Munich Personal RePEc Archive

Linkages between Defence Spending and Income Inequality in Iran

Muhammad, Shahbaz and Reza, Sherafatian-Jahromi and Muhammad, Nasir Malik

COMSATS Institute of Information Technology, Lahore, Pakistan, University Putra Malaysia, Malaysia, Huazhong University of Science and Technology, Wuhan, China

6 October 2012

Online at https://mpra.ub.uni-muenchen.de/41983/
MPRA Paper No. 41983, posted 17 Oct 2012 12:35 UTC

Linkages between Defence Spending and Income Inequality in Iran

Muhammad Shahbaz
Department of Management Sciences,
COMSATS Institute of Information Technology,
Lahore, Pakistan. Email: shahbazmohd@live.com
www.ciitlahore.edu.pk, UAN: 0092-42-111-001-007,
Fax: 0092-42-99203100, Mobile: +92334-3664-657

Reza Sherafatian-Jahromi
Department of Economics,
University Putra Malaysia,
43400UPM Serdang, Selangor, Malaysia
Email: rezasherafatian@yahoo.com

Muhammad Nasir Malik
Huazhong University of Science and Technology,
Wuhan, China**. Email:** mnmalik@gmail.com

Abstract:

This paper contributes in economic literature by investigating the impact of defence spending on income inequality in a case of Iran using time series data over the period of 1969-2011. For this purpose, we have applied the ARDL bounds testing approach to cointegration for long run relationship in the presence of structural breaks arising in the series. The stationarity properties of the variables are tested using structural break unit root tests. The causal relationship between defence spending and income inequality is examined by employing the VECM Granger causality approach. Our findings validate the long run relationship between the series. The results indicated that defence spending improves income distribution in Iran. An inverted-U shaped relationship exists between defence spending and income inequality. Economic growth deteriorates income inequality. The causality analysis reveals that defence spending Granger causes income inequality and feedback effect exists between income inequality and economic growth.

Keywords; Defense Spending, Income Inequality

Introduction

The mechanism on relationship between the rise in military spending and income distribution is simple. Actually wages of labour employed in defense or defense related industries is high with rise in defense spending. Wages will be increased during the inter-industry dispersion as rents paid by the industry to inelastic portion of personnel (working in defense industry) rises. On contrary, initially wages are high in defense or defense linked industry while relative wages will be low with the reduction in defense spending that leads to decline in income inequality. The efficiency wage theory asserts that workforce enjoys high wages in defense or defense related industry. This implies that defense spending and income inequality are endogenous variables (Ali, 2003, 2007).

Opportunity Cost Burden Effect Model reveals a trade-off between increased in defense spending and reduced spending on development projects that tends to increase income inequality in the society. It is documented that income inequality in the society is affected with low social and human development with the rise in military spending on the cost of diminishing returns on social sector's development. In long span of time, positive impact of government spending is nullified if productive resources of an economy transferred for financial support of the military spending. The rapid increase in military expenditures leads to rise in total government spending fastly. There is also a cost of rapid increase of defense spending because it forces the government to lower down the spending on the development projects (Chaitanya, 2008). This shows that "*cost of best alternative use (opportunity cost) is forgone by the country as it diverts development spending towards funding the defense sector growth requirement*" (Chaitanya, 2008)[1].

The main objective of present study is to examine the effect on defence spending on income distribution over the period of 1969-2011 in case of Iran. This study contributes to existing literature by five-folds: (i) pioneering effort investigating the relationship between military spending and income inequality by incorporating economic growth in inequality function in case of Iran; (ii) we apply structural break unit root tests to test stationarity properties of the variables[2]; (iii) we also utilize the ARDL bounds testing approach to cointegration in the presence of structural break in the series for long run relationship between the variables; (iv) OLS and ECM approaches are used to analyze long run and short run dynamics between the series; (v) the direction of causality between the variables is examined by applying the VECM Granger causality approach. Our findings report that cointegration between the variables exists for long run relationship in case of Iran. Military spending reduces income inequality while inverted-U hypothesis between military spending and income inequality is validated. Economic growth worsens income distribution. There is bidirectional causality found between economic growth and income inequality and military spending Granger causes income inequality.

The rest balance of study is organized as following: section-II presents the review of literature, empirical model is constructed in section-III as well as estimation strategy, section-IV deals with results and their discussion, conclusion and policy implications are drawn in section-V.

II. Review of Literature

On the basis of previous literature, there are many studies based on the association between military spending and economic growth[3]. There is still lacking in the field of military spending and income distribution. The efforts were made to explore the relationship between income inequality and political institutional conditions. Gradtien et al. (2001) reported that democratization environment of political institutions causes to improve income distribution. Further, they concluded that strong correlation between smooth functioning of democratic institution and higher wage rate decline income inequality. These results are supported by Lipset et al. (1993); Diamand, (1992) and Rodrik, (1999). Dinardo et al. (1996) showed that de-unionization is an important factor to perk up the wage inequality. There are numerous factors that affect the wage condition in economy like, relative decentralization of the wage-setting mechanism, institutional policies towards labour laws wage adjustment. Loony, (1990) determined the interaction between military/civilian regime and socio-economic performance. The results indicated that LDCs having a higher defense burden because these nation has large proportion of budget spending on the military needs. Similarly; Melman, (1974) documented that high income inequality is the economic cost of permanent war. Income transfer programs and military spending on federal budget deficit has been discussed by Seiglie, (1997) for US economy. Seiglie reported that defense spending and budget deficits are linked positively. Budget deficit is used to make income distribution more equal between black and white people.

