Effective Tax Rates in Corporate Taxation: a Quantile Regression for the EU

Francisco J. Delgado, Elena Fernandez-Rodriguez, Antonio Martinez-Arias

University of Oviedo
Avda del Cristo s/n. 33007 Oviedo, Spain
E-mail. fdelgado@uniovi.es, mefernan@uniovi.es, martinar@uniovi.es

In this work we study the determinants of the effective tax rates for corporate taxation in countries of the European Union. First, we carry out an exhaustive review of the empirical literature where no consensus is reached about the signs of the determinants and we can observe that in the case of the European countries this topic has scarcely received attention, contrary to the US case. Then from the Compustat database and for the period 1992–2009, we estimate quantile regressions that allow possible nonlinear relationships to be detected. The estimations reveal different effects of factors such as size, debt, asset composition and profitability on the effective corporate tax rate depending on the decile. In short, for companies with lower ETRs, the most influential variables are the size, the intensity of inventories and the profitability, whereas for the companies that suffer the highest fiscal pressure it is debt that turns out to be the strongest determinant. These results justify the employment of quantile regression instead of the traditional linear approximations.

Keywords: *Corporate Taxation, Size, Effective Tax Rate, Quantile Regression, European Union.*

Introduction

Corporate Tax (CT) is a fundamental tool of the fiscal system due to its high collection capacity, its sensitivity to the economic cycle, and the influence that it can have on the economic decisions of enterprises. It is therefore unsurprising that there has been a proliferation of studies worldwide centered on corporate fiscal pressure and its determinants. However, in the case of the European countries this topic has scarcely received attention.

The aim of the present study is to analyse the determinants of the tax burden borne by listed companies in the European Union (EU). To do so we analyze the countries of the EU-15 for the period 1992–2009. In particular, we study effective corporate tax rates[1] by using quantile (nonlinear) regressions that allow us to check whether these rates vary depending on the quantiles of the sample or whether they remain linear for all companies.

The contribution of this paper is three-fold. Firstly, the available empirical literature to date is not conclusive, and has yielded contradictory results regarding the variables explaining the Effective Tax Rate (ETR). Secondly, few studies exist in the context of the EU countries as most of attention has been centred on the USA. Finally, the econometric approach based on quantile regression is new in this type of studies, the only exception being the article of (Hsieh, 2012) for the case of companies listed in China.

The remainder of the paper is organized as follows. In the second section we present an overview of the situation of corporate tax in the EU. The third section provides a review of the literature. The fourth section is dedicated to

the methodology and the data. The main results are showed in the fifth section and in the final section we present the most relevant conclusions.

Corporate Tax in the European Union: an Overview

From a world-wide perspective, corporate tax has been characterized in recent years by a gradual decrease of the Nominal Tax Rate (NTR), and the countries of the EU are no exception. Thus, KPMG (2011) reveals that for more than 125 countries the average NTR has fallen by 7.07 percentage points over the last decade from 29,03 % in 2000 to 22,96 % in 2011, which represents a reduction of more than 24 %. If we exclude the zero-rate countries, the average NTR would be 24,64 % in 2011 and 24,43 % in 2012 (KPMG, 2012). The evolution of the statutory rates in the EU is presented in Table 1.

The data in Table 1 highlight the important decrease of the average NTR in the EU, both for the EU-27 Member States and for the EU-15. In addition, it can be seen that the average for the countries of the EU-27 is consistently lower than the average for the EU-15, which implies that the new Member States generally have a lower tax rate. However, it can be observed that the decreasing trend has weakened from 2008. It should also be noted that other countries of reference such as the USA, Japan or the BRIC countries (Brazil, Russia, India and China) have higher NTRs than those of the EU.

In spite of the decreases in the NTRs, however, there has been an increase in tax collection in the EU countries in recent years - concretely, during the years before the beginning of the crisis - both in terms of GDP as well as in percentage terms in comparison to the remaining taxes.

---

[1] *In the literature we find interesting related studies. For example (Deveraux et al., 2004) studied corporate tax competition in the OECD and concluded that competition exists in both the statutory and the marginal tax rates. (Slemrod, 2004) analyzed the convergence in corporate nominal tax rates and the ratio between corporate tax collection and GDP.*

Table 1

Average Corporate Nominal Tax Rates in the EU: 2000–2012

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
EU-27	31,9	30,7	29,3	28,3	27,0	25,5	25,3	24,5	24,0	23,9	23,7	23,4	23,5
EU-15	35,4	33,8	32,6	31,9	31,4	30,1	29,6	28,7	28,2	27,9	28,0	27,5	27,6

Source: European Commission (2012)

This phenomenon, labelled by (Albi, 2010) as "the paradox of collection", was initially explained by pointing to the fact that recent fiscal reforms have comprised two measures with opposing effects, namely the reduction of tax rates and increases in the tax base (the latter with a view to reinforcing collection). Nevertheless, several studies have tried to give other answers to the aforementioned paradox, such as the increases in the profitability of companies, the growth of certain sectors such as the financial sector and services, or the increase in the number of companies at the expense of the sole proprietor (Devereux *et al.*, 2004; Auerbach, 2006; Sorensen, 2007; Mooij & Nicodeme, 2008).

It should be highlighted that the very evolution of the fall of the NTR itself may explain the increase in collection due to the parabolic relation detected between the tax rate and corporate tax collection (Paredes-Gomez, 2012). According to this, at high rates of corporate tax a reduction of the rate can lead to a fall in the collection. A similar result was found by (Clausing, 2007) for 29 OECD countries: a reduction of corporate tax rates can produce an incentive effect that increases the level of the economic activity, reduces tax evasion and attracts foreign investment both in real terms and in accounting terms through techniques such as transfer pricing. Moreover, (Clausing, 2007) estimated the NTR that maximizes tax collection for the set of the OECD at 33 %, though this rate will vary across countries depending on their size and degree of openness. In particular, it will be lower for smaller countries and more open economies.[2] It should be noted that the NTRs of the EU are substantially lower than 33 %.

Given that the NTRs have gone down and the collection has increased, it is interesting to know what has happened with the tax burden really suffered by companies. On this matter, the Government Accountability Office (GAO, 2008) indicated that the NTR does not provide a complete measure of corporate fiscal pressure as it does not contemplate aspects such as temporal differences, compensation of negative tax bases, and other incentives. The ETR, on the other hand, is considered a good indicator of the tax burden that companies really bear.

