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Performance Budgeting Model in the Environmental Perspective: Tackling Waste Pollution

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Abstract: *Performance budgeting is the latest trend in attempts to improve government performance. In this article we investigate the interaction between environmental taxes, environmental expenditures and environmental impacts in the field of waste management. Performance budgeting is realized only once all three groups have been taken into consideration. We confirm direct and indirect effects of environmental taxes on the reduction of waste pollution. Further, we test the earmarking of environmental taxes through the effect of environmental indicators on environmental taxes and note that the rate is high.*

Keywords: performance budgeting, EU, environnemental tax, environnemental expenditure, waste pollution; impact

JEL: Q50, Q54, Q58

Introduction

Performance budgeting is a tool that holds promise for improving the governance and accountability of public finance expenditures. This new budget concept links the findings of performance measurement to budget allocations (Joyce, 2003) and investigates the connection between spent public resources and planned environmental impacts (Aristovnik and Seljak, 2009; van Nispen and Posseth, 2006). The purpose of this paper is to investigate the interaction between environmental taxes, environmental expenditures and environmental impacts in the field of waste management. Taking into account all three categories, we achieve performance budgeting as a whole (Perrin, 2002).

Environmental protection presents one of the key EU policies and due to cross-boundary international character of pollution-related issues a joint action of nation states is crucial for the effective and efficient implementation of the policy (Cardwell, 2006). Environmental taxes are an economic instrument of environmental protection whose primary purpose is to promote the reduction of environmental pollution through the "polluter pays" principle. Authors (Brett and Keen, 2000; do Valle et al., 2012; Haibara, 2009) discuss that environmental taxes are earmarked, in the sense of the revenues they raise being pre-committed to

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specific environmental programmes, e.g. revenues of these taxes are redistributed to polluters in the form of subsidies to abatement technologies (Millock, Nauges, 2006; Androniceanu, Drăgulănescu, 2016).

The revenues for environmental expenditures are funded directly from environmental taxes (Brett and Keen, 2000; Haibara, 2009; Androniceanu, 2017) and present a source of income for municipal and state budgets, and as such source for environmental protection (do Valle et al., 2012).

The link between environmental taxes and environmental impacts, i.e. waste pollution has also been recognized by several scholars. In an effort to reduce waste in the sector households various instruments such as integrated sales tax exemptions and virgin material taxes have been proposed and/or implemented. Studies by Choe and Fraser (1999), and Fullerton and Kinnaman (2010) suggest that introduction or increase of waste tax for households will reduce the quantity of waste collected and will have a positive effect on collection of waste and water pollution. Xie and Saltzman (2000) argue that tax payment of the households for disposing of its waste or a penalty for improper waste disposal may correlate with the amount of waste collected. However, in the case of hazardous waste Sigman (1996) estimates that current taxes have only a very limited effect on total generation of waste because they represent only a small share of total environmental taxes collected and waste management costs. Fullerton and Kinnaman (1995) and Porter (1978) estimate waste taxes may encourage illegal waste disposal.

Emitters themselves will not pay for pollution control, except in case of government regulation that may limit the level of pollution and oblige emitters to behave in a more environmentally friendly way, e.g. by recycling or installing a cleaning device. Less pollution as a result of the use of environmental technologies and increased environmental awareness lead to cleaner environment what may lead to reduction of taxation (Smith, 2011). In our case, however, this is not directly detectable, because the amount of waste is on average increasing. Smith (2011) argues that more waste generation irrepressibly leads to increased taxation, proportional to the increase in pollution.

For the purpose of our article we combined environmental data for environmental taxes, environmental expenditures, and environmental impacts, i.e. waste pollution in panels of time series from different cross-sectional units and used it on a sample of 11 EU Member States in time series 1995-2010 (Androniceanu, 2016). In order to analyse the panel data and evaluate regression functions, an OLS method was used.

The major results of the analysis are that direct effects of environmental taxes on the optimization of environment-related processes for minimizing waste are confirmed. We confirm indirect effects of environmental taxes through environmental expenditures on the reduction of waste pollution. Further, we test the earmarking of environmental taxes through the effect of environmental indicators on environmental taxes and note that the rate is high.