Our interest is to explore the studies investigating the relationship between military spending and income inequality. For example; Abell, (1994) explored the relationship between military spending and income inequality using data of United States by applying OLS regression. His finding unveiled that military spending worsens income inequality by controlling other some macroeconomic variables such as economic growth, taxes, interest rates, non-military spending and inflation. After that, Ali and Galbraith, (2003) used panel regression to investigate the impact of GDP growth, per capita income, size of armed forces and military spending on income distribution. Their results indicated that military spending increases income inequality. Comton

(2005) noted a negative relationship between military spending and income inequality in United States. He unveiled that increase in military spending generates more jobs for unskilled workers and improves income distribution in the country. Additionally, Henderson et al. (2008) illustrated that cut in military spending increases income inequality. They claimed that employing the people in productive sectors and less productive sectors proportionately contribute to income inequality in United States. Chaitanya, (2007) explored the relationship between military spending on income distribution using data of South Asia using model based on opportunity cost burden effect theory[4]. His panel regression analysis sported the view that military spending, arms imports and armed forces deteriorate income inequality. In case of Turkey; Ozsoy, (2008) noted that budget deficit is negatively correlated with transfer payments programs. Huge increase in military spending, education, health spending seemed to force budget deficit to worsen which in resulting increases income inequality. Latter on, Elveren, (2012) confirmed the findings of Ozsoy, (2008) by reporting that military spending Granger causes income inequality. However, in another study on military spending and income inequality Lin and Ali, (2009) applied panel Granger non-causality test but did not find any causal relationship between said variables.

Hirnissa et al. (2009) used the data of ASEAN countries to examine the impact of military spending on income inequality by applying the ARDL bounds testing approach to cointegration for long run relationship between the variables[5]. Their results indicated that the variables are cointegrated for long run relationship. Military spending Granger causes income inequality in Malaysia, feedback effect is found between both variables in case of Singapore and neutral relationship exists between military spending and income distribution in rest countries such as

Indonesia, Singapore, Philippines, India and South Korea. Ali, (2012) used the data of Middle Eastern and North Africans (MENA) countries to examine the effect of defence spending on income distribution. Ali reported that military spending improves income distribution and income inequality and economic growth have negative affect on military spending. Kentor et al. (2012) introduced high-tech weaponry as "new" military and used the military expenditure per solders as a proxy of military capital intensiveness for 82 developed and less developed countries. Their results pointed out that high-tech military spending exacerbates income inequality. Recently, Elveren, (2012) used Turkish data on military spending and income inequality to test direction of causal relationship between both series. The Engle-Granger cointegration and causality approaches were applied. Results indicated a long run relationship between military spending and income inequality and defence spending Granger causes income distribution i.e. rise in military spending leads higher income inequality. There is no study in case of Iran investigating the relationship between military spending and income inequality. This study is humble effort to fill gap regarding Iranian economy.

III- Modeling, Methodological Framework and Data Collection

This study aims to investigate the link between defence spending and income inequality. Our model includes economic growth as an additional contributing factor towards income inequality and takes the following form:

$$IE_t = f(D_t, Y_t) \qquad (1)$$

Where IE_t denotes income inequality, D_t denotes defence spending and Y_t denotes economic growth. In order to curtail acuity in the data and achieve consistent and reliable results we have transformed the entire series into its log-linear specification using logarithm (Shahbaz, 2010). The empirical model takes the following form:

$$\ln IE_t = \theta_1 + \theta_2 \ln D_t + \theta_3 \ln Y_t + \varepsilon_i \qquad (2)$$

Where $\ln IE_t$, is natural log of income inequality proxied by Gini-coefficient, $\ln D_t$ is the natural log of defence spending per capita, $\ln Y_t$ is natural log of economic growth proxied by real GDP per capita, and ε is residual term having zero mean and finite variance. In order to test for the nonlinear relationship, the squared term of defence spending is added to the model which is as following:

$$\ln IE_t = \theta_{11} + \theta_{22} \ln D_t + \theta_{33} \ln D_t^2 + \theta_{44} \ln Y_t + \varepsilon_t \qquad (3)$$

In equation-3, if: $\theta_{33} < 0$ and $\theta_{44} = 0$ then income inequality is decreasing, $\theta_{33} = 0$ and $\theta_{44} > 0$ then income inequality is increasing, $\theta_{33} > 0$ and $\theta_{44} < 0$ then inverted-U shaped hypothesis is confirmed, $\theta_{33} < 0$ and $\theta_{44} > 0$ U-shaped relationship is accepted

