CONSTRUCTION OF INPUT-OUTPUT TABLE AND ITS MULTIPLIERS

PRESENTER

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SUPPLY AND USE TABLES (SUTs)

CONSTRUCTION OF INPUT-OUTPUT TABLE

SAMPLE: INPUT-OUTPUT TABLE

CONSTRUCTION OF INPUT-OUTPUT MULTIPLIERS

SAMPLE: I-O MULTIPLIERS

DIFFERENCE BETWEEN THE IOT MODELS
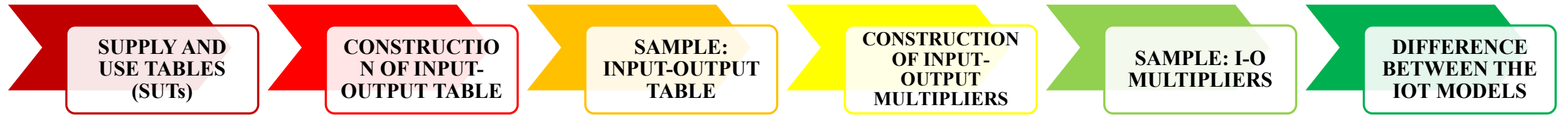
SUPPLY-USE TABLES

Supply and Use tables are two tables,

- Supply Table – It describes the supply of the goods and services, which are either produced in the domestic industry or imported.

- Use Table – It shows where and how goods and services are used in the economy.

- Supply and Use tables are in the form of matrices that record how supplies of different kinds of goods and services originate from domestic industries and imports and how those supplies are allocated between various intermediate or final uses, including export. (OCED, 2001)

In Case of India,

- Use annexure 1 (SUT 140 Sector Product Classification, pp. 15-22)[1]
- Use annexure 2 (SUT 66 Sector Industry Classification, pp. 23-27)[2]
- Use table on Identification of Industries and Products (pp. 5)[3]

- We map the products into industries.

- We cannot map a single product into 2 different industries.

- Because we don't know how much percentage of that product is being captured by those two industries.

- Certainly, no two industries can capture 100% of the product. This is the case of multiplicity and needs to be avoided while mapping products into industries, diligently.

- The Table matrix should be a square matrix only. In this case, 66 x 66 or 7x7

[1,2] Ministry of Statistics and Programme Implementation (MoSPI), (2016), "*Supply and Use Table: A Note on Compilation for 2011-12 and 2012-13*", pp. 1-27.
[3] Ministry of Statistics and Programme Implementation (MoSPI), (2016), "*Note on Supply-Use Table (SUT) 2016-17*", pp. 1-23.

Sl. No.	Economic Activities	No. of Industries	No. of products
1	Agriculture, forestry and fishing	4	29
2	Mining and quarrying	6	11
3	Manufacturing	30	72
4	Electricity, gas, water supply & other utility services	4	4
5	Construction	1	1
6	Trade, repair, hotels and restaurants	2	3
7	Transport, storage, communication & services related to broadcasting	7	7
8	Financial services	2	2
9	Real estate, ownership of dwelling & professional services	5	6
10	Public administration and defence	1	1
11	Other services	4	4
	Total	66	140

Source: National Account Division, MoSPI, (2016), "*Note on Supply-Use Table (SUT) 2016-17*", pp. 4-5.

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USE TABLE AT PURCHASER'S PRICE

- Through the given Supply Table and Use Table, we observe that Supply Table is compiled at basic price (BP), Producer's Price (Prod P), and Purchaser's Price (PP).

- Whereas, Use Table is compiled at Purchaser's Price only.

- Therefore, it is required for any researcher and developer to diligently convert the Use Table at PP to Use Table at BP.

- **Trade and Transport Margins (TTM)**

  - **Trade Margin –** The difference between the actual or imputed price realised on a good purchased for resale and the price that would have to be paid by the distributor to replace the good at the time it is sold or otherwise disposed of.

  - **Transport Margin –** Cost paid separately by the buyer in retrieving goods at the specified time and location.

- **Product Taxes less Subsidies** – It refers to the difference between taxes on products and subsidies on products. These taxes and subsidies payable (received) based on the quantity or value of the goods and services produced or sold.

- **Import Duty** – a type of tax levied on the import and specific exports of a nation's customs authorities. The value of goods will generally decide the amount of import duty that will be imposed.

- **Change-in-Stock (CIS)** – For a stock, change is the difference between the current price and the last trade of the previous day.

Supply Table

Supply at PP

SNo.	Product/Industry Name	Product 1	….	Product N	Supply at BP (x)	Imports	CIF adj.	Total (Imports + CIF) [m]	Product taxes less Subsidies	Import Duty	Total (IMPC)	Trade and Transport Margins	Supply at PP (q)

Use Table

SNo.	Total TTM (Down)	Product 1	….	Product N	Inter-Industry Consumption	PFCE	GFCE	GFCF	CIS	Valuables	Export	Total TTM

The primary observation is that it follows a process,

Output Price (x)
+
Imports and CIF adjustments (m)
+
Product Taxes Less Subsidies
+
Import Duty
+
Trade and Transport Margin (TTM)
+
Supply at Purchaser's Price (q)

There are three types of TTM,

- Positive
- Negative
- Zero

<u>Zero TTM</u>

Service sector does not have any trade and transport margins, and therefore, they have zero value for TTM.

<u>Negative TTM</u>

Trade and Transport sectors are known as margin sectors, and therefore, have negative values. As, what they take is what they give out, specially, the trade sector.

<u>Positive TTM</u>

All other sectors such as agriculture, manufacture, livestock, fishing, forestry, mining, quarrying, etc. are called non-margin sectors. They use the facilities of margin sectors to function and hence, are positive in nature.

TTM Matrix,

$$ttm_{ij} = \left(\frac{\$\,TTM_i}{\$\,(Total\ Use\ at\ PP_i)} \right) * U_{ij}$$

where,

ttm_{ij} – Trade and Transport Margin Matrix

$\$TTM_i$ – Trade and Transport Margin column values. '**$**' signifies that the value remains same for the entire row, $i,$ calculation.

U_{ij} – Individual values from the use table corresponding to the TTM_i , Total Use at PP_i

EXCEPTION

Trade sector shows the error corresponding to divisibility of 0 (DIV!/0).

Reason: because trade sector does supply (viz. goods and services) to the entire economy. Contrarily, it does not consume (in this case, use) any goods and services in its entirety, concluding the use of a different formula, as below,

$$ttm_{\$(trade\ sector)j} = \left(\frac{Total\ Use\ (down)_{\$\ i}}{\$\ (Total\ Use\ (Down)\ at\ PP_i)} \right) * \$TTM_{\$\ (trade\ sector)j}$$

VERIFICATION

Total in the TTM Matrix = TTM Column Values at Supply Table

This process is known as **allocation of resources.**

The Net Indirect Taxes (NIT) includes,

- Product Taxes less Subsidies
- Import Duty

From Supply Table, we can observe the column for Product Taxes less Subsidies and Import Duties. We add them up, as below,

$$Total_{NPT+ImD} = NPT_i + ImD_i$$

We use the same formulation similar to TTM matrix without the use of exception, to calculate the Net Indirect Taxes.