The information published by the (European Commission, 2012) shows that the ETR has also diminished in recent years in the Member States, but to a lesser extent than the statutory rate. This reveals that the fiscal reforms have been beneficial for companies since the fall of the NTRs has been more influential than the extension of the tax base.

It is evident that one of the reasons for which countries reduce NTRs is to attract investment. In this respect, (Albi, 2010) indicates that the nominal, marginal or average tax rates concern different aspects of direct investment decisions. Concretely, these decisions take into account not only the NTRs but also the tax base and the possible fiscal benefits such as the treatment of depreciation, fiscal incentives for investment, systems of valuation of stock, treatment of capital gains, compensation of losses or flows of international incomes. However, taxation varies across the different Member States and, in consequence, different ETRs exist. Indeed (Sanz-Gadea, 2011) argues that in the context of the current dispersion of effective corporate tax rates and consequent distortions of a fiscal origin, it is illusory to assume that investment decisions – both real and financial - answer exclusively to economic guidelines.

The disparities of the effective fiscal pressures of different taxes in the Member States of the EU generates a distortion incompatible with the proper functioning of the single market, with the dispersion of the statutory tax rates being the main cause of the disparity. Nevertheless, the harmonization (Cuenca-Garcia *et al.*, 2013) of corporate tax in the Member States is not directed towards reducing intervals in NTRs but towards the establishment of a Common Consolidated Corporate Tax Base (European Commission, 2011). Concretely, the aim of the Common Consolidated Corporate Tax Base (CCCTB) is to overcome some of the principal obstacles to economic growth in the single market. As a common regulation does not exist in the area of the corporate tax, the interaction of the national tax systems often produces an excessive taxation and a double taxation, so that companies have to bear onerous administrative burdens and high compliance costs, which discourages investment in the EU.

The common approach proposed would guarantee the coherence of the national fiscal systems but it would not imply a harmonization of NTRs. The existence of differentiated rates allows for a certain degree of tax competition inside the single market, which conveys greater transparency and allows Members States to take into account both competitiveness in the market as well as budgetary needs when determining tax rates.

In sum, this proposal seeks fiscal harmonization in the determination of the consolidated tax base for all the companies that form a part of a European group, but it does not concern itself with either financial accounting or the establishment of common tax rates.

Literature Review

Most of the existing literature on corporate fiscal pressure has centered on the search for the determining factors of the ETR in different countries. Several individual country studies have been carried out for different geographical areas, whereas few studies have analyzed multiple countries. In Table 2 we synthesize these studies in chronological order.

---

[2] *(Devereux, 2006) found similar results to those of (Clausing, 2007) for a study centred on 20 countries of the OECD during 1965–2004: the tax rate that maximized collection was estimated to be 30 %.*

Table 2

Literature review on ETR

Author/year	Country	Period	Database
Stickney and McGee (1982)	USA	1978–1980	Annual Compustat Industrial File
Zimmerman (1983)	USA	1947–1981	Annual Compustat Industrial File and Internal Revenue Service
Porcano (1986)	USA	1982–1983	Value Line Data Base-II
Wang (1991)	USA	1978–1983	NAARS Database
Omer *et al.*, (1993)	USA	1980–1986	Annual Compustat Industrial File
Wilkie & Limberg (1993)	USA	1968–1985	Annual Compustat Industrial File
Manzon & Smith (1994)	USA	1978–1980; 1982–1985; 1988–1990	Annual Compustat Industrial File
Collins & Shackelford (1995)	Canada, Japan, UK and USA	1982–1991	Standards & Poor's International Financial Database
Gropp (1997)	USA	1979–1991	Annual Compustat Industrial File
Gupta & Newberry (1997)	USA	1982–1985; 1987–1990	Annual Compustat Industrial File
Holland (1998)	UK	1968–1993	Datastreem
Kim & Limpaphayom (1998)	Hong Kong, Korea, Malaysia, Taiwan and Thailand	1975–1992	Listed companies
Mills *et al.*, (1998)	USA	1990-1992	Annual Compustat Industrial File
Molloy (1998)	Japan and USA	1989–1991	Listed companies
Bauman & Schadewald (2001)	USA	1993–1997	US Multinationals Companies (FORBES)
Wilkinson *et al.*, (2001)	New Zealand	1991–1995	Listed companies
Buijink *et al.*, (2002)	USA	1990–1996	Worldscope Database
Derashid & Zhang (2003)	Malaysia	1990–1999	Listed companies
Harris & Feeny (2003)	Australia	1993–1997	Big companies (ATO)
Plesko (2003)	USA	1992	Internal Revenue Services Statistics of Income (SOI)
Fernandez-Rodriguez (2004)	Spain	1993–1997	Listed companies
Calvé-Pérez *et al.* (2005)	Spain	1992–1999	Database SABE
Janssen (2005)	Netherlands	1994–1999	CD-ROM REACH A
Feeny *et al.*, (2006)	Australia	1993–1996	IBIS Enterprise Database
Liu & Cao (2007)	China	1998–2004	Listed companies
Richardson & Lanis (2007)	Australia	1997–2003	Listed companies
Rohaya *et al.*, (2008)	Malaysia	2000–2004	Thomson Datastream
Chen *et al.*, (2010)	USA	1996–2000	Standards & Poor's
Rohaya *et al.*, (2010)	Malaysia	1993–2006	Thomson Datastream
Fernandez-Rodriguez and Martinez-Arias (2011)	USA and EU	1995–2007	Thomson Datastream
Fonseca Diaz *et al.*, (2011)	Spain	1993–2004	Banks and savings banks
Delgado *et al.*, (2012)	USA	1992–2009	Annual Compustat Industrial File
Hsieh (2012)	China	1998–2001	Taiwan Economic Journal
Wu *et al.*, (2012)	China	1999–2006	JuYan Database
Huang *et al.*, (2013)	China	1999–2008	Taiwan Economic Journal database

Source: own elaboration.

Most of the studies reviewed have centered on the United States, though some papers have analyzed other geographical areas such as Australia, Canada, China, Korea, Hong Kong, Japan, Malaysia, Thailand and Taiwan, as well as some countries of the EU including Spain.

