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THE VAT LAFFER CURVE AND THE BUSINESS CYCLE

Francisca Guedes de Oliveira
Universidade Católica Portuguesa (Porto)

Leonardo Costa
Universidade Católica Portuguesa (Porto)

The *VAT* Laffer Curve and the Business Cycle

Francisca Guedes de Oliveira
foliveira@porto.ucp.pt

Leonardo Costa
lcosta@porto.ucp.pt

School of Economics and Management
Catholic University of Portugal

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Abstract

A *VAT* Laffer Curve is estimated for the EU-27 countries in the period 2000-2010. Results show that countries such as Portugal are already in the prohibitive range of the curve. Structural differences exist between low growth years and high growth years. Collected *VAT* revenue is smaller in low growth years than in high growth years, which illustrates the existence of a *VAT* automatic stabilizer effect. The *VAT* rate that maximizes *VAT* revenue is slightly higher in low growth years, which can be explained by changes in the structure of consumption and of *VAT* collection enforcement. A procyclical *VAT* rate policy increases the underlying business cycle volatility and may also have as an outcome the increase of overall government inter-temporal collected *VATR*.

Keywords: *VAT* Laffer Curve, EU-27, Portugal, Business Cycle

1. Introduction

The world financial crisis, the Eurozone crisis, and the Troika rescue programs of the most indebted European Union countries have brought to the arena the discussion on fiscal policy and tax increases. It has been argued for these countries that if taxes continue to increase, tax revenues will decrease and hence the fiscal deficits and debts will not be reduced. This effect has already been felt in several countries, namely in Portugal, where *VAT* and Income tax increases have proven ineffective in terms of increasing revenues.

The inverted U-shaped relation between tax rate and tax revenue has been discussed in the literature at least since 1978, in a well-known paper by Wanniski (1978), and it has been known ever since as the 'Laffer Curve'. According to Wanniski, the Laffer Curve simply says that 'there are always two tax rates that yield the same revenue'. One adds, except when the maximum tax rate is reached. For instance, with an income tax rate of 0% total revenue is zero but the same holds with an income tax rate of 100%, as the economy shut downs. Thus, the tax revenue (*TR*) can be expressed as a function of the tax rate (*t*) and of the tax base (*TB*):

$$TR = t \times TB \tag{1}$$

The tax base is the measure upon which tax liability is based. For instance, taxable income is the tax base for the income tax while *VAT* rated final consumer spending is the tax base for *VAT*.

According to Laffer (2004) himself, the Laffer Curve translates the idea that a change in the tax rate has two opposed effects on tax revenue: i) the arithmetic effect and ii) the economic effect. The former says that *TR* increases with *t*, for a given *TB*. The latter says that the *TB* (and consequently *TR*) decreases with *t*, because higher *t* gives an incentive to reduce consumption, production or work, and thus to reduce *TB*. As long as the direct effect of *t* on *TR* is larger than the indirect effect of *TB*, *TR* will increase. This will happen up to a given point (the maximum tax rate). From that point forward (Laffer calls it the 'prohibitive range') any increase in *t* leads to a decrease in *TR*.

There is a wide range of empirical literature that estimates the Laffer Curve for several different taxes. Feige and McGee (1983) developed a simple macro model from which they derived a Laffer Curve for Sweden. They found the shape and position of the Laffer Curve depending of supply side effects, the progressivity of the tax system, and the size of the unobserved or informal economy.

Yu (1996) estimated a personal income tax Laffer Curve for the US in the period 1959-1991. He confirmed the inverted U-shaped relation between *t* and *TR* and estimated the maximum personal income tax rate to be in the interval [32%, 35%].

Dalamagas (1998) estimated for the G7 a three-equation model combining output, capital growth and marginal product of capital, in the context of a convex model of endogenous growth. He showed that the expansionary effects of lower taxes can actually generate smaller deficits in the long run only for those countries (the USA, the UK and Italy) that exhibit 'crowding-out behavior'.

Hansson and Stuart (2003) calculated the Laffer limits for OECD countries over the period 1972–1992. Based on the experiences of six countries that attained the greatest peak fiscal sizes (Belgium, Ireland, Sweden, Denmark, the Netherlands, and Norway) they concluded that it is difficult to sustain full tax revenue much above 70% of GDP.

