Using Output and Labour Multipliers to Target Incentives for Fast Economic Recovery: The Cases of Ethiopia and Kenya

Max Mendez-Parra

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Bringing Rigour and Evidence to Economic Policy Making in Africa

Using Output and Labour Multipliers to Target Incentives for Fast Economic Recovery: The Cases of Ethiopia and Kenya

By

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Contents

List of tables

List of figures

List of abbreviations and acronyms

IFPRI	International Food Policy Research Institute
SAM	Social Accounting Matrix

Abstract

This paper provides an initial approach on the use of input-output tables to calculate output and labour multipliers. It uses the Ethiopia and Kenya country case studies to illustrate the procedure.The output and labour multipliers are helpful to understand the backward linkages and the economy-wide employment generation of specific sectors. The multipliers indicate the capability of a demand-induced shock to generate output and employment directly and indirectly. In this way, it is possible to determine the sectors that, through stimulus of different nature, can deliver the maximum effect on economic recovery.

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1. Introduction

A policy maker interested in promoting economic transformation needs information about the type of sectors and activities that have the greatest knock-on effects on output and employment of different types of labour. The most appropriate sectors have the ability to raise the output of other sectors through backward linkages and to generate jobs. This remains relevant in the current crisis context. Understanding the sectors with the largest direct and indirect impact in output and in employment will help to design a fast economic recovery strategy.

In particular, the identification of sectors with maximum direct and indirect employment impact is critical in the development of opportunities for the young. The generation of employment for its young population constitutes one of the most critical challenges that African countries face. The multiplier analysis can help to identify, from the demand point of view, sectors where targeted policies can help to boost employment for the youth. On the supply-side, a series of policies aimed to enhance existing or create new skills can complete the strategy.

Output and employment multipliers calculate the value of production in all sectors and payments to factors of production (mainly labour) that will be necessary in order to meet a level of final demand. They take into account the direct and indirect effects through all sectors of the economy. The analysis can also be turned around. In this example, we calculate output and employment multipliers using social accounting matrices (SAMs) for Ethiopia and Kenya.

The remainder of this paper is structured as follows. Section 2 discusses the data and methodology used to calculate the multipliers. It uses the specific case of Kenya alongside the methodological discussion. Section 3 and Section 4 present the calculations and discussions for Kenya and Ethiopia, respectively. The paper closes with some conclusions in Section 5.

2. Data and methodology

There are a number of data options for calculating multipliers; but at the minimum, they need to include information about how sectors are linked to each other through purchasing and delivering inputs. Input-output (I-O) tables usually contain these data. For this example, we use the Kenyan Social Accounting Matrix for 2013 (Randriamamonjy & Thurlow, 2017). It represents 58 activities and commodities. However, it does not make a distinction between different types of labour based on the level of education. Having this information would have allowed to target incentives towards the sectors that employ significant numbers of low-skilled workers and, consequently, potentially more vulnerable. However, in the context of accelerating the economic recovery, targeting sectors with significant losses in terms of employment may provide a better strategy. The matrix informs about the sector use of capital and land.

The matrix represents the transfers and transactions between sectors and institutions. Activities purchase factors and use these to produce goods and services. They sell them via commodity markets (plus imports) to households, the government, investors, and the rest of the world. This circular framework implies that each institution's expenditure becomes the income of another institution. For additional discussion, please see Pyatt and Round (1985) and Relnert and Roland-Holst (1997).

An increase in an exogenous variable, such as exports, raises output in a sector, which triggers both direct and indirect effects. Direct effects are those exclusively affecting the sector where the shock hit first. For example, an increase in the demand for maize will have a direct impact on maize production. In addition, it will have indirect effects coming from the maize production linkages to other sectors. In turn, the production effect on these other sectors might also influence maize production through their linkages with this sector. When we add the direct and indirect effects, we get a measure of the multiplier effect of the shock.

