CYCLICAL TAX ENFORCEMENT

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ABSTRACT

We investigate the impact of the economic cycle on tax enforcement. With this aim, we sketch a theoretical model based on Andreoni (1992) to raise our main hypotheses: the presence of financial constraints faced by taxpayers can play a crucial role in defining the optimal tax enforcement response to an economic shock. In particular, in absence of severe financial constraints, tax administration finds it optimal to set tax enforcement in a counter-cyclical way (i.e., more stringent), while when taxpayers face a severe financial downturn, pro-cyclicity cannot be ruled-out. We test these hypotheses by means of ordered response models applied to Spanish survey data and find results that are coherent with theory. Tax enforcement is cyclical: presents a prevailing counter-cyclical trend, but in presence of severe economic crisis turns out to be pro-cyclical.

Keywords: tax enforcement, tax compliance, audit perception, economic cycle
JEL Classification: D78, H12, H26, H83

ACKNOWLEDGMENTS: We are grateful to Umberto Galmarini, Amedeo Piolatto, and to Adam Spencer for their helpful comments. We would also like to thank participants at the seminar of the Department of Economics of the University of Ferrara; XXVI Conference of the Spanish Public Economics Society (University of Oviedo), 5th TARC Workshop on Tax Administration (University of Exeter) and XXVIII SIEP Conference (University of Lecce) for their useful comments. The authors acknowledge funding from the Instituto de Estudios Fiscales (Ministerio de Hacienda), financial support from the Ministerio de Economía y Competitividad/FEDER (ECO2015- 63591-R). Durán-Cabré and Esteller-Moré also acknowledge funding from the project 2017SGR796 (Generalitat de Catalunya). The usual disclaimer applies.

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1. Introduction

The economic downturn associated with the global financial crisis caused an important fall in tax revenues in many countries. In advanced economies, fiscal deficit increased by 2.5% of GDP in 2008 and by about 5% in 2009, provoking serious concern about the need to lower substantially their deficits to be able to control their debt-to-GDP ratios (IMF, 2010). Between 2008 and 2013, quite a few countries augmented the VAT rates (e.g. 19 out of the 28 EU countries raised the general rate, with an average increase of 3 percentage points) and even some increased their top marginal rates of the income tax (e.g. 13 out of the 28 EU, with an average increase of about 6 percentage points). But given the multidimensional nature of tax systems, tax enforcement is another tax parameter in hands of the public sector – through its tax administration – to collect more revenues (Slemrod and Gilitzer, 2014). In other words, tax enforcement and the fight against tax evasion were to play a crucial role in many countries during the crisis[1].

Furthermore, the effects of the crisis on low and middle-class income also caused an increasing concern about the unfair distribution of the tax burden, particularly related with evasion and avoidance practices of multinationals and wealthy taxpayers very often through tax havens. The G20 declared the "end of bank secrecy" in April 2009 and the OECD established the Global Forum on Transparency and Exchange of Information for Tax Purposes (Global Forum), charged with monitoring the implementation of the tax transparency standard for exchange of information "on request". In 2013, responding to a G20 call to take the next step in tax transparency, the OECD developed the single Common Reporting Standard (CRS) for the automatic exchange of financial account information. As indicated in an article at *The Economist*, "governments once turned a blind eye to their wealthy citizens' offshore tax acrobatics. Now they are strapped for cash and hungrily hunt every penny in tax revenue"[2]. In

[1] Analyzing the finances of the southern European countries, *The Economist* indicated "Now that these countries are trying to get their finances in order, bringing down rates of tax evasion is a high priority" (Aug 12th, 2010). Between 2010 and 2012, the annual Eurostat publication *Taxation Trends in the European Union* indicates that southern European countries (e.g. Greece, Italy, Portugal, Spain) but also other European governments (e.g. Belgium, Bulgaria, Norway) introduced changes in the administration of taxes in order to fight against tax evasion and raise revenues.

[2] Feb 11th, 2012.

conclusion, the role to be played by tax administrations has acquired even more significance during the economic downturn.

However, with worsening economic situation and financial credit almost unavailable, tax administrations face growing compliance risks. As Brondolo (2009) indicates, under a recession, on the one hand, taxpayers may perceive the tax administration to be less stringent in enforcing taxes, as may have some positive effects on the economy. On the other hand, credit-constrained taxpayers may be tempted to use tax evasion as an alternative source of finance, as they may perceive the risks of tax evasion (penalties) much smaller than the potential gains (avoiding bankruptcy). Regarding taxpayers' behaviour, in a recent paper, Alm *et al*. (2019) analyse whether the financial constraints faced by a firm increase the extent of firm tax evasion and, working with a survey of firms from 27 transitional countries, find evidence that more financially constrained firms are more likely to be involved in tax evasion activities.

This idea was analysed by Andreoni (1992) for individuals in a theoretical model in which the tax administration could act as a last-resort lender ("the tax agency as a loan shark"). In our paper we sketch a theoretical framework based on that model, and show that when taxpayers face binding financial constraints, they may consider evading taxes as this is their only option to intertemporally smooth consumption. They would do so even if evasion were not a fair gamble, that is, regardless the expected return from evasion was negative. Only severely financial constrained taxpayers would act like this, something very relevant at the aggregate level in times of crisis. But from the tax administration perspective, we show that, as long as it internalizes this potential behaviour, its best strategy – in particular, to be more (counter-cyclical) or less (such that it could even be pro-cyclical) stringent in promoting tax enforcement during an economic downturn – depends on its objective function and may vary along the economic cycle.

We test for the Spanish case whether the tax administration's performance follows this theoretical setting. We do so by means of ordered response models applied to data extracted from repeated surveys and other sources. In general, we find results that are coherent with theory. In particular, tax enforcement presents a prevailing counter-cyclical trend, but in presence of severe economic downturns even turns out to be pro-cyclical. Hence, tax enforcement is sensitive to the state of the economy. This is the main contribution of this paper.

The role of tax evasion as a substitute for loans is also analysed by Fishlow and Friedman (1994), in a paper where they focus on the public resort of tax evasion in developing countries. They use a theoretical model of intertemporal consumption that characterizes the behaviour of taxpayers in a financially constrained economy and show that negative shocks over current income raise evasion. The agents use evasion to substitute for loans in economies where credit is not available.

The seminal paper by Allingham and Sandmo (1972) introduced evasion as a choice in the modern theory of taxation and analysed what affects people's choice. In their model, a risk-averse taxpayer chooses to report a share of her actual income to tax authorities by maximizing her expected utility. Hence, similarly to a gamble, she has the choice of whether and how much to evade, and her payoff will depend on the probability of being investigated and on the penalty rate. For a risk adverse taxpayer, there will be a given amount of evasion at the optimum as long as she faces a fair gamble, that is, the expected gain from evasion is positive. However, under financial constraints, as we will see, that is not a necessary condition to have evasion at the optimum; in other words, evasion can become an unfair gamble (Andreoni, 1992). That seminal paper fostered a vast literature on the determinants of tax administration policies.

The most common approach sees tax administration as a public agency whose aim is maximizing tax revenues given a certain budget (e.g. Shaw et al., 2009; Slemrod and Yitzhaki, 2002, 1987). But, as we said before, tax enforcement policies carried out by the tax administration might be linked to the economic cycle. Furthermore, recent empirical studies suggest that political as well as budgetary variables play a role in determining tax administration's enforcement efforts (see, for example, Young et al., 2001; Baretti et al., 2002; Esteller-Moré, 2005, 2011; Bönke et al., 2017).

Another strand of literature underlines the institutional capacity of countries to raise revenues, which includes an administration for the collection of taxes and the monitoring of tax compliance (Besley and Persson, 2009). From this perspective, tax administration should play a counter-cyclical role, that is, under a negative external shock (e.g. an economic downturn), tax enforcement should be reinforced. This idea seems to be confirmed in an empirical study by Chen (2017) for China: a revenue loss (in that case, the abolition of a local tax) was largely offset by tougher tax enforcement. However, the empirical literature is scarce, and the context caused by the economic downturn associated with the global financial crisis, with individuals and companies facing very important financial constraints, offers the opportunity to analyse more deeply the role of tax administration over the economic cycle[3].

The rest of the paper is organized as follows: section 2 develops a theoretical model to raise the main hypotheses concerning the impact of the economic cycle on tax enforcement; section 3 presents the empirical strategy we employ to test the main theoretical findings; section 4 presents the results of the empirical analysis, and section 5 concludes. Appendix 1 reports the results of robustness analyses.

2. Theoretical Framework

In order to identify the incentives of the tax administration along the economic cycle, we sketch a simple model based on Andreoni (1992). We will focus our analysis on a single representative individual, whose behaviour we explain next.

Individuals

Individuals live two periods, t = 1, 2. In period 1, they earn taxable income, W_1; the corresponding tax return might be audited in the future. In period 2, they get an untaxed bequest, W_2[4], which is known with certainty by individuals in period 1. Thus, the

[3] Almost 40% of the 49 revenue bodies analysed by the OECD, reported an increase in the aggregate value of their debt inventory over the years 2007 to 2009 exceeding 20%, and for 13 revenue bodies, this increase exceeded 40% (OECD, 2011). These are unpaid debts, that is, tax liabilities recognized by taxpayers but not paid. After 2009 peak, average tax debt levels decreased, but in 2011 it remained in excess of 20% of the average reported for 2007. The incidence varied enormously across countries and in eight OECD countries the level remained in 2011 over 50% their level in 2007 (OECD, 2013).

[4] To simplify we assume this bequest is untaxed (or if taxed, there is no possibility of evasion). This simplification is justified on the grounds that we just want to focus on the incentives to evade taxes (today) under the presence of liquidity constraints (today). We are not interested in dynamic models of tax evasion like Engel and Hines (1999) or Niepelt (2005).

financial benefits from evasion accrue in period 1, while the costs of evasion – if audited by the tax administration –accrue in period 2. Apart from the traditional incentive to evade based on a fair gamble (*i.e.*, the expected financial return from evasion is positive), this delay might create a peculiar financial incentive for individuals. This is due to a capital market imperfection because potential lenders do not know in advance about the existence of W_2 (as individuals do), and so in absence of other collaterals, evasion might be the only alternative that liquidity constrained individuals have to smooth consumption along time.

Analytically, X_1 is the amount of undeclared income in period 1 such that $X_1 = W_1 - W_1^r$, where W_1^r is the reported amount of taxable income. Hence, consumption in period 1 is $C_1 = W_1 - W_1^r \tau - S_1 = \bar{W} + \tau X_1 - S_1$, where S_1 is personal savings, τ is the personal income tax rate, and $\bar{W} = W_1(1-\tau)$ is net income under full tax compliance. Thus, tax evasion generates a virtual income for the taxpayer equal to τX_1. With a random probability, p, the evader might be audited in period 2, and then consumption is $C_2^A = W_2 + S_1 - (\tau + \gamma)X_1$, where γ is the fine per unit of evaded taxes and we assume the interest rate is equal to zero; otherwise, in absence of an audit, and with random probability $(1-p)$, $C_2^{NA} = W_2 + S_1$.

Intertemporal additively separable utility, U, is $u(C_1) + (1-p)u(C_2^{NA}) + pu(C_2^A)$, such that $u'' < 0 < u'$[5]. Therefore, ideally, the taxpayer would like to have a smooth path of consumption along time. However, this might not be guaranteed due to financial constraints, as lenders do not know in advance the existence of W_2. Under this framework, one of the following circumstances may arise:

Non-financially constrained situation: for a given $\bar{W}$, $W_2 \leq \bar{W}$. In this case, the analysis does not differ from the standard one, and so the taxpayer will evade if evasion is a fair gamble, that is, if the expected financial benefit, μ, such that $\mu := \tau - p(\tau + \gamma)$, is positive. Moreover, if $W_2 < \bar{W}$, $S_1 > 0$, and the taxpayer will save to smooth consumption between both periods.

