810	0.808	0.822	
Number of code	25	25	25	25	23	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Estimation results for the top marginal personal labor income tax rate

GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6) (IV)
Top marginal personal income tax	0.00872*	0.00476	0.244**	0.269**	0.219*	-1.926
	(0.00440)	(0.0376)	(0.103)	(0.107)	(0.117)	(4.766)
Top marginal personal income tax^2		0.000537	-0.0315**	-0.0347**	-0.0275*	0.236
		(0.00527)	(0.0139)	(0.0144)	(0.0159)	(0.590)
Initial per capita income			-0.0604***	-0.0571***	-0.0716***	-0.186
			(0.0165)	(0.0154)	(0.0240)	(0.305)
Investment			0.0313	0.0317	0.0185	0.0630
			(0.0225)	(0.0225)	(0.0232)	(0.0949)
Unemployment			0.00543	0.00442	0.00111	0.00800
			(0.00649)	(0.00737)	(0.00765)	(0.0217)
Dependency ratio			0.0154	0.0161	-0.0152	-0.156
			(0.0321)	(0.0340)	(0.0437)	(0.477)
Government expenditures			-0.0734**	-0.0719**	-0.0932***	-0.0643
			(0.0308)	(0.0318)	(0.0282)	(0.0910)
Tax revenues			0.0157	0.0123	0.0204	0.0864
			(0.0329)	(0.0341)	(0.0357)	(0.193)
Openness			0.0451***	0.0470***	0.0374***	-0.0515
			(0.0117)	(0.0113)	(0.0118)	(0.219)
Labor force growth			-0.000274	-0.000154	0.000156	-0.000762
			(0.00177)	(0.00179)	(0.00188)	(0.00550)
Inflation				-0.00274		0.0156
				(0.00369)		(0.0419)
Savings					-0.0144	
					(0.00946)	
Constant	0.0520***	0.0592	0.382	0.321	0.649	6.144
	(0.0178)	(0.0664)	(0.272)	(0.273)	(0.445)	(12.69)
Observations	185	185	124	123	117	123
R-squared	0.754	0.754	0.850	0.849	0.870	
Number of code	25	25	25	25	23	25

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Estimation results for corporate and personal income tax rates

GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6) (IV)
Corporate tax rate	-0.00546	0.253**	0.233***	0.234***	0.184**	69.99
	(0.0149)	(0.112)	(0.0827)	(0.0800)	(0.0863)	(4,324)
Corporate tax rate^2		-0.0381**	-0.0348***	-0.0346***	-0.0272**	-10.02
		(0.0159)	(0.0119)	(0.0115)	(0.0121)	(618.7)
Top marginal personal income tax rate	0.0118**	-0.0571	0.200	0.207	0.209	21.46
	(0.00524)	(0.0580)	(0.127)	(0.123)	(0.141)	(1,284)
Top marginal personal income tax rate^2		0.00846	-0.0263	-0.0271	-0.0269	-3.018
		(0.00764)	(0.0175)	(0.0170)	(0.0195)	(180.9)
Initial per capita income			-0.0460***	-0.0405***	-0.0585**	5.312
			(0.0145)	(0.0141)	(0.0245)	(334.5)
Investment			0.0293	0.0314	0.0161	-0.969
			(0.0227)	(0.0226)	(0.0252)	(60.88)
Unemployment			0.00463	0.00329	0.000669	-0.0551
			(0.00638)	(0.00729)	(0.00817)	(4.230)
Dependency ratio			-0.0267	-0.0228	-0.0557	-15.60
			(0.0419)	(0.0432)	(0.0562)	(965.3)
Government expenditures			-0.0570**	-0.0539**	-0.0783***	3.746
			(0.0253)	(0.0259)	(0.0246)	(235.9)
Tax revenues			0.0335	0.0257	0.0423	1.363
			(0.0365)	(0.0371)	(0.0369)	(80.30)
Openness			0.0401***	0.0419***	0.0346***	1.187
			(0.0105)	(0.00987)	(0.0120)	(71.94)
Labor force growth			0.000191	0.000256	0.000428	0.155
			(0.00168)	(0.00170)	(0.00185)	(9.510)
Inflation				-0.00347		-0.108
				(0.00397)		(6.853)
Savings					-0.0123	
					(0.0105)	
Constant	0.0608	-0.233	-0.00747	-0.0565	0.272	-166.5
	(0.0502)	(0.153)	(0.294)	(0.302)	(0.466)	(10,275)
Observations	161	161	118	117	111	117
R-squared	0.693	0.718	0.835	0.834	0.852	
Number of code	25	25	25	25	23	25