Regarding the results in this literature, it should be noted that there is more or less a consensus with regard to the principal explanatory variables of the ETR: these are size, debt, composition of the assets, and profitability. Nevertheless, as we will see below the results are not conclusive, especially for the variables size, the debt or the capital intensity, which justifies the quantile approach used in this work.

Size and Effective Tax Rate

Company size is the variable most used in studies on corporate fiscal pressure. This is justified by two opposing arguments. On one hand, the political costs hypothesis predicts a positive relation between size and ETR because the biggest companies suffer greater taxation as a consequence of the greater governmental control to which they are submitted. On the other hand, big companies will have greater possibilities of carrying out policies of fiscal planning and/or adopting accounting practices to reduce taxes, which would lead to an expected negative relation between corporate size and ETR.

The empirical evidence does not show a clear relation between company size and ETR. Authors such as (Zimmerman, 1983; Wang, 1991; Omer *et al.*, 1993; Plesko, 2003; Calve-Perez *et al.*, 2005; Rohaya *et al.*, 2010) find a positive relation between size and fiscal pressure, in agreement with the political costs hypothesis.

On the contrary, (Porcano, 1986; Kim & Limpaphayom, 1998; Derashid & Zhang, 2003; Harris & Feeny, 2003; Janssen, 2005; Richardson & Lanis, 2007; Chen *et al.*, 2010) uncover a negative relation, indicating that size can be inversely related to the tax burden.

Nevertheless, (Stickney & McGee, 1982; Gupta & Newberry, 1997; Wilkinson *et al.*, 2001; Fernandez-Rodriguez, 2004; Feeny *et al.*, 2006; Liu & Cao, 2007) do not find any type of significant relation between size and ETR. Additionally, Wu *et al.* (2012) find both positive and negative relations depending on the subsample used.

Recently, (Fernandez-Rodriguez & Martinez-Arias, 2011; Fonseca-Diaz *et al.*, 2011; Delgado *et al.*, 2012)[3] have found a nonlinear relation between size and ETR, such that up to a certain size the relation is positive but from that size on the biggest companies suffer less fiscal pressure.

Leverage and Effective Tax Rate

The relation between the capital structure of the company and fiscal pressure has been widely analyzed in the literature both at theoretical and empirical levels. The deductibility in corporate tax of the interests paid on debt can make external financing preferable to obtaining its own resources.

In their seminal work, (Modigliani & Miller, 1963) held that the tax savings derived from managerial debt have the consequence that company value depends not only on the value of investment opportunities but also on the financing decisions adopted. In fact, in the case that only corporate tax is considered these authors show that the value of an indebted company is larger by the quantity of the tax saving derived from the debt.

The relation between debt and the tax burden has been empirically tested in previous studies including those of (Stickney & McGee, 1982; Plesko, 2003; Fernandez-Rodriguez, 2004; Calve-Perez *et al.*, 2005; Liu & Cao, 2007; Richardson & Lanis, 2007; Rohaya *et al.*, 2010; Wu *et al.*, 2012), who all find a negative relation in agreement with the classical exposition.

Alternatively, it may be possible to find a positive relation between ETR and debt for companies with high rates of fiscal pressure in the sense that they can have incentives to finance themselves by debt to reduce the ETRs. In line with this argument, (Harris & Feeny, 2000, 2003; Janssen, 2005; Feeny *et al.*, 2006; Chen *et al.*, 2010) have found such a positive relation between ETRs and debt. On the other hand, (Kim & Limpaphayom, 1998; Wilkinson *et al.*, 2001) do not find any significant relation between debt and ETR.

Finally, (Fernandez-Rodriguez & Martinez-Arias, 2011; Delgado *et al.*, 2012) find a nonlinear relation between debt and ETR.

Asset Composition and Effective Tax Rate

The composition of assets can have a clear effect on the ETR supported by companies, in particular through the non-current assets permitting companies to deduct the expenses derived from amortization in all fiscal regimes. Therefore, companies with high fixed assets should bear lower fiscal pressure that those with less fixed assets.

Empirical evidence exists showing that a greater proportion of depreciable non-current assets is associated

with lower ETRs. Thus, (Stickney & McGee, 1982; Gupta & Newberry, 1997; Derashid & Zhang, 2003; Calve-Perez *et al.*, 2005; Janssen, 2005; Richardson & Lanis, 2007; Chen *et al.*, 2010; Rohaya *et al.*, 2010; Fonseca Diaz *et al.*, 2011) all find an inverse relation between intensity of the capital and fiscal pressure.

On the other hand, (Janssen & Buijink, 2000; Wilkinson *et al.*, 2001; Plesko, 2003; Feeny *et al.*, 2006; Wu *et al.*, 2012) find a direct relation between capital intensity and tax burden, whereas still other studies do not find any significant relation between these variables (Harris & Fenny, 2000; Fernandez-Rodriguez, 2004; Liu & Cao, 2007). Again, Fernandez-Rodriguez & Martinez-Arias, 2011; Delgado *et al.*, 2012) find a nonlinear relation between intensity of the capital and fiscal pressure.

Moreover, when we consider the relation between ETR and managerial assets we must bear in mind that the structure of economic capital is subordinate to the sector of activity, so that the possibility of obtaining lowers ETRs will be determined by the volume of current assets that companies need to carry out the activity, and in particular on the level of stock. From this perspective, investment in stock is considered to be an alternative employment of funds to non-current assets and consequently limits the possibilities of reducing the managerial ETR. Therefore, it might be considered that the intensity of inventory would lead to higher fiscal pressure.

However, the use of the stock as an explanatory variable of the ETR is not common in the previous literature. The only studies that have included this variable are (Gupta & Newberry, 1997; Fernandez, 2004; Richardson & Lanis, 2007; Rohaya *et al.*, 2010; Fernandez-Rodriguez & Martinez-Arias, 2011; Wu *et al.*, 2012), which all found a positive and significant relation, and (Derashid & Zhang, 2003), who did not find any significant relation.

Profitability of the Company and Effective Tax Rate

Profitability constitutes a determining factor of fiscal pressure since the most profitable companies pay taxes in every economic year. On the contrary, companies that make lower profits, or losses, pay less tax or, in the case of losses, do not pay taxes. In addition, the compensation for such losses implies paying lower taxes in the previous or the following years, as companies are compensated backwards or forwards. All this amounts to a benefit in terms of the tax burden for companies that incur losses.