NET INDIRECT TAXES MATRIX

$$NIT_{ij} = \left(\frac{\$Total\ _{(NPT+ImD)_i}}{\$Total\ Use\ at\ PP_i} \right) * U_{ij}$$

VERIFICATION

Total in the NIT Matrix = Total NIT (NPT + ImD) Column Values from the Supply Table

The imports matrix includes,
- Imports
- CIF Adjustments

From Supply Table, we can observe the column for Imports and CIF adjustments. We add them up, as below,

$$Total_{Imp} = Imports_i + CIF\ adj._i$$

We use the same formulation similar to TTM matrix and NIT Matrix.

$$Imp_{ij} = \left(\frac{\$Total\ _{(Imp)_i}}{\$Total\ Use\ at\ PP_i} \right) * U_{ij}$$

<u>VERIFICATION</u>

Total in the Imp Matrix = Total Imp (Imp + CIF Adj.) Column Values from the Supply Table

Now, we have our Net Indirect Taxes Matrix

We can calculate Use Table at Basic Price using the formula below,

$$Use\ at\ BP_{ij} = U_{ij} - ttm_{ij} - NIT_{ij} - Imp_{ij}$$

We have our Use Table at Basic Price.

<u>VERIFICATION</u>

Total Output (x) = Total Use at Basic Price

Supply Table

SNo.	Product/ Industry Name	Product 1	….	Product N	Supply at BP **(x)**	Imports	CIF adj.	Total (Imports + CIF) **[m]**	Total Supply at BP incl. Imports and CIF	Product taxes less Subsidies	Import Duty	Total (PTS + import Duty)	Supply at Producer Price + Import Duty	Trade and Transport Margins	Supply at PP **(q)**

Use Table

SNo.	Product/Industry Name	Product 1	….	Product N	Inter-Industry Consumption	PFCE	GFCE	GFCG	CIS	Valuables	Export	Total Use at Basic Price

V	Make matrix = Transpose of Supply Matrix (Industry-by-Product)
V^T	Supply matrix (product-by-industry)
U	Use matrix for intermediates (product-by-industry)
Y	Final use matrix (product-by-category)
F	Final use matrix (industry-by-category)
S	Matrix for intermediates (product-by-product)
B	Matrix for intermediates (industry-by-industry)
E	Gross Value-added Matrix (Components-by-homogenous branches)
W	Gross Value-added matrix (components-by-industry)
$\hat{g}$	Diagonal matrix of industry output
ẍ	Diagonal matrix of product output
Y	Row vector of final use
W	Column vector of gross value added
I	Unit matrix

X	Column vector of industry output
X^T	Row vector of product output
g	Column vector of industry output
g^T	Row vector of product output
m	Column vector of total imports
d	Index for domestic origin
m	Index for Imported origin

Supply Table

	Industries	Output	Imports	Supply at BP
Product	V^T	x	m	q
Output	g^T			

Use Table

	Industries	Final Use	Use at BP
Domestic Products	U_d	Y_d	x
Imported Products	U_m	Y_m	m
GVA	W		W
Output	g^T	Y	

INTEGRATED SUPPLY AND USE FRAMEWORK

	Domestic Products	Industries	Final Use	Total
Domestic Products		U_d	Y_d	x
Imported Products		U_m	Y_m	m
Industries	V			g
GVA		W		W
Total	x^T	g^T	Y	

INPUT-OUTPUT TABLE (PRODUCT-BY-PRODUCT)

	Products	Final Use (Demand)	Use
Domestic Products	S_d	Y_d	x
Imported Products	S_m	Y_m	m
GVA	E		W
Output	x^T	Y	

	Industries	Final Use (Demand)	Output
Domestic Industries	B_d	F_d	g
Import from Industries	B_m	F_m	m
GVA	W		W
Output	g^T	Y	

MARKET SHARE COEFFICIENT OF SUPPLY TABLE

$C = V^T (\hat{g})^{-1}$	Product-mix matrix (share of each product in output of an industry)
$D = V (\ddot{x})^{-1}$	Market shares matrix (contribution of each industry to the output of a product)

- Capital letters denote matrices and the small letters vectors.
- Transpose matrices are written as matrices with the attachment of a superscript (T).
- Vectors are written as column vectors and row vectors are written as transposed column vectors with the attachment of a superscript (T).

NOTE - $\hat{g}$ *and* $\ddot{x}$ indicates diagonal vectors.

Based on product technology assumption,

Each product is produced in its own specific way, irrespective of the industry where it is produced.

Negatives possible

$T = (D^T)^{-1}$	Transformation Matrix
$S_d = U_d . T$	Domestic Intermediates
$S_m = U_m . T$	Import Intermediates
$E = W . T$	GVA
$Y_d = Y_d$	Final Use of Domestic Products
$Y_m = Y_m$	Final Use of Imported Products

Based on industry technology assumption,

Each industry has its own specific way of production, irrespective of its product mix.

No negatives possible

$T = C^T$	Transformation Matrix
$S_d = U_d . T$	Domestic Intermediates
$S_m = U_m . T$	Import Intermediates
$E = W . T$	GVA
$Y_d = Y_d$	Final Use of Domestic Products
$Y_m = Y_m$	Final Use of Imported Products

Based on fixed industry sales structure assumption,

Each industry has its own specific sales structure, irrespective of its product mix.

Negatives possible

$T = C^{-1}$	Transformation Matrix
$B_d = T . U_d$	Domestic Intermediates
$B_m = T . U_m$	Import Intermediates
$W = W$	GVA
$F_d = T . Y_d$	Final Use of Domestic Products
$F_m = T . Y_m$	Final Use of Imported Products

Based on fixed product sales structure assumption,

Each product has its own specific sales structure, irrespective of the industry where it is produced.

No negatives possible

$T = D$	Transformation Matrix
$B_d = T. U_d$	Domestic Intermediates
$B_m = T. U_m$	Import Intermediates
$W = W$	GVA
$F_d = T. Y_d$	Final Use of Domestic Products
$F_m = T. Y_m$	Final Use of Imported Products

सत्यमेव परमो धर्मः

The classical cause for negatives elements in model A and Model C is because of the systematic negatives in $(D^T)^{-1}$ and C^{-1} respectively.

The reasons,
- There may be multiple technologies for the production of a product.
- The economic transactions may not fully record technological relations.
- The products may represent heterogenous elements.
- There may be data errors in the SUTs.

