

Allocating fiscal stimulus during COVID-19 crisis based on sectoral linkages in Egypt for increasing growth and reducing unemployment

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Abstract

Purpose – This paper aims to study the inter-sectoral linkages in the Egyptian economy, to increase the efficiency of allocating L.E 100bn fiscal stimulus package (FSP) to tackle the economic fallout from COVID-19 based on the strength of the backward and forward linkages of various sectors, and the values of both employment and value-added multipliers. The paper also measures the impact of the new FSP on the capability of various sectors in creating job opportunities and increasing economic growth.

Design/methodology/approach – The paper studies the intersectoral linkages by calculating backward and forward linkages index based on the latest input and output tables available for the Egyptian economy published in 2018. It also depends on a bivariate optimization model to distribute new investments allocated through the FSP based on the values of both employment and value-added multiplier for those sectors. The paper calculated both employment and value-added coefficients to measure the impact of the FSP on creating job opportunities and increasing growth rates.

Findings – Based on the results of the empirical analysis, both key sectors (with strong backward and forward linkages) and sectors with strong backward linkages have the highest impact on creating job opportunities and increasing growth rates in the Egyptian economy, which means that allocating FSPs in a way which targets those sectors, especially during economic crisis, could help in increasing the positive impacts of those packages.

Originality/value – The paper is based on the unbalanced growth theory of Hirschman and uses the empirical analysis to study the intersectoral linkages and allocate new investments through FSP through different sectors. The main policy implication of the empirical results of this paper suggests targeting the key sectors and the sectors with strong backward linkages during tough economic times related to COVID-19, to increase the positive impact of the package on the whole economy.

Keywords Sectoral linkages, Key sectors, Backward and forward linkages, Fiscal stimulus package, Employment multiplier, Value added multiplier, Input output table

Paper type Research paper



1. Introduction

The world economy has witnessed a period of declining rates of economic growth and employment in response to COVID-19 pandemic crisis, with a majority of the population staying home, and many routine services closed as “non-essential”, income and spending was drastically affected. The pandemic poses a huge challenge to economic policymakers; countries now are doing their best to formulate policies that could reduce the negative impact of the crisis. Since the onset of the COVID-19 crisis, considerable number of governments in developing and developed countries have relaxed their fiscal policy measures and initiated stimulus plans to help contain the adverse effects of the crisis.

In this context, allocating the fiscal stimulus packages (FSPs) in a way that maximizes its positive impact on the economy becomes of great importance to the decision-makers, especially in economies who suffer from having limited amount of resources. New macro-models of the pandemic suggest that sectoral-specific stimulus may generate the largest fiscal stimulus per pound spent. The best way to maximize the impact of fiscal stimulus in this regard is to identify sectors that have strong backward and forward sectoral linkages, that are capable of increasing GDP growth rates and employment opportunities more than others.

In this regard, the input–output framework has been widely used as a powerful tool for policy analysis to predict the direct and indirect impact of government policies and exogenous shifts in final demand, as input–output models are designed to trace the impact of changes in final demand, such as consumer expenditures, investment and government spending on the structure of output and employment by industry or sector. (Grady and Muller, 1986, p. 3)

The Egyptian Government was among those who provided FSPs with the aim of containing the possible adverse repercussions of the global pandemic and reduce the threat of the expected decline in the rate of economic growth and declining levels of unemployment, so that Egypt could maintain the sustainability of the economic reform and structural adjustment and continue its development path. In this regard, the paper focuses mainly on three main aspects as follows:

- (1) Measuring and analyzing the sectoral linkages and interdependencies in the Egyptian economy, using the input output table methodology, to determine the leading economic sectors, the sectors with strong backward linkages, the sectors with strong forward linkages and the sectors with weak linkages.
- (2) Distributing a fiscal stimulus of L.E 100bn among various sectors, through an optimization model according to the strength of the sectoral linkages and the value of growth and labor multiplier.
- (3) Measuring the short-run potential changes in the number of job vacancies and economic growth generated by the fiscal stimulus package on the sectoral levels, the sectoral findings are then articulated to derive the economy-wide effects of the package on the level of domestic employment and growth.

In this regard, the paper is organized as follows: After introduction, Section 2 presents the literature review. Section 3 analyzes the methodological framework for determining sectoral linkage, computing employment and value-added multipliers and an econometric model for distributing the FSP in an optimal way that maximizes its return on both employment and economic growth, whereas Section 4 highlights the key results related to determining the intersectoral linkages and allocating the fiscal stimulus in an optimal way. Section 5 ends up with the conclusion.

2. Literature review

2.1 *Input–output table and its usage*

The input–output table provides a descriptive set of social accounts, recording purchases by and sales from different sectors in the economy. It also provides a snapshot picture at a point in time of the interdependencies between activities in an economy. (Jahangard and Keshtvarz, 2012, p. 36). The input-output framework also helps in examining changes in the structure of an economy over time, in this regard, the paper depends on analyzing sectoral linkages through using input output tables, as it is considered an optimal tool for national economic planning, especially during economic shocks as it helps in revealing the impacts of decisions or shocks in all sectors, fully accounting for their inter-related and balanced nature.

2.2 *Determining sectoral linkages*

Linkages analysis is crucial for determining the importance of each sector within the economy. It basically examines the interdependency of production structures; these sectors play a major role boosting the economy. The first well-known research in this field were performed in the early fifties, when Rasmussen (1956), Chenery and Watanabe (1958) and Hirschman (1958) proposed different measures of linkages (Fernández and Santos Bartolomé, 2015). Since that, many attempts took place to define sectoral linkages and determine linkages coefficients, the most important of which could be stated as follows:

- (1) The classical linkage literature in introducing Backward and forward linkages was first led by Hirschman (1958) in his publishment the Strategy of Economic Development, who was primarily a development economist with a particular interest on Latin American countries, this can be viewed as a first attempt to introduce the analytical concept of the key sector of the economy as a sector with forward and backward linkages above average. although it was not particularly concerned with the relation between interdependence on the one side and technological development and technology diffusion on the other, which has gained much interest in the last decade, rather it was solely focused on demand and supply effects, searching for the industries that had the maximal effects on the total system through their demand and supply relations with other industries, (Drejer, 2002, pp. 2-3). Hirschman also proposed using the Leontief inverse to calculate linkages and put forward these concepts as important considerations for developing economies when targeting industries for future investments.
- (2) The Rasmussen dispersion indices, were presented by the Danish economist Rasmussen (1956) in his doctoral thesis Studies in Inter-Sectoral Relations, they have been widely used as measures of Hirschman-linkages, despite the fact that Rasmussen's thesis was published before Hirschman introduced his linkage concept in The Strategy of Economic Development in 1958. Rasmussen was the first to introduce the term “key industry”. He described key industries as those industries with high backward linkages while, simultaneously, other industries displaying a low amount of variance in their dependence upon the industry being measured (Choi *et al.*, 2014, p. 4). In this regard Rasmussen proposed two indices that are widely used as measures for the identification of key sectors, which are the power of dispersion and sensitivity of dispersion (Thakur, 2011, p. 14), defined as follows:
 - The power of dispersion is defined as the ratio of the average direct and indirect coefficient from column j to the average direct and indirect coefficient

in the regional table. This implies if the ratio is larger than 1, a unit increase in the final demand for the power of dispersion is defined as the ratio of the average direct and indirect coefficient from column j to the average direct and indirect coefficient in the regional table.

- The sensitivity of dispersion measure is defined as the averages of the direct and indirect coefficients from row i to the average direct and indirect coefficient of the regional table. This implies if the final demand increases by 1 unit, the row will experience a more than an average impact on economic activities.
- (3) Chenery and Watanabe (1958) also presented one of the earliest attempts in using static input output tables to measure the forward and backward linkages where he used the inter-industry shares of purchases and sales in the total output of a sector to compute them. They inferred that the higher the ratio of intermediate deliveries of supplies to total output, the greater the dependence of that sector on the system and the fewer the dependence on primary inputs or final demand (Rao and Harmston, 1979, p. 79). One drawback of this method is that only the increasing direct backward and forward linkages is considered for the output of a specific industry; so, it does not consider the indirect effects. Another drawback is that its measurements are on the basis of mean values and therefore it does not precise the range of the data. (Jahangard and Keshtvarz, 2012, p. 42)
 - (4) In the middle of the (1970s), a series of improvements on the measurement of key sectors were proposed, the most important of which are being identified by Hazari (1970), Laumas (1975) and McGilvray (1977), since that time researchers gradually accepted that the concept of the key sector was diverse since it often depended on the objectives that were to be studied and measured. On the other hand, several authors, although accepting the total backward multipliers, criticized that the forward multipliers that estimated by the Leontief inverse were so far from reality due to the strong hypothesis – identical growth of final demand in every sector. (Choi, 2014, p. 4)
 - (5) Porter (1990) highlighted a new dimension in defining the concept of key sectors which is related to the national competitiveness, where he emphasized that economic prosperity does not depend only on the state's raw materials and natural resources, but rather on the policies that the state adopts to optimally exploit its resources, hence Porter's interest in studying the leading sectors comes from his strong belief that targeting key sectors helps in maintaining countries national competitiveness. (Porter, 1990, p. 73).

In this context, it is worth mentioning that although various trials took place since the early 50s in defining key sectors, yet the underlying idea of every method followed in this regard basically focused on finding out those sectors with the highest degree of interrelations, and they all agreed that those sectors play a major role boosting the economy, yet the concept of key sectors should not be regarded as an absolute truth as emphasized by porter since it depends on the policy objectives. These objectives could focus mainly on employment and output increase with a different degree, which emphasizes the importance of calculating the employment and the value-added multipliers values of various economic sectors and linking the concept of key sectors with the policy objectives.

2.3 Unbalanced growth theory and its role in determining key sectors

A major development debate from the 1940s to the 1960s was mainly concerned with balanced growth versus unbalanced growth, one of the oldest and strongest challenges to

the planning approach to development in this regard, comes from Albert Hirschman response to the theory of balanced growth.

The balanced growth doctrine involves the synchronized development of all sectors or the expansion of a large number of industries in all sectors and regions of an economy. It intends investment in diversified fields which in turn creates a large number of industries each generating a market for one another. To ensure a balanced growth a huge capital investment is required indicating that the availability of capital gauges the level of investment.

Hirschman responded to the balance growth theory with an alternative framework of “unbalanced growth.” (Ellerman, 2001, p. 2) where he raised one critical question regarding the ability of governments in developing countries to finance simultaneous industrialization across all sectors, and he claims that because of having a limited amount of resources developing countries could not do other than to promote certain sectors to the deliberate neglect of others, in this regard developing economy can promote economic growth by initially investing in industries with high backward and forward linkages.

Unbalanced growth identifies both forward linkages (firms creating essential inputs for other key firms in the economy) and backward linkages (key firms buy industrial inputs from a large number of domestic firms). Those with the greatest number of backward and forward links were to be prioritized. State support would initiate large-scale investment in a leading sector creating the necessary external economies to induce supplying and client industries which would in turn stimulate a secondary wave of investment and Entrepreneurship (Kaur, n.d.), Nafziger (1997) also points out that “unbalancing the economy” is something that is done intentionally, hopefully in line with an overarching development plan, so as to stimulate investment in “lead” sectors with powerful linkages that might carry other sectors with them (Ingle, 2012, p. 5469)

3. Methodological framework and data set

The paper methodology depends on using the latest the input-output matrix available for the Egyptian economy published in august 2018, which includes 90 subsectors, to: estimate intersectoral linkages in the Egyptian economy, compute employment and value-added multipliers of various sectors and allocate FSP based on multipliers effects in a way that maximizes employment and growth rates, the empirical tools used in this regard could be highlighted as follows:

3.1 Determining sectoral linkages

The underlying idea of calculating sectoral linkages is based mainly on finding the sectors with the highest degree of interrelation using Rasmussen approach, each sector simultaneously plays the role of a seller of its output to other industries and final demanders, and of a purchaser of outputs of other industries and of primary inputs. Theoretically, input-output tables are used in literature to record the economy’s inter-industry transactions via the disaggregation of the economic activity into “n” sectors or industries representing the producing sectors of the economy, where the economy’s total production (X) is the result of the sum of the production intended for intermediate consumption by different sectors (Z) and the final demand. The economy’s total production (X) also represents the extent to which sector j used goods produced by sector i in its total production and indicates the percentage of inputs sold to industry j by sector i in relation to the total production of sector j (Marconi *et al.*, 2016, p. 479).

