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The Association between Subsidies and Productivity: Panel Analysis *

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Abstract. This study investigates the impact of subsidies, which is a proxy for incentives given to firms in an economy, on value added created by entire economy and four different sectors (i.e., agriculture, manufacturing, industry, and services). The largest period under study is between 1972 and 2013 and the largest sample covers 151 countries. First of all univariate and multivariate fixed time effect models (FEM) and the following univariate and multivariate random time effect models (REM) were estimated using unbalanced panel data. Value added and its logarithmic values are used in the model as a dependent variable. Five different value added variables are used in order to evaluate the sensitivity and validity of our empirical results. This study empirically investigates the effect of subsidy on value added level of a country. In order to test this relationship the study use five different indicators for value added. The data used in analyses are unbalanced data and cover the years between 1972 and 2013 for 151 countries in the largest sense. The main finding of the study implies that countries with higher subsidy level experience higher level of value added.
Keywords. Subsidies, Value added, Incentives.
JEL. H20, H21, H22.

1. Introduction

State aid is often referred to as the concept of incentives, subsidies and subventions. In a broad sense, subsidies are the use of public resources in the production of certain goods and services to a certain region, sector or private enterprise (Gediz-Oral & Uğur, 2013). State aid to manufacturing, industrial and service sectors in the form of grants and subsidies has been a key component of regional policy. As is known, the economic supports provided by the state are a means of economic and social policies applied in the country. The state aims to achieve some benefits such as reducing regional development disparities, expanding certain sectors, increasing employment, collecting and supporting social support with these subsidies.

Public subsidy is aimed at influencing the regional allocation of investments and employment in order to increase competitiveness, self-sustaining growth and new employment in low income regions. A great deal of financial resources has been allocated to such schemes so is not surprising that the literature on the effect

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of subsidies on firm behavior is vast. However, the empirical evidence is diverse and often contradictory, reflecting the severe difficulties in carrying out a rigorous micro-econometric evaluation in this area (Bernini & Pellegrini, 2011).

While subsidies are given for a variety of purposes, they are mainly used by the private sector to make more investments, to direct investments to specific sectors and / or regions, and to reduce regional disparities (Yavan, 2012). On the other hand, in developing countries, while incentive schemes aim at economic growth in the long run, they aim to produce high goods with competitiveness, reduce unemployment and attract foreign investors to the country. In such countries with long-term economic growth plans and development programs, incentive schemes are prepared in accordance with development strategies and the subsidies function as stabilizers (Akdeve & Karagöl, 2013).

However, negative effects were also brought about by the large scale governmental subsidy (Yongqing & Xiaohan, 2016). A significant portion of public expenditure in many countries is directed towards the support of production units and, while some of these outlays support R&D and other innovative activities, more often than not they are directed towards establishments that are unproductive (Samaniego, 2006). It is possible to say that the subsidies for the more regional basis in Turkey and its goals for developing the provinces and regions have often resulted in failure. With the incentives implemented, provinces and regions, especially Turkey's western regions and country-wide city centers, have widened with the migration they have received, and the development strategy has remained backward (Ünsaldı, 2006).

This paper contributes to this literature by shedding more light on sectoral growth and development of subsidies given in Turkey and in the world. In the following sections of the study, the literature will be discussed first, and empirical studies on the impact of subsidies, which is a proxy for incentives given to firms in an economy, on value added created by entire economy and four different sectors (i.e., agriculture, manufacturing, industry, and services). Then, data and methodology will be explained and the data, model and methodology used in the analysis will be explained. Then the results of the estimation will be reported and discussed. The final part will be included in the result section.

2. Literature

There are many empirical studies in the literature that have examined subsidies. Economic literature covers a variety of aspects with regard to subsidies. A lot of works deal with effects of various types of subsidies on investment (Svoboda, Lososová & Zdeněk, 2016). Studies try to bring clarity over effectiveness, motives and effects on energy sector, taxes, SME's, R&R, competition, welfare and so on.

According to Buts & Jegers (2013) economic literature covers a variety of aspects with regard to State aid. Studies try to bring clarity over effectiveness, motives and effects on competition and welfare.