The negatives is majorly due to structural cause. Specific approaches to dealing with negatives,
- Merging industries
- Changing the primary producer
- Applying industry technology within the product technology framework
- Introducing new products
- Correcting errors in the SUTs
- Making manual corrections to IOTs

AUSTRALIAN I-O TABLE STRUCTURE

From \ To	Row prefix	Intermediate Demand					Intermediate usage (sub-total)	Final Demand						Final Demand (sub-total)	Total supply (grand total)
		Agriculture, etc	Mining	Manufacturing, etc	Construction	Services		Final consumption expenditure —private	Final consumption expenditure —government	Gross fixed capital expenditure —private	Gross fixed capital expenditure —public enterprises	Gross fixed capital expenditure —general government	Increase in stocks		
Column prefix		01.01-04.00	11.01-16.00	21.01-37.01	41.01-41.02	47.01-93.01		Q1	Q2	Q3	Q4	Q5	Q 6		
Intermediate inputs Agriculture	01.01-04.00														
Mining	11.01-16.00			QUADRANT 1						QUADRANT 2					
Manufacturing, etc.	21.01-37.01			INTERMEDIATE USAGE						FINAL DEMAND					
Construction	41.01-41.02														
Services	47.01-93.01														
Intermediate inputs (sub-total)															
Primary inputs Wages, salaries and supplements	P1														
Gross operating surplus	P2			QUADRANT 3						QUADRANT 4					
Commodity taxes (net)	P3			PRIMARY INPUTS TO PRODUCTION						PRIMARY INPUTS TO FINAL DEMAND					
Indirect taxes n.e.c. (net)	P4														
Sales by final buyers	P5														
Australian production															

The shaded areas correspond to aggregates shown in the National production account.
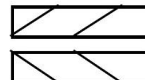
⧄ corresponds to aggregates shown as the components of 'gross domestic product' at market prices.
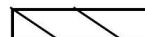
⧄ corresponds to aggregates shown as the components of 'expenditure on gross domestic product'.

Source: Australian Bureau of Statistics

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INPUT-OUTPUT TABLE: MODEL D (2018-19)

| USING INDUSTRY / SUPPLYING INDUSTRY	Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	Mining and Quarrying	Manufacturing	Construction	Trade and Transportation	Service Industries	Public Administration and Defence	Inter-Industry Consumption	PFCE	GFCE	GFCF	CIS	Valuables	Export	Total Use BP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	249838	462	858074	111339	35493	180488	117492	**1553187**	2121449	3083	7689	30155	0	87237	**3802799**
Mining and Quarrying	0	93	507635	11473	701	42199	0	**562100**	906	0	0	28100	0	8861	**599967**
Manufacturing	150705	51117	3419496	1042914	582555	704652	60662	**6012100**	2700527	4115	1406335	167787	144643	1455160	**11890668**
Construction	2585	45987	296801	0	115848	299262	14617	**775101**	154055	63846.54814	2678155.436	15388	0	25713	**3712259**
Trade and Transportation	19430	61958	234786	8668	481363	688916	81951	**1577072**	2371442	9603	8401	0	0	436316	**4402834**
Service Industries	189115	80488	687735	484375	498309	1227706	39119	**3206846**	3642588	536132	470331	74	63	1150865	**9006900**
Public Administration and Defence	0	0	0	0	0	0	0	**0**	0	1347234	0	0	0	4235	**1351469**

INPUT-OUTPUT TABLE: MODEL D (2018-19)

USING INDUSTRY	Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	Mining and Quarrying	Manufacturing	Construction	Trade and Transportation	Service Industries	Public Administration and Defence	Inter-Industry Consumption	PFCE	GFCE	GFCF	CIS	Valuables	Export	Total Use BP
SUPPLYING INDUSTRY	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Total Use BP	611673	240106	6004526	1658769	1714268	3143223	313842	13686406	10990967	1964013	4570912	241504	144706	3168387	34766896
Production Taxes less Subsidies	-101562	3230	8507	7986	-13137	51631	0	-43345	--	--	--	--	--	--	--
Consumption of Fixed Capital	199858	59154	425809	89904	2,60,359	8,16,767	132433	1984284	--	--	--	--	--	--	--
Compensation of Employees	453038	101222	687644	874139	605091	2279737	913055	5913926	--	--	--	--	--	--	--
Operating Surplus	2478592	214056	1685967	380089	1892763	2668797	0	9320264	--	--	--	--	--	--	--
GVA (by Income Approach)	3029926	377662	2807927	1352118	2745076	5816932	1045488	17175129	--	--	--	--	--	--	--
TTM (down)	86271	-48019	1079109	310138	-315232	-431946	-36767	643554	-1089004	0	353501	62195	38750	-8994	0

INPUT-OUTPUT TABLE: MODEL D (2018-19)

USING INDUSTRY	Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	Mining and Quarrying	Manufacturing	Construction	Trade and Transportation	Service Industries	Public Administration and Defence	Inter-Industry Consumption	PFCE	GFCE	GFCF	CIS	Valuables	Export	Total Use BP
SUPPLYING INDUSTRY	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Total NIT (down)	24239	12817	316472	97730	92826	162578	11735	718396	512849	33689	255898	13191	9551	180966	1724540
Total Imports CIF adj.	50691	17402	1682633	293504	165897	316113	17171	2543410	876717	47850	388112	85451	33097	425935	4400572
Total Production	3802800	599967	11890666	3712259	4402835	9006900	1351469	34766895	11291529	2045552	5568422	402340	226104	3766294	58067137