In calculating sectoral linkages, Rasmussen and Chenery and Watanbe depended mainly on the technical coefficient matrix, which shows, for each industry in the economy, the

proportional value of inputs purchased from all sectors in the economy (including itself) per monetary unit of output and could be stated as $(a_{ij} = Z_{ij}/X_j)$. In this context we could differentiate between two types of linkages basically known as forward and backward linkages, which could be derived based on the following equation:

$$X = (I - A)^{-1}F$$

Where:

- x = vector output;
 I = unit matrix; and
 $(I - A)^{-1}$ = is the inverse of Leontief's matrix.

In this regard, sectoral linkages approach depends on classifying different sectors according to the power of their forward and backward linkages into four main categories stated as follows:

- (1) a Key sector is one with strong linkages (interdependency) relationships with other sectors, the economic activity of those sectors exerts a greater than average influence on the whole economy.

$$(BLI > 1 \text{ \& } FLI > 1)$$

- (2) Sectors with strong backward linkages highlight increased input demand resulting from accelerated production in a given sector, where an increased production in one of the industries may result in increased demand on the industries that produce the intermediate inputs.

$$(BLI > 1 \text{ and } FLI < 1)$$

- (3) Sectors with strong forward linkages bring into focus increased output (supply) of a sector that stimulates its increased use in other sectors, in other words an increased production in a certain industry may result in an increased supply of output for other industries to use in their production (Bess and Ambargis, 2011, p. 7):

$$(FLI > 1 \text{ and } BLI < 1)$$

- (4) sectors with weak linkages are defined as those sectors with weak sectoral interdependence, where both the forward and the backward linkages are weak:

$$(BLI < 1 \text{ and } FLI < 1)$$

As specified previously, the concept of key sectors depends mainly on the policy objectives, which emphasizes the importance of multiplier analysis. The literature on the calculation of I-O multipliers traces back to Leontief's work in 1951. Leontief developed a set of national level multipliers that could be used to estimate the economy-wide effect that an initial change in final demand has on an economy.

3.2 Computing employment and value-added multipliers

Usually various kinds of multipliers could be used to capture the effects an exogenous shock (increased demand) has on the economy. As the paper targets mainly measuring how investment in some industries would impact the overall economy, both the employment and

value-added multiplier are being calculated for 90 subsectors included in the I-O table. The multiplier effects include both indirect effects in the form of demand for intermediate inputs from other sectors in the economy and induced effects through changes in consumption demand resulting from higher household income and employment (Kamal, 2018) and could be highlighted as follows (Moursi and EL Mossalamy, 2010, p. 14–16):

- Value added multipliers: which measures the value added generated in each sector as a result of the new output and could be derived as follows:

$$mva = va \cdot R \cdot va^*$$

Where:

- VA is row vector containing the $(n+1)$ Type II labor multipliers of the ratio of the value added to the gross output for each sector
- R is the inverse of Leontief matrix
- Va* is a diagonal matrix $(n+1) \times (n+1)$ whose diagonal elements are the reciprocals of the elements of Va

Employment multipliers: which captures the number of jobs generated in each sector as a function of new output and could be derived as follows:

$$ml = L \cdot R \cdot L^*$$

Where:

- L is row vector containing the $(n+1)$ Type II labor multipliers of the ratio of the labor coefficient to the gross output for each sector
- R is the inverse of Leontief matrix
- L* is a diagonal matrix $(n+1) \times (n+1)$ whose diagonal components are the elements of the $(n+1) \times (n+1)$ row vector of labor coefficients.

3.3 Allocating fiscal stimulus package based on multipliers effects

Although measuring the sectoral linkages, is essential for measuring interdependencies between different sectors in the economy, but measuring the impact of increasing investments on those sectors on both growth rates and their ability to create job opportunities on both the sectoral level and the macro-level is also considered of the same importance to ensure optimal allocation of resources in a way that maximizes the positive impact of the investments allocated.

Optimal allocation of new investments is being done through an optimization model which tries to maximize the return on new investments based on two decision variables: employment multiplier and value-added multiplier. The model also allows decision maker to assign different weights to both goals according to the needs and priorities of the country (under the condition that $w_1 + w_2 = 1$). the model could be displayed as follows:

$$\text{Maximize} = w_1 \sum_i x_i (ml_normalized_i) + w_2 \sum_i x_i (mva_normalized_i)$$

$$\text{s.t.} \sum_i x_i \leq \text{Total Investment}$$

$$L_i \leq x_i \leq U_i, \forall i$$

$$L_i = (0.7 \times P_i \times \text{Total Investment})$$

$$B_i = (1.3 \times P_i \times \text{Total Investment})$$

$$P_i = \frac{\frac{ml_normalized_i - \min_i(ml_normalized_i)}{\max_i(ml_normalized_i) - \min_i(ml_normalized_i)}}{\sum_i \frac{ml_normalized_i - \min_i(ml_normalized_i)}{\max_i(ml_normalized_i) - \min_i(ml_normalized_i)}}$$

where:

- (ML_Normalized) _i denotes the normalized employment multiplier.
- (Mva_Normalized) _i denotes the normalized value-added multiplier.
- Xi is the Decision Variable which shows the new investments in sector I for every sector of the sectors available in the input output table.
- W1 and w2 shows the weights assigned for both employment and growth respectively where W1+ W2=1
- Li is the minimum amount of investments that could be allocated in the sector.
- Bi is the maximum amount of investments that could be allocated in the sector.

