Keynesian Multiplier: Does it Matter to Egyptian Economy?

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Abstract: The study aims at investigating the impact of Keynesian multiplier on the four-sector open economy like Egyptian economy and testing the significance of aggregate demand components on Gross domestic product (GDP) over the period (1980-2017), the study adopts a descriptive analytical approach and econometrics methodology. The main findings that the theoretical literature is more likely meet the evidence for developed countries and unlikely for the developing countries. Unit Root tests show that variables are integrated of order one I(1), and they have long term equilibrium relationship. The four-sector multiplier value varied from year to year depending on the value of MPW. The mean value of the multiplier equals to 0.938 times. The significant of the model R^2 indicates that 89.1 % of GDP explained by the independent variables over the study period. The lag consumption, investment, government expenditure and imports are significant at 5% level, while the lag exports is insignificant due to the international demand pattern fluctuations and the most of domestic production directed to supply at local market. For policy recommendations, the policy makers should decrease the leakages from income circular flow and increase the share of investment in GDP by suggesting investment future plan for needed investment projects in addition to applying dampening policy that decrease imports of both unnecessary consumption and luxury goods.

Keywords: Macroeconomics, Keynes, Multiplier, National income, Egypt

JEL Calcifications: E2, E6, H1

1. Introduction

During the great depression in 1930th USA and several Western European economics had fall in output, declined in price levels while unemployment was very high. Keynes suggested a solution to help these countries to recover and pull the global economy out of depression by giving the state or national government an active role in the economy in order to stimulate the growth in productivity and output. Keynes argued that helping the economy requires government intervention to stimulate the aggregate spending or demand by money injection into the economy for employing more people in public works who will be able to spend money on goods and services, which would increase the demand, output via the multiplier effect and create other jobs in the economy. (Keynes, 1936)

Multiplier concept was initially introduced by Kahn (1931) and developed by Keynes (1963) who measured the national income and employment determination in both open and closed economy and illustrated how the increase in national income caused by many different injections such as government expenditure, investment, and exports. For example, if government spending increases by ($1), it causes the aggregate demand to increase by more than ($1). "The initial round of spending stimulates the next rounds of spending in this way the final effect on output is multiplier times the original increase in spending" (Hayat & Qadeer, 2016: 207-208).

Keynes assumed that the multiplier would work in any economy when, first, there is no full employment level or there is an excess capacity that gives flexibility to production sector to respond when there is an increase in demand. Second, marginal Propensity to consume (MPC) that equals to (Δ consumption / Δ income) is constant while income increases in various rounds of consumption expenditure. Third, consumption is function of disposable income. Four, there is no time lag in income generation process, and finally prices are fixed.

There are several studies tried to measure the impact of multiplier on national income in both developed and developing countries. Some studies such as [Rao (1952), Dasgupta (1954), Hassan (1960), Mahi (2008), Alkawaz(2011) and Gaber &Ali(2013)] found that the assumptions of multiplier might not applicable in developing countries; therefore the significant role of multiplier does not work in real terms although the value of MPC is high . They argued that the elasticity of supply of output is low and the production sector could not expand its capacity to respond the new demand. Thus, the effect of multiplier would just cause inflation. On the other hand, some studies such as [Khatkhate (1954), Behrman (1975), Syed (2011), Ilzetzki et al. (2011) and Bose & Bhanumurthy (2015)] found that "the multiplier could operate in developing economies in a state of transition, when it is associated with a carefully designed pattern of investment and the growth rate is fast enough to generate capacity at the rate at which demand increases".

The empirical studies of developed countries such as [Baxter& King(1993), Hussain (1994), Romer (2000) Benassy(2006), Polyzos & Sofios (2008), Trezzi et al. (2010), Christiano et al., (2010), Jamec et al. (2011), Espinoza & Senhadji (2011), Marattin& Salotti (2011), Baum et al., (2012), Blanchard &Leigh (2013) Silva et al. (2013), Parkyn & Vehbi (2014), Minea & Mustea (2015) and De Cos & Moral (2016)] found that the multiplier has significant and positive effect -in both forward and backward directions- on accelerating national income. Despite the basic structure of the multiplier remains same, the size of multiplier varies from country to country. It depends mainly on the state of the business cycle, through the size the economy, the values of MPC, the prevalence of Ricardian Equivalence, and exchange rate flexibility.

