**Investment to employment and income multipliers by sector for the MENA countries: An Input-Output analysis using GTAP data base**

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1. **Introduction**

Fiscal policy is often used to manage economic growth and its fluctuations over time. Providing economic incentives to enhance investment is a common fiscal policy that has been used by policy makers to maintain economic growth and support employment opportunities over time. A priority investment list can help policy makers to apply this policy more effectively. Economic activities respond to investment in different ways. Ceteris paribus, some activities may provide more job opportunities, while others contribute more to economic growth. An investment, in agricultural activities could provide more employment opportunities for low skilled labor, than an investment in energy sectors. However, an investment in energy sectors may facilitate faster economic growth. The employment and income multipliers are two important measures that have been calculated and used to govern public policies towards investment.

Two main approaches of econometric and modeling approaches have been used to determine investment to employment and income multipliers. The first approach requires a major effort to collect data to provide credible estimates of these measures by sector for a given economy. The required data for this approach are difficult to collect and not usually available. The second method, economic modeling, is a more common approach and has been used more frequently.

In this approach, using Input-Output (IO) analysis is a dominant method. In this research, we use this method to evaluate the investment to employment, value added, and output multipliers by sector for the Middle Eastern and North African (MENA) countries. To calculate these multipliers, we use an extended version of the latest GTAP Data Base which represents the global economy in 2014 and represents IO tables for 144 regions. The standard version of this data base covers 141 countries and is missing Input-Output tables for Iraq, Syria, and Lebanon. Taheripour et al. (2020) have extended this data base and included IO tables for these three economies as well. This report concentrates on the MENA economies.

In the rest of this report, we first provide a short theoretical background and literature review. Then we introduce the base data used, its geographical and sectoral aggregations and the list of countries examined in this report. Finally, we present the results.

1. **A brief literature review and method**

The theoretical foundation of using IO tables in assessing employment and income multipliers due to changes in final demand or investment has been widely discussed in the literature (a few examples are: Miernyk (1967); Richardson (1972); Miller and Blair (1985); Pleeter (1980); Richardson (1985)). This approach has been frequently used to evaluate these multipliers at regional and national levels around the world for different economic activities (a few cases are: Lenzen (2001); Bekhet (2011); Bivens (2019); and Cassar (2015)). The income and employment multiplier can be determined due to changes in: final demand for goods and services or availability of primary inputs. In what follows, we briefly introduce methods and their basic relationships.

***Basic concepts***

The basic variables in an IO framework are:

: Output of sector *j*,

: Input *i* used by sector *j*,

: Final demand for good (or service) *i*,

: Value added of sector *j,*

: Labor used in sector *j*,

: Capital used in sector *j*,

In an IO framework, the prelateship between inputs used by each sector and its output represents a Leontief production function. In this type of production, the ratio of capital to output () is fixed in each sector:

(1)

The ratio of labor to output is () also fixed:

(2)

From (1) and (2) we can find that:

(3)

Equation 3 provides direct effect of an investment, , in sector *j* on its demand for labor.

**Demand multipliers**

The relationship between the demand and supply sides in an IO framework can be illustrated by the following relationship

(4)

In this relationship: *Y* is a vector of and its elements are: , value of production of commodity *i* which is equal to the value of output of sector ; *I* is an identity matrix of ; *A* is a matrix of and its elements are: ; and *F* is a vector of and its elements are: , final demand for commodity *i*.

Using equation (4), one can determine the impacts of changes in final demand on sectoral output and then calculate the income and employment multipliers (for details see chapter 2 of Miller and Blair (1985)).

***Supply multipliers***

The following relationship establishes the foundation to calculate the supply multipliers:

(5)

In this equation: is the transpose of vector ; represents transpose of vector of value added; and .

Using equation (5) one can determine the impacts of changes in value added on sectoral outputs and then calculate the income and employment multipliers due to changes in investment (for details see chapter 12 of Miller and Blair (1985)).

1. **Calculated multipliers and data used**

In this research we calculate three sets of sectoral multipliers due to an investment by one million USD in each sector:

* Employment multiplier by skill,
* Value added (income) multiplier,
* Gross output multiplier.