The empirical evidence reveals a positive relation between profitability and ETR, as shown by the studies of (Stickney & McGee, 1982; Wilkie & Limberg, 1993; Gupta & Newberry, 1997; Plesko, 2003; Fernandez-Rodriguez, 2004; Calve-Perez *et al.*, 2005; Richardson & Lanis, 2007; Chen *et al.*, 2010; Fernandez-Rodriguez & Martinez-Arias, 2011; Delgado *et al.*, 2012; Wu *et al.*, 2012), which all find that the most profitable companies suffer a larger tax burden that those with lower profitability.

Nevertheless, in the concrete case of the studies centered on Malaysia (Derashid & Zhang, 2003; Rohaya *et al.*, 2008 & 2010) the results are the opposite, that is, the most profitable companies suffer less fiscal pressure. This

---

[3] *In these studies the strategy consisted of introducing the squared explanatory variables.*

is a consequence of the fiscal compensations granted by the government to the most efficient companies.

Finally, in the case of the Spanish financial institutions (Fonseca-Diaz *et al*., 2011) do not observe any significant effect of profitability on the ETR.

Methodology and Data

With the aim of capturing possible nonlinear effects of the explanatory variables depending on the ETR that the companies face, in this study quantile regression is used.[4] With the purpose of studying heterogeneous behavior at different levels of the dependent variable, this semiparametric approach, proposed initially by (Koenker & Basset, 1978), minimizes the deviations in absolute value with asymmetric weighting instead of minimizing the squares of the errors. In synthesis, the quantile regression is described as follows:

$$y_i = x_i'\beta_\theta + u_{\theta i} \qquad (1)$$

$$Quant_\theta(y_i|x_i) = \inf\left\{y : F_i(y|x) \geq \theta\right\} = x_i'\beta_\theta$$

$$Quant_\theta(u_{\theta i}|x_i) = 0$$

where $Quant_\theta(y_i/x_i)$ denotes the conditional quantile of y_i on the vector x_i. Hence the quantile θ $(0<\theta<1)$ solves the expression:

$$\min_\beta \frac{1}{n}\left\{\sum_{i:y_i \geq x_i\beta}\theta|y_i - x_i\beta| + \sum_{i:y_i < x_i\beta}(1-\theta)|y_i - x_i\beta|\right\}$$

$$(2)$$

In the quantile estimations all the observations are used and the coefficients are estimated iteratively by linear programming at the different points of the distribution. As such, the estimator is more efficient than that of OLS when the distribution of the errors is increasingly non-normal (Buchinsky, 1998).

The information has been obtained from the database Compustat and corresponds to non-financial listed companies in the EU15[5] during the period 1992–2009, comprising a total of 28,416 observations. The estimations have been obtained with the software Stata.

The variables used in the study are the following:

- ETR: the dependent variable, defined as the ratio of the current expenditure on corporate tax to the accounting result before taxes. As in previous studies, we have not considered the observation when either of the two components is negative.
- SIZE: the size of the company, measured as the logarithm of total assets.
- LEV: the leverage, defined as the ratio of total debt to total assets.

- CAPINT: the capital intensity, defined as the ratio of tangible assets to total assets.
- INVINT: the inventory intensity, measured as the ratio of investment in inventories to total assets.
- ROA (Return on Assets): the ratio of earnings before income tax to total assets.
- RATE: the statutory corporate tax rate in every country for each year.

In addition, we have included dummies for countries, years and sectors. For the sectors we have availed of the Standard Industrial Classification (SIC), dropping the financial sector (including Finance, Insurance, and Real Estate) and disaggregating the manufacturing and services sectors in light of the vast number of companies in those sectors. This disaggregation has been carried out in both cases using the second-level SIC codes. Concretely, we have considered the following sectors:

1. *Agriculture, Forestry, Fishing;*
2. *Mining;*
3. *Construction;*
4. *Manufacturing I;*
5. *Manufacturing II;*
6. *Transportation, Communication, Electric, Gas, and Sanitary Services;*
7. *Wholesale Trade;*
8. *Retail Trade;*
9. *Services I ;*
10. *Services II ;*
11. *Nonclassifiable Establishments.*

In Table 3 we present the descriptive statistics and the correlation matrix, where it can be seen that all correlations are significant. It should be also noted the gap between the effective and the statutory tax rates, 5,5 percentage points on average, showing the relative importance of the tax incentives to companies in the European countries.

Results

The main results of the quantile estimations are summarized in Table 4[6] alongside the OLS results, where the latter can be considered as a benchmark that can be interpreted as the average of the distribution. To facilitate the interpretation of the results, we have represented the coefficients by quantiles in Figure 1, with the 95 % confidence intervals (discontinuous lines) in order to illustrate the variability in each case in comparison to the estimation by OLS (straight lines).

As stated previously, quantile regression allows for different effects of the explanatory variables at different points of the distribution of the ETR of the companies, and this approach is appropriate in the presence of outliers, heteroscedasticity or structural changes. It can be observed how in all cases the results confirm the nonlinearities detected in previous studies in other contexts, such as (Fernandez-Rodriguez & Martinez-Arias, 2011; Delgado *et al*., 2012; Hsieh, 2012), although only the latter study employs the quantile approach.

---

[4] *In another related context, an interesting study is that of (Fattouh et al., 2008) who use this technique to capture nonlinear relations between the debts of English companies and the determining factors. See (Buchinsky, 1998; Koenker & Hallock, 2011) for a general vision of the econometric methodology.*

[5] *We have decided to work with the EU-15 for different reasons. Firstly, this group fits well with the period analyzed; secondly, there is greater availability and quality of information for these countries compared to the rest; and finally, the sample is more homogeneous since the newer members of the EU generally have a lower ETR than the rest.*

[6] *Besides quantile regression by deciles, we have also estimated by quartiles (0,25; 0,5; 0,75), with similar results.*

Table 3

Descriptive statistics and correlations

a) Descriptive statistics

	Mean	Standard deviation	Minimum	Maximum
ETR	0,2815	0,170	0,000	1,000
SIZE	5,5740	2,328	-6,215	12,712
LEV	0,5378	0,203	0,000	1,000
CAPINT	0,2625	0,216	0,000	1,000
INVINT	0,1309	0,135	0,000	0,959
ROA	0,0547	0,270	-22,636	2,310
RATE	0,3361	0,070	0,125	0,597

b) Correlation matrix

	ETR	SIZE	LEV	CAPINT	INVINT	ROA	RATE
ETR	1						
SIZE	0,243***	1					
LEV	0,233***	0,358***	1				
CAPINT	0,042***	0,277***	0,112***	1			
INVINT	0,137***	0,029***	0,136***	-0,104***	1		
ROA	0,213***	0,185***	0,055***	0,044***	0,089***	1	
RATE	0,270***	0,074***	0,149***	0,024***	0,111***	0,051***	1

***, **, * denotes statistical significance at the 1 %, 5 % and 10 % levels, respectively.
Source: Compustat and own elaboration.