The recursion present between direct and indirect effects—where the effects on the backward linkages may affect the sector where the shock originated—is worked out using the Leontief Input-Output Model. This framework estimates the effects of a one-unit increase in the sectoral final demand on the output of all the sectors of the economy. In addition, it indicates the total effect on the payments to each of the production factors (a payroll effect). This will include both the payments made by the sector directly affected and those made through the indirect effects. Assuming

infinitely elastic labour supply in such a way that changes in the payments to factors are attributed exclusively to changes in quantities, it is possible to find the effects of the shock on the use of each of the factors of production. More discussion and detailed formulae on the multipliers can be found in Round (2003) and Breisinger et al. (2009); see also the appendix.

It is important to highlight the unconstrained nature of this exercise. It is assumed that the economy can meet any final demand shock and that no frictions exist. In reality, there will be competition for resources. For example, maize, sorghum, and oilseeds tend to compete for land. This means that an increase in the demand for one of these crops may require the reduction of output in the others. Moreover, some sectors have their output capacity limited. For example, the output of mining depends on the availability of the mineral resource extracted. Although it is possible to introduce output limitations to the input-output model, the competition for resources as well as other interactions between all the markets in the economy needs to be explored with other methodologies such as computable general equilibrium models.

An additional limitation of the input-output model is associated with its high level of sectoral aggregation. As we mentioned, the Kenyan SAM includes 58 sectors. Although it presents a detailed disaggregation for agriculture and food products, it presents very high levels of aggregation in the rest of the sectors. This presents problems at the time of evaluating the effects, as it is necessary to extend average results to multiple products and sub-sectors. For example, machinery and vehicles represents a very heterogeneous group of sectors that will receive the same impact. Other methodologies, such as partial equilibrium models, allow a further disaggregation of the economy; however, the indirect effects, by definition, are lost.

Finally, the data requirements of input-output tables and SAMs are very high. This implies that they are frequently outdated (the current version for Kenya from the International Food Policy Research Institute (IFPRI) refers to 2013, and we know that the economy may have suffered some structural changes since then. Moreover, they represent single points in time without further observations. As long as the economy has not been subjected to shocks that substantially changed its structure, it is possible to use a ‘recent’ SAM. However, any economy would experience long-term transformations, which require updates of input-output tables or SAMs.

3. Output and employment effects in Kenya

Table 1 presents the multiplier effects in output and in labour and the value of output in each sector. Each number indicates the increase in the output or payment to labour (in millions of Kenyan shillings, or any other unit) caused by an increase of one billion in the final demand of each product. A one unit shock (e.g., one million Kenyan shillings) applied to maize, for example, will have a total output effect of 1.78 units (in millions of Kenyan shillings). This includes the direct effect on maize and the indirect effects on the rest of the sectors. In addition, the shock will increase by 0.60 million Kenyan shillings the total payments to workers. Therefore, it is possible to identify the sectors that will have a stronger multiplier effect on output and labour.

The sectors placed in the top of the table have the highest output multiplier (although many sectors are not currently exporting). These are sectors with important final demand components. However, the limited size of the domestic market may hamper final demand which makes those sectors unlikely to stimulate large increases in output and employment. They could only do so if they manage to find additional demand in the rest of the world. Moreover, the direct effects primarily explain the size of the total multipliers, because the backward linkages in these sectors tend to be small.

If we go further down the table, there are some sectors with positive and large exports and an important multiplier effect. These are typical industrial products (sisal, livestock, fisheries, pulses, cashews) but also services such as hotels and catering. The latter is associated with, among other activities, tourism.