1. The Model

The original source of inspiration for applying time series and cross-sectional data comes from Wooldridge (2003) and Gujarati (2003). In our model we linked together environmental taxes, expenditures, and waste pollution. Collected environmental taxes and expenditures used for environmental purposes are expected to cause lower level of waste pollution. Furthermore, the effects of waste pollution, measured by environmental indicators, on environmental taxes in the next year were also taken into account. We use the following baseline specification to explain performance budgeting model in the environmental perspective:

$$\Delta I_{it} = \alpha_0 + \sum_{j=1}^{L} \alpha_{ij} T_{j(t-k)} + \sum_{k=1}^{M} \alpha_{L+k} z_{it1} + \sum_{j=1}^{N} \beta_{ij} E_{j(t-l)} + \sum_{k=1}^{M} \beta_{N+k} z_{it2} + u_{i1} \quad (1)$$

$$T_{it} = \gamma_0 + \sum_{j=1}^{K} \gamma_{ij} I_{j(t-1)} + \sum_{k=1}^{M} \gamma_{K+k} z_{it3} + u_{i2} \quad (2)$$

I environmental impacts (K categories)
E environmental expenditures (N categories)
T environmental taxes (L categories)
i cross section data – environmental indicator for environmental tax, expenditure, or impact, belonging to one of the 11 EU Member States
t time period (1995–2010)
k, l time lag
α, β, γ coefficients (parameters to be estimated)
z_{it1}, z_{it2}, z_{it3} control variables
u_{i1}, u_{i2} idiosyncratic structural errors
$\Delta I_t = I_t - I_{t-1}$ differentiation between environmental impacts (I) of two successive years

Equation (1) shows the effect of environmental taxes and expenditures on the change of waste pollution. Equation (2) shows the dependence of environmental taxes on waste pollution.

The effects often depend to a large extent on a specific country, which is usually modelled using fixed effect dummy variables. However, it transpired that this effect is efficiently summarized by the use of some relevant control variables, namely: a group of variables that covers economic development and a group of variables that embraces environmental awareness. This step aptly summarizes the context of a country and preserves the degrees of freedom we cannot afford to lose due to the small size of the sample.

Environmental taxes have direct and indirect effect on the change of waste pollution (ΔI_t). This effect has an indirect influence on environmental taxes in the next year, which may present the problem of simultaneity. However, the annual change of I_t, which we denote by ΔI_t, typically varies between 0 and ±10 per cent of the value of I_t. On this basis, this indirect effect of ΔI_t has been neglected.

2. Empirical results

Variables used in the model 1 are presented in Table 1. The value of the change in the amount of waste in the sector households is differentiated in time. It's average is 8.15 that signifies the amount of waste in this sector is on average increasing.

The main results are reported in Table 2. For parsimony and simplicity of exposition only OLS results are shown in the text. The empirical results of the OLS regression show that the model (adjusted R2) explains 33.9 % of the change in the amount of waste in the sector households. We find that for dependent variable the change in the amount of waste in the sector households, environmental taxes and environmental expenditure have a statistically significant effect.

