The Impact of Tax Ratio on Environmental performance in Iran; with Emphasis on Sustainable Economic Development

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Abstract: The aim of this paper is considering the impact of tax ratio on environmental performance in Iran at 1960-2009 periods. For do it, I have used regression analysis. Result of cointegration test indicates that there is a long run relationship between environmental performance and tax ratio. Estimation results indicate that tax rate has a negative effect on CO2 emission, so increasing in tax rate increases environmental performance. Energy consumption and economic growth have a positive effect on pollution. So these variables have a negative effect on environmental performance. So, taxation policies could improve environmental performance in Iran.
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1. Introduction

Tax on individuals and firms is based on the quantity of incomes from economic activities in Iran. Tax is taken by Iran Tax Affairs Organization based on rights of Iran. Many factors effect on taxation as situation, firm, quality of services and so on. Taxation in Iran generates particular unease among foreign firms because they appear to be arbitrarily enforced – tax bills are initially based on 'assumed earnings' calculated by the Finance and Economy Ministry according to the size of the company and the sector in which it operates. Factors such as the quality and location of a company's offices are also widely believed to have an impact on tax assessment. The Environmental Performance Index (EPI) is a method of quantifying and numerically benchmarking the environmental performance of a country's policies. This index was developed from the Pilot Environmental Performance Index, first published in 2002, and designed to supplement the environmental targets set forth in the U.N. Millennium Development Goals.

Pearce (1991), Repetto et al. (1992), Nordhaus (1993) or Grubb (1993) among others argue that it is possible to improve tax efficiency by means of an ETR, while others, as Bovenberg and Mooij (1994) argue that this is not possible, in general, because environmental taxes are likely to increase, rather than reduce, previous distortions.Parry (1995) points out the relevance of choosing a partial equilibrium or a general equilibrium approach to answer this question. Partial equilibrium models do not take into account the interactions between environmental taxes and previous distortions, and these effects tend to cause the double dividend to hold in partial equilibrium models but not in general equilibrium models. This is because the environmental tax eventually falls on labor income, so that labor taxes and emission taxes distort the labor market in a similar way. However labor taxes are more efficient from the levying point of view because environmental taxes also distort the relative prices between polluting and non-polluting goods, which erodes the tax base. So, from a non-environmental point of view, emission taxes are likely to cause a larger excess of burden.

Notwithstanding, the economic literature also describes some mechanisms that may cause a strong double dividend, or an employment double dividend to happen in a general equilibrium framework. An ETR could facilitate wage moderation and the reduction of labor market distortions in a situation in which imperfect competition has led to excessively high wages (Brunello, 1996; Carraro et al., 1996). Bovenberg (1994) and Carraro and Soubeyran (1996) show that, if the initial tax system is suboptimal from a non-environmental point of view, an ETR can simultaneously reduce pollution and unemployment. We can conclude that opportunities to get a double dividend typically arise when there exist some market failures or some imperfections in the tax system (see also Bovenberg and Goulder, 2002). For a survey on ETR and the double dividend, see Mooij (1999) or Goulder (1995). Given the difficulties to obtain clear-cut theoretical conclusions, it makes sense to perform an empirical analysis to test the economic effects of a specific reform in a selected country or region, by means of a suitable applied model. A number of authors, like Bovenberg and Goulder (1996), Bye (2000), Dessus and Bussolo (1998), Wender (2001), Xie and Saltzman (2000) or Yang (2001), have used

Computable General Equilibrium (CGE henceforth) models to assess the economic effects of an ETR. These models perform a disaggregate representation of all the activity sectors and the equilibrium of all markets, according to basic microeconomic principles. In Spain, Gomez-Plana et al. (2003), Labandeira et al. (2003) and Manresa and Sancho (2005) use CGE models to simulate the effect of environmental tax reforms nationwide. The aim of this paper is considering the impact of tax ratio on environmental performance in Iran. For do it, I have used regression analysis. This paper is organized by four sections. The next section is devoted to research method. In section 3, empirical results are reported. Final section is devoted to conclusion.

2. Material and Methods

I have used the following model for considering the impact of tax rates on environmental performance:

$$CO_2Emmision_t = \alpha + \beta t_t + \delta X_t + \varepsilon_t \quad (1)$$

$CO_2Emmision_t$ is index of environmental performance, t_t is tax ratio or the share of tax incomes in GDP, X_t is vector of control variables as population, GDP growth and energy consumption (oil consumption per capita). ε_t is error term.

Data is collected by World Development Indicator (WDI) of 2011.