Table 1: Multiplier effect of increase of one million Kenyan shillings in final demand by product in Kenya

	Value of output (in millions of Ksh)	Output Multiplier	Employment Multiplier
Education	324,266	2.03	0.80
Construction	648,238	1.92	0.11
Sugar cane	33,385	1.90	0.48
Other roots	46,422	1.88	0.74
Fruits and nuts	158,023	1.87	0.74
Other cereals	34,554	1.86	0.89
Fruit and vegetable processing	58,638	1.81	0.33
Cassava	10,066	1.81	0.71
Coffee and tea	179,675	1.79	0.71
Groundnuts	9,359	1.79	0.59
Maize	193,606	1.78	0.60
Rice	12,339	1.77	0.43
Pulses	97,868	1.75	0.68
Other foods	157,664	1.75	0.30
Other services	122,558	1.73	0.25
Health and social work	107,377	1.71	0.43
Other crops	69,001	1.71	0.60
Cattle	276,092	1.71	0.40
Accommodation and food services	181,658	1.69	0.19
Wholesale and retail trade	688,307	1.68	0.23
Public administration	328,726	1.64	0.42
Information and communication	154,739	1.62	0.19
Other livestock	30,632	1.62	0.52
Electricity, gas and steam	130,743	1.62	0.16
Cotton and fibres	1,167	1.61	0.62
Water supply and sewage	113,175	1.60	0.23
Finance and insurance	227,538	1.59	0.31
Vegetables	125,696	1.58	0.60
Fats and oils	41,001	1.54	0.28
Beverages	126,231	1.51	0.22
Sorghum and millet	12,099	1.50	0.65
Poultry	28,817	1.50	0.38
Real estate activities	385,622	1.49	0.38
Transportation and storage	508,021	1.39	0.20
Sugar refining	55,066	1.37	0.22
Business services	120,040	1.32	0.35

continued next page

Table 1 Continued

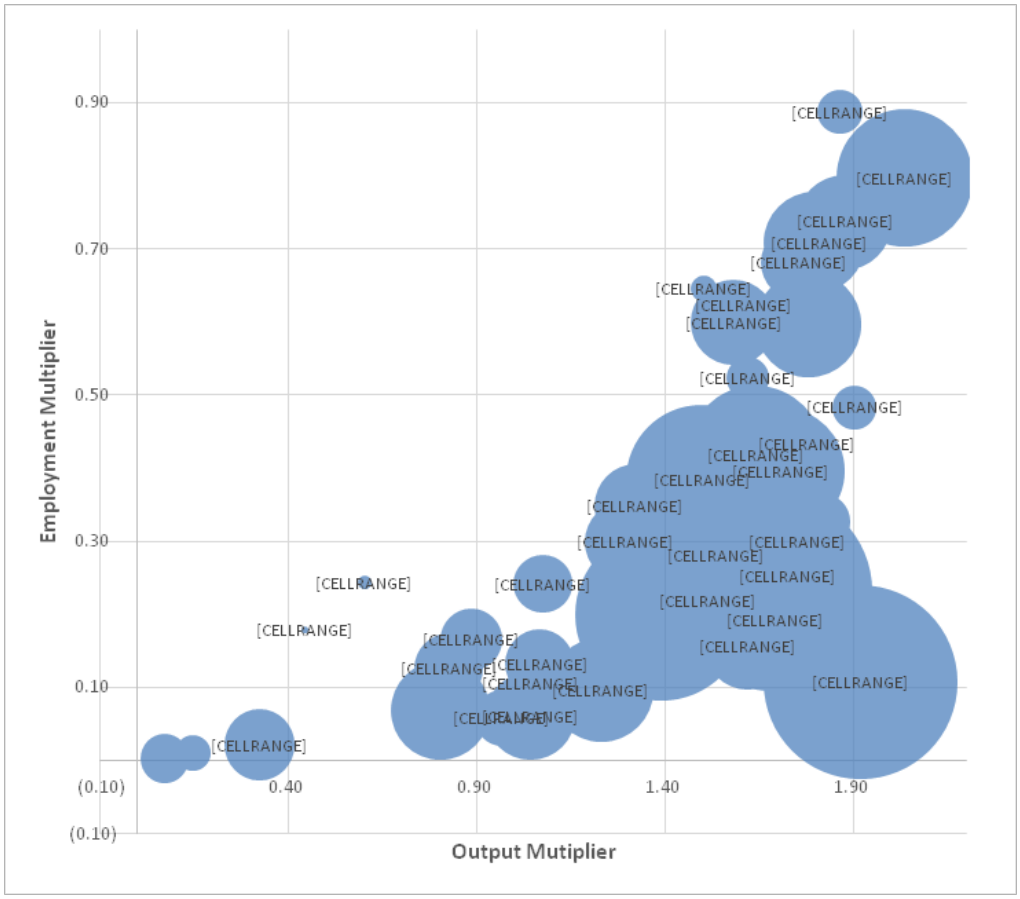
	Value of output (in millions of Ksh)	Output Multiplier	Employment Multiplier
Grain milling	109,926	1.29	0.30
Other manufacturing	187,762	1.23	0.10
Forestry	58,785	1.08	0.24
Meat, fish and dairy	81,171	1.07	0.13
Tobacco processing	28,634	1.05	0.08
Fishing	33,827	1.04	0.11
Wood and paper	136,781	1.04	0.06
Non-metal minerals	53,736	0.97	0.06
Other mining	66,826	0.88	0.17
Clothing	83,248	0.83	0.13
Chemicals	168,070	0.80	0.07
Leather and footwear	35,142	0.77	0.05
Tobacco	2,829	0.60	0.24
Other oilseeds	790	0.44	0.18
Petroleum	86,135	0.33	0.02
Metals and metal products	22,073	0.15	0.01
Textiles	2,715	0.11	0.02
Machinery and equipment	41,769	0.07	0.00