[5] Partial derivates of functions of a single variable are indicated by a prime (as many primes, as the degree of the corresponding partial derivative).

Financially constrained situation: for a given $\overline{W}$, $W_2 > \overline{W}$. Since a situation where $S_1 < 0$ is not feasible due to the existence of asymmetric information between the financial sector and the taxpayer, and given the absence of another collateral, the taxpayer might find further incentives to evade apart from those due to the existence of a financial fair gamble. Recall the taxpayer would like to have a smooth path of consumption along time. This is the interesting situation to analyse: the behaviour of taxpayers under liquidity constraints, and the characterization of the corresponding optimal tax auditing policy.

In this regard, Andreoni (1992) showed that if individuals are financially constrained, they all will evade, but also save, as long as $\mu > 0$. Nevertheless, if $W_2$is above a given threshold, that is, if taxpayers are under *severe* financial constraints, they will evade even if $\mu < 0$, and then will not save (to evade even more). To understand these results, note that for a given value of savings, $\hat{S}_1$, and for $X_1 = 0$, a positive optimal level of evasion holds as long as the FOC of the taxpayer's intertemporal maximization problem with respect to X_1 is positive, that is, if

$$u'\left(\overline{W} - \hat{S}_1\right)\tau - pu'\left(W_2 + \hat{S}_1\right)(\tau + \gamma)\Big|_{X_1=0} > 0 \qquad [1]$$

The first term picks up the (current) marginal benefit of evading taxes, and the second one is picking up the expected (future) marginal cost of evasion. We define the marginal rate of substitution between current and future consumption, m, as $m := u'(C_1)/u'(C_2^A)$, where $m > 1$ under financial constraints when W_2 is above a given threshold. Then, rearranging expression [1], we have:

$$\mu > \tau(1 - m) \qquad [2]$$

Evading taxes ($X_1 > 0$) is optimal if [2] holds. For a given tax rate, the right-hand side of this latter inequality, which is negative, will be larger in absolute levels, the larger the marginal rate of substitution, m. Hence, even for $\mu < 0$, those severely constrained (large m) will find evading taxes to be welfare-enhancing; that is, the benefit of smoothing consumption overcomes the cost of an unfair gamble ($\mu < 0$). This is the peculiar incentive of evasion under financial constraints. In any case, independently of the severity of the taxpayer's financial constraint, it is clear that lower values of μ (including negative ones) are compatible with the existence of evasion with respect to a situation where taxpayers are not financially constrained[6].

In the next section, we will characterize the optimal tax enforcement policy when taxpayers are financially constrained. In order to stress the nature of tax enforcement policy within this context, we will assume the representative taxpayer is severely constrained such that at the optimum $S_1 = 0$, and the presence of evasion is compatible even with $\mu < 0$. For that analysis, we need some basic comparative static results. Specifically,

$$\frac{dX_1}{dp} < 0;\ \frac{dX_1}{dW_2} > 0 \qquad [3]$$

As expected, the greater the level of tax enforcement, the lower the level of tax evasion (Allingham and Sandmo, 1972), $\frac{dX_1}{dp} < 0$; and a larger bequest in period 2, which implies the taxpayer becomes more financially constrained in period 1, provokes higher levels of tax evasion, $\frac{dX_1}{dW_2} > 0$. All these results are derived from total differentiation of the FOC of the taxpayer's maximization problem with respect to X_1[7]. Recall we are assuming the taxpayer is risk averse, that is, $u'(C_i) > 0 > u''(C_i)$.

The Tax Administration

Optimal auditing policy under financial constraints is analysed by Andreoni (1992). In particular, he analyses with some detail the case when $\mu < 0$, which as we explained before might apply to a situation where taxpayers are severely financially constrained, and the tax administration maximizes tax revenue. We will also focus on this situation by formalizing the optimal tax enforcement policy, but under a welfare-oriented tax administration.

[6] We skip the proofs about the results regarding the optimal level of savings depending on the value of μ and on the financial constraints of the taxpayer. See Andreoni (1992), section 2.3.
[7] The full derivation of these total derivatives is available upon request from the authors.

According to the above context, the tax administration maximizes the taxpayer's indirect utility function, $V(X_1^*)$, subject to an intertemporal budget constraint, $W_1^r\tau + p(\tau+\gamma)(W_1 - W_1^r) = R$, where R is the exogenous target of public resources, and λ identifies the Lagrange multiplier, that is, the social marginal utility cost of public funds, which is strictly positive[8]. The FOC of this maximization problem is the following:

$$V(C_2^{NA}) - V(C_2^A) = \lambda\left\{(\tau+\gamma)X_1 - \frac{\partial X_1}{\partial p}[\tau - p(\tau+\gamma)]\right\} = \lambda\left\{(\tau+\gamma)X_1 - \frac{\partial X_1}{\partial p}\mu\right\} > 0 \qquad [4]$$

Andreoni focuses on a revenue-maximizing tax administration such that only considers the component of [4] in keys. With respect to that component, which is weighted by the shadow price of public funds, there is a marginal revenue gain from increasing p, $(\tau+\gamma)X_1$, but there may also be a cost, $\frac{\partial X_1}{\partial p}\mu$, given $\frac{\partial X_1}{\partial p} < 0$. If evasion is a fair gamble to the taxpayer, $\mu > 0$, the term $-\frac{\partial X_1}{\partial p}\mu$ will always be positive; then, a reduction of X_1 due to a higher level of tax enforcement will always increase tax revenue, and so in absence of administrative costs and of any other consideration, the optimal p would equal one. Otherwise, if evasion is an unfair gamble to the taxpayer, $\mu < 0$, the tax administration is not necessarily better-off – in terms of public revenues – being so strict in promoting tax enforcement; note this has to do with the procedure of revenue collection and not with the taxpayer's welfare.

However, in expression [4], the scale of the tax administration – measured by p – is also contingent on the taxpayer's welfare[9]. In particular, the welfare cost of increasing p is picked up by the difference between the net income when the (representative) taxpayer is not audited (less likely) and when she is audited (more likely now). Hence, with respect to a revenue maximizing tax administration, p will be smaller; we will come back to this below. All in all, the optimal level of tax enforcement equals the marginal cost (MC) of higher tax enforcement (left hand side) with the marginal benefit (MB) (right hand side) (see, for example, Slemrod and Gillitzer, 2014, Chapter 8).

[8] We abstract here from marginal costs of tax administration.

[9] On the optimal size of the tax administration, see Slemrod and Yitzhaki (1987).

The nature of the equilibrium is shown in Graph 1 below. From the SOC of expression [4], we can verify both functions, MB and MC are negatively sloped with respect to tax enforcement[10], p. Additionally, under the SOC, we have that $\partial MB/\partial p - \partial MC/\partial p < 0$, such that at the optimum the MB crosses the MC from above. This explains the shape of the functions in the graph. The optimal level of tax auditing is such that $MB = MC$.

[GRAPH 1 AROUND HERE]

In Andreoni (1992), for financially constrained individuals and a revenue-maximizing tax administration, the optimal μ is negative. In our more general context where the tax administration also considers the impact of tax enforcement on taxpayer's welfare, this is not necessarily so. In order to show this, note that for $p = \tau/(\tau + \gamma)$, $\mu = 0$. This will be our relevant threshold, since p is our control variable. Given the single-crossing condition stated in the previous paragraph, the sign of μ will be such that:

If $MB < MC$ evaluated at $p = \tau/(\tau + \gamma)$, then $\mu > 0$

If $MB > MC$ evaluated at $p = \tau/(\tau + \gamma)$, then $\mu < 0$

This implies that, at the optimum, the sign of μ will depend on:

$$\lambda(\tau+\gamma)\hat{X}_1 \overset{>}{\underset{<}{}} V\left(\hat{C}_2^{NA}\right) - V\left(\hat{C}_2^{A}\right) \begin{array}{l} \Rightarrow \ \mu < 0 \\ \Rightarrow \ \mu > 0 \end{array} \qquad [5]$$

where ^ indicates the corresponding variable is evaluated at $p = \tau/(\tau + \gamma)$. As long as we do not consider the impact of tax enforcement on taxpayer's welfare, such that $V\left(\hat{C}_2^{NA}\right) - V\left(\hat{C}_2^{A}\right) = 0$, then $\mu < 0$ if $m > 1$, which replicates Andreoni's result. Otherwise, the sign of μ is ambiguous depending on the above relationship. In any case, here given the existence of a positive marginal cost, the audit probability is smaller with respect to a situation where $MC = 0$. See the next Proposition.

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[10] The negative slope of MC arises straight from $\partial MC/\partial p = V'\left(C_2^A\right)(\tau+\gamma)\,\partial X_1/\partial p < 0$, while to obtain the negative sign of MB with respect to *p*, we need to use the SOC of the tax administration maximization problem.

Proposition. *If the objective of the tax administration is maximizing the amount of tax revenue collected, and under the presence of financial constraints on the taxpayers' side* $(m > 1)$, *it is optimal for the tax administration to play an unfair gamble with taxpayers* (Andreoni, 1992). *If it also takes into account taxpayers' welfare, it will still play an unfair gamble with them as long as the shadow price of public funds is above a given threshold,* $\frac{V(\hat{C}_2^{NA})-V(\hat{C}_2^{A})}{(\tau+\gamma)\hat{X}_1}$*; otherwise, it will play a fair gamble.*

The threshold stated in the above Proposition is implicitly defined in [5]. All in all, the decision to play or not an unfair gamble with taxpayers depends on a trade-off between the revenue needs of the tax administration (in favour of an unfair gamble) and the welfare costs of audits (in favour of a fair gamble).

Optimal Cyclical Tax Enforcement

Our purpose – for the empirical analysis – is now inferring how the tax enforcement policy will vary when the economy faces an economic shock.

With this purpose, we will perform a basic comparative statics exercise. In front of an increase in W_2, *i.e.* when the representative taxpayer is under more severe financial constraints (this is our definition of an aggregate shock, as all individuals are equal), the impact on the marginal benefit (MB) is the following:

$$\frac{\partial MB}{\partial W_2} = \lambda\left[(\tau+\gamma)\frac{dX_1}{dW_2} - \frac{\partial}{\partial W_2}\left(\frac{dX_1}{dp}\right)\mu\right] \gtrless 0 \qquad [6]$$

First, the MB goes up due to the fact that, given current p, there is now more tax evasion, since $\frac{dX_1}{dW_2} > 0$, and so more potential tax revenue to collect. Second, there is an impact on the marginal productivity of tax enforcement, accounted for by the term $\frac{\partial}{\partial W_2}\left(\frac{dX_1}{dp}\right)$ which has an ambiguous sign. This latter term is picking up how productivity varies when the taxpayer becomes more liquidity constrained. If the sign of that second derivative is positive (negative), productivity goes down (up). Given $\mu < 0$, the sign of this term is positive (null) when the degree of risk aversion of the taxpayer is increasing (constant) with respect to the net income which we disregard since the most common assumption is that it should be decreasing. In this light, a necessary and sufficient condition to guarantee that expression [6] is positive – and so optimal p goes up – can be provided under Decreasing Absolute Risk Aversion (DARA)[11]. In any case, what is important to stress is that, given evasion is an unfair gamble to the taxpayer, the tax administration marginally gains promoting tax evasion. Then, since the impact of increasing p on evasion is not so strong now, such a decrease in productivity points to a counter-cyclical tax enforcement policy. This would be a situation where the tax administration just cares about maximizing tax revenues collected, and so the reaction of the administration only has to do with the procedure of tax collection weighted by the shadow price of public revenues. Under a welfare approach, it will also take into account the impact on the marginal cost.

