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TAX POLICY STANCE OVER THE BUSINESS CYCLE:

EVIDENCE FROM EUROPE

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ABSTRACT

We contribute to the literature addressing the cyclical behavior of tax policy. Most recent studies have relied on tax revenues and adjusted measures of tax collections to analyze this issue. We argue that such methodology is insufficient to characterize tax policy cyclicality, as tax revenues move endogenously with the business cycle. Consequently, this topic is revisited by making use of the policy instrument, tax rate, as opposed to the policy outcome, tax revenues. Using data for 13 European countries, we find that tax policy has mostly been a-cyclical over the last 30 years.

Keywords: business cycle, tax policy, tax rate, cyclicality.

1. INTRODUCTION AND LITERATURE REVIEW

The response of fiscal policy to the cyclical conditions of the economy has been under substantial empirical investigation. Whether fiscal authorities are able to pursue macroeconomic stabilization is an ongoing topic gaining additional relevance for euro area countries. By joining the European Monetary Union (EMU) these countries lost monetary policy and rely exclusively on national fiscal policies to correct for undesired economic fluctuations. One example of such circumstances was the aftermath of the recent global crisis where European governments applied strong counter-cyclical fiscal packages. As a result of this policy, large fiscal deficits popped up and concerns on sovereign debt sustainability started to dominate financial news around the world. With the shift of policy intentions from fiscal stimulus to fiscal adjustment, many European countries increased taxes to combat explosive debt dynamics under a negative economic outlook. Motivated by these events, we aim at characterizing what has been the behavior of European tax policy over the business cycle in the past 30 years. Were European countries able to pursue counter-cyclical tax policies (i.e. by raising tax revenues in good times allowing for greater budget flexibility in bad times), or has tax policy followed a completely different path (e.g. requiring actions driven by fiscal sustainability motives precisely when expansionary actions are needed the most). Before going any further, an important clarification is needed concerning the various forces that might drive fiscal policy. To start with, the so-called automatic stabilizers are a result of previously set fiscal rules and laws that link some components of government balances directly to GDP fluctuations (e.g. unemployment benefits are amplified in recessions and tax revenue is enhanced in good times motivated by larger tax bases). Moreover, fiscal policy might incorporate discretionary actions aiming at smoothing the underlying business cycle (heightening the effect of automatic stabilizers), as well as innovations driven by fiscal sustainability concerns, assuring non explosive debt dynamics. Finally, some fiscal actions might also be driven by other factors such as political considerations. That said, several authors attempt to study “how fiscal policy is being conducted over the business cycle”. Concerning this topic of fiscal policy cyclicality, three possibilities emerge. The standard Keynesian theory argues that output deviations from its potential level create undesired costs to the society, recommending therefore that fiscal policy should manipulate aggregate demand to bring output to its potential level. This way, fiscal policy should be conducted in a counter-cyclical fashion, having a stabilizing role in the economy. We say that fiscal policy is counter-cyclical as it tends to smooth the business cycle by being contractionary in good times (lowering government spending and raising tax rates) and expansionary in bad times (raising government spending and lowering tax rates). On the other hand, a pro-cyclical fiscal policy entails the opposite behavior, involving higher (lower) government spending and lower (higher) tax rates in good (bad) times. We call such a policy pro-cyclical, because it tends to reinforce the business cycle (fiscal policy is expansionary in good times and contractionary in bad times). Finally, an a-cyclical fiscal policy involves constant government spending and constant tax rates along the economic cycles (i.e. government spending and tax rates do not tend to vary systematically with the business cycle). Such cyclical conduct is revised in the Tax Smoothing Hypothesis inspired by Barro (1979), in which he argues that tax rates should be held constant over the business cycle, with governments borrowing in recessions and repaying in booms. In this work, we will be assessing which of the cyclical behaviors can be