The current study aims at measuring the open economy multiplier in an Egyptian economy and determines its signficance, in addition to investigating that if the government can increase the multiplier value in order to increment the national income. For these purposes, the study adopts the descriptive analytical approach and econometrics methodology by employing unit root and cointegration tests in addition to OLS regression. For this purpose, time series data of different components of the aggregate demand function over the period 1980 to 2017 collected from the annual reports of Central Bank of Egypt (CBE), Central Agency of public mobilization and statistics (CAPMS), and the World Bank (WB) database.

The rest of the study is structured as follows: Section two overviews the Keynesian multiplier, while section three illustrates the methodology. Section four shows the empirical results while section five concluding remarks.

2. Keynesian multiplier: An overview

The Keynesian model of income determination depends on the following function:

Y= f(C, I , G , X , M)   (1)

Where: C: Consumption, I: Gross Investment, G: Government expenditures, X: Exports,   M: Imports.

The left hand side of equation (1) represents the national income or GDP, while the right hand side is the main components of aggregate demand or expenditure. The following equations show how to get the four-sector multiplier, which consists of three-sub multipliers, investment, taxes and foreign trade multipliers.

$$C = \alpha + b(Y - T_0 - tY) \qquad (2)$$

$$M = m_0 + m_1 Y \qquad (3)$$

$$Y = \alpha + b(Y - T_0 - tY) + I + G + X - m_0 - m_1 Y \qquad (4)$$

$$Y - bY + tY + m_1 Y = \alpha - T_0 + I + G + X - m_0 \qquad (5)$$

$$Y[(1-b) + t + m_1] = \alpha - T_0 + I + G + X - m_0 \qquad (6)$$

$$Y = \frac{1}{[(1-b) + t + m_1]} * (\alpha - T_0 + I + G + X - m_0) \qquad (7)$$

$$KM = \frac{1}{MPS + MPT + MPM} = \frac{1}{MPW} \qquad (8)$$

Where: α : autonomous consumption, b: marginal propensity to consume (MPC), $(1-b)$ is a Marginal Propensity to Save (MPS), T_0 : autonomous taxes, t: marginal propensity to tax (MPT) that equals to $(\Delta T / \Delta Y)$, m_0 = autonomous imports, m_1 : marginal propensity to import (MPM) that equals to $(\Delta M / \Delta Y)$.

Equation (7) determinates the national income equilibrium and it argues that "multiplier gives the multiple times of change in national income due to injections in the economy" (Syed, 2011: 6388). Equation (8) shows that the size of multiplier depends mainly on the value of marginal propensity to withdraw (MPW) which is the amount of money withdrawn from the circular flow. The value of multiplier is always positive but sometimes it could be negative if the government cut spending and some workers in public sector lose their jobs; this will cause an initial fall in spending, and bigger final fall in national income.

3. Methodology

The study uses annual data for the main components of Aggregate demand, which obtained from CBE, CAMPS and WB. The time series data starts from 1980 and ends 2017. All independent variables are lagged by one year and the natural log difference approach employed to estimate the regression equation. The following equation applied for each variable under study:

$$Ln\ X = Ln\ [X_t / X_{t-1}] \qquad (9)$$

Where: X_t is the value of the variable for the current year (t), X_{t-1} is the value of variable for the previous day.

First, we have examined the time series properties of the data and establish their order of integration by using two Unit root tests, which are Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) tests. The study employs the tests that include intercept and trend term. The null hypothesis (H_0) is that variables are non-stationary, while the alternative hypothesis (H_1) states that variables are stationary and integrated of the same order. In order to identify the probable stationarity order, the study uses Schwartz Information Criteria (SIC) to estimate the appropriate number of lags before performing these tests. The latter are conducted at the level and at first differences in case the variables have unit root at levels (John et al., 2007).