Matthews (2003) used EU-14 unbalanced time-series of data, ranging from 1970 to 1998. He found the revenue maximizing rate of *VAT* as being between 18,0% and 19,3%, for given conditions of non-compliance. Matthews (2003) argued that when the *VAT* tax rate increases: i) people consume less (avoidance) and ii) people scape paying *VAT* whenever possible (evasion). The latter effect is directly related to the size and characteristics of a country's informal economy. Thus, *VAT* avoidance and evasion are positively related with the tax rate.

Heijman and Ophen (2005) argued that the negative effect of the tax rate on the tax revenue has two mains causes: i) an increase in the tax rate leads to a decrease in activities (labor, consumption, investment, etc.) in the formal economy - avoidance; ii) an increase in the tax rate leads to an increase in activities in the informal economy – evasion.

Brill and Hasset (2007) found evidence that supports the existence of a corporate tax Laffer Curve.

Trabandt and Uhlig (2011) estimated the maximum rates of several taxes for the US and for the EU-14. Concerning capital and labor taxes, they concluded that the EU is closer to its maximums than the US. However, in what refers to the consumption tax they do not find a maximum.

Ioan (2012) estimated an aggregated tax Laffer Curve for Romania in the period 1999-2009. The author used a Logit model to infer on the impact of variations in *t* (measured by total tax revenue as a percentage of GDP) in the probability of increasing *TR* (measured by total tax revenue - direct and indirect taxes). Ioan (2012) concluded in favor of a 'Laffer Effect'. To increase tax revenues in Romania tax rates have to decrease and tax evasion must be strongly controlled.

There is also literature that addresses structural instability in several economic aggregates or functions. For instance, Deyak *et al.* (1989) examined structural stability of US imports.

McConnell *et al.* (2000) documented a structural break in the volatility of United States GDP growth.

Soguer and Stiassny (2002) addressed issues concerning parameter stability in Okun's law.

This article aims to contribute to the empirical literature on the Laffer Curve and to the current discussion on fiscal policy in the EU. A *VAT* Laffer Curve is estimated for the EU-27 countries in the period 2000-2010. Structural stability of this curve in what concerns the business cycle is tested. Particularly, the hypothesis of the existence of two *VAT* Laffer Curves (one during low growth years and the other otherwise) is not rejected.

The article unfolds as follows. In section 2, one describes the *VAT* revenue determination, the data, the assumptions and the regression model. In section 3, one discusses the empirical results. Section 4 concludes.

2. Empirical Model

2.1. *VAT* revenue determination, data and assumptions

From equation (1), one takes that *VAT* revenue (*VATR*) is a function of the *VAT* rate (v) and of the *VAT* base $(VATB)$. Using Matthews (2003) terminology, *ceteris paribus*, *VATR* decreases with tax avoidance and with tax evasion. Tax avoidance and tax evasion depend on v and affect *VATB*.[1] Thus, *VATB* is a function of v and one can write:

$$VATR = v \times VATB(v) \tag{2}$$

The functional form in (2) identifies the model variables and it is unknown. An approximation can be provided by the following quadratic form on v:

$$VATR = av^2 + bv + c \tag{3}$$

To estimate equation (3) for the EU-27 countries, a balanced panel data covering the EU-27 countries in the period 2000-2010 has been used. The data is available from the Eurostat report (Eurostat Statistical Books, 2012) and from on-line Eurostat statistics.

As Laffer himself presumably would do, rational expectations (and thus no money illusion) and a real business cycle have been assumed. Therefore, one has worked with real *GDP* instead of nominal *GDP*, namely, *GDP* at constant prices of 2005.

VATR is available as percentage of nominal *GDP* for each country and time. By multiplying these percentages by *GDP* at constant prices of 2005 one has computed *VATR* at constant prices of 2005.

Concerning the *VAT* rate v, as in Matthews (2003), one has considered the available official *VAT* standard rate applicable to each country in each year (Eurostat Statistical Books, 2012).[2]

[1] In this research *VATB* is the *VAT* rated final consumer spending after avoidance and evasion.
[2] Matthews (2003) used the standard rate of *VAT* as a proxy for the representative *VAT* rate. EC (2004) gives an idea of how good this proxy is. The strategy in this research is slightly different: in the regression model, year and country intercepts capture the effects of *VAT* non-standard rates over *VATR*.