3.4 Measuring the impact of the fiscal stimulus package on both growth and employment

The impact of the FSP on growth could be measured by calculating the value-added coefficient, while the number of job opportunities could be calculated based on the employment coefficient, as follows:

- (1) **Normalized value-added coefficient:** which denotes the new value added created in the sector as a result of the new investments generated where:

$$\Delta VA = MVAC . \Delta Fi$$

$$\forall i MVAC = MVA.VA$$

- ΔVA denotes the change in value added resulting from the change in final demand (the change in final demand is basically due to the increase in investment as a result of the assumed FSP).
 - ΔFi denotes the change in final demand (due to the increase in investment).
 - MVAC denotes the value-added coefficient which is equivalent to the value-added multiplier multiplied by the vector VA (derived from the technical coefficient matrix).
- (2) Normalized employment coefficient: which refers to the multiplier deflated by the average wages for each sector:

$$AL = MLC.AFi$$

$$\forall i MLC = MLL.L/W$$

- L denotes the change in employment level resulting from the change in final demand (the change in final demand is basically due to the increase in investment as a result of the assumed FSP).
- ΔFi denotes the change in final demand (due to the increase in investment).
- MVLC denotes the employment coefficient which is equivalent to the employment multiplier multiplied by the vector L deflated by the average wages for each sector (to reflect the number of job opportunities offered as the input output table only shows monetary values).

4. Intersectoral linkages and optimal allocation of fiscal stimulus key results

4.1 Sectoral composition of the Egyptian economy

The section below highlights the sectoral composition of the Egyptian economy based on the latest I-O table available for Egypt which was being published in 2018, the sectors could be categorized in four main categories as follows:

4.1.1 Key sectors indicators. 14 sectors were being considered as leading or key sectors. most of them belong to the industrial sector which includes: manufacturing of computer, electronic and optical products, manufacturing of rubber and plastics products, manufacturing of textiles.it also includes some petroleum industries such as: generating electricity and gas delivery, Coke and refined petroleum Products, other mining and quarrying activities. The large number of industrial sectors within the key sectors confirm the importance of the manufacturing sector in the process of industrial growth in the economy.

Regarding their ability to generate growth and increase employment levels, it is worth mentioning that the key sectors ranked the highest among the sectors in terms of value-added multiplier (with a mean equal to 2.95) and also recorded high levels of employment multipliers (with a mean equal to 1.77) (Figure 1).

4.1.2 Strong backward linkages sectors indicators. 22 sectors had high Backward Linkages, which means that those sectors have more dependency to other sectors, and they act as intermediate buyers rather than intermediate sellers. most of those sectors also belong to the manufacturing industries. the sectors with the highest backward linkages within the manufacturing industry includes: Manufacturing of food products, Manufacturing of paper

	Sub sectors	Backward Linkage Index	Forward Linkage Index	Value added Multiplier	Employment multiplier
1	Support activities to agriculture and post-harvest crop activities	1.014	2.397	1.54	1.15
2	Other mining and quarrying	1.101	2.681	1.59	1.64
3	Manufacture of textiles	2.137	2.389	3.82	1.85
4	Coke and refined petroleum Products	2.764	1.760	3.27	2.25
5	Manufacture of chemicals and chemical products	1.621	1.774	2.33	2.03
6	Manufacture of rubber and plastics products	2.117	1.167	3.98	2.00
7	Other non-metal products	1.831	1.234	2.67	1.97
8	Manufacturing basic metals	1.434	3.366	1.95	2.24
9	Manufacture of fabricated metal products, except machinery and equipment	1.244	1.564	1.73	1.72
10	.Manufacture of machinery and equipment n.e.c	1.841	3.169	2.67	1.46
11	Manufacturing of transport equipment	1.726	1.199	2.43	1.20
12	Manufacture of computer, electronic and optical products	2.154	1.057	7.23	2.40
13	Generating electricity	3.406	1.007	2.19	1.26
14	Gas delivery	1.624	1.137	3.85	1.64
	Mean	1.85	1.85	2.95	1.77
* Sectors are being categorized according to the values of both employment & value-added multipliers, darker color code reflects higher multiplier values category.					
Low Values of linkages and multiplier effect			High Values of linkages and multiplier effect		

Figure 1.
Key sectors
backward and
forward linkages
index and multipliers

and paper products, Manufacturing of leather and related products, and Manufacturing of transport equipment.

Although most of the sectors with high backward linkages came from the manufacturing sector, but some of them belongs to the service sector such as: Food and Beverage Services Activities, Accommodation, Travel Agency, Tour Operator, Reservation Service and Related Activities. The estimated multipliers for both job opportunities and value-added multipliers varied considerably across sectors ranging between 1.559 for Telecommunication to 3.896 for Manufacturing of Manufacture of paper and paper products for the value-added multiplier and 1.107 for water collection, treatment and sewage networks and 13.43 for the manufacture of Manufacture of leather and related products for the employment multiplier, which is considered the highest sector in terms of creating job opportunities (Figure 2).

4.1.3 Strong forward linkages sectors indicators. The forward linkage of a sector reflects the dependence of the remaining sectors in the economy on sectors supplies that are produced within the production process (Fathi, 2014, p. 12), 22 sectors within the input output table shows strong forward linkages, the value of the indicator reflects the proportion of final demand of the sector is larger than its intermediate demand in Egypt, which means that those sectors has a leading role in creating demand. Most of the sectors with strong forward linkages belongs to the service sectors, which includes: Architectural and Engineering Activities; Technical Testing and Analysis, Repair of Computers and Personal and Household Goods, together with some petroleum related activities including: Extraction of Crude Petroleum and Natural Gas, and Mining