(Values in ₹ Crore)
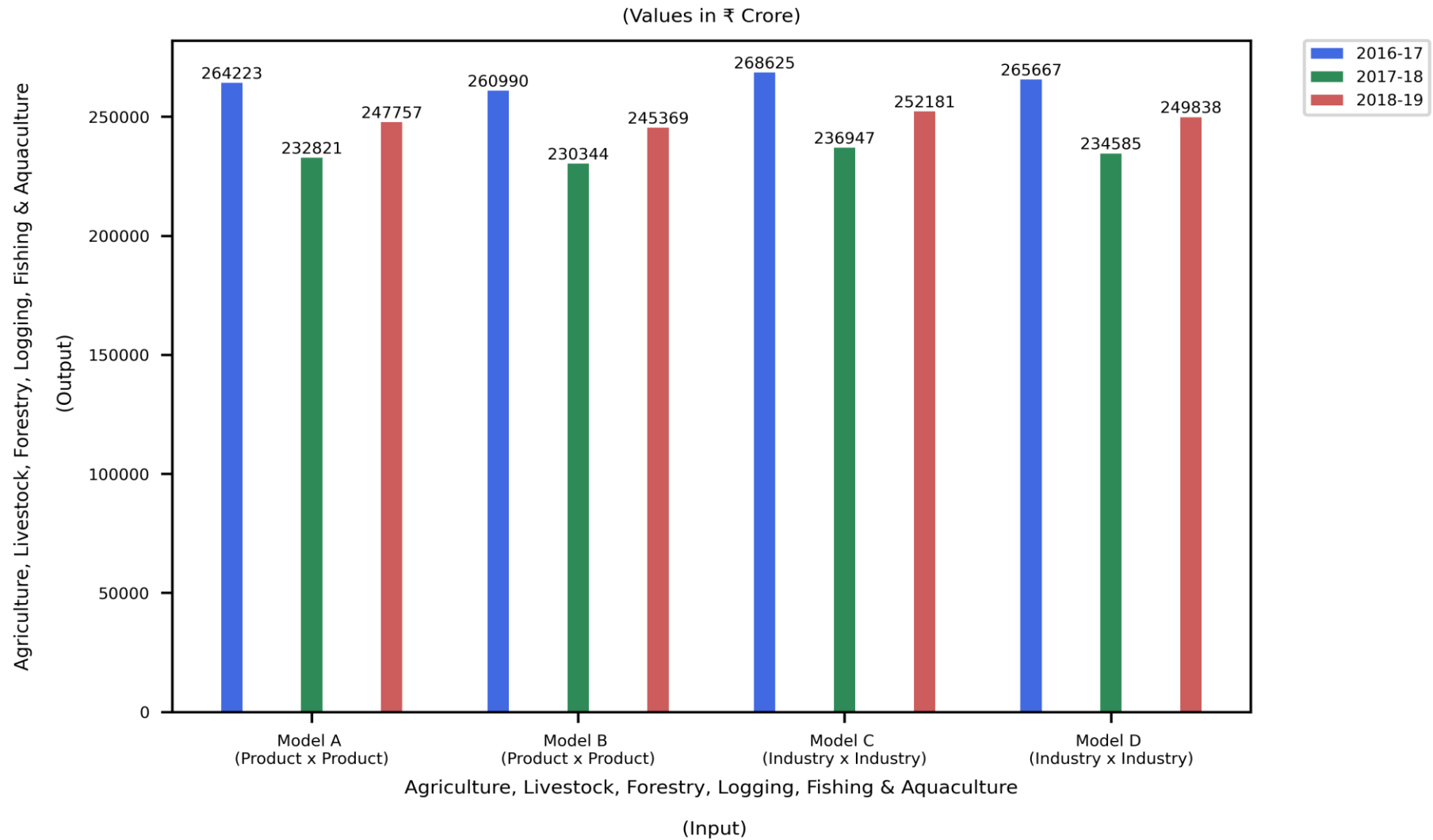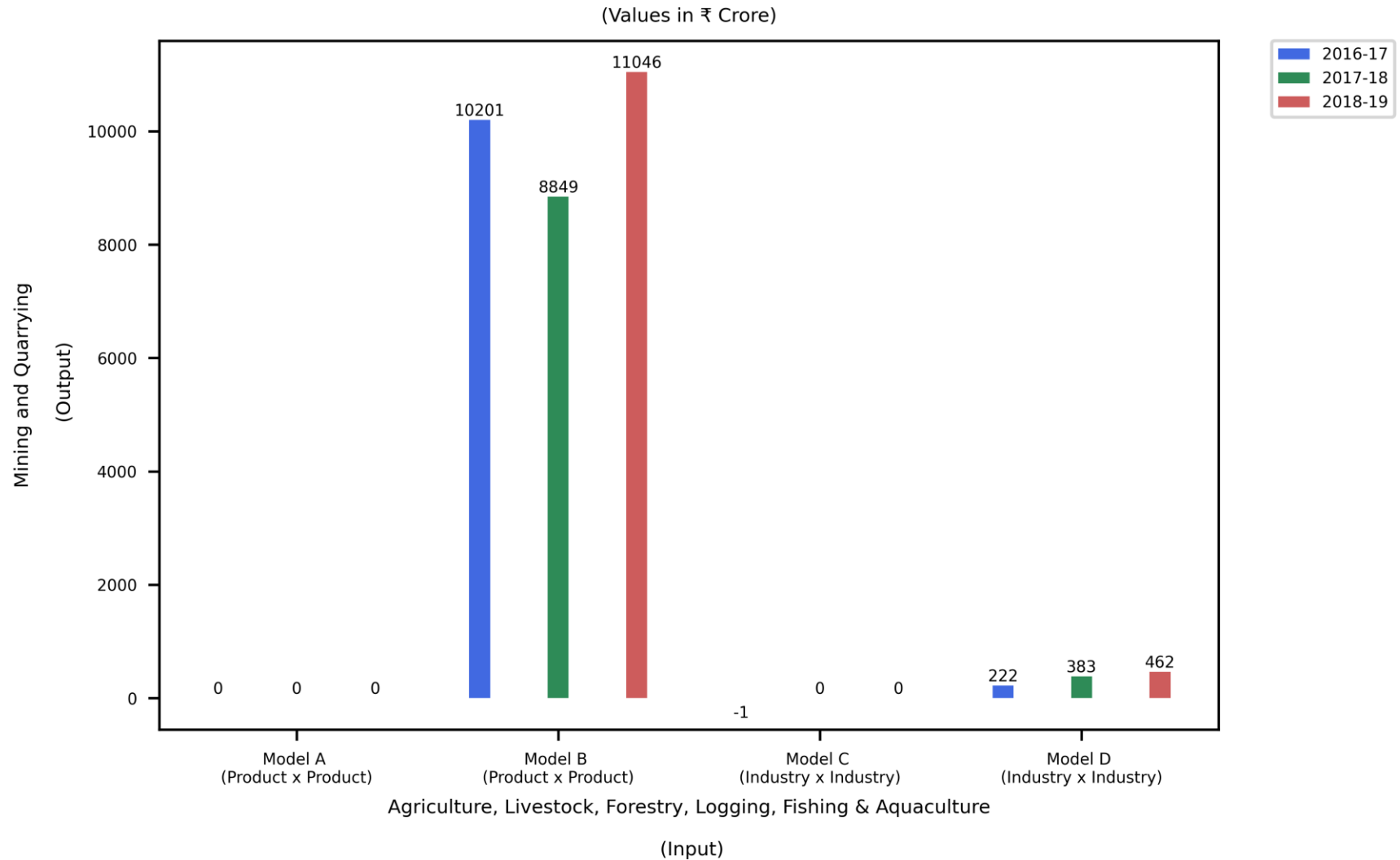
Gph 101: Agriculture* (INPUT) vs. Agriculture* (OUTPUT)