Going into more detail, the coefficients of the size variable - which is the most commonly analyzed in studies of the determinants of the ETR - are significant and positive, supporting the political costs hypothesis though in an unequal way along the sample. In particular, the coefficient falls as we move along the ETR, taking higher values for the first quantiles of the distribution and then remaining practically constant for the latter deciles. Thus, the effect of size on the ETR is 20 times larger in the first decile than in the ninth one. In addition it should be noted that the confidence intervals estimated for the size variable are very narrow, only widening in the case of the last decile of the distribution.

In the case of the debt variable, the coefficients turn out to be significant and positive, though with a path very different from the size variable. In concrete, the effect is increasing for the first and last sections of the distribution, while being almost constant in the intermediate part. In comparative terms, the coefficient of the last decile is eight times larger than that of the first one, highlighting a much more intense effect of debt in companies with the highest ETR. These results are in line with the theoretical arguments supporting a positive relation between ETR and debt for the companies with high rates of fiscal pressure in the sense that they can have greater incentives to finance themselves through debt in order to reduce the effective rates.

Table 4

Quantile regression estimations

Variable	OLS	Quantiles								
		0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
SIZE	0,01195 ***	0,02095 ***	0,01653 ***	0,01120 ***	0,00731 ***	0,00508 ***	0,00381 ***	0,00347 ***	0,00294 ***	0,00322 ***
	(0,0005)	(0,0007)	(0,0007)	(0,0005)	(0,0004)	(0,0003)	(0,0003)	(0,0003)	(0,0004)	(0,0008)
LEV	0,09078 ***	0,02553 ***	0,05951 ***	0,07805 ***	0,08421 ***	0,07483 ***	0,07257 ***	0,07350 ***	0,08536 ***	0,14529 ***
	(0,0051)	(0,0079)	(0,0079)	(0,0056)	(0,0046)	(0,0037)	(0,0033)	(0,0038)	(0,0044)	(0,0094)
CAPINT	0,01455 ***	-0,00403	0,00414	0,02727 ***	0,03640 ***	0,03440 ***	0,02590 ***	0,02087 ***	0,01219 ***	-0,00031
	(0,0048)	(0,0073)	(0,0073)	(0,0052)	(0,0044)	(0,0035)	(0,0032)	(0,0036)	(0,0042)	(0,0086)
INVINT	0,09336 ***	0,12790 ***	0,13614 ***	0,11339 ***	0,09200 ***	0,06772 ***	0,04363 ***	0,03339 ***	0,01307*	-0,02184
	(0,0082)	(0,0132)	(0,0132)	(0,0093)	(0,0076)	(0,0059)	(0,0053)	(0,0059)	(0,0068)	(0,0136)
ROA	0,09205 ***	0,16203 ***	0,28190 ***	0,31397 ***	0,29107 ***	0,24737 ***	0,19424 ***	0,14465 ***	0,06918 ***	0,01409 ***
	(0,0034)	(0,0030)	(0,0033)	(0,0027)	(0,0136)	(0,0025)	(0,0026)	(0,0034)	(0,0046)	(0,0025)
RATE	0,39736 ***	0,08888 ***	0,25468 ***	0,36027 ***	0,44259 ***	0,48418 ***	0,55676 ***	0,57624 ***	0,57452 ***	0,46553 ***
	(0,0191)	(0,0247)	(0,0267)	(0,0198)	(0,0171)	(0,0138)	(0,0127)	(0,0142)	(0,0166)	(0,0337)

***, **, * denote statistical significance at the 1 %, 5 % and 10 % levels, respectively.
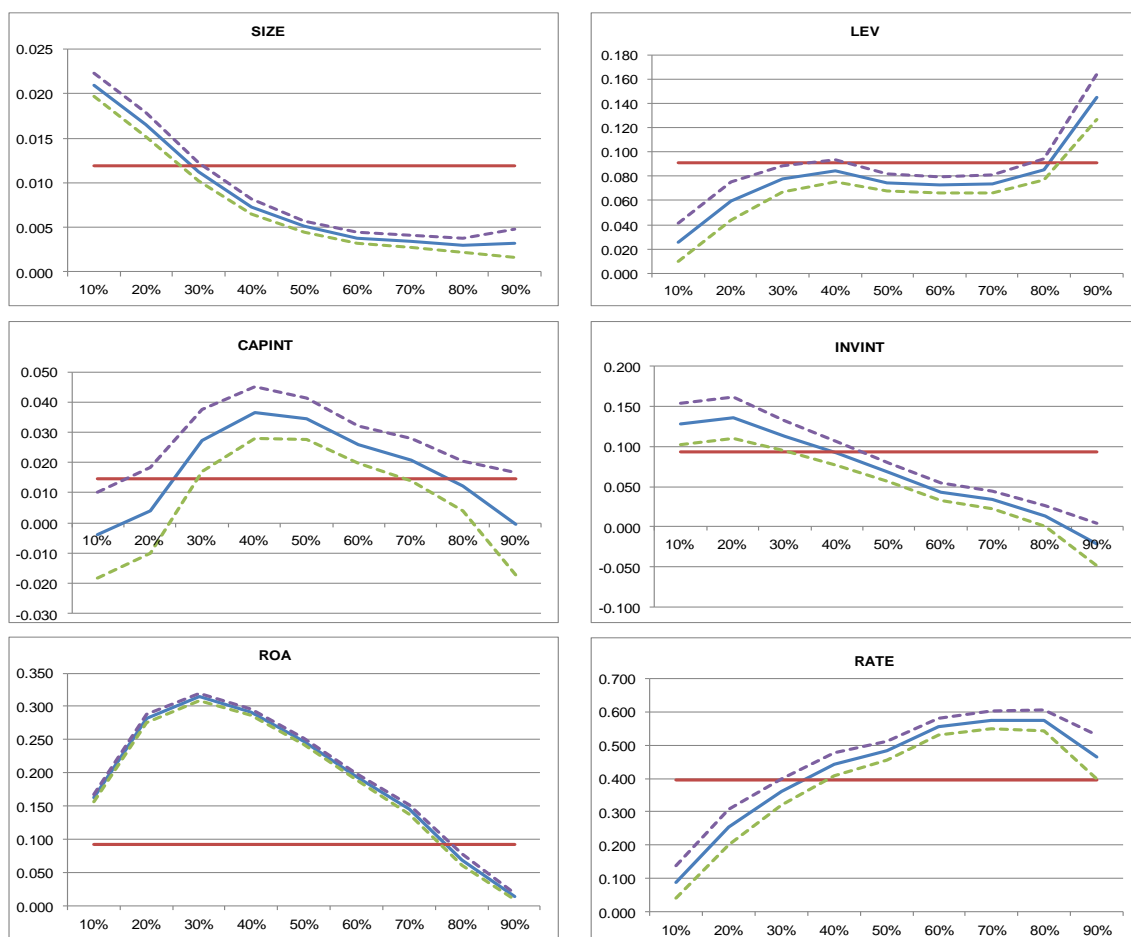*Standard errors in parenthesis.*