Second, if the variables are stationary and integrated of the same order, the study proceeds with carrying out the Johansen cointegration test for investigating the existence of long-run equilibrium among the variables under study. Johansen test includes two statistic sub-tests, which are:

- **Trace Eigenvalue**: The null hypothesis of the trace test is that the cointegration vectors number is (r = r*< k), while the alternative hypothesis is that (r=k), this test proceeds sequentially for r*=1,2,3,….n.

- **Max. Eigenvalue test**: Its null hypothesis is (r = r*< k) vs. the alternative hypothesis which is (r = r*+1).

If the p-value is less than 0.05, this means we reject the null hypothesis and accept that at least one cointegration vector exist among the variables under study at the level 0.05 level (Erik & Par, 2007).

The study employs OLS regression method to determine the significant effect of consumption, investment, government expenditure, exports and imports on GDP. Accordingly, the model of the study is:

$$Y_t = ß_0 + ß_1 C_{t-1} + ß_2 I_{t-1} + ß_3 G_{t-1} + ß_4 X_{t-1} - ß_5 M_{t-1} + u_t \quad (10)$$

Set of diagnostic tests are employed in order to assess the appropriateness of the regression results such as Jarque-Bera (JB) test for residual normality, Breusch-Godfrey LM and D.W tests for serial correlation and both ARCH and White tests for heteroscedasticity (Jarque & Bera, 1980: 255-259).

4. Empirical results

4.1 Descriptive analysis

A descriptive analysis of the data presented in Table (1) which shows the variability for most variables under study. Skewness index and probability of Jarque-Bera normality test show the non-normality of the six variables. Table (2) illustrates the correlation matrix of the variables under study. The highest positive correlation between GDP and Consumption (0.702); it means that both variables move in line together where the increasing in Y causes increasing in C. The lowest correlation between GDP and Investment (0.069); this consistent with the Granger causality test that shown in table (3).The negative correlation between I and G indicates that there is crowding out between both of them .The weak correlation between I and X means that investors might direct most of their production to the local market than to export. The negative correlation between G and X means that increasing government spending on domestic goods reduces the volume of exports. Finally, the positive correlation between Y and M means that the more Y the more M or increasing in Y causes increasing in (M). Moreover, the increasing in C and G causes increasing in M as shown in Table (3).

4.2 Unit Root test

Table (4) shows the results of the ADF and PP tests on the levels and at first differences. All variables are non-stationary at level where the statistic value is less than the critical ones; therefore, the study performs the tests on first differences for all variables where both tests reject the null hypothesis that means all series are stationary at first differences, and they are integrated of order one I (1).

4.3 Johansen Multivariate Co-integration

Since the time series have been integrated to the same order I(1), we can employ Johansen cointegration procedure. Table (5) shows the outcomes of maximum and trace statistics. Trace eigenvalue test and Max. eigenvalue test show that, there are four and two cointegration equations respectively at the 0.05 level, which means that accepting the alternative hypothesis, which states that

there are more than two cointegrated vectors among the variables under study. It indicates that there is a long run equilibrium relationship among the variables, and thus we can estimate the regression equation by using the initial variables.

4.4 Multiplier calculation

Using equation (8) to find the value of multiplier by calculating MPS, MPT and MPM over the study period as illustrated in figures (1-3). The maximum value of MPS is (0.41) in year 2011, and the minimum is (0.11) in year 1990, while the maximum and minimum values of MPT are (0.26) and (-0.56) in years 2009 and 1987 respectively. Few results of MPM are greater than one starting from year 2012 until the end of the study period; this may be due to some exogenous factors or because of the economic cyclical movement effect during the period of time or due to the recession in the Egyptian economy.

The average value of MPS is (0.25) while the average values of MPT and MPM are (0.06) and (0.43) respectively. The average values are at acceptable range according to the defined rules.

