Eurasian Journal of Economics and Finance, 8(2), 2020, 85-94
DOI: 10.15604/ejef.2020.08.02.003

EURASIAN JOURNAL OF ECONOMICS AND FINANCE

www.eurasianpublications.com

TRENDS AND DRIVERS OF TAX EFFORT: INTERNATIONAL EMPIRICAL EVIDENCE

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Received: May 1, 2020 Accepted: June 24, 2020

Abstract

This paper aims to identify the tax effort and its macroeconomic determinants in a sample composed of 13 countries from the MENA region and European countries using a set of macroeconomic variables considered by previous studies. This study employs two empirical methods to capture tax effort, and to analyze macroeconomic determinants of tax effort. Firstly, the paper uses a panel-stochastic frontier method to identify the tax effort and inefficiency term. Then, it uses a panel data regression model to analyze the determinants of tax effort in the years between 2005 to 2013. However, the selected sample includes two groups; the first group involves 6 European countries known with their high tax collections and low corruption. And the second group contains 7 developing countries with low tax collections and high corruption levels from the MENA region. The main findings of the study indicate that trade openness, inflation, and corruption are vital determinants for tax effort in sample countries. It is also found that developed countries have a higher tax effort than developing countries in general. However, Algeria has the most efficient tax administration with more than 98% tax effort, while Jordan is the least efficient among sample countries with 75% tax effort.

Keywords: Tax Effort, Macroeconomic Variables, Stochastic Frontier, Panel Data

JEL Classifications: E6, C33, E31, H2

1. Introduction

Tax collection has been a critical issue for all economies, as taxation is a vital tool for any government around the world. Without sufficient tax collection, a government may fail to provide public goods and services such as national defense, education, health, social security, and

justice. The discussion over the efficiency of tax collection revolves around the concepts of tax effort and tax capacity. Tax effort is defined as the actual amount of tax collected from their maximum expected tax revenues, which in turn called tax capacity, it represents how efficient tax administrative is and to what extent they can collect taxes. In addition to the efficiency of tax administration, while tax capacity is defined as the potential amount of taxes that could be collected within a period (Pessino and Fenochietto, 2010). In this study, to analyze the impact of macroeconomic variables besides corruption on tax performance, we included countries from the Middle East and Europe, since five out of the most ten corrupted countries in 2017 were Middle Eastern countries; Syria, Yemen, Sudan, South Sudan, and Libya (Transparency International, 2018). This study is designed to measure the determinants of the gap between the actual and potential tax revenues in a sample of seven Middle Eastern countries which suffer from tax collection inefficiencies and six European countries (developed countries) classified with high tax collections.

What makes this study unique is the use of two statistical models to identify tax effort and then analyze the macroeconomic determinants of tax effort in the sample. The first model is the stochastic frontier analysis (SFA), employing different variables, such as demographic, macroeconomic, and institutional variables published by international institutions. This model is a useful tool to predict relative inefficiency levels within countries and to give feedback for decision-makers to take correctional decisions, by implementing the first model we identified the tax inefficiency level, which is the difference between tax capacity and tax effort. The second model is panel data analysis, to study the determinants of tax effort using a set of macroeconomic variables. Unlike previous studies, we implemented two statistical methods instead of one and chosen a balanced sample in order to capture the impact of specific variables on tax effort, which makes our results reliable and gives sufficient information for the reader. Another critical contribution of the study is that it helps to define tax administration efficiency and tax capacity as well, and a secondary aim of the study is to analyze the relationship between corruption and tax effort and to what extent tax collection is affected by corruption in the Middle East in the light of higher corruption in the Middle East area compared to Europe. The reason behind selecting seven developing countries from the Middle east is to increase the weighted average of countries suffering from corruption.

Coming in line with previous literature, our findings illustrate that tax effort is positively affected by volume of international trade, and negatively by the inflation rate and corruption level. However, although signs came in accordance with what we expected, there was no enough evidence on the impact of other variables such as the agriculture contribution and GDP per capita.

This paper is arranged as follows; Section 2 discusses related literature and reviews the most important contributions with this regard; Section 3 describes the data used and methodology, including sources and models used to obtain the analysis. Empirical tests and results are illustrated in Section 4. The conclusion is listed in Section 5.

