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# Investigating Wagner's law in Iran's economy

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**The aim of this paper is investigating Wagner's law by using Iran's time series data of period the 1960 - 2000. Carrying out the Engel-Granger cointegration test showed that GNP, government expenditure and government consumption expenditure were not cointegrated. Results showed that real income elasticity for non-proportional versions were bigger than one and for proportional ones were bigger than zero. In addition, Wagner's low was accepted for Iran's economy. Therefore along this period of time government expenditure growth and the size of government was a natural result of economic growth.**

**Key words:** Government size, cointegration, causality.

## INTRODUCTION

Relative growth of government size is one of the developed and developing countries characteristics. After World war II, government expenditure growth has occurred all over the world. As a result of this, government expenditure growth as a proportion of GNP has been attracting econometrists to analyze the phenomenon of government expenditure growth (Charemza and Deadman, 1992). This fact is one of the most important challenges of most countries economy. It seems that Iran in consequence of this world trend is face with government expenditure growth.

In order to elucidate government expenditure growth, numerous models exist among which the most ancient and famous of them is Wagner's law. Wagner (1883) proposed a model to determine government expenditure. In this model government expenditure growth is a natural result of economic growth. Wagner's law states that the government expenditure rate of increase is more than national production rate. In other words, accompany with increasing per capita income in industrious countries, increases relative importance of governmental sections (Bird, 1971).

At list six versions of this law have been investigated experimentally-Table 1 (Goffman, 1968; Gupta, 1967; Mann, 1980; Musgrave, 1969; Peacock and Wiseman, 1961; Pryor, 1969). Recent progresses in time-series analyses, by using cointegration analyses, ECM mechanisms and causality test, have made it possible to investigate this long-run relationship between government expenditure and GNP. Due to lack of any criterion in order to determine superior version-follow this determining if government size growth is under the influence of economic growth- this study in framework of time-series data of period 1960 - 2000 of Iran's economy has been tested by all six versions of Wagner's law. Six versions of Wagner's law presented in Table 1.

Many researchers have analyzed and tested Wagner's law. Some of these researchers have used traditional regression. Recently some of them have employed causality test and cointegration analysis.

Experimental tests of Wagner's law showed that results vary between different countries and different time periods. For instance, investigating of turkeys' economy endorse Wagner's law for the period of 1950 - 1960 and showed less than 1 income elasticity of government expenditure related to GNP for the period of 1947 - 1967 (Krzyzaniak, 1972; Onder, 1974).

Several researches paid attention to effect the of government size on economic growth. For instance Landau's study (1983) on 104 countries showed a negative relationship between government expenditure quota in GNP and growth rate of real per capita GDP. Barro's (1990) study indicated that large government size decreases per capita production growth. Investigating 47 countries by Kormendi and Meguire (1985) pointed to no relationship between government size and average growth of GDP. Whilst, Ram's (1986) study on 115 coun-

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**Table 1.** Several versions of Wagner's law.

| Number of version | Functional form | Version |
|---|---|---|
| 1 | LG = $a_1$+$a_2$LGNP | Peacock and Wiseman (1961) |
| 2 | LC = $a_1$+$a_2$LGNP | Pryor (1969) |
| 3 | LG = $a_1$+$a_2$L(GNP/P) | Goffman (1968) |
| 4 | L(G/GNP) = $a_1$+$a_2$L(GNP/P) | Musgrave (1969) |
| 5 | L(G/P) = $a_1$+$a_2$L(GNP/P) | Gupta (1967) |
| 6 | L(G/GNP) = $a_1$+$a_2$LGNP | Mann (1980) |

L: Natural logarithm

tries showed a positive effect of growth rate of total government expenditure on growth rate of real GDP (Barro, 1990; Kormendi and Meguire, 1985; Landau, 1983; Ram,1986).

Soory and Keihani Hekmat (2004), investigated the effect of government size on economic growth rate, by entering population variables. Results of this study showed that population variables in addition to influencing economic growth, are also determining government size too. Dependency burden has a positive relationship with government size. Whereas, entering population variables to growth equations showed negative effect of government size (Soory and Keihani Hekmat, 2004).

By using the ARDL model, another study, explored relationship between government size and economic growth of Iran. Results of this study showed that government size has a significant positive effect on agricultural sector growth (Rafiee and Zibaii, 2003).