The average growth rate of real *GDP* in each country in the period 2000-2012 has been computed. A dummy variable was built to distinguish years of country high growth (with a growth rate equal or above the country average) from years of country low growth (otherwise). The same has been done for the EU-27 as a whole, to distinguish years of EU-27 high growth (with a growth rate equal or above the EU-27 average) and years of EU-27 low growth (otherwise). These dummy variables have been used to test for EU-27 countries *VAT* Laffer Curve structural differences.

In all regressions robust estimation has been used.

2.2. Regression Model

One has considered the following three regressions:

$$VATR_{it} = \beta_{0i} + \beta_{1t} + \beta_2 v_{it} + \beta_3 v_{it}^2 + u_{it} \quad (4)$$

$$VATR_{it} = \beta_{0i} + \beta_{1t} + \beta_2 v_{it} + \beta_3 v_{it}^2 + \beta_4 D_{gc} + \beta_5 D_{gc} v_{it} + \beta_6 D_{gc} v_{it}^2 + u_{it} \quad (5)$$

$$VATR_{it} = \beta_{0i} + \beta_{1t} + \beta_2 v_{it} + \beta_3 v_{it}^2 + \beta_4 D_{geu} + \beta_5 D_{geu} v_{it} + \beta_6 D_{geu} v_{it}^2 + u_{it} \quad (6)$$

The first regression in (4) yields the *VAT* Laffer Curve. The second and third regressions in (5) and (6) test for structural differences between years of high growth and low growth, comparing for each year, respectively, country growth and EU-27 growth with country average growth and with EU-27 average growth.

VATR never assumes negative values. The model used to reproduce *VATR* must therefore be limited to the same interval. Thus, truncated regressions have been estimated, imposing a lower limit of zero to *VATR*.

In all regressions it has been considered a different intercept per country and per year. Country intercepts capture the set of (observable and non-observable) factors that are specific to a given country. For instance, *ceteris paribus*, the scale of the country matters in what concerns *VATR* collected. Cultural differences across countries matter in what concerns tax evasion and thus *VATR* collected. Etc.

Year intercepts capture the set of (observable and non-observable) factors that are specific to a given year. For instance, differences in a year may arise because of

changes in other than the standard *VAT* rates and/or in other taxes. Consumers' confidence may change in time. Etc.

Finally, dummy variables that distinguish years of high growth and low growth for each country and for the EU-27 as a whole enter respectively in regressions (5) and (6) in an additive and multiplicative way. This allows the Laffer Curve to shift up and down, left and right.

In the next section the estimation results are illustrated and discussed.

3. Empirical Results

Table 1 provides estimation results for all countries of the EU-27 in the period 2000-2010 (The Appendix reports the intercept and country and time fixed effects estimates)[3].

Table 1: Estimation results

$VATR_{it}$	Equation (4)		Equation (5)		Equation (6)	
	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$
v_{it}	1552.263	0.000	1748.593	0.000	1694.302	0.000
v_{it}^2	-3480.231	0.000	-3884.018	0.000	-3765.412	0.000
Dgc	-	-	41.95726	0.047	-	-
$Dgc \times v_{it}$	-	-	-343.3635	0.072	-	-
$Dgc \times v_{it}^2$	-	-	706.3763	0.098	-	-
$Dgeu$	-	-	-	-	35.42703	0.068
$Dgeu \times v_{it}$	-	-	-	-	-293.2129	0.095