1.2. Unit Root Tests

If an OLS regression is estimated with non-stationary data and residuals, then the regression is spurious. To overcome this problem the data has to be tested for a unit roots (i.e. whether it is stationary). If both sets of data are I (1) (non-stationary), then if the regression produces an I(0) error term, the equation is said to be counteracted. The most basic non-stationary time series is the random walk, the Dickey-Fuller test essentially involves testing for the presence of a random walk.

$$y_t = y_{t-1} + u_t \quad (2)$$

Although this has a constant mean, the variance is non-constant and so the series is non-stationary. If a constant is added, it is termed a random walk with drift. To produce a stationary time series, the random walk needs to be first-differenced:

$$\Delta y_t = u_t \quad (3)$$

2.2. Augmented Dickey-Fuller (ADF) Test

The Dickey-Fuller test is used to determine if a variable is stationary. To overcome the problem of autocorrelation in the basic DF test, the test can be augmented by adding various lagged dependent variables. This would produce the following test:

$$\Delta y_t = (\rho - 1)y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta y_{t-i} + u_t \quad (4)$$

The correct value for m (number of lags) can be determined by reference to a commonly produced information criteria such as the Akaike criteria or Schwarz-Bayesian criteria. The aim being to maximize the amount of information. As with the DF test, the ADF test can also include a drift (constant) and time trend.

Common criticisms of these tests include sensitivity to the way the test is conducted (size of test), such that the wrong version of the ADF test is used. The power of the test may depend on:

-The span of the data, rather than the sample size. (This is particularly important for financial data)

-If ρ is almost equal to 1, but not exactly, the test may give the wrong result.

-These tests assume a single unit root I (1), but there may be more than one presents I (2).

-If the time series contains a structural break, the test may produce the wrong result.

3.2. Engle-Granger test for Cointegration

To test for cointegration between two or more non-stationary time series, it simply requires running an OLS regression, saving the residuals and then running the ADF test on the residual to determine if it is stationary. The time series are said to be cointegrated if the residual is itself stationary. In effect the non-stationary I(1) series have cancelled each other out to produce a stationary I(0) residual.

$$y_t = \beta_0 + \beta_1 x_t + u_t \quad (5)$$

Where y and x are non-stationary series. To determine if they are cointegrated, a secondary regression is estimated:

$$\underset{(0.10)}{\Delta u_t = -0.56u_{t-1}} \quad (6)$$

This produces a t-statistic of –5.60. If the critical value for this model is –2.95 (for example), we would reject the null hypothesis of non-stationary time series and conclude the error term was stationary and the two variables are cointegrated.

4.2. The Granger Representation Theorem

According to this theorem, if two variables y and x are cointegrated, then the relationship between the two can be expressed as an error correction model

(ECM), in which the error term from the OLS regression, lagged once, acts as the error correction term. In this case the cointegration provides evidence of a long-run relationship between the variables, whilst the ECM provides evidence of the short-run relationship. A basic error correction model would appear as follows:

$$\Delta y_t = \chi_0 + \chi_1 \Delta x_t - \tau(u_{t-1}) + \varepsilon_t \qquad (7)$$

Where τ is the error correction term coefficient, which theory suggests should be negative and whose value measures the speed of adjustment back to equilibrium following an exogenous shock. The error correction term u_{t-1}, which can be written as: $(y_{t-1} - x_{t-1})$ is the residual from the cointegrating relationship in (4).

5.2. Johansen's Procedure

Intuitively, the Johansen test is a multivariate version of the univariate DF test. Consider a *reduced form* VAR of order p:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + Bx_t + u_t \quad (5A)$$

Where y_t is a *k*-vector of I (1) variables, x_t is a n-vector of deterministic trends, and u_t is a vector of shocks. We can rewrite this VAR as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + u_t \qquad (6A)$$

Where $\Pi = \sum_{i=1}^{p} A_i - 1, \Gamma_i = -\sum_{j=t+1}^{p} A_j$

The error correction model (ECM), due to Engel and Granger (1987). The Π matrix represents the adjustment to disequilibrium following an exogenous *shock*. If Π has reduced rank *r* < *k* where *r* and *k* denote the rank of Π and the number of variables constituting the long-run relationship, respectively, then there exist two $k \times r$ matrices α and β, each with rank *r,* such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. *r* is called the *cointegration rank* and each column of β is a cointegrating vector (representing a long-run relationship). The elements of the α matrix represent the *adjustment* or *loading* coefficients, and indicate the speeds of adjustment of the endogenous variables in response to disequilibrating shocks, while the elements of the Γ matrices capture the short-run dynamic adjustments. Johansen's method estimates the Π matrix from an unrestricted VAR and tests whether we can reject the restrictions implied by the reduced rank of Π. This procedure relies on relationships between the rank of a matrix and its characteristic roots (or eigenvalues). The rank of Π equals the number of its characteristic roots that differ from zero, which in turn corresponds to the number of cointegrating vectors. The asymptotic distribution of the Likelihood Ratio (Trace) test statistic for cointegration does not have the usual χ^2 distribution and depends on the assumptions made regarding the deterministic trends.