found in the data. Focusing on the spending side, Lane (2003) and Ilzetzki and Vegh (2008) computed the degree of cyclicality of government consumption and government investment (the analysis of aggregated government spending was left behind as it includes government transfers which move endogenously with the cycle). Surprisingly, the results from their works supported a pro-cyclical behavior of government expenditure in industrialized economies, contradicting the conventional wisdom that spending policy should be counter-cyclical. Regarding taxation, a first approach to study the stance of tax policy over the business cycle used to be done by relating tax revenues and tax revenues as proportion of GDP with measures of cyclical conditions. One example of such methodology is the work of Furceri and Karras (2010). However, because tax revenues automatically co-move with the business cycle such approach was obviously flawed. During economic expansions tax bases get larger and therefore tax revenues are also amplified. For this reason, tax collections are not a suitable variable to evaluate the discretionary behavior of tax policy over the business cycle since higher tax revenues in good times are consistent with higher, unchanged and even lower tax rates. Corroborating this view, Kaminsky, Reinhart and Vegh (2004) show that tax collections as a ratio of GDP provide ambiguous analysis of tax policy cyclicality. In an attempt to correct for the endogenous fluctuations in the tax base, several authors computed cyclically adjusted tax revenues to evaluate the cyclical stance of tax policy. Among them, Fatas and Mihov (2009) focused in finding the structural level of tax revenues (what tax revenues would be if the economy was placed at its full employment level), through the extraction of the cyclical component from tax revenues. By doing so, changes in such measure should be foreseen as actual tax policy changes. However, this methodology is severely criticized in Riera-Crichton, Vegh and Vuletin (2012), as they argue that such variable will most likely suffer from relevant measurement errors, producing biased analysis. The main justification for such statement, is the assumption of time invariant tax elasticities to output (constant tax base to GDP ratio) of standard cyclical adjustment procedures. In fact, as pointed out in Girouard and Andre (2005), current cyclical adjustment methods fail to take into account temporary factors, not directly linked to the economic cycle, such as one-off operations or asset price cycles. Because tax collections are affected by such dynamics, shifts in cyclically adjusted revenues will be triggered by other reasons than actual policy innovations. This major drawback makes such indicator a poor proxy for discretionary tax policy changes and thus an inaccurate variable to evaluate the cyclical stance of tax policy. Summing up, there is no good substitute for tax rates, arguably the true policy instrument, when analyzing the cyclical properties of tax policy. Unfortunately, and with the exception of Vegh and Vuletin (2012), studies on tax policy cyclicality using the policy instrument (tax rate), as opposed to the policy outcome (tax revenues), are practically inexistent, apparently due to lack of data on tax rates. Getting around this limitation, Vegh and Vuletin (2012) constructed a novel annual data set on value added, personal income and corporate income tax rates for 20 industrial countries between 1960 and 2009. By computing the degree of cyclicality of each tax rate, they conclude that tax policy in high income countries has been a-cyclical, as no systematic relationship between tax rate changes and cyclical GDP was found. In the light of this approach, and because evidence on tax rate cyclicality is scarce, we also moved in the direction of gathering data on tax rates attempting to provide evidence on the cyclicality of this policy instrument. From this effort resulted a collection of data on personal income, corporate income and value added tax rates, for 13 European countries over the last 30 years. Subjecting the data to different econometric specifications, we were able to find some cross-country heterogeneity with respect to the way tax policy is being conducted over the business cycle. While a counter-cyclical behavior of tax rates is completely refuted by the data, evidence of tax smoothing (tax rate a-cyclicality) is supported for most countries in the sample with a few exhibiting some indication of pro-cyclicality. As we will see next, these results are robust to adjustments concerning endogeneity issues. The reminder of the article is organized as follows: section 2 describes the data and the empirical methodology, section 3 presents our main findings and section 4 concludes.