The first multiplier covers employment by skill categories of: Agricultural and unskilled labors; Clerks; Officials and managers; Service and shop workers; and Technicians and associate professionals.

To calculate these multipliers, we use the latest version of GTAP data base that represents the world economy in 2014. The standard GTAP data base does not cover economies of Iraq, Syria, and Lebanon. Taheripour et al. (2020) have added these countries to the GTAP data base. The labor data set is prepared by the GTAP center using the ILO data.

***Sectoral aggregation***

The sectoral aggregation is presented in appendix A. As shown in this appendix, economic activities are classified into 24 sectors including:

Crops, Livestock, Forestry, Fishing, Fossil Fuels, Mining, Processed Food, Textile, Wood, Paper, Industries G1, Electronics, Industries G2, Electricity, Water, Construction, Trade, Hotels and Restaurants, Transportation, Other services, Public Administration, Education, Health, Dwellings

***Regions covered***

In this report we present the results for the following countries including: Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates (UAE), Egypt, Morocco, Tunisia, and the Rest of Western Asia.

In addition, this report cover the results for a long list of emerging countries all across the world.

1. **Results**

Two tables represent the results for each country. The first table of each county shows direct and total employment multiplier. This table also shows the value-added and output multiplier by sector. The second table of each country decomposes the sectoral employment multipliers by 5 skill categories of labor divided by direct, indirect, and total. Results are presented in Appendix C country by country. In addition, for each country, Appendix D provides information some key macro variables including: Ration of capital to gross output, ratio of capital to gross domestic product, ratio of capital to labor, and rate of return on capital (value added of capital over capital stock).

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**Appendix A**

**Sectoral aggregation**

|  |  |  |  |
| --- | --- | --- | --- |
| Number | Code | Description ([Detailed Sector Breakdown](https://www.gtap.agecon.purdue.edu/databases/contribute/detailedsector.asp)) | Aggregated sectors |
| 1 | pdr | Paddy rice | Crops |
| 2 | wht | Wheat | Crops |
| 3 | gro | Cereal grains nec | Crops |
| 4 | v\_f | Vegetables, fruit, nuts | Crops |
| 5 | osd | Oil seeds | Crops |
| 6 | c\_b | Sugar cane, sugar beet | Crops |
| 7 | pfb | Plant-based fibers | Crops |
| 8 | ocr | Crops nec | Crops |
| 9 | ctl | Bovine cattle, sheep and goats, horses | Livestock |
| 10 | oap | Animal products nec | Livestock |
| 11 | rmk | Raw milk | Livestock |
| 12 | wol | Wool, silk-worm cocoons | Livestock |
| 13 | frs | Forestry | Forestry |
| 14 | fsh | Fishing | Fishing |
| 15 | coa | Coal | Fossil fuels |
| 16 | oil | Oil | Fossil fuels |
| 17 | gas | Gas | Fossil fuels |
| 18 | oxt | Other Extraction (formerly omn Minerals nec) | Mining |
| 19 | cmt | Bovine meat products | Processed food |
| 20 | omt | Meat products nec | Processed food |
| 21 | vol | Vegetable oils and fats | Processed food |
| 22 | mil | Dairy products | Processed food |
| 23 | pcr | Processed rice | Processed food |
| 24 | sgr | Sugar | Processed food |
| 25 | ofd | Food products nec | Processed food |
| 26 | b\_t | Beverages and tobacco products | Processed food |
| 27 | tex | Textiles | Textile |
| 28 | wap | Wearing apparel | Textile |
| 29 | lea | Leather products | Textile |
| 30 | lum | Wood products | Wood |
| 31 | ppp | Paper products, publishing | Paper |
| 32 | p\_c | Petroleum, coal products | Industries G1 |
| 33 | chm | Chemical products | Industries G1 |
| 34 | bph | Basic pharmaceutical products | Industries G1 |
| 35 | rpp | Rubber and plastic products | Industries G1 |
| 36 | nmm | Mineral products nec | Industries G1 |
| 37 | i\_s | Ferrous metals | Industries G1 |
| 38 | nfm | Metals nec | Industries G1 |
| 39 | fmp | Metal products | Industries G1 |
| Number | Code in GTAP | Description ([Detailed Sector Breakdown](https://www.gtap.agecon.purdue.edu/databases/contribute/detailedsector.asp)) | Aggregated sectors |
| 40 | ele | Computer, electronic and optical products | Electronics |
| 41 | eeq | Electrical equipment | Electronics |
| 42 | ome | Machinery and equipment nec | Electronics |
| 43 | mvh | Motor vehicles and parts | Industries G2 |
| 44 | otn | Transport equipment nec | Industries G2 |
| 45 | omf | Manufactures nec | Industries G2 |
| 46 | ely | Electricity | Electricity |
| 47 | gdt | Gas manufacture, distribution | Fossil fuels |
| 48 | wtr | Water | Water |
| 49 | cns | Construction | Construction |
| 50 | trd | Trade | Trade |
| 51 | afs | Accommodation, Food and service activities | Hotels and restaurants |
| 52 | otp | Transport nec | Transportation |
| 53 | wtp | Water transport | Transportation |
| 54 | atp | Air transport | Transportation |
| 55 | whs | Warehousing and support activities | Transportation |
| 56 | cmn | Communication | Other services |
| 57 | ofi | Financial services nec | Other services |
| 58 | ins | Insurance (formerly isr) | Other services |
| 59 | rsa | Real estate activities | Other services |
| 60 | obs | Business services nec | Other services |
| 61 | ros | Recreational and other services | Other services |
| 62 | osg | Public Administration and defense | Public administration |
| 63 | edu | Education | Education |
| 64 | hht | Human health and social work activities | Health |
| 65 | dwe | Dwellings | Dwelling |