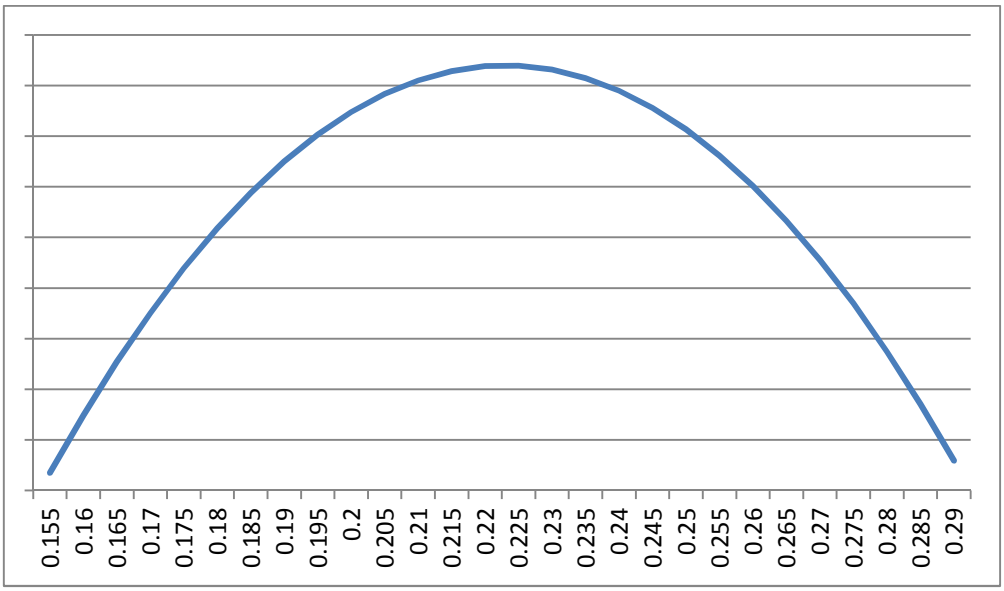
[3] The intercept is for Portugal 2010. Country and time fixed effects have been estimated respectively as deviations from Portugal 2010 intercept. The curves for another country or another year can be derived taking into account the corresponding fixed effects.

$Dgeu \times v_{it}^2$	-	-	-	-	616.3183	0.119
Lower limit	0		0		0	
Upper limit	+inf		+inf		+inf	
Log.pseudolikelihood	-631.236		-622.304		-627.868	
Number of obs	297		297		297	
Wald chi2 (38)	42082.21		42351.91		43801.92	
Prob >chi2	0.000		0.000		0.000	

Figures 1, 2, and 3 illustrate the Laffer Curves for Portugal in 2010.

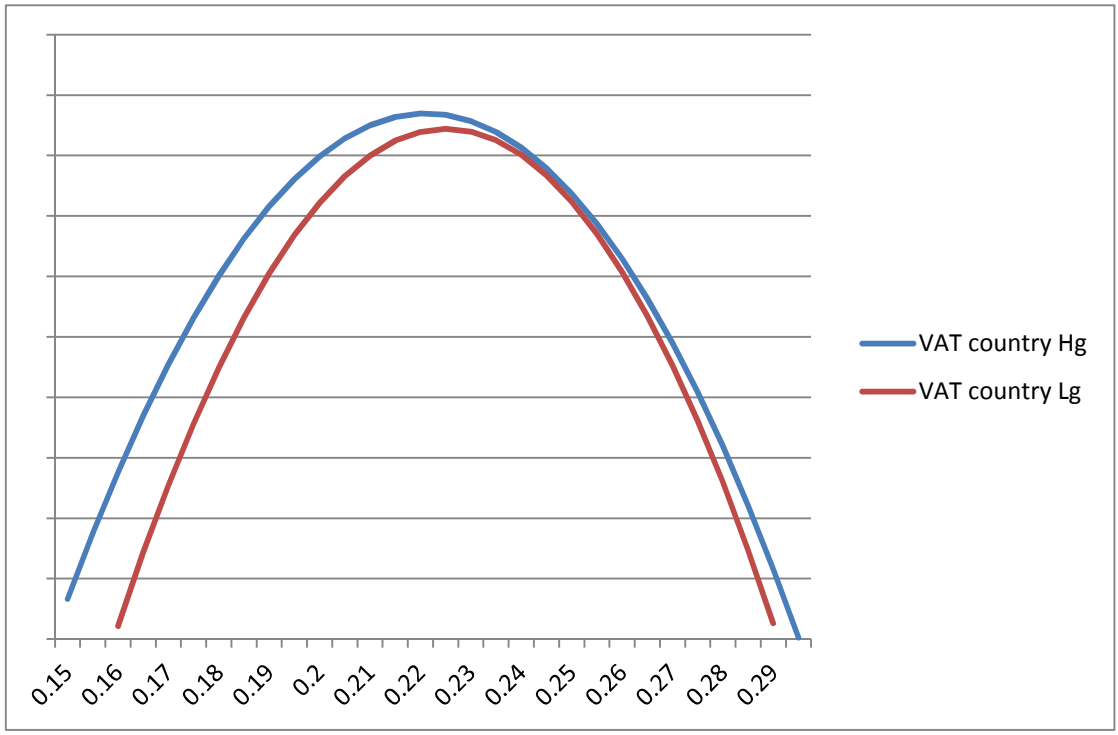
All variables are statistically significant in all regressions. v_{it} and v_{it}^2 are significant at a significance level of 1%. The other variables are significant at least at significance levels of 10% (Equation (5)) and 12% (Equation (6)).