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Estimation results for shareholders' top marginal tax rates on dividends and employers' social security contributions

GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6)
Dividend tax	-0.206*	-0.229**	-0.279**			
	(0.121)	(0.100)	(0.134)			
Dividend tax rate^2	0.0262*	0.0304**	0.0365**			
	(0.0150)	(0.0133)	(0.0179)			
Social security				0.00815	-0.144**	-0.073
				(0.0466)	(0.0544)	(0.0743)
Social security^2				0.00006	0.0265**	0.0170
				(0.0081)	(0.0107)	(0.0148)
Corp tax rate			0.250***			0.2897***
			(0.0368)			(0.1008)
Corp tax rate 2			-0.036***			-0.0422***
			(0.0056)			(0.0161)
Top marginal tax rate			0.123			-0.2109
			(0.185)			(0.247)
Top marginal tax rate			-0.016			0.0259
			(0.025)			(0.0330)
Initial per capita income		-0.113***	-0.0780**		-0.0733***	-0.0321*
		(0.0287)	(0.038)		(0.0236)	(0.0166)
Investment		0.0024	-0.0003		0.0247	0.0298
		(0.0232)	(0.0332)		(0.0317)	(0.0338)
Unemployment		-0.0135	-0.018		0.0036	0.0016
		(0.00987)	(0.013)		(0.0113)	(0.0117)
Dependency ratio		-0.0841	-0.093		-0.0349	-0.0428
		(0.0722)	(0.088)		(0.0634)	(0.0588)
Government expenditures		-0.0869**	-0.0768**		-0.0973*	-0.0907
		(0.0353)	(0.032)		(0.0560)	(0.0638)
Tax revenues		0.0244	0.0326		0.0730	0.0845
		(0.0316)	(0.0455)		(0.0546)	(0.0678)
Openness		0.0118	0.0244		0.0364*	0.0295
		(0.0135)	(0.015)		(0.0210)	0.0263)
Labor force growth		-0.00172	-0.0005		-0.0013	0.00165
		(0.00150)	(0.0019)		(0.0017)	(0.0025)
Constant	0.458	2.189***	1.271	0.0423	1.212	0.603
	(0.244)	(0.634)	(0.7512)	(0.0694)	(0.487)	(0.735)
Observations	142	114	97	120	93	82
R-squared	0.562	0.781	0.824	0.517	0.772	0.814
Number of code	25	25	24	22	22	21

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Estimation results based on 5-year averages

GDP per capita growth	(1)	(2)	(3)	(4)	(5)
Corporate tax rate	0.292***		0.315***		0.292**
	(0.0774)		(0.0903)		(0.125)
Corporate tax rate^2	-0.042***		-0.0453***		-0.0411**
	(0.0113)		(0.0130)		(0.0183)
Top marginal personal income tax rate		0.0989	0.136		0.132
		(0.190)	(0.183)		(0.254)
Top marginal personal income tax rate^2		-0.0115	-0.0173		-0.0176
		(0.0246)	(0.0238)		(0.0341)
Dividend tax				-0.0687	-0.121
				(0.171)	(0.263)
Dividend tax^2				0.00933	0.0148
				(0.0214)	(0.0326)
Initial per capita income	-0.0351**	-0.0448*	-0.0321	-0.0798***	-0.0401
	(0.0171)	(0.0232)	(0.0250)	(0.0253)	(0.0516)
Investment	-0.00474	0.00748	0.00886	-0.0196	0.00582
	(0.0162)	(0.0213)	(0.0209)	(0.0217)	(0.0259)
Unemployment	0.00537	0.00403	0.00451	-0.00270	0.000315
	(0.00476)	(0.00590)	(0.00562)	(0.00897)	(0.0104)
Dependency ratio	-0.0624	0.0487	-0.0390	-0.0575	-0.0556
	(0.0433)	(0.0552)	(0.0618)	(0.0632)	(0.0901)
Government expenditures	-0.0816***	-0.0772***	-0.0572**	-0.0999***	-0.0549
	(0.0205)	(0.0277)	(0.0270)	(0.0281)	(0.0476)
Tax revenue	0.0507**	0.0200	0.0237	0.0612*	0.0175
	(0.0235)	(0.0304)	(0.0315)	(0.0350)	(0.0513)
Openness	0.00816	0.0241	0.0263	0.00230	0.0251
	(0.0118)	(0.0171)	(0.0165)	(0.0174)	(0.0318)
Labor force growth	-0.000387	-0.00115	-0.000447	-0.00190	-0.000548
	(0.00103)	(0.00151)	(0.00171)	(0.00129)	(0.00247)
Constant	0.213	0.347	-0.143	1.275**	0.291
	(0.289)	(0.575)	(0.569)	(0.600)	(1.184)
Observations	108	93	89	89	73
R-squared	0.874	0.852	0.878	0.641	0.719
Number of code	25	24	24	25	23