	Sub sectors	Backward Linkage Index	Forward Linkage Index	Value added Multiplier	Employment multiplier
1	Growing of Cereals (Except Rice), Leguminous Crops And Oil Seeds	0.985	2.796	1.496	1.762
2	Growing of rice	0.751	1.653	1.338	1.569
3	Other crops	0.372	2.489	1.144	1.216
4	Extraction of Crude Petroleum and Natural Gas	0.125	2.413	1.045	1.321
5	Mining of Metal Ores	0.861	3.845	1.428	1.994
6	Mining Support Service Activities	0.843	2.325	1.401	1.304
7	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.267	4.507	1.110	1.514
8	Other manufacturing Industries	0.088	2.234	1.031	1.028
9	Repair Of Machinery	0.001	2.528	1.000	1.000
10	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	0.692	1.210	1.342	1.258
11	Computer Programming, Consultancy & Related Activities	0.212	1.827	1.081	1.089
12	Other Financial Service Activities, Except Insurance & Pension Funding Activities	0.228	1.227	1.085	1.068
13	Activities of Head Offices; Management Consultancy Activities	0.373	1.827	1.146	1.150
14	Architectural and Engineering Activities; Technical Testing and Analysis	0.843	1.827	1.401	1.272
15	Repair of Computers and Personal and Household Goods	0.246	1.507	1.098	1.728
16	Advertising and Market Research	0.486	1.823	1.197	1.193
17	Other Professional, Scientific and Technical Activities	0.531	1.827	1.219	1.072
18	Rental and Leasing Activities	0.947	1.731	1.514	1.212
19	Usage activities	0.194	1.482	1.073	1.100
20	Security and Investigation Activities	0.137	1.482	1.054	1.058
21	Services to Buildings and Landscape Activities	0.237	1.482	1.091	1.074
22	Office Administrative, Office Support and Other Business Support Activities	0.540	1.541	1.231	1.177
	Mean	0.45	2.07	1.20	1.28

* Sectors are being categorized according to the values of both employment & value-added multipliers, darker color code reflects higher multiplier values category. Low Values of linkages and multiplier effect High Values of linkages and multiplier effect

Figure 2.
Sectors with strong
backward linkages
index and multipliers

Support Service Activities. Some agricultural products also have strong forward linkages such as: Growing of Cereals (Except Rice), Leguminous Crops and Oil Seeds, and growing rice.

Regarding their ability to generate growth and increase the employment levels, it is worth mentioning that those sectors have relatively low ability of increasing growth rates and in creating job opportunities, where the value-added Multiplier ranged between 1 for repair of machinery and 1.514 for Rental and Leasing Activities, while the employment multiplier ranged between 1.000 also for the repair of machinery and 1.994 for Mining of Metal Ores (Figure 3).

4.1.4 Weak sectoral linkages sectors indicators. Those sectors are the sectors that do not have considerable values in either backward linkages or forward linkages, 32 sub sectors from the 90 sub sectors in the input output tables (nearly 30%) have weak sectoral linkages. Most of them belong to the service sector, in addition to few sectors related to the retail and wholesale trade, and two sectors related to the agricultural products including: Growing of Vegetables and Melons, Roots and Tubers and Fishing and aquaculture. It is worth mentioning that those sectors have limited ability in terms of increasing growth rate represented through the value-added multiplier ranging between 1.004 for Scientific research and development and 1.535 for Libraries, the employment multiplier within those sectors ranges between 1.013 for education and 2.390 for real estate activities (Figure 4).

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20	Security and Investigation Activities	0.137	1.482	1.054	1.058
21	Services to Buildings and Landscape Activities	0.237	1.482	1.091	1.074
22	Office Administrative, Office Support and Other Business Support Activities	0.540	1.541	1.231	1.177
	Mean	0.45	2.07	1.20	1.28
* Sectors are being categorized according to the values of both employment & value-added multipliers, darker color code reflects higher multiplier values category.					
Low Values of linkages and multiplier effect		High Values of linkages and multiplier effect			

Figure 3.
Sectors with strong forward linkages index and multiplier

	Sub sectors	Backward Linkage Index	Forward Linkage Index	Value added Multiplier	Employment multiplier
1	Public administration and defense; compulsory social security	0.732	0.059	1.347	1.074
2	Education	0.211	0.034	1.079	1.013
3	Human health activities	0.843	0.053	1.429	1.099
4	Residential Care Activities and Social Work Activities with accommodation	0.599	0.075	1.272	1.232
5	Other Social Work Activities Without Accommodation	0.615	0.075	1.281	1.161
6	Creative, arts and entertainment activities	0.867	0.251	1.457	1.425
7	Libraries, Archives, Museums and Other Cultural Activities	0.997	0.251	1.535	1.074
8	Sports activities and amusement and recreation activities	0.488	0.054	1.217	1.050
9	Other personal service activities	0.674	0.838	1.320	1.284
10	Home services activities	0.000	1.000	1.000	1.000
11	Veterinary activities	0.587	0.075	1.252	1.262
12	Scientific research and development	0.010	0.835	1.004	1.105
13	Activities Auxiliary to Financial Service and Insurance Activities	0.590	0.449	1.252	1.054
14	Real estate activities	0.388	0.024	1.153	2.390
15	Legal and accounting activities	0.475	0.472	1.194	1.113
16	Insurance, reinsurance and pension funding, except compulsory social security	0.459	0.213	1.186	1.157
17	Information service activities	0.443	0.683	1.185	1.168
18	Wholesale Trade, Except of Motor Vehicles and Motorcycles	0.553	0.836	1.256	1.321
19	Retail Trade, Except of Motor Vehicles and Motorcycles	0.427	0.668	1.193	1.170
20	Water transport	0.846	0.121	1.425	1.461
21	Warehousing and support activities for transportation	0.111	0.222	1.040	1.101
22	National posts and parcel activities	0.258	0.456	1.097	1.040
23	Motion Picture, Video and Television Program Production, Sound Recording and Music Publishing Activities	0.465	0.251	1.194	1.631
24	Programming and broadcasting activities	0.933	0.141	1.468	1.199
25	Electric power transmission and distribution	0.758	0.690	1.403	1.036
26	Waste Collection, Treatment and Disposal Activities; Materials Recovery	0.687	0.022	1.351	1.710
27	Specialized construction activities	0.881	0.432	1.429	1.417
28	Manufacture of wearing apparel	0.850	0.115	1.413	2.116
29	Manufacture of furniture	0.765	0.032	1.365	1.185
30	Printing and Reproduction of Recorded Media	0.197	0.776	1.077	1.232
31	Growing of Vegetables and Melons, Roots and Tubers	0.659	0.523	1.287	1.322
32	Fishing and aquaculture	0.373	0.324	1.149	1.079
	Mean	0.55433	0.3452	1.25966	1.271216

* Sectors are being categorized according to the values of both employment & value-added multipliers, darker color code reflects higher multiplier values category. Low Values of linkages and multiplier effect High Values of linkages and multiplier effect

Figure 4.
Sectors with weak
linkages index and
multiplier

4.2 Allocating fiscal stimulus packages based on sectoral linkages

Accordingly, the paper tries to measure the impact of allocating L.E 100 bn new investments offered as a fiscal stimulus in Egypt to reduce the negative impact of COVID-19 based on the sectoral linkages in a way that targets more the key sectors and the sectors which have strong backward linkages as they are more capable of increasing growth rates and offering more job opportunities (which is clearly obvious from the values of both the value added and employment multipliers).