The impact on the marginal cost (MC) is also uncertain as shown by:

$$\frac{\partial MC}{\partial W_2} = [V'(C_2^{NA}) - V'(C_2^{A})] + V'(C_2^{A})(\tau + \gamma)\frac{dX_1}{dW_2} \lessgtr 0 \qquad [7]$$

On the one hand, keeping constant the level of evasion, the marginal cost of increasing p diminishes, since there is a positive income effect for the taxpayer pointing to a higher level of enforcement, as $V'(C_2^{NA}) < V'(C_2^{A})$. In particular, the term $-V'(C_2^{A}) < 0$ indicates that an increase in W_2 reduces the MC of increasing p since the taxpayer is now wealthier. In contrast, the term $V'(C_2^{NA}) > 0$ entails a higher MC, since by increasing p the tax administration is making less likely the state of the world in which

[11] By defining, the coefficient of absolute risk aversion as $R(C_i) := -U''(C_i)/U'(C_i) > 0$, and the degree of absolute prudence of the taxpayer as $P(C_i) := -U'''(C_i)/U''(C_i) > 0$, a milder sufficient condition granting $\frac{\partial MB}{\partial W_2} > 0$ is that $P(C_2^A) > R(C_2^A)\frac{\mu - p(\tau+\gamma)}{\mu} > R(C_2^A)$. $P(C_2^A) > R(C_2^A)$ guarantees that absolute risk aversion decreases in (net) income (see, for example, Eeckhoudt *et al.*, 2005, Prop. 1.6, Ch. 1), $R' < 0$. This is compatible with the so-called "Decreasing Absolute Risk Aversion" (DARA) utility functions, like a logarithmic one. See, for example, Eeckhoudt *et al.*, 2005, Section 1.7, Ch. 1. A. More generally, a necessary and sufficient condition for a countercyclical tax enforcement $\left(\frac{\partial MB}{\partial W_2} > 0\right)$ is that $P\left(C_2^A\right) - R\left(C_2^A\right) < A$, where $A = R(C_1)\frac{\tau}{\tau+\gamma} - \frac{p}{\mu} > 0$, that is, the degree of absolute risk aversion decreases in (net) income, but not excessively.

the wealthier taxpayer enjoys the income benefits of tax evasion at a null cost. All in all, the aggregate impact of this direct income effect implies a reduction in the MC. On the other hand, there is also a second order effect due to the fact that taxpayer's net income decreases if audited, due to the higher incentives to evade when the taxpayer is more liquidity constrained, that is, $V'(C_2^A)(\tau+\gamma)\frac{dX_1}{dW_2}>0$. This effect points to a lighter enforcement policy. This impact on taxpayer's welfare seems to pick up the one suggested by Brondolo (2009), where $\frac{dX_1}{dW_2}$ is implicitly picking up the larger demand of a "loan" shark weighted by the marginal utility of private net income. The greater the impact on demand, the greater the increase in the MC; so, this is pointing to a less counter-cyclical tax enforcement policy.

Therefore, under a welfare approach, it is not possible to sign the impact of greater taxpayer's liquidity constraints on the degree of tax enforcement:

$$\frac{\partial MB}{\partial W_2}-\frac{\partial MC}{\partial W_2}=[V'(C_2^A)-V'(C_2^{NA})]+[\lambda-V'(C_2^A)](\tau+\gamma)\frac{dX_1}{dW_2}-\lambda\mu\frac{\partial}{\partial W_2}\left(\frac{dX_1}{dp}\right)\gtrless 0 \qquad [8]$$

Note, though, the term $[\lambda-V'(C_2^A)](\tau+\gamma)\frac{dX_1}{dW_2}$ is showing a trade-off between the financial constraints of the public sector – represented by λ and pointing to countercyclical enforcement – and those affecting the taxpayer – represented by $V'(C_2^A)$ and pointing to lower and hence less countercyclical tax enforcement. Therefore, as long as the public sector is also liquidity constrained, the net impact will depend on which agent is more liquidity constrained. Hence, ceteris paribus (i.e. given the same level of λ), a welfarist tax administration tends to set a more procyclical tax enforcement in presence of financially constrained taxpayers compared to a revenue maximizing one. In the end, it is an empirical matter to test whether tax enforcement is cyclical, and in this case, what its nature is.

3 Empirical Analysis

The theoretical framework described in section 2 presents interesting and novel insights about the evolution of tax enforcement along the economic cycle that requires empirical testing. Next, we present the employed methodology to test these findings, discuss our identification strategy, and finally we present and comment the main results emerging from the analysis.

3.1 The empirical framework

In order to test the hypotheses raised in the theoretical model about the level of tax enforcement along the economic cycle, we employ tax enforcement as it is perceived by individuals in Spain[12]. This is our endogenous variable, which is extracted from the repeated waves of the survey "Public opinion and fiscal policy", conducted annually (1994-2015) and released by the Spanish Centre of Sociological Research (*Centro de Investigaciones Sociológicas* in Spanish, CIS henceforth). This repeated cross-section survey reports some information on subjective perceptions of the fiscal policy – including tax enforcement–, public provided goods and services, and other aspects of the tax system in Spain.

The relevant question used to define the endogenous variable is the following one: "Do you think that the tax administration is currently taking many/quite a few/a few/very few steps in its efforts to fight against tax evasion?"[13]; this question has remained unchanged over the 1994-2015 period. For any respondent *i*, in autonomous community (AC, henceforth) j, in survey year *t*, we code the answer to this question into the variable p_{ijt}, which is scaled from very low (1) to very high (4) according to the answer. Thus, by defining p_{ijt} as an ordinal dependent variable measuring the

[12] What matters about the decision to evade is the perception of taxpayers (Slemrod, 2019). For instance, Blank and Levin (2010) show that the U.S. Department of Justice Tax Division issues a disproportionately large number of tax enforcement press releases during the weeks immediately prior to Tax Day (when income tax returns are due) compared to the rest of the year, with the aim to influence individual taxpayers' perceptions and knowledge of the audit probability. Hence, this perception might be directly affected by the actions of the tax administration. In any case, there is vast evidence that individuals tend to overestimate the probability of their being audited even when fully informed about actual policy (see e.g. Kahneman and Tversky, 1979). We will explain later on how we tackle this.

[13] The original question in Spanish is "¿Cree Ud. que, en la actualidad. la Administración hace muchos, bastantes, pocos o muy pocos esfuerzos para luchar contra el fraude fiscal?" (see e.g. question n. 21 of the survey n. 2994 released in 2013, as the numbering of the questions might change from year to year).

unobservable actual perceived tax enforcement of individuals $\left(p^*{}_{ijt}\right)$, we can design an ordered response model (see e.g. Wooldridge, 2002, pp. 504-509)[14]:

$$p^*{}_{ijt} = \beta EC_{jt} + \boldsymbol{Y_{ijt}\psi} + \boldsymbol{X_{jt}\alpha} + \vartheta_j + \tau_t + \varepsilon_{ijt}$$

$$p_{ijt} = \begin{cases} 1 & \text{if } \; p^*{}_{ijt} \leq \omega_1 \\ 2 & \text{if } \; \omega_1 \leq p^*{}_{ijt} \leq \omega_2 \\ 3 & \text{if } \; \omega_2 \leq p^*{}_{ijt} \leq \omega_3 \\ 4 & \text{if } \; p^*{}_{ijt} \geq \omega_3 \end{cases} \qquad [9]$$

Where EC_{jt} is a proxy of the AC-specific economic cycle at time *t*. In particular, we alternatively employ the GDP of the AC *j* during year *t* (GDP_{jt}) or the level of unemployment in AC *j* during year *t* $\left(Unemployment_{jt}\right)$. In our theoretical framework we parameterized a negative financial shock to the economy by an increase in W_2 with respect to W_1. Here, we can coherently interpret W_2 as the potential or the long run GDP in period *t* and W_1 as the effective GDP at that time. Thus, a low value of GDP_{jt} with respect to its potential long run level – implicitly accounted for through AC fixed effects – implies an economic downturn. The symmetric reasoning holds when $Unemployment_{jt}$ is employed as a proxy for the economic cycle. Therefore, we identify a counter-cyclical tax enforcement with a negative (positive) sign when EC_{jt} is proxied by GDP_{jt} ($Unemployment_{jt}$).

Since socio-economic information about the respondents is also included in the survey data, we collect this information in vector $\boldsymbol{Y_{ijt}}$ to control for personal characteristics, while $\boldsymbol{X_{jt}}$ is a vector collecting other AC-specific relevant variables. We discuss in detail all these variables in section 3.2. Finally, we account for fixed effects (ϑ_j), time effects (τ_t) and ε_{ijt} is the error term. We estimate the coefficients as well as the cut-points in equation [9] through an ordered probit model[15] by means of maximum

[14] Since the dependent variable is defined as an ordinal discrete ranking, employing an ordered response model is the most appropriate estimation strategy (see e.g. Greene, 2002, p. 736).

[15] The difference between an ordered probit and an ordered logit model regards the distribution of ε_{ijt}. As main strategy, by employing an ordered probit model, we are assuming a normal distribution of the error term. We also replicate the analysis assuming a logistic distribution (*i.e.*

likelihood technique.

By estimating [9], we can evaluate the pooled effect of the economic cycle on tax enforcement. This effect could vary depending on the level of financial constraints experienced by taxpayers and thus depending on the state of the economy. In order to appreciate this potential change in the optimal response of the tax enforcement to the economic cycle we employ a linear spline approach (see *e.g.* Poirier and Garber, 1974; Gould, 1993; or Johnston and Di Nardo, 1997) by specifying the relationship between ${p^*}_{ijt}$ and EC_{jt} as a piecewise seamless compound linear function. In other words, the relationship between ${p^*}_{ijt}$ and EC_{jt} is estimated as a function composed of linear segments that meet at the knots. The following expression formally describes such specification:

$${p^*}_{ijt} = f(EC_{jt}) + \boldsymbol{Y_{ijt}\psi} + \boldsymbol{X_{jt}\alpha} + \vartheta_j + \tau_t + \varepsilon_{ijt}$$

$$f(EC_{jt}) = \begin{cases} \beta_1 EC_{jt} + a_1 & \text{if } EC_{jt} \leq knot_1 \\ \beta_2 EC_{jt} + a_2 & \text{if } knot_1 \leq EC_{jt} \leq knot_2 \\ \beta_3 EC_{jt} + a_3 & \text{if } EC_{jt} \geq knot_2 \end{cases}$$

$$p_{ijt} = \begin{cases} 1 & \text{if } {p^*}_{ijt} \leq \omega_1 \\ 2 & \text{if } \omega_1 \leq {p^*}_{ijt} \leq \omega_2 \\ 3 & \text{if } \omega_2 \leq {p^*}_{ijt} \leq \omega_3 \\ 4 & \text{if } {p^*}_{ijt} \geq \omega_3 \end{cases} \qquad [10]$$

The knots are alternatively equally spaced over the range of EC_{jt} or are placed at convenient percentiles of EC_{jt} in order to identify severe economic downturns by considering extreme values of EC_{jt}. Specifically, we set knot1 and knot2 at the first and the fifth percentiles of GDP_{jt} or at the 95th and 99th percentiles of $Unemployment_{jt}$.

Alternatively, we also employ another standard approach employed in the literature to identify non-linearity that consists of including quadratic and cubic terms of EC_{jt} in the regression model. This methodology is represented by:

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estimating an ordered logit model) and as a robustness check we also estimate an OLS model (see Appendix 1).

$$p^*_{ijt} = \beta_1 EC_{jt} + \beta_2 (EC_{jt})^2 + \beta_3 (EC_{jt})^3 + \boldsymbol{Y_{ijt}\psi} + \boldsymbol{X_{jt}\alpha} + \vartheta_j + \tau_t + \varepsilon_{ijt}$$

$$p_{ijt} = \begin{cases} 1 & \text{if } p^*_{ijt} \leq \omega_1 \\ 2 & \text{if } \omega_1 \leq p^*_{ijt} \leq \omega_2 \\ 3 & \text{if } \omega_2 \leq p^*_{ijt} \leq \omega_3 \\ 4 & \text{if } p^*_{ijt} \geq \omega_3 \end{cases} \qquad [11]$$

Since non-linear and linear terms are highly correlated and there is the risk of getting inflated standard errors, we orthogonalize the EC_{jt} polynomial variables (see Sribney, 1995).

