# Assessment of Egypt's Population and Labour Supply Policies

## "Results from a Population Economy Interaction Model"

By

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# 1. <u>Introduction</u>

The interrelationship and interactions between population policies and the economic performance of a country has been traditionally investigated by several researchers and scholars [Hussien, 1991, Hassanin et al, 1993, Khorshid, 1994 and Bloom et al, 1999]. Some of them used computational models to assess the impact of population growth on medium and long term behaviour of alternative macroeconomic and economy wide variables. Nevertheless, there is no common agreement among them about the size or magnitude of this impact over time as well as the most appropriate analytical tool to apply, in this respect. Although Egypt is typically suffering from an increasing natural population growth rate, especially after the revolution of January 2011(with an annual growth rate of 2.58% in 2013/14[1], a significantly high unemployment rate among young population reaching 26.3% on the average in 2014[2] and a growing poverty level accounting for 26% of the domestic population in 2012[3], population economy interaction studies are limited to a great extent.

Based on the above rationale, a major strategic concern facing Egypt is to develop appropriate analytical tool directed to assess the impact of alternative population and labour supply policies on the performance of the whole economy as well as its components. Economy wide models based on Computable General Equilibrium (CGE) tradition and social accounting matrix principles represent an efficient toolkit to achieve this analytical purpose. They are generally used to assess the impact of alternative policy measures and external conditions on medium term performance of the economy as a whole. In this paper, a dynamically adjusted population economy interaction model is constructed, implemented and used to assess the impact of population policies on the performance of the Egyptian economy.

Given the above background, the paper includes five sections. After the introduction, section two introduces the research objectives and methodology. Section three describes the estimated population economy wide interaction accounting structure along with their data sources. Section four focuses on the model structure,

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[1] CAPMAS (2015) Statistical Year Book.

[2] CAPMAS (2015) International Youth Day. www.capmas.gov.eg

[3] CAPMAS (2013) Poverty indicators of Household Income, Expenditure, and Consumption Survey (HHEICS) (2012/2013). http://www.capmas.gov.eg/pepo/c.pdf. Last access 5/12/2014.

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economic rationale, mathematical specifications and inter-period dynamic relations. The main results, conclusions and policy recommendations based on the population economy interaction model, are shown in the last section.

## 2. Research Objectives and Methodology

The purpose of the paper is to construct an analytical tool directed to test alternative population scenarios and assess their impact on the performance of economy as a whole. This can be achieved via linking a population - labour supply sub-module with a dynamically adjusted economy wide simulation model.

This process includes three stages:

1. Build an integrated modelling tool composed of population and labour sub-module based on population and labour policies and parameters in the medium/long term (2014-2024).

2. Construct an economy wide model based on CGE tradition that captures the structural feature and behaviour of the economy and can be efficiently used to test alternative socio-economic policies and estimate the interactions within the economic system.

3. Establish the linkage and mathematical relations explain the interaction between population and labour force sub-model and the economy wide model.

## 3. Population Economy Wide Interaction Accounting Structure

The issue-oriented social accounting matrix (SAM) representing the population economy wide interaction model, adopts a specific disaggregation scheme reflecting the economy population interaction context. Production activities are classified into nine sectors. The industrial sectors are broken down according to labour intensity as low intensive, medium intensive and high intensive labour activities. This classification reflects the current trend to invest in high intensive labour sectors in order to reduce the level of unemployment. Other production sectors include primary activities, infrastructure, construction, and both social and productive services. The integration of these nine production activities in the SAM are shown in table (1). The classification of labour intensive activities based on the report of the United Nations Industrial Development Organization (UNIDO, 2013). In addition, the SAM as well as the model includes four types of commodities (composite, domestic, imported and exported) and they are classified according to the nine production

activities. Factors of production consist of labour compensation and capital services. Labour compensation is disaggregated by production activities and by economic sector (private and public enterprises in addition to government), by household area (urban/rural) and by educational level (4 education levels; illiterate, read and write, Primary or preparatory or intermediate less than university, and University & above). The economy includes five domestic institutions (urban and rural households, companies and government) and Rest of the World. Taxes and subsides account includes (direct and indirect taxes and subsidies). The capital account of the SAM is includes domestic and foreign savings and gross fixed capital spending. The researchers adjusted the Social Accounting Matrix constructed by Motaz Khorshid and Assad Alsadek for the fiscal year (2010/2011)**.** The distribution of intermediate consumption from activity to commodity and the disaggregation of imports, exports and household final consumption by nine commodities are obtained from the input-output tables produced by the Central Agency for Public Mobilization and Statistics (CAPMAS, 2014).

**Table (1): The Disaggregation of Activities in the Social Accounting Matrix for Egypt.**

| **Activities:** |
| --- |
| **1- Agriculture:** |
| **2- Other Primary:** |
| Includes extraction of crude petroleum & natural gas and other extraction. |
| **3- Infrastructure :** |
| It contains electricity and gas – water – sewerage. |
| **4- Construction:** |
| **5- High Labour Intensive:** |
| 1- Food products |
| 2- Beverages |
| 3- Tobacco products |
| 4- Textiles |
| 5- Paper and paper products and printing and reproduction of recorded media |
| 6- Wearing apparel |
| 7- Leather and related products |
| 8- Wood and of products of wood and cork, except furniture;  articles of straw and plaiting materials |
| 9- Furniture and of wood products not classified in any other place. |
| **6- Medium Labour Intensive:** |
| 1- Coke and refined petroleum products. |
| 2-  Rubber and plastics products |
| 3-  Other  non-metallic mineral products |
| 4-  Basic metals and Other manufacturing |
| 5-  Fabricated metal products, except machinery and equipment. |
| **7- Low Labour Intensive:** |

| |
|---|
| 1-Chemicals and chemical products and basic pharmaceutical products and pharmaceutical preparations |
| 2- Computer, electronic and optical products |
| 3- Electrical equipment |
| 4- Machinery and equipment n.e.c. |
| 5- Electrical equipment and other transport |
| 6- Motor vehicles, trailers and semi-trailers and Repair of computers and personal and household goods. |
| **8- Social Services:** |
| 1-Social insurance. |
| 2- NPISHs. |
| 3-Education. |
| 4- Health and social work. |
| 5- Other social services. |
| 6- Real estate ownership. |
| 7- Business activities. |
| **9- Productive Service:** |
| 1-Wholesale and retail trade. |
| 2-Financial services. |
| 3-Insurance. |
| 4-Transportation & storage. |
| 5-Communication. |
| 6-Information. |
| 7-Suez canal. |
| 8- Restaurants and hotels |