Figure 1: Portugal 2010 *VAT* Laffer Curve



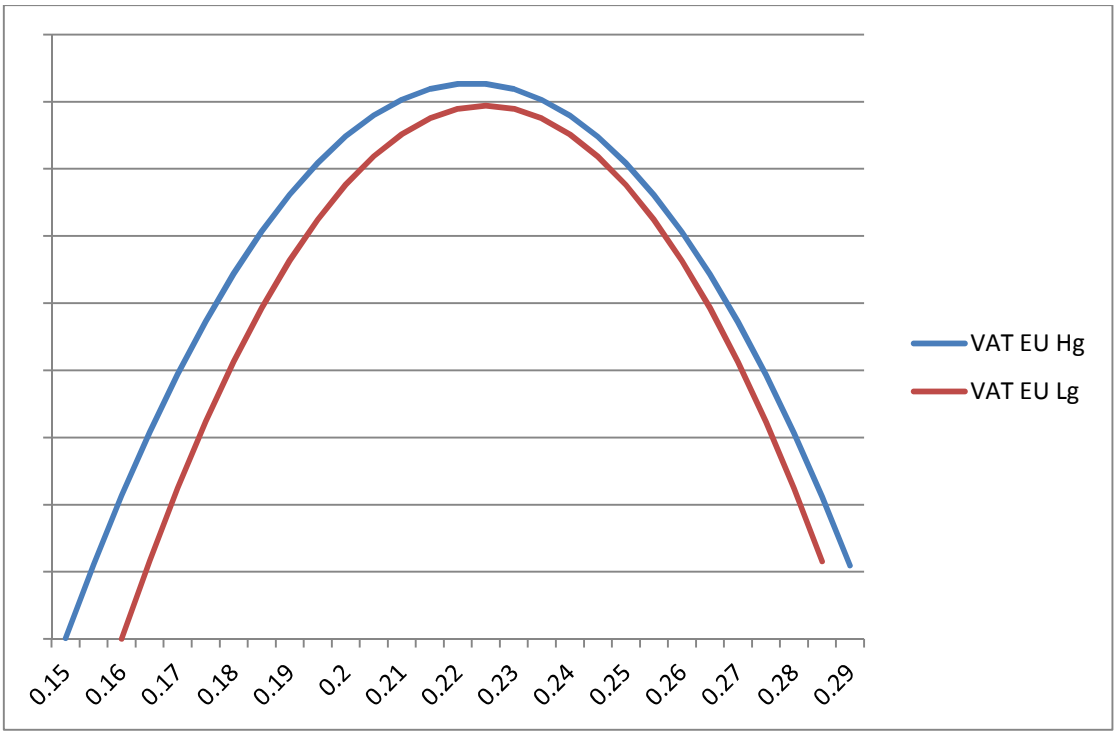
The estimates of equation (4) in Table 1 support the existence of a *VAT* Laffer Curve for the EU-27 countries[4]. Figure 1 illustrates the Laffer Curve for Portugal in 2010.[5] The *VAT* rate *v* that maximizes *VATR* is 22,5%. Thus, countries such as Portugal, currently with a *VAT* rate of 23%, are already operating in the prohibitive range of the curve. Results are consistent with those obtained by Matthews (2003) for the EU-14 countries in the decade before, although the maximum *VAT* rates obtained by Matthews (2003) were slightly lower. The latter indicates an increasing time trend of the *VAT* rate that maximizes *VATR*.[6] This long run effect doesn't preclude a short run or cyclical effect as described below and illustrated in Figures 2 and 3.[7]

Figure 2: Portugal 2010 *VAT* Laffer Curve, country high growth (Hg) and low growth (Lg) years



[4] These estimates are common to all countries and years. See the Appendix for differences across countries and years.
[5] The EU-27 *VAT* Laffer Curve in 2010 can be easily retrieved by averaging the fixed effects for all countries and adding this average to the Portuguese 2010 intercept.
[6] The EU has now more member states and the structure of the *VAT* rate has changed substantially in the last decade for most European countries.
[7] Buchanan and Lee (1982) have already noticed that there is a distinction between short and long run Laffer effect.