In next section, we discuss our identification strategy.

3.2 Identification strategy

One can observe from Graph 2 that the answers given by citizens to the question employed to define our endogenous variable change over time and among ACs.

[GRAPH 2 AROUND HERE]

Unfortunately, our endogenous variable is not a direct description of the real efforts carried out by the tax administration. Part of its variation along time can certainly be explained by how the actual policy implemented by the tax administration varies year-to-year. However, given the survey nature of the variable, it might also vary along time due to the variation of individual risk perception even if efforts carried out by the tax administration do not change (see fn. 12); the response could also be normative, that is, what level of enforcement the interviewed thinks should hold at that particular time. These last two dimensions are the individual component of p^*_{ijt}; in the regression we will include individual variables to control for those potential biases in our endogenous variable.

Nonetheless, both the actual policy dimension and the individual one might be subject to different types of fluctuations along the economic cycle. Indeed, both factors can be broken down into a structural component, a common national cyclical component and an AC-specific cyclical one. Hence, since we want to identify the impact of the AC-specific economic cycle on the actual policy, our strategy entails first controlling for the structural and common cyclical components of both dimensions of ${p^*}_{ijt}$, and second refining β in order to identify the AC-specific cyclical component of the actual policy. Indeed, the coefficient β in equation [9] is picking up the potential effect of the AC-specific economic cycle on both dimensions of ${p^*}_{ijt}$. The main challenge we face for a correct identification is being able to isolate such an effect. Below, we detail the procedure we employ to deal with this issue.

Controlling for the actual policy: structural component

In equation [9], by employing fixed effects (ϑ_j) and AC-specific contextual variables ($\boldsymbol{X_{jt}}$), we are already implicitly controlling for the structural component of the actual policy. Nevertheless, we try to strengthen this strategy by controlling for 5 years fixed effects (*i.e.* by interacting the AC-specific dummies with 5 years common trend time dummies) instead of pure fixed effects. In this way we should control for potential changes in the long-term level of EC_{jt} over time. In order to account for AC-specific contextual variables, vector $\boldsymbol{X_{jt}}$ includes several controls. First, we include a set of variables to identify the regional productive structure through the percentage composition of the regional gross value added (GVA)[16]. Namely, these are: the percentage of GVA represented by the secondary sector (without the construction subsector), the percentage of GVA represented by the construction subsector – which has particularly been important in Spain – and finally the percentage of GVA given by the tertiary sector. We also include the regional population in order to account for the demographic dimension of any AC, and the total number of employees of the tax administration – per capita terms – in order to account for the capacity of the tax authority to enforce the existing tax legislation. Finally, we include a dummy variable to account for the AC electoral cycle and a dummy identifying whether the AC government stands on the left of the political spectrum.

[16] These are introduced with 5-year lags in order to account for the long run productive structure of any AC.

Controlling for the individual dimension: structural component

In order to account for the structural component of the individual dimension of perceived tax enforcement we control for individual characteristics of the respondents ($\boldsymbol{Y_{ijt}}$), which may influence the risk perception and the tax enforcement demand of individuals. We include dummies for female, head of household, married individual, retired, self-employed, public employee, left-wing voter, nationalist voter[17], as well as for the estimated low unemployment risk (UR, henceforth)[18]. We also control for the municipality size, age of the respondent – which are both included also in squared terms to account for non-linearity in their effect – and the educational level attained by the respondent.

Controlling for the common cyclical components (individual dimension & actual policy)

By employing common time effects (τ_t) we account for the common national cyclical component of our endogenous variable. Moreover, in order to control for the sensitivity of the individual component of ${p^*}_{ijt}$ on the national economic cycle we interact the vector of individual variables ($\boldsymbol{Y_{ijt}}$) with the common time dummies (τ_t) allowing the risk perception and demand dimension of ${p^*}_{ijt}$ to sluggishly adjust along the national economic cycle. Indeed, respondents may answer differently implicitly showing a different risk perception / demand of tax enforcement efforts depending on the national economic cycle.

Controlling for the individual dimension: AC-specific cyclical component

After all the previous controls that account for the aforementioned effects, we might have a serial correlation problem. Indeed, the relationship between the AC-specific economic cycle and our endogenous variable will capture both the sensitivity of the tax administration throughout the economic cycle (*i.e.* the AC-specific cyclical component of the actual policy) and the evolution of individual risk perception / demand throughout

[17] The dummy nationalist is defined as equal to 1 if the respondent voted for one of the nationalist parties of the historical nationalities recognized in Spain.
[18] The methodology employed to estimate UR is explained below in this section.

the cycle (*i.e.* the AC-specific cyclical component of the individual dimension of ${p^*}_{ijt}$). This means that the estimated effect of the cycle on the (latent) endogenous variable – the coefficient β – could result biased.

In order to deal with this issue, we follow the approach adopted by Backus and Esteller (2017). The initial step of this strategy is to split our sample of surveyed individuals into two groups, the first one – say group 1 – composed by people whose risk perception and demand of tax enforcement should not vary along the AC-specific economic cycle and the second one constituted by the complementary cluster (group 2). To this end, coherently with Backus and Esteller (2017), we provide an estimate of each individual's UR based on their labour market characteristics[19]. This is an estimate of an individual's idiosyncratic risk of unemployment, scaled between 0 and 1, and provides us with a proxy of the impact of the economic cycle on the risk perception / demand of tax enforcement of those individuals. The rationale is that the higher the UR, the higher the individual's exposure to the economic cycle, and thus, the higher should be the potential impact of the economic cycle on her risk perception and probably demand for tax enforcement. In other words, an individual with low UR is less likely to change her perception/demand of tax enforcement along the economic cycle and thus is more likely to contribute to produce a correct estimation of β. We identify the cluster of individuals whose risk perception and demand of tax enforcement should not vary along the AC economic cycle (group 1) by defining the dummy variable "low UR" equal to 1 if the UR of a certain individual in year *t* is lower than the average UR of that year[20].

The following step consists of running separate regressions for these two groups, and

[19] More precisely, we estimate the individual UR by employing a probit model on a sub-sample of individuals who are employed plus those that are currently unemployed but were employed in previous periods. Specifically, we establish the relationship $UR_{ijt} = \boldsymbol{w_{ijt}\omega} + \eta_{ijt}$ where UR_{ijt} is a dummy equal to 1 if i is unemployed and 0 if i is employed, $\boldsymbol{w_{ijt}}$ is a vector of i's employment – or previous employment – characteristics reported in the CIS surveys. Those include: occupation, industry of employment and level of education all interacted with the sector of employment and year effects, $\boldsymbol{\omega}$ is a vector of parameters to be estimated, and η_{ijt} is the error term. The predicted probabilities $\widehat{UR}_{ijt}$, represent the estimated UR variable (for more details see Backus and Esteller, 2017, p. 207). Additionally, we assign a value equal to zero to the UR of retired individuals.

[20] Alternatively, we have also employed the median of the UR of any year to define the threshold and obtain qualitatively the same results. They are available upon request to the authors.

checking whether there is a statistically significant difference between the estimated coefficient $\hat{\beta}$ for the two clusters (*i.e.* testing whether $\hat{\beta}_1 \neq \hat{\beta}_2$ is statistically significant[21]). If this is the case, and according to our identification strategy, then we should choose $\hat{\beta}_1$ as the best approximation to the real impact of the AC economic cycle on the actual tax enforcement policy. Otherwise, we can conclude that this source of bias is not relevant.

In next section we present some descriptive statistics and detail the sources of the variable included in the analysis.

3.3 Data and Sources

Our dataset comprises information about individual-level and AC-level variables for the 1994-2015 period. Our endogenous variable, as well as all the individual-level control variables, are extracted from the above-mentioned repeated waves of the annually published survey by the CIS. The only exception is given by the UR, and the relative dummy for low unemployment risk, which have been estimated through the methodology presented in section 3.2.

Contextual variables refer to the 15 Spanish "common regime" ACs and are obtained from the following statistical sources. The information about the GDP, the unemployment, the productive structure and the population of ACs is provided by the Spanish National Institute of Statistics (INE). The variable that controls for the tax enforcement capacity – the total number of employees of the tax administration – accounts for the number of employees employed in both AC-specific tax agencies and regional offices of the national tax authority and it is relativized per capita terms. This variable represents a measure of the size of each tax agency with respect to the population in any AC and year[22]. In order to define this variable we rely both on

[21] In order to perform this test, we implement a fully interacted specification (FIS) of equation [10], by allowing any coefficient to differ depending on whether individual *i* belongs to group 1 or 2 (see Backus and Esteller, 2017, p. 209 for more details).

[22] The national tax agency (AEAT) is responsible for the effective application of the main national taxes, such as personal income tax, value added tax and corporate tax. And AC tax agencies are responsible for the application of national taxes ceded to the regional governments, such as transfer tax, annual wealth tax and inheritance and gift tax, in addition to other minor regional taxes.

information provided by the Statistical Bulletins of the Central Personnel Registry ("Boletines Estadísticos del Registro Central de Personal" in Spanish) and on information made available in the Report on the ceded taxes to ACs ("Informe sobre la cesión de tributos a las Comunidades Autónomas" in Spanish) published every year jointly with the project of the general State budget. Information on the electoral cycle and on the political colour of the government in office in any AC/year is available on the database of the Spanish Interior Ministry. Table 1 reports the pooled summary statistics of the variables employed in our empirical analysis while Table 2 presents the descriptive statistics referred to the two subsamples defined on the basis of the dummy "low UR" (panels A and B) and a test for the equality of subsamples means (Panel C).

[TABLE 1 AROUND HERE]

[TABLE 2 AROUND HERE]

Next, we present the results of our empirical analysis.

4 Results

Table 3 presents the results of the estimation of equation [9]. In particular, in columns 1-3 we measure the economic cycle through GDP_{jt}, while in columns 4-6 we use $Unemployment_{jt}$. The structure of the table is coherent with the filtering process presented in our estimation strategy. More precisely, columns 1 and 4 estimate the baseline model presented in equation [9] including fixed effects and time effects, columns 2 and 5 substitute standard fixed effects with five-year fixed effects and finally in columns 3 and 6 we add the interaction between any individual variable and the time dummies. In every model the proxy for the economic cycle is highly significant and presents a sign that is coherent with a pooled counter-cyclical tax enforcement policy confirming that, as theory suggests, in most of cases this is the optimal response of tax authorities to economic shocks. In particular, concerning our filtering process, by substituting standard fixed effects with five-year fixed effects has a significant impact on the magnitude of the coefficients of the economic cycle, while introducing the interactions between individual variables and time dummies has a negligible if not null impact. This seems to suggest that the individual component of the perception/demand of tax enforcement does not vary too much along the economic cycle. For these reasons, and in order to be able to more easily interpret the effect of relevant individual variables, we choose the results for five-year fixed effects (columns 2 and 5) as our best estimates for the pooled regression. Further analyses presented in tables 4 and 5 is based on these models.

As explained in detail in section 3.2, the control variables have been included as part of our identification strategy. Thus, the interpretation of their impact on the dependent variable is not key for the purpose of this paper. Nevertheless, it is interesting to stress some results. In particular, regions with a higher percentage of GVA generated by the tertiary sector tend to have higher tax enforcement. The capacity of tax administration to enforce the existing tax legislation seems to be oversized as the coefficient of the TA per-capita employees variable suggests. The impact of size of the municipality in which the respondent to the survey resides is reported to be non-linear as the impact of the age of the respondent. Leftist voters report a lower tax enforcement suggesting a demand for a more stringent fight against fiscal fraud. On the other hand, being a voter of a regional nationalist party has the opposite effect on the individual perception/demand. Self-employed individuals report a higher level of tax enforcement which is coherent with the higher probability they have to be audited. Finally, individuals employed in the public sector tend to report a lower level of tax enforcement, while people with a lower estimated expected unemployment rate show the opposite effect.