Source: Own calculations and Kenyan SAM.

Figure 1 and Figure 2 compare output and the low-skilled labour multipliers. In addition, the size of the bubbles represents the magnitude of the value of the payments to the considered labour type in each of the sectors. Given the assumptions presented above with respect to the labour market, Figure 1 and Figure 2 indicate the magnitude of the current employment in each of the sectors. However, it is important to highlight that the calculated multipliers apply to the whole economy and not just to the shocked sector and its payments to labour. Whilst the multipliers include the direct and the indirect effects of a shock in a sector on the output and the employment demand for each type of labour, the size of the bubbles would be a proxy of the magnitude of the direct effects on the employment in that sector.

In general, a shock that increases demand for services tends to have the strongest effect on the output of the economy. However, the multiplier effect on employment generation tends to be modest. The weaker backward linkages of the services sector with the rest of the economy explain this result.

Figure 1: Multipliers for output and labour in Kenya



Note: The size of a bubble represents the magnitude of the payments to that type of labour.
Source: Own calculations, and Pradesha and Diao (2014).

The employment effects of increases in the final demand tend to be higher in the agricultural and fisheries sector. Increases in the final demand of sugar, other roots, fruit and nuts, and other cereals lead to stronger effects on employment. The combination of a direct effect and important backward linkages with the rest of the economy that generate additional demand for labour is behind this result. In addition, the output effects, though smaller than for services, are not negligible.

The industrial sectors are located at bottom-right of the charts. The multiplier effects on the industrial sectors are smaller in both output and labour. An increase in the final demand for products generated in these sectors would have weak output effects as a result of low direct and indirect effects.

4. Output and labour multipliers in Ethiopia

Ethiopian SAM (Mengistu et al., 2019) provides a very comprehensive picture of the Ethiopian economy in 2015/16. The SAM captures a very detailed labour disaggregation by skill and location, and households by location. In contrast with other SAMs, it allows activities to produce multiple products as well as it considers production for auto-consumption. Adding the good product disaggregation (95 products), it provides a very good detail of results.

