Size of Government and Economic Growth: A Non Linear Analysis

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Abstract—The study analyzes the Armey’s idea of a quadratic curve; Armey (1995) asserted that low public expending boost economic growth as far as it arrives at a certain scope; however, exaggerated public expending reduced the economic growth. The present study seeks to determine the inverse U shape association between public activity and economic output and also estimates the optimal size of government for Pakistan’s Economy by using the annual data for the period of 1976 to 2013. The findings support the robustness of Armey curve; and the optimal size of government is observed to be around 19.3% of the GDP. However, the actual size of government spending in contemporary year is 21.4%. The results highlight that the actual size of government spending is higher than the estimated optimal level of government size. Consequently the study suggests the diminution of total government expending to reach at the growth maximizing level. Moreover, this paper contributes to the literature that the Armey curve is a phenomenon not only for developed economies but also for developing economies.

Keywords: Optimal size of government, Armey curve, Economic growth, public spending, inverse u shape relationship

I. INTRODUCTION

The association among the economic growth and the size of government is one of the imperative and most significant issues in economics for ages. Undoubtedly, the association between these variables has a significant policy connotation. Even though, the affect of government spending on economic growth is a debatable topic. The Wagner’s law describes the positive correlation between the public spending and economic growth. Moreover, he proposed that causality runs from GDP (economic growth) to public spending. However, another famous impendent, formulated by Keynes, considers that the government expenditures are exogenous variable; therefore Keynes suggests that causality runs from public expenditures to GDP or economic growth.

The association among government spending and economic growth was initially explored in a linear model through a Cob Douglas production function; for the first time formulated by (Feder, 1983). The studies found the different results according to the considered time period and variables; regarding the positive and negative signs. Grossman (1988) predicted the non linear association between government size and economic output, and explored the positive impact of government size on economic output at a certain extent. Furthermore, the literature accentuate the presence of inverted U-shape curve among the government size and GDP growth, also known as Armey Curve (Armey & Armey, 1995) or also recognized as BARS Curve (Barro, 1988).

The Armey curve is defined as, that there is positive connection among the government expending and economic output up to a certain extent, after that the association turns to negative. Armey curve is the mechanism which shows the function of the state in economic process. The peak of the Armey curve render the “optimal” government size; the size that exaggerate the economic growth. Consequently, the argument deviates from the sign of the association among the government size and economic output (either positive or negative) to the investigation of the optimal government size.

In the present study, we explore the Armey curve (the anatropous U shape association between public activity and economic output), and then investigate the optimal size of government (government can have an effective positive impact on economic output until it approaches to certain point (optimal size of government) and after this, it can have an adverse impact on economic output); the contribution of government expending that maximizes the economic output. The objective of this study is achieved by using the time series analysis, for the period of 1976 to 2013. The data is obtained from the World Development Indicator and Economic Survey of Pakistan (different issues). The first goal of the study will be achieved after careful evaluation of time-series properties of data and then by applying the OLS method; the second objective of the study for optimal size of government would be achieved through threshold level or by using the formula for optimum.

To prosecute the aforesaid objective, the present study has been formulated into five sections:- including the contemporary introductory section one, section two describes the literature review. Section three illustrates the data and methodological framework. However section four illustrates the empirical analysis of estimation and discussion of findings of the present study and compares the results with earlier studies. Final section concludes the study, and provides the remarkable policy recommendation.

II. LITERATURE REVIEW

A large number of studies have discussed the Armey Curve empirically both for developing and developed countries, similar studies have been conducted for Pakistan. Zareen and Qayyum (2014) found the optimum size of government for Pakistan by using the data of the period from 1973 to 2012. They explored the size of government about 17% of economic output; however there was almost 1% difference between the
actual size of government and the estimated size of government. Moreover, another study conducted by (Husnain, 2011) for Pakistan, predicted the optimum size of government around 21.34% which is actually smaller than the current size of government.

For France, (Facchin & Melki, 2011) has explored the non linear association among the public spending and economic output. The finding suggested the existence of inverted U shape relationship among the government size and economic output. Another contribution is by (Altunc & Aydin, 2013) for Turkey, Romania and Bulgaria. They also found the existence of inverted U shape relationship for the above mentioned countries; they also explored the optimal size for these three countries which are around 25, 20 and 22% for Turkey, Romania and Bulgaria, respectively.

Herath (2010) determined the non linear association among the public spending and economic output for Sri Lankan economy by using the data for the period of 1959 to 2003. He suggested that both variables are positively related up to the threshold level and the relationship turns negative after this level. Forte and Magazzino (2011) analyzed the Armey curve for European countries by using the time series and panel data for the period of 1970 to 2009. However, they suggested the existence of Armey curve for the selected group of countries. The positive association between government spending and economic output has been explored by (Bairam, 1990; Cooray, 2009; Herath, 2010; Kormendi & Meguire, 1995; Ram, 1986), and the negative relationship between these variables have been predicted by (Abrams, 1999; Barro, 1988; Chen & Lee, 2005; Landau, 1983; Lee & Lin, 1994; Zhang & Zou, 1998). On the other hand, many studies found the ambiguous results; (Lee & Lin, 1994; Scully, 2008).