The four-sector multiplier is being calculated for each year over the study period as shown in figure (4), the values of multiplier is varied from year to year depending on the value of MPW. The highest value of multiplier is (2.5) in year 2003 while the lowest value is (-1.6) in year 2000. In order to obtain a single value of the multiplier; we take the arithmetic mean of the multiplier which equals to (0.938) that implies that if the aggregate demand increases [due to increase in (I) or (G) or (X)] by 100 Egyptian pounds, the national income will increase by 93.8 Egyptian pounds. The value of average multiplier is less than one may be due to the leakage of income that shown in the high value of MPM especially during the last five years, which indicates that part of multiplier effect goes to foreign countries via imports.
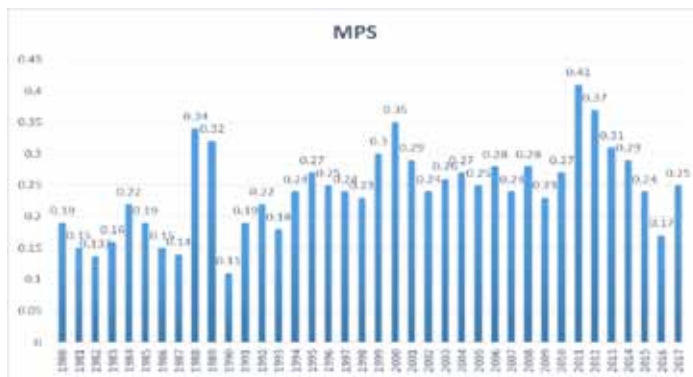

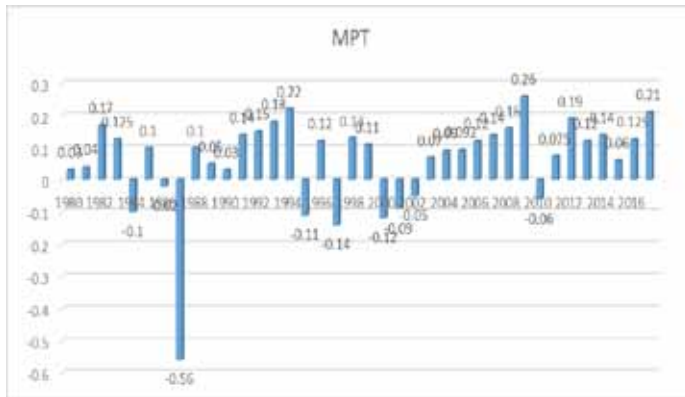**Figure 1. MPC values during the period (1980-2017)**
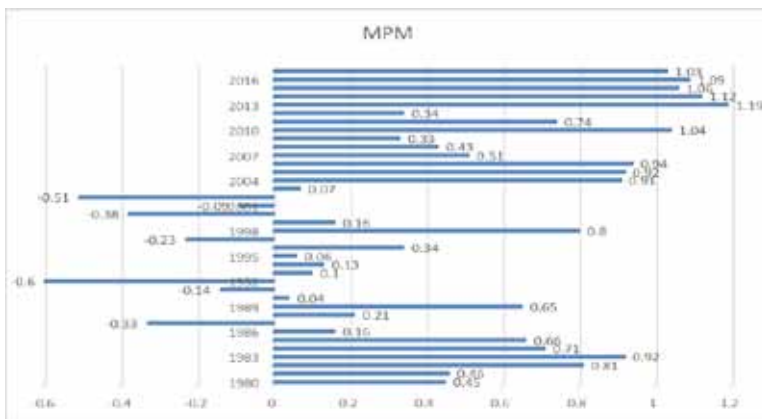
Figure 2. MPT values during the period (1980-2017)

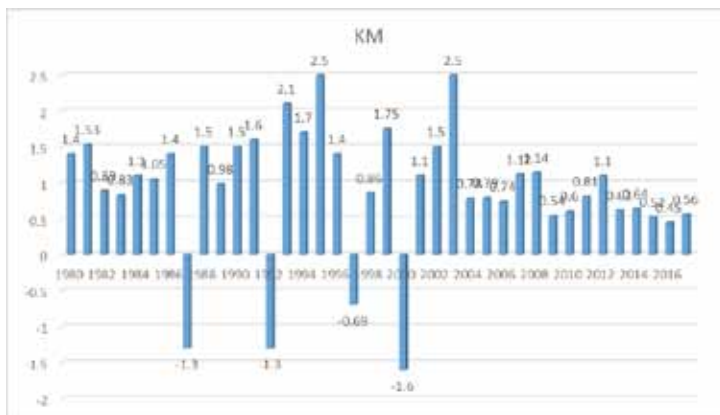**Figure 3. MPM values during the period (1980-2017)**