Table 2 and Figure 2 present the output and labour (aggregated into skill categories) multipliers. Table 2 is ordered based on the total labour multiplier. A series of own consumed crops appear in the top position which reflect the low productivity of these sectors. Even though these sectors may have significant output and labour multipliers, there is no possibility of demand stimulus by virtue that these products are not consumed by other households or exported.

Fruit crops, vegetable nec, raw milk, and enset appear as the top commercial crops with the highest labour multiplier effects. These are the products where a boost in exogenous demand may lead to the highest employment and output effects. Real estate and education appear as the sectors with the highest employment effects in the services sector. Manufactures, in general, present low labour impact given the weak backward linkages in the domestic economy.

Table 2: Multiplier effect of increase of one million birrs in final demand by product in Ethiopia

	Output	Unskilled-Labour	Semi-Skilled	Skilled	Total Labour	Value of production (millions of birr)
Fruit crops (own consumed)	2.81	2.12	0.16	0.15	2.43	1,161
Vegetables nec (own consumed)	2.81	2.04	0.16	0.15	2.34	10,815
Enset (own consumed)	2.82	1.80	0.15	0.14	2.09	17,144
Fruit crops	2.69	1.81	0.15	0.14	2.09	5,876
Vegetables nec	2.75	1.62	0.14	0.14	1.90	37,167
Raw milk (own consumed)	2.82	1.53	0.13	0.13	1.79	18,533

continued next page

Table 2 Continued

	Output	Unskilled-Labour	Semi-Skilled	Skilled	Total Labour	Value of production (millions of birr)
Raw milk	2.82	1.52	0.13	0.13	1.78	22,464
Maize (own consumed)	2.82	1.49	0.13	0.13	1.75	41,220
Sugar cane own consumed	2.84	1.49	0.13	0.13	1.75	333
Barley (own consumed)	2.81	1.47	0.13	0.13	1.73	11,137
Enset	2.77	1.42	0.13	0.14	1.69	3,642
Forestry (own consumed)	2.85	1.43	0.13	0.13	1.68	13,653
Maize	2.78	1.41	0.13	0.13	1.67	12,788
Pulses (own consumed)	2.81	1.41	0.13	0.13	1.66	25,284
Real estate and renting services	3.10	0.77	0.32	0.57	1.65	90,585
Manure	2.89	1.41	0.11	0.13	1.65	3,872
Coffee (own consumed)	2.83	1.37	0.13	0.13	1.63	3,594
Chat (own consumed)	2.83	1.37	0.13	0.13	1.63	1,692
Teff (own consumed)	2.81	1.36	0.13	0.13	1.62	29,499
Wheat (own consumed)	2.82	1.36	0.12	0.13	1.62	28,872
Sorghum (own consumed)	2.82	1.35	0.13	0.13	1.60	26,706
Forestry	2.86	1.32	0.13	0.14	1.59	83,780
Oil seeds (own consumed)	2.83	1.34	0.12	0.13	1.59	438
Education	2.95	0.75	0.18	0.65	1.58	51,100
Sorghum	2.81	1.32	0.12	0.13	1.58	3,163
Cereal grains and other crops nec (own consumed)	2.80	1.32	0.12	0.12	1.57	14,064
Animal products nec (own consumed)	2.86	1.32	0.12	0.12	1.57	1,676
Barley	2.68	1.30	0.12	0.13	1.55	6,725
Goat (own consumption)	2.83	1.30	0.12	0.12	1.55	829
Sheep (own consumption)	2.83	1.30	0.12	0.12	1.55	777
Camel	2.81	1.30	0.12	0.12	1.54	394
Camel (own consumed)	2.81	1.29	0.12	0.12	1.54	35
Teff	2.79	1.27	0.12	0.13	1.53	20,048
Goat	2.83	1.28	0.12	0.13	1.53	10,268
Cattle (own consumption)	2.80	1.29	0.12	0.12	1.53	2,607
Poultry; other small livestock (own consumed)	2.79	1.28	0.12	0.12	1.53	1,239
Tea	2.72	1.28	0.12	0.12	1.53	598