[TABLE 3 AROUND HERE]

Following our identification strategy, Table 4 presents the results of the estimation of separate regressions for different groups of individuals based on their UR-type. More precisely, columns 1 and 2 replicate model 2 of Table 3 for low-UR type and high-UR type individuals respectively. Similarly, columns 3 and 4 reproduce model 5 of Table 3 for the same clusters of individuals. The results show counter-cyclical tax enforcement for both clusters of individuals. Testing for significantly different coefficients for these two groups lead to rejecting this hypothesis[23], so we maintain the results shown in model 2 and 5 of Table 3 as best approximation to the pooled effect of the economic cycle on tax enforcement.

[TABLE 4 AROUND HERE]

Hence, thus far, our study confirms the results obtained by Chen (2017) for China corroborating the existence of a fiscal capacity argument in the setting of tax enforcement. By analysing a different country-framework and by employing different data and methodology, we show that on average tax revenue losses due to the economic downturn tend to be offset by tougher tax enforcement by tax administrations. Our paper, though, has the ambition to go a step further in order to try to disentangle whether the tax administration may change its incentives according to the severity of the economic downturn.

In this vein, Table 5 presents the results of the analysis of the presence of potential non-linearity in the response of the tax enforcement to the economic cycle. More specifically, columns 1-4 are related to equation [10]. Columns 1 and 2 employ a linear spline methodology with equally spaced knots; columns 3 and 4 use a linear spline methodology with knots at specified extreme points (*i.e.* 1st and 5th percentiles for the GDP based model and 95th and 99th percentiles for the Unemployment based model); and columns 5 and 6 present the results of the estimation of equation [11] that employs an orthogonalized third degree polynomial to account for non-linearity in the economic cycle.

The results of this analysis seem to suggest a change in the behaviour of tax administration. Namely, the models that employ linear spline with equally spaced knots do not show a change in the sign of the slope, but we can at least appreciate a change in the slope magnitude. A drawback of this approach is that in order to identify the change in the economic cycle employing knots, they are equally spaced. Nevertheless, by using linear spline models with knots at specified extreme points that identify severe financial

[23] The test is based on a fully interacted specification of equation 10 based on the dummy identifying the two groups (see Backus and Esteller, 2017 for more details). The results are available upon request.

constraints, we are able to appreciate a significant change in the slope of the reaction of tax enforcement to the economic cycle. More specifically, column 3 (4) show that for very low (high) values of GDP (Unemployment) the tax enforcement policy turns out to be pro-cyclical while remaining counter-cyclical for the rest of economic cycle. This suggests that when the economic downturn is particularly severe, the tax administration`s optimal strategy is to waive additional tax revenues that could be raised strengthening the tax enforcement and set a pro-cyclical enforcement policy. We obtain a similar effect also for the results related to equation [11] but just for what concerns the Unemployment-based model (column 6).

[TABLE 5 AROUND HERE]

In Appendix 1 we present the results obtained by replicating the analysis presented in tables 3 to 5 by estimating equations [9]-[11] by means of ordered logit and OLS models, respectively. The results obtained through this robustness analysis are qualitatively identical to the one presented in this section (see tables 6 to 11, Appendix 1).

5 Conclusions

Despite a strand of the literature on public finance acknowledges tax enforcement is an additional parameter of an optimal fiscal system (see *e.g.*, Slemrod and Gillitzer, 2014), there is little literature checking whether this is the case. That is, there are not many positive analyses aiming at explaining the performance of the tax administration. This lack of research is even more intense when relating tax compliance and tax enforcement to the economic cycle. This is the challenge of this paper.

In particular, we estimate, first, if tax enforcement reacts to the state of the economy, and if so, second, estimate its nature (pro or counter-cyclical). This challenge, though, is not without difficulties. This is so, since we do not have information about the real level of tax enforcement. Alternatively, we have used survey data, as a proxy of those efforts, and tried to filter any other potential (individual) explanation in the survey responses that might bias our dependent variable. From the analysis, we conclude that tax enforcement is cyclical: the tax administration reacts, and the nature of the reaction depends on the severity of the crisis.

These results are interesting, as they show – maybe financial markets should be aware of that – that the tax administration is another channel to overcome public budget difficulties in the short run. It would be interesting to test this result in other contexts, where the institutional design of the tax administration is different from the Spanish one. Finally, we think this line of research might merit further theoretical developments.

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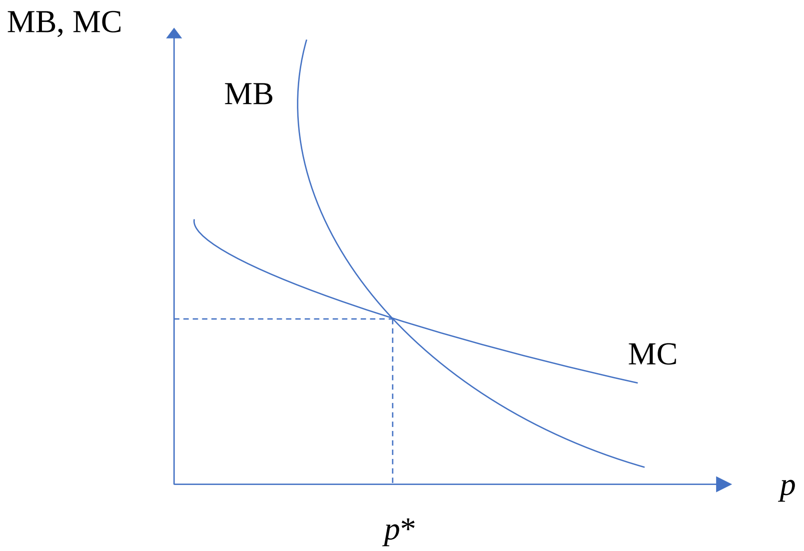
Graphs & Tables

Graph 1



Graph 2: Average p_{ijt} variability along time by AC

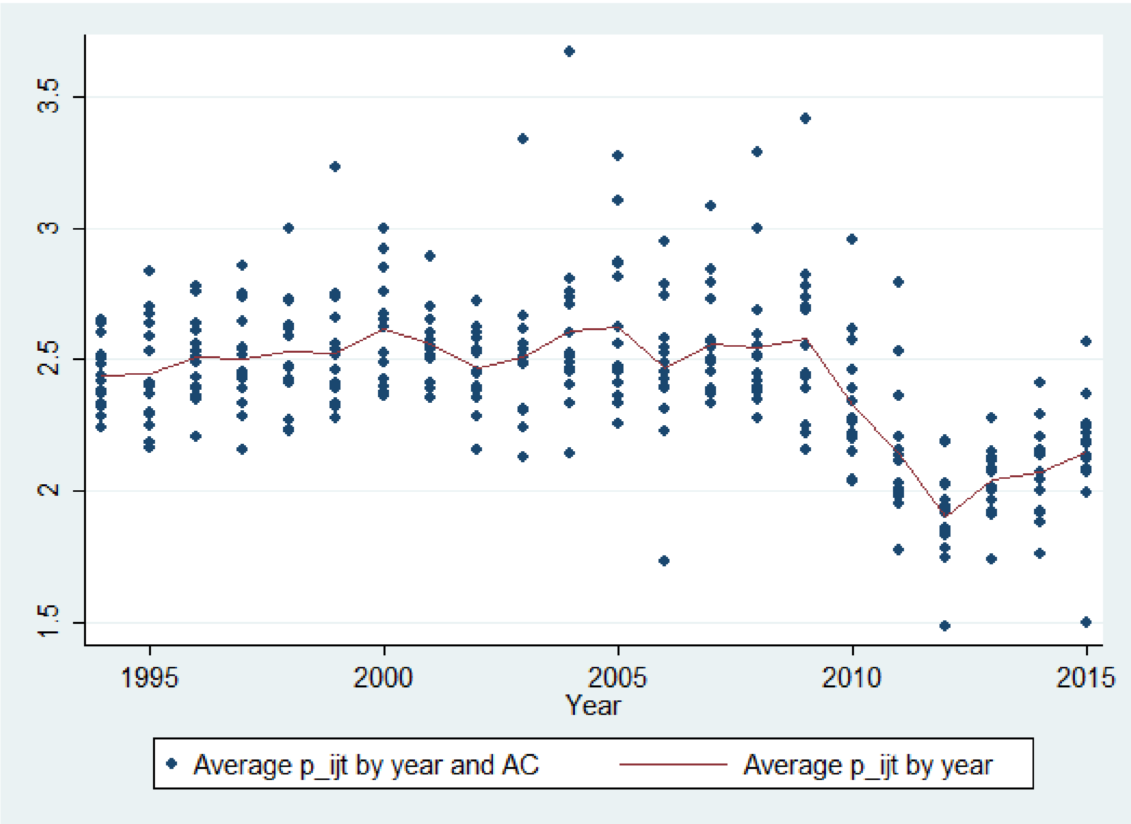


Table 1: Pooled summary statistics

Variable	Measurement unit	Obs.	Mean	Std.	Min	Max
Endogenous variable						
p	Ranking	32357	2.360	0.812	1	4
Proxies of the Economic Cycle (main explanatory variables)						
GDP (CA)	Hundreds of thousands of millions of euros	36935	1.006	0.643	0.051	2.150
Unemployment (CA)	Millions of people	36935	0.427	0.425	0.005	2.186
AC-specific explanatory variables						
FYL_%GVA_Secondary_sector	Share	36935	0.219	0.073	0.076	0.441
FYL_%GVA_Construction_sector	Share	36935	0.092	0.029	0.029	0.149
FYL_% GVA_Tertiary_sector	Share	36935	0.647	0.076	0.416	0.827
Population (CA)	People	34345	4606319	2488351	263056	8449985
Leftist government (CA)	Dummy	36935	0.352	0.478	0	1
Electoral cycle (CA)	Dummy	36935	0.277	0.447	0	1
TA per-capita employees	Per capita employees	32522	0.001	0.000	0.000	0.002
Individual-level explanatory variables						
Dummy self employed	Dummy	36946	0.147	0.354	0	1
Left	Dummy	36946	0.535	0.499	0	1
Female	Dummy	36946	0.422	0.494	0	1
Age	Nr. of years	36940	48.899	17.994	18	99
Age squared	Nr. of years (squared)	36940	2714.857	1872.325	324	9801
Head of household	Dummy	36946	0.609	0.488	0	1
Dummy married	Dummy	36919	0.353	0.478	0	1
Education level	Nr. of years	36852	4.296	3.042	0	15
Nationalist	Dummy	36946	0.065	0.246	0	1
Municipality size	Units	36946	3.351	2.126	0	7
Municipality size squared	Units squared	36946	15.748	15.216	0	49
Dummy Retired	Dummy	36946	0.329	0.470	0	1
Dummy public employee	Dummy	36946	0.171	0.376	0	1
Unemployment risk	Probability	35369	0.109	0.144	0	0.837
Dummy low Unemployment risk (mean)	Dummy	36946	0.621	0.485	0	1