The literature reviewed in this context is shown in Table 1.

Table 1. *Literature Summary*

Author	Period/ Countries/Firms	Results
Svoboda, Lososová & Zdeněk (2016)	2004-2013 28 countries	The relationship between subsidies on investments and gross investment ranges from middle to higher dependency. The amount of subsidies on investments does not significantly affect the amount of current Farm Net Income.
Iriani & Trabelsi (2015)	1980-2001 6 countries	The analysis of GDP-Energy causality relationship in the UAE supports the neutrality hypothesis. These results suggest that appropriate energy policies geared at phasing out subsidies, hence inducing a more efficient use of energy in this region.
Minviel & Witte (2017)	2006-2011 313 firms	The estimates indicate that public subsidies influence negatively the conditional technical efficiency of farms. This suggests that public subsidies affect both the range of the attainable set for the inputs and outputs and the distribution of the efficiency scores

		inside the attainable set
Dennis (2016)	59 countries for 21 products	Finds that while welfare implications are unambiguously positive for government the results are mixed for private households, although in an overwhelming majority of cases, the results are positive. However, even in the cases where the welfare implications are negative for private households we find that it is possible for governments to carry out the reforms in such a way as to be welfare improving to households incomes by compensating them with some of the fiscal savings gained from the subsidy reform.
Bronzini & Piselli (2016)	2005-2011 1246 firms	Evaluates the impact of an R&D subsidy program implemented in a region of northern Italy in the early 2000s on innovation by beneficiary firms.
Sakai (2017)	1996-2011 23 countries	Results show that the effect of subsidies depends on the type of subsidy and the management regime. Within this sample, cost-reducing subsidies have no effect on stocks if management is individual quota based but have negative effects if management uses traditional input/output restrictions. Subsidies for improving fishery management and infrastructure produce beneficial effects on stocks under traditional management, but no effect with individual quota–based management.
Plante (2014)	2007-2011 37 countries	The subsidy reduces aggregate welfare. The losses are fairly small for subsidy-to-GDP ratios on the order of 1 to 2% of GDP, but they grow quickly as the ratio increases to higher levels

3. Data and Methodology

This study investigates the impact of subsidies, which is a proxy for incentives given to firms in an economy, on value added created by entire economy and four different sectors (i.e., agriculture, manufacturing, industry, and services). Efficiency and productivity are interchangeable concepts. There are many ways in which productivity or efficiency are measured, including accounting methods. This study refers to sector productivity.Value added is used as a proxy of productivity. Therefore, the value added measure is used in the physical measurement of sector productivity. In addition to the political and economic factors affecting productivity level in an economy (Koyuncu & İşcan, 2016). The largest period under study is between 1972 and 2013 and the largest sample covers 151 countries. By using unbalanced panel data we estimated the following univariate and multivariate fixed time effect models (FEM) respectively;

$$VALUEAD_{it} = (\alpha + \tau_t) + \beta_1 SUBSIDY_{it} + u_{it} \quad (1a)$$

$$VALUEAD_{it} = (\alpha + \tau_t) + \beta_1 SUBSIDY_{it} + \beta_2 FIXCAP_{it} + \beta_3 INFLATION_{it} + \beta_4 HUMCAP_{it} + u_{it} \quad (1b)$$

and the following univariate and multivariate random time effect models (REM) respectively;

$$VALUEAD_{it} = \alpha + \beta_1 SUBSIDY_{it} + (\tau_t + u_{it}) \quad (2a)$$

$$VALUEAD_{it} = \alpha + \beta_1 SUBSIDY_{it} + \beta_2 FIXCAP_{it} + \beta_3 INFLATION_{it} + \beta_4 HUMCAP_{it} + (\tau_t + u_{it}) \quad (2b)$$

where *it* subscript stands for the *i-th* country's observation value at time *t* for the particular variable. α is the intercept term and τ_t represents time-specific effects which affect all countries in the same way (i.e., τ_t is variant across time but not across countries). u_{it} is idiosyncratic error term of the regression model.