Table (2) presents the issue-oriented social accounting matrix (SAM) of Egypt for the year 2010/2011 and it is computed in LE millions. This original SAM consists of 31 rows and columns. The researchers extended this matrix to a square matrix consisting of 116 rows and columns according to the classification of activities in table (1).

The distribution of non-government labor compensation and capital services by the production activities was obtained from the report of national accounts (2010/2011) (Ministry of planning (MOP), 2013). Concerning capital account in the SAM, productive services and other primary activities have the highest Return on capital while infrastructure has the lowest return on capital. Activities receive revenues from the sales of commodities. It is observed that services have the highest share of sales revenue among productive activities.

Households receive its income from the factors of production (labour, capital) in the form of compensation of employees and profits from informal companies, as well as various types of transfers from other institutions (government, companies and the outside world). Households purchase final consumption goods & services from commodity markets. It is observed that services in general and agriculture have the highest share of the household final consumption. On the other hand, households devote the other part of their income to pay direct taxes to government, save and pay transfers to other institutions.

Companies' income is obtained from corporate profits or return on capital, investment income from abroad and transfers from other institutions. The companies' expenditure is divided into direct tax payment to government, accumulated savings, and transfers to other institutions.

The government collects its taxes revenues minus subsides and receives transfers from other institutions. On the other hand, general government purchases goods and services (the disaggregation of government final consumption by nine commodities was obtained from the report of national accounts (MOP, 2013), pay transfers to other institutions, and accumulate saving (which are negative in the SAM to represent public deficit).

The Rest of the world account purchases domestic commodities and pay export proceeds, transfer investment income to domestic companies, pay worker remittances from abroad as well as other transfers to institutions. The outside world revenues come from imports of commodities and transfers from other domestic institutions. The difference between income and spending determine the savings of the outside world.

**Table (2): Aggregated Social Accounting Matrix SAM of Egypt for Year (2010/2011) (Million LE).**

| 2010/2011 | | Activities – Agriculture | Other Primary | Low labour intensive | Medium labour intensive | High labour intensive | Infra-structure | Construction | Social Services | Productive Services | Commodities – Agriculture | Other Primary | Low labour intensive | Medium labour intensive | High labour intensive | Infra-structure | Construction | Social Services | Productive Services |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activities** | Agriculture | | | | | | | | | | 235062.1 | | | | | | | | |
| | Other Primary | | | | | | | | | | | 210352.5 | | | | | | | |
| | Low labour Intensive | | | | | | | | | | | | 97650.9 | | | | | | |
| | Medium labour Intensive | | | | | | | | | | | | | 262945.4 | | | | | |
| | High labour Intensive | | | | | | | | | | | | | | 213182.8 | | | | |
| | Infrastructure | | | | | | | | | | | | | | | 42434.6 | | | |
| | Construction | | | | | | | | | | | | | | | | 136634.9 | | |
| | Social Services | | | | | | | | | | | | | | | | | 399346.198 | |
| | Productive Services | | | | | | | | | | | | | | | | | | 505305.5 |
| **Commodities** | Agriculture | 21448.187 | | 454.569 | 120.09 | 59015.32 | 0.003 | 0.346 | 890.2 | 6232.511 | | | | | | | | | |
| | Other Primary | 66.044 | 424.335 | 5336.144 | 135399.174 | 289.339 | 13454.016 | 3198.346 | 575.4 | 675.394 | | | | | | | | | |
| | Low labour Intensive | 8287.11 | 1093.924 | 12088.602 | 5613.905 | 3614.258 | 95.786 | 1137.571 | 15674.9 | 8464.578 | | | | | | | | | |
| | Medium labour Intensive | 569.294 | 4516.65 | 18787.49 | 42569.182 | 10870.323 | 1607.928 | 25307.324 | 16610.1 | 48319.962 | | | | | | | | | |
| | High labour Intensive | 10709.434 | 87.659 | 1825.218 | 1000.891 | 28546.47 | 2.937 | 1854.932 | 8202 | 16600.704 | | | | | | | | | |
| | Infrastructure | | 45.523 | 574.239 | 2771.035 | 849.774 | 2851.607 | 65.931 | 4586.9 | 3759.75 | | | | | | | | | |
| | Construction | | 269.516 | 133.788 | 143.705 | 90.419 | 28.976 | 25281.065 | 2311 | 2804.6 | | | | | | | | | |
| | Social Services | 50.268 | 1134.315 | 1373.013 | 3137.292 | 1282.142 | 100.14 | 4372.202 | 25051 | 25843.525 | | | | | | | | | |
| | Productive Services | 6946.963 | 7502.698 | 6367.655 | 8870.256 | 19443.702 | 565.117 | 16726.026 | 24624 | 43221.688 | | | | | | | | | |
| **Factors** | Remittance | | | | | | | | | | | | | | | | | | |
| | Labour | 28740.3 | 5340.1 | 15600.9 | 21769 | 34158.5 | 12501.1 | 19531 | 156368.0 | 70759.3 | | | | | | | | | |
| | Capital | 158244.5 | 189258 | 34125.1 | 39950.5 | 53686.8 | 11226.3 | 39141.7 | 144452.6 | 275035.5 | | | | | | | | | |
| | Invest income | | | | | | | | | | | | | | | | | | |
| **Institution** | Households | | | | | | | | | | | | | | | | | | |
| | Firms | | | | | | | | | | | | | | | | | | |
| | Government | | | | | | | | | | | | | | | | | | |
| **Taxes & Subsidies** | Direct taxes | | | | | | | | | | | | | | | | | | |
| | Indirect taxes | | | | | | | | | | 482.6 | 3297.2 | 3821.5 | 24732.5 | 5094.6 | 2439 | 3145.4 | 7433.3 | 25799.8 |
| | Import duties | | | | | | | | | | 1696 | 88.7 | 2224.2 | 1610.7 | 1112.1 | 90.2 | 1520.8 | 2083.5 | 3473.8 |
| | Subsidies | | | | | | | | | | -2864.4 | 0 | -3180.4 | -2651.8 | -7986.3 | -2705.8 | -212.5 | -314.2 | -9015.7 |
| **Investments/savings** | | | | | | | | | | | | | | | | | | | |
| **Rest of world** | | | | | | | | | | | 38107.5 | 13409.4 | 106118.3 | 76847.3 | 53057 | 5857.6 | 1402.9 | 21046.13 | 22653.87 |
| **Subtotals** | | 235062.1 | 210352.5 | 97650.907 | 262945.366 | 213182.812 | 42434.599 | 136634.897 | 399346.198 | 505305.494 | 272483.8 | 227147.8 | 206634.557 | 363484.116 | 264460.2 | 48115.599 | 142491.5 | 429595 | 548217.2 |

