Can Macroeconomic Impact of Human Capital be Modeling? Bahrain Experience

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Abstract: The objective of this study is to develop a small dynamic model for Bahrain economy in order to examine the effect of human capital investment on key macroeconomic variables through forecasting and simulation. The results clearly indicate that the human capital investment positively affect the real output of the country over the period of 1990 and 2015. Additionally, forecasting and simulation for the model in different scenarios show that an adjustment in government spending on education enhances both labor demand and GDP growth rates which raise much due mainly to employment and multiplier accelerator principle. Proposed model could be handy for policy makers to find out some of the paths while evaluating the major macroeconomic variables associated with the spending on education.

Keywords: Macroeconomic Modeling, Human capital, Economic growth, Simulation, Bahrain.

1. INTRODUCTION

The human capital is one of the most fundamental determinants of economic and social development of any society (Marshall, 1920) which has prompted many countries to invest in human capital through education and training whereas education is a critical part of preparing the future workforce to productive lives within their societies. According to Eric A., (2013) expenditure incurred in workforce education is an investment for the future progress and should not be considered as an expense. On the other hand, Stokey (1991) emphasizes that increasing the regional capacity of the human capital generation and utilizing this capital could be a vital strategy to regional policies for the future's high-tech economy. Human capital includes the meaning of "human as creator" extensively who frames knowledge, skills, competency and experience originated by continuously connecting between "self" and "environment". (Odusola,1998).

The importance of human capital-in the form of education- as an engine of economic growth and development has widely been recognized in economics theories and empirical studies over the long period of time. The origin of human capital goes back to the emergence of classical economics in 1776 where Adam Smith includes the term in his definition of capital, and concludes that human skills increase the wealth both of individuals and of society. Economists such as Romer, Lucas, Solow and Schultz prescribe education as an important factor and develop many economic growth theories and models over this concept. Neoclassical growth models of Solow

(1957) and Romer (1990) are the main theoretical approaches of modelling the relationship between education and economic performance.

Numerous empirical studies focus on the issue of education and economic development. The most studies find skills and knowledge of a country's population are significant in determining economic growth in the long run[1]. When it comes to Bahrain, there are just a few papers discuss on human capital. For instance, Byengju (2002) measures the aggregate human capital input for 45 lowest and highest income countries by adopting labor's income method, and finds that Bahrain and another two countries (Argentina and Portugal) have implausibly high level of human capital input. Nadir and Hatidje (2007) make an attempt to determine the Qualitative Indicators of Human Capital (QIHC) at macroeconomic level. For this purpose, they build QIHC for 105 countries over the period of 1964 through 2005. According to QIHC Mathematic and QIHC of sciences Bahrain ranks 58th and 55th respectively during the study period. Saad (2014) examines the role of education and human capital in Bahrain and discusses the opportunities for future collaborations with Malaysia. In this study, definition of the human capital is given and educational development of Bahrain is gone through. Ahmed et al. (2014) argue the human capital concept in Bahrain from an Islamic perspective and its relationship with firms' performance at micro level by considering 140 randomly picked SMEs where their owners are Muslims.

Attempts to construct macroeconomic modeling of Bahrain economy to linkage between human capital investment and key macroeconomic variables have not been undertaken. This paper proposes a macroeconomic modeling framework of Bahrain to fill this gap.

The concept of macroeconomic modeling traces back to the work of Jan Tinbergen in the 1930s. Since then a number of researchers employ macroeconomic model as an important tool to understand the structural relationship among different macroeconomic variables[2]. This technique provides cause and effect relationship between policy and target variables and helps in forecasting and policy assessment (Herve et al., 2010). It consists of behavioral equations and identities that indicate various interrelations and portray the structure of the economy. The numerical relationships embedded in the equations and identities are estimated using econometric techniques. The estimation outcomes provide a systematic explanation of how the economy works. The model can also be empirically validated and exercised for simulating the effects of policy changes (Bodkin et al., 1986).

Human capital investment is one of the main priorities of the Kingdom's government. With the purpose of achieving sustainable economic growth, the authorities devote their efforts to improving human capital. The government so far has adopted an expansion of education and dropped the rate of illiteracy to the lowest level ever and has been trying to make primary education compulsory for all citizens. Furthermore, it concentrates on the quality of education to enhance human capital efficiency and to raise productivity. Consequently, woman rights have been improved so as to integrate them into the country's economic and social life.

[1] See Maddision(1970),Mincer (1974), Becker et al. (1990), Robert(1991), World Bank (1993),Thirwall (2000), Baldacci et al.(2004), Obah et al.(2010), and Olatunji et al. (2014).