2. Literature review

A limited number of studies have been conducted to measure tax effort and capacity for countries; the differences between this study and preceding ones are that majority of them have employed regression models to find the determinants of tax effort or tax collection ratio. On the other hand, some literature body analyzes tax effort using a different technique known as Stochastic Frontier Analysis; this method provides better explanation tools for inefficiency in collecting taxes which is the method we have used.

A study by Bird *et al.* (2008) analyzed the impact of corruption on the tax effort of a sample of developing countries. A key finding for this study is that accountability and corruption are significant determinants for tax effort within the sample. However, one of the criticisms for this study is that the author's definition of tax effort term is limited at actual tax collections for GDP, not the ratio of tax collection as a share of tax capacity. The main variables assessed were population growth, openness level, and share of agriculture contribution to the economy.

Another regression model is implemented to measure the impact of grants in the USA on tax effort for local government between 1993 and 1994 by Rajaraman and Vasishtha (2000).

Piancastelli (2001) has employed a regression model to analyze tax effort in 75 countries over ten years from 1985 to 1995. It concluded that the level of development, which is indexed by per capita income, trade openness, and agriculture's added value to the economy, are the main determinants of tax effort for the 75 countries. Tax effort determinants have also been studied by Eltony (2002) using a regression model for tax collection and some variables such as mining, international trade, and agriculture share of the economy. For non-oil countries, it is found that the share of agriculture and trade openness is the critical determinants for tax collection.

On the other hand, Wijeweera *et al.* (2010) used the stochastic frontier analysis (SFA) model to analyze the impact of foreign direct investment (FDI) on economic growth; this model is not only used to analyze tax effort but also for other aspects of research such as economic growth and FDI. However, one of the most recent implications of the model in analyzing tax effort is Pessino and Fenochietto (2010), who employed stochastic frontier analysis to determine tax effort and capacity in 96 countries, this study focused mainly on inefficiency term to determine tax effort, which in turn is used later to find tax capacity and effort based on the determinant variables in the model. However, it is found that tax effort is affected positively by education and GDP per capita and negatively by corruption and agricultural contribution to GDP.

Corruption has been seen as one of the main threats for tax collections according to Pessino and Fenochietto (2010), Langford and Ohlenburg (2016), Le *et al.* (2012). In this regard, Langford and Ohlenburg (2016) utilized data from 85 countries over a 27 years period found that fighting corruption is a crucial step towards higher tax collection in developing countries. Le *et al.* (2012) also found that tax effort depends mainly on demographic and institutional factors, which explains differences between countries in terms of tax collection. Atsan (2017) analyzed the determinants of tax effort in Turkey and found that tax effort in Turkey is determined by per-capita income and agricultural sector contribution to economic activity, although evidence on corruption's impact was not enough, it is believed that it has a negative impact on tax effort.

3. Data and methodology

In the first stage, the SFA model will be used to evaluate the efficiency tax effort sampled countries using the same model introduced by Aigner *et al.* (1977). This model is implemented later by Fenochietto and Pessino (2013) to determine tax effort. To achieve reliable results of the analysis, a panel-stochastic frontier method is employed to capture changes over the years, rather than using cross-section analysis for a single year. Then, the second part will apply a panel data regression model covering the years between 2005 to 2013 to analyze the determinants of tax effort in the Middle East and Europe using a set of variables considered by previous studies. A Stochastic Frontier model can be expressed basically as in the following:

$$\mathrm{Ti} = \alpha + \beta Xit + Vit - U\mathrm{it} \quad (1)$$

where, U_{it} is inefficiency term, or the failure to collect the maximum amount of tax (tax capacity), this variable always takes a positive value, which means that there is a general inefficiency. V_{it} is the error term results from unknown omitted variables that are not considered while obtaining the analysis. T is tax effort to GDP in time t for country i. X is explanatory variables affecting tax collection in time t for country i. β = vector of parameters.

In this model, a low tax effort means that a country has a broader inefficiency term (U) compared to other countries in the sample and does not necessarily mean that this country is inefficient in collecting taxes. In this model, we depend on inefficiency term to calculate the tax effort and tax capacity as well, since tax capacity represents the maximum collectible amount of taxes and includes tax effort and inefficiency term, which has been identified as a percentage.