**Source: Adjusted by Researchers based on Social Accounting Matrix Constructed by Khorshid and Alsadek**

| 2010/2011 | | Remittance | Labour | Capital | Invest-ment Income | Households | Companies | Government | Direct Taxes | Indirect Taxes | Import Duties | Subsidies | Investments/ savings | Rest of world | Subtotals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Factors** | | | | **Institutions** | | | **Taxes & Subsidies** | | | | | | |
| **Activities** | Agriculture | | | | | | | | | | | | | | 235062.100 |
| | Other Primary | | | | | | | | | | | | | | 210352.500 |
| | Low labour Intensive | | | | | | | | | | | | | | 97650.907 |
| | Medium labour Intensive | | | | | | | | | | | | | | 262945.366 |
| | High labour Intensive | | | | | | | | | | | | | | 213182.812 |
| | Infrastructure | | | | | | | | | | | | | | 42434.599 |
| | Construction | | | | | | | | | | | | | | 136634.897 |
| | Social Services | | | | | | | | | | | | | | 399346.2 |
| | Productive Services | | | | | | | | | | | | | | 505305.494 |
| **Commodities** | Agriculture | | | | | 170982.0 | | 3160.7 | | | | | 205.6 | 9974.2 | 272483.800 |
| | Other Primary | | | | | 21991.6 | | 0.7 | | | | | 0.0 | 45737.3 | 227147.800 |
| | Low labour Intensive | | | | | 52573.2 | | 77.7 | | | | | 77114.9 | 20798.2 | 206634.557 |
| | Medium labour Intensive | | | | | 109503.1 | | 121.5 | | | | | 26578.1 | 58123.2 | 363484.116 |
| | High labour Intensive | | | | | 159638.6 | | 171.5 | | | | | 11020.2 | 24799.7 | 264460.212 |
| | Infrastructure | | | | | 28219.0 | | 3546.3 | | | | | 0.0 | 845.6 | 48115.599 |
| | Construction | | | | | 4953.8 | | 554.5 | | | | | 101793.2 | 4127.0 | 142491.497 |
| | Social Services | | | | | 201829.8 | | 146345.9 | | | | | 4114.9 | 6753.3 | 429595.0 |
| | Productive Services | | | | | 286509.0 | | 2982.3 | | | | | 13704.3 | 110753.5 | 548217.224 |
| **Factors** | Remittance | | | | | | | | | | | | | 14200.0 | 14200.000 |
| | Labour | | | | | | | | | | | | | | 364768.200 |
| | Capital | | | | | | | | | | | | | | 945121.000 |
| | Investment income | | | | | | | | | | | | | 3100.0 | 3100.00 |
| **Institution** | Households | 14200.0 | 364768.2 | 386,894.7 | | 10,000.0 | 330,213.5 | 135,819.5 | | | | | | | 1241895.900 |
| | Companies | | | 552,428.0 | 2,400.0 | 76,663.2 | 75,579.7 | 32,313.1 | | | | | | 62304.9 | 801688.883 |
| | Government | | | 5,798.3 | 700.0 | 8,389.4 | 54,429.0 | 0.0 | 99309.3 | 76245.9 | 13900.0 | -28931.0 | | 395.1 | 230235.997 |
| **Taxes & Subsidies** | Direct taxes | | | | | 19,359.0 | 79,950.3 | | | | | | | | 99309.300 |
| | Indirect taxes | | | | | | | | | | | | | | 76245.900 |
| | Import duties | | | | | | | | | | | | | | 13900.000 |
| | Subsidies | | | | | | | | | | | | | | -28931.000 |
| **Investments/savings** | | | | | | 91284.3 | 227134.8 | -99901.6 | | | | | | 16013.7 | 234531.200 |
| **Rest of world** | | | | | | | 34381.600 | 5043.900 | | | | | | | 377925.500 |
| **Subtotals** | | 14200.0 | 364768.2 | 945121.0 | 3100 | 1241895.9 | 801688.9 | 230236.0 | 99309.3 | 76245.9 | 13900.0 | -28931.0 | 234531.2 | 377925.5000 | |

**Source: Adjusted by Researcher based on Social Accounting Matrix Constructed by Khorshid and Alsadek.**

## 4. Model Structure and Economic Rationale

The constructed population economy interaction model for Egypt has two sub-models; the first, represents the static economy wide sub-model which is determined by three factors; i) the structural features of the economy and its circular flow of income as reflected by the-base year social accounting matrix (SAM), ii) the independent decisions of the economic agents intervening in the economy such as producers, consumers, importer and exporters, and iii) the set of closure rules that ensures the consistency of independent decisions of various economic agents to reflect the policy choices adopted by the Egyptian government. The second sub-model includes the dynamic adjustment mechanisms relying on by population growth, capital stock in the base year, gross fixed capital, and exogenous parameters describing the future development scenarios for the Egyptian economy as well as other inter-period dynamic relations.