Figure 1. Estimates by quantiles

Regarding capital intensity, the coefficients are for the most part positive and significant, except in the first and last deciles when the sign is negative but not significant. Therefore, in most cases we observe a positive influence of the asset composition (i.e., capital intensity) on the effective tax rate, with the relationship being more intense in the central part of the distribution.

The results corresponding to inventory and profitability are very similar, as both are positive and significant with an initially ascending path which then turns and falls rapidly, practically falling to zero in the last decile. Thus, for companies with the highest ETRs, the effect of inventory is eliminated and that of profitability is greatly reduced.

Lastly, the estimates associated with the nominal rate are as expected for this control variable. In short, for companies with lower ETRs, the most influential variables are the size, the intensity of inventories and the profitability, whereas for the companies that suffer the highest fiscal pressure it is debt that turns out to be the strongest determinant.

Comparing with the only available study to date using quantile regressions, namely (Hsieh, 2012) for companies listed in China, we observe similar nonlinearity for all the analyzed variables. However, the results only coincide in their entirety for the debt variable, since for size and capital intensity (Hsieh, 2012) finds opposite signs.

Concluding Remarks

Corporate Tax is an important figure in the European tax system and its relevance goes beyond collection capacity. On one hand, corporate tax is able to affect market unity, and on the other it affects certain strategic decisions of the companies. In recent years there has been a gradual decrease in statutory tax rates, though European efforts at harmonizing this tax have centered on the project of the consolidated common tax base, leaving Member States freedom to establish the tax rates in spite of the marked differences that exist at present.

In this study we analyse the determining factors of the effective tax rates of non-financial listed companies in the EU-15 countries. As such relations may be nonlinear, we employ the quantile regression approach. Concretely, we carry out quantile regression by deciles, which allows different coefficients to be estimated at different points of the distribution of the effective tax rate in contrast to the linearity of the OLS approach traditionally used in these studies.

Regarding the literature review, it should be noted that there is more or less a consensus with regard to the principal explanatory variables of the ETR: these are size, debt, composition of the assets, and profitability. However, the results are not conclusive, especially for the variables size, the debt or the capital intensity, and this may be partially

caused by the existence of a nonlinear connection. These previous mixed results found in the literature justify the nonlinear technique employed here.

Effectively, our results confirm the existence of a relation that varies depending on the decile of the conditional distribution. Thus, the OLS estimates used as benchmarks and the quantile results differ significantly, with the latter showing differentiated, nonlinear effects.

With more detail, regarding the size of the companies, a major aim within this literature, the coefficient is significant and positive for all quantiles but the effect clearly diminishes along the distribution, being 20 times higher for the 10 % of companies with lower average rates than for those in the last decile. Thus, between the two conflicting theoretical views on the relationship of size and effective tax rate, our results support the political costs hypothesis in line with (Watts & Zimmerman, 1978) instead of the political power theory started by (Siegfried, 1974) though in an unequal manner along the analyzed sample. As stated above, the empirical evidence is also mixed and hence this result contributes to the existent discussion.

In the case of debt, the coefficient is also positive and significant but is again clearly nonlinear, increasing in the first and last sections of the distribution of rates. These results are in line with the theoretical arguments supporting a positive relation between ETR and debt for the companies with high rates of fiscal pressure in the sense that they can have greater incentives to finance themselves through debt in order to reduce the effective rates. With regard to capital intensity, the relation by deciles is represented by an inverted U-shaped curve, with positive values along most of the distribution but with insignificant coefficients in both the first and last deciles. Thus, for the companies with

the lowest and highest effective tax rates, capital intensity does not seem to be relevant as a determinant factor.

Inventory intensity turns out to be significant with positive coefficients, though these diminish along the distribution to the point of becoming non-significant in the last decile. The effect of profitability is similar, with positive coefficients which increase over the first deciles but then fall along the rest of the distribution.

Overall, the results obtained in this study highlight the sensitivity of the determining factors of the corporate effective tax rates to the particular level of the tax rate. More concretely, for companies with lower ETRs, the most influential variables are size, inventory intensity and profitability, whereas for the companies with the highest fiscal pressure the debt is the most important determining factor. Our results clearly justify the employment of quantile regressions instead of the classic linear approach.

These results are useful for tax policy-makers to improve the design and effects of the Corporate Tax in Europe, as this figure is subject to an important corporation tax planning with impact on the revenue collection and also in the tax competition within Europe in the increasingly globalized context. Some countries use this tax to attract investment and harmful tax competition can emerge. Finally, as future extensions of this research, it would be interesting to replicate the study in the future with information regarding the reforms approved in these last years as consequence of the long economic crisis. It would be also useful to perform a more disaggregated study to analyze the behaviour of the main sectors of the economy and hence to discover different sectoral patterns.

References

Albi, E. (2010). Impuesto sobre Sociedades: la investigacion economica y los criterios para su reforma en España. Document 13/10, Instituto de Estudios Fiscales, Madrid.