The allocation of the stimulus package across sectors is portrayed in the figure below. The diagram indicates that both the largest share of the new investments allocated from the fiscal stimulus should be allocated among the key sectors and the sectors with strong backward linkages as they are the most capable of creating job opportunities and increasing growth rates, while the shares of both sectors with strong forward linkages and sectors with weak linkages should be relatively low (Figure 1).

According to the results of the optimization model:

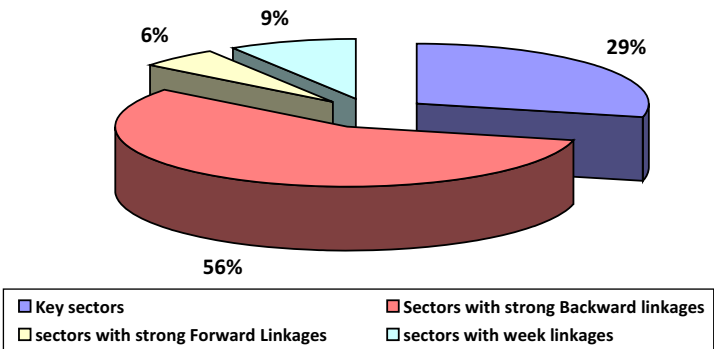
- Sectors with strong backward linkages grasped L.E 55.91 bn representing nearly 56% of the new investments allocated from the fiscal stimulus through the optimization model, this could be simply interpreted by the fact that those sectors were the highest in terms of the value-added multiplier and the employment multiplier.
- The Key sectors came in the second stage in terms of the investments allocated through the fiscal stimulus from the optimization model, as they are also characterized by their strong value-added and employment multiplier which ensures their positive impact on the economy as a whole in terms of increasing growth rates and increasing job opportunities, in this regard L.E 27.98 bn of the fiscal stimulus are being allocated among key sectors representing nearly 27.98%.
- The share of both groups including sectors with strong forward linkages and those with weak sectoral linkages were relatively low compared to the key sectors and those with strong backward linkages, their share from the FSP represent nearly 5.4% and 8.73% respectively, where the sectors with strong forward linkages grasped only L.E 5.4 bn from the new investments distributed among the FSP, while the weak sectoral linkages grasped L.E 8.73 bn.

4.3 Calculating the fiscal stimulus package impact on growth and employment

According to the results of the FSP of allocating L.E 100 bn among different sectors the growth rate will increase by 1.768%, resulted from an increase in the GDP by L.E 108522.63 mn. the fiscal stimulus also resulted in an increase in the number of job opportunities by 575.83 thousand jobs. Major highlights of the FSP effects on the economy as a whole could be displayed from the following table, then key findings are being highlighted on the level of each category based on their intersectoral linkages after considering both the value-added coefficient and employment coefficient (Table 1):

- (1) The key sectors managed to increase the GDP growth rate by 0.58% and managed to create 144.64 thousand job opportunities, the manufacturing sectors were the highest in terms of offering job opportunities within the key sectors, where the Manufacture of textiles created 46.24 thousand job opportunities, the Manufacture of rubber and plastics products created 23.11 thousand job opportunities, while the gas delivery created 17.58 thousand job opportunities (Figure 6).

Figure 5.
Share of different
sectoral groups in the
fiscal stimulus based
on the intersectoral
linkages



- (2) It is also worth mentioning that the manufacturing sectors were also leading in terms of their ability to increase growth rate, where the highest sectors in this regard includes: Manufacture of computer, electronic and optical products, together with Manufacture of rubber and plastics products and Manufacture of textiles.
- (3) The new investments allocated through the FSP to the sectors with strong backward linkages helped in increasing the GDP growth rate by 0.948% and in offering 354.5 thousand job opportunities, the manufacturing sectors also took the lead in creating job opportunities within the sectors with strong backward linkages including: Manufacture of leather and related products 63.281 thousand job opportunities, Manufacture of food products 30.823 thousand job opportunities, Manufacture of paper and paper products 28.819 thousand job opportunities, and Manufacture of transport equipment 17.225 thousand job opportunities. The manufacturing sectors also took the lead in terms of their ability in increasing growth rates, where the highest sector was Manufacture of leather and related products (Figure 7).
- (4) Both the sectors with strong forward linkages and the sectors with weak linkages share in increasing growth rate and employment opportunities are relatively small

Table 1.
Effects of the FSP on
both growth and
employment in the
egyptian economy

Category	New Growth Rate (%)	New value added (mn L.E)	New Job Opportunities (Thousand job opportunities)
1 Key sectors	0.58	35518.55	144.64
2 Strong Backward Linkages Sectors	0.948	58444.35	354.5
3 Strong Forward Linkages Sectors	0.09	5558.03	17.89
4 Weak Linkages Sectors	0.15	9001.7	58.8
Total	1.768	108522.6	575.83