The variables used in our analysis were chosen in the light of previous studies found in the literature, the availability of the data and our main hypothesis (Yıldırım, Koyuncu, & Yalçınkaya-Koyuncu, 2009). Our dependent variable is

value added and its logarithmic values are used in the model. Five different value added variables are used in order to evaluate the sensitivity and validity of our empirical results. Results may vary depending on which value added variable is used. If the results hold across different value added variables, it will be an indication of their robustness. The list of dependent variables, their definitions, and the data sources are given in Table 2 below.

Table 2. *List of Dependent Variables*

Variables	Definition	Source
GROSVALUEAD	Gross value added at factor cost (current LCU)	WDI
AGRVALUEAD	Agriculture, value added (current LCU)	WDI
MANVALUEAD	Manufacturing, value added (current LCU)	WDI
SERVALUEAD	Services, etc., value added (current LCU)	WDI
INDVALUEAD	Industry, value added (current LCU)	WDI

Our interested primary explanatory variable is subsidy (SUBSIDY). SUBSIDY variable is subsidies and other transfers (current LCU) and gathered from WDI. In this study we investigate the effect of subsidies on value added. If the subsidies are efficient then we expect to have a positive impact on value added. Otherwise we anticipate reverse impact on value added. In analysis, its logarithmic values are used.

Besides the SUBSIDY variable, we also introduced three more determinants peculiar to value added into our analysis to see how robust our finding is. The control variables used in our analysis were chosen in the light of previous studies found in the literature, the availability of the data and our main hypothesis. Definition and data source of other three independent variables are given in Table 3 below.

Table 3. *List of Independent Variables*

Variables	Definition	Source
FIXCAP	Gross fixed capital formation (current LCU)	WDI
INFLATION	Inflation, consumer prices (annual %)	WDI
HUMCAP	Human capital index	Penn World Table

The following further describes the independent variables and discusses their expected signs.

FIXCAP variable represents the physical capital level in an economy and its logarithmic values are utilized. If investment level and so physical capital level in an economy increase then it is expected that the levels of value added created in that economy rise. Hence, the prior sign for the coefficient of FIXCAP variable is positive.

INFLATION variable in the model reflects the three things; namely degree of uncertainty in an economy, political instability, and economic instability. Countries with higher degree uncertainty and instability are less able to produce more value added. Therefore, we expect to have a negative relationship between INFLATION and SUBSIDY variables.

HUMCAP variable represents the human capital level in an economy and its annual growth rate values are used. Economies with higher human capital endowments experience higher production levels having higher value added. Thus, the anticipated sign for the coefficient of HUMCAP variable is positive.

Whenever taking logarithmic value of a variable is not possible then in order to make it have a logarithmic value we added a specific enough value to each observation of the relevant variable.

4. Estimation Results

The results of univariate estimations are reported in Table 4 for five different indicators of value added. Hausman test is used for the selection between fixed time effect model (FEM) and random time effect model (REM), and decision is

made at %1 significance level. According to Hausman test results FEM models are selected in all models.

As seen from Table 4, the coefficient of SUBSIDY variable takes the anticipated positive sign and statistically highly significant in all models. This finding hints that countries with higher subsidies experience more value added.

Table 4. *Univariate Estimation Results*

Dependent Var. →	*GROSVALUEAD*	*AGRVALUEAD*	*MANVALUEAD*	*SERVALUEAD*	*INDVALUEAD*
C	6,1197	3,8511	2,9028	5,7613	4,1529
Std. Error	0,1568	0,2678	0,1647	0,1449	0,1599
Prob.	0,0000	0,0000	0,0000	0,0000	0,0000
SUBSIDY	0,8540	0,8379	0,9082	0,8486	0,8861
Std. Error	0,0066	0,0112	0,0069	0,0061	0,0067
Prob.	0,0000	0,0000	0,0000	0,0000	0,0000
Num. Of Obs.	2308	2361	2299	2378	2378
Num. Of Countires	140	150	148	151	151
Period	1972-2013	1974-2013	1976-2013	1974-2013	1974-2013
R-square	0,8908	0,7198	0,8903	0,9009	0,8892
F-statistic	439,7439	148,9998	482,7214	531,4091	468,8279
Prob(F-statistic)	0,0000	0,0000	0,0000	0,0000	0,0000
Hausman Statistics	28,6548	21,9409	47,8036	48,5952	43,7053
Prob(Hausman-tat.)	0,0000	0,0000	0,0000	0,0000	0,0000
Selected Model	FEM	FEM	FEM	FEM	FEM