Auerbach, A. (2006). The future of capital income taxation. *Fiscal Studies,* 27, 399–420. http://dx.doi.org/10.1111/j.1475-5890.2006.00040.x

Bauman, Ch., & Schadewald, M. (2001). Impact of foreign operations on reported effective tax rates: Interplay of foreign taxes, U.S. taxes and U.S. GAAP. *Journal of International Accounting, Auditing and Taxation,* 10, 177–196. http://dx.doi.org/10.1016/S1061-9518(01)00043-X

Buchinsky, M. (1998). Recent advances in quantile regression models: a practical guideline for empirical research. *Journal of Human Resources,* 33(1), 88–126. http://dx.doi.org/10.2307/146316

Buijink, W., Janssen, B., & Schols Y. (2002). Evidence of the effect of domicile on corporate average effective tax rates in the European Union. *Journal of International Accounting, Auditing and Taxation*, 11, 115–130. http://dx.doi.org/10.1016/S1061-9518(02)00069-1

Calve-Perez, J. I., Labatut-Serer, G., & Molina-Llopis, R. (2005). Variables economico-financieras que inciden sobre la presion fiscal soportada por las empresas de reducida dimension: efectos de la reforma fiscal de 1995 en las empresas de la Comunidad Valenciana. *Spanish Journal of Finance and Accounting*, 127, 875–897.

Chen, S., Chen, X., Cheng, T., & Shevlin, T.J. (2010). Are family firms more tax aggressive than non-family firms? *Journal of Financial Economics*, 95, 41–61. http://dx.doi.org/10.1016/j.jfineco.2009.02.003

Clausing, K. (2007). Corporate tax revenues in OECD countries. *International Tax and Public Finance*, 14, 115–133. http://dx.doi.org/10.1007/s10797-006-7983-2

Collins, J. H., & Shackelford, D. A. (1995). Corporate domicile and average effective tax rates: the cases of Canada, Japan, the United Kingdom and the United States. *International Tax and Public Finance*, 2, 55–83. http://dx.doi.org/10.1007/BF00873107

Cuenca-Garcia, E., Navarro-Pabsdorf, M, & Mihi-Ramirez, A. (2013). Fiscal harmonization and economic integration in the European Union. *Inzinerine Ekonomika-Engineering Economics* 24(1), 44–51.

Delgado, F. J., Fernandez-Rodriguez, E., & Martinez-Arias, A. (2012). Size and other determinants of corporate effective tax rates in US listed companies. *International Research Journal of Finance and Economics*, 98, 160–165.

Derashid, C., & Zhang, H. (2003). Effective tax rates and the "industrial policy" hypothesis: evidence from Malaysia. *Journal of International Accounting, Auditing & Taxation*, 12, 45–62. http://dx.doi.org/10.1016/S1061-9518 (03)00003-X

Devereux, M. P. (2006). Developments in the taxation of corporate profit in the OCDE since 1965: rates, bases and revenues. Conference of the Alliance for Competitive Taxation, June.

Devereux, M. P., Griffith, R., & Klemm, A. (2004). Why has the UK corporation tax raised so much revenue?. *Fiscal Studies*, 25, 367–388. http://dx.doi.org/10.1111/j.1475-5890.2004.tb00543.x

European Commission (2011). Proposal for a COUNCIL DIRECTIVE on a Common Consolidated Corporate Tax Base (CCCTB) 2011/0058 (CNS). Available from internet: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri= COM:2011 :0121:FIN:EN:PDF).

European Commission (2012). Taxation trends in the European Union, Eurostat. Available from internet: http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/tax_structures/index_en.htm).

Fattouh, B., Harris, L., & Scaramozzino, P. (2008). Non-linearity in the determinants of capital structure: evidence from UK firms. *Empirical Economics*, 34(3), 417–438. http://dx.doi.org/10.1007/s00181-007-0128-3

Feeny, S., Gillman, M., & Harris, M. N. (2006). Econometric accounting of the Australian corporate tax rates: a firm panel example. *Accounting Research Journal*, 19, 64–73.

Fernandez-Rodriguez, E. (2004). Los factores condicionantes de la presion fiscal empresarial española a partir de la informacion contable. Especial mencion a las decisiones financieras. *Spanish Journal of Finance and Accounting*, 120, 125–159.

Fernandez-Rodriguez, E., & Martinez-Arias, A. (2011). Determinants of effective tax rate: evidence for USA and the UE. *Intertax,* 39, 381–395.

Fonseca-Diaz, A. R., Fernandez-Rodriguez, E., & Martinez-Arias, A. (2011). Factores condicionantes de la presion fiscal de las entidades de crédito espanolas, ¿existen diferencias entre bancos y cajas de ahorros?. *Spanish Journal of Finance and Accounting*, 151, 491–516.

Government Accountability Office (GAO) (2008). Effective tax rates are correlated with where income is reported, Report to the Committee on Finance U.S. Senate, GAO-08-950, August, United States. Available from internet: http://www.gao. gov/new.items/d08950.pdf).

Gropp, R. E. (1997). The effect of expected effective corporate tax rates on incremental financing decisions. International Monetary Fund, *IMF Staff Papers*, 44, 485–509. http://dx.doi.org/10.2307/3867463

Gupta, S., & Newberry, K. (1997). Determinants of the variability in corporate effective tax rates: evidence from longitudinal data. *Journal of Accounting and Public Policy*, 16, 1–34. http://dx.doi.org/10.1016/S0278-4254(96) 00055-5

Harris, M., & Feeny, S. (2003). Habit persistence in corporate effective tax rates. *Applied Economics*, 35, 951–958. http://dx.doi.org/10.1080/0003684032000050577

Holland, K. (1998). Accounting policy choice: the relationship between corporate tax burdens and the company size. *Journal of Business Finance and Accounting*, 25(3-4), 265–288. http://dx.doi.org/10.1111/1468-5957.00187

Hsieh, Y. C. (2012). New evidence on determinants of corporate effective tax rates. *African Journal of Business Management*, 6(3), 1177–1180.

Huang, D. F, Chen, N. Y, & Gao, K. W. (2013). The tax burden of listed companies in China. *Applied Financial Economics*, 23(14), 1169–1183. http://dx.doi.org/10.1080/09603107.2013.786163

Janssen, B., & Buijink, W. (2000). Determinants of the variability of corporate effective tax rates (ETRs): Evidence for the Netherlands. MARC Working Paper, WP/3/2000-08, Universiteit Maastricht, the Netherlands.