Summarizing the literature review we conclude that the empirical findings of studies investigate the non linear relationship between public spending and economic growth. The impact of public spending on growth is positive up to a certain level (that is the optimum government spending; which maximizes the economic output) and after that level; the relationship between these variables turns negative.

A. The concept of Armey curve

Armey (1995) asserted that low public expenditure boost economic output as far as it arrives at a certain scope; however, exaggerated public expenditure reduced the economic output. The inverse U shape association between public activity and economic output neither proposed that “all government is speculative”, nor that “all government is beneficial”. Government can have an effective positive impact on economic output until it approaches to certain point and after this, it can have an adverse impact on economic output. Hence, an optimal size of government would exist (figure 1, G*).

The upward trend of the slope depicts the constructive and dynamic consequences of modest government, at the same time the downward direction of graph illustrates the ineffective results of enormous government. The most eminent point (maximum point) exemplifies the level where the marginal benefits against the intensive government expenditure reach zero.

Fig1. Graph of the ineffective results of enormous government

III. Data and Methodology

Data has been collected from the World Development Indicator (WDI) database and the Economic Survey of Pakistan (different issues) and is analyzed for the period of 1976 to 2013. The following variables have been taken to investigate the Armey curve and government size; government size is expressed by total public expenditure as a percentage of output (GDP), and the growth of the economy is expressed by growth of total output (real GDP). This economic analysis handles more expenditure-side indicators that may have an effect on economic output as control variables. These explanatory variables include the investment share of GDP (I); investment is measured as gross fixed capital formation as percent of GDP. Similarly the openness of the economy (T.O); is measured as exports and imports share in GDP, the total public expenditure1 of GDP (G) and the square term of public expenditure of GDP (G^2) have also been considered; the current and development costs included in total public expenditure. The insertion of the economic indicator G^2 assists in empirically verifying or confutative the phenomenon of the Armey curve within this framework.

The relationship among public costs and economic output is determined through this linear regression model.

GR of GDP = \alpha_0 + \alpha_1 (Public Expenditures) + \beta X + \epsilon

GR of GDP Shows the growth rate of economic output which is the dependent variable and public expenditure is the independent variable. By the same token, we use different variables as control variables. Here, X explains the explanatory variables. Formally, the anatropous-U relationship among public spending and economic output can be expressed as follows:

GR of Y = \alpha_0 + \alpha_1 G - \alpha_2 G^2

1 The data of public expenditure have been taken from economic survey of Pakistan (different issues).
And the empirical verifiable model with control variables suggested by Herath (2010), (Facchini & Melki, 2011) and Tunar (2014) can be described as follows:  
\[ GR \ of \ Y = \alpha_0 + \alpha_1 G - \alpha_2 G^2 + \alpha_3 I + \alpha_4 Pop + \alpha_5 (T.O) + \epsilon \]

The positive coefficient of the linear \( G \) term indicates the productive impression of government expenditure on economic output (upward slope in the graph), and the anticipated negative coefficient which belongs to square term of government expenditure depicts the pessimistic impact of augmented government expenditure (downward slope in the graph). This equation demonstrates the second degree polynomial function due to the fact that the above equation consists of linear term and the squared term of government expenditure hence the verifiable model is a quadratic function. After wards the parameters of quadratic function (the values of alphas) are linear therefore, we can apply the OLS technique to estimate the Armey curve (the impact of government expenditure on economic output) and the optimal size of government measured through this squared term (government share of \( GDP \ G^2 \)). The purpose is to overcome the earlier studies’ methodological impuissance in terms of Government size. Zareen and Qayyum (2014) determined the optimal size of government by using the data of tax rate. However in the present study; the optimal size of government has been determined by using the new theoretical framework and considering the several other explanatory variables (investment share of \( GDP \ I \), the population growth, the openness of the economy \( T.O \)) and the square term of government share of \( GDP \ G^2 \).

**IV. Empirical Results**

Table 1. Unit Root Test

<table>
<thead>
<tr>
<th>Economic Indicators</th>
<th>Level</th>
<th>t-stat</th>
<th>1%</th>
<th>5%</th>
<th>10%</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GDP Growth</strong></td>
<td>level</td>
<td>-3.8 9</td>
<td>-3.6 2</td>
<td>-2.9 4</td>
<td>-2.6 1</td>
<td>Stationary</td>
</tr>
<tr>
<td><strong>LnTPE</strong></td>
<td>1st diff</td>
<td>-6.5 7</td>
<td>-3.6 4</td>
<td>-2.9 5</td>
<td>-2.6 1</td>
<td>Stationary</td>
</tr>
<tr>
<td><strong>Inv</strong></td>
<td>1st diff</td>
<td>-6.8 6</td>
<td>-3.6 2</td>
<td>-2.9 4</td>
<td>-2.6 1</td>
<td>Stationary</td>
</tr>
<tr>
<td><strong>Pop Growth</strong></td>
<td>1st diff</td>
<td>-3.0 8</td>
<td>-3.6 2</td>
<td>-2.9 4</td>
<td>-2.6 1</td>
<td>Stationary</td>
</tr>
<tr>
<td><strong>T.O</strong></td>
<td>level</td>
<td>-3.0 4</td>
<td>-3.6 2</td>
<td>-2.9 4</td>
<td>-2.6 1</td>
<td>Stationary</td>
</tr>
</tbody>
</table>