There are some concerns that were considered with particular attention in this article. It has carefully considered the time-series characteristics stationary and cointegration of the data in used. The application of usual econometric methods to non-stationary time series can give spurious results and invalid conclusions (Sims et al., 1990). The question of whether or not to use level or difference data should be carefully checked. Another affair that needs extra attention is the choice of lag length (Hatemi, 2002). The choice of the lag length and the characteristics of the data are quite important and should be handled accurately in causality tests. This is because causality tests are sensitive to the presence of unit roots and to model selections (Sims et al., 1990). Hence, in the choice of the lags, Hsiao's systematic method was used.

## MATERIALS AND METHODS

### Data

The data used in this study included Gross National Production (GNP), Total Government Expenditure (G), Governmental Consumption expenditure (C) and Population (P) for the period 1960 - 2000 of Iran's economy. These are presented by the Central Bank of the Islamic Republic of Iran and World Bank. It is necessary to mention that each variable is deflated by GNP Deflator. Also, in order to carry out this article Microfit 4.0, Eviews 4.0 and Shazam 9.0 were applied.

### Stationary

In primarily studies, without paying attention to variables time series characteristics and stationary hypothesis of variables, this law was investigated. Whilst, time series analysis recent progresses, showed that most of macroeconomic series are integrated. In order to obviate this deficit, present study used time series stationary test.

As suggested by Engle and Granger (1987), before applying the cointegration tests, Augmented Dickey- Fuller (ADF) unit root tests are applied to each series and their first differences to determine the stationarity of each individual series (Ismet et al., 1998). The ADF test is derived, respectively, from the following regression[1] (Engle and Granger, 1987):

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^{p} \phi_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta\Delta Y_t = \alpha + \beta t + \delta \Delta Y_{t-1} + \sum_{i=1}^{p} \phi_i \Delta\Delta Y_{t-i} + \varepsilon_t \quad (2)$$

Where represents first differences of series, p is number of lags and t indicates time. Applied principle in order to determine lag length is that number of lag should be little to keep degree of freedom and on the other side it should be big to exclude auto correlation between residual terms. The minimum of the Akaike information criteria (AIC), is used to determine the appropriate lag length (value of p) in the ADF test (Brester and Goodwin, 1993). As is shown, the null hypothesis of the unit root test is that the variable under consideration has a unit root.

$$H_0 : \delta = 0$$
$$H_1 : \delta \neq 0$$

Accepting null hypothesis indicates that the series does not have stationarity.

### Cointegration

Cointegration indicates a long run relationship between economical

[1] In practice, it is considered as the most preferred test among the practitioners.

variables. In other words, according to the statistical point of view, long run relationship means variables close to themselves by passing time. As a result of this short run residuals remove from long run trend (Manning and Adriacanos, 1993).

Determining variables order of integration and be acquainted with all variables are integrated of order one (I (1)) - which means that they are non-stationary in levels but stationary in first differences - is first step of cointegration test (Noferesti, 2000). In order to determine variables order of cointegration, Dicky-Fuller and augmented Dicky-Fuller tests were applied

In step two, long run equilibrium relationship estimates by running OLS repressor. This regression called cointegration regression. After that, in order to test stationary characteristic of regression's residuals terms ($u_t$), Dicky-Fuller and augmented Dicky-Fuller tests - following regression - were employed.

$$\Delta u_t = \alpha + \beta u_{t-1} + \sum_{i=1}^{p} \phi_i \Delta u_{t-1} + v_t$$
$$H_0 : \beta = 0 \quad (3)$$
$$H_1 : \beta \neq 0$$

Accepting null hypothesis indicates that series are not cointegrated.

### Granger causality and Hisao's systematic synthesis

Granger causality test has vast usages in applied econometric studies and is defined as follows: "if Y is predicted better with past values of X - rather than without these values - X is Granger causality of Y (Bird, 1971)".

Several studies on Granger causality test indicates that least square version of this test is suitable because of its power and easy interpretation (Guilkey and Salemi, 1982). Granger's Standard test is admirable when original series - which generates growth rate series - are not cointegrated (Bahmani-Oskooe and Alse, 1993).

In order to investigate if GNP growth ( $\Delta LX$ ) is cause of ( $\Delta LY$ ) following equations are generated:

$$\Delta LY_t = \alpha + \sum_{i=1}^{m} \beta_i \Delta LY_{t-i} + \sum_{i=1}^{n} \delta_i \Delta LX_{t-i} + e_t \quad (4)$$

$$\Delta LX_t = a + \sum_{j=1}^{q} b_j \Delta LX_{t-j} + \sum_{j=1}^{r} c_j \Delta LY_{t-j} + v_t \quad (5)$$

Where m, n, q and r represent maximum lag length, $e_t$ and $v_t$ are uncorrelated white noises.