Kim, K.A., & Limpaphayom, P. (1998). Taxes and firm size in Pacific-Basin emerging economies. *Journal of International Accounting, Auditing & Taxation*, 7, 47–68. http://dx.doi.org/10.1016/S1061-9518(98)90005-2

Koenker, R., & Basset, G. (1978). Regression quantiles. *Econometrica*, 46, 33–50. http://dx.doi.org/10.2307/1913643

Koenker, R., & Hallock, K. (2001). Quantile regression. An introduction. *Journal of Economic Perspectives*, 15(4), 143–156. http://dx.doi.org/10.1257/jep.15.4.143

KPMG (2011). Corporate and Indirect Tax Rate Survey 2011. Available from internet: http://www.kpmg.com/MY/en/ IssuesAndInsights/ ArticlesPublications/Documents/2011/corporate-indirect-tax-rate-survey-2011.pdf).

KPMG (2012). Corporate and Indirect Tax Rate Survey 2012. Available from internet: http://www.kpmg.com/MY/ en/IssuesAndInsights/ArticlesPublications/Documents/2012/corporate-indirect-tax-rate-survey-2012.pdf).

Liu, X., & Cao, S. (2007). Determinants of corporate effective tax rates. Evidence from listed companies in China. *The Chinese Economy*, 40, 49–67. http://dx.doi.org/10.2753/CES1097-1475400603

Manzon, G. B., & Smith, W. R. (1994). The effect of the economic recovery tax act of 1981 and the tax reform act of 1986 on the distribution of effective tax rates. *Journal of Accounting and Public Policy*, 13, 349–362. http://dx.doi.org/10.1016/0278-4254(94)90004-3

Mills, L., Erickson, M. M., & Maydew, E. L. (1998). Investments in tax planning. *The Journal of the American Taxation Association,* 20, 1–20.

Modigliani, F., & Miller, M. (1963). Taxes and the cost of capital: a correction. *American Economic Review*, 53, 433-443.

Molloy, K. H. (1998). An approach for comparing U.S. and Japanese effective corporate tax rates. *Journal International Accounting, Auditing & Taxation,* 7(1), 69–80. http://dx.doi.org/10.1016/S1061-9518(98)90006-4

Mooij, R., & Nicodeme, G. (2008). Corporate tax policy and incorporation in the EU. *International Tax and Public Finance*, 15, 478–498. http://dx.doi.org/10.1007/s10797-008-9072-1

Omer, T. C., Molloy, K., & Ziebart, D. (1993). An investigation of the firm size–effective tax rate relation in the 1980s, *Journal of Accounting, Auditing and Finance*, 8, 167-182.

Plesko, G. A. (2003). An evaluation of alternative measures of corporate tax rates. *Journal of Accounting and Economics*, 35, 201–226. http://dx.doi.org/10.1016/S0165-4101(03)00019-3

Paredes-Gomez, R. (2012). Reflexiones sobre la reforma del impuesto sobre sociedades en tiempos de crisis. *Cronica Tributaria*, 142, 95-111.

Porcano, T. M. (1986). Corporate tax rates: progressive, proportional or regressive. *The Journal of the American Taxation Association*, 7, 17-31.

Richardson, G., & Lanis, R. (2007). Determinants of the variability in corporate effective tax rates and tax reform: Evidence from Australia. *Journal of Accounting and Public Policy*, 26, 689–704. http://dx.doi.org/10.1016/j.jaccpubpol.2007.10.003

Rohaya, M. N., Norazam, M., & Barjoyai, B. (2008). Corporate effective tax rates: A study on Malaysian public listed companies. *Malaysian Accounting Review*, 7(1), 1–20.

Rohaya, M. N., Nur, S. M. F., & NorAzam, M. (2010). Corporate tax planning: a study on corporate effective tax rates of Malaysian listed companies. *International Journal of Trade, Economics and Finance,* 1(2), 189–193. http://dx.doi.org/10.7763/IJTEF.2010.V1.34

Sanz-Gadea, E. (2011). El Impuesto sobre Sociedades. ¿Un impuesto en crisis? *Cronica Tributaria*, 141,179–209.

Siegfried, J. J. (1974). Effective average US corporation income tax rates. *National Tax Journal*, 27(2), 245–259.

Slemrod, J. (2004). Are corporate tax rates, or countries, converging? *Journal of Public Economics*, 88, 1169–1186. http://dx.doi.org/10.1016/S0047-2727(03)00061-6

Sorensen, P. B. (2007). Can capital income taxes survive? and should they? *CESifo Economic Estudies,* 53(2), 172–228. http://dx.doi.org/10.1093/cesifo/ifm010

Stickney, C. P., & McGee, V. E. (1982). Effective corporate tax rates. The effect of size, capital intensity, leverage, and other factors. *Journal of Accounting and Public Policy*, 1, 125–152. http://dx.doi.org/10.1016/S0278-4254(82)80004-5

Wang, S. (1991). The relation between firm size and effective tax rates: a test of firms` political success. *The Accounting Review*, 66, 158–169.

Watts, R. L., & Zimmerman, J. L. (1978). Towards a positive theory of the determination of accounting standards. *The Accounting Review,* 53(1), 112–134.

Wilkie, P. J., & Limberg, S. (1993). Measuring explicit tax (dis) advantage for corporate taxpayers: An alternative to average effective tax rates. *The Journal of the American Taxation Association*, 15(1), 46–71.

Wilkinson, B., Cahan, S., & Jones, G. (2001). Strategies and dividend imputation: the effect of foreign and domestic ownership on average effective tax rate. *Journal of International Accounting, Auditing & Taxation*. 10, 157–175. http://dx.doi.org/10.1016/S1061-9518(01)00042-8

Wu, L., Wang, Y., Luo, W., & Gillis, P. (2012). State ownership, tax status and size effect of effective tax rate in China. *Accounting and Business Research*, 42(2), 97–114. http://dx.doi.org/10.1080/00014788.2012.628208

Zimmerman, J. L. (1983). Taxes and firm size. *Journal of Accounting and Economics*, 5(2), 119–149. http://dx.doi.org/10.1016/0165-4101(83)90008-3