Consistent with evidence that revenues accruing from environmental taxes are used to make environmental improvements (Ekins, 1999), and that revenues they raise are pre-committed to particular environmental programmes (Brett and Keen, 2000; do Valle et al., 2012; Millock and Nauges, 2006), our results for waste pollution are unambiguous. Table 2 presents estimates for direct effects of environmental taxes and indirect effects of environmental taxes through environmental expenditures on the change in the amount of waste in the sector households. This result is consistent with the evidence suggested by Choe and Fraser (1999), and Fullerton and Kinnaman (2010) that increase of environmental tax reduce the quantity of waste collected and has a positive effect on the environment. The results thus show that the central finding of Bernauer and Koubi (2006), according to which the increase of public spending for environmental purposes, crucially influences on the occurrence of desirable environmental impacts. Taken together, our findings imply the important effects of both environmental taxes and expenditures on waste generation. This further means that the adoption of the EU Waste Framework Directives that set recycling standards and include an obligation for EU Member States to develop national waste prevention programmes, clearly have positive results. The directives set the basic concepts and definitions related to waste management and lays down waste management principles such as the “polluter pays principle” (Cardwell, 2006). Statistically significant effects of environmental taxes could be explained as direct and indirect effects of effective promotion of environmental measures aimed to ensure that polluters reduce the level of pollution. The EU countries use different economic and financial instruments for the protection of the environment, e.g. taxes, financial guarantees, environmental deposits and other forms of security, direct and indirect subsidies, and tax allowances. Especially the last two represent financial incentives and opportunities for polluters to make the advantage of using advanced green technologies in order to reduce costs and improve competitiveness by reducing energy and resource consumption, and thus contribute to lower the total amount of waste. Such measures are usually more stimulating for polluters than taxation or sanctions. In this context, polluters partly avoid paying environmental tax and are entitled to subsidies.

Moreover, the results show that environmental protection expenditures used for waste-related programmes and investments in sector households have significant positive effect on waste generation. This finding is consistent from a quantitative point of view to those of Soukopová and Struk (2012) that actually calculate the minimum value of expenditures per municipal waste ton that municipality should spend for waste pollution purposes, and Frodyma (2013) that finds support on the analysis of Polish local governments. Her findings support an explanation that increased investment for waste management and effective management reduce the amount of waste. Our approach shows that the use of environmental taxes and expenditures is justifying its cause, which is to reduce the amount of waste.

To characterise further our results we analyse other factors that might play a role in explaining the effect of taxes and expenditures. Different control variables (table 1) are included in the model that measure the influence of economic development and environmental awareness of a country, e.g. production in industry, final consumption expenditure of general government, and journeys to work by bicycle. Intuitively, increasing economic growth of a country depends upon the fact as to what extent it can increase its resources taking into account private production and public spending. Increase of waste generation is the by-product of these activities. Moreover, the environmental awareness of a country shows the level of awareness among the population. For this reason, the overall high level of environmental awareness among EU countries results in positive environmental impacts (Table2).

Table 1. Descriptive Statistics, model 1

Variable	**Mean**	**Std. Dev.**
Δ amount of waste in the sector households (in tonnes transformed per 1 euro of GDP)	8.1454	92.25951
Energy taxes (in millions of euro transformed per1000 euro GDP)	20.4162	3.54921
Pollution/Resource taxes (in millions of euro transformed per 100000 euro of GDP)	127.4099	191.41518
Expenditures in sector agriculture, forestry and fishing (in millions of euro transformed per 1000000 euro GDP)	72.5263	55.74509
Expenditures in sector industry (in millions of euro transformed per 100000 euro GDP)	65.0388	58.30847
Expenditures in other business sectors (in millions of euro transformed per 100000 euro GDP)	49.3862	37.60958
Production in industry (in % change)	.5893	5.29896

Variable	**Mean**	**Std. Dev.**
Final consumption expenditure of general government (in millions of euro transformed per 10 euro of GDP)	2.1714	.31803
Journeys to work by bicycle (in %)	12.1263	7.62635
Number of observations	138	

(Source: Own calculations; Eurostat, 2016)

Table 2. Coefficients, model 1[a, b]

Model	**OLS**	
	Coef.	**Std.Error**
(Constant)	-5.419*	83.425
Energy taxes (lag 3)	-7.857***	3.549
Pollution/Resource taxes (lag 3)	-.108**	.051
Expenditures in sector and fishing (lag 3)	-.645***	.143
Expenditures in sector industry (lag 3)	-.224*	.130
Expenditures in other business sectors (lag 3)	-.518***	.180
Production in industry	9.958***	1.355
Final consumption expenditure of general government	139.982***	30.585
Journeys to work by bicycle	-2.901**	1.396

(Source: Own calculations; Eurostat, 2016)

a) Dependent Variable: Δ amount of waste in the sector households.
b) R Square = .38, adjusted R Square = .34. ***, **, * denote significance at the levels of 1%, 5% and 10%, respectively.