	Sub sectors	Value added Coefficient	Employment Coefficient	New Job Opportunities (Thousand job opportunities)	New Value added (mn L.E)	New Growth Rate (%)
1	Support activities to agriculture and post-harvest crop activities	1.04	0.33	2.30	382.06	0.01
2	Other mining and quarrying	1.01	0.14	1.76	645.01	0.01
3	Manufacture of textiles	1.01	0.67	46.24	3630.50	0.06
4	Coke and refined petroleum Products	1.34	0.05	2.97	4535.23	0.07
5	Manufacture of chemicals and chemical products	1.05	0.25	5.82	1286.64	0.02
6	Manufacture of rubber and plastics products	1.09	0.31	23.11	4202.44	0.07
7	Other non-metal products	1.10	0.26	6.88	1508.27	0.02
8	Manufacturing basic metals	0.99	0.11	2.32	1110.28	0.02
9	Manufacture of fabricated metal products, except machinery and equipment	0.99	0.15	2.14	744.13	0.01
10	Manufacture of machinery and equipment n.e.c	1.00	0.28	6.04	1115.46	0.02
11	Manufacturing of transport equipment	1.02	0.50	8.33	878.22	0.01
12	Manufacture of computer, electronic and optical products	1.50	0.10	14.24	11153.55	0.18
13	Generating electricity	1.26	0.33	4.90	961.93	0.02
14	Gas delivery	0.99	0.27	17.58	3364.85	0.05
	Total			144.64	35518.55	0.58

* Sectors are being categorized according to the values of both employment & value-added multipliers, darker color code reflects higher multiplier values category.

Low Values of linkages and multiplier effect High Values of linkages and multiplier effect

Figure 6.
Effects of the FSP on
both growth and
employment of key
sectors

compared to both key sectors and sectors with strong backward linkages, where the sectors with strong forward linkages increased growth rates by 0.09 and offered 17.89 job opportunities, while the sectors with weak linkages managed in increasing growth rates by 0.15% and offered 58.80 thousand job opportunities. The highest performing sectors among both categories could be displayed as follows:

- Among the sectors with strong forward linkages: Growing of Cereals (Except Rice), Leguminous Crops and Oil Seeds, together with Other Professional, Scientific and Technical Activities were the highest in terms of creating job opportunities due to the new investments offered through the FSP. While most of the sectors within the forward linkages category were relatively limited in terms of their ability in increasing growth rates (Figure 8).
- Among the sectors with weak linkages: The Wholesale Trade, Except of Motor Vehicles and Motorcycles, Libraries, together with Archives, Museums and Other Cultural Activities, and the Human health activities were the highest in terms of creating job opportunities due to the new investments offered through the FSP. the sectors with weak sectoral linkages category were relatively limited in terms of their ability in increasing growth rates (Figure 9).

	Sub sectors	Value added Coefficient	Employment Coefficient	New Job Opportunities (Thousand job opportunities)	New Value added (mn L.E)	New Growth Rate (%)
1	Growing Perennials	2.17	1.63	5.693	937.060	0.015
2	Animal production	1.94	1.88	3.467	942.394	0.015
3	Manufacture of food products	3.75	3.89	30.823	5497.647	0.089
4	Manufacture of beverages	2.02	2.13	5.382	1119.018	0.018
5	Manufacture of tobacco products	1.92	1.43	4.440	643.983	0.010
6	Manufacture of leather and related products	2.79	13.44	63.281	13497.93	0.219
7	Manufacture of paper and paper products	3.90	2.23	28.819	4223.761	0.069
8	pharmaceutical products and pharmaceutical preparations	3.23	1.57	7.609	1582.981	0.026
9	Manufacture of electrical equipment	3.18	1.66	15.705	2759.524	0.045
10	Manufacture of transport equipment	3.70	2.55	17.225	4023.611	0.065
11	water collection, treatment & sewage networks	1.93	1.11	8.071	628.118	0.010
12	Construction of buildings	2.41	2.65	5.671	2913.652	0.047
13	Civil Engineering	2.41	1.35	4.301	913.457	0.015
14	Land transport & Transport via pipelines	1.65	1.15	3.301	475.078	0.008
15	Air transport	2.13	1.55	1.420	1080.290	0.018
16	Accommodation	1.59	1.60	2.492	645.801	0.010
17	Food & Beverage Services Activities	1.67	1.68	5.688	701.562	0.011
18	Publishing Activities	1.95	1.18	9.056	633.234	0.010
19	Telecommunication	1.56	1.91	1.280	775.257	0.013
20	Travel Agency, Tour Operator, Reservation Service and Related Activities	1.87	2.23	2.353	1099.731	0.018
21	Gambling & Betting Activities	9.61	3.58	109.94	12362.58	0.201
22	Activities of Membership Organizations	2.54	1.27	18.485	987.677	0.016
Total				354.5	58444.35	0.948
* Sectors are being categorized according to the values of both employment & value-added multipliers; darker color code reflects higher multiplier values category.						
			Low Values of linkages and multiplier effect			
			High Values of linkages and multiplier effect			

Figure 7.
Effects of the FSP on both growth and employment of sectors of strong backward linkages

	Sub sectors	Value added Coefficient	Employment Coefficient	New Job Opportunities (Thousand job opportunities)	New Value added (mn L.E)	New Growth Rate (%)
1	Growing of Cereals (Except Rice), Leguminous Crops and Oil Seeds	1.01	0.00	2.481	645.587	0.010
2	Growing of rice	1.00	0.00	1.652	464.797	0.008
3	Other crops	1.00	0.00	0.646	184.173	0.003
4	Extraction of Crude Petroleum and Natural Gas	1.00	0.00	0.076	183.574	0.003
5	Mining of Metal Ores	1.02	0.00	0.726	732.162	0.012
6	Mining Support Service Activities	1.00	0.00	1.323	366.094	0.006
7	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1.01	0.00	0.336	316.120	0.005
8	Other manufacturing Industries	1.00	0.00	0.117	30.253	0.000
9	Repair of Machinery	1.00	0.00	0.001	0.279	0.000
10	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	1.08	0.00	0.410	335.240	0.005
11	Computer Programming, Consultancy & Related Activities	1.01	0.00	0.162	88.092	0.001
12	Other Financial Service Activities, Except Insurance & Pension Funding Activities	1.00	0.00	0.151	79.219	0.001
13	Activities of Head Offices; Management Consultancy Activities	1.00	0.00	0.459	152.250	0.002
14	Architectural and Engineering Activities; Technical Testing and Analysis	1.00	0.00	1.299	348.999	0.006
15	Repair of Computers and Personal and Household Goods	1.00	0.01	1.071	201.137	0.003
16	Advertising and Market Research	1.00	0.01	1.630	152.818	0.002
17	Other Professional, Scientific and Technical Activities	1.10	0.01	2.280	415.672	0.007
18	Rental and Leasing Activities	1.00	0.00	0.256	88.776	0.001
19	Usage activities	1.01	0.01	0.389	57.804	0.001
20	Security and Investigation Activities	1.01	-	-	86.149	0.001
21	Services to Buildings and Landscape Activities	1.01	0.01	1.521	211.789	0.003
22	Office Administrative, Office Support and Other Business Support Activities	1.01	0.00	0.903	417.049	0.007
	Total			17.89	5558.03	0.09