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Table 2 Continued

	Output	Unskilled-Labour	Semi-Skilled	Skilled	Total Labour	Value of production (millions of birr)
Public administration and defence	2.87	0.90	0.18	0.44	1.51	99,954
Sheep	2.82	1.27	0.12	0.13	1.51	11,396
Oil seeds	2.79	1.24	0.12	0.13	1.49	17,824
Sugar cane sugar beet	2.73	1.22	0.12	0.14	1.48	1,961
Cattle	2.77	1.21	0.12	0.13	1.45	28,565
Animal feed	2.72	1.21	0.12	0.13	1.45	21,700
Poultry; other small livestock	2.76	1.21	0.12	0.13	1.45	4,821
Tea (own consumed)	2.85	1.21	0.12	0.12	1.45	24
Chat	2.73	1.15	0.12	0.14	1.41	12,326
Pulses	2.55	1.17	0.11	0.12	1.40	32,636
Recreation and other services	2.56	1.17	0.09	0.13	1.39	42,058
Fishing	3.08	1.09	0.15	0.14	1.38	1,141
Coffee	2.75	1.07	0.12	0.14	1.33	36,982
Cereal grains and other crops nec	2.49	1.09	0.11	0.11	1.32	56,515
Animal products nec	2.97	1.09	0.10	0.12	1.32	5,165
Health	2.44	0.61	0.09	0.56	1.26	22,845
Construction	2.69	0.87	0.19	0.18	1.25	409,771
Flower	3.00	0.90	0.14	0.15	1.19	5,126
Financial services	2.62	0.66	0.10	0.37	1.13	60,227
Trade and repair services	2.83	0.85	0.12	0.15	1.12	260,893
Minerals nec	2.65	0.87	0.11	0.13	1.11	23,474
Vegetable products; animal oils and fats	2.70	0.78	0.11	0.14	1.03	3,163
Manufactured tea	3.05	0.80	0.10	0.12	1.02	1,770
Water	2.85	0.72	0.11	0.18	1.01	15,447
Meat products	3.09	0.80	0.10	0.11	1.01	5,690
Hotels and restaurants	2.75	0.72	0.10	0.15	0.97	121,923
Business Services	1.81	0.45	0.19	0.33	0.97	20,854
Grain mill products and grain mill services	2.46	0.74	0.11	0.10	0.95	16,738
Electricity	2.76	0.54	0.12	0.28	0.95	11,870
Dairy products	2.27	0.71	0.10	0.11	0.92	2,967
Cement	2.79	0.68	0.09	0.13	0.90	16,577