Null hypothesis of no Granger causality should carry out. If calculated F be more than table F, null hypothesis is not accepted. It means that causality in direction of " $\Delta LX$ to $\Delta LY$ " is accepted, otherwise it is not accepted.

Determining optimal lag length is very important issue in Granger causality test. In related literature, lags are selected sequentially and with equal values. Usually, lags are determined 1, 2, 3 or 4 (Bird, 1971).

In order to determine optimal lag length, Hisao proposed a systematic synthesis. On the way to determine optimal lag length, this method combines Granger causality and Akaike's minimum Final Prediction Error (FPE) criterion. First step of Hisao's synthesis, offer lag length for i and its second step suggest j.

Notice to following equation:

$$\Delta LY_t = \alpha + \sum_{i=1}^{m} \beta_i \Delta LY_{t-i} + \sum_{i=1}^{n} \delta_i \Delta LX_{t-i} + e_t \quad (6)$$

This model, at first determines m, following that by using this m, will determine optimal n. In order to determine optimal lag length ($m^*$) a regression should be estimated for each lag - with no pay attention to second summation of right hand side terms. Then for each regression FPE criterion - by using following equation - should be calculated:

$$FPE(m) = \frac{T + M + 1}{T - M - 1} \frac{SSR(m\ )}{T} \quad (7)$$

Where T is sample size, m represents lag length and SSR(m) is sum of square of residuals. In order to determine optimal lag length, these FPEs should be compared. Regression with minimum FPE gives optimal lag length.

Step two, in order to determine optimal lag length of n, estimates equation 6 with determined m. it generates FPE for each regression:

$$FPE(m^*, n) = \frac{T + m^* + n + 1}{T - m^* - n - 1} \frac{SSR(m^*, n)}{T} \quad (8)$$

Where $m^*$ is optimal lag length of step one and n represents second term of right hand side of equation 6. Optimal lag length is achieved from regression with minimum FPE. According to FPE criterion, X does have effect on Y, if entering Y in equation 4, decreases FPE and entering Y in equation 5, increases FPE. Y does have effect on X, if entering X in equation 5, decreases FPE and entering X in equation 4, increases FPE. If putting one variable in other equation, decreases FPE, Feedback will occur, otherwise - increasing FPE - it is no relationship between variables.

## RESULTS AND DISCUSSION

In order to determine series order of integration, unit root test is carried out. Results - represented in Tables 2, 3 and 4 - showed that all series have unit root. Applying this test for first differences of series showed that all series are integrated of order one I (1). Therefore, applying cointegration analysis for the series is possible. Of course equality of series order of integration before applying cointegration test - in order to survey long run relationship between these two economic series - is necessary.

The time series properties of the residuals are reported in Table 5. The standard Dickey-Fuller (Dickey and Fuller, 1981) (DF) test and the Sargan and Bhargava (1983) CRDW test are applied to determine the order of integration.

According to results of unit root tests for residual series, null hypothesis of non stationary is not rejected for each of the 6 versions. The elasticities of the real income in all equations are found to be positive and in non-proportional versions are bigger than one. Based on these elasticities Wagner's law will be accepted, but because variables are not cointegrated, these results are

**Table 2.** Dicky-Fuller test - with intercept, without trend.

| Variable | DF | ADF(1) | ADF(2) | ADF(3) |
|---|---|---|---|---|
| LGNP | -2.2210 | -1.9549[ASH] | -1.9890 | -1.9314 |
| LG | -3.5103 | -2.8508[S] | -2.8918[AH] | -2.9591 |
| LC | -3.8347 | -2.9462[S] | -2.5949[AH] | -2.9985 |
| L(GNP/P) | -1.9618 | -2.0358[S] | -2.2882[AH] | -2.1513 |
| L(G/P) | -2.8460 | -2.6176 | -2.8978[SH] | -3.1097[A] |
| L(G/GNP) | -2.8732[ASH] | -2.8104 | -2.7306 | -2.7290 |

Critical value: -2.9446, A: AIC, S: SBC, H: HQC

**Table 3.** Dicky-Fuller test - with intercept and trend.

| Variable | DF | ADF(1) | ADF(2) | ADF(3) |
|---|---|---|---|---|
| LGNP | -1.1428 | -1.5895[S] | -1.9568[AH] | -1.7187 |
| LG | -1.7207 | -1.8884[S] | -2.2225[AH] | -2.5436 |
| LC | -1.7772 | -1.8917[S] | -2.2673[AH] | -2.4630 |
| L(GNP/P) | -1.3305 | -1.6749[S] | -2.1006[AH] | -1.8866 |
| L(G/P) | -1.8019 | -1.9481 | -2.3376[SH] | -2.6770[A] |
| L(G/GNP) | -2.4833[ASH] | -2.3521 | -2.1665 | -2.2215 |