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, *p<0.1

Table 7a. Estimation results based on annual data

GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Corporate tax rate	0.150**						0.125*		
	(0.067)						(0.0643)		
Corporate tax rate^2	-0.022**						-0.0173*		
	(0.010)						(0.010)		
Corporate tax rate lagged(-2)		0.254**						0.257***	
		(0.10)						(0.086)	
Corporate tax rate^2 lagged (–2)		-0.037**						-0.038***	
		(0.015)						(0.013)	
Corporate tax rate lagged(-4)			0.173**						0.135
			(0.068)						(0.088)
Corporate tax rate^2 lagged (–4)			-0.025**						-0.0207
			(0.010)						(0.013)
Top marg personal income tax rate				0.388*			0.261		
				(0.223)			(0.190)		
Top marg personal income tax rate^2				-0.0503*			-0.0339		
				(0.0288)			(0.0247)		
Top marg personal income tax rate (lagged-2)					0.0120			0.0369	
					(0.201)			(0.188)	
Top marg personal income tax rate^2 (lagged-2)					0.0008			-0.00330	
					(0.026)			(0.0238)	
Top marg personal income tax rate (lagged-4)						-0.00111			-0.046
						(0.072)			(0.105)
Top marg personal income tax rate^2 (lagged-4)						0.0020			0.0077
						(0.010)			(0.014)
Observations	361	359	360	316	311	317	308	304	312
R-squared	0.622	0.618	0.628	0.706	0.668	0.638	0.686	0.662	0.624
Number of code	25	25	25	25	25	24	25	25	24

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, *p<0.1

Table 7b. Estimation results based on annual data

GDP per capita growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dividend	-0.281*						-0.412*		
	(0.159)						(0.200)		
Dividend ^{2}	0.0370*						0.0544*		
	(0.0202)						(0.0267)		
Dividend		-0.0243						-0.0397	
lagged (-2)		(0.194)						(0.317)	
Dividend ^{2}		0.00625						0.00515	
lagged (-2)		(0.0243)						(0.0395)	
Dividend			0.0504						-0.75***
lagged (-4)			(0.297)						(0.212)
Dividend ^{2}			-0.00550						0.09***
lagged (-4)			(0.0374)						(0.027)
Social security				-0.114*			-0.0384		
				(0.0600)			(0.0767)		
Social security^2				0.0208*			0.00447		
				(0.0119)			(0.0145)		
Social security					-0.0449			-0.0853	
lagged(-2)					(0.056)			(0.0704)	
Social security^2					0.0052			0.0158	
lagged(-2)					(0.010)			(0.0119)	
Social security						-0.0406			-0.0598
lagged(-4)						(0.0495)			(0.040)
Social security^2						0.00681			0.0074
lagged(-4)						(0.0080)			(0.008)
Corporate tax rate							0.0768	0.0409	0.134
(lagged accordingly)							(0.0911)	(0.0790)	(0.146)
Corporate tax rate^2							-0.00965	-0.00247	-0.0182
(lagged accordingly)							(0.0143)	(0.0123)	(0.023)
Top marg tax rate							0.0998	-0.378*	-0.320
(lagged accordingly)							(0.177)	(0.213)	(0.187)
Top marg tax rate^2							-0.0144	0.0466	0.0409
(lagged accordingly)							(0.0234)	(0.0290)	(0.025)
Observations	307	294	286	254	241	231	220	205	202
R-squared	0.589	0.582	0.579	0.608	0.600	0.588	0.726	0.693	0.618
Number of code	25	25	25	22	22	22	21	21	19