Historically, in order to test stationarity properties of the variables, unit root tests such as ADF by Dickey and Fuller (1979), P-P by Philips and Perron (1988), KPSS by Kwiatkowski et al. (1992), DF-GLS by Elliott et al. (1996) and Ng-Perron by Ng-Perron, (2001) have been used. However, due to lack of information on structural break points, these tests produce unreliable results. To remove this anomaly, Zivot-Adndrews, (1992) suggested another model that allows to accommodate single unknown structural break in the variables at level form, in the slope of trend component, and in the intercept and trend function. Using Zivot-Andrews, (1992) model the structural break in the series can be checked as:

$$\Delta x_t = a + ax_{t-1} + bt + cDU_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \qquad (5)$$

$$\Delta x_t = b + bx_{t-1} + ct + bDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \qquad (6)$$

$$\Delta x_t = c + cx_{t-1} + ct + dDU_t + dDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \qquad (7)$$

Where DU_t denotes dummy variable and gives the mean shift incurred at each point while DT_t denotes trend shift variable.

$$DU_t = \begin{cases} 1 \ldots if \quad t > TB \\ 0 \ldots if \quad t < TB \end{cases} \text{ and } DU_t = \begin{cases} t - TB \ldots if \ \ t > TB \\ 0 \ldots if \ \ t < TB \end{cases}$$

The null hypothesis of unit root break date is $c = 0$ which indicates that series is not stationary with a drift not having information about structural break point while $c < 0$ hypothesis implies that the variable is found to be trend-stationary with one unknown time break. Zivot-Andrews unit root test fixes all points as potential for possible time break and does estimation through regression for all possible break points successively. Then, this unit root test selects that time break which decreases one-sided t-statistic to test $\hat{c}(= c - 1) = 1$. Zivot-Andrews intimate that in the presence of end points, asymptotic distribution of the statistics is diverged to infinity point. It is necessary to choose a region where end points of sample period are excluded. Further, Zivot-Andrews suggested the trimming regions i.e. (0.15T, 0.85T) are followed.

Clemente et al. (1998) improved on Perron and Volgelsang, (1992) methodology to allow for two structural breaks and better handles the problems due to structural breaks compared to Perron and Volgelsang, (1992); Zivot-Andrews, (1992), unit root tests which can handle series with only one potential structural break. The null hypothesis H_0 and alternate H_a are as follows:

$$H_0 : x_t = x_{t-1} + a_1 DTB_{1t} + a_2 DTB_{2t} + \mu_t \qquad (8)$$

$$H_a : x_t = u + b_1 DU_{1t} + b_2 DTB_{2t} + \mu_t \qquad (9)$$

Where DTB_{1t} denotes pulse variable which is 1 if $t = TB_i + 1$ or else 0, and $DU_{it} = 1$ if $TB_i < t(i = 1,2)$ or else 0. Mean modification is shown by TB_1 and TB_2 time periods. For simplicity, we assume that $TB_i = \delta_i T(i = 1,2)$ where $1 > \delta_i > 0$ while $\delta_1 < \delta_2$ (Clemente et al. 1998). If case of two structural breaks contained by an innovative outlier the unit root hypothesis can be tested using the following model:

$$x_t = u + \rho x_{t-1} + d_1 DTB_{1t} + a_2 DTB_{2t} + d_3 DU_{1t} + d_4 DU_{2t} + \sum_{i=1}^{k} c_j \Delta x_{t-1} + \mu_t \qquad (10)$$

This model gives minimum value of t-ratio using simulations and then constraining the value of autoregressive parameter to 1 the value of simulated t-ratio can be used to mark all break points. To derive asymptotic distribution of the estimate, it is assumed that $\delta_2 > \delta_1 > 0, 1 > \delta_2 - 1 > \delta_0$ where, δ_1 and δ_2 have the values in interval i.e. $[(t+2)/T, (T-1)/T]$ by applying the largest window size. The assumption i.e. $\delta_1 < \delta_2 + 1$ is used to show that cases where break points exist in repeated periods are purged (see Clemente et al. 1998). Two steps approach is used to test the unit root hypothesis, if shifts can explain the additive outliers. In the first step the deterministic trend is removed as follows:

$$x_t = u + d_5 DU_{1t} + d_6 DU_{2t} + \widehat{x} \qquad (11)$$

In the second step minimum t-ratio is calculated to verify whether $\rho = 1$ as follow:

$$\widehat{x}_t = \sum_{i=1}^{k} \phi_{1i} DTB_{1t-1} + \sum_{i=1}^{k} \phi_{2i} DTB_{2t-1} + \rho \widehat{x}_{t-1} + \sum_{i=1}^{k} c_i \Delta \widehat{x}_{t-1} + \mu_t \qquad (12)$$

A dummy variable is included in the estimation to ensure that $\min t^{IO}_{\rho\ t}(\delta_1, \delta_2)$ congregates in distribution:

$$\min t^{IO}_{\rho\ t}(\delta_1, \delta_2) \rightarrow \inf_{\gamma} = \wedge \frac{H}{[\delta_1(\delta_2 - \delta_1)]^{1/2} K^{1/2}}$$