The validity of the result of univariate analysis is examined by introducing three control variables to the model and the results of multivariate estimations are reported in Table 5. According to Hausman test results at %1 significance level, except one model, in all models REM models are selected.

Table 5. *Multivariate Estimation Results*

Dependent Var. →	*GROSVALUEAD*	*AGRVALUEAD*	*MANVALUEAD*	*SERVALUEAD*	*INDVALUEAD*
C	-2,1164	-8,0750	-4,1825	-1,9286	-3,9278
Std. Error	0,2344	0,4376	0,2439	0,2030	0,2348
Prob.	0,0000	0,0000	0,0000	0,0000	0,0000
SUBSIDY	0,4637	0,2720	0,4581	0,4501	0,4805
Std. Error	0,0100	0,0193	0,0111	0,0093	0,0103
Prob.	0,0000	0,0000	0,0000	0,0000	0,0000
FIXCAP	0,6775	0,9713	0,6935	0,6626	0,6852
Std. Error	0,0151	0,0289	0,0162	0,0136	0,0153
Prob.	0,0000	0,0000	0,0000	0,0000	0,0000
INFLATION	-0,0002	-0,0001	-0,0014	-0,0002	-0,0002
Std. Error	0,0000	0,0001	0,0002	0,0000	0,0000
Prob.	0,0000	0,0272	0,0000	0,0000	0,0000
HUMCAP	0,1000	0,2609	0,0484	0,0683	0,1049
Std. Error	0,0266	0,0539	1,6652	0,0246	0,0282
Prob.	0,0002	0,0000	0,0960	0,0056	0,0002
Num. Of Obs.	1922	1948	1890	1965	1965
Num. Of Countires	114	121	119	122	122
Period	1972-2013	1974-2013	1976-2013	1974-2013	1974-2013
R-square	0,9289	0,7945	0,9259	0,9474	0,9299
F-statistic	6263,4730	1878,5140	5890,0450	804,4136	6501,0910
Prob(F-statistic)	0,0000	0,0000	0,0000	0,0000	0,0000
Hausman Statistics	9,1037	6,9046	11,0104	38,6833	6,3638
Prob(Hausman-Stat.)	0,0586	0,1410	0,0264	0,0000	0,1736
Selected Model	REM	REM	REM	FEM	REM

Once again the coefficient of SUBSIDY variable is highly statistically significant and takes the prior anticipated sign in all five multivariate models. Hence the main finding of the analysis did not change with the introduction of three more determinants of value added to the model.

In regard to other control variables in the model, the estimated coefficient of FIXCAP variable takes the theoretically expected positive sign and is statistically significant at %1 significance level in all models. Thus, as the level of physical capital in an economy increases, value added level in that particular economy increases as well.

The coefficient of the INFLATION variable is statistically significant and takes the anticipated negative sign in all models. This result points out that countries with

higher uncertainty and instability are less able to achieve higher level of value added.

The coefficient of the HUMCAP variable is statistically significant and takes the anticipated positive sign in all models. This result implies that countries with higher human capital endowment experience more production and thus more value added.

Meantime, in terms of robustness, our results are robust in the sense that our primary finding remains valid no matter which indicator is used for value added in our models.

5. Conclusion

This study investigates the effect of subsidy on value added level of a country. In order to test this relationship the study use five different indicators for value added. The data used in analyses are unbalanced data and cover the years between 1972 and 2013 for 151 countries in the largest sense.

The main finding of the study implies that countries with higher subsidy level experience higher level of value added. This result remains valid once we added other three peculiar determinants of value added into our models. Also, our results are robust in the sense that our primary finding does not alter based on which indicator is used for value added in our models.

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