2. DATA AND METHODOLOGY

While, by now, the strong consensus in the literature is that government spending has typically been pro-cyclical, little is known about the cyclical behavior of tax rates. When analyzing the business cycle properties of the spending policy, government consumption and government investment are commonly used as fiscal measures. While these two variables totalize the policy instrument on the spending side, governments do not rely on a single tax rate to conduct tax policy. The existence of several tax categories including, among others, individual and corporate income taxes, social security contributions as well as taxes on property and transactions, turn the analyses of changes in tax policy particularly challenging. Although since almost 80% of total tax revenue in industrialized countries comes from the sum of personal income, corporate income and value added taxation, we consider that tax rates for these 3 revenue categories should provide a suitable proxy of the overall tax policy stance. Given that, we concentrated our efforts in the collection of annual data on personal income, corporate income and value added tax rates for 13 European countries: Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and the United Kingdom (the choice of the countries was dictated by data availability). Starting with personal income taxation, the existence of several rates for different income brackets along with a complex system of deductions turn the analysis of such tax category particularly tricky. One existing variable in the literature that takes into account such properties of personal income taxation, constituting a serious candidate to measure personal income tax policy changes, is the average marginal income tax rate (AMITR). However, as referred in Riera-Crichton, Vegh and Vuletin (2012), this variable suffers from an important shortcoming. Such measure is probably affected by shifts in the marginal tax rate distribution of households and therefore, increases in the AMITR could reflect the migration of households into higher income brackets triggered for example by higher inflation episodes. This concern is particularly relevant in countries of the developed world with a history of high moderate and persistent levels of inflation such as Greece, Spain, Italy and Portugal. Because of such drawback, and due to lack of data on the AMITR, we elected the personal income tax rate for the highest income threshold our preferred measure when it comes to analyze tax policy innovations for the personal income tax category. Enhancing the power of our choice, Vegh and Vuletin (2012) found significantly positive correlations between the AMITR and the top marginal personal income tax rate for some industrialized countries. Moreover, the use of a single rate allows the researcher to clearly evaluate discretionary tax policy actions. Annual data on personal income tax (PIT) rates was extracted from the OECD Tax Database comprising the period 1981-2012. The PIT rate employed in this study, refers to the top income threshold central government personal income tax rate, for a single person without dependents. Regarding corporate taxation, actions on this branch of tax policy are easier to evaluate, in the sense many countries exhibit a corporate tax rate system with a flat rate amongst several levels of profits. When this is not the case we will be making use of the top corporate income tax (CIT) rate. Annual data on corporate income tax rates was obtained in the OECD Tax Database covering the period 1981-2013. The CIT rate employed refers to the adjusted central government corporate income tax rate. Concerning indirect taxation, we will be using the standard rate of value added taxes (VAT) as it covers the biggest slice of economic transactions. Data on VAT rates was gathered from the European Commission for the 13 countries included in the sample since the year of implementation. Table 1 provides the coverage period of tax rate data. Value added taxes in Europe dates from 1967 with Denmark being the first country to establish such type of taxation. Countries such as France, Germany, Netherlands and Sweden rapidly followed the Danish example while Portugal, Spain and Greece introduced the VAT rate only 20 years later. Doing a quick overview throughout the tax rate data, a clear long run pattern emerges (Figure 1). A moderate downward trend of the PIT and CIT rates is observed since the 80's till late 00's with VAT rates presenting the opposing tendency. The average PIT rate across main European countries dropped from 60% in 1980 to 40% in 2010 while the average CIT rate recorded a fall from 45% in 1980 to 25% in 2010. Opposing this trend, average VAT rates increased from 18.5% in the 1990's to 20% in 2009, escalating since then reaching almost 22% in 2013. Concerning the tax revenue structure of European countries, Table 2 provides descriptive statistics on the tax burden, defined as government tax revenues in % of GDP, and the tax revenue composition, the weight of each tax category in total taxation. The Northern countries, Sweden and Denmark display the highest tax burdens across European countries, with tax revenues totalizing 48% and 47% of own GDP. On the other hand, Portugal and Greece show the lowest tax burden schedules, 28% and 29% respectively. Comprising the tax revenue composition, the weight of personal income taxes in total taxation goes from 52% in Denmark to just 13% in Greece, while corporate income revenues reaches 9.4% of total revenues in the UK and only 4.2% in Austria. Regarding value added taxation, Portugal seems to rely heavily on this tax category as 23% of total revenues comes from this class of taxes. In the other extreme of the list, Italy presents the lowest weight of value added taxes in total taxation, about 14%. In order to evaluate the behavior of tax policy over the business cycle, the purpose of this paper, tax rates are related to measures of cyclical conditions (data on Real GDP was collected from the AMECO database). Such analysis is performed by computing the degree of cyclicality of each tax category, making use of the respective tax rate (PIT, CIT and VAT), as well as of a tax index constructed in the light of Vegh and Vuletin (2012):

$$Tax\ Index_{it} = w_i^{PIT} * PIT\ rate_{it} + w_i^{CIT} * CIT\ rate_{it} + w_i^{VAT} * VAT\ rate_{it} \qquad (1)$$

The referred index aims at representing the overall tax policy stance by aggregating the three types of tax rates weighted by the relative importance of each tax category in the tax system. The level of the personal income tax rate is therefore multiplied by the tax revenue on individual income divided by the sum of individual income, corporate income and valued added tax revenues. The method is replicated for the remaining two tax rates. To notice that the weights are not indexed to time. The option for time invariant weights aims at creating a tax index that resumes discretionary tax policy actions across the three rates by excluding any response of tax bases, and therefore tax revenues and weights, to tax policy innovations. Taking such effects into consideration, the weights for each country result from the average weights of each tax across the sample period (tax revenue data is obtained from the OECD database). Jumping into the empirical methodology, and inspired by Vegh and Vuletin (2012), we search for significant correlations between the cyclical components of each tax rate and the tax index, and real GDP (cyclical components were estimated using the Hodrick-Prescott filter with a smoothing parameter of 6.5). The following equation is estimated individually for each country in the sample (by OLS) for the PIT, CIT and VAT rates, as well as for the constructed tax index:

$$CC\ of\ Tax\ Rate_{it} = \beta_i * CC\ of\ Real\ GDP_{it} + u_{it} \quad (2)$$

A significantly positive β implies that the cyclical components of each tax and real GDP are positively correlated, suggesting that tax policy actions are intended to smooth the underlying business cycle (counter-cyclical tax policy). In contrast, a negative and significant β captures the case of pro-cyclical tax policy, as the output gap is potentially being amplified by tax policy innovations (negative systematic relationship between the cyclical components of tax rates and GDP). Finally, no correlation between tax rates and GDP indicates a-cyclicality of tax policy, meaning that the representative policymaker is not being sensitive to the state of economic activity when performing tax policy changes. While the use of the HP filter to extract the cyclical components from fiscal variables is a typical approach when addressing fiscal policy cyclicality on the spending side, such method is less obvious for tax rates that change less frequently. For this reason, we perform a robustness check of results by subjecting the data to a second empirical specification:

$$\Delta Tax\ Rate_{it} = \alpha_i + \beta_i * \ Real\ GDP\ growth_{it} + u_{it} \quad (3)$$

