Input-Output Analysis

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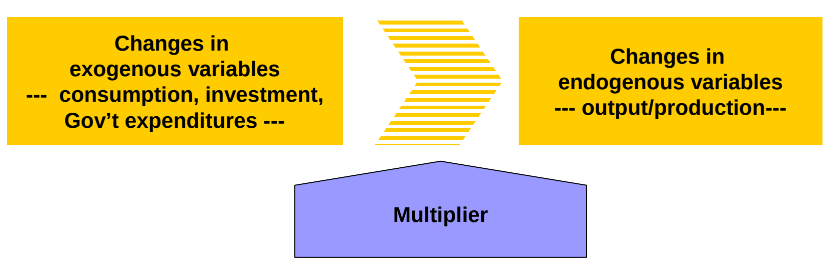
Session 2.1

Basic Input-Output Analysis

Multiplier Analysis

Multiplier

- Multiplier analysis seeks what happens with the endogenous variables (i.e., the sectoral output) if there is a change in exogenous variables (i.e., the final demand)



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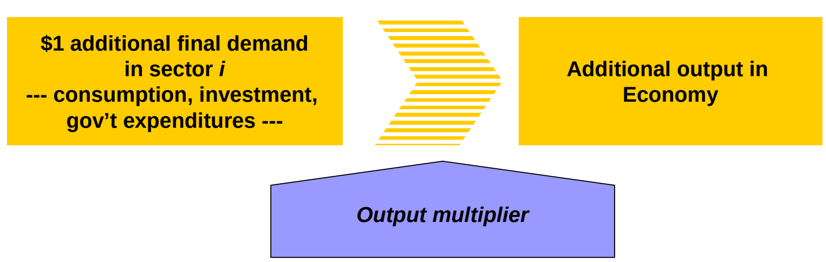
Three types of multipliers

- Output multiplier
- Income multiplier
- Employment multiplier

Output multiplier

- If there is $1 additional final demand in a particular sector (say sector i), how much is the additional output in the economy?



From the previous hypothetical example

$$\mathbf{A} = \begin{bmatrix} 0{,}1 & 0{,}2 \\ 0{,}3 & 0{,}3 \end{bmatrix} \qquad (\mathbf{I} - \mathbf{A})^{-1} = \begin{bmatrix} 1{,}228 & 0{,}351 \\ 0{,}526 & 1{,}579 \end{bmatrix}$$

Let's say there is additional $1 final demand for sector 1, While that of sector 2 is intact. We write:

$$\Delta\mathbf{Y} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

And, using

$$\Delta\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\Delta\mathbf{Y}$$

$$\Delta\mathbf{X} = \begin{bmatrix} 1{,}228 & 0{,}351 \\ 0{,}526 & 1{,}579 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1{,}228 \\ 0{,}526 \end{bmatrix}$$

Output multiplier of sector 1:

$$O_1 = \frac{\$1{,}754}{\$1} = 1{,}754$$

For sector 2 and so on …

In the same way, if there is $1 additional final demand in sector 2, While final demand in sector 1 intact, then

$$\Delta\mathbf{Y} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

And, using

$$\Delta\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\Delta\mathbf{Y}$$

$$\Delta\mathbf{X} = \begin{bmatrix} 1{,}228 & 0{,}351 \\ 0{,}526 & 1{,}579 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0{,}351 \\ 1{,}579 \end{bmatrix}$$

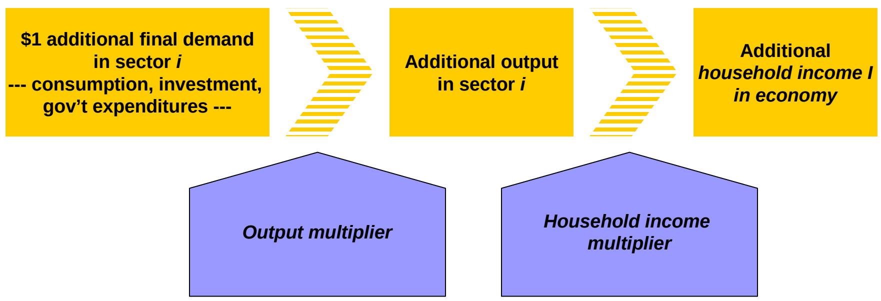
Output multiplier sector 2:

$$O_1 = \frac{\$1{,}930}{\$1} = 1{,}930$$

In general we can write ⟶ $O_j = \sum_{i=1}^{n} b_{ij}$

Household income multiplier

- If there is $1 additional final demand in a particular sector (say sector *i*), how much income of household would increase ?
- Household income comes from wages/salaries – which in turn is a proportion of produced sectoral output