Thus, tax effort is calculated by subtracting inefficiency term from 100%, while tax capacity is the result of dividing actual tax collection by tax effort.

With regard to data, the study will consider a secondary macroeconomic, demographic, and institutional data published by international research institutions. Table 1 indicates variables and their sources. However, data covers the period between 2005 to 2013 and includes 13 countries from Europe and the Middle East, namely Morocco, Algeria, Tunisia, Egypt, Lebanon, Jordan, and Sudan; along with another six countries mainly from Europe (France, Sweden, Turkey, Denmark, and Norway) to create a sample balance for the stochastic frontier analysis and to capture the possible effect of corruption in the sample.

The stochastic frontier model works more efficiently as long as the sample is representative and includes the maximum number of countries to identify their inefficiency term. To strike a balance between data validity and reliability of results, only seven other states (known with low corruption) are included to the model to give a higher weight for Middle East countries as they represent 50% of the sample. In contrast, in other studies, they represent less than 5%, and thus their country-specific factors are most likely omitted.

Table 1. List of variables and their definitions

Variable	Definition	Expected sign	Source
Tax Revenue	Tax revenue refers to mandatory transfers to the government for public purposes, such as fines, penalties, and most social security contributions are not included.	Dependent variable	WDI
GDP Per Capita	GDP per capita is GDP divided by the midyear population. Data are in current U.S. dollars.	+	WDI
Human capital Index	Refers to the Mean Years of schooling and expected Years of Schooling.	+	UNDP/HDR
Economic Complexity Index	ECI measures the knowledge intensity of an economy by considering the knowledge intensity of the products it exports.	-	OEC
Urbanization	This refers to the people living in urban areas. The data are collected and smoothed by the United Nations Population Division.	+	WDI
Added Value by Manufacturing	Value added is the net output after adding up all outputs and subtracting intermediate inputs.	+	WDI
CPI/ Inflation	It is measured by the consumer price index.	-	WDI
Trade Openness	It is the sum of exports and imports of goods and services over the GDP.	+/-	WDI
Added Value by Agriculture	Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. It Includes several activities such as forestry, hunting, and cultivation of crops and livestock production, etc.	-	WDI
Corruption Index	Indicate to scores countries on how corrupt their governments are believed to be. A low score reflects a high degree of corruption.	+	Transparency International

4. Empirical tests

A crucial step before performing any analysis is to check the validity of data, as data stationarity and the unit root problem is a serious challenge for all analysis, to make sure of data validity we obtained a Levin Lin Chu unit root test for panel data, the test Null hypothesis supports the

existence of unit root feature in the series, while the alternative hypothesis stands for data stationarity. Results of the test are listed in Table 2 showing that all variables are stationary and valid for analysis.

Table 2. Result of Levin-Lin-Chu unit-root test

	Statistic	P-Value
Tax revenue	-3.87	0.00
Agriculture contribution	-6.60	0.00
Trade openness	-2.15	0.01
Inflation	-3.21	0.00
Manufacturing	-8.05	0.00
Urbanization	-4.23	0.00
ECI	-19.37	0.00
Human capital index	-6.75	0.00
GDP Per capita LN	-6.39	0.00
Corruption index	-3.19	0.00

Source: Authors own compilation

Hausman test is sometimes known as model specification test. Especially in panel data analysis this test helps to choose between fixed Effects model and Random-effects model, null hypothesis dictates that the preferred test is the random-effects model. In contrast, the alternative hypothesis suggests the fixed effects model. If the p-value of the test is lower than 0.05, we reject the null hypothesis (the fixed effect is preferred), if the p-value is higher than 0.05, we accept the null hypothesis (the random effect is preferred). Based on Table 3, p-value is higher than 0.05. So we do not have sufficient evidence to reject the null hypothesis, which stands for the random effect model.

Table 3. Result of Hausman specification test

	T statistic	P-Value
Ho: Supports Random effect method	11.09	0.26

Source: Authors own compilation

5. Results

The maximum likelihood method is employed to obtain the frontier analysis, using tax revenue as a percentage of GDP as a dependent variable while variables listed in Table A1 in Appendix represent determinants for tax revenue according to maximum likelihood analysis. As listed in Table A1 in Appendix, only trade openness and inflation rate were significant in the model. Thus, values of inefficiency were calculated based on it, giving higher weights for significant variables compared to other variables. However, all of the coefficients are significant since their value is different from zero despite their p-values. Signs have come up with previous literature results except for the urbanization index, which might be affected by political changes or public preferences, which came in contrast with demographic changes.