From an analytical point of view, the main contributions of this research work are delineated in the following points. (i) The paper adopts a specific disaggregation scheme of the social accounting matrix as well as the model, relevant to the economy population interaction context. To achieve this analytical goal, the production activities are classified into nine sectors. The industrial sectors are broken down according to labour intensity into low intensive, medium intensive and high intensive labour activities. Furthermore, to allow for the disaggregated analysis of labour supply and demand policies, labour compensation is disaggregated by production activities (9 sectors), economic sector (private, public and government), household area (urban versus rural) and by educational level (4 education levels). (ii) With respect to the demographic variables, labour supply is classified by sex and education status in order to evaluate alternative labour participation policies. (iii) The inter-period dynamic module of the model includes five dynamic behavioural equations directed to capture the impact of population size on the economy.

The model is designed and constructed to assess the impact of two alternative population scenarios on the economy as a whole. Most of the model structural parameters are computed from the SAM whereas the behaviour parameters are based on estimates from other models and similar studies for Egypt as well as econometric

estimation methods. The model represents an economy with an investment/saving macroeconomic closure rule that treats gross fixed capital formations as exogenous variables, gross savings as endogenous variables depending on institutional income and expenditure patterns, and the foreign savings that clear the macroeconomic system.

The production function is disaggregated into four levels. In the first level, activity has to pay intermediate consumption and generate gross value added. The second level assumes that Intermediate consumption spending of composite commodities per each activity is based on Leontief function (**IO**) (i.e. fixed quantity shares) and the gross value added of each activity distributes its generated income using constant elasticity of substitution function (**CES**) of private and public sector. The third level determines the breakdown of the public and private value added into labour and capital by CES function. The fourth level disaggregates public labour by educational level using has CES function and private labour by educational level using Leontief function.

The allocation of gross output between domestic sales and exports is based on a constant elasticity of transformation function (CET). Total supply of commodities is broken down between domestic sales and imports using Armington approach based on a constant elasticity of substitution function (CES) function. This demand function allows imports to be imperfect substitutes of domestic sales. The supply of exports – from the CET function - interacts with world demand on the Egyptian export – affected by the elasticity of trade as well as the ratio of supply price of exports and their international counterpart, to determine the equilibrium volume of exports. Transfers from the rest of the world are fixed in foreign currency whereas transfers from the domestic institutions to the rest of the world are a function of their disposable income.

Government revenues obtained from different resources are; capital revenue (profits from public companies), transfers from (domestic and foreign) institutions, direct taxes from households and companies, indirect taxes (import taxes and taxes on production). There are several factors or policies affect the expenditure of general

government and they are as follows: expenditure on education is affected by the growth rate of students, expenditure on health and social services is affected by total population growth rate, and finally government expenditure on public administration and other services is based on government policy. Government final expenditure is computed in real term and government savings are computed as a residual (clearing variable).

Companies' income is obtained from capital revenue, investment income and transfers from other institutions. The companies' expenditure can be divided into three parts; direct taxes to government, savings, and transfers to other institutions. Companies' income account is collected as fixed shares of alternative revenues. Part of household (urban/rural) disposable income goes to consumption. Household final consumption (urban/rural) has linear expenditure function (**LES**) of composite commodities.

## Market Clearing Mechanism

A set of market closure rules has been defined based on the economic structure and alternative policy measures adopted by Egypt's government. These rules are classified according to markets of goods and services, market factors and the macroeconomic closure rules.

There are nine markets for goods and services. The exchange price is used to clear the market under the price liberalization policy currently adopted in Egypt. Factors Markets include labour and capital. Government wage bill is fixed in real terms; Labour demand in the public and private sectors is determined by the level of output and the form of the production function. Return on capital (or gross operating surplus in real term) is considered as an exogenous variable, and it is computed however as function of last year capital stock, gross fixed capital formation and the consumption of fixed capital in the inter-period dynamic part.

Given market imperfection and high unemployment rates, wage rates by economic sector and educational level are fixed within period but the change between periods based on the employment and wage policy. Natural growth rate of population

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and labour supply and the distribution of labour supply by sex and education level are used to dynamically adjust population size and labour force by sex and educational level between periods according population and labour force scenarios.

## The Inter-Period Dynamic Module

The inter-period dynamic module of the model includes five dynamic behavioural equations directed to capture the impact of population size on the economy. Per capita household final consumption depends on lagged values of per capita Gross Domestic Product (GDP). Government final consumption expenditure on education has two equations (one for pre-university spending and the second for the university & above levels). Government final consumption of pre-university education is determined as a function of the size of pre-university students, and government final consumption spending on the above education is determined from the size of the university & above students per 100000 population.

## Development of Policy Scenarios

Figure(1) summarizes population and labour force scenarios. It consists of three parts. **The first part** presents two population scenarios. The reference path scenario (Laisser-faire scenario) assumes the continuation of the same trend of policy measures in the past (i.e. there is no intervention). (i)The reference path (low reduced fertility scenario) assumes that total fertility rate (TFR) decrease from 3.47 child per woman in the base year to 2.8 child per woman over the planning period (i.e. the population growth rate will decrease to 1.65% in 2024). (ii) The second scenario (or the policy scenario) assumes however, that there will be an effective effort of Egypt's government to support and facilitate the implementation of the family planning program. As a result, women will be more likely to use family planning and spacing between born children. Based on this rationale, TFR is expected to decrease from 3.47 child per woman in the base year to 2.3 child per woman in 2024-2025. This will be reflected in the population growth rate, the population growth rate will decline to 1.3% in 2024.