Since traditional approaches to cointegration have certain demerits, we have used the autoregressive distributed lag model or the ARDL bounds testing approach to cointegration accommodating the structural break stemming in the series. The ARDL bounds testing approach to cointegration has certain merits like it is flexible regarding integrating order of the variables whether variables are found to be stationary at I(1) or I(0) or I(1) / I(0). In addition, Monte Carlo investigation confirms that this approach is better suited for small sample size (Pesaran and Shin, 1999). Moreover, a dynamic unrestricted error correction model (UECM) can be derived from the ARDL bounds testing through a simple linear transformation. The UECM integrates the short run dynamics with the long run equilibrium without losing any information for long run. The empirical equation of the ARDL bounds testing approach to cointegration is given below:

$$\Delta \ln IE_t = \alpha_1 + \alpha_T T + \alpha_{DUM} DUM + \alpha_{IE} \ln IE_{t-1} + \alpha_D \ln D_{t-1} + \alpha_Y \ln Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \ln IE_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln D_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln Y_{t-k} + \mu_t \tag{13}$$

$$\Delta \ln D_t = \alpha_1 + \alpha_T T + \alpha_{DUM} DUM + \alpha_{IE} \ln IE_{t-1} + \alpha_D \ln D_{t-1} + \alpha_Y \ln Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln D_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln IE_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln Y_{t-k} + \mu_t \tag{14}$$

$$\Delta \ln Y_t = \alpha_1 + \alpha_T T + \alpha_{DUM} DUM + \alpha_{IE} \ln IE_{t-1} + \alpha_D \ln D_{t-1} + \alpha_Y \ln Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln Y_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln IE_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln D_{t-k} + \mu_t \quad (15)$$

Where, Δ denotes difference operator, μ_s denotes residual terms, and DUM denotes dummy variable to capture the structural breaks arising in the series[6]. F-statistics are computed to compare with upper and lower critical bounds generated by Pesaran et al. (2001) to test for existence of cointegration. The null hypothesis to examine the existence of long run relationship between the variables is $H_0 : \alpha_{IE} = \alpha_D = \alpha_Y = 0$ against alternate hypothesis is $H_a : \alpha_{IE} \neq \alpha_D \neq \alpha_Y \neq 0$ of cointegration for equation-4. Using Pesaran et al. (2001) critical bounds, if computed F-statistic is more than upper critical bound (UCB) there is cointegration between the variables. If computed F-statistic does not exceed lower critical bound (LCB) the variables are not cointegrated for long run relationship. If computed F-statistic falls between lower and upper critical bounds then decision regarding cointegration between the variables is uncertain. However, since our sample size is small (43 observations), critical bounds generated by Pesaran et al. (2001) may be inappropriate to take decision whether cointegration exists or not. Therefore, we use lower and upper critical bounds developed by Narayan, (2005). The stability tests, to scrutinize stability of the ARDL bounds testing estimates, have been applied i.e. CUSUM and CUSUMSQ (Brown et al. 1975).

The ARDL bounds testing approach can be used to estimate long run relationships between the variables. For instance, if there is cointegration in equation-4 where income inequality (IE_t), defence spending (D_t) and economic growth (Y_t) are used as forcing variables then there is established long run relationship between the variables that can be molded in following equation given below:

$$\ln IE_t = \theta_0 + \theta_1 \ln D_t + \theta_2 \ln Y_t + \mu_i \qquad (18)$$

where $\theta_0 = -\alpha_1 / \alpha_{IE}, \theta_1 = -\alpha_D / \alpha_1, \theta_2 = -\alpha_Y / \alpha_1$ and μ_t is the error term supposed to be normally distributed. These long run estimates are computed using the ARDL bounds testing approach to cointegration when income inequality (IE_t) treated dependent variables. This model can be further improved by including other dependent variables. On confirmation of long run relationship, it is important to find the direction of causality as below:

$$(1-L)\begin{bmatrix} \ln IE_t \\ \ln D_t \\ \ln Y_t \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} + \sum_{i=1}^{p}(1-L)\begin{bmatrix} b_{11i} b_{12i} b_{13i} \\ b_{21i} b_{22i} b_{23i} \\ b_{31i} b_{32i} b_{33i} \end{bmatrix} \times \begin{bmatrix} \ln IE_{t-1} \\ \ln D_{t-1} \\ \ln Y_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha \\ \beta \\ \delta \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \qquad (19)$$

Where $(1-L)$ denotes the difference operator and ECT_{t-1} denotes the lagged residual term generated from long run relationship, $\varepsilon_{1t}, \varepsilon_{2t}$ and ε_{3t} are error terms assumed to be normally distributed with mean zero and finite covariance matrix. The long run causality is indicated by the significance of t-statistic connecting to the coefficient of error correction term (ECT_{t-1}) and statistical significance of F-statistic in first differences of the variables shows the evidence of short run causality between variables. Additionally, joint long-and-short runs causal relationship can be estimated by joint significance of both ECT_{t-1} and the estimate of lagged independent variables. For instance, $b_{12,i} \neq 0 \forall_i$ shows that defence spending Granger-causes income inequality and causality is running from income inequality to defence spending indicated by $b_{21,i} \neq 0 \forall_i$.