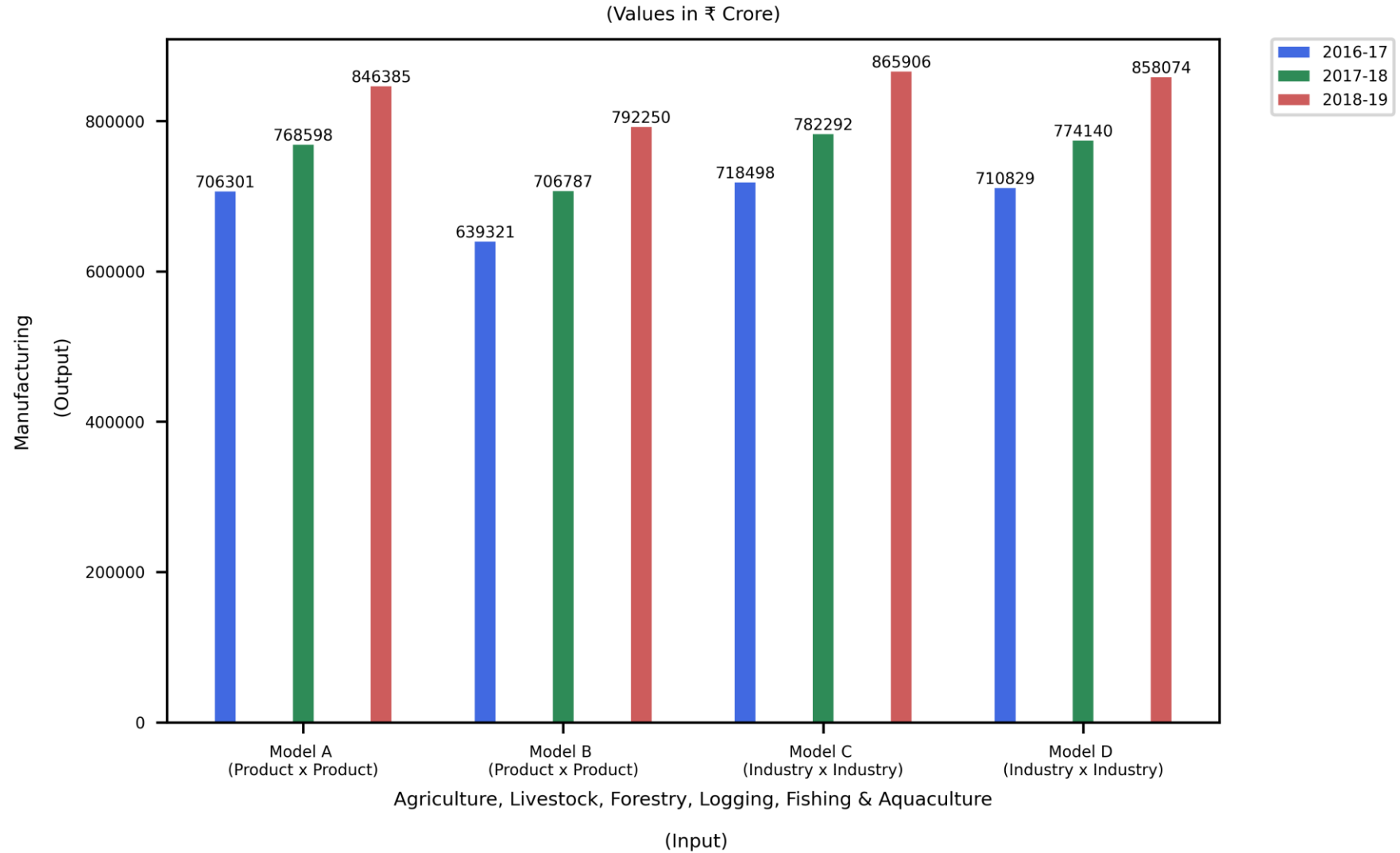**Agriculture*** - Agriculture, Livestock, Forestry, Logging, Fishing, and Aquaculture

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Gph 102: Agriculture* (INPUT) vs. Mining and Quarrying(OUTPUT)

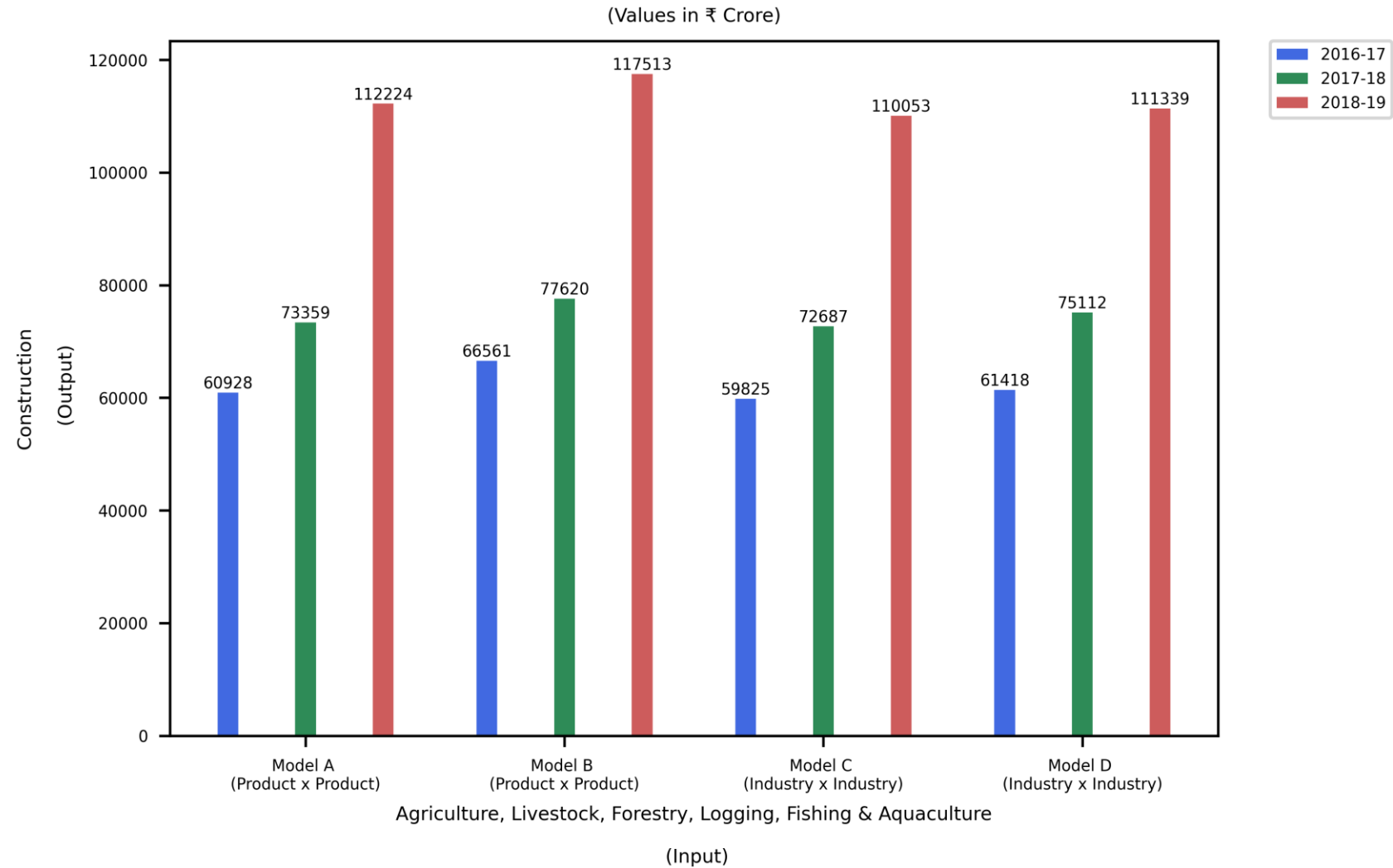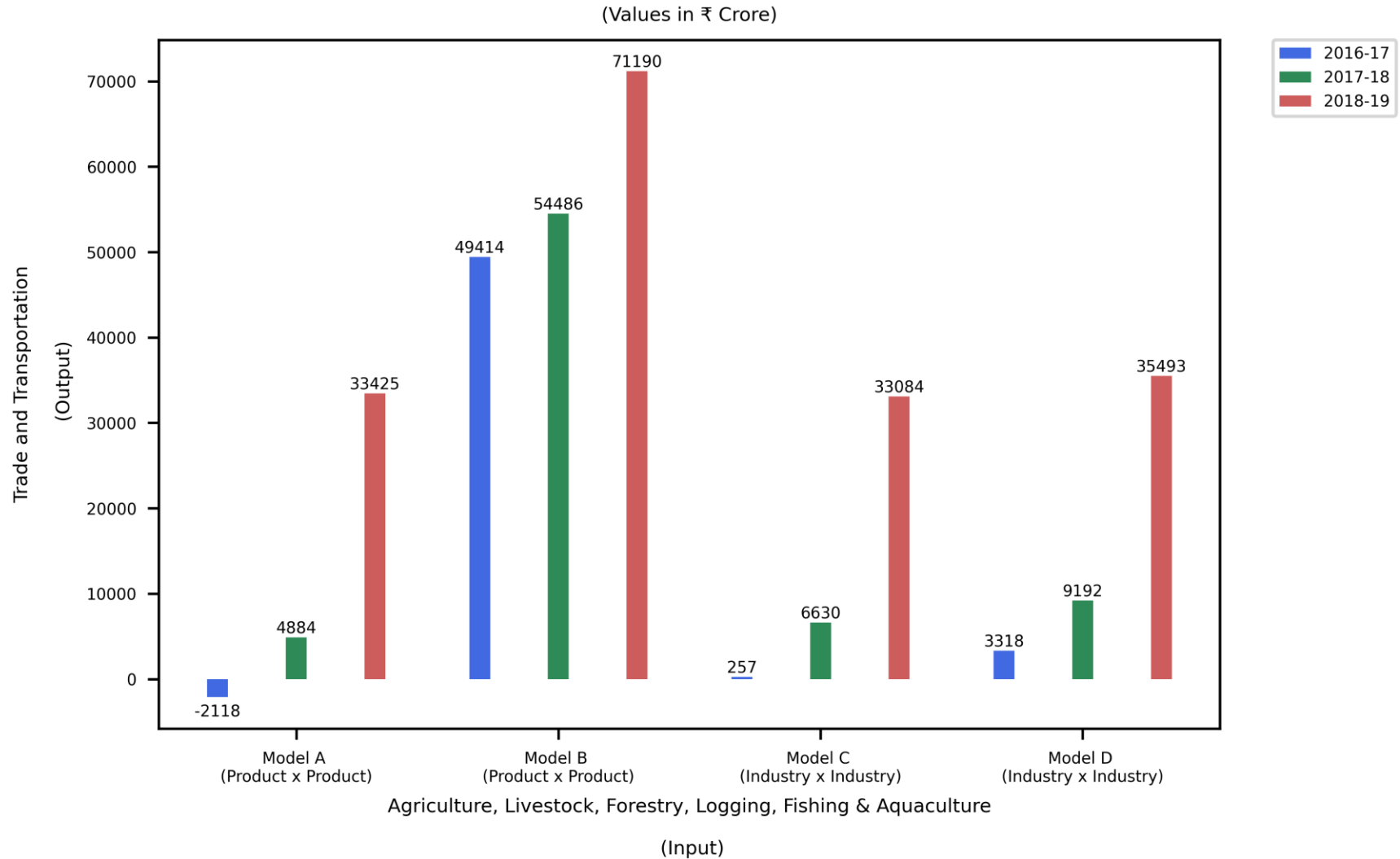**Agriculture*** - Agriculture, Livestock, Forestry, Logging, Fishing, and Aquaculture