Table 2 : summary statistics by UR type

Panel A: High UR

Variable	Measurement unit	Obs.	Mean	Std.	Min	Max
Endogenous variable						
p	Ranking	12593	2.308	0.813	1	4
Proxies of the Economic Cycle (main explanatory variables)						
GDP (CA)	Hundreds of thousands of millions of euros	13984	1.020	0.638	0.051	2.150
Unemployment (CA)	Millions of people	13984	0.432	0.417	0.005	2.186
AC-specific explanatory variables						
FYL_%GVA_Secondary_sector	Share	13984	0.219	0.074	0.076	0.441
FYL_%GVA_Construction_sector	Share	13984	0.088	0.032	0.029	0.149
FYL_% GVA_Tertiary_sector	Share	13984	0.652	0.075	0.416	0.827
Population (CA)	People	12987	4691425	2492062	263056	8449985
Leftist government (CA)	Dummy	13984	0.341	0.474	0	1
Electoral cycle (CA)	Dummy	13984	0.321	0.467	0	1
TA per-capita employees	Per capita employees	12281	0.001	0.000	0.000	0.002
Individual-level explanatory variables						
Dummy self employed	Dummy	13990	0.111	0.314	0	1
Left	Dummy	13990	0.570	0.495	0	1
Female	Dummy	13990	0.425	0.494	0	1
Age	Nr. of years	13989	39.082	13.457	18	99
Age squared	Nr. of years (squared)	13989	1708.481	1188.069	324	9801
Head of household	Dummy	13990	0.516	0.500	0	1
Dummy married	Dummy	13980	0.419	0.493	0	1
Education level	Nr. of years	13971	4.495	4.951	0	99
Nationalist	Dummy	13990	0.060	0.237	0	1
Municipality size	Units	13990	3.381	2.018	0	7
Municipality size squared	Units squared	13990	15.505	14.465	0	49
Dummy Retired	Dummy	13990	0.051	0.219	0	1
Dummy public employee	Dummy	13990	0.108	0.310	0	1
Unemployment risk	Probability	12413	0.254	0.155	0	0.837

Panel B: Low UR

Variable	Measurement unit	Obs.	Mean	Std.	Min	Max
Endogenous variable						
p	Ranking	19764	2.393	0.809	1	4
Proxies of the Economic Cycle (main explanatory variables)						
GDP (CA)	Hundreds of thousands of millions of euros	22951	0.997	0.646	0.051	2.150
Unemployment (CA)	Millions of people	22951	0.423	0.431	0.005	2.186
AC-specific explanatory variables						
FYL_%GVA_Secondary_sector	Share	22951	0.220	0.073	0.076	0.441
FYL_%GVA_Construction_sector	Share	22951	0.094	0.026	0.030	0.149
FYL_% GVA_Tertiary_sector	Share	22951	0.644	0.076	0.416	0.827
Population (CA)	People	21358	4554569	2484725	263056	8449985
Leftist government (CA)	Dummy	22951	0.360	0.480	0	1
Electoral cycle (CA)	Dummy	22951	0.250	0.433	0	1
TA per-capita employees	Per capita employees	20241	0.001	0.000	0.000	0.002
Individual-level explanatory variables						
Dummy self employed	Dummy	22956	0.169	0.375	0	1
Left	Dummy	22956	0.514	0.500	0	1
Female	Dummy	22956	0.421	0.494	0	1
Age	Nr. of years	22951	54.882	17.784	18	99
Age squared	Nr. of years (squared)	22951	3328.259	1946.403	324	9801
Head of household	Dummy	22956	0.665	0.472	0	1
Dummy married	Dummy	22939	0.312	0.463	0	1
Education level	Nr. of years	22951	4.464	5.220	0	99
Nationalist	Dummy	22956	0.068	0.252	0	1
Municipality size	Units	22956	3.332	2.189	0	7
Municipality size squared	Units squared	22956	15.896	15.654	0	49
Dummy Retired	Dummy	22956	0.498	0.500	0	1
Dummy public employee	Dummy	22956	0.209	0.406	0	1
Unemployment risk	Probability	22956	0.031	0.039	0	0.170

Panel C: Means difference High UR – Low UR

Variable	Mean high UR	Mean low UR	Difference	p-value
Endogenous variable				
p	2.308	2.393	-0.085	0.000***
Proxies of the Economic Cycle (main explanatory variables)				
GDP (CA)	1.020	0.997	0.023	0.001***
Unemployment (CA)	0.432	0.423	0.009	0.040**
AC-specific explanatory variables				
FYL_%GVA_Secondary_sector	0.219	0.220	-0.001	0.312
FYL_%GVA_Construction_sector	0.088	0.094	-0.006	0.000***
FYL_% GVA_Tertiary_sector	0.652	0.644	0.008	0.000***
Population (CA)	4691425	4554569	136856	0.000***
Leftist government (CA)	0.341	0.360	-0.019	0.000***
Electoral cycle (CA)	0.321	0.250	0.071	0.000***
TA per-capita employees	0.001	0.001	-0.000	0.000***
Individual-level explanatory variables				
Dummy self employed	0.111	0.169	-0.058	0.000***
Left	0.570	0.514	0.056	0.000***
Female	0.425	0.421	0.005	0.365
Age	39.082	54.882	-15.800	0.000***
Age squared	1708.481	3328.259	-1619.778	0.000***
Head of household	0.516	0.665	-0.150	0.000***
Dummy married	2.0000	0.419	0.312	0.107
Education level	4.495	4.464	0.031	0.576
Nationalist	0.060	0.068	-0.008	0.002***
Municipality size	3.381	3.332	0.049	0.032**
Municipality size squared	15.505	15.896	-0.391	0.017**
Dummy Retired	0.051	0.498	-0.447	0.000***
Dummy public employee	0.108	0.209	-0.101	0.000***
Unemployment risk	0.254	0.031	0.223	0.000***

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: The determinants of perceived tax enforcement along time. Ordered-Probit, 1994-2014.

	(1)	(2)	(3)	(4)	(5)	(6)
GDP (CA)	-0.311***	-0.794***	-0.778***			
	(-3.027)	(-3.898)	(-3.666)			
Unemployment (CA)				0.157***	0.201***	0.201***
				(3.939)	(3.349)	(3.114)
FYL_%GVA_Secondary_sector	1.469	-0.593	-0.723	0.548	-1.951	-1.937
	(1.629)	(-0.419)	(-0.481)	(0.629)	(-1.324)	(-1.246)
FYL_%GVA_Construction_sector	-1.133	1.024	1.390	-0.993	0.648	1.156
	(-1.023)	(0.515)	(0.670)	(-0.903)	(0.325)	(0.555)
FYL_% GVA_Tertiary_sector	2.419**	2.742*	2.695*	1.948**	2.050	2.118
	(2.421)	(1.765)	(1.670)	(1.963)	(1.296)	(1.295)
Leftist government (CA)	0.004	0.024	-0.007	0.011	0.047	0.014
	(0.177)	(0.653)	(-0.189)	(0.457)	(1.251)	(0.361)
Electoral cycle (CA)	-0.004	-0.003	-0.005	-0.003	0.004	0.002
	(-0.196)	(-0.148)	(-0.244)	(-0.174)	(0.192)	(0.123)
TA per-capita employees	-420.391***	-399.161***	-440.371***	-408.611***	-391.118***	-433.468***
	(-7.196)	(-6.618)	(-7.207)	(-6.991)	(-6.470)	(-7.081)
Population (CA)	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(1.600)	(1.467)	(1.157)	(-1.409)	(-0.673)	(-0.779)
Municipality size	-0.086***	-0.085***	-0.033	-0.087***	-0.085***	-0.033
	(-4.695)	(-4.610)	(-0.369)	(-4.750)	(-4.626)	(-0.368)
Municipality size squared	0.009***	0.009***	0.005	0.009***	0.009***	0.005
	(4.025)	(3.858)	(0.423)	(4.082)	(3.864)	(0.422)
Left	-0.037***	-0.035***	-0.195***	-0.037***	-0.034***	-0.195***
	(-2.802)	(-2.604)	(-2.854)	(-2.792)	(-2.592)	(-2.854)
Female	-0.009	-0.007	-0.065	-0.009	-0.007	-0.065
	(-0.583)	(-0.500)	(-0.947)	(-0.579)	(-0.503)	(-0.946)
Age	-0.004*	-0.004*	-0.018	-0.005*	-0.004*	-0.018
	(-1.932)	(-1.923)	(-1.451)	(-1.944)	(-1.913)	(-1.451)
Age squared	0.000***	0.000***	0.000	0.000***	0.000***	0.000
	(2.774)	(2.760)	(1.505)	(2.785)	(2.758)	(1.506)
Head of household	0.012	0.015	-0.009	0.012	0.015	-0.009
	(0.749)	(0.978)	(-0.123)	(0.779)	(0.978)	(-0.122)
Dummy married	-0.023	-0.024	-0.033	-0.023	-0.023	-0.032
	(-1.536)	(-1.565)	(-0.366)	(-1.516)	(-1.530)	(-0.364)
Dummy self employed	0.044*	0.045**	0.109	0.044*	0.045*	0.109
	(1.941)	(1.969)	(0.961)	(1.914)	(1.948)	(0.962)
Dummy Retired	-0.014	-0.013	-0.223	-0.014	-0.013	-0.223
	(-0.570)	(-0.511)	(-1.617)	(-0.567)	(-0.524)	(-1.618)
Dummy public employee	-0.032*	-0.029	0.018	-0.032*	-0.029	0.018
	(-1.747)	(-1.564)	(0.192)	(-1.739)	(-1.563)	(0.193)
Dummy low Unemployment risk (mean)	0.044**	0.042**	0.136	0.044**	0.042**	0.136
	(2.333)	(2.234)	(1.443)	(2.324)	(2.235)	(1.442)
Education level	0.008***	0.008***	0.001	0.008***	0.008***	0.001
	(5.165)	(5.185)	(0.165)	(5.144)	(5.168)	(0.164)
Nationalist	0.077***	0.069**	-0.009	0.077***	0.071**	-0.009
	(2.664)	(2.403)	(-0.059)	(2.672)	(2.447)	(-0.059)
Observations	28384	28384	28384	28384	28384	28384
Log-likelihood	-32878.452	-32793.464	-32554.842	-32875.319	-32796.059	-32557.085
Fixed Effects	YES	NO	NO	YES	NO	NO
Time Effects	YES	YES	YES	YES	YES	YES
FE×5years TE	NO	YES	YES	NO	YES	YES
Individual_Var.s×TE	NO	NO	YES	NO	NO	YES

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: The determinants of perceived tax enforcement along time. Ordered-Probit, 1994-2014; Separate regressions by UR type.

	(1) Low UR	(2) High UR	(3) Low UR	(4) High UR
GDP (CA)	-0.779***	-0.837**		
	(-3.031)	(-2.421)		
Unemployment (CA)			0.171**	0.243**
			(2.296)	(2.330)
FYL_%GVA_Secondary_sector	-1.131	1.558	-2.163	-0.461
	(-0.665)	(0.585)	(-1.225)	(-0.165)
FYL_%GVA_Construction_sector	-1.368	5.986*	-1.713	5.581
	(-0.558)	(1.685)	(-0.696)	(1.567)
FYL_% GVA_Tertiary_sector	3.343*	3.010	2.759	2.126
	(1.764)	(1.055)	(1.427)	(0.733)
Leftist government (CA)	-0.011	0.101	0.009	0.125**
	(-0.225)	(1.614)	(0.198)	(1.989)
Electoral cycle (CA)	0.004	-0.023	0.011	-0.018
	(0.181)	(-0.731)	(0.448)	(-0.556)
TA per-capita employees	-385.338***	-437.502***	-377.656***	-428.109***
	(-5.034)	(-4.374)	(-4.918)	(-4.275)
Population (CA)	0.000	0.000*	-0.000	0.000
	(0.236)	(1.824)	(-1.298)	(0.504)
Municipality size	-0.087***	-0.069**	-0.087***	-0.068**
	(-3.734)	(-2.272)	(-3.757)	(-2.252)
Municipality size squared	0.009***	0.007*	0.009***	0.007*
	(3.150)	(1.874)	(3.154)	(1.858)
Left	-0.050***	-0.013	-0.050***	-0.012
	(-2.932)	(-0.578)	(-2.924)	(-0.557)
Female	-0.015	0.002	-0.015	0.002
	(-0.799)	(0.100)	(-0.791)	(0.090)
Age	-0.007**	-0.001	-0.007**	-0.001
	(-2.127)	(-0.247)	(-2.117)	(-0.226)
Age squared	0.000***	0.000	0.000***	0.000
	(3.081)	(0.385)	(3.075)	(0.370)
Head of household	0.015	0.012	0.015	0.012
	(0.773)	(0.495)	(0.771)	(0.483)
Dummy married	-0.002	-0.058**	-0.002	-0.057**
	(-0.108)	(-2.536)	(-0.102)	(-2.487)
Dummy self employed	0.038	0.070	0.038	0.069
	(1.444)	(1.358)	(1.423)	(1.342)
Dummy Retired	-0.032	0.056	-0.032	0.054
	(-1.008)	(0.803)	(-1.012)	(0.773)
Dummy public employee	-0.034	-0.004	-0.034	-0.003
	(-1.550)	(-0.126)	(-1.564)	(-0.095)
Education level	0.008***	0.008***	0.007***	0.008***
	(3.587)	(3.670)	(3.573)	(3.658)
Nationalist	0.091**	0.031	0.091**	0.033
	(2.478)	(0.647)	(2.483)	(0.698)
Observations	17371	11013	17371	11013
Log-likelihood	-20002.350	-12706.730	-20004.587	-12707.245
Fixed Effects	NO	NO	NO	NO
Time Effects	YES	YES	YES	YES
FE×5years TE	YES	YES	YES	YES
Individual_Var.s×TE	NO	NO	NO	NO