The study covers the period of 1965-2011. The data on real GDP per capita, real military spending per capita and Gini-coefficient (income inequality), has been sourced from world development indicators (CD-ROM, 2012).

IV- Results and their Discussion

Descriptive statistics of income inequality ($\ln IE_t$), economic growth ($\ln Y_t$) and defense spending ($\ln D_t$) are presented in Table-1. While sample means of economic growth and defense spending are positive, it is negative when income inequality is considered. Skewness and kurtosis are measure the shape of the distribution. Positive skewness illustrates that all the series are right-skewed. The value of kurtosis indicates that they are leptokurtic relative to a normal distribution. Jarque-Bera results show that the null hypothesis of normal distribution cannot be rejected implying that income inequality ($\ln IE_t$), economic growth ($\ln Y_t$) and defense spending ($\ln D_t$) have normal distributions with finite variance. The correlation analysis indicates that economic growth is positively correlated with income inequality. The negative correlation is found between defence spending and income distribution. There is a positive correlation between defence spending and economic growth.

Table-1: Descriptive Statistics and Correlation Matrix

Variables	$\ln IE_t$	$\ln Y_t$	$\ln D_t$
Mean	-0.8834	15.4696	11.5537
Median	-0.9105	15.4323	11.4443
Maximum	-0.6891	15.8075	12.4023
Minimum	-1.0936	15.0898	11.0468
Std. Dev.	0.0853	0.1935	0.3748
Skewness	0.5470	0.0746	0.7974
Kurtosis	3.2455	2.0030	2.5512
Jarque-Bera	2.1481	1.7359	3.6893
Probability	0.3416	0.4198	0.1958
$\ln IE_t$	1.0000		
$\ln Y_t$	0.3067	1.0000	
$\ln D_t$	-0.1132	0.4263	1.0000

Log-run results are shown in Table-5. Our findings indicate that all coefficients are according to our expectations and statistically significant. Furthermore, there is a negative relationship between defense spending and income inequality is found. It is noted that all else is same, a 1 per cent increase in defence spending will decline income inequality by 0.1167 per cent. This relationship is statistically significant at 1 per cent level of significance. These findings are contradictory with Abell, (1994) for US; Ali and Galbraith, (2003) for global data; Chaitanya, (2007) for South Asia; Ozsoy, (2008) for Turkey; Henderson et al. (2008) for; Kentor et al.

(2012) for 82 developed countries but consistent with Comton, (2005) for US; Ali, (2011) for Eastern and North Africans (MENA) countries. The impact of economic growth on income inequality is positive and it is statistically significant at 1 per cent level of significance. A 1 per cent increase in economic growth exacerbates income inequality by 0.2536 per cent keeping other things constant. These findings are consistent with Musai et al. (2011) and Keivani, (2011) in case of Iran.

Furthermore, we have included squared term of defence spending i.e. $\ln D_t^2$ to examine non-linear relationship between defence spending and income inequality. Our empirical exercise shows that inverted U-shaped relationship between defense spending and income inequality is found in case of Iran. It is noted that signs of linear and nonlinear terms are positive and negative respectively and statistically significant at 5 per cent level. This implies that a 1 per cent increase in defence spending increases income inequality by 4.7783 per cent (shown by linear term) while negative sign of squared term of defence spending (shown by nonlinear term) verifies the delinking point of income inequality and defence spending. The lower segment of Table-5 reveals that residual term is normally distributed with constant variance and zero mean. There is no serial correlation between dependent variables and residual term and, same inference can be drawn for autoregressive conditional heteroskedasticity (ARCH). No evidence is found for the existence of white heteroskedasticity. Moreover, model is well articulated confirmed by Ramsey reset test statistic.

Table-5: Long Run Analysis

Dependent Variable = $\ln IE_t$				
Model	Linear Model		Nonlinear Model	
Variables	Coefficient	T. Statistic	Coefficient	T. Statistic
Constant	-3.4604*	-3.7023	-31.0496**	-2.3862
$\ln D_t$	-0.1167*	-3.0168	4.7783**	2.1381
$\ln D_t^2$	….	….	-0.2059**	-2.1607
$\ln Y_t$	0.2536*	3.5395	0.1594**	2.2937
Diagnostic Tests				
R^2	0.2813	….	0.2407	….
F-statistic	7.0454*	….	3.6986**	….
$\chi^2 NORMAL$	1.4023	(0.4960)	0.8653	(0.6486)
$\chi^2 SERIAL$	1.7638	(0.1144)	1.4306	(0.2220)
$\chi^2 ARCH$	2.0359	(0.3250)	1.8759	(0.1305)
$\chi^2 RAMSEY$	0.3449	(0.5607)	1.5443	(0.2224)
Note: * and ** denote the significant at 1% and 5% levels respectively. $\chi^2 NORM$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test.				