Figure 3: Portugal 2010 *VAT* Laffer Curve, EU high growth (Hg) and low growth (Lg) years



The estimates of equation (5) and (6) support the existence of two *VAT* Laffer Curves for the EU-27 countries. Figures 2 and 3 illustrate these curves, respectively, for country and EU-27 high growth (blue) and low growth (red) years.

In both cases, the *VAT* Laffer Curve for the EU-27 countries in high growth years encloses the *VAT* Laffer Curve for the EU-27 countries in low growth years. That is, for the same *VAT* rates, *VATR* is always higher in high growth years than it is in low growth years, which illustrates a *VAT* automatic stabilizer effect. In addition, in low growth years the curve is steeper, particularly in its non-prohibitive range. Furthermore, the *VAT* rate that maximizes *VATR* is slightly higher in low growth years than it is in high growth years (respectively 22,5% against 22%). The latter result can be explained looking to the structure of final consumption and to *VAT* collection enforcement. It is expected final consumption to be more price elastic in high growth years than it is in low growth years. That is, in high growth years it is more likely that consumers can achieve tax avoidance by lowering their consumption.

The reason is in the structure of consumption: consumer's bundles have more luxury and/or non-essential goods in high growth years than they have in low growth years. Concerning *VAT* collection enforcement is likely to be stronger in low growth years, when government need for *VATR* is more urgent. Consequently, tax evasion is harder to achieve in low growth years than it is in high growth years.

Although tax avoidance and evasion are higher, for the same *VAT* rate *v*, total *VATR* collected by the government is higher in high growth years than in low growth years. This is similar to the automatic stabilizer effect known to income taxes, it is a *VAT* automatic stabilizer effect. Table 2 illustrates for Portugal 2010, *VAT* rate *v* elasticities of *VATR* in high growth years and in low growth years, within the range of historically observed *VAT* tax rates in the period 2000-2010.

Table 2: Portugal 2010 *VAT* rate *v* elasticities of *VATR* in high growth (Hg) and Low growth (Lg) years

v	$\varepsilon_{H_g}^{VATR}$	$\varepsilon_{L_g}^{VATR}$
17%	6.075	14.294
18%	3.912	7.021
19%	2.624	4.282
20%	1.680	2.701
21%	0.872	1.540

As expected, *VAT* rate *v* elasticities of *VATR* are higher in low growth years, when avoidance and evasion are smaller, than in high growth years.

Table 3 shows an exercise of starting with a single *VAT* rate *v* and then increasing it in low growth years and decreasing it in high growth years. Depending of the starting point *v*, for the government to keep constant inter-temporal collected *VATR*, an increase of *v* in low growth years may require a more than proportional decrease of *v* in high growth years. For instance, an increase of the *VAT* rate from 18% to 19% in low growth years demands a decrease of the VAT rate below 17% in high growth years, to keep inter-temporal collected *VATR* constant. Otherwise, inter-temporal collected *VATR* will increase.

Table 3: Portugal 2010 variations of *v* and *VATR* in low growth (Lg) and high growth (Hg) years

Δv Lg	ΔVATR Lg (2005 1000 €)	Δv Hg	ΔVATR Hg (2005 1000 €)
18%-19%	3.115	**18%**-17%	-2.931
19%-20%	2.338	**19%**-18%	-2.295
20%-21%	1.561	**20%**-19%	-1.659

A procyclical fiscal policy is usually considered a pervasive phenomenon, as it reinforces - instead of mitigating - the underlying business cycle volatility (Végh and Vuletin, 2012).[8] In addition, this research shows that a procyclical *VAT* rate policy may also have as an outcome the increase of overall government inter-temporal collected *VATR*.