**The second part** displays two labour force scenarios. (i)The reference path assumed that labour force participation rate of males will follow a decreasing trend while females have an increasing trend during the planning period but at slower pace than policy scenario. (ii) Policy scenario assumed that labour force participation rate of males will follow a decreasing trend while females have an increasing trend during the planning period. This scenario is based on the idea that women become more likely to be more empowered and entering the labour force to support themself and their families.

**The third part** is devoted to illustrate the distribution of labour force by education level scenarios, (i) Under the reference path scenario, the proportion of illiterate and read and write persons is expected to decrease in favour of the higher educational categories but at slower pace than policy scenario during the scenario's planning period. (ii) Policy scenario assumed that the share of illiterate and read and write labour force is expected to decrease rapidly compared with the reference path scenario. This scenario is based on the idea that the government will facilitate and support the literacy programs.

The model is composed of a static and a dynamic sub-models. The static model is composed of 993 equations and the nominal exchange rate is selected as the numeraire of the model. The model inter-period sub-model. The model has been implemented on a computer using the general algebraic software modelling system (GAMS).

## Population and Labour Force Policies

### Population Policies:
**Population Growth Rate (2014-2024):**

|      | Reference Path | Policy Scenario |
|------|----------------|-----------------|
| **2014** | **2.75** | **2.75** |
| **2015** | 2.43 | 2.39 |
| **2016** | 2.35 | 2.27 |
| **2017** | 2.26 | 2.15 |
| **2018** | 2.17 | 2.03 |
| **2019** | **2.09** | **1.91** |
| **2021** | 2.00 | 1.79 |
| **2021** | 1.91 | 1.66 |
| **2022** | 1.82 | 1.54 |
| **2023** | 1.73 | 1.41 |
| **2024** | **1.65** | **1.30** |

### Activity Rates Policies:
**Refined Activity Rates (15+) by Sex (2014-2024):**

|      | Reference Path | | Policy Scenario | |
|------|------|--------|------|--------|
|      | **Male** | **Female** | **Male** | **Female** |
| **2014** | **70.2** | **21.4** | **70.2** | **21.4** |
| 2015 | 69.846 | 22.057 | 69.846 | 23.2 |
| 2016 | 69.506 | 22.723 | 69.506 | 23.7 |
| 2017 | 69.208 | 23.311 | 69.208 | 24.2 |
| 2018 | 68.871 | 23.882 | 68.871 | 24.7 |
| **2019** | **68.486** | **24.434** | **68.486** | **25.2** |
| 2020 | 68.051 | 24.965 | 68.051 | 25.8 |
| 2021 | 67.572 | 25.476 | 67.572 | 26.3 |
| 2022 | 67.07 | 25.98 | 67.07 | 26.8 |
| 2023 | 66.55 | 26.48 | 66.55 | 27.3 |
| **2024** | **66.05** | **26.99** | **66.05** | **27.8** |

### Supply of labour force by Education Policy:
**Labour force by Sex and Education (2014-2024):**

#### Male

|      | Illiterate | Read & Write | Primary/ Preparatory /Intermediate Less university | University & Above | Total |
|------|------------|--------------|----------------------------------------------------|--------------------|-------|
| **Reference Path** | | | | | |
| 2014 | 21.4 | 10.3 | 52.5 | 15.9 | 100 |
| 2019 | 20.4 | 10.0 | 53.3 | 16.3 | 100 |
| 2024 | 18.7 | 9.6 | 54.4 | 17.3 | 100 |
| **Policy Scenario** | | | | | |
| 2014 | 21.4 | 10.3 | 52.5 | 15.9 | 100 |
| 2019 | 17.2 | 8.9 | 56.3 | 17.6 | 100 |
| 2024 | 13.8 | 7.6 | 59.1 | 19.5 | 100 |

#### Female

|      | Illiterate | Read & Write | Primary/ Preparatory /Intermediate Less university | University & Above | Total |
|------|------------|--------------|----------------------------------------------------|--------------------|-------|
| **Reference Path** | | | | | |
| 2014 | 26.2 | 2.9 | 41.4 | 29.6 | 100 |
| 2019 | 24.45 | 2.82 | 42.32 | 30.41 | 100 |
| 2024 | 17.25 | 2.49 | 43.48 | 36.78 | 100 |
| **Policy Scenario** | | | | | |
| 2014 | 26.2 | 2.9 | 41.4 | 29.6 | 100 |
| 2019 | 18.7 | 2.5 | 43.6 | 35.2 | 100 |
| 2024 | 13 | 2.2 | 43.9 | 40.9 | 100 |

**Figure(1): Population and Labour Force Policies (2014-2024)**

## 5. Experimental Results

Tables in this section present the impact of two population and labour force scenarios on the economic performance (medium/long term) in terms of principal national accounts, the balance of payments and GDP at market price, sectorial GDP in real terms, per-capita GDP indicators and population, labour supply and demand. Table(3) presents the principal national accounts during the period from 2014 to 2024 under two population and labour force scenarios. It indicates that policy scenario has the lowest gross domestic, national product, and final consumption compared with the reference path scenario while it has the highest net current transfers and national saving relative during the period from 2014 to 2024. The majority of the gross national income goes to final consumption for all scenarios but at different pace. The share of final consumption from the gross national income is slightly higher in the reference path scenario compared with the policy scenario.