Gph 103: Agriculture* (INPUT) vs. Manufacturing (OUTPUT)

Agriculture* - Agriculture, Livestock, Forestry, Logging, Fishing, and Aquaculture

(Values in ₹ Crore)

Gph 104: Agriculture* (INPUT) vs. Construction (OUTPUT)

Agriculture* - Agriculture, Livestock, Forestry, Logging, Fishing, and Aquaculture
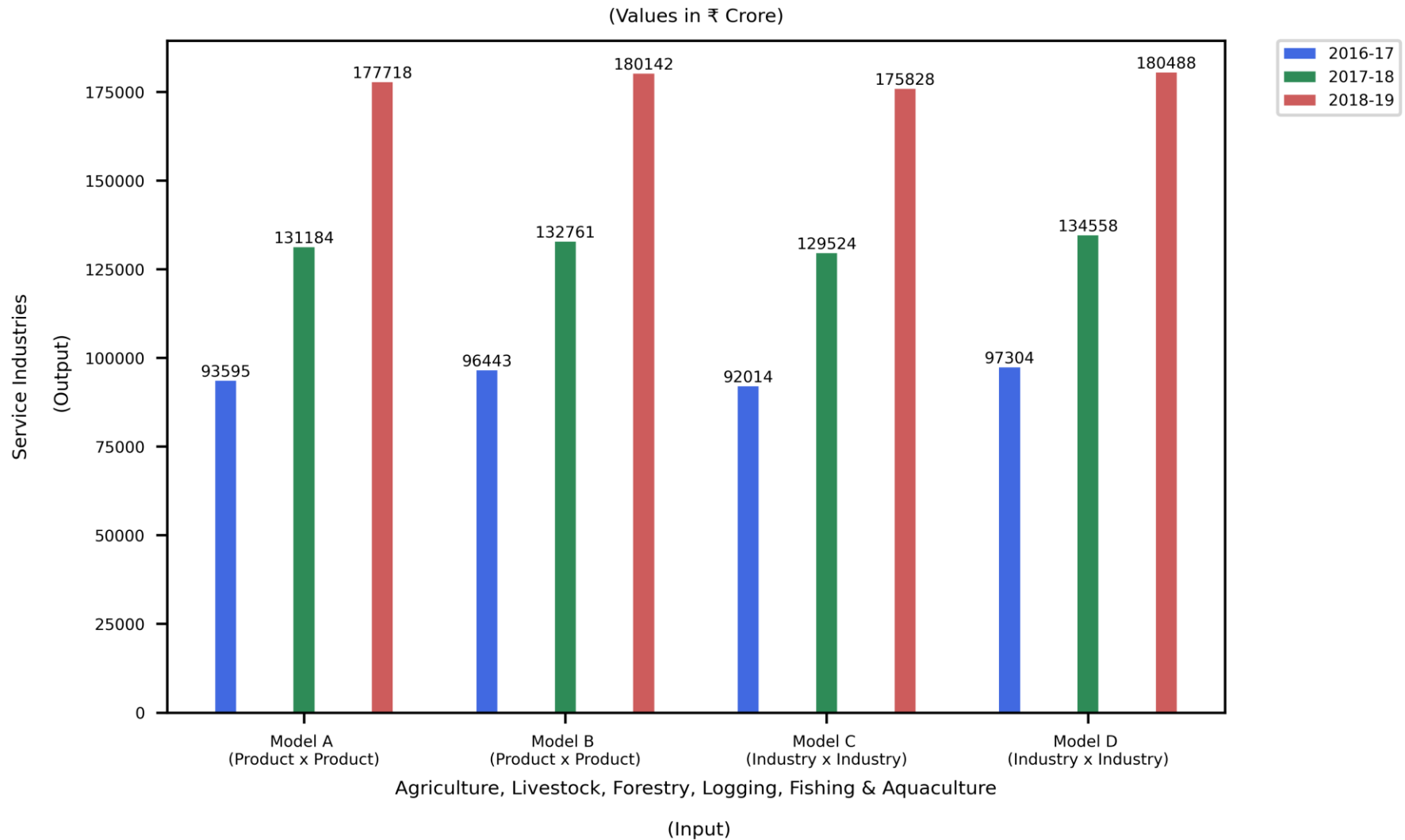
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(Values in ₹ Crore)