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, *p<0.1

Figure 1. Mean corporate tax rates and top marginal tax rates on personal income

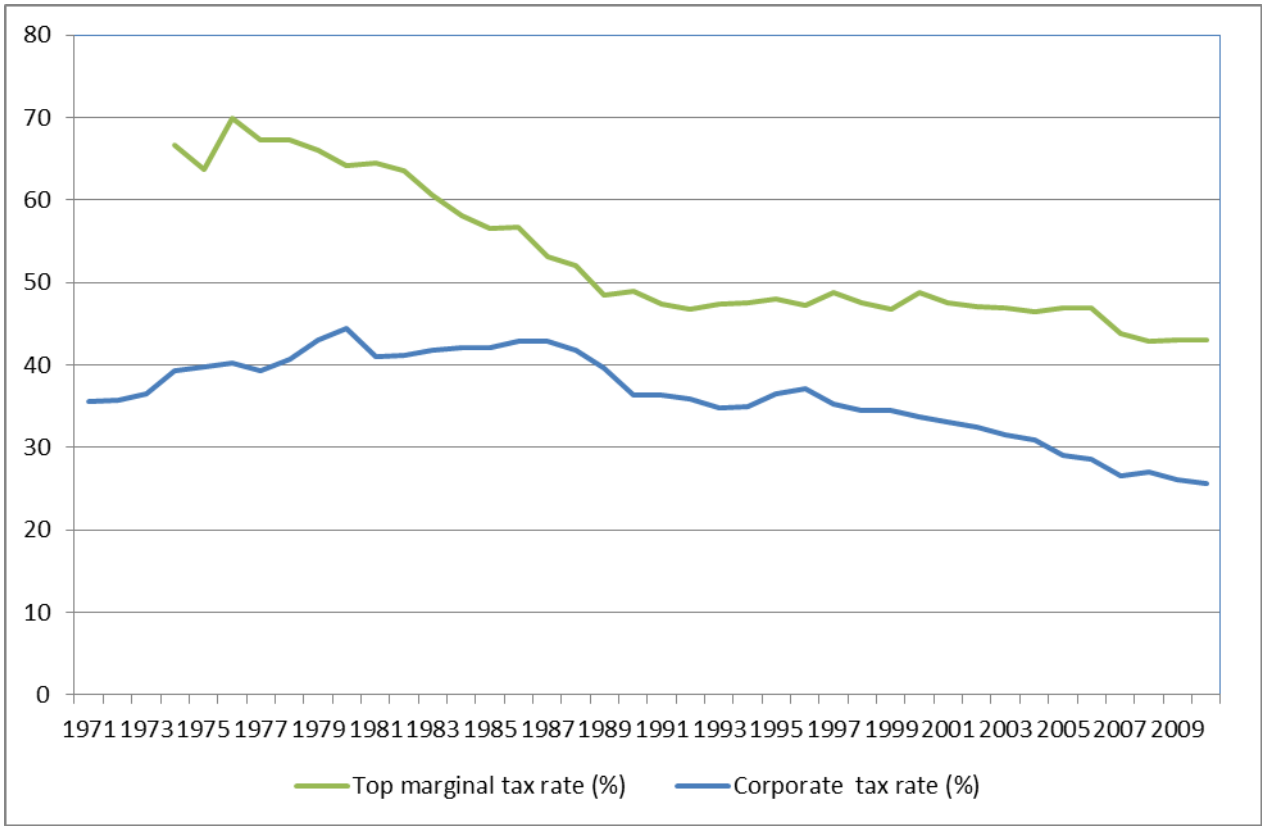
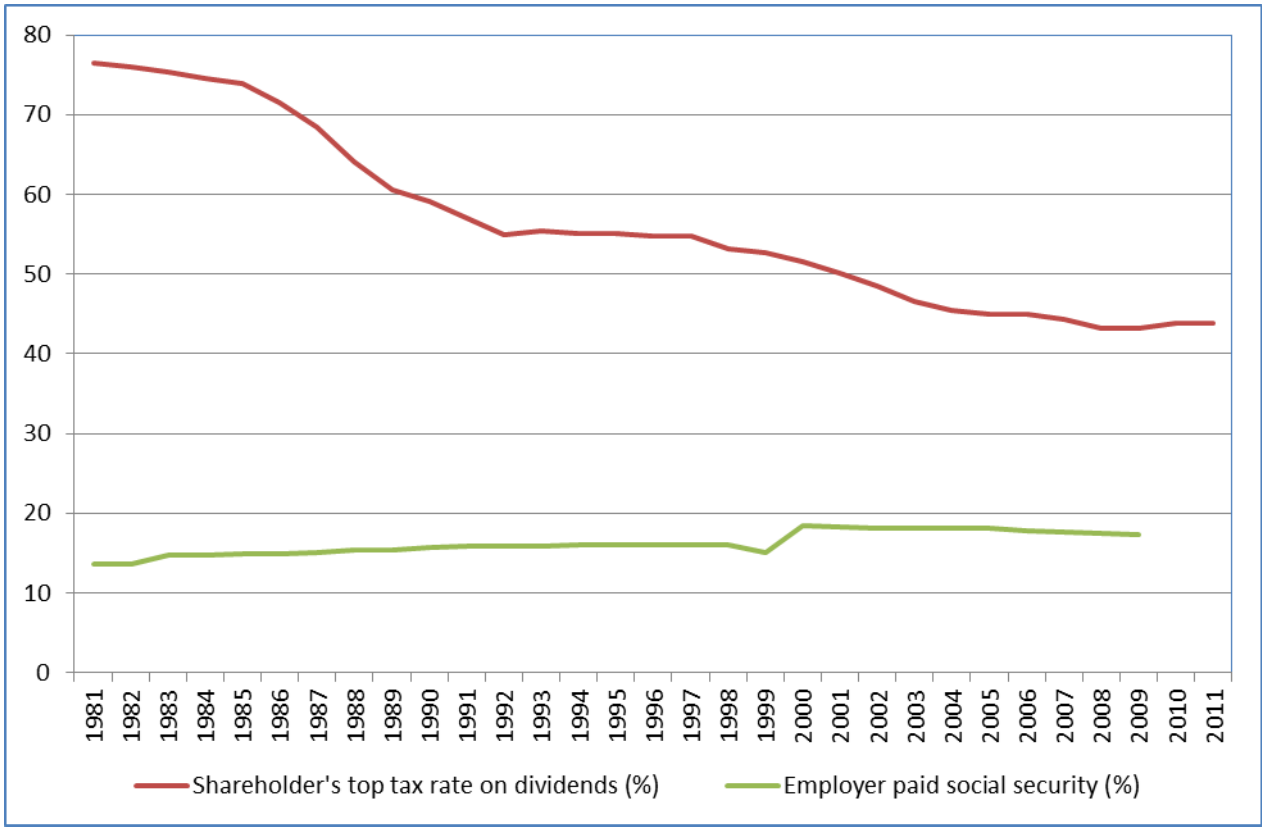