[2] See Klien and Goldberger (1955), Klein et al., (1961), Meredith (1989), Bryant et al., (1993), Khan and Din,(2011), and Faisal and Abdul Waheed (2014)

Most recently, Bahrain has also launched some further reforms in prime fields of education such as establishing new colleges, organizing teacher training programs, developing vocational programs among others. In order to assess and evaluate the improvements, Quality Assurance Authority for Education and Training (QAA) was established and quality standards were set throughout the country. In accordance with Bahrain's Economic Vision, Tamkeen was established so as to provide support to enterprises and individuals to enhance their productivity and growth. The statistics of ministry of education on Bahrain show that the education sector experienced robust growth during the study period of time, expending by a cumulative 280% between 1990 and 2015. The government spending on this sector rose from BD 55.7 million in 1990 to BD 211.67 million in 2015, pushing up the GDP share of education from 2.3% to almost 4.1%. (Ministry of Education of Bahrain, Annual Reports)

The current study is unique that makes an effort to develop a dynamic macroeconomic model for the Kingdom of Bahrain to measure the impact of human capital investment on the country's economic growth through forecast and simulation over the period of 1990 and 2015. Equally, the suggested model may also bear a hand to find out some future paths to evaluate the key macroeconomic parameters concerning with the government's spending on education. The study adopts a narrow definition of human capital and uses education enrollment as an indicator of human capital due to availability of the official data.

The rest of the study proceeds as follows: Section two specifies data sources and the structure of the model. Section three shows model estimation. Section four, test the accuracy of the model, whereas section five, simulate the model, and finally section six concludes with recommendations.

2. DATA AND MODEL STRUCTURE SPECIFICATIONS

2.1 DATA

The current study utilizes annual data to estimate the model from 1990 to 2015, covering 16 years. The data is primarily collected from various issues of publications of Central Bank of Bahrain (CBB) such as: Statistical Bulletin, Annual Reports, Balance of Payments reports and Economic Indicators Report. Some of the missing observations were updated with comparable data from the World Bank International Financial Statistics database. The description of these variables is shown in table (1).

2.2 SPECIFYING THE MODEL STRUCTURE

The macroeconomic modeling of Bahrain's economy is built in a dynamic aggregate demand-aggregate supply framework. The aggregate demand side is composed of both consumption and investment together with exports and imports of goods and services whereas neoclassical theory of production function is represented on the supply side of the model. The model includes fifteen equations out of which ten are behavioral equations for production function, labor demand, human capital, consumption, investment, exports of goods and services, imports of goods and services, and tradable and non-tradable goods price. There are twenty one variables in total. Out of which twelve variables are endogenous and nine are exogenous variables, where the latter also

includes the predetermined (lagged) as well. The structural specifications of the macroeconomic model are discussed below and equations are given in table (2).

2.2.1 BEHAVIORAL EQUATIONS

- **Production function**

Neoclassical growth theory focuses on supply side factors such as capital and technology for determining the country's economic growth. It argues that the aggregate supply is a function of physical and human capital, labors and knowledge. An important requirement for the aggregate neoclassical production function is that as the utilization of the factors of production increases (decreases) its rate of return decreases (increases). (Kim 1988, Lucas 1987). Accordingly, output (Y_t) will be function of Labor (L_t) which measured by yearly employed labors, physical capital (K_t) that counted by gross capital formation and human capital (HC_t) which is measured by gross secondary education enrollment. All variables are taken in logarithmic form, and the study expects that all variables will have positive and significant impact on output as theoretically argued.

- **Labor demand**

Labor force in Bahrain growth rate is increasing from over recent years, it includes youth who are either graduated or got more training and skills; therefore, the labor demand (LD_t) function in Bahrain depends on labor force (L_t) and the lag of human capital(HC_{t-1}) as explanatory variables. The increasing in labor force will decrease real wage which will increase the quantity demand for labor. As well as, the increasing in labor productivity (as a result of HCI) will lead to increase the quantity demand for labor.

- **Human capital**

According to previous empirical studies, Human capital (HC_t) mainly depends on the income (Y_t), government spending on education as a percentage of GDP (GSEt) as a proxy of human capital investment, and the lag of human capital (HC_{t-1}). The expected coefficients of income and government spending on education as a percentage of GDP are positive and significant.

- **Aggregate consumption**

Aggregate consumption is the major component of the Aggregate demand. It consists of private consumption and government consumption. Government consumption is taken as a policy variable. Private consumption is based on Keynesian consumption function and wealth effect. Therefore private consumption is function of the disposable income (Yd_t), lagged of private consumption ($PCon_{t-1}$), real interest rate (r_t) as a proxy of opportunity cost consumption and money balance ($M2_t$) as a proxy of wealth effect. The study expects that disposable income and money balance exert positive effect on private consumption, while the real interest rate has negative effect.

- **Aggregate investment**

Investment is another major element that is disaggregated into private and government investments. Government investment is a policy variable; it mostly concentrates on the provision of infrastructure and exerts an important influence on private investment. Private investment ($PInv_t$) represents the key variable for achieving and sustaining higher economic growth. Private investment decisions mainly depend on the investment in long lived capital assets and future

expectations. Considering the Classical and Keynesian investment theories, there are several explanatory variables of private investment such as income, real interest rate, government investment (GInvt) and bank credit to the private sector (BCP_t). The study expects the sign of income coefficient is positive as stated in the Keynesian accelerator principle, the sign of real interest rate coefficient is negative which is consistent classical view, the sign of bank credit to the private sector expects to positive, while the public sector investment coefficient sign depends on whether the government investment crowds in or crowds out the private sector investment. The study expects the coefficient sign will be positive which means government investment might crowd in private investment; this could be because the government of Bahrain has an active role of in providing infrastructure facilities for local and foreign investors, as well as its role in social and economic activities.