All the economic indicators are non-stationary at level, however, **T.O** (Trade openness), and **growth rate of GDP** is stationary at level shown in Table 1. The other indicators, **Inv** (investment share of GDP, population growth and **LnTPE** (total public expenditures) are stationary at first difference.

Transformed stationary variables will be used in the following regression models to explore the relation of Armey curve and to determine the optimal size of government.

**A. Regression results on impact of government expenditure on economic output**

<table>
<thead>
<tr>
<th>Economic indicator</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>3.04</td>
<td>23.3</td>
<td>2.53</td>
<td>0.01</td>
</tr>
<tr>
<td>TPE ( G )</td>
<td>0.31</td>
<td>0.20</td>
<td>1.92</td>
<td>0.03</td>
</tr>
<tr>
<td>TPE ( G^2 )</td>
<td>-0.008</td>
<td>0.04</td>
<td>-1.95</td>
<td>0.05</td>
</tr>
<tr>
<td>Investment ( I )</td>
<td>0.45</td>
<td>0.31</td>
<td>1.44</td>
<td>0.15</td>
</tr>
<tr>
<td>Pop Growth</td>
<td>2.69</td>
<td>0.84</td>
<td>3.18</td>
<td>0.00</td>
</tr>
<tr>
<td>Trade Openness ( T.O )</td>
<td>0.09</td>
<td>0.18</td>
<td>0.50</td>
<td>0.62</td>
</tr>
</tbody>
</table>

**DW= 2.05 \quad R^2= 0.34**

The results indicate in Table 2 that the Armey curve endure for the Pakistan’s Economy. The total public expenditures have the positive and significant impact on the economic growth up to a certain level. While the squared or the quadratic term has the significant negative effect on economic output which shows the robustness of Armey Curve for the Pakistan’s Economy; public expenditure have the positive impact on economic output up to a certain level (the coefficient of G is positive) and after that level the relationship among the public expenditure and economic output switches into negative (the coefficient of \( G^2 \) is negative). The tremendous government sizes drive to diminish economic output while restrained government sizes drive to improved growth. However the control variable investment and trade openness have the expected signs whereas the population growth has the paradoxical affect.

The optimal size of government for Pakistan’s economy can be calculated by using partial differentiation.

\[ GR \ of \ Y = \alpha_0 + \alpha_1 G - \alpha_2 G^2 + \alpha_3 I + \alpha_4 Pop + \alpha_5 (T.O) \]

Differentiating the equation with respect to government expenditure maximizing the economic growth; while all the other control variables held constant,

\[ \frac{\partial(y_t - y_{t-1})}{\partial G} = \alpha_{1-2}\alpha_2 G \]

\[ \alpha_{1-2}\alpha_2 G = 0 \]

\[ G = 19.3\% \]

This empirical scrutiny shows the optimum government size for Pakistan’s Economy, conversely the identical size of public expenditure is determined to be approximately 19.3% against the 21.4% of GDP in 2013. This indicates a diminution in public expenditure over the preceding year. On the contrary, the current actual size of government expenditure is 20.4, whereas the
calculated optimum size of government from the above estimation is 19.3%.
This outcome is immensely fascinating ever since it emphasized that the current size of government in Pakistan is higher than the optimal level and there is tranquilize scope of diminution in total government expending to the GDP ratio in Pakistan. However, our findings are not persistent with the study of Zareen and Qayyum (2014); they found 17% government size of Pakistan for the period of 2012. Moreover the present findings are consistent with the hypothesis of Friedman (1997); that the range of optimum size of government should be 15% to 50% of GDP.

V. CONCLUSION AND POLICY RECOMMENDATION

In the present study, we explored the existence of nonlinear theory of Armey curve; non linear inverted U shape relationship among the government expending and economic output for Pakistan’s Economy by using the annual data of 1976 to 2013. The Armey curve yield the possibility of estimating the optimum size of government expending, consequently useful for policy making suggesting the efficient level of government size. There are two main findings of the study we found the robustness of Armey curve; the expression of the coefficients of the public expending of GDP and its square term verify the robustness of inverted U-shaped Armey curve for Pakistan. Besides this, the second major finding is optimum size of government around the 19.3% for Pakistan; comparing to current government size which is around 21.4%. Consequently the study suggests diminution of total government expending to reach at the growth maximizing level of the government size. This can be achieved through plummeting the gratuitous government expending and diversion of the redundant non-development government expenditure towards development spending. It is important to increase the efficiency of government expending and economic output.

VI. REFERENCES