Short-run dynamics investigated by applying the error correction model (ECM). Table-6 illustrates the results of both linear and nonlinear models. The linear model shows that defence spending has positive impact on income inequality but it is statistically insignificant. The positive effect is found of economic growth on income inequality and significant at 5 per cent. This implies that by 1 per cent increase in economic growth deteriorates income distribution by 0.3681 per cent. The nonlinear model indicates that inverted-U shaped relationship between defence spending and income inequality exists but it is insignificant. The coefficient of ECM_{t-1}

indicates short run deviations towards long run equilibrium path. The sign of lagged error term of linear and nonlinear models are significant in 5% level. The coefficient of ECM_{t-1} is 0.3958 for linear and 0.4182 for nonlinear model. This means that deviations in short run towards long run are corrected by 39.58 and 41.82 per cent per year for linear and nonlinear models respectively.

Table-6: Short Run Analysis

Dependent Variable = $\ln IE_t$				
Model	Linear Model		Nonlinear Model	
Variables	Coefficient	T. Statistic	Coefficient	T. Statistic
Constant	-0.0069	-0.7039	-0.0033	-0.2766
$\ln D_t$	0.0549	1.1228	0.0479	0.8760
$\ln D_t^2$	….	….	-0.0982	-0.4815
$\ln Y_t$	0.3681**	2.2347	0.3825**	2.6146
ECM_{t-1}	-0.3958**	2.8034	-0.4182**	-2.7843
Diagnostic Tests				
R^2	0.3111	….	0.3159	….
F-statistic	5.1201*	….	3.8113**	….
$\chi^2 NORMAL$	1.0750	(0.2908)	0.8533	(0.6300)
$\chi^2 SERIAL$	0.3099	(0.5814)	0.3155	(0.5781)
$\chi^2 ARCH$	1.8146	(0.1746)	1.8450	(0.1739)
$\chi^2 RAMSEY$	0.2447	(0.6600)	2.1113	(0.1224)

Note: * and ** denote the significant at 1% and 5% levels respectively. $\chi^2 NORM$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test.

The lower segment of Table-6 reveals that short run models seem to pass all diagnostic tests. The results illustrate that error terms are normally distributed with constant variance and zero mean for both models. No serial correlation is found between dependent variables and residual term. There is no evidence about the existence of autoregressive conditional heteroskedasticity (ARCH) and white heteroskedasticity. Moreover, both models are well specified validated by Ramsey reset test statistic.

The VECM Granger Causality Analysis

Casual relationship between income inequality, defense spending and growth is investigated by applying the VECM Granger approach. Knowledge about the direction of causality between the series can help policy makers in crafting an integrated and sustainable environmental policy. Granger, (1969) suggested if the series are first difference stationary and cointegrated the VECM. The results are detailed in Table-7. Our estimated ECM_{t-1} coefficients are significant with negative sign for income inequality and economic growth equations. It reveals that the shock exposed by system converging to long run equilibrium path at a higher speed for income inequality (-0.5095) the VECM as compared to adjustment speed of economic growth (-0.1785) the VECM.

The causality analysis reveals that in long run, defence spending Granger causes income inequality. These findings are consistent with existing literature such as Ozsoy, (2008) and Elveren, (2012) for Turkey; Hirnissa et al. (2009) for ASEAN countries. The feedback effect is found between economic growth and income inequality. The unidirectional causality exists running from defence spending to economic growth. This empirical finding is consistent with Dunne and Vougas, (1999) for South Africa; Kollias et al. (2007) for European Union; Karagol and Palaz, (2004) and Karagianni and Pempetzoglu, (2009) for Turkey; Shahbaz and Shabbir, (2012) for Pakistan but contradictory with Tiwari and Shahbaz, (2012) for India; Shahbaz et al. (2012) for Pakistan and Farzanegan, (2012) for Iran.

Table-7: The VECM Granger Causality Analysis

Dependent Variable	Direction of Causality								
	Short Run				Long Run	Joint Long-and-Short Run Causality			
	$\Delta \ln IE_{t-1}$	$\Delta \ln D_{t-1}$	$\Delta \ln D^2_{t-1}$	$\Delta \ln Y_{t-1}$	ECT_{t-1}	$\Delta \ln IE_{t-1}, ECT_{t-1}$	$\Delta \ln D_{t-1}, ECT_{t-1}$	$\Delta \ln D^2_{t-1}, ECT_{t-1}$	$\Delta \ln Y_{t-1}, ECT_{t-1}$
$\Delta \ln IE_t$	….	2.6567*** [0.0872]	2.9813*** [0.0664]	2.3277 [0.1155]	-0.5095** [-2.9714]	….	2.3154*** [0.0966]	2.2875*** [0.0966]	2.9013** [0.0517]
$\Delta \ln D_t$	2.4407*** [0.1042]	….	5.9470* [0.041]	0.7798 [0.4675]	….	….	….	….	….
$\Delta \ln D^2_t$	2.5400*** [0.1001]	7.0181* [0.0010]	….	1.2501 [0.3014]	….	….	….	….	….
$\Delta \ln Y_t$	3.4881** [0.0440]	1.4879 [0.2589]	1.7915 [0.1853]	….	-0.1784** [-2.3483]	4.0750** [0.0161]	2.3423*** [0.0946]	2.6161*** [0.0707]	….
Note: *, ** and *** show significance at 1, 5 and 10 per cent levels respectively.									