- **Export of goods and services**

Since Bahrain is a small open economy and it is price taker in the world markets (especially the world price of petroleum); the change in the world price affects the domestic production level, which in turn, affects exports levels. Accordingly, the quantity of exports mainly depends on the effective exchange rate (Eex_t) and world income (WY_t).

- **Import of goods and services**

Bahrain imports of goods and services depend mainly on effective exchange rate, domestic income and lag of imports. Depreciation in effective exchange rate leads to contraction in imports demand. While an increase in domestic income leads to raise imports.

- **Prices**

Modeling prices represents one of the most important components of macroeconomic models, According to Moser (1995), the general price level (P_{Lt}) can be expressed as a weighted average of the tradable goods and non-tradable goods prices.

The price of tradable goods (TP_{Lt}) is determined exogenously in the world market. In domestic currency term, it can be shown by import prices (ImP_{Lt}) and effective exchange rate. In a small country like Bahrain, where the biggest categories of imports are machinery, mineral products, transportation, metals and chemicals which represent more than 50% of total imports.(Central Information Organization, 2014).An increase in import prices is more likely to increase the overall price level significantly. The price of non-tradable goods (NTP_{Lt})is assumed to be affected by domestic money market (board money) and domestic income. By substituting the values of prices of tradable and non-tradable goods we can get the final form of general price equation as shown in table (2).

- **Linkages of the model**

Based on the above model specification, it is argued that the model captures different linkages as they exist in the economy as follows: (a) Government spending on education as a percentage of GDP affects human capital and consecutively affects the real output. (b) Production affects consumption, investment, government expenditure, exports, and imports, and also it affects the

price level.(c)Real interest rate affects private consumption as well as private investment; it's consecutively affects the real output. (d) Government investment influences the private investment, which affects the economy through various channels. (e) Effective real exchange rate determines the exports and imports of goods and services, and general price level, and further affects the private investment, and finally. (F) Foreign price level affects the general price level through imports prices of goods and services.

2.2.2 IDENTITIES EQUATIONS

The study adds five identities in order to close the model. The first identity is the total real output which is the sum of domestic absorption (DA_t) and trade balance (TB_t). Second identity represents the total investment which is the sum of private investment and government investment. Third identity is the trade balance which measured as the difference between exports and imports of goods and services. Fourth identity is about the real interest rate which is the difference between nominal interest rate and inflation rate. Fifth identity is the inflation rate which equals to the percentage change in general price level.

3. ESTIMATING THE MODEL

Before estimating the specific model, it is important to study the unit root properties of the data; we use the Augmented Dickey Fuller (ADF) test, which is widely used to determine the stationarity of time series date (Dickey& Dickey-Fuller, 1979). The results of the unit root test for variables in their level and first differences is illustrated in table (3). The data series of variables are found to be non-stationary at level while they are stationary at the first differences. Accordingly, the study variables are integrated of the same order of one I(1).

The study employs the ordinary least squares (OLS) method in order to compute individuals' equations. In addition to assess the appropriateness of the estimated equations, the study applies set of diagnostic tests such as: Jarque-Bera (JB) for residual normality, Lagrange Multiplier (LM) for series correlation, ARCH and White tests for heteroscedasticity, and Remsay's RESET for functional specification (Smith J., 1985). Table (4) shows the estimated equations along with the results of the diagnostic tests as follows:

The estimated outcomes of production function are presented in equation (1) indicated that labor force, capital stock and lagged of human capital affect positively on output as per theoretical expectation. Labors force and capital stock have higher effect than human capital. The marginal product of labor is 0.375 which is relatively small compared to capital stock; this could be due to the most of production of Bahrain depends mainly on capital intensive techniques. The estimated equation fits the data well as indicated by the diagnostic statistics. The ADF statistics used to test the stationarity of the residuals equals to -3.95 which is higher than the critical values, confirming the long run relationship between output and its determinants. In overall, the results of the production function are quite satisfactory.

Equation (2) shows the estimation of labor demand function. It can be observed that labor force and human capital lagged by one year influence labor demand positively. The ADF statistics is -3.28

which is significant at the 10% level of significance, confirms a valid long run relationship between variables included in equation(2).

The empirical results of equation (3) signified that output growth and increasing government spending in education stimulate human capital in Bahrain. The diagnostic tests do not indicate any misspecification problem. The ADF statistic is -5.123 which is significant indicating the long run relationship between variables included in equation (3).