**Appendix B**

**Sectoral employment, income, and output multipliers by country**

**Employment multipliers are presented in the following categories**

|  |  |  |
| --- | --- | --- |
| **Category code** | **Simple code** | **Skill** |
| Direct impact 1 | D1 | Agricultural and unskilled labors |
| Direct impact 2 | D2 | Clerks |
| Direct impact 3 | D3 | Officials and managers |
| Direct impact 4 | D4 | Service and shop workers |
| Direct impact 5 | D5 | Technicians and associate professionals |
| Indirect impact 1 | I1 | Agricultural and unskilled labors |
| Indirect impact 2 | I2 | Clerks |
| Indirect impact 3 | I3 | Officials and managers |
| Indirect impact 4 | I4 | Service and shop workers |
| Indirect impact 5 | I5 | Technicians and associate professionals |
| Total impact 1 | T1 | Agricultural and unskilled labors |
| Total impact 2 | T2 | Clerks |
| Total impact 3 | T3 | Officials and managers |
| Total impact 4 | T4 | Service and shop workers |
| Total impact 5 | T5 | Technicians and associate professionals |

**Appendix C**

This appendix shows the overall impacts of one million dollar investment by sector in each region. This includes direct employment multiplier, total employment multiplier, the impact on regional value added, and the impact on regional output. The tables also provide four metrics to show the significance of each sector in the economy. This includes:

s1: Represent how large is a sector according to its gross output at market price. In this columns: “s” stands for “small” which means the gross output of a sector is less than $100 million and “vs” stands for “very small” which means the gross output of sector is less than $10 million.

s2: sectoral share in regional output (%)

s3: sectoral share in regional value added (%)

s4: sectoral share in regional employment (%)

Please note that there is a slightly different sectoral aggregation for Iraq, Lebanon, and Syria. There, the “Hotels and Restaurants” sector is embedded in “Other Services”. Also, the “Education” sector and the “Health” sector are embedded in “Public Administration” sector.

Tables are presented in a separate PDF file.