This second methodology aims at testing the relationship between tax rate changes and real output growth. Once again, a positive coefficient entails counter-cyclical tax policy, while a negative one indicates a pro-cyclical stance. The case of a-cyclicality is equally represented by zero correlation (no systematic relationship) between tax rate changes and GDP growth. Equation (3) is estimated by OLS, country by country, for the tax index and for each tax category. A well-know concern when addressing the issue of fiscal policy cyclicality is the problem of endogeneity, which is caused by the likely correlation between the regressor, that defines the cyclical position of the economy, and the error term. By estimating the above empirical models by OLS we are assuming that causality goes from the business cycle to tax rates. However, because fiscal innovations have an effect on GDP, the error term u_{it} of the empirical specifications is, most likely, correlated with the explanatory variable. In the case of tax policy, since an increase in taxes have a negative effect on output, the cyclical coefficient (β) might suffer from a downward bias. To overcome this problem of reverse causality, we pursue instrumental variable estimation with carefully chosen instruments previously proposed in the literature. For the first empirical specification, we follow Fatas and Mihov (2009) on their work with cyclically adjusted revenues. The cyclical component of real GDP for each country is instrumented with one lag of the own cyclical component of real GDP, as well as the current value of the cyclical component of US GDP. In relation to the second empirical methodology, instruments for output growth derive from the work of Lane (2003) on government spending cyclicality. He used an average of the output growth of a country's trading partners as an instrument for the real GDP growth of a given country. Based on his suggestion, as the main trading partners of European countries are European countries themselves, we use the euro area GDP growth as an instrument for the output growth of each country in the sample. Additionally, one lag of the domestic GDP growth for each country is added to the instrument list.

3. EMPIRICAL FINDINGS

In this section, we present our main findings concerning the way European tax policy has been conducted over the business cycle. Appendix 3 summarizes the cyclical behavior of the PIT, CIT and VAT rates as well as the tax index. As a general rule, estimation results support that tax policy has mostly been a-cyclical over the last 30 years, completely discarding a counter-cyclical stance. Tables 3 to 6 illustrate this picture by presenting non significant correlations between the cyclical components of each tax rate and the tax index, and real GDP for most countries in the sample (standard errors robust to heteroskedasticity and autocorrelation are also reported, as well as the coefficient p-value). As discussed in section 2, the alleged pro-cyclicality found for the CIT rate in Netherlands, Portugal and Spain, for the VAT rate in Belgium, Greece and Spain and for the aggregated tax index in Spain (p-values lower than 10%) could just reflect the effect of tax multipliers on output (when taxes increase (decrease), output contracts (expands)). Attempting to eliminate the downward bias of OLS estimates created by this possible endogeneity, tables 7 trough 10 present instrumental variable estimates for the relationship between the cyclical components of the fiscal variables and real GDP (in order to assure the exogeneity of the chosen instruments, the p-value of the Sargan test is equally tabled – the null hypothesis of uncorrelation between the instruments and the error term can be almost always not rejected across all European countries and specifications). The instrumental variable estimation, results in only one country (Netherlands) sustaining pro-cyclical behavior of corporate income taxation, with Germany even showing some indication of counter-cyclicality for value added taxes. Because extracting the cyclical components from variables with a similar behavior to tax rates is not customary, as discussed in section 2, we attempt to corroborate such findings with a second empirical specification. This time we exploit the relationship between tax rate changes and real GDP growth. A quick overview of the results confirms the main finding of the first empirical method (a-cyclicality of tax policy). Also, a common pattern is striking, tax rate changes appear to be slightly more responsive to output growth than the output gap (cyclical component of real GDP). One possible explanation for such finding is that while GDP growth can be directly observed by the policymaker, the output gap cannot. Tables 11 to 14 display OLS estimates for this empirical specification. Once again, the estimation results support no systematic correlation between tax policy changes and economic activity for most countries in the sample. Interestingly, some degree of pro-cyclicality pops up for the same group of countries as in the specification of the cyclical components. For personal income and value added taxation, Greece and Spain are the countries exhibiting pro-cyclical behavior, while Ireland, Netherlands and Portugal display negative correlations between the CIT rate and output growth. At the same time, estimates for the tax index entails pro-cyclicality for Ireland, Portugal and Spain. Contrarily to the model with the cyclical components, such source of pro-cyclicality does not disappear once the endogeneity problem is taken into account. After pursuing instrumental variable estimations (Tables 15-18), the pro-cyclical stance remains for Spain in the PIT and VAT classes and for Ireland, Netherlands and Portugal in the CIT class. Also, Ireland, Portugal and Spain are able to keep the pro-cyclical behavior in the tax index. Summing up, while the a-cyclical findings for most European countries are robust to both specifications, for countries as Ireland, Portugal and Spain are not, suggesting that tax policy in those countries might be suffering from some source of pro-cyclicality.