Output-household income relation

- Household income comes from wages/salaries paid by production sectors
- For every $1 output of sector *i*, how much is spent on wages/ salaries?
- Wages/salaries recorded in the primary input matrix, usually as the first item in the value added matrix

		Production Sector		Final Demand				Total Output
		1	2	C	I	G	E	X
Production Sector	1	z_{11}	z_{12}	C_1	I_1	G_1	E_1	X_1
	2	z_{21}	z_{22}	C_2	I_2	G_2	E_2	X_2
Value Added	L	L_1	L_2					L
	N	N_1	N_2					N
Import	M	M_1	M_2					M
Total Input	X	X_1	X_2	C	I	G	E	X

Therefore, the proportion of wages/salaries in the Total production can be seen in the coefficient $a_{n+1,i}$

Dari contoh kasus hipotetis terdahulu

		Production Sectors 1	Production Sectors 2
Production Sector	1	100	400
	2	300	600
Primary Input	L	200	700
	N	400	300
Total Input		1000	2000

$$a_{n+1,1} = 0,2$$
$$a_{n+1,2} = 0,35$$

$$(\mathbf{I} - \mathbf{A})^{-1} = \begin{bmatrix} 1,228 & 0,351 \\ 0,526 & 1,579 \end{bmatrix}$$

Additional household income:

$$H_1 = (0,2)(1,228) + (0,35)(0,526) = 0,4297$$
$$H_2 = (0,2)(0,351) + (0,35)(1,579) = 0,6228$$

This is called SIMPLE HOUSEHOLD INCOME MULTIPLIER, denoted as:

$$H_j = \sum_{i=1}^{n} a_{n+1,i} b_{ij}$$

Alternative initial effect → Type-I multiplier

In earlier example, the initial effect is \$1. Therefore we can actually wrote:

$$H_1 = (0,2)(1,228) + (0,35)(0,526) = 0,4297$$

$$H_1 = \frac{\$0.4297}{\$1} = 0.4297$$

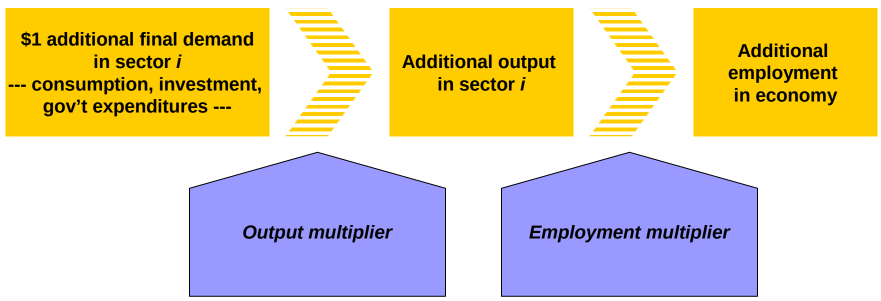
Another alternative is to use the proportion of wages/salaries in total output (i.e., coefficient $a_{n+1,j}$) as the initial effect. Therefore:

$$Y_1 = \frac{(0,2)(1,228) + (0,35)(0,526)}{0,2} = 2,148$$

This is called TYPE-1 HOUSEHOLD INCOME MULTIPLIER

Employment multiplier

- If there is $1 additional final demand in sector *i*, how many more employment will be created in the economy?
- Need to know the proportional relationship between output produced and labor employed in each sector. This proportion is assumed fixed



From earlier hypothetical example

We need sectoral employment data.
Assume the following labor requirement:
Sector 1 = 4 labor
Sector 2 = 10 labor

$$(\mathbf{I}-\mathbf{A})^{-1} = \begin{bmatrix} 1{,}228 & 0{,}351 \\ 0{,}526 & 1{,}579 \end{bmatrix}$$