**Appendix D:**

**Regional economic indicators**

k/out: capital to gross output

k/gdp: capital to gross domestic product

k/lab: $1000 capital per labor

ror : regional rate of return on capital (value added of capital over capital stock)

|  | **k/out** | **k/gdp** | **k/lab** | **ror** |
| --- | --- | --- | --- | --- |
| **irn** | 1.59 | 3.12 | 45.64 | 24.5% |
| **isr** | 1.85 | 4.24 | 242.51 | 7.7% |
| **jor** | 1.09 | 3.15 | 34.46 | 21.3% |
| **kwt** | 1.23 | 1.92 | 117.56 | 36.3% |
| **omn** | 2.12 | 3.49 | 89.52 | 18.5% |
| **qat** | 1.69 | 2.78 | 269.41 | 24.7% |
| **sau** | 2.15 | 3.65 | 182.30 | 16.1% |
| **tur** | 1.38 | 3.36 | 67.57 | 21.6% |
| **are** | 1.66 | 2.80 | 169.18 | 24.0% |
| **xws** | 1.19 | 2.24 | 28.45 | 26.8% |
| **egy** | 0.72 | 1.34 | 11.58 | 36.9% |
| **mar** | 0.86 | 2.26 | 17.54 | 16.9% |
| **tun** | 1.04 | 2.54 | 23.60 | 23.5% |
| **Iraq** | 0.83 | 2.10 | 22.64 | 25.8% |
| **Syria** | 1.61 | 3.30 | 45.45 | 21.3% |
| **Lebanon** | 1.49 | 2.78 | 19.35 | 18.5% |
| **chn** | 1.47 | 4.78 | 51.10 | 10.2% |
| **mng** | 1.95 | 4.51 | 32.91 | 13.3% |
| **xea** | 0.90 | 2.28 | 10.46 | 23.3% |
| **brn** | 2.54 | 4.00 | 294.54 | 15.8% |
| **khm** | 0.85 | 2.24 | 3.67 | 21.2% |
| **idn** | 1.60 | 3.25 | 21.20 | 15.8% |
| **lao** | 1.47 | 3.22 | 9.83 | 12.2% |
| **mys** | 1.05 | 3.20 | 65.64 | 16.3% |
| **phl** | 1.61 | 3.33 | 19.14 | 17.7% |
| **sgp** | 0.77 | 2.27 | 189.66 | 23.8% |
| **tha** | 1.54 | 4.18 | 36.78 | 14.0% |
| **vnm** | 1.12 | 3.25 | 8.83 | 12.7% |
| **xse** | 0.68 | 1.61 | 4.11 | 29.4% |
| **bgd** | 1.45 | 2.99 | 7.63 | 14.5% |
| **India** | 1.49 | 3.28 | 11.88 | 13.1% |
| **npl** | 1.74 | 3.53 | 3.28 | 12.9% |
| **pak** | 0.87 | 1.73 | 6.15 | 34.3% |
| **lka** | 1.68 | 3.12 | 25.04 | 21.5% |
| **xsa** | 1.75 | 3.34 | 6.28 | 14.8% |
| **mex** | 1.93 | 3.81 | 74.15 | 17.0% |
| **arg** | 1.50 | 2.82 | 64.87 | 16.8% |
| **bol** | 1.00 | 2.36 | 11.83 | 18.6% |
| **bra** | 1.59 | 3.65 | 63.19 | 13.1% |
| **chl** | 1.60 | 3.43 | 87.56 | 15.2% |
| **col** | 1.79 | 3.65 | 42.96 | 16.6% |
| **ecu** | 2.05 | 3.80 | 46.54 | 15.0% |
| **pry** | 1.33 | 2.96 | 24.20 | 13.4% |
| **per** | 1.27 | 2.85 | 29.54 | 12.5% |
| **ury** | 2.33 | 5.11 | 122.98 | 10.9% |
| **ven** | 1.69 | 2.95 | 95.29 | 14.3% |
| **xsm** | 1.55 | 3.35 | 61.06 | 15.5% |
| **cri** | 1.55 | 3.09 | 52.65 | 16.7% |