The bidirectional causality exists between income inequality and defense spending in short run. In short run, the unidirectional causal relationship is found running from income inequality to economic growth. Furthermore, our results validated the existence of inverted-U shaped relationship between defence spending and income inequality as both linear and nonlinear terms of defence spending Granger cause income inequality in short run as well as long run.

V- Conclusion and Policy implications

This paper has assessed the relationship between defense spending and income inequality in Iran using annual data over the period of 1969-2011. In doing so, the ARDL bound testing approach to cointegration in the presence of structural break is applied after confirming integrating order of the variables by using structural break unit root test. Our cointegration analysis shows that there is a long run relationship between defense spending, economic growth and income inequality. Furthermore, defense spending improves income distribution in Iran. An inverted-U shaped relationship between defense spending and income inequality is also existed. Economic growth increases income inequality. The causality analysis points out that military spending Granger causes income distribution. This confirmed the existence of an inverted-U shaped relationship between defence spending and income inequality. The feedback hypothesis is validated between economic growth and income inequality.

With the notice to the negative effects of defense spending on income inequality, it seems that in Iran defense sector is much more attractive for people belongs to low income groups in comparison with people in high income groups. According to Ali, (2012) negative relationship between defense spending and income inequality would be because of "… One possible interpretation could be that the military establishment in MENA (including Iran) countries is entrenched in all aspect of the society and it is complicated to parse-out the efficient from the inefficient allocations of the societal resources. Other possible interpretation could be that this negative impact of military expenditure on inequality might capture the equity side of military industrialization at the expense of efficiency. Also this negative relationship could be indicative of attempts by governments to consolidate their power by providing more subsidies and social programs while on the other hand, they are offering the stick by boosting military expenditures."

Footnotes

1. Chaitanya has explained Opportunity Cost Burden Effect Model with help of diagram.
2. The results of all studies regarding unit root properties of the variables are biased. The traditional unit root tests do not have information regarding structural break stemming in the series.
3. See Tiwari and Shahbaz, (2012); Shahbaz et al. (2012)
4. India, Pakistan, Sri Lanka and Bangladesh
5. Malaysia, Indonesia, Singapore, Philippines, India and South Korea
6. The structural breaks are based on Clemente et al. (1998)

References

1. Abell, J. D., (1994). Military Spending and Inequality. Journal of Peace Research, 31, 35-43.
2. Ali, E. H., (2012). Military Expenditures and Income Inequality in the Middle East and North Africa: A Panel Analysis. Defence and Peace Economics, forthcoming issue.
3. Ali, H. E., (2007). Military Expenditures and Inequality: Empirical Evidence from Global Data. Defence and Peace Economics, 18, 519-535.
4. Ali, H. E., (2011). Military Expenditures and Human Development: Guns and Butter Arguments Revisited: A Case Study from Egypt. Peace Economics, Peace Science and Public Policy, 17, 1-19.
5. Ali, H. E., (2011). Military Expenditures and Inequality in the Middle East and North Africa: Panel Analysis. Defence and Peace Economic. DOI:10.1080/10242694.2012.663578
6. Ali, H.E., Galbraith, J., (2003). Military Expenditures and Inequality: Empirical Evidence from Global Data. The University of Texas at Austin UTIP Working Paper No. 24.
7. Brown, R.L., Durbin, J., Evans, J. M., (1975). Techniques for Testing the Constancy of Regression Relations over time. Journal of the Royal Statistical Society, 37, 149-163.
8. Chaitanya, V. K., (2008). Exploring the Relationship between Military Spending & Income Inequality in South Asia. William Davidson Institute Working Paper Number 918, February 2008.
9. Clemente, J., Montanes, A., Reyes, M., (1998). Testing for a Unit Root in Variables with a Double Change in the Mean. Economics Letters, 59, 175-182.
10. Comton. C., (2005). All Men Created Unequal: Tends and Factors of Inequality in the United States. Issues in Political Economy, 13, 1-20.

11. Diamond, L., (1992). Economic Development and Democracy Reconsidered, In Gary Marks & Larry Diamond, ed., Re-examining Democracy: Essays in Honor of Seymour Martin Lipset. Newbury Park, CA: Sage (93-139).

12. Dickey, D. A., Fuller, W. A., (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. Econometrica, 49, 1057-1079.

13. DiNardo, J., Fortin, N., Lemieux, T., (1996). Labor Market Institutions and the Distribution of Wages, 1973-1993: A Semi-Parametric Approach. Econometrica, 64, 1001-1045.

14. Dunne, J. P., Vougas, D., (1999). Military Spending and Economic Growth in South Africa. Journal of Conflict Resolution, 43, 521-537.

15. Elliott, G. R., Thomas, J., Stock, J. H., (1996). Efficient Tests for an Autoregressive Unit Root. Econometrica, 64, 813-836.

16. Elveren, Y. A., (2012). Military Spending and Income Inequality: Evidence on Cointegration and Causality for Turkey, 1963-2007. Defence and Peace Economics, 23, 289-301.

17. Farzanegan, M. R., (2012). Military Spending and Economic Growth: The Case of Iran. Defence and Peace Economics, DOI:10.1080/10242694.2012.723160.

18. Gradstein, M., Milanovic, B., Ying, Y., (2001). Democracy and Income Inequality: An Empirical Analysis. Washington, DC: World Bank.