* Sectors are being categorized according to the values of both employment & value-added multipliers, darker color code reflects higher multiplier values category. Low Values of linkages and multiplier effect High Values of linkages and multiplier effect

Figure 8.
Effects of the FSP on
both growth and
employment of
sectors of strong
forward linkages

5. Conclusion

During tough economic times, the government is required to make hard decisions related to the optimal allocation of resources, COVID-19 pandemic was one of the worst global crises, which affected the world economy negatively. In this regard, new investments should be allocated in industries with the highest returns to the overall economic activities, with high sectoral linkages and high multiplier effects. studying intersectoral linkages based on IO analysis helps in understanding how domestic industries are interrelated with one another, IO models, in this context is considered a powerful tool for estimating the economy-wide effects of an initial change (being it an endogenous or exogenous shock) in economic activity. The paper employed a static input-output model to identify inter-linkages within the Egyptian economy. Also, multipliers are being used to determine which industries would have the highest spillover effects at the economy wide level in case of an industry specific investment, then it concludes with measuring the effect of the FSP on both increasing the GDP growth rate and increasing employment opportunities.

The paper distributed economic sectors among 4 main categories according to the strength of their intersectoral linkages where: 14 sectors were considered key sectors, 22 sectors were considered sectors with strong backward linkages, 22 sectors were considered sectors with strong forward linkages, and 32 sectors were considered of weak linkages. It is worth mentioning that both the leading sectors and the sectors with strong backward linkages were among the highest in terms of offering job opportunities and increasing growth rates.

The paper also focused on allocating a fiscal stimulus of L.E 100bn as new investments among different economic sectors to reduce the negative effect of COVID-19 on the economy

Figure 9.
Effects of the FSP on
both growth and
employment of
sectors of weak
forward linkages

		Value added Coefficient	Employment Coefficient	New Job Opportunities (Thousand job opportunities)	New Value added (mn L.E)	New Growth Rate (%)
	Sub sectors					
1	Growing of Vegetables and Melons, Roots and Tubers	1.01	0.00	1.08	314.11	0.01
2	Fishing and aquaculture	1.01	0.00	0.49	119.45	0.00
3	manufacture of wearing apparel.	1.00	0.01	6.53	771.09	0.01
4	Printing and Reproduction of Recorded Media	1.01	0.00	0.24	157.38	0.00
5	manufacture of furniture	0.99	0.01	3.20	283.03	0.00
6	Electric power transmission and distribution	1.13	0.01	2.47	263.99	0.00
7	Waste Collection, Treatment and Disposal Activities; Materials Recovery	1.11	0.00	0.51	596.07	0.01
8	Specialized construction activities	1.00	0.00	1.18	434.40	0.01
9	Wholesale Trade, Except of Motor Vehicles and Motorcycles	1.06	0.00	0.65	311.94	0.01
10	Retail Trade, Except of Motor Vehicles and Motorcycles	1.05	0.00	0.64	195.97	0.00
11	Water transport	1.06	0.00	1.41	483.40	0.01
12	Warehousing and support activities for transportation	1.00	0.00	0.08	71.50	0.00
13	National posts and parcel activities	1.00	0.01	0.73	71.50	0.00
14	Retail Trade, Except of Motor Vehicles and Motorcycles	1.02	0.00	1.08	423.78	0.01
15	Wholesale Trade, Except of Motor Vehicles and Motorcycles	1.02	0.02	7.80	355.04	0.01
16	Information service activities	1.02	0.01	1.20	185.16	0.00
17	Insurance, reinsurance and pension funding, except compulsory social security	1.01	0.00	0.61	178.63	0.00
18	Legal and accounting activities	1.01	0.03	4.85	162.71	0.00
19	Real estate activities	1.00	0.00	0.71	773.86	0.01
20	Activities Auxiliary to Financial Service and Insurance Activities	1.00	0.00	0.63	159.72	0.00
21	Scientific research and development	1.00	0.00	0.01	54.23	0.00
22	Veterinary activities	1.01	0.01	1.76	265.20	0.00
23	Public administration and defense; compulsory social security	1.04	-	-	231.01	0.00
24	Education	1.00	0.03	1.45	48.76	0.00
25	Human health activities	1.03	0.01	3.68	286.36	0.00
26	"Residential Care Activities and Social Work Activities with accommodation	1.02	0.01	1.80	266.36	0.00
27	Other Social Work Activities Without Accommodation	1.02	0.02	3.59	234.48	0.00
28	Creative, arts and entertainment activities	1.09	0.00	1.31	493.87	0.01
29	Libraries, Archives, Museums and Other Cultural Activities	1.05	0.02	4.97	338.75	0.01
30	Sports activities and amusement and recreation activities	1.04	0.02	3.31	145.14	0.00
31	Other personal service activities	1.04	0.00	0.85	324.78	0.01
32	Home services activities	1.00	0.01	0.00	0.00	0.00
	Total			58.80	9001.70	0.15
* Sectors are being categorized according to the values of both employment & value-added multipliers, darker color code reflects higher multiplier values category. Low Values of linkages and multiplier effect High Values of linkages and multiplier effect						

based on empirical model which targeted more those sectors with higher employment and value-added multipliers to increase the positive impact of the fiscal stimulus. In this regard the FSP managed to increase growth rate by 1.768% and offered 575.83 job opportunities, where both key sectors and sectors with strong backward linkages had the largest share combined in terms of creating job opportunities and increasing growth rates, further studies could be done in this regard to encourage investing in key sectors and sectors with strong backward linkages to increase their positive impact on the economy as a whole.

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