| **gtm** | 1.46 | 2.81 | 22.14 | 17.2% |
| **hnd** | 1.48 | 3.79 | 15.99 | 11.7% |
| **nic** | 1.58 | 3.66 | 13.22 | 11.3% |
| **pan** | 1.47 | 3.10 | 66.31 | 14.2% |
| **slv** | 1.29 | 2.43 | 20.12 | 25.6% |
| **xca** | 1.09 | 2.81 | 18.52 | 12.6% |
| **dom** | 2.07 | 3.49 | 40.45 | 18.7% |
| **jam** | 1.70 | 3.98 | 29.72 | 11.1% |
| **pri** | 1.71 | 3.68 | 278.65 | 15.9% |
| **tto** | 1.86 | 3.53 | 130.47 | 16.3% |
| **xcb** | 1.72 | 3.84 | 34.40 | 14.3% |
| **grc** | 1.55 | 3.83 | 126.62 | 17.8% |
| **hun** | 1.04 | 3.24 | 70.39 | 18.8% |
| **mlt** | 1.65 | 5.17 | 195.03 | 12.7% |
| **alb** | 2.13 | 4.51 | 36.11 | 11.7% |
| **blr** | 0.77 | 2.47 | 27.79 | 16.3% |
| **rus** | 1.21 | 2.89 | 56.32 | 20.2% |
| **ukr** | 1.59 | 4.70 | 22.45 | 8.7% |
| **xee** | 0.93 | 2.66 | 12.40 | 15.2% |
| **xer** | 1.72 | 4.57 | 62.34 | 14.7% |
| **kaz** | 1.04 | 1.89 | 41.37 | 31.6% |
| **kgz** | 0.63 | 1.59 | 3.58 | 29.2% |
| **tjk** | 1.05 | 2.17 | 4.95 | 27.2% |
| **xsu** | 1.15 | 2.46 | 12.62 | 21.5% |
| **arm** | 0.89 | 1.93 | 12.07 | 25.7% |
| **aze** | 1.70 | 2.90 | 41.48 | 20.5% |
| **geo** | 0.94 | 1.95 | 15.88 | 21.6% |
| **ben** | 1.93 | 4.19 | 5.96 | 7.2% |
| **bfa** | 1.85 | 3.06 | 4.72 | 18.4% |
| **cmr** | 1.20 | 2.63 | 6.85 | 14.0% |
| **civ** | 1.35 | 2.96 | 10.02 | 9.3% |
| **gha** | 1.80 | 3.63 | 8.86 | 8.0% |
| **gin** | 0.81 | 1.68 | 1.69 | 37.9% |
| **nga** | 1.55 | 2.02 | 18.50 | 15.5% |
| **sen** | 1.86 | 4.49 | 10.57 | 13.4% |
| **tgo** | 1.60 | 4.40 | 3.64 | 7.6% |
| **xwf** | 1.40 | 2.98 | 3.71 | 16.0% |
| **xcf** | 1.58 | 3.26 | 15.92 | 16.9% |
| **xac** | 1.77 | 3.63 | 10.98 | 14.0% |
| **eth** | 1.52 | 2.95 | 2.98 | 15.8% |
| **ken** | 1.12 | 2.29 | 7.22 | 22.3% |
| **mdg** | 0.88 | 1.94 | 1.55 | 19.8% |
| **mwi** | 1.44 | 3.25 | 2.27 | 11.6% |
| **mus** | 2.25 | 4.20 | 77.94 | 10.8% |
| **moz** | 1.25 | 2.65 | 3.10 | 14.0% |
| **rwa** | 1.24 | 2.12 | 2.48 | 16.5% |
| **tza** | 1.78 | 3.08 | 4.74 | 11.2% |
| **uga** | 1.80 | 3.03 | 5.18 | 19.5% |
| **zmb** | 1.19 | 2.79 | 9.66 | 13.9% |
| **zwe** | 1.76 | 3.64 | 5.41 | 12.6% |
| **xec** | 1.40 | 2.67 | 8.16 | 17.3% |
| **bwa** | 2.01 | 3.49 | 44.88 | 17.1% |
| **nam** | 1.92 | 4.65 | 51.26 | 11.9% |
| **zaf** | 1.44 | 3.86 | 53.70 | 13.1% |
| **xsc** | 1.67 | 3.84 | 15.71 | 15.6% |
| **xtw** | 1.67 | 4.07 | 149.13 | 12.9% |