**Table(3): Principal National Accounts (Nominal Prices) according to the Population and Labour Force Policies (Million LE).**

| Principal National Accounts | Base year 2014/15 | Population and Labour Force Policies | | | |
|---|---|---|---|---|---|
| | | Reference Path | | Policy Scenario | |
| | | 2019/20 | 2024/25 | 2019/20 | 2024/25 |
| **GDP at Market Price** | 2069883 | 3432146 | 5552559 | 3416426 | 5459041 |
| **Net Factor Income** | 43227 | 87219.4 | 182479.4 | 87219.4 | 182479.4 |
| **Gross National Product** | 2113110 | 3519365 | 5735038 | 3503645 | 5641520 |
| **Net transfers** | 44102 | 104383 | 199066.5 | 104738 | 201150 |
| **Gross National Income** | 2157212 | 3623749 | 5934105 | 3608383 | 5842670 |
| **Final Consumption** | 2001695 | 3574211 | 5884853 | 3555890 | 5776397 |
| **National Saving** | 155518 | 49537.2 | 49251.9 | 52493.1 | 66273 |

Based on table(4), it is noted that the policy scenario shows higher exports, net factor income, less imports relative to reference path scenario during the period from 2014 to 2024. For instance, the exports will be 319.3 billion LE in 2024/25 under the policy scenario compared with 318.1 billion LE in the reference path scenario while imports expected to reach 1384.6 billion LE in 2024/25 under the policy scenario

compared with 1405.2 billion LE in the reference path scenario. As expected, the trade balance is in favour of the policy scenario.

**Table(4): Balance of Payments (Nominal Prices) according to the Population and Labour Force Policies (Million LE).**

| Balance of Payments | Base year 2014/15 | Population and Labour Force Policies | | | |
|---|---|---|---|---|---|
| | | Reference Path | | Policy Scenario | |
| | | 2019/20 | 2024/25 | 2019/20 | 2024/25 |
| Exports | 285160.1 | 247285.5 | 318103.5 | 247567.3 | 319354.1 |
| Imports | 540613.1 | 864621 | 1405222.3 | 861078.6 | 1384565.9 |
| Trade Balance | -255453 | -617335.5 | -1087118.8 | -613511.3 | -1065211.8 |
| Net Factor Income | 43227 | 87219.4 | 182479.4 | 87219.4 | 182479.4 |
| Net transfers | 44102 | 104383 | 199066.5 | 104738 | 201150 |
| Current Surplus | 168124 | 425733 | 705573 | 421554 | 681582 |

Table(5) indicates that under the reference path scenario, GDP at market price will grow on the average by 4.34% per annum relative to 4.30% in policy scenario. As expected, real public and private consumption are higher in the reference path scenario relative to policy scenario and the gap between them increases over time. For example, real private consumption will increase on the average by 7.36% per annum in the policy scenario during the period (2014-2024) compared with 7.51% per annum in the reference path scenario. Policy scenario shows higher exports compared with the reference path scenario while higher imports are observed in the reference path scenario. Moving from the policy scenario to the reference path scenario will increase the gap between exports and imports in favour of imports.

**Table(5): GDP at Market Price at Real Term according to the Population and Labour Force Policies (Million LE).**

| GDP at Market Price | Base year 2014/15 | Population and Labour Force Policies | | | | | |
|---|---|---|---|---|---|---|---|
| | | Reference Path | | | Policy Scenario | | |
| | | 2019/20 | 2024/25 | *Growth (%) (2014/24) | 2019/20 | 2024/25 | *Growth (%) (2014/24) |
| Household Consumption | 1344436.9 | 1891569 | 2353666 | 7.51 | 1887047 | 2334283 | 7.36 |
| Government Consumption | 187701.2 | 225682 | 275433.7 | 4.67 | 225428 | 273449.6 | 4.57 |
| Investment | 242942.6 | 288805 | 343324.1 | 4.13 | 288805 | 343324.1 | 4.13 |
| Exports | 235232.2 | 179818 | 183453.6 | -2.2 | 180378 | 185400.6 | -2.12 |
| Imports | 409202.2 | 682595 | 859803.8 | 11.01 | 679804 | 847221.8 | 10.7 |
| GDP usage | 1601110.5 | 1903279 | 2296074 | 4.34 | 1901854 | 2289236 | 4.3 |

*Average annual growth rate

Table(6) presents the distribution of GDP uses and indicates that the distribution of GDP uses varies over time. However, household final consumption has the highest share of GDP uses during the scenario period in all scenarios. The share of imports increases while the share of exports decreases during the scenario period.

**Table(6): The distribution of GDP Uses according to the Population and Labour Force Policies (Million LE).**

| GDP at Market Price | Base year 2014/15 | Population and Labour Force Policies | | | |
|---|---|---|---|---|---|
| | | Reference Path | | Policy Scenario | |
| | | 2019/20 | 2024/25 | 2019/20 | 2024/25 |
| Household Consumption | 83.97 | 99.38 | 102.51 | 99.22 | 101.97 |
| Government Consumption | 11.72 | 11.86 | 12.00 | 11.85 | 11.95 |
| Investment | 15.17 | 15.17 | 14.95 | 15.19 | 15.00 |
| Exports | 14.69 | 9.45 | 7.99 | 9.48 | 8.10 |
| Imports | 25.56 | 35.86 | 37.45 | 35.74 | 37.01 |
| GDP usage | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

Table(7) presents the sectorial GDP at real price according to the population and labour force policies. It is noticed that social services followed by infrastructure and low technology have the highest growth rate while the other primary has the lowest growth rate among other sectors during the period from 2014 to 2024. Social services will increase by 6.4% per annum while other primary will increase by 2.19% per annum during the period from 2014 to 2024 under policy scenario. The distribution of sectorial GDP will slightly change over the time period (2014-2024), but still services have the highest share of GDP among other sectors while infrastructure has the lowest share of GDP followed by high technology during the same period.