The equation (4) reports the estimation of the private consumption function. It can be seen from the results that real disposable income exerts positive and significant impact on real private consumption function. The marginal propensity to consume (MPC) is equal to 0.79, which implies that Bahraini people spends 79% of their income on consumption. This means the marginal propensity to save (MPS) out of real disposable income is relatively small (0.21). The real interest rate exerts negatively impact on private consumption; however, the magnitude of this variable is very small. The results show also that real money supply has positive effect on real private consumption. The ADF statistics for testing the non-stationarity of the residuals is - 3.38, higher than the critical value at 10% level of significance which supports the long run relationship between real private consumption, real disposable income, real interest rate, real money supply and real private consumption lagged by one year. The diagnostic tests indicate no misspecification of the estimated model.

Equation (5) shows the estimated coefficient of the real private investment function. The real output, bank credit to the private sector and government investment show positive effect on real private investment. The positive and significant coefficient of real output supports the idea of accelerator principle in the determination of private investment. The coefficient of government investment is positive and significant which indicates that government investment has crowding in effect on real private investment, this implies that government of Bahrain plays a leading role in influencing private sector activities. The positive sign of bank credit to the private sector's coefficient supports the view the supply of funds is an important factor in investment decisions. Moreover, it implies that well developed financial markets are essential to mobilize funds for investment purpose. The real interest rate represents the cost of capital, which constraints private investment. The coefficient of real interest rate is negative and significant which supports the view that cost of capital is one of the main factors in investment decisions. However, the results show that the effect of real interest rate is very small (-0.01), clarifying that higher real interest rate exerts very weak effect on real private investment. The corresponding value of ADF statistic for residuals stationarity is -4.89, which yield significance at the 1% level of significance. Moreover, the diagnostic tests associated with the model do not detect any specification problem.

Equation (6) implies the empirical outcomes of exports of goods and services. The results clearly indicate that all the variables possess expected sign and are significant. The coefficient of world income possesses theoretical expected positive sign. Effective real exchange rate influences exports positively too. The positive coefficient of foreign income suggests that increase in foreign economic activity would boost the real demand for exports, while the positive coefficient of effective real exchange rate implies that raising the effective real exchange rate by one unit will lead to increase exports by 0.078 units; which affects positively on the balance of trade. Moreover, exports lagged by

one year were taken as an independent variable to capture the partial adjustment effect of exports. The model passes all the diagnostic statistics and the ADF statistic for residuals stationarity is equal to -5.16, which is significant at 1% level of significance.

The empirical outcomes of imports of goods and services are shown in equation (7). The results obviously signify that the real income positively affects the imports demand of goods and services, because of favorable environment and stable policies of Bahrain, while the import price negatively affects the imports. Moreover the effective real exchange rate also shows negative effect which means effective real exchange may weaken the imports. The ADF statistics yields the statistic equal to -4.67, which is significant at 1% level, confirming the relationship among the variables. The overall fit of the model is good as indicated by the diagnostic statistics.

Equations (6) and (7) indicate that the income elasticity of imports is higher than the income elasticity of exports, indicating that the imports rise higher relative to Bahrain's GDP while exports increases less proportionally with the rise in the world income.

The results of general price level are shown in equations (8-10), which clearly supports that the imports prices, real money supply and effective real exchange rate are the main factors accelerating inflationary pressure in Bahrain. The impact of real money supply is 0.077% on domestic price level, followed by import prices (0.063%) and effective real exchange rate (0.033%). On the other hand, the coefficient of real output is -0.052 implies that an increase in real GDP would significantly decrease the inflationary pressure by 0.052%. The results support the view that monetarist and structuralist factor are responsible in accelerating inflationary pressure in Bahrain in the long run. The ADF statistic is equal to -3.92, which is significant at 5% level. On the whole, the model fits well as indicated by the diagnostic tests.

4. FORECASTING AND EVALUATING THE MODEL

Since the main objective of the current model is to predict and analyze the effects of different scenarios of government spending in education on the paths of macroeconomic variables, the criterion used to evaluate the model's performance over the entire sample period is how the estimated equations are linked to each other with plausible coefficients of the variables and how closely historical data series (Makridakis, S., 1993). The validity of the current model is checked by the Mean Absolute Percent Error (MAPE) and the Theil inequality coefficient (U), in addition to correlation factor. The first two measures are scaled invariant and can be used to assess the forecasting performance of the model directly. (Welfe,W.,2011).

The MAPE and the Theil inequality coefficient (U) for key macroeconomic variables are shown in Table (5) which illustrates that the model enables to track the historical development of Bahrain reasonably well. The MAPE coefficients for both static and dynamic for most of the behavioral equations is reasonable and its range between 1% and 8% which implies that the dynamic stability of the complete model. The coefficient of U is less than unity and closest to zero for most of endogenous variables, which indicates that, the model is best fit for future policy simulation. This can also clear by the correlation coefficients, which show high correlation between the actual and estimated series. Moreover the marginal forecast errors could be traced by inspecting the sum of the two proportion statistics which are variance proportion and bias proportion. The sum of both of

them for all equations lies between range 1% and 4% for static forecast and by 1% and 9% range for dynamic forecast. Accordingly, the study concludes that, the overall forecast ability of the estimated equations is satisfactory and the model has good forecasting ability.