Figure 2. Mean employers' social security contributions and shareholders' top tax rate on distributed dividends



Appendix

Variable	Description	Source
Growthgdppc	Average annual growth rate of per capita GDP	OECD1
Incomepc	GDP per capita for the initial year of each subperiod, current	OECD1
Taxrev	General government tax revenue as share of GDP, current prices	OECD2
Govexp	General government expenditure as share of GDP, current prices	OECD1
Natinv	National investment as share of GDP, current prices	OECD1
Unempl	Unemployment as share of labor force	OECD1
Dep	Population aged 0-15 and >65 as share of total population	OECD3
Open	Exports and imports of goods and services as share of GDP	OECD1
Labgrowth	Average annual growth rate of labor force	OECD3
Infl	Average inflation rate	OECD1
natsav	National savings as share of GDP, current prices	OECD1
corptax	Top statutory corporate tax rate, for initial year of each subperiod	IBFD, OTPR
topmtrlabor	Top marginal tax rate on labor income, for initial year of each subperiod	IBFD, OTPR
dividend tax	Top marginal tax rate on dividends (both corp and shareholder level), for initial year of each subperiod	OECD4
employer social sec	Employers' maximal social security contribution rates, for initial year of each subperiod	OECD4

Publications

IBDF, European Tax Handbook

Online Databases

OECD1: OECD, National Accounts Main Aggregates

OECD2: OECD, Revenue Statistics

OECD3: OECD, General Statistics

OECD4: OECD, Tax database

Country list

Australia	Finland	Ireland	New Zealand	Sweden
Austria	France	Italy	Norway	Switzerland
Belgium	Germany	Japan	Poland	Turkey
Canada	Greece	Luxembourg	Portugal	United Kingdom
Denmark	Iceland	Netherlands	Spain	United States

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