**Table(7): Sectorial GDP at Real Term (LE Million) according to the Population and Labour Force Policies.**

| Economic indicators | Base year 2014/15 | Population and Labour Force Policies | | | | | |
|---|---|---|---|---|---|---|---|
| | | Reference Path | | | Policy Scenario | | |
| | | 2019/20 | 2024/25 | *Growth (%) (2014/24) | 2019/20 | 2024/25 | *Growth (%) (2014/24) |
| Agriculture | 233093.2 | 297789.9 | 361346.5 | 5.5 | 298271.0 | 363348.8 | 5.59 |
| Other Primary | 213304.4 | 218717.5 | 260324.6 | 2.2 | 218653.5 | 260084.2 | 2.19 |
| Low labour Intensive | 54629.9 | 57510.7 | 68862.1 | 2.61 | 57491.2 | 68796.5 | 2.59 |
| Medium labour Intensive | 67737.8 | 74026.0 | 87425.0 | 2.91 | 74035.4 | 87479.4 | 2.91 |
| High labour Intensive | 109150.7 | 140246.7 | 175147.3 | 6.05 | 140548.3 | 176484.7 | 6.17 |
| Infrastructure | 28994.3 | 37599.3 | 46949.9 | 6.19 | 37681.8 | 47302.8 | 6.31 |
| Construction | 60892.9 | 71646.2 | 85360.3 | 4.02 | 71653.3 | 85397.2 | 4.02 |
| Productive Services | 386068.9 | 475596.1 | 572639.3 | 4.83 | 476331.9 | 576057.6 | 4.92 |
| Social Services | 223682.2 | 295294.5 | 363997.6 | 6.27 | 295968.0 | 366905.4 | 6.4 |

*Average annual growth rate

Table(8) shows that the highest per-capita GDP is observed under the policy scenario relative to the reference path scenario during the period from 2014 to 2024. Real per-capita GDP will increase on average by 1.91% per annum in the policy scenario relative to 1.72 per annum in the reference path scenario. All per-capita indicators are in favour of the policy scenario during the planning period.

**Table(8): Per-Capita Indicators in Real Terms according to the Population and Labour Force Policies (Million LE).**

| | Per-Capita Indicators | Base year 2014/15 | Population and Labour Force Policies | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Reference Path | | | Policy Scenario | | |
| | | | 2019/20 | 2024/25 | *Growth (%) (2014/24) | 2019/20 | 2024/25 | *Growth (%) (2014/24) |
| Real | Per Capita GDP | 18455 | 19617 | 21622 | 1.72 | 19709 | 21979 | 1.91 |
| | Per Capita Final Consumption | 17659 | 21822 | 24759 | 4.02 | 21892 | 25037 | 4.18 |
| | Per Capita Household Consumption | 15496 | 19496 | 22165 | 4.30 | 19556 | 22411 | 4.46 |
| | Per Capita Government Consumption | 2163 | 2326 | 2594 | 1.99 | 2336 | 2625 | 2.14 |
| Nominal | Per Capita GDP | 23858 | 35375 | 52289 | 11.92 | 35405 | 52412 | 11.97 |
| | Per Capita Final Consumption | 23072 | 36839 | 55418 | 14.02 | 36850 | 55458 | 14.04 |
| | Per Capita Household Consumption | 20553 | 33586.61 | 51042.95 | 14.83 | 33586.73 | 51042.81 | 14.83 |
| | Per Capita Government Consumption | 2519 | 3260 | 4386 | 7.41 | 3264 | 4416 | 7.53 |
| | Per Capita Gross National Production | 24356 | 36297 | 54040 | 12.2 | 36309 | 54164 | 12.24 |

*Average annual growth rate

Table(9) presents the population size, labour supply by sex and labour demand by educational status during the period from 2014 to 2024. Under the policy scenario, population size increases by almost 20.1% during the same planning period to reach 104.2 million persons in 2024. Total labour force will increase similarly by almost 25.4% during the period (2014-2024) to attain 34.6 million in 2024 (24.6 million and 10 million for males and females respectively). According to the reference path scenario, population will increase by almost 22.4% during the period from 2014 to 2024, and it is expected to reach 106.2 million persons in 2024, with total labour force that increase by almost 24.2% during the planning period (2014-2024) to reach 34.3 million in 2024 (this corresponds to 24.6 million and 7.9 million for males and females, respectively). With respect to the quantity demanded of labour, it is assumed that the high bulk of labour size is belong to the primary and higher education.

**Table(9): Population Size, Labour Supply by Sex and Labour Demand by Educational Status (by 1000) according to the Population and Labour Force Policies.**

| | | Base year 2014/15 | Population and Labour Force Policies | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | Reference Path | | | Policy Scenario | | |
| | | | 2019/20 | 2024/25 | *Growth (%) (2014/24) | 2019/20 | 2024/25 | *Growth (%) (2014/24) |
| Population | | 86760 | 97023 | 106189 | 2.24 | 96495 | 104157 | 2.01 |
| Male Labour Force | | 21267 | 22964 | 24555 | 1.55 | 22958 | 24553 | 1.55 |
| Female Labour Force | | 6303 | 7970 | 9739 | 5.45 | 8234 | 10030 | 5.91 |
| Total Labour Force | | 27569 | 30934 | 34294 | 2.44 | 31192 | 34583 | 2.54 |
| Labour Demand | Illiterate | 5843 | 6425 | 6095 | 0.39 | 5390 | 6227 | 0.71 |
| | Read & Write | 2184 | 2379 | 2484 | 1.26 | 2165 | 2504 | 1.48 |
| | Primary / Preparatory / intermediate less university | 11713 | 13386 | 15278 | 2.66 | 14290 | 15600 | 2.72 |
| | University & Above | 4224 | 4951 | 6346 | 4.29 | 5517 | 6472 | 4.07 |
| | Total | 23964 | 27142 | 30203 | 2.3 | 27362 | 30802 | 25 |

**\*Average annual growth rate**

## 6. Conclusions and Policy Recommendations
### 6.1. Conclusions

This paper aimed to test the impact of two population and labour force policies scenarios on the economic performance. The paper adopts a specific disaggregation scheme of the social accounting matrix as well as the model, relevant to the economy wide population interaction context. An important effort should be directed to assemble and test the accounting framework given that socioeconomic data are fragment, inconsistent and use different estimation methods. Social accounting matrix is considered a corner stone of the model is constructed based on comprehensive & consistent data. In the developed model, the impact of population is captured through Supply/demand relation and equations of household final consumption and government final consumption (education - health - social services).