5. SIMULATING THE MODEL

Following estimation and validation of the stability of the model, the next step is to foresee the impacts of changes in government spending on education on different macroeconomic variables such as real GDP, private investment, and trade balance through simulations. In this model we consider one shock which is government spending on education as a percentage of GDP and there are four suggested scenarios as follows: *Scenario one* assumes the government spending on education rises to be 5% over the period 2016- 2021. *Scenario two* suggests that the government spending on education increases to be 4.5% in 2016, 5% in 2017, 5.5% in 2018, 6% in 2019, 6.5% in 2020, and 7% in 2021.*Scenario three* assumes the government spending on education will jump to be 5% over the period 2016 and 2018 and 6% over the period 2019 and 2021, and finally, *scenario four* suggests that the government spending on education will raise to be 5% during 2016 and 2017, 6% during 2018 and 2019, and 7% during 2020 and 2021. Simulation effects are computed using the deviation of major macroeconomic variables from the baseline during 2016-2021 and are shown in table (6).

Scenario one: Effects of increasing the government spending on education to be 5% of GDP over the period 2016- 2021

In this scenario, the enrolment will increase by 9.02% in year 2017 which is above its baseline growth rate, the following years the enrolment rate increases but at decreasing rate, where it increases in year 2021 by 8.23%. Employment responded in 2017 to this shock. A 4.57% increases in employment from baseline is recorded in 2017 which reaches 4.99% in 2021. The raise in human capital tends to increase GDP by 1.52% in year 2017, and it is forecasted to rise by 1.99% at the end of year 2021. The effect of higher GDP creeps into private consumption, private investment, imports of goods and services, and general price level. Private consumption increases by 1.8% from baseline in 2017. This deviation reaches 2.14% in 2021; however the price level of non-tradable goods falls by 1.58% in 2017 and it continued to decline through the forecasting period. Private investment responds to this shock, where it increases by 2.23% from its baseline and ends at 2.71% in 2021. A 1.93% increase in imports of goods and services from baseline is counted which reach 3.37% in 2021.This might be affect negatively on the trade balance. The price level falls relative to base line by 1.64% in 2017 and it continues to decline through the forecasting period.

This scenario clearly indicates that the increasing in government spending on education to be 5% of GDP during the period 2016-2021 raises the human capital and employment by 8.71% and 4.45 % on average respectively, which affect positively the output growth which expected to raise by 1.74% on average, while private consumption, private investment and imports of goods and services jump by 1.9%, 2.4% and 2.46% on average respectively. The model predicts that inflation rate will fall by 1.5% on average over the period 2016 and 2021.

Scenario two: Impacts of increasing the government spending on education to be 4.5% in 2016, 5% in 2017, 5.5% in 2018, 6% in 2019, 6.5% in 2020, and 7% in 2021.

Enrollment rate responds to the shock by an increase of 8.3% from the baseline in 2016, the deviation of enrolment rate increases slowly with time and reached 9.32% in 2021. Employment increases by 4.48% from the baseline in 2017 and it increases in smooth manner and reaches 5.46% in 2021.This shock increases GDP by 1.42% from the baseline in 2017 and the deviation increases during the forecasting period and it reaches 2.54% in 2021. Private consumption increases by 1.57% from baseline in 2017 and ends at 2.39% in 2021. The private investment increases by 2.31% from baseline and the deviation remains quite stable during the forecasting period. Imports of goods and services respond to this shock by increasing by 1.84% from baseline in 2017.The deviation increases during the forecasting period and it reaches 3.61% in 2021. General Price level deviation from to baseline has been declining by 1.72% in 2017 and it continues over the forecasting period.

This scenario shows that the human capital and employment rose by 8.9% and 4.6% on average respectively; this leads to increased GDP growth rate by 1.9% on average while it reduces the general price level by 1.61% on average for the period 2016-2021. Private consumption, private investment and imports of goods and services rose by 1.94%, 2.69% and 2.49% on average respectively. Accordingly, the growth rate of GDP of scenario two is larger relative to scenario one, while the declining in general price level is almost equal on average in both scenarios.

Scenario three: Effects of increasing the government spending on education to be 5% over the period 2016-2018 and 6% over the period 2019-2021

The increase in human capital affects the labor demand and employment in 2017. A 4.57% increases in employment as compared to the baseline is recorded in 2017 which increased further during the next years and reaches 5.03% in 2021. GDP growth rate has been affected in 2017, where it increases by 1.52% from baseline. The deviation of GDP growth rate from baseline increases further due to employment and multiplier accelerator principle, where in 2021 this deviation reaches 2.01 % from baseline. The increase in GDP affects private consumption positively in 2017 where it increases by 1.8% from baseline and it reaches 2.21 % in 2021. This Shock increases also private investment by 2.23% from baseline in 2017 and the deviation increases till 2019. In 2020, the deviation from baseline decreases and reaches 2.14% in 2021. The overall economic activities have been increasing. Imports of goods and services increase by 1.93% from baseline in 2017 and the deviation increases and it reaches 3.41% in 2021. Non-tradable goods price and general price levels decline relative to the baseline during the forecasting period.