4. CONCLUSIONS

While, by now, it is universally agreed in the literature that government spending has typically been pro-cyclical, evidence on tax rate cyclicality is almost nonexistent due to lack of data. Getting around this apparent limitation, we were able to collect data on personal income, corporate income and value added tax rates for 13 European countries over a spanning period of more than 30 years. We find that, by and large, tax policy has been a-cyclical in Europe over the last decades. Interestingly, some degree of heterogeneity emerge across countries. While Northern and Central Europe countries display a-cyclical tax policies, some Southern countries as Portugal and Spain, alongside with Ireland exhibit some sign of pro-cyclicality. Given that, we believe future research should be conducted in order to confirm and disentangle such particular behavior. If this source of pro-cyclicality in good times is a cause of fragile fiscal systems, or an effect of debt stabilization programs in bad times, is left to be shown.

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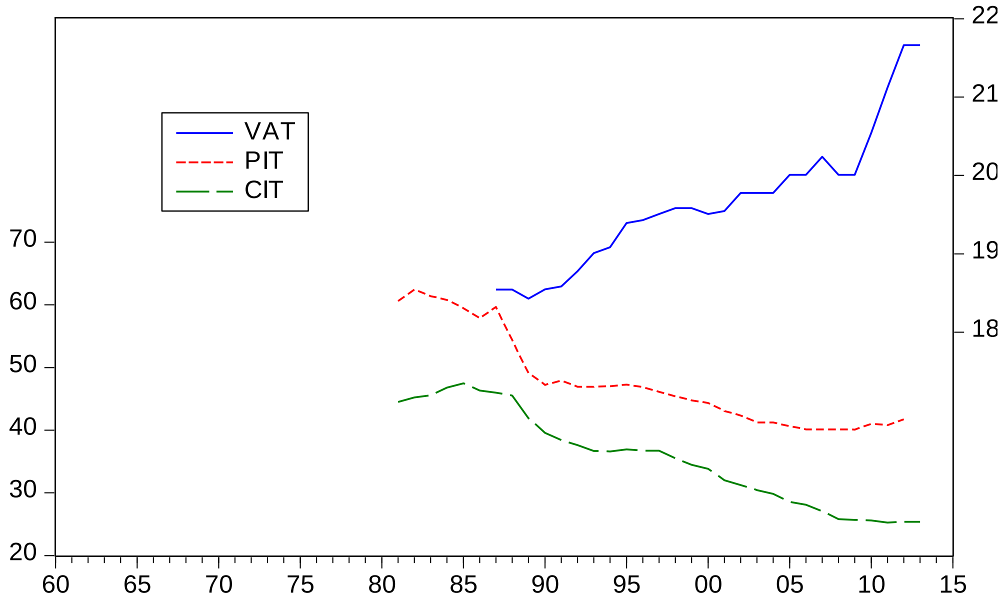
APPENDIX 1.

Figure 1 – Cross-country average rates



years

APPENDIX 2.

Table 1
Tax Rate data: Period of coverage

	PIT	CIT	VAT
Austria	1981-2012	1981-2013	1973-2013
Belgium	1981-2012	1981-2013	1971-2013
Denmark	1981-2012	1981-2013	1967-2013
France	1981-2012	1981-2013	1968-2013
Germany	1981-2012	1981-2013	1968-2013
Greece	1981-2012	1981-2013	1987-2013
Ireland	1981-2012	1981-2013	1972-2013
Italy	1981-2012	1981-2013	1973-2013
Netherlands	1981-2012	1981-2013	1969-2013
Portugal	1981-2012	1981-2013	1986-2013
Spain	1981-2012	1981-2013	1986-2013
Sweden	1981-2012	1981-2013	1969-2013
UK	1981-2012	1981-2013	1973-2013

Table 2
Tax burden and tax revenue composition
1981-2012 average
*for Portugal data is only available from 1989 onwards
Source: OECD