Gph 105: Agriculture* (INPUT) vs. Trade and Transportation (OUTPUT)

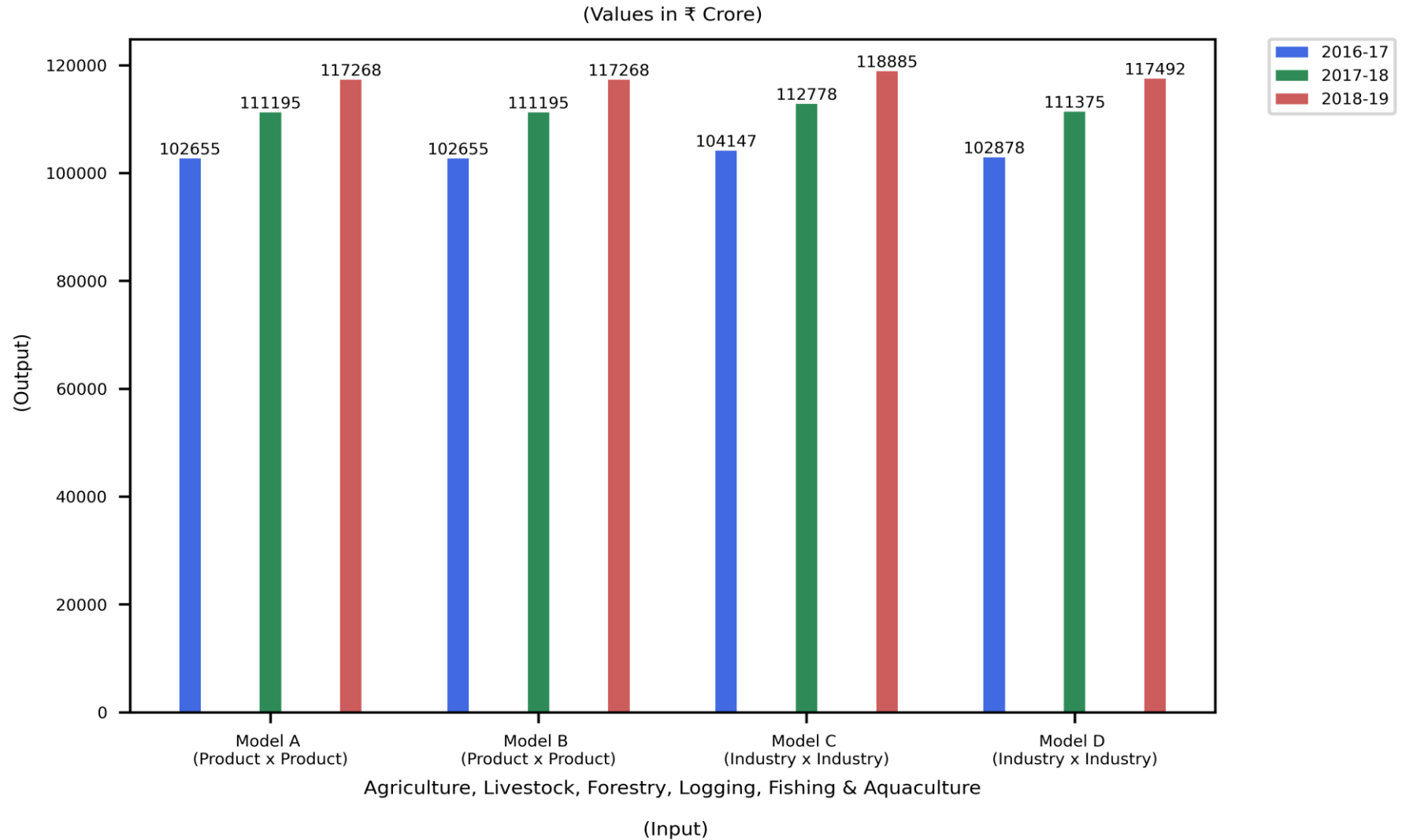**Agriculture*** - Agriculture, Livestock, Forestry, Logging, Fishing, and Aquaculture

Gph 106: Agriculture* (INPUT) vs. Service Industries (OUTPUT)

Agriculture* - Agriculture, Livestock, Forestry, Logging, Fishing, and Aquaculture

(Values in ₹ Crore)

Gph 107: Agriculture* (INPUT) vs. Public Administration and Defence (OUTPUT)

Agriculture* - Agriculture, Livestock, Forestry, Logging, Fishing, and Aquaculture

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INTRODUCTION

Input-Output multipliers are summary measures used for predicting the total impact on all industries in an economy of changes in the demand for the output of any one industry. They describe average effects, not marginal effects, and thus do not take account of economies of scale, unused capacity or technological change. (McLennan, 2016)[1]

Technological change does not occur rapidly in most industries. The various multipliers generally remain fairly stable over time. The exceptions would be those industries producing commodities that are susceptible to wide fluctuation in price on the world market, such as petroleum products, and those of agricultural industries most affected by adverse climatic conditions, namely sheep and wheat.

The standard I-O model used to calculate multipliers is the demand-side I-O model, in which the model is driven by demand for its outputs. The model assume that, in a particular year, fixed amounts of given inputs are required to produce a given output.

[1] McLennan, W., (2016), "*Informational Paper: Australian National Accounts: Introduction to Input-Output Multipliers*", Australian Bureau of Statistics, Catalogue No. 5246.0, pp. 1-29.

INITIAL EFFECT

The initial requirement for an extra crore's worth multiplier (output/income/employment) of a given industry is called the *initial effect.*

FIRST ROUND EFFECT

It is the amount of multiplier (output/income/employment) required from all industries of the economy to produce the initial effect.

SIMPLE MULTIPLIER

The combined effects of the initial effects plus all of the production induced rounds of extra multiplier (output/income/employment) are called the *simple multiplier.*

INDUCED SUPPORT EFFECTS

Since we already know the initial effects, the first round effects and simple multiplier, we can now calculate the *industrial support effects*, the effects of the second and subsequent rounds o induced production.