In this scenario, GDP growth rate increased by 1.75% due to growing in employment by 4.4% while general price level declined by 1.9% on average. From the other hand, private consumption, private investment and imports of goods and services rise by 1.93%, 2.33% and 2.5% on average respectively over the period 2016 and 2021.

Scenario four: Effects of increasing the government spending on education to be 5% during years 2016 and 2017, 6% during years 2018 and 2019, and 7% during years 2020 and 2021.

Enrolment increases by 9.02 % from the baseline in 2017 and it continues to increase where it reaches 9.65% in 2021. The demand for labor increases by 4.57% from the baseline in 2017, and it reaches 5.78% in 2021. This shock increases GDP by 1.52% from the baseline in 2017 and the

deviation increases during the forecasting period and it reaches 2.67% in 2021. The private investment increases by 2.23% from baseline in 2017 and the deviation remains quite stable during the forecasting period, where it reaches 3.66% in 2021.The private consumption increases by 1.8% from baseline in 2016 and it reaches 2.54 % in 2021. Imports of goods and services raised by 1.93% from baseline in 2017 and it reaches 4.01% in 2021. General Price level falls relative to the baseline by 1.64% in 2017 and it continues declining during the forecasting period.

In this scenario, the increase in GDP growth rate on average is 2.07% which is larger than the GDP growth rate in other scenarios, because the growth rate of enrolment and employment on average is also high (9.31% and 4.77% respectively). This reflected on the general price level which declines by 2.05% on average for the period 2016-2021.

6. CONCLUSION

Current study is an initial attempt to develop a macroeconomic model for Bahrain economy which is built in a dynamic aggregate demand-aggregate supply framework so as to measure the impact of human capital investment on the key macroeconomic variables. The main findings that emerge especially from the simulation of the proposed model is that gradually increased government spending on education dramatically affects the human capital in terms of both productivity of labors and employment resulting in rising economic growth, private consumption and investment and also reducing the inflation. Consequently, the study suggests adopting scenario four where the GDP growth rate, enrolment and employment rates are higher than other scenarios; moreover, decline in inflation rate is larger than previous scenarios. We believe that the proposed model could be handy for policy makers to find out some of the paths to evaluate key macroeconomic variables associated with spending on education in the future.

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Table (1) Description of the study variables and data sources

Variable	Description	Unit	Data source
Y	Real output / Real GDP (2005=100)	BD Millions	CBB
L	Labor measured by yearly employed labors	Thousand person	CBB
K	Gross capital formation	BD Millions	WB
HC	Human capital, measured by gross secondary education enrollment	Thousand person	CBB
LD	Labor demand, measured by the difference between the labor force and the unemployment	Thousand person	CBB
PCon	Real Private consumption	BD Millions	WB
PInv	Real Private investment	BD Millions	WB
Exp	Exports of goods and services	BD Millions	CBB
Imp	Imports of goods and services	BD Millions	CBB
Yd	Real disposable income	BD Millions	CBB
GSE	Government spending on education as a percentage of GDP	Ratio	CBB
r	Real interest rate	Ratio	CBB
i	Nominal inters rate measured by weighted average of lending rate	Ratio	CBB
M2	Real Money supply	BD Millions	CBB
GInv	Government investment	BD Millions	CBB
BCP	Bank credit to the private sector	BD Millions	CBB
WY	World GDP (2005=100)	US Millions	CBB
Eex	Effective exchange rate	BD	CBB
PL	General price level	BD	CBB
TPL	Tradable goods price	BD	CBB
NTPL	Non-tradable goods price	BD	CBB
ImPL	Import price level	BD	CBB
Inf	Inflation rate	Ratio	CBB

Table (2) Equations of the model

Behavioral equations	
$Y_t = f_1(L_t, K_t, HC_t)$	(Production function)
$LD_t = f_2(L_t, HC_{t-1})$	(Labor demand)
$HC_t = f_3(Y_t, GSE_t, HC_{t-1})$	(Human capital)
$PCon_t = f_4(Yd_t, r_t, M2_{t-1}, PCon_{t-1})$	(Aggregate Consumption)
$PInv_t = f_5(Y_{t-1}, r_t, GInv_t, BCP_t, PInv_{t-1})$	(Aggregate Investment)
$Exp_t = f_6(WY_t, Eex_t, Exp_{t-1})$	(Exports of goods and services)
$Imp_t = f_7(Eex_t, Y_t, Imp_{t-1})$	(Imports of goods and services)
$TPL_t = f_8(ImPL_t, Eex_t)$	(prices of tradable goods)
$NTPL_t = f_9(M2_{t-1}, Y_t)$	(Prices of non-tradable goods)
$PL_t = f_{10}(ImPL_t, Eex_t, M2_{t-1}, Y_t)$	(General price level)
Identities	
$Y_t \equiv DA_t + TB_t$	(Total real output/ GDP)
$I \equiv PInv_t + GInv_t$	(Total investment)
$TB_t \equiv Exp_t + Imp_t$	(Trade balance)
$r_t \equiv i_t$ - Inf.	Real interest rate
$Inf = (PL_t - PL_{t-1}) / PL_{t-1}$	Inflation rate
Exogenous & Predetermined Variables: L_t / $GInv_t$ / WY_t / BCP_t / Eex_t / $M2_t$ / GSE_t / HC_t / $ImPL_t$	
Endogenous Variables : Y / Yd_t / $PCon_t$ / $PInv_t$ / Exp_t / Imp_t / r_t / PL_t / LD_t / K_t / $NTPL_t$ / TPL_t	