19. Granger, C. W. J., (1969). Investigating Causal Relations by Econometric Models and Cross-spectral Methods. Econometrica, 37, 424-438.

20. Henderson, D. R., McNab, R. M., Rozsas, T. (2008). Did Inequality Increase in Transition: An Analysis of the Transition Countries of Eastern Europe and Central Asia. Eastern European Economics, 46, 28-49.

21. Hirnissa, M. T., Habibullah, M. S., Baharom, A. H., (2009). Defense Spending and Income Inequality: Evidence from Selected Asian Countries. Modern Applied Science, 3, 96-111.
22. Karagianni, S., Pempetzoglu, M., (2009). Defence Spending and Economic Growth in Turkey: A Linear and Non-linear Granger Causality Approach. Defence and Peace Economics, 20, 139-148.
23. Karagol, E., Palaz, S., (2004). Does Defence Expenditure Deter Economic Growth in Turkey? A Cointegration Analysis. Defence and Peace Economics, 15, 289-298.
24. Keivani, F. S., (2011). Synchronization of Economic Growth and Income Distribution. 2011 International Conference on Sociality and Economics Development. IPEDR vol.10 (2011) © (2011) IACSIT Press, Singapore, pp: 7-11.
25. Kentor, J., Jorgenson, A. K., Kick, E., (2012). The ‘‘New’’ Military and Income Inequality: A Cross National Analysis. Social Science Research, 41, 514-526.
26. Kollias, C., Mylonidis, N., Paleologou, M. S., (2007). A Panel Data Analysis of the Nexus between Defence Spending and Growth in the European Union. Defence and Peace Economics. 18, 75-85.
27. Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., Shin, Y., (1992). Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root. Journal of Econometrics, 54, 159-178.
28. Lin, E. S., Ali, H., (2009). Military Spending and Inequality: Panel Granger Causality Test. Journal of Peace Research, 49, 671-685.
29. Looney, R., (1990). The Policy Relevance of Recent Research on the Economics of Third World Military Expenditures. Journal of Social, Political & Economic Studies, 15, 213-223.

30. Melman, S., (1974). The Permanent War Economy: American Economy in Decline, Simon & Schuster, New York.

31. Musai, M., Abhari, M. F., Hemat, R. K., (2011). Income Distribution and Economic Growth in Iran. European Journal of Social Sciences, 20, 416-424.

32. Narayan, P. K., (2005). The Savings and Investment Nexus for China: Evidence from Co-integration Tests. Applied Economics, 37, 1979-1990.

33. Ng, S., Perron, P. (2001). Lag Length Selection and the Construction of Unit Root Test with Good Size and Power. Econometrica, 69, 1519-1554.

34. Ozsoy, O., (2008). Defence Spending and the Macroeconomy: The Case of Turkey. Defence and Peace Economics, 19, 195-208.

35. Perron, P., Vogelsang, T. J., (1992). Testing for a Unit Root in a Time Series with a Changing Mean: Corrections and Extensions. Journal of Business & Economic Statistics, 10, 467-470.

36. Pesaran, M. H., Shin, Y., (1999). An Autoregressive Distributed-led Modeling Approach to Cointegration Analysis. In *Econometrics and Economic Theory in the 20th Century. The Ragnar Frisch Centennial Symposium*, ed. Steinar Strom. Cambridge: Cambridge University Press.

37. Pesaran, M. H., Shin, Y., Smith, R. J., (2001). Bounds Testing Approaches to the Analysis of Long Run Relationships. Journal of Applied Econometrics, 16, 289-326.

38. Phillips, P. C. B., Perron, P. (1988). Testing for a Unit Root in Time Series Regressions. Biometrika, 75, 335-346.

39. Rodrik, D., (1999). Democracies Pay Higher Wages. Quarterly Journal of Economics, 114, 707-738.

40. Seiglie, C., (1997). Deficits, Defence, and Income Distribution. CATO Journal, **17,** 11-18.

41. Shahbaz, M., (2010). Income Inequality-Economic Growth and Non-linearity: A Case of Pakistan. International Journal of Social Economics, 37, 613-636.

42. Shahbaz, M., Afza, T., Shabbir, M. S., (2012). Does Defence Spending Impede Economic Growth? Cointegration and Causality Analysis for Pakistan. Defence and Peace Economics. http://dx.doi.org/10.1080/10242694.2012.723159.

43. Shahbaz, M., Shabbir, M. S., (2012). Military Spending and Economic Growth in Pakistan: New Evidence from Rolling Window Approach. Economic Research, 25, 144-159.

44. Smith, Ron, 1977. 'Military Expenditure and Capitalism', Cambridge Journal of Economics 1(1): 61–76.

45. Tiwari, A. K., Shahbaz, M., (2012). Does Defence Spending Stimulate Economic Growth in India? A Revisit. Defence and Peace Economics. DOI:10.1080/10242694.2012.710814

46. Zivot, E., Andrews, D., (1992). Further Evidence of Great Crash, the Oil Price Shock and Unit Root Hypothesis. Journal of Business and Economic Statistics, 10, 251-270.