In this model, in line with Pessino and Fenochietto (2010) and Langford and Ohlenburg (2016), trade openness and inflation variables are the determinant variables of tax effort; trade openness (the size of commercial activity) has a positive relationship with tax collections, meaning that the higher the volume of commodity exchange, the higher is tax collection. On the other hand, the inflation rate is statistically significant. It has a negative sign, which means a country with a higher inflation rate, has the potential to collect less tax.

Table A2 in Appendix lists countries and their tax effort based on frontier analysis yearly, and shows technical inefficiency term, actual tax revenue, tax effort (based on inefficiency term) and tax capacity as a percentage of GDP. Generally speaking, European countries are noticed to have higher tax effort and lower inefficiency compared to developing

countries in the same sample. What can be seen in Table A2 in Appendix is that Algeria has the highest tax effort (lowest inefficiency) with 1.4% only. On the other hand, Jordan has the worst figures in terms of tax effort percentage, with more than 25% of inefficiency value. However, looking with an eye of detail for both countries, depending on analysis results, we can notice that a reason for Algeria's high tax effort is the correction taken against corruption and the increasing volume of trade. At the same time, Egypt had suffered from decreasing levels of transparency and decreasing the amount of trade as well, which does make sense in accordance with results.

Another note from the figures is the decreasing tax effort in Lebanon, which can be attributed to political instability, increasing corruption level, and fluctuations in trade volume, especially when other variables were partially constant.

In sum, the results of the regression analysis show robust statistical evidence for the impact of trade openness on tax collection level with a positive sign, meaning a higher collection of taxes is tied to higher trade volume. Inflation, as well, is found to have a significant negative impact on tax effort, which fits with previous literature. As suggested by most of the previous literature, such as Pessino and Fenochietto (2010); Langford and Ohlenburg (2016), corruption also has a negative effect on tax collection; it means a higher level of the index, which indicates a lower level of corruption leads to higher tax collections. On the other hand, although signs of other variables such as the size of the agriculture sector, manufacturing, and GDP per capita were in accordance with previous literature, they were not found to have a significant relationship with the tax collection level (Table A3 in Appendix).

6. Conclusion and discussions

SFA model is applied to determine the inefficiency term and then tax capacity of a sample, including 13 countries, mostly from the Middle East and Europe. This model is a relative measurement process and indicates the relative inefficiency term of a country with respect to the best performing one (tax frontier). However, the inefficiency term calculated represents both technical inefficiency and policy issues, which include tax rates and public preferences. This study's findings are consistent with previous literature in terms of variable coefficient sign and significance. For instance, despite their statistical significance, results show that agriculture added value, corruption, and inflation level have a negative sign with tax collection which corroborates previous literature such as Pessino and Fenochietto (2010); Gupta (2007); Bird *et al.* (2008). On the other hand, education level and trade openness come up with previous literature, which in turn has a positive coefficient sign, i.e. Baunsgaard and Keen (2010). According to the analysis result, the tax collection level is determined mainly by trade openness, inflation rate, and corruption. Thus, decreasing levels of corruption, stable or decreasing inflation rates or/and increasing trade volume have the highest tax effort among other countries, according to Awasthi and Bayraktar (2015), countries with simple tax systems have lower levels of corruption in tax administration and thus higher tax effort. In the same context, administrative efficiency found lower in countries with central and complicated tax systems (Thornton *et al.* 2019). Moreover, states that failed to enhance determinant figures such as corruption and inflation found to have an increasing inefficiency value and hence, a lower tax effort such as Sudan, Lebanon, and Tunisia. Thus, and in the light of tax effort determinants, countries that suffer from low tax collection capability could improve their tax collection level by enhancing determinant factors such as, imposing strict control on tax administrations to minimize corruption, tax regime simplifications, allow liberalization of markets and trying to keep stable, predictable and low inflation rates in both long and short-run.