Each labor would in average produce the following output:

$$w_j = \frac{X_j}{L_j}$$

That is: $w_1 = \frac{4}{1000} = 0{,}004$

$$w_2 = \frac{10}{2000} = 0{,}005$$

Additional number of labor:

$$E_1 = (1{,}228)(0{,}004) + (0{,}526)(0{,}005) = 0{,}0075$$
$$E_2 = (0{,}351)(0{,}004) + (1{,}579)(0{,}005) = 0{,}0093$$

This is SIMPLE EMPLOYMENT MULTIPLIER, denoted as

$$E_j = \sum_{i=1}^{n} w_{n+1,i} b_{ij}$$

Alternative initial effect → Type-I multiplier

In earlier example the initial effect is \$1. Therefore we actually wrote:

$$E_1 = (1{,}228)(0{,}004) + (0{,}526)(0{,}005) = 0{,}0075$$

$$E_2 = (0{,}351)(0{,}004) + (1{,}579)(0{,}005) = 0{,}0093$$

Another alternative is to use the proportion of output/labor ratio as the initial output. That is the coeffcient w_j. Therefore:

$$W_1 = \frac{0{,}0075}{0{,}004} = 1{,}875$$

$$W_2 = \frac{0{,}0093}{0{,}005} = 1{,}860.$$

This is called:
TYPE-1 EMPLOYMENT MULTIPLIER

Data input-output Indonesia 1990

Kode tabel
1 Pertanian
2 Pertambangan & penggalian
3 Industri
4 Listrik, gas & air minum
5 Konstruksi
6 Jasa non-publik
7 Jasa publik & jasa lainnya
8 Kegiatan yg tdk jelas batasannya

Matriks Kebalikan Leontief
Tabel Input-Output Indonesia menurut Harga Produsen, 1990

Sektor	1	2	3	4	5	6	7	8
1	1,065	0,014	0,305	0,116	0,164	0,064	0,064	0,112
2	0,014	1,012	0,138	0,180	0,132	0,021	0,028	0,052
3	0,140	0,059	1,445	0,533	0,672	0,186	0,275	0,525
4	0,003	0,002	0,015	1,182	0,010	0,018	0,016	0,024
5	0,006	0,009	0,007	0,022	1,009	0,022	0,009	0,004
6	0,055	0,073	0,156	0,208	0,278	1,183	0,115	0,118
7	0,008	0,011	0,013	0,024	0,014	0,037	1,021	0,015
8	0,001	0,001	0,013	0,005	0,006	0,003	0,003	1,302
Total kolom	1,292	1,180	2,094	2,270	2,288	1,534	1,531	2,152

Kode sektor lihat Tabel 2.4.

Angka pengganda pendapatan RT

Tabel 3.3
Keofisien Upah dan Gaji,
Angka Pengganda Pendapatan Rumah Tangga Biasa dan Jenis I
Tabel Input-Output Indonesia menurut Harga Produsen, 1990

Sektor	1	2	3	4	5	6	7	8
a_{n+1}	0,1534	0,0753	0,0864	0,0908	0,1655	0,1528	0,5206	0,1379
Biasa	0,198	0,089	0,181	0,206	0,379	0,234	0,797	0,297
Jenis I	1,292	1,180	2,094	2,270	2,288	1,534	1,531	2,152

Kode sektor lihat Tabel 2.4.

Angka pengganda tenaga kerja

Tabel 3.4
Jumlah Pekerja, Koefisien Tenaga Kerja (juta orang),
Rata-rata Pekerja per Output (orang per juta rupiah), dan
Angka Pengganda Pendapatan Lapangan Kerja Biasa
Tabel Input-Output Indonesia menurut Harga Produsen, 1990

Sektor	1	2	3	4	5	6	7	8
Jumlah pekerja	42,378	0,528	7,693	0,135	2,059	13,858	9,070	0,128
Rata-rata pekerja per output (w_j)	1.174	54.182	16.438	33.456	18.892	6.479	3.318	1.352
Angka pengganda	1.517	63.925	34.422	75.943	43.218	9.938	5.078	2.910

Kode sektor lihat Tabel 2.4.