Critical value: -3.5386, A: AIC, S: SBC, H: HQC

**Table 4.** Dicky-Fuller test for first difference - with intercept, without trend.

| Variable | DF | ADF(1) | ADF(2) | ADF(3) |
|---|---|---|---|---|
| LGNP | -3.6612[ASH] | -2.4361 | -2.5095 | -3.9673 |
| LG | -3.4226[S] | -2.1853[AH] | -1.7610 | -1.9595 |
| LC | -3.2771[S] | -2.0589[AH] | -1.7300 | -1.6752 |
| L(GNP/P) | -3.9856[ASH] | -2.5254 | -2.5816 | -2.8809 |
| L(G/P) | -3.6159[S] | -2.2404[AH] | -1.7827 | -1.9490 |
| L(G/GNP) | -6.1892[ASH] | -4.7074 | -3.1356 | -2.4456 |

Critical value: -2.9472, A: AIC, S: SBC, H: HQC.

**Table 5.** Cointegration regression and DF/ADF tests.

| Number of version | Dependent variable | Constant | Coefficient of independent variable | $\bar{R}^2$ | CRDW | ADF(*) |
|---|---|---|---|---|---|---|
| 1 | LG | -3.40 | 1.26* | 0.959 | 0.384 | -2.2294(0) |
| 2 | LC | -3.89 | 1.18* | 0.948 | 0.272 | -1.8019(0) |
| 3 | LG | -3.46 | 2.00* | 0.910 | 0.417 | -2.2442(0) |
| 4 | L(G/GNP) | -3.86 | 0.49* | 0.663 | 0.692 | -2.0398(0) |
| 5 | L(G/P) | -3.86 | 1.49* | 0.948 | 0.694 | -2.0460(0) |
| 6 | L(G/GNP) | -3.40 | 0.26* | 0.513 | 0.380 | -2.2124(0) |

Critical value: -2.9446 *: Indicates rejection of the null hypothesis at $\alpha = 0.10$.

not reliable.

Although these results could not reject null hypothesis of lack of long run relationship between variables, but according to cointegration analysis constraints - like omitting or including series of proportional price, demographic variables, agricultural and industrial and from cointegration regression (Mann, 1980)- these results should be interpreted with discretion. Results of the test

**Table 6.** Results of Granger causality test for 6 version of Wagner's law.

| Version | Granger causality | t statistics (lag) | |
|---|---|---|---|
| 1 | *DLGNP* → *DLG* | 6.438*(1) | |
| | *DLG* → *DLGNP* | 3.035*(4) | |
| 2 | *DLC* → *DLGNP* | 3.288*(3) | 3.853*(4) |
| 3 | *DL(GNP/P)* → *DLG* | 5.790*(1) | |
| | *DLG* → *DL(GNP/P)* | 3.239*(4) | |
| 4** | ----- | ------ | |
| 5** | ----- | ------- | |
| 6 | *DL(G/GNP)* → *DL(GNP)* | 3.012*(4) | |

*:Indicates rejection of the null hypothesis at $\alpha = 0.05$ **: lack of causality.

for all 6 versions represented in Table 5.

All 6 versions of Wagner's law indicate lack of a long run relationship between public expenditure and GNP in Iran economy (Table 5). Disability to see a long run relationship between government expenditure and GNP might be as a result of structural breaks. In other words, invisibility of a long run relationship does not mean lack of long run relationship. On the other side, lack of long run relationship could be due to short period of investigated time (Banarjee et al., 1993).

Because of no indication of cointegration between series it is not possible to apply an error correction process for short run dynamic models (ECM), whilst using Granger causality test -in order to survey causality relation among variables - is possible (Ansari et al., 1997). As a result of this, it is investigated by applying Granger causality test in next section.

## Causality between government expenditure and national income in Wagner's law

Based on general finance point of view national income growth is a reason of government expenditure growth (Wagnerian approach), whilst macroeconometic models (Keynesian approach) indicated an opposite causal flow (Nelson and Plosser, 1982). Results of Granger causality test are different among developed and developing countries (that is, causal flow runs from government expenditure to income (or inverse), lack of causality and two-way causality between income and government expenditure (Ansari et al., 1997; Khan, 1990; Oxley, 1994; Pryor, 1969).