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Appendix

Table A1. Result of SFA maximum likelihood - truncated

Tax Revenue % GDP	Coef.	P-Value
agriculture contribution	-0.19	0.18
trade openness	0.10	0.00
Inflation	-0.18	0.00
Manufacturing	-0.10	0.62
Urbanization	-0.14	0.20
ECI	-0.95	0.38
\Human capital index	1.87	0.86
GDP Per capita LN	1.01	0.64
Corruption index	0.86	0.11
Constant	30.95	0.04

Source: Authors own compilation

Table A2. Result of Stochastic Frontier analysis SFA model

Country	Year	Technical Inefficiency %	Tax Revenue	Tax Effort %	Tax Capacity %GDP
Algeria	2005	1.43	30.77	98.57	31.21
Algeria	2006	1.44	40.75	98.56	41.35
Algeria	2007	1.44	37.43	98.56	37.98
Algeria	2008	1.45	45.25	98.55	45.92
Algeria	2009	1.45	35.14	98.55	35.66
Algeria	2010	1.46	34.40	98.54	34.91
Algeria	2011	1.46	37.18	98.54	37.74
Algeria	2012	1.47	38.46	98.53	39.03
Algeria	2013	1.47	40.49	98.53	41.09
Egypt	2005	21.42	14.07	78.58	17.90
Egypt	2006	21.49	15.83	78.51	20.16
Egypt	2007	21.56	15.35	78.44	19.57
Egypt	2008	21.63	15.32	78.37	19.55
Egypt	2009	21.70	15.66	78.30	20.00
Egypt	2010	21.77	14.13	78.23	18.06
Egypt	2011	21.84	14.01	78.16	17.92
Egypt	2012	21.92	12.38	78.08	15.86
Egypt	2013	21.99	13.50	78.01	17.30
Jordan	2005	25.18	19.23	74.82	25.70
Jordan	2006	25.26	19.26	74.74	25.77
Jordan	2007	25.34	18.26	74.66	24.45
Jordan	2008	25.42	17.77	74.58	23.83
Jordan	2009	25.51	17.04	74.49	22.88
Jordan	2010	25.59	15.98	74.41	21.47
Jordan	2011	25.67	15.02	74.33	20.21
Jordan	2012	25.75	15.29	74.25	20.60
Jordan	2013	25.84	15.33	74.16	20.67
Lebanon	2005	22.57	15.32	77.43	19.78
Lebanon	2006	22.64	15.16	77.36	19.60
Lebanon	2007	22.71	15.10	77.29	19.53
Lebanon	2008	22.79	16.36	77.21	21.18
Lebanon	2009	22.86	16.82	77.14	21.80
Lebanon	2010	22.94	16.86	77.06	21.87
Lebanon	2011	23.01	16.32	76.99	21.19
Lebanon	2012	23.08	15.25	76.92	19.83
Lebanon	2013	23.16	14.33	76.84	18.65