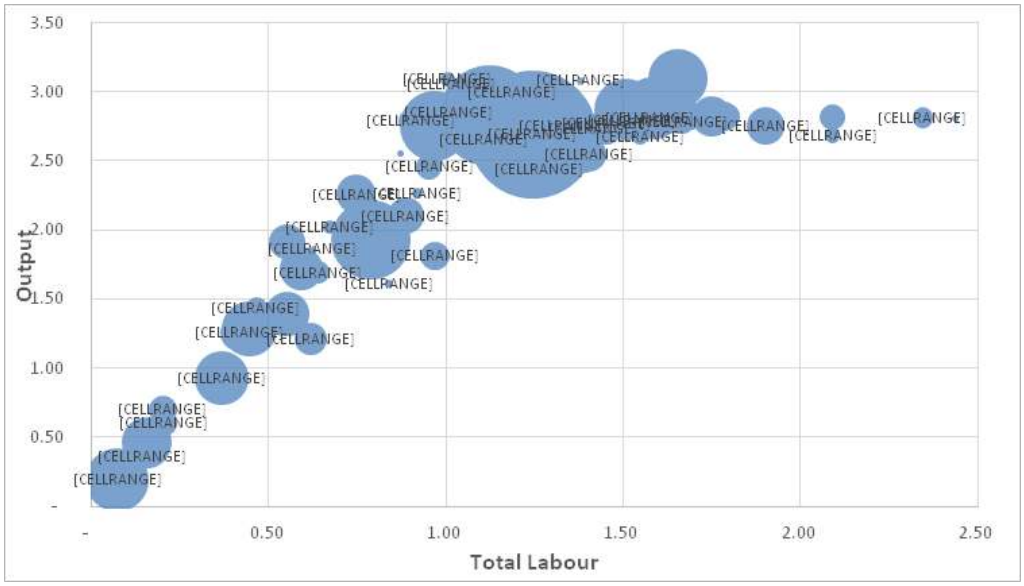
continued next page

Table 2 Continued

	Output	Unskilled-Labour	Semi-Skilled	Skilled	Total Labour	Value of production (millions of birr)
Communication	2.10	0.55	0.11	0.23	0.89	32,965
Linted cotton	2.55	0.67	0.09	0.11	0.87	1,095
Cotton	1.61	0.68	0.07	0.09	0.84	2,008
Transport services	1.93	0.57	0.10	0.12	0.79	161,107
Beverages	2.26	0.57	0.08	0.10	0.75	37,784
Leather products	2.02	0.51	0.08	0.09	0.67	5,008
Sugar and sugar confectionary	1.69	0.50	0.07	0.08	0.64	13,024
Tobacco input products	1.86	0.49	0.06	0.07	0.63	733
Wheat	1.21	0.51	0.05	0.06	0.62	26,196
Manufactured tobbaco	1.84	0.48	0.06	0.07	0.62	2,380
Food products nec; animal feeds	1.72	0.46	0.06	0.07	0.59	47,112
Machinery and equipment nec	1.39	0.42	0.06	0.08	0.55	50,552
Metal products	1.92	0.41	0.06	0.09	0.55	31,641
Mineral products nec	1.41	0.36	0.05	0.07	0.48	9,914
Manufactures nec	1.33	0.35	0.06	0.06	0.47	32,764
Paper products publishing	1.43	0.35	0.05	0.06	0.47	11,753
Chemicals, rubber and plastic products	1.28	0.32	0.06	0.07	0.45	76,412
Wearing apparel	1.26	0.31	0.05	0.06	0.42	33,898
Wood products	1.22	0.29	0.04	0.05	0.39	6,651
Petroleum coal products	0.93	0.28	0.04	0.05	0.37	72,895
Pharmaceutical products	0.60	0.16	0.02	0.03	0.21	16,534
Textiles	0.70	0.15	0.02	0.03	0.20	21,024
Motor vehicles and parts; other transport equipment	0.47	0.12	0.02	0.02	0.16	62,380
Electronic equipment	0.44	0.12	0.02	0.02	0.16	53,656
Fertilisers	0.36	0.11	0.02	0.02	0.14	9,960
Metals nec	0.19	0.06	0.01	0.01	0.07	101,645

Note: The size of a bubble represents the magnitude of the payments to that type of labour.
Source: Own calculations, and Mengistu et al. (2019).

Figure 2: Multipliers for output and labour in Ethiopia



Note: The size of a bubble represents the value of production.
Source: Own calculations, and Mengistu et al. (2019).

5. Final comments

The analysis of the linkages and employment effects using multipliers allows for the identification of sectors and products with high output and employment generation potential. Policies that can help generate additional exogenous demand, for example through exports, are effective in sectors with high multipliers in both output and employment. Export promotion activities, production development, and secure additional market access in other countries in these sectors would pull strongly in the economy, in employment and income.

Agricultural products (sugar, other roots, fruit and nuts, and other cereal) present strong output and employment effects. Some services sectors, particularly those that can be associated to tourism, such as hotels and catering, feature high employment effects, although their ability to generate output in the rest of the economy is more limited.