As mentioned before, despite the lack of cointegration between government expenditure and GNP (or GNP/P), applying Granger causality test for stationary series is possible. In other words it is possible to apply causality Granger test for first differences of series.

As Table 6 indicates, it is not possible to speak about first and third versions. Because both versions lead to conflicting results in first and fourth lags. In first lag they indicate GNP (and per capita GNP) variation is a cause of government expenditure variation, whilst in fourth lag they indicate government expenditure variation is a cause of GNP (and per capita GNP) variation. But versions 2 and 6 have different conditions. Based on the second version government consumption expenditure variation is a reason for GNP variation and according to version 6, ratio of government expenditure to GNP variation is a cause of GNP variation. As a matter of fact the Keynesian approach is accepted. In addition to these, versions 4 and 5 show no causal relationship between variables.

Although, usually this technique of determining lag length is used in experimental studies, but (like versions 1 and 3) due to high sensitivity of Granger causality test, it leads to deceptive results and has a lot of problems and criticisms. As a result of this problem in order to determine optimal lag length other techniques like AIC, SBC, HQC and Akaike FPE were used.

Applying FPE criterion has been determined by optimal lag length for each equation of Table 6. These results represented in Table 7.

As it is shown in Table 7, both null hypotheses 1 and 2 are rejected at 5% level of significance. In other words, variation of GNP is a reason of government expenditure variation and vice versa (acceptation of both Wagnerian and Keynesian approaches). But testing fourth hypothesis indicates that variation of government consumption expenditure is an origin of GNP variation. In other words, in the mentioned period increasing in government consumption expenditure, increases GNP. Testing fifth hypothesis showed that variation of per capita GNP is a cause of government expenditure (acceptation of Wagnerian approach). Testing hypothesis 9 indicates per capita GNP variation is an origin of per capita government expenditure variation.

According to the eleventh hypothesis, variation of GNP is a reason for ratio of government expenditure to GNP variation (acceptation of Wagnerian approach), whilst testing the twelfth hypothesis, it indicates that variation of ratio of government expenditure to GNP is a reason of GNP variation. In other words, Keynesian approach is accepted here.

**Table 7.** Results of Granger causality test for 6 versions of Wagner's law with applying FPE in order to determine optimal lag length.

| Number of Hypothesis | Null Hypothesis | Number of lag | F statistics | Prob | FPE |
|---|---|---|---|---|---|
| 1 | DLGNP does not Granger Cause DLG | 1 | 6.438** | 0.016 | 58666 |
| 2 | DLG does not Granger Cause DLGNP | 4 | 3.035** | 0.035 | 0.014348 |
| 3 | DLGNP does not Granger Cause DLC | 1 | 2.577 | 0.117 | 0.015707 |
| 4 | DLC does not Granger Cause DLGNP | 3 | 3.288** | 0.035 | 0.014620 |
| 5 | DL(GNP/P) does not Granger Cause DLG | 1 | 5.79** | 0.021 | 58590 |
| 6 | DLG does not Granger Cause DL(GNP/P) | 1 | 2.02 | 0.163 | 0.014802 |
| 7 | DL(GNP/P) does not Granger Cause DL(G/GNP) | 4 | 1.515 | 0.226 | 0.014565 |
| 8 | DL(G/GNP) does not Granger Cause DL(GNP/P) | 1 | 1.112 | 0.298 | 69209 |
| 9 | DL(GNP/P) does not Granger Cause DL(G/P) | 1 | 3.769* | 0.060 | 69209 |
| 10 | DL(G/P) does not Granger Cause DL(GNP/P) | 1 | 1.254 | 0.271 | 0.014802 |
| 11 | DL(GNP) does not Granger Cause DL(G/GNP) | 1 | 2.867* | 0.099 | 61880 |
| 12 | DL(G/GNP) does not Granger Cause DL(GNP) | 4 | 3.012** | 0.036 | 0.014223 |

**: Indicates rejection of the null hypothesis at $\alpha = 0.05$ *: Indicates rejection of the null hypothesis at $\alpha = 0.10$.

## Conclusion

According to results of this study, for the duration of 1960 - 2000, Wagner's law is accepted in Iran economy. So, along this period government expenditure growth is a natural result of economic growth. In other words, based on Wagner's law, economic growth is a reason for increasing of government size. At the side of this, increasing of government size causes GNP increasing. So this cycle (some this is missing please check out) vast government size, continuously.

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