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: The determinants of perceived tax enforcement along time. Ordered-Probit, 1994-2014; non linearity in the response to economic cycle

	(1)	(2)	(3)	(4)	(5)	(6)
	Linear spline with knots equally spaced		Linear spline with knots at specified points		Orthogonalized third degree polynomial	
			(1st & 5th pctls)	(95th & 99th pctls)		
$GDP\ (CA)_1$	-0.947***		11.017*			
	(-2.949)		(1.662)			
$GDP\ (CA)_2$	-0.235*		-3.204			
	(-1.773)		(-0.934)			
$GDP\ (CA)_2$	-0.430***		-0.321***			
	(-3.842)		(-3.093)			
$Unemployment\ (CA)_1$		-0.168		0.190*		
		(-1.023)		(1.779)		
$Unemployment\ (CA)_2$		0.380***		0.507**		
		(2.847)		(2.244)		
$Unemployment\ (CA)_3$		-0.026		-4.940***		
		(-0.163)		(-2.730)		
Orthogonalized GDP (CA)					-0.086	
					(-1.227)	
Orthogonalized $[GDP\ (CA)]^2$					-0.463***	
					(-3.295)	
Orthogonalized $[GDP\ (CA)]^3$					-0.015	
					(-0.560)	
Orthogonalized Unemployment (CA)						0.273**
						(2.534)
Orthogonalized $[Unemployment\ (CA)]^2$						0.235***
						(2.752)
Orthogonalized $[Unemployment\ (CA)]^3$						-0.236**
						(-2.499)
Observations	28384	28384	28384	28384	28384	28384
Log-likelihood	-32874.364	-32791.823	-32876.756	-32791.934	-32792.843	-32791.664
AC-specific explanatory variables	YES	YES	YES	YES	YES	YES
Individual-level explanatory variables	YES	YES	YES	YES	YES	YES
Fixed Effects	NO	NO	NO	NO	NO	NO
Time Effects	YES	YES	YES	YES	YES	YES
FE×5years TE	YES	YES	YES	YES	YES	YES
Individual_Var.s×TE	NO	NO	NO	NO	NO	NO

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix 1: Robustness analysis

Table 6: The determinants of perceived tax enforcement along time. Ordered-Logit, 1994-2014.

	(1)	(2)	(3)	(4)	(5)	(6)
GDP (CA)	-0.508***	-1.362***	-1.347***			
	(-2.841)	(-3.816)	(-3.621)			
Unemployment (CA)				0.239***	0.320***	0.340***
				(3.476)	(3.065)	(3.010)
FYL_%GVA_Secondary_sector	2.519	-0.912	-1.111	1.035	-3.129	-3.223
	(1.617)	(-0.371)	(-0.422)	(0.688)	(-1.224)	(-1.184)
FYL_%GVA_Construction_sector	-1.906	1.998	2.981	-1.640	1.391	2.568
	(-1.001)	(0.577)	(0.819)	(-0.867)	(0.400)	(0.702)
FYL_% GVA_Tertiary_sector	4.075**	4.830*	4.896*	3.326*	3.727	3.888
	(2.366)	(1.794)	(1.739)	(1.945)	(1.360)	(1.363)
Leftist government (CA)	0.013	0.048	-0.007	0.022	0.084	0.029
	(0.303)	(0.740)	(-0.105)	(0.532)	(1.295)	(0.434)
Electoral cycle (CA)	0.001	-0.002	-0.008	0.001	0.008	0.004
	(0.030)	(-0.068)	(-0.231)	(0.040)	(0.257)	(0.106)
TA per-capita employees	-711.092***	-680.642***	-747.679***	-693.481***	-670.527***	-737.511***
	(-7.066)	(-6.543)	(-7.043)	(-6.887)	(-6.433)	(-6.933)
Population (CA)	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(1.345)	(1.518)	(1.273)	(-1.534)	(-0.565)	(-0.626)
Municipality size	-0.143***	-0.142***	-0.049	-0.144***	-0.142***	-0.049
	(-4.520)	(-4.466)	(-0.317)	(-4.556)	(-4.473)	(-0.317)
Municipality size squared	0.015***	0.015***	0.006	0.015***	0.015***	0.006
	(3.948)	(3.807)	(0.305)	(3.983)	(3.806)	(0.304)
Left	-0.067***	-0.062***	-0.327***	-0.067***	-0.061***	-0.327***
	(-2.930)	(-2.695)	(-2.765)	(-2.903)	(-2.653)	(-2.765)
Female	-0.014	-0.011	-0.084	-0.013	-0.011	-0.084
	(-0.536)	(-0.443)	(-0.708)	(-0.532)	(-0.445)	(-0.707)
Age	-0.005	-0.005	-0.031	-0.006	-0.005	-0.031
	(-1.356)	(-1.324)	(-1.441)	(-1.371)	(-1.325)	(-1.441)
Age squared	0.000**	0.000**	0.000	0.000**	0.000**	0.000
	(2.297)	(2.261)	(1.557)	(2.311)	(2.268)	(1.557)
Head of household	0.024	0.030	0.023	0.025	0.030	0.023
	(0.915)	(1.118)	(0.185)	(0.949)	(1.127)	(0.185)
Dummy married	-0.036	-0.036	-0.036	-0.035	-0.035	-0.035
	(-1.384)	(-1.379)	(-0.236)	(-1.362)	(-1.340)	(-0.234)
Dummy self employed	0.081**	0.082**	0.176	0.080**	0.082**	0.176
	(2.056)	(2.083)	(0.883)	(2.043)	(2.081)	(0.884)
Dummy Retired	-0.016	-0.013	-0.439*	-0.016	-0.013	-0.439*
	(-0.374)	(-0.290)	(-1.833)	(-0.372)	(-0.293)	(-1.834)
Dummy public employee	-0.062*	-0.056*	0.074	-0.061*	-0.055*	0.074
	(-1.942)	(-1.745)	(0.469)	(-1.926)	(-1.733)	(0.470)
Dummy low Unemployment risk (mean)	0.073**	0.070**	0.265	0.073**	0.070**	0.265
	(2.260)	(2.137)	(1.589)	(2.258)	(2.137)	(1.589)
Education level	0.014***	0.015***	0.001	0.014***	0.015***	0.001
	(5.497)	(5.621)	(0.039)	(5.476)	(5.602)	(0.039)
Nationalist	0.121**	0.110**	0.040	0.121**	0.111**	0.040
	(2.452)	(2.207)	(0.150)	(2.449)	(2.240)	(0.150)
Observations	28384	28384	28384	28384	28384	28384
Log-likelihood	-32817.696	-32728.489	-32489.116	-32815.782	-32731.662	-32491.495
Fixed Effects	YES	NO	NO	YES	NO	NO
Time Effects	YES	YES	YES	YES	YES	YES
FE×5years TE	NO	YES	YES	NO	YES	YES
Individual_Var.s×TE	NO	NO	YES	NO	NO	YES

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

**Table 7: The determinants of perceived tax enforcement along time.
OLS, 1994-2014.**

	(1)	(2)	(3)	(4)	(5)	(6)
GDP (CA)	-0.222***	-0.573***	-0.554***			
	(-3.000)	(-3.907)	(-3.650)			
Unemployment (CA)				0.112***	0.144***	0.143***
				(3.896)	(3.322)	(3.080)
FYL_%GVA_Secondary_sector	1.034	-0.412	-0.492	0.375	-1.388	-1.357
	(1.587)	(-0.402)	(-0.454)	(0.595)	(-1.302)	(-1.212)
FYL_%GVA_Construction_sector	-0.902	0.718	0.996	-0.803	0.447	0.828
	(-1.133)	(0.499)	(0.666)	(-1.016)	(0.309)	(0.552)
FYL_% GVA_Tertiary_sector	1.716**	1.993*	1.955*	1.379*	1.498	1.545
	(2.373)	(1.769)	(1.679)	(1.921)	(1.306)	(1.309)
Leftist government (CA)	0.003	0.018	-0.005	0.008	0.034	0.010
	(0.185)	(0.650)	(-0.196)	(0.461)	(1.247)	(0.349)
Electoral cycle (CA)	-0.003	-0.002	-0.004	-0.002	0.002	0.001
	(-0.210)	(-0.181)	(-0.283)	(-0.188)	(0.162)	(0.085)
TA per-capita employees	-304.817***	-288.553***	-315.498***	-296.325***	-282.800***	-310.592***
	(-7.237)	(-6.653)	(-7.221)	(-7.032)	(-6.506)	(-7.094)
Population (CA)	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(1.591)	(1.453)	(1.138)	(-1.405)	(-0.685)	(-0.781)
Municipality size	-0.062***	-0.061***	-0.197	-0.063***	-0.061***	-0.178
	(-4.701)	(-4.610)	(-0.003)	(-4.755)	(-4.626)	(-0.002)
Municipality size squared	0.007***	0.006***	0.057	0.007***	0.006***	0.055
	(4.049)	(3.876)	(0.001)	(4.106)	(3.882)	(0.001)
Left	-0.027***	-0.025***	-0.179***	-0.027***	-0.025***	0.180***
	(-2.831)	(-2.635)	(-3.785)	(-2.821)	(-2.623)	(3.342)
Female	-0.006	-0.005	-0.019	-0.006	-0.005	-0.016
	(-0.575)	(-0.495)	(-0.361)	(-0.571)	(-0.497)	(-0.318)
Age	-0.003*	-0.003*	-0.006	-0.003*	-0.003*	-0.006
	(-1.861)	(-1.851)	(-0.694)	(-1.873)	(-1.840)	(-0.714)
Age squared	0.000***	0.000***	0.000**	0.000***	0.000***	0.000**
	(2.722)	(2.706)	(2.569)	(2.733)	(2.703)	(2.428)
Head of household	0.009	0.011	0.100	0.009	0.011	0.103
	(0.777)	(1.001)	(1.594)	(0.807)	(1.001)	(1.636)
Dummy married	-0.016	-0.017	-0.054	-0.016	-0.016	-0.053
	(-1.507)	(-1.533)	(-0.841)	(-1.488)	(-1.501)	(-0.830)
Dummy self employed	0.032*	0.032**	0.027	0.032*	0.032*	0.027
	(1.942)	(1.961)	(0.338)	(1.914)	(1.938)	(0.334)
Dummy Retired	-0.011	-0.010	0.102	-0.011	-0.010	0.100
	(-0.603)	(-0.545)	(0.964)	(-0.599)	(-0.559)	(0.947)
Dummy public employee	-0.023*	-0.021	-0.018	-0.023*	-0.021	-0.018
	(-1.761)	(-1.579)	(-0.161)	(-1.753)	(-1.577)	(-0.160)
Dummy low Unemployment risk (mean)	0.032**	0.031**	-0.016	0.032**	0.031**	-0.016
	(2.354)	(2.260)	(-0.193)	(2.345)	(2.260)	(-0.200)
Education level	0.006***	0.006***	0.012	0.006***	0.006***	0.012
	(5.208)	(5.228)	(1.278)	(5.186)	(5.210)	(1.287)
Nationalist	0.056***	0.050**	-0.003	0.056***	0.051**	-0.003
	(2.669)	(2.407)	(-0.029)	(2.679)	(2.453)	(-0.029)
Observations	28384	28384	28384	28384	28384	28384
Log-likelihood	-33234.878	-33149.888	-32909.535	-33231.771	-33152.552	-32911.802
Fixed Effects	YES	YES	YES	YES	YES	YES
Time Effects	YES	YES	YES	YES	YES	YES
FE×5years TE	NO	YES	YES	NO	YES	YES
Individual_Var.s×TE	NO	NO	YES	NO	NO	YES

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: The determinants of perceived tax enforcement along time. Ordered-Logit, 1994-2014; Separate regressions by UR type.