Table (3) Results of ADF test for Unit Root

	Level	Frist Difference		Level	Frist Difference
Y_t	-2.15 (2)	-3.51(1)***	K_t	-2.14(0)	-3.62(1)**
HC_t	-2.18(1)	-5.14(0)*	Yd_t	-1.36(1)	-3.31(0)***
LD_t	-2.32(1)	-3.51(0)***	Yc_t	-1.78(1)	-3.29(1)***
$PCon_t$	-2.02(2)	-4.21(1)**	r_t	-2.58(3)	-3.91(1)**
$PInv_t$	-2.26(1)	4.11(2)**	$GInv_t$	-2.62(1)	-3.26(0)***
Exp_t	-2.86(2)	-5.98(1)*	WY_t	-2.59(1)	-3.40(0)***
ImP_t	-2.33(1)	-3.64(0)**	Eex_t	-2.26(1)	-3.79(1)**
PL_t	-1.38(1)	-3.31(1)***	GSE_t	-1.89(2)	-3.91(1)**
TPL_t	-1.21 (1)	-3.45(0)***	$M2_t$	-2.14(1)	-3.86(2)**
$NTPL_t$	-1.02(1)	-3.39(1)***	$ImPL_t$	-2.89(2)	-4.01(1)**
L_t	-2.87(1)	-4.42(2)*	BCP	-2.08(0)	-3.31(1)***

Sources: Authors' estimation, ADF critical values with constant and trend: -4.37 at 1%, -3.6 at 5% and -3.24 at 10%, the numbers in parentheses are lag length, which are augmented up to a maximum 4 lags, the optimal lag length is determined based on Schwarz information Criterion (SIC.

Table(4) Empirical results of model estimation

Equation	1	2	3	4	5	6	7	8	9	10
Variables	Y_t	LD_t	HC_t	$PCon_t$	$PInv_t$	EXp_t	IMP_t	TPL_t	$NTPL_t$	PL_t
C	1.15	1.63	2.03	5.33	6.19	1.54	4.8	4.34	1.07	2.11
L_t	0.375 (0.097)*	1.134 (0.343)*								
K_t	0.504 (0.261)***									
HC_{t-1}	0.121 (0.064)***	0.651 (0.301***	1.032 (0.443)**							
Y_t			0.161 (0.055)*		0.156 (0.066)**		0.201 (0.109)***		-0.075 (-0.041)***	-0.052 (-0.022)**
Yd_t				0.791 (0.231)**						
GSE_t			0.237 (0.081)*							
$M2_t$				0.093 (0.041)***						
$M2_{t-1}$									0.041 (0.016)**	0.077 (0.017)*
$PCon_{t-1}$				0.364 (0.129)**						
r_t				-0.013 (-0.006)***	-0.01 (-0.005)***					
$GInv_t$					0.146 (0.065**					
BCP_t					0.138 (0.064)**					
WY_t						0.013 (0.006)**				
Eex_t						0.078 (0.041)***	-0.424 (-0.193)**	-0.027 (-0.012)**		-0.033 (-0.015)***
Imp_{t-1}							0.495 (0.178)**			
$ImPL_t$								0.492(0.239)**		0.063 (0.035)***
$Pinv_{t-1}$					0.218 (0.058)*					
EXp_{t-1}						0.340 (0.116)*				
Adj.R^2	0.998	0.984	0.867	0.891	0.971	0.934	0.986	0.895	0.936	0.983
Std. Error	0.019	0.065	0.066	0.67	0.042	0.039	0.040	0.140	0.341	0.079
F-stat	14.35	12.51	24.45	22.137	18.391	19.148	23.815	42.221	35.145	33.814
DW stat	1.834	1.795	1.925	2.034	1.987	2.026	2.130	1.621	2.246	2.157
LM Test	0.186	0.431	0.058	1.214	2.015	1.831	0.016	1.936	0.198	1.341
ARCH test	0.364	0.955	0.744	0.489	0.862	0.567	0.622	1.089	0.624	1.050
White test	0.608	1.592	1.241	0.815	1.437	0.946	1.038	1.816	1.041	1.751
Chow test	0.189	0.234	0.894	0.347	0.237	0.582	0.369	0.165	0.431	0.536
ADF	-3.95**	-3.28***	-5.123*	-3.38***	-4.89*	-5.16*	-4.67*	-3.67**	-3.43***	-3.92**
JB test	0.345	0.380	0.073	0.293	0.866	0.219	0.029	0.608	0.080	0.380
Ramsey test	0.266	0.743	0.156	0.363	0.482	0.565	0.091	0.142	0.054	0.542