Table A2. Continued

Morocco	2005	15.35	20.97	84.65	24.78
Morocco	2006	15.40	21.45	84.60	25.36
Morocco	2007	15.45	23.91	84.55	28.27
Morocco	2008	15.50	26.49	84.50	31.35
Morocco	2009	15.55	23.46	84.45	27.78
Morocco	2010	15.60	22.82	84.40	27.04
Morocco	2011	15.65	23.30	84.35	27.62
Morocco	2012	15.70	23.35	84.30	27.71
Morocco	2013	15.75	21.20	84.25	25.16
Sudan	2005	13.80	23.73	86.20	27.53
Sudan	2006	13.85	22.00	86.15	25.54
Sudan	2007	13.89	21.00	86.11	24.39
Sudan	2008	13.94	24.00	86.06	27.89
Sudan	2009	13.98	16.00	86.02	18.60
Sudan	2010	14.03	19.00	85.97	22.10
Sudan	2011	14.08	18.00	85.92	20.95
Sudan	2012	14.12	9.00	85.88	10.48
Sudan	2013	14.17	11.00	85.83	12.82
Tunisia	2005	20.57	18.88	79.43	23.76
Tunisia	2006	20.63	18.51	79.37	23.32
Tunisia	2007	20.70	19.07	79.30	24.05
Tunisia	2008	20.77	20.50	79.23	25.88
Tunisia	2009	20.83	20.05	79.17	25.32
Tunisia	2010	20.90	20.14	79.10	25.46
Tunisia	2011	20.97	21.19	79.03	26.82
Tunisia	2012	21.04	21.13	78.96	26.76
Tunisia	2013	21.11	21.00	78.89	26.62
Belgium	2005	22.83	25.35	77.17	32.86
Belgium	2006	22.91	25.17	77.09	32.65
Belgium	2007	22.98	24.71	77.02	32.08
Belgium	2008	23.06	25.09	76.94	32.60
Belgium	2009	23.13	23.62	76.87	30.73
Belgium	2010	23.21	24.33	76.79	31.69
Belgium	2011	23.28	24.71	76.72	32.21
Belgium	2012	23.36	25.71	76.64	33.55
Belgium	2013	23.43	26.19	76.57	34.20
Denmark	2005	12.96	33.07	87.04	37.99
Denmark	2006	13.00	31.86	87.00	36.62
Denmark	2007	13.04	35.09	86.96	40.36
Denmark	2008	13.08	33.42	86.92	38.45
Denmark	2009	13.13	33.18	86.87	38.20
Denmark	2010	13.17	32.74	86.83	37.70
Denmark	2011	13.21	32.75	86.79	37.74
Denmark	2012	13.26	33.45	86.74	38.56
Denmark	2013	13.30	33.82	86.70	39.01
France	2005	18.44	22.29	81.56	27.33
France	2006	18.50	22.57	81.50	27.69
France	2007	18.56	22.15	81.44	27.19
France	2008	18.62	22.03	81.38	27.07
France	2009	18.68	20.71	81.32	25.46
France	2010	18.74	21.95	81.26	27.01
France	2011	18.80	21.83	81.20	26.89
France	2012	18.86	22.55	81.14	27.80
France	2013	18.92	23.23	81.08	28.66

Table A2. Continued

Norway	2005	18.07	28.20	81.93	34.42
Norway	2006	18.13	28.90	81.87	35.29
Norway	2007	18.19	28.11	81.81	34.36
Norway	2008	18.24	27.87	81.76	34.08
Norway	2009	18.30	25.88	81.70	31.68
Norway	2010	18.36	26.82	81.64	32.85
Norway	2011	18.42	27.68	81.58	33.93
Norway	2012	18.48	26.96	81.52	33.08
Norway	2013	18.54	25.08	81.46	30.79
Sweden	2005	16.71	28.50	83.29	34.22
Sweden	2006	16.77	28.49	83.23	34.23
Sweden	2007	16.82	28.45	83.18	34.20
Sweden	2008	16.88	27.03	83.12	32.51
Sweden	2009	16.93	26.94	83.07	32.43
Sweden	2010	16.99	27.11	83.01	32.66
Sweden	2011	17.04	26.49	82.96	31.93
Sweden	2012	17.10	26.07	82.90	31.45
Sweden	2013	17.15	26.25	82.85	31.68
Turkey	2005	16.73	17.15	83.27	20.60
Turkey	2006	16.78	16.48	83.22	19.81
Turkey	2007	16.84	17.57	83.16	21.13
Turkey	2008	16.89	17.70	83.11	21.29
Turkey	2009	16.95	18.26	83.05	21.99
Turkey	2010	17.00	19.41	83.00	23.38
Turkey	2011	17.06	18.74	82.94	22.60
Turkey	2012	17.11	18.39	82.89	22.19
Turkey	2013	17.17	18.53	82.83	22.37

Source: authors own compilation

Table A3. Results of random - effects GLS regression

Tax Revenue	Coef.	Std. error	z	P > z
Agriculture contribution	-0.21	0.14	-1.45	0.14
Trade openness	0.10	0.02	5.09	0.00
Inflation	-0.17	0.05	-3.10	0.00
Manufacturing	0.00	0.19	0.04	0.96
Urbanization	-0.11	0.11	-1.01	0.31
ECI	-0.62	1.06	-0.59	0.55
Education index	1.70	11.40	0.15	0.88
GDP Per capita LN	-0.04	2.13	-0.02	0.98
Corruption index	1.05	0.52	1.99	0.04
Constant	17.98	16.10	1.12	0.26
R squared	0.4379			

Source: authors own compilation