	(1) Low risk	(2) High risk	(3) Low risk	(4) High risk
GDP (CA)	-1.343***	-1.439**		
	(-2.980)	(-2.351)		
Unemployment (CA)			0.288**	0.363**
			(2.223)	(1.970)
FYL_%GVA_Secondary_sector	-1.875	2.786	-3.663	-0.263
	(-0.638)	(0.597)	(-1.201)	(-0.054)
FYL_%GVA_Construction_sector	-2.182	11.228*	-2.781	10.646*
	(-0.511)	(1.790)	(-0.649)	(1.691)
FYL_% GVA_Tertiary_sector	6.177*	4.329	5.154	3.105
	(1.879)	(0.868)	(1.538)	(0.613)
Leftist government (CA)	0.007	0.151	0.040	0.188*
	(0.082)	(1.390)	(0.484)	(1.733)
Electoral cycle (CA)	0.012	-0.042	0.023	-0.032
	(0.283)	(-0.755)	(0.535)	(-0.579)
TA per-capita employees	-664.776***	-733.473***	-653.571***	-722.656***
	(-5.007)	(-4.268)	(-4.908)	(-4.201)
Population (CA)	0.000	0.000*	-0.000	0.000
	(0.391)	(1.776)	(-1.104)	(0.519)
Municipality size	-0.140***	-0.128**	-0.140***	-0.127**
	(-3.478)	(-2.413)	(-3.492)	(-2.392)
Municipality size squared	0.015***	0.014**	0.015***	0.013**
	(2.955)	(2.087)	(2.953)	(2.069)
Left	-0.086***	-0.028	-0.085***	-0.027
	(-2.914)	(-0.758)	(-2.883)	(-0.719)
Female	-0.023	0.007	-0.023	0.007
	(-0.702)	(0.179)	(-0.700)	(0.170)
Age	-0.009	0.001	-0.009	0.001
	(-1.574)	(0.153)	(-1.569)	(0.163)
Age squared	0.000***	0.000	0.000***	0.000
	(2.603)	(0.021)	(2.601)	(0.014)
Head of household	0.030	0.026	0.030	0.026
	(0.874)	(0.608)	(0.879)	(0.604)
Dummy married	0.004	-0.099**	0.005	-0.098**
	(0.119)	(-2.489)	(0.133)	(-2.444)
Dummy self employed	0.070	0.113	0.069	0.113
	(1.524)	(1.288)	(1.517)	(1.281)
Dummy Retired	-0.050	0.072	-0.050	0.070
	(-0.904)	(0.601)	(-0.905)	(0.578)
Dummy public employee	-0.070*	-0.006	-0.070*	-0.004
	(-1.835)	(-0.103)	(-1.841)	(-0.067)
Education level	0.014***	0.015***	0.014***	0.014***
	(3.794)	(3.860)	(3.780)	(3.850)
Nationalist	0.145**	0.047	0.145**	0.051
	(2.299)	(0.576)	(2.299)	(0.616)
Observations	17371	11013	17371	11013
ll	-19971.477	-12679.094	-19973.757	-12680.192
Fixed Effects	NO	NO	NO	NO
Time Effects	YES	YES	YES	YES
FE×5years TE	YES	YES	YES	YES
Individual_Var.s×TE	NO	NO	NO	NO

Note: t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: The determinants of perceived tax enforcement along time.
OLS, 1994-2014; Separate regressions by UR type.

	(1) Low risk	(2) High risk	(3) Low risk	(4) High risk
GDP (CA)	-0.552***	-0.617**		
	(-2.994)	(-2.474)		
Unemployment (CA)			0.122**	0.175**
			(2.275)	(2.314)
FYL_%GVA_Secondary_sector	-0.766	1.073	-1.504	-0.377
	(-0.624)	(0.558)	(-1.179)	(-0.187)
FYL_%GVA_Construction_sector	-1.023	4.309*	-1.272	4.019
	(-0.579)	(1.674)	(-0.716)	(1.557)
FYL_% GVA_Tertiary_sector	2.444*	2.104	2.027	1.477
	(1.787)	(1.015)	(1.452)	(0.700)
Leftist government (CA)	-0.007	0.072	0.007	0.089*
	(-0.211)	(1.578)	(0.211)	(1.954)
Electoral cycle (CA)	0.003	-0.018	0.008	-0.014
	(0.178)	(-0.793)	(0.441)	(-0.606)
TA per-capita employees	-279.459***	-313.565***	-273.953***	-306.853***
	(-5.094)	(-4.352)	(-4.977)	(-4.253)
Population (CA)	0.000	0.000*	-0.000	0.000
	(0.245)	(1.814)	(-1.267)	(0.473)
Municipality size	-0.062***	-0.050**	-0.062***	-0.050**
	(-3.715)	(-2.292)	(-3.738)	(-2.271)
Municipality size squared	0.006***	0.005*	0.006***	0.005*
	(3.142)	(1.907)	(3.147)	(1.891)
Left	-0.036***	-0.010	-0.036***	-0.010
	(-2.922)	(-0.644)	(-2.915)	(-0.623)
Female	-0.011	0.002	-0.011	0.002
	(-0.823)	(0.144)	(-0.816)	(0.133)
Age	-0.005**	-0.001	-0.005**	-0.001
	(-2.046)	(-0.203)	(-2.037)	(-0.182)
Age squared	0.000***	0.000	0.000***	0.000
	(3.016)	(0.343)	(3.009)	(0.328)
Head of household	0.011	0.010	0.011	0.009
	(0.772)	(0.542)	(0.770)	(0.529)
Dummy married	-0.001	-0.042**	-0.001	-0.041**
	(-0.086)	(-2.521)	(-0.081)	(-2.474)
Dummy self employed	0.027	0.049	0.027	0.048
	(1.423)	(1.319)	(1.401)	(1.302)
Dummy Retired	-0.024	0.037	-0.024	0.036
	(-1.040)	(0.738)	(-1.044)	(0.706)
Dummy public employee	-0.025	-0.003	-0.025	-0.003
	(-1.568)	(-0.129)	(-1.581)	(-0.099)
Education level	0.005***	0.006***	0.005***	0.006***
	(3.592)	(3.702)	(3.578)	(3.690)
Nationalist	0.065**	0.023	0.065**	0.025
	(2.458)	(0.667)	(2.462)	(0.720)
Observations	17371	11013	17371	11013
ll	-20218.956	-12851.742	-20221.121	-12852.414
Fixed Effects	NO	NO	NO	NO
Time Effects	YES	YES	YES	YES
FE×5years TE	YES	YES	YES	YES
Individual_Var.s×TE	NO	NO	NO	NO

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: The determinants of perceived tax enforcement along time. Ordered-Logit, 1994-2014; non linearity in the response to economic cycle

	(1)	(2)	(3)	(4)	(5)	(6)
	Linear spline with knots equally spaced		Linear spline with knots at specified points		Orthogonalized third degree polynomial	
			(1st & 5th pctls)	(95th & 99th pctls)		
GDP (CA)$_1$	-1.711***		17.000			
	(-3.015)		(1.484)			
GDP (CA)$_2$	-0.339		-6.157			
	(-1.452)		(-1.016)			
GDP (CA)$_2$	-0.749***		-0.528***			
	(-3.839)		(-2.924)			
Unemployment (CA)$_1$		-0.335		0.307*		
		(-1.160)		(1.654)		
Unemployment (CA)$_2$		0.657***		0.787**		
		(2.842)		(1.992)		
Unemployment (CA)$_3$		-0.107		-7.496**		
		(-0.381)		(-2.373)		
Orthogonalized GDP (CA)					-0.150	
					(-1.198)	
Orthogonalized [GDP (CA)]^2					-0.782***	
					(-3.119)	
Orthogonalized [GDP (CA)]^3					-0.042	
					(-0.904)	
Orthogonalized Unemployment (CA)						0.462**
						(2.457)
Orthogonalized [Unemployment (CA)]^2						0.409***
						(2.734)
Orthogonalized [Unemployment (CA)]^3						-0.410**
						(-2.485)
Observations	28384	28384	28384	28384	28384	28384
Log-likelihood	-32812.394	-32727.130	-32816.241	-32728.491	-32727.389	-32727.275
AC-specific explanatory variables	YES	YES	YES	YES	YES	YES
Individual-level explanatory variables	YES	YES	YES	YES	YES	YES
Fixed Effects	NO	NO	NO	NO	NO	NO
Time Effects	YES	YES	YES	YES	YES	YES
FE×5years TE	YES	YES	YES	YES	YES	YES
Individual_Var.s×TE	NO	NO	NO	NO	NO	NO

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: The determinants of perceived tax enforcement along time. OLS, 1994-2014; non linearity in the response to economic cycle

	(1)	(2)	(3)	(4)	(5)	(6)
	Linear spline with knots equally spaced		Linear spline with knots at specified points		Orthogonalized third degree polynomial	
			(1st & 5th pctls)	(95th & 99th pctls)		
GDP (CA)$_1$	-0.681***		7.785*			
	(-2.930)		(1.650)			
GDP (CA)$_2$	-0.164*		-2.376			
	(-1.702)		(-0.956)			
GDP (CA)$_2$	-0.310***		-0.230***			
	(-3.840)		(-3.071)			
Unemployment (CA)$_1$		-0.122		0.136*		
		(-1.026)		(1.762)		
Unemployment (CA)$_2$		0.273***		0.363**		
		(2.833)		(2.217)		
Unemployment (CA)$_3$		-0.019		-3.506***		
		(-0.158)		(-2.667)		
Orthogonalized GDP (CA)					-0.062	
					(-1.227)	
Orthogonalized [GDP (CA)]^2					-0.333***	
					(-3.283)	
Orthogonalized [GDP (CA)]^3					-0.012	
					(-0.642)	
Orthogonalized Unemployment (CA)						0.197**
						(2.523)
Orthogonalized [Unemployment (CA)]^2						0.170***
						(2.751)
Orthogonalized [Unemployment (CA)]^3						-0.171**
						(-2.496)
Observations	28384	28384	28384	28384	28384	28384
Log-likelihood	-33230.653	-33148.297	-33233.213	-33148.547	-33149.155	-33148.103
AC-specific explanatory variables	YES	YES	YES	YES	YES	YES
Individual-level explanatory variables	YES	YES	YES	YES	YES	YES
Fixed Effects	NO	NO	NO	NO	NO	NO
Time Effects	YES	YES	YES	YES	YES	YES
FE×5years TE	YES	YES	YES	YES	YES	YES
Individual_Var.s×TE	NO	NO	NO	NO	NO	NO

Note: *t* statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$