Figure 4. Multiplier values during the period (1980-2017)

4.5 Regression analysis

Table (6) shows the results of regression estimation of equations (10) by using OLS regression model. The value of R^2 equals (0.891) that means 89.1% of the variation in (Y) is explained by the independent variables; this may be due to the significant unbiased data and the Adj.R^2 (0.885) is closer to the R^2. F-stat shows the independent variables have a real impact on (Y). The absolute value of t-stat of consumption is greater than critical values, which mean it has significant impact on (Y) at 0.05 levels. Investment has a weak significant effect on (Y). government expenditure has positive and strong effect on (Y), while the imports has negative significant impact on (Y) and it represents one of the main leakages of foreign currencies from Egypt to abroad. Finally, exports have insignificant effect on (Y) due to the recession in several years in Egypt and the fluctuation in the international trade pattern, Moreover, the local production directed to the Egyptian market. According to diagnostic tests, there is no autocorrelation problem in the model. This shown from the value of DW test (1.74), in addition to the p-value of f-stat of Breusch-Godfrey LM test is (0.12) which is higher than (0.05). The p-value of ARCH and White tests show there is no heteroscedasticity. Moreover, Jarque-Bera test indicates that the data have Skewness and kurtosis matching a normal distribution.

5. Concluding Remarks

The study tries to calculate the value of four-sector multiplier of Egyptian economy and estimate the aggregate demand function over the period 1980-2017. The MPC reveals that the initial rise in income will induce an increase in consumption spending, while the MPM indicates that some of the additional consumption spending will be for imported goods. The average value of multiplier is less than one (0.938) where the MPM average value is high (0.43), which indicates more leakage from income circular flow and it leads to smallest second stage increase in domestic income. The value of R^2 reveals that 89.1% of the variation in (Y) is explained by the independent variables. The lag C, I, and G have positive significant impact on (Y) and M has negative significant effect on (Y), while the lag X has insignificant impact. The study recommends that the policy makers should simulate the of multiplier effect by decreasing the leakages from income circular flow, and increase the share of investment in GDP, this could happen by adopting future investment plan for the next five years that determines what investment projects needed by the Egyptian economy, which will supply goods that were imported from abroad in addition to provide employment opportunities. On the other hand, they should employ expenditure dampening policy to decrease imports of both unnecessary consumption and luxury goods while enhance imports of raw materials or machinery that produces value added products for exports. In addition to they have to return to specialization in some goods that Egypt has a comparative advantage.

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Appendix

Table 1. Statistical properties of equity market indices

	Mean	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.	Obs.
LY_t	0.051	0.145	0.017	0.024	1.82	7.85	56.8	0.00	37
LC_{t-1}	0.051	0.2	0.007	0.033	2.53	11.9	162.8	0.00	37
LI_{t-1}	0.038	0.213	0.17	0.08	-0.24	2.96	6.3	0.08	37
LG_{t-1}	0.44	0.191	0.02	0.36	1.7	8.92	72.06	0.00	37
LX_{t-1}	0.037	0.253	0.145	0.09	0.203	2.57	5.2	0.07	37
LM_{t-1}	0.033	2.34	2.3	0.56	-0.25	17.42	32.1	0.00	37

Table 2. Correlation matrix

	LY_t	LC_{t-1}	LI_{t-1}	LG_{t-1}	LX_{t-1}	LM_{t-1}
LY_t	1	0.702	0.069	0.36	0.263	-0.363
LC_{t-1}		1	-0.27	0.173	0.143	0.302
LI_{t-1}			1	-0.535	0.168	0.036
LG_{t-1}				1	-0.23	0.312
LX_{t-1}					1	0.101
LM_{t-1}						1