	Total tax revenues as % of GDP	PIT revenues (% of total taxation)	CIT revenues (% of total taxation)	VAT revenues (% of total taxation)
Austria	41%	22.2%	4.2%	19.4%
Belgium	43%	31.6%	5.9%	15.8%
Denmark	47%	52.0%	5.2%	20.0%
France	43%	14.2%	5.4%	17.6%
Germany	36%	26.3%	4.5%	17.6%
Greece	29%	13.6%	6.5%	22.4%
Ireland	31%	30.4%	8.1%	21.6%
Italy	39%	26.1%	8.4%	14.2%
Netherlands	41%	20.0%	7.8%	17.0%
Portugal	28%	17.6%	9.1%	23.2%
Spain	31%	20.7%	7.3%	16.2%
Sweden	48%	34.3%	5.2%	16.8%
UK	35%	28.4%	9.4%	17.8%

APPENDIX 3. Estimation results:

Table 3 – PIT rate cyclicality: model 1 (OLS estimates)
Dependent Variable : Cyclical Component of PIT rate
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	Obs.
Austria	-0.2781	0.2260	0.22	32
Belgium	-0.2124	0.2867	0.46	32
Denmark	-0.0825	0.1016	0.42	32
France	0.0548	0.2374	0.81	32
Germany	-0.0526	0.0648	0.42	32
Greece	-0.0939	0.2110	0.65	32
Ireland	-0.0278	0.0628	0.66	32
Italy	-0.1399	0.2178	0.52	32
Netherlands	-0.1218	0.2463	0.62	32
Portugal	-0.4616	0.2846	0.11	32
Spain	-0.4321	0.2800	0.13	32
Sweden	-0.2880	0.3294	0.38	32
UK	-0.4100	0.4195	0.33	32

Table 4 – CIT rate cyclicality: model 1 (OLS estimates)
Dependent Variable: Cyclical Component of CIT rate
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	Obs.
Austria	-0.7987	0.4911	0.11	33
Belgium	0.1319	0.1626	0.42	33
Denmark	0.0949	0.1766	0.59	33
France	0.1196	0.2244	0.59	33
Germany	0.0378	0.1057	0.72	33
Greece	0.1724	0.2358	0.46	33
Ireland	-0.0177	0.0776	0.82	33
Italy	-0.0310	0.2617	0.90	33
Netherlands	-0.5160	0.1244	0.00	33
Portugal	-0.3061	0.0877	0.00	33
Spain	-0.1008	0.0497	0.05	33
Sweden	0.4514	0.2980	0.13	33
UK	0.0846	0.0740	0.26	33

Table 5 – VAT rate cyclicality: model 1 (OLS estimates)
Dependent Variable: Cyclical Component of VAT rate
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	Obs.
Austria	0.0022	0.0324	0.94	41
Belgium	-0.0664	0.0395	0.10	43
Denmark	0.0102	0.0361	0.77	47
France	-0.0622	0.0785	0.43	46
Germany	0.0347	0.0410	0.40	46
Greece	-0.1137	0.0661	0.09	27
Ireland	-0.0983	0.0929	0.29	42
Italy	-0.0210	0.0535	0.69	41
Netherlands	0.0168	0.0493	0.73	45
Portugal	0.0009	0.0411	0.98	28
Spain	-0.1429	0.0732	0.06	28
Sweden	-0.0982	0.0916	0.28	45
UK	0.1091	0.0998	0.28	41

Table 6 – Tax Index cyclicality: model 1 (OLS estimates)
Dependent Variable: Cyclical Component of the Tax Index
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	Obs.
Austria	-0.2245	0.1577	0.16	32
Belgium	-0.1225	0.1789	0.49	32
Denmark	-0.0506	0.0692	0.46	32
France	0.0378	0.0978	0.70	32
Germany	-0.0168	0.0516	0.74	32
Greece	-0.0930	0.1106	0.40	26
Ireland	-0.0445	0.0651	0.49	32
Italy	-0.0833	0.1340	0.53	32
Netherlands	-0.1545	0.1241	0.22	32
Portugal	-0.1561	0.1361	0.26	27
Spain	-0.2291	0.1175	0.06	27
Sweden	-0.1373	0.1864	0.46	32
UK	-0.1956	0.2340	0.40	32

Table 7 – PIT rate cyclicality: model 1 (IV estimates)
Dependent Variable: Cyclical Component of PIT rate
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	-0.1835	0.2639	0.49	0.88
Belgium	-0.1693	0.4924	0.73	0.25
Denmark	0.2038	0.1576	0.20	0.00
France	-0.1471	0.5065	0.77	0.46
Germany	0.0874	0.1939	0.65	0.65
Greece	0.3240	0.6253	0.60	0.63
Ireland	-0.0854	0.0828	0.31	0.15
Italy	-0.5013	0.4409	0.26	0.81
Netherlands	0.1903	0.1920	0.32	0.04
Portugal	-0.4078	0.3004	0.18	0.76
Spain	-0.6153	0.5445	0.26	0.44
Sweden	-1.9052	1.2964	0.15	0.97
UK	-0.5383	0.3888	0.17	0.01