4. Conclusions

The European Union is still finding the best way to deal with the impacts of the World Great Recession. The rescue programs of the most indebted EU countries, such as Portugal, have brought to the arena the discussion on fiscal policy and tax increases.

Using a panel data for the EU-27 countries in 2000-2010, assuming rational expectations and a real business cycle, one has estimated the *VAT* Laffer Curve for the EU-27 countries in the period 2000-2010 and found the maximum *VAT* rate as being 22,5%. Thus, countries such as Portugal are already operating in the prohibitive range of the curve.

Evidence was also found supporting the existence of two Laffer Curves: one in high growth years and the other in low growth years. The former curve encloses the latter. The low growth curve maximum is slightly higher than the high growth one. The latter curve is steeper than the former curve. Altogether, *VAT* collected revenue and consumer avoidance and evasion are higher in high growth years than they are in low growth years.

[8] Fiscal policies may also have an impact on consumer's sentiment. On this see Westerhoff and Hohnischb (2010).

A procyclical *VAT* rate policy increases - instead of mitigating - the underlying business cycle volatility and may have as an outcome the increase of overall government inter-temporal collected *VATR*.

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Appendix – PT 2010 Intercept and other Countries and Years Fixed Effects

$VATR_{it}$	Equation (4)		Equation (5)		Equation (6)	
	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$
PT 2010	**-156.2908**	**0.001**	**-179.922**	**0.000**	**-174.7171**	**0.000**
AT	6.075786	0.000	6.103138	0.000	6.081735	0.000
BE	6.158103	0.000	6.169006	0.000	6.181467	0.000
BG	-15.08959	0.000	-15.09227	0.000	-14.95578	0.000
CY	-0.7512376	0.880	-1.544721	0.741	-1.288681	0.796
CZ	-7.09702	0.000	-7.085706	0.000	-7.132871	0.000
DK	2.825495	0.223	2.826259	0.179	2.597632	0.245
EE	-21.38119	0.000	-20.94534	0.000	-21.10858	0.000
FI	-3.305667	0.020	-3.343985	0.019	-3.277785	0.018
FR	108.7038	0.000	108.594	0.000	108.7456	0.000
DE	148.5056	0.000	148.5508	0.000	148.1941	0.000
EL	2.107999	0.191	1.751296	0.235	2.134653	0.159
HU	-4.990401	0.023	-4.910126	0.013	-5.124693	0.015
IE	-3.777284	0.005	-3.969145	0.003	-3.782121	0.003
IT	72.93097	0.000	72.81836	0.000	72.93692	0.000
LV	-22.21387	0.000	-21.84147	0.000	-21.94583	0.000
LT	-15.96468	0.000	-15.85767	0.000	-15.76687	0.000
LU	1.709321	0.726	1.557936	0.732	1.070566	0.827
MT	-35.42568	0.000	-33.81293	0.000	-34.68382	0.000
NL	26.25647	0.000	25.84682	0.000	26.18938	0.000
PL	2.412396	0.116	2.436245	0.096	2.453177	0.101
RO	-6.570592	0.000	-6.99672	0.000	-6.533328	0.000
SK	-12.36925	0.000	-12.44865	0.000	-12.31552	0.000
SI	-14.16243	0.000	-14.2971	0.000	-14.05645	0.000
ES	50.86862	0.000	49.88297	0.000	50.6851	0.000
SE	15.69208	0.000	15.63647	0.000	15.46404	0.000
UK	113.085	0.000	112.6397	0.000	113.0558	0.000
2000	-3.67605	0.002	-4.640336	0.000	-3.864751	0.002
2001	-3.790346	0.000	-4.488074	0.000	-3.952817	0.000
2002	-4.049327	0.000	-4.099026	0.000	-2.434226	0.026
2003	-3.402998	0.001	-3.393911	0.000	-1.770553	0.100
2004	-2.073081	0.046	-3.100681	0.004	-2.247079	0.029
2005	-1.015351	0.354	-1.562851	0.125	-1.164989	0.276
2006	0.3846857	0.727	-0.649623	0.558	0.2289117	0.831
2007	1.509636	0.175	0.6007327	0.581	1.404019	0.198
2008	0.9345984	0.399	1.384347	0.207	2.55124	0.027
2009	-1.627666	0.234	1.34014	0.595	0	Omitted