Table 3. Pairwise Granger Causality test Sample 1980-2017   lags: 2

Null Hypothesis	Obs.	F. statistic	Prob.
LC_{t-1} does not Granger cause LY_t	35	2.41	0.078
LY_t does not Granger cause LC_{t-1}	35	10.8	0.003
LI_{t-1} does not Granger cause LY_t	35	2.12	0.098
LY_t does not Granger cause LI_{t-1}	35	0.53	0.59
LG_{t-1} does not Granger cause LY_t	35	2.23	0.09
LY_t does not Granger cause LG_{t-1}	35	3.15	0.05
LX_{t-1} does not Granger cause LY_t	35	1.35	0.27
LY_t does not Granger cause LX_{t-1}	35	0.69	0.5
LM_{t-1} does not Granger cause LY_t	35	3.54	0.041
LY_t does not Granger cause LM_{t-1}	35	5.42	0.009
LM_{t-1} does not Granger cause LC_{t-1}	35	4.84	0.015
LC_{t-1} does not Granger cause LM_{t-1}	35	19.06	0.0002
LM_{t-1} does not Granger cause LG_{t-1}	35	3.18	0.05
LG_{t-1} does not Granger cause LM_{t-1}	35	11.64	0.0002

Table 4. Unit root tests

		LY_t	LC_{t-1}	LI_{t-1}	LG_{t-1}	LX_{t-1}	LM_{t-1}
ADF test T-Statistics	Level	-0.3 (0.987)	1.61(1.00)	-2.27(0.43)	1.08(0.99)	-1.85(0.511)	-2.13(0.511)
	1st differences	-4.3 (0.007)*	-3.21(0.01)*	-5.55(0.0003)*	-5.9(0.0001)*	-4.82(0.003)*	-7.10(0.00)*
PP test Adj. t-Stat	Level	-0.144 (0.992)	1.45(1.00)	-2.28(0.43)	1.08(0.99)	-1.82(0.671)	-2.27(0.43)
	1st differences	-3.21 (0.097)*	-4.59(0.004)*	-5.54(0.0003)*	-5.9(0.0001)*	-4.4(0.006)*	-7.20(0.00)*

Critical values : at 1% (-4.22), at 5% (-3.55), at 10% (-3.21)

Table 5. Johansen Cointegration test results

A- Unrestricted cointegration rank test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Stat.	0.05 Critical Value	Pro. **
None*	0.790	141.18	95.75	0.000
At most 1*	0.628	86.54	69.81	0.0013
At most 2*	0.466	51.89	47.85	0.019
At most 3*	0.361	29.89	29.79	0.048
At most 4*	0.191	14.21	15.49	0.077
At most 5*	0.171	6.55	3.84	0.0105

Trace test indicates (4) cointegration eqn(s) at the 0.05 level

B- Unrestricted cointegration rank test (Max. Eigen)

Hypothesized No. of CE(s)	Eigenvalue	Max. Eigen stat.	0.05 Critical Value	Pro. **
None*	0.790	54.63	40.07	0.0006
At most 1*	0.628	34.65	33.87	0.0403
At most 2*	0.466	21.99	27.58	0.220
At most 3*	0.361	15.68	21.13	0.243
At most 4*	0.191	7.65	14.26	0.414
At most 5*	0.171	6.55	3.84	0.010

Max-eigenvalue test indicates (2) cointegration eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level ** Mackinnon- Huge-Michelis (1999) p-value

Table 6. OLS regression results

	C_0	LC_{t-1}	LI_{t-1}	LG_{t-1}	LX_{t-1}	LM_{t-1}	R^2 =0.891 Adj. R^2=0.885 F-stat=7.63 Prob.(0.00)
Coefficient	2.31	0.674	0.298	3.52	0.471	-0.267	Jarque-Bera = 41.41 Prob.(0.003)
t-Stat.	3.28	3.45	2.07	5.64	1.450	-2.83	LM test = 0.617 Prob.(0.12) D.W test : 1.74
Prob.	0.06	0.05	0.098	0.019	0.187	0.072	ARCH test= 0.512 Prob.(0.66) White test= 0.411 Prob.(0.70) Breusch-Pagan-Godfrey test=2.45 Prob.(0.052)