Sources: Authors' estimation, *All variables are taken in logarithmic form
Durbin-Watson Statistic: 5 % Significance Points of dL and dU
*Significance at 1%, ** Significance at 5%, ***Significance at 10%

Table(5) Validation statistics of the model (1990-2015)

	Correlation	MAPE		Theil inequality coefficient		Bais + Variance Proportion	
		Static	Dynamic	Static	Dynamic	Static	Dynamic
Production function	0.997	4.561	4.68	0.013	0.017	0.047	0.059
Labor demand	0.996	2.153	2.943	0.004	0.016	0.042	0.062
Human capital	0.969	1.609	1.557	0.025	0.031	0.035	0.091
Aggregate Consumption	0.991	1.345	1.267	0.010	0.014	0.021	0.033
Aggregate Investment	0.978	3.87	4.023	0.027	0.035	0.007	0.021
Exports of goods and services	0.994	4.239	4.056	0.019	0.024	0.005	0.011
Imports of goods and services	0.988	2.98	3.261	0.004	0.010	0,029	0.078
prices of tradable goods	0.981	2.912	3.045	0.009	0.014	0.021	0.010
Prices of non-tradable goods	0.993	2.067	3.14	0.028	0.033	0.002	0.061
General price level	0.987	1.781	1.872	0.001	0.005	0.001	0.003

Sources: Authors' estimation

Table(6) Simulation results of various scenarios

Scenario one : Increasing the government spending on education to be 5% over the period 2016-2021

	016	017	018	019	020	021
HC	9.35	9.02	8.76	8.54	8.36	8.23
LD	2.3	4.57	4.83	4.88	4.93	4.99
Y	1.38	1.52	1.78	1.84	1.93	1.99
PCon	1.67	1.8	1.83	1.91	2.02	2.14
PInv	2.2	2.23	2.5	2.53	2.63	2.71
Imp	1.83	1.93	1.87	2.67	3.11	3.37
NTPL	-2.5	-1.58	-2.25	-2.27	-2.9	-2.53
PL	-1.4	-1.64	-1.3	-1.37	-1.46	-1.85

Scenario two: Increasing the government spending on education to be 4.5% in 2016, 5% in 2017, 5.5% in 2018, 6% in 2019, 6.5% in 2020, and 7% in 2021.

	016	017	018	019	020	021
HC	8.38	8.47	8.92	9.02	9.21	9.32
LD	2.05	4.68	4.93	5.19	5.27	5.46
Y	1.31	1.42	1.79	2.08	2.25	2.54
PCon	1.5	1.57	1.99	2.08	2.16	2.39
PInv	2.21	2.31	2.67	2.85	2.95	3.14
Imp	1.69	1.84	1.96	2.37	3.48	3.61
NTPL	-2	-1.55	-2.43	-2.7	-2.6	-2.65
PL	-1.66	-1.72	-1.69	-1.61	-1.57	-1.46

Scenario three: Increasing the government spending on education to be 5% over the period 2016-2018 and 6% over the period 2019-2021

	016	017	018	019	020	021
HC	**9.35**	**9.02**	**8.76**	8.61	8.43	8.29
LD	**2.3**	**4.57**	**4.83**	4.87	4.97	5.03
Y	**1.38**	**1.52**	**1.78**	1.87	1.98	2.01
PCon	**1.67**	**1.8**	**1.83**	2.03	2.08	2.21
PInv	**2.2**	**2.23**	**2.5**	2.61	2.35	2.14
Imp	**1.83**	**1.93**	**1.87**	2.7	3.18	3.41
NTPL	**-2.5**	**-1.58**	**-2.25**	-2.63	-2.74	-2.84
PL	**-1.4**	**-1.64**	**-1.3**	-2.25	-2.36	-2.46

Scenario four: Increasing the government spending on education to be 5% during 2016 and 2017, 6% during 2018 and 2019, and 7% during 2020 and 2021.

	016	017	018	019	020	021
HC	9.35	9.02	9.17	9.23	9.42	9.65
LD	2.3	4.57	5.18	5.31	5.49	5.78
Y	1.38	1.52	2.11	2.35	2.41	2.67
PCon	1.67	1.8	2.01	2.16	2.38	2.54
PInv	2.2	2.23	2.98	3.25	3.35	3.66
Imp	1.83	1.93	3.17	3.43	3.87	4.01
NTPL	-2.5	-1.58	-2.55	-2.65	-2.74	-3.01
PL	-1.4	-1.64	-2.19	-2.27	-2.36	-2.48

Sources: Authors' estimation