Based on the analysis presented in this report, the upcoming calculations for the other countries and the other papers and analysis delivered as part of the project, country teams can design horizontal and targeted policies to boost economic recovery by supporting employment creation among the youth. In this sense, this report aims to contribute to the discussion of the policy making process by providing evidence-based advice on the most effective sectors to boost employment among the young population.

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Appendix

How to calculate multipliers using a social accounting matrix

The calculations of the output and employment multipliers are based on the Leontief model. They use an input-output table or a social accounting matrix (SAM). A SAM contains payments and transfers between activities, households, markets, and other economic agents representing a given economy at a particular point in time. The SAM is a square matrix formed by the following sub-matrices:

Table A1: Social accounting matrix

	Activities	Commodities	Factors	Households	Exogenous Demand	Total
Activities		X_{ji}				X
Commodities	Z_{ij}			H_i	E_i	Z
Factors	V_j					V
Households			V			Y
Exogenous Demand		G_j		S		E
Total	X	Z	V	Y	E	

Activities pay for the commodities (represented by Z_{ij}) used in production. These products are then domestically commercialized (X_{ji}). Activities also pay for factors of production (labour, land, and capital) for their use and they are represented by matrix V_j. X represents the value of their output.

The total demand (Z) consists of intermediate use (Z_{ij}), household demand (Hi), and exogenous demand (E_j). By exogenous we mean that the model does not determine that type of demand. The exogenous demand builds up primarily from government consumption, investment, and exports. Total supply consists of domestic supply and imports (G_j). Households derive their income from factors (V) which they spent on goods; they also pay direct taxes and/or receive subsidies (S).

To apply the Leontief model, we need to divide each element in each column by its column total to derive the technical coefficients matrix, M:

Table A2: Matrix of technical coefficients

	Activities	Commodities	Factors	Households	Exogenous Demand	Total
Activities		$b_j i = X_{ji}/Z_i$				X
Commodities	$a_{ij} = Z_{ij}/X_j$			$c_i = H_i/Y$	E_i	Z
Factors	$v_j = V_j/X_j$					V
Households			1			Y
Exogenous Demand		$I_j = G_j/Z_i$		s =S/Y		E
Total	X	Z	V	Y	E	

Total demand Z can be expressed as:

$$Z_i = a_{ij} X_j + c_i Y + E_i \tag{A1}$$

Gross output X is only a part of total demand Z:

$$X_j = b_{ji} Z_i \tag{A2}$$

At the same time, total household income is formed by the factors' earnings:

$$Y = v_j X_j \tag{A3}$$

Substituting (A2) into (A3) gives:

$$Y = v_j b_{ji} Z_i \tag{A4}$$

Replacing (A2) and (A4) into (A1):

$$Z_i = a_{ij} b_{ji} Z_i + c_i v_j b_{ji} Z_i + E_i \tag{A5}$$

Moving all endogenous components to the right-hand side and grouping Z terms together yields:

$$\left(1 - a_{ij} b_{ji} - c_i v_j b_{ji}\right) Z_i = E_i \tag{A6}$$

Assuming any number of activities and commodities, (A6) can be written as:

$$(I - M)Z = E \tag{A7}$$

Rearranging terms:

$$(I - M)Z = E \tag{A8}$$

Equation A7 indicates the value of vector Z, supply, necessary to meet final demand E. Domestic production is a share of total supply, therefore,

$$X = b(I - M)^{-1}E \tag{A9}$$

An increase in the final demand (i.e., exports) would require an output large enough to meet its increased demand plus the intermediate demands of other activities. The employment multiplier is defined in the same way. This means:

$$V = vb(I - M)^{-1}E \tag{A10}$$

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Contact Us
African Economic Research Consortium
Consortium pour la Recherche Economique en Afrique
Middle East Bank Towers,
3rd Floor, Jakaya Kikwete Road
Nairobi 00200, Kenya
Tel: +254 (0) 20 273 4150
communications@aercafrica.org