3. Empirical Results

In this section, I tested unit root test for the variables. Co2 is I(1), Tax ratio is I(1), GDP growth is I(0), Oil Consumption is I(1) and population is I(2).

Table1. Unit Root Tests

Null Hypothesis: D(CO2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.047771	0.0000
Test critical values:	1% level	-3.581152	
	5% level	-2.926622	
	10% level	-2.601424	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(T) has a unit root
Exogenous: Constant
Lag Length: 9 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.963534	0.0513
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: GROWT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.587297	0.0101
Test critical values:	1% level	-3.592462	
	5% level	-2.931404	

	10% level	-2.603944	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(OIL) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.708419	0.0000
Test critical values:	1% level	-3.639407	
	5% level	-2.951125	
	10% level	-2.614300	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(POP,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.426162	0.0149
Test critical values:	1% level	-3.577723	
	5% level	-2.925169	
	10% level	-2.600658	

*MacKinnon (1996) one-sided p-values.

Table 2. Cointegration Test

Sample (adjusted): 1975 2007
Included observations: 33 after adjustments
Trend assumption: Linear deterministic trend
Series: CO2 T GROWT OIL POP
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.585326	78.58336	69.81889	0.0085
At most 1 *	0.488817	49.53471	47.85613	0.0345
At most 2	0.409181	27.39080	29.79707	0.0924
At most 3	0.210651	10.02469	15.49471	0.2788
At most 4	0.065021	2.218632	3.841466	0.1364

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 2 indicates cointegration test for the model. Result indicates that there is a long run relationship between environmental performance and tax ratio.

Table 3. Estimation Results

Method: Least Squares
Date: 11/22/11 Time: 09:27
Sample (adjusted): 1973 2007
Included observations: 35 after adjustments
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.141045	0.642668	6.443521	0.0000
T	-3.102498	2.147938	2.375534	0.0141
OIL	0.007869	0.003696	2.128912	0.0416
GROWT	0.028545	0.013807	2.067450	0.0474
POP	-2.48E-08	2.01E-08	-1.233085	0.2271

R-squared	0.789508	Mean dependent var	4.528254
Adjusted R-squared	0.761443	S.D. dependent var	1.093238
S.E. of regression	0.533963	Akaike info criterion	1.714583
Sum squared resid	8.553494	Schwarz criterion	1.936776
Log likelihood	-25.00521	Hannan-Quinn criter.	1.791284
F-statistic	28.13083	Durbin-Watson stat	0.473486
Prob(F-statistic)	0.000000		

Table 3 indicates estimation results. Results indicate tax rate decrease on CO2 emission, so increasing in tax rate increases environmental performance and Sustainable Development. Energy consumption and economic growth have a positive effect on pollution. So these variables have a negative effect on environmental performance. R-squared is 79%. This means that the model has a suitable goodness of fit.

4. Discussions

Tax bills are initially based on 'assumed earnings' calculated by Iran Tax Affairs Organization according to the size of the company and the sector in which it operates. Factors such as the quality and location of a company's offices are also widely believed to have an impact on tax assessment. The Environmental Performance Index (EPI) is a method of quantifying and numerically benchmarking the environmental performance of a country's policies. This index was developed from the Pilot Environmental Performance Index, first published in 2002, and designed to supplement the environmental targets set forth in the U.N. Millennium Development Goals.

The aim of this paper is considering the impact of tax rates on environmental performance in Iran. For do it, I have used regression analysis. I tested unit root test for the variables. Co2 is I(1), Tax ratio is

I(1), GDP growth is I(0), Oil Consumption is I(1) and population is I(2). Result of cointegration test indicates that there is a long run relationship between environmental performance and tax ratio. Estimation results indicate that tax rate decrease CO2 emission, so increasing in tax ratio increases environmental performance and suitable development. Energy consumption and economic growth have a positive effect on pollution. So these variables have a negative effect on environmental performance. So, taxation policies could improve environmental performance in Iran and this is an important on suitable development in Iran.

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