Table 8 – CIT rate cyclicality: model 1 (IV estimates)
Dependent Variable: Cyclical Component of CIT rate
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	-0.9905	0.7276	0.18	0.91
Belgium	0.2634	0.1909	0.17	0.61
Denmark	0.5143	0.4406	0.25	0.92
France	0.1591	0.2910	0.58	0.93
Germany	0.0175	0.2024	0.93	0.05
Greece	0.0920	0.3191	0.77	0.89
Ireland	-0.0963	0.1519	0.53	0.57
Italy	-0.6709	0.5413	0.22	0.50
Netherlands	-0.6053	0.1369	0.00	0.92
Portugal	0.0296	0.1491	0.84	0.69
Spain	-0.0914	0.1421	0.52	0.00
Sweden	1.6871	1.0905	0.13	0.29
UK	-0.3252	0.3057	0.29	0.73

Table 9 – VAT rate cyclicality: model 1 (IV estimates)
Dependent Variable: Cyclical Component of VAT rate
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	0.1885	0.1794	0.29	0.11
Belgium	-0.1409	0.1159	0.23	0.81
Denmark	0.1035	0.0836	0.22	0.06
France	-0.3428	0.1606	0.03	0.14
Germany	0.1620	0.0921	0.08	0.85
Greece	0.0781	0.1151	0.50	0.92
Ireland	-0.3380	0.2355	0.15	0.66
Italy	-0.0729	0.0862	0.40	0.74
Netherlands	0.0970	0.0886	0.27	0.33
Portugal	0.0156	0.1017	0.87	0.22
Spain	-0.0772	0.0795	0.34	0.01
Sweden	0.2296	0.2230	0.30	0.81
UK	0.1215	0.1244	0.33	0.38

Table 10 – Tax Index cyclicality: model 1 (IV estimates)
Dependent Variable: Cyclical Component of the Tax Index
Regressor: Cyclical Component of Real GDP

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	-0.0939	0.2014	0.64	0.84
Belgium	-0.0725	0.2878	0.80	0.22
Denmark	0.1729	0.1038	0.10	0.00
France	-0.0887	0.2232	0.69	0.49
Germany	0.1184	0.1431	0.41	0.91
Greece	0.1299	0.3447	0.70	0.95
Ireland	-0.1427	0.1408	0.31	0.47
Italy	-0.4367	0.2990	0.15	0.70
Netherlands	0.0048	0.0861	0.95	0.06
Portugal	-0.1666	0.1315	0.21	0.98
Spain	-0.2111	0.1988	0.29	0.89
Sweden	-1.0006	0.6874	0.15	0.88
UK	-0.3516	0.1988	0.08	0.00

Table 11 – PIT rate cyclicality: model 2 (OLS estimates)
Dependent Variable: Change in PIT rate
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	Obs.
Austria	-0.2715	0.2640	0.31	31
Belgium	-0.2220	0.2326	0.34	31
Denmark	-0.1399	0.1166	0.23	31
France	-0.1289	0.1744	0.46	31
Germany	0.0097	0.0523	0.85	31
Greece	-0.2081	0.1240	0.10	31
Ireland	-0.0831	0.0635	0.20	31
Italy	-0.2545	0.1757	0.15	31
Netherlands	-0.2223	0.2141	0.30	31
Portugal	-0.6107	0.3706	0.11	31
Spain	-0.6178	0.2260	0.01	31
Sweden	-0.1486	0.2728	0.59	31
UK	-0.4585	0.4056	0.26	31

Table 12 – CIT rate cyclicality: model 2 (OLS estimates)
Dependent Variable: Change in CIT rate
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	Obs.
Austria	-0.5780	0.5304	0.28	32
Belgium	0.0536	0.1397	0.70	32
Denmark	0.1660	0.2068	0.42	32
France	-0.1566	0.1272	0.22	32
Germany	0.0661	0.0839	0.43	32
Greece	0.0204	0.1420	0.88	32
Ireland	-0.2214	0.0720	0.00	32
Italy	0.0503	0.0997	0.61	32
Netherlands	-0.2747	0.1442	0.06	32
Portugal	-0.3656	0.0939	0.00	32
Spain	-0.0020	0.0183	0.91	32
Sweden	0.6822	0.4432	0.13	32
UK	-0.0286	0.1059	0.78	32

Table 13 – VAT rate cyclicality: model 2 (OLS estimates)
Dependent Variable: Change in VAT rate
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	Obs.
Austria	0.0027	0.0514	0.95	40
Belgium	-0.0492	0.0394	0.21	42
Denmark	0.0197	0.0372	0.59	46
France	-0.0125	0.1018	0.90	45
Germany	0.0014	0.0211	0.94	45
Greece	-0.1082	0.0407	0.01	26
Ireland	-0.0815	0.0631	0.20	41
Italy	0.0077	0.0201	0.70	40
Netherlands	0.0426	0.0730	0.56	44
Portugal	-0.0367	0.0329	0.27	27
Spain	-0.1714	0.0789	0.03	27
Sweden	-0.0786	0.0784	0.32	44
UK	0.0397	0.0792	0.61	40