The main key findings of population economy wide interaction model are shown in the following points. First, reference path scenario shows as expected higher real public and private consumption spending than policy scenario. If the policy scenario is adopted, we can avoid 0.4% an increase in the average annual real growth rate of imports during time period (2014-2024). Besides, the gap between imports and exports (Trade Balance) will be in favor of the policy scenario compared with the reference path scenario during the planning period. In addition, aggregate national saving is observing an increase in light of the policy scenario over the same time period. Finally, most of the per-capita indicators are in favour of the policy scenario relative to reference path scenario and the gap is getting larger over time. For instance, there will be 0.19% an increase in the average annual real growth rate of per capita GDP and 0.16% an increase in the average annual real growth rate of per capita final consumption under the policy scenario relative to the reference path scenario (which is considered a gain).

Second, in case of the policy scenario, population size increases by almost 20.1% during the same planning period to reach 104.2 million persons in 2024. Total labour force will increase similarly by almost 25.4% during the period (2014-2024) to

attain 34.6 million in 2024 (24.6 million and 10 million for males and females respectively). According to the reference path scenario, population will increase by almost 22.4% during the period from 2014 to 2024, and it is expected to reach 106.2 million persons in 2024, with total labour force that increase by almost 24.2% during the planning period (2014-2024) to reach 34.3 million in 2024 (this corresponds to 24.6 million and 7.9 million for males and females, respectively). With respect to the quantity demanded of labour, it is assumed that the high bulk of labour size is belong to the primary and higher education.

## 6.2. Policy Recommendations

The policy recommendations of the study are outlined as follow:

- The preparation and formulation of the national economic development plan should not be in isolation from the population and labour force policies because eventually these neglected policies will be an obstacle to the development progress.
- Achieving the goals of the policy scenario demands a considerable effort from the Egyptian government supported by appropriate measures from nongovernmental organizations and an effective role of the mass media.
- Investing in labour intensive sectors is the appropriate way to absorb the upcoming increase in labour force and then reduce the unemployment rate.
- Emphasizing the quality of education should be one of the priorities of government plan in order to enhance the skills needed by the labour market in the knowledge era of the twenty one century.

## References

1) Bloom, D.E., Canning, D., and Malaney, P.N.  (1999) Demographic Change and Economic Growth in Asia. Center for International Development at Harvard University Working Paper No. 15.

2) CAPMAS (2014) Input-Output Tables 2010/2011Within the Framework of National Accounts System.

3) Hassanin, M.M., Osman, M. and Khorshid, M. (1993). A Multi - Sector Population Economy wide Simulation Model for Egypt. National Population Council. Egypt.

4) Hosoe, N., Gasawa, K., and Hashimoto, H. (2010)"Textbook of Computable General Equilibrium Modeling". Programming and Simulation. Palgrave Macmillan.

5) Hussien, E. (1991) Demographic Development Model to Study the Interaction between Economic Development A Case Study of the Egyptian Experience. Faculty of Economics and Political Science. Cairo University. PHD thesis.

6) Khorshid, M., Mohamed, A. and Abdel Aziz, W. (2015) Population Economy Wide Interaction Simulation Model For Egypt "Structure, Rationale and Medium Term Projections". The proceedings of the Conference of Institute of Statistical Studies and Research. Cairo University.

7) Khorshid, M., Mohamed, A. and Abdel Aziz, W. (2014) Population, Labour force and Requirements of Education Needs Projections during the Time Period (2014-2026). The proceedings of the Conference of Institute of Statistical Studies and Research. Cairo University.

8) Khorshid, M. and El-Sadek, A. (2014) Egypt's Post Revolution Development Path from a Dynamic Economy Wide Model "A Three-Year Economic Recovery Plan". The proceedings of the International Conference on Policy Modeling. Bali, Indonesia. EcoMod2014.

9) Khorshid, M. and El-Sadek, A. (2013) Egypt's Post Revolution Development Path from a Dynamic Economy Wide Model "A Goal seeking Analysis". The proceedings of the International Conference on Policy Modeling. Prague. EcoMod2013.

10) Khorshid, M. and El-Sadek, A. (2012) A Multi-sector ICT Economy Interaction Model for Egypt "The Path to Information Society". The proceedings of the International Conference on Policy Modeling, Seville | Spain. EcoMod2012.

11) Khorshid, M. and El-Sadek, A. (2011) An ICT Economy Interaction Model for Egypt "Impact on Growth and Productivity". The proceedings of the International Conference on Policy Modeling, Ponta Delgada | Portugal. EcoMod2011.

12) Khorshid, M., Kamaly, A., El-Laithy, H. and Abou El-Enein, S. (2011). "Assessing Development Strategies to Achieve the MDGs in The Arab Republic of Egypt: Country Study"., *Report of Realizing the Millennium Development Goals through socially inclusive macroeconomic policies*. United Nations: Department for Social and Economic Affairs.

13) Khorshid, M. (2009) An Energy Economy Interaction Model for Egypt. "Results of Alternative Price Reform Scenarios". The Proceedings of the International Conference on Policy Modeling (EcoMod2009).Ottawa, Canada.

14) Khorshid, M. (2008). Social accounting Matrices for Modeling and policy Analysis. "Development Issues from the Middle East Countries". The proceedings of the International Conference on Policy Modeling, Berlin, Germany.

15) Khorshid, M. (2003). Alternative Socioeconomic Development Scenarios for Egypt. "Results From an Economy-Wide Simulation Model". Published by Economic Research Forum (ERF), the proceedings of the 10th Annual Conference Marrakech, December 2003.

16) Khorshid, M. (2002) "Issue-Oriented Social Accounting Matrices for Development Policy: Experience from the Middle East and North Africa Region", the proceedings of the 14th International Conference on Input-Output Techniques, Montreal, Canada.

17) Khorshid, M. (1994) " A Multi-sector Population Economy-wide Simulation Model for Egypt." Finance and Industry. The Industrial Bank of Kuwait. No. 12: 39-155.

18) Ministry of Planning (2013) National Accounts 2010/2011. Egypt.

19) United Nations Industrial Development Organization (2013) Industrial Development Report 2013. Sustaining Employment Growth: The Role of Manufacturing and Structural Change.