Furthermore, we evaluated the model 2 to examine whether the amount of waste pollution, measured by environmental indicators, has an effect on environmental taxes in the next year. Table 3 shows the descriptive statistics of the variables of the analysis. The empirical results in Table 4 show that model (adjusted R^2) explains 56.8 % of energy taxes. A variable the amount of waste in the sector water supply; sewerage, waste management and remediation activities, influences on the increase of energy taxes. The main reason for this is that the environment is becoming increasingly laden with waste, because the amount of waste is increasing. Irrespective of the use of environmental technologies and increased environmental awareness among population that relatively help to reduce the level of waste (Smith, 2011), the amount of waste is still increasing, mainly because of economic development and population growth. Therefore, larger quantities of waste lead to higher tax revenues (Smith, 2011). This presents a feedback loop in testing the performance budgeting model.

Table 3. Descriptive Statistics, model 2

Variable	Mean	Std. Dev.
Energy taxes (in millions of euro transformed per 1000 euro GDP)	19.8193	3.26681
Amount of waste in the sector water supply; sewerage, waste management and remediation activities (in tonnes standardized per 10 euro of GDP)	93.6419	48.67777
Final consumption expenditure of general government (in millions of euro transformed per 10 euro of GDP)	2.1291	.30439
Energy intensity of the economy (in kilograms of oil equivalent transformed per 1000 euro)	154.43	34.84242
Fossil fuel energy consumption (in % of total)	74.0953	18.69987
Hydropower generation (thousand tonnes of oil equivalent per 10000 euro of GDP)	53.5122	65.52441
Protection of natural resources - Common bird index (Index, 2000=100)	94.2059	9.01808
Year	2004	3.755
Number of observations	143	

(Source: Own calculations; Eurostat, 2016)

Table 4. Coefficients, model 2[a, b]

Model	OLS	
	Coef.	Std.Error
(Constant)	389.234***	118.083
Amount of waste in the sector water supply; sewerage, waste management and remediation activities (lag 1)	.039***	.004
Final consumption expenditure of general government	7.048***	.763
Energy intensity of the economy	.029***	.009
Fossil fuel energy consumption	.090***	.020
Hydropower generation	.013***	.004
Protection of natural resources	-.078***	.026
Protection of natural resources- Common bird index	-.196***	.058

(Source: Own calculations; Eurostat, 2016)

a) Dependent Variable: Energy taxes.
b) R Square = .59, adjusted R Square = .57. ***, **, * denote significance at the levels of 1%, 5% and 10%, respectively.

In the empirical analysis above spurious regression as an effect of time trends could be present. We modeled it by including the time variable in the models. In model 2 the variable Year overtook the time trends effect. In contrast, in model 1 no such trends did show. This would partially be a consequence of diferentiation, the presence of control variables for a country and relatively short time series of a dataspan.

3. Conclusions

In this paper we consider a performance budgeting model by connecting environmental taxes, environmental expenditures, and environmental impacts in the field of waste management. It is quite perspective tool for the swift use in practice. We apply the proposed method to a panel data of 11 EU Member States to illustrate the usefulness of our approach. We confirmed that direct and indirect effects of environmental taxes for minimizing waste pollution exist. Furthermore, we showed that environmental deterioration, measured by environmental indicators, leads to increased taxation. In this respect, the use of panels of time series from different cross-sectional units did substantiate the connection between environmental taxes, environmental expenditures and environmental impacts.

The degree of variability explained in model 1 is 33.9 % and 56.8 % in model 2. However, there is some unexplained variability. This may come from different tax rates and different tax collection efficiency within countries that cannot be directly measured.

The methodology developed here could also be used in similar research fields, such as macroeconomics and education, macroeconomics forecasting or administration. It will contribute to a more comprehensive understanding of assessment of environmental policy measures. The research results will enable political decision makers to take more suitable ex-ante decisions for allocation of resources and to improve the ex-post accountability. Quantitative analysis can at best strengthen or weaken policy arguments, putting decision making on a more informed basis.

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