Table 14 – Tax Index cyclicality: model 2 (OLS estimates)
Dependent Variable: Change in the Tax Index
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	Obs.
Austria	-0.2098	0.1856	0.26	31
Belgium	-0.1332	0.1439	0.36	31
Denmark	-0.0811	0.0814	0.32	31
France	-0.0762	0.0695	0.28	31
Germany	0.0119	0.0344	0.73	31
Greece	-0.1075	0.0658	0.11	25
Ireland	-0.0993	0.0585	0.10	31
Italy	-0.1256	0.0966	0.20	31
Netherlands	-0.1757	0.1218	0.15	31
Portugal	-0.2966	0.1635	0.08	26
Spain	-0.3545	0.1469	0.02	26
Sweden	-0.0336	0.1456	0.81	31
UK	-0.2543	0.2222	0.26	31

Table 15 – PIT rate cyclicality: model 2 (IV estimates)
Dependent Variable: Change in PIT rate
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	-0.3610	0.3439	0.30	0.67
Belgium	-0.2186	0.2365	0.36	0.14
Denmark	0.1088	0.1338	0.42	0.00
France	-0.3959	0.2723	0.15	0.76
Germany	-0.0313	0.0545	0.57	0.80
Greece	-0.1426	0.1173	0.23	0.85
Ireland	-0.1505	0.0666	0.03	0.79
Italy	-0.3104	0.2186	0.16	0.36
Netherlands	-0.3142	0.2293	0.18	0.28
Portugal	-0.6098	0.3976	0.13	0.92
Spain	-0.5486	0.2712	0.05	0.63
Sweden	-0.6650	0.9352	0.48	0.63
UK	-1.1331	0.8259	0.18	0.13

Table 16 – CIT rate cyclicality: model 2 (IV estimates)
Dependent Variable: Change in CIT rate
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	-0.6861	0.6644	0.31	0.50
Belgium	-0.0762	0.1510	0.61	0.91
Denmark	-0.1980	0.2713	0.47	0.25
France	-0.0823	0.1546	0.59	0.80
Germany	-0.0266	0.1115	0.81	0.49
Greece	-0.1131	0.1932	0.56	0.34
Ireland	-0.3457	0.1333	0.01	0.50
Italy	-0.0993	0.2063	0.63	0.71
Netherlands	-0.2652	0.1264	0.04	0.88
Portugal	-0.2878	0.1002	0.00	0.43
Spain	-0.0136	0.0241	0.57	0.21
Sweden	-0.2259	0.7422	0.76	0.68
UK	-0.1161	0.1548	0.45	0.52

Table 17 – VAT rate cyclicality: model 2 (IV estimates)
Dependent Variable: Change in VAT rate
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	0.0705	0.0581	0.23	0.39
Belgium	-0.0429	0.0370	0.25	0.92
Denmark	0.1057	0.0648	0.11	0.05
France	-0.0112	0.1025	0.91	0.57
Germany	0.0015	0.0269	0.95	0.93
Greece	-0.0239	0.0452	0.60	0.89
Ireland	-0.0950	0.0979	0.33	0.95
Italy	0.0115	0.0290	0.69	0.21
Netherlands	0.0503	0.0758	0.51	0.54
Portugal	-0.0006	0.0323	0.98	0.42
Spain	-0.1655	0.0775	0.04	0.14
Sweden	0.1935	0.1310	0.14	0.36
UK	0.1173	0.1972	0.55	0.01

Table 18 – Tax Index cyclicality: model 2 (IV estimates)
Dependent Variable: Change in the Tax Index
Regressor: Real GDP growth
***constant terms not reported**

	Coefficient	Std. Error	P-value	P(J-stat)
Austria	-0.2328	0.2319	0.32	0.64
Belgium	-0.1371	0.1500	0.36	0.12
Denmark	0.0540	0.0884	0.54	0.00
France	-0.1761	0.1141	0.13	0.88
Germany	-0.0149	0.0440	0.73	0.96
Greece	-0.0380	0.0663	0.57	0.99
Ireland	-0.1741	0.0845	0.04	0.72
Italy	-0.1855	0.1277	0.15	0.37
Netherlands	-0.2160	0.1271	0.10	0.30
Portugal	-0.2817	0.1688	0.10	0.60
Spain	-0.3061	0.1591	0.06	0.58
Sweden	-0.4323	0.5959	0.47	0.65
UK	-0.6103	0.4207	0.15	0.04