Industrial support effects = simple multiplier - initial effects - first round effects

PRODUCTION INDUCED EFECTS

Production induced effects = first round effects + industrial support effects

TOTAL MULTIPLIER

The household sector receives wages for work done in the production process and spends some or all of this wage income on goods and services. The wages are shown in *Compensation of Employees* and consumption by households is shown in the *Private final consumption expenditure (PFCE)* column of the flow matrix. The PFCE can be regarded as generating the production of goods and services by the industries of the economy. This induced production of extra goods and services is referred to as the consumption induced effects. A new set of multipliers can be calculated taking into account the initial effects, the production induced effects and the consumption induced effects. These are called the *total multiplier.*

CONSUMPTION INDUCED EFFECTS

Consumption induced effects = total multiplier – simple multiplier

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DIRECT REQUIREMENT COEFFICIENTS (IOT-MODEL D)

USING INDUSTRY / SUPPLYING INDUSTRY	Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	Mining and Quarrying	Manufacturing	Construction	Trade and Transportation	Service Industries	Public Administration and Defence	Inter-Industry Consumption	PFCE	GFCE	GFCF	CIS	Valuables	Export	Total Use BP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	0.0657	0.0008	0.0722	0.0300	0.0081	0.0200	0.0869	0.0447	0.1879	0.0015	0.0014	0.0749	0.0000	0.0232	0.0655
Mining and Quarrying	0.0000	0.0002	0.0427	0.0031	0.0002	0.0047	0.0000	0.0162	0.0001	0.0000	0.0000	0.0698	0.0000	0.0024	0.0103
Manufacturing	0.0396	0.0852	0.2876	0.2809	0.1323	0.0782	0.0449	0.1729	0.2392	0.0020	0.2526	0.4170	0.6397	0.3864	0.2048
Construction	0.0007	0.0766	0.0250	0.0000	0.0263	0.0332	0.0108	0.0223	0.0136	0.0312	0.4810	0.0382	0.0000	0.0068	0.0639
Trade and Transportation	0.0051	0.1033	0.0197	0.0023	0.1093	0.0765	0.0606	0.0454	0.2100	0.0047	0.0015	0.0000	0.0000	0.1158	0.0758
Service Industries	0.0497	0.1342	0.0578	0.1305	0.1132	0.1363	0.0289	0.0922	0.3226	0.2621	0.0845	0.0002	0.0003	0.3056	0.1551
Public Administration and Defence	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6586	0.0000	0.0000	0.0000	0.0011	0.0233

DIRECT REQUIREMENT COEFFICIENTS (IOT-MODEL D)

USING INDUSTRY	Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	Mining and Quarrying	Manufacturing	Construction	Trade and Transportation	Service Industries	Public Administration and Defence	Inter-Industry Consumption	PFCE	GFCE	GFCF	CIS	Valuables	Export	Total Use BP
SUPPLYING INDUSTRY	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Total Use BP	**0.1608**	**0.4002**	**0.5050**	**0.4468**	**0.3894**	**0.3490**	**0.2322**	**0.3937**	**0.9734**	**0.9601**	**0.8209**	**0.6002**	**0.6400**	**0.8412**	**0.5987**
Production Taxes less Subsidies	-0.0267	0.0054	0.0007	0.0022	-0.0030	0.0057	0.0000	-0.0012	--	--	--	--	--	--	--
Consumption of Fixed Capital	0.0526	0.0986	0.0358	0.0242	0.0591	0.0907	0.0980	0.0571	--	--	--	--	--	--	--
Compensation of Employees	0.1191	0.1687	0.0578	0.2355	0.1374	0.2531	0.6756	0.1701	--	--	--	--	--	--	--
Operating Surplus	0.6518	0.3568	0.1418	0.1024	0.4299	0.2963	0.0000	0.2681	--	--	--	--	--	--	--
GVA (by Income Approach)	**0.7968**	**0.6295**	**0.2361**	**0.3642**	**0.6235**	**0.6458**	**0.7736**	**0.4940**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
TTM (down)	**0.0227**	**-0.0800**	**0.0908**	**0.0835**	**-0.0716**	**-0.0480**	**-0.0272**	**0.0185**	**-0.0964**	**0.0000**	**0.0635**	**0.1546**	**0.1714**	**-0.0024**	**0.0000**

DIRECT REQUIREMENT COEFFICIENTS (IOT-MODEL D)

USING INDUSTRY	Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	Mining and Quarrying	Manufacturing	Construction	Trade and Transportation	Service Industries	Public Administration and Defence	Inter-Industry Consumption	PFCE	GFCE	GFCF	CIS	Valuables	Export	Total Use BP
SUPPLYING INDUSTRY	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Total NIT (down)	0.0064	0.0214	0.0266	0.0263	0.0211	0.0181	0.0087	0.0207	0.0454	0.0165	0.0460	0.0328	0.0422	0.0480	0.0297
Total Imports CIF adj.	0.0133	0.0290	0.1415	0.0791	0.0377	0.0351	0.0127	0.0732	0.0776	0.0234	0.0697	0.2124	0.1464	0.1131	0.0758
Total Production	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

MATRIX USED TO CONSTRUCT THE OPEN MODEL
DIRECT ALLOCATION MATRIX

(7x7)　　　　**A MATRIX**

QUADRANT 1						
INTERMEDIATE USAGE						

MATRIX USED TO CONSTRUCT THE CLOSED MODEL
DIRECT ALLOCATION MATRIX

(8x8)   **B MATRIX**

							PRIVATE FINAL CONSUMPTION EXPENDITURE
QUADRANT 1							
INTERMEDIATE USAGE							
COMPENSATION OF EMPLOYEES							

The multiplier (output/income/GVA) for a given industry is defined as the total value of that multiplier, as in the direct allocation matrix, required to satisfy a crore's worth of final demand for the output of that industry.

The coefficient for the multiplier is already calculated in the row of the direct requirement matrix, and these are the initial effects also. For simplicity, we refer them as 'h'.

The remaining multipliers can be calculated using the matrix multiplication function,

first round effects = h * A

simple multiplier = h * (I-A)$^{-1}$

total multiplier = h * (I-B)$^{-1}$

In Case of INCOME MULTIPLIER,

-    **TYPE 1A Multiplier**
For one crore increase in the wages and salaries earned by income earners in the industry being studied, the amount of additional wages, salaries and supplements earned by income earners in all industries in the economy, after initial and first round of induced output.

-    **TYPE 1B Multiplier**
For one crore increase in the wages and salaries earned by income earners in the industry being studied, the amount of additional wages, salaries and supplements earned by income earners in all industries in the economy, after initial, first round and industrial support of induced output.

-    **TYPE 2A Multiplier**
The amount of total additional wages and salaries earned by income earners in all industries in the economy due to a one crore increase in the wages and salaries earned by income earners in the industry being studied. The amount includes the original one crore increase in wages, salaries and supplements.

-    **TYPE 2B Multiplier**
Type 2B equals Type 2A less the original one crore increase in wages and salaries.

In Case of INCOME MULTIPLIER,

TYPE 1A Multiplier

$$Type\ 1A = \frac{initial\ +\ first\ round}{initial}$$

TYPE 1B Multiplier

$$Type\ 1B = \frac{initial\ +\ prodction\ induced}{initial}$$

TYPE 2A Multiplier

$$Type\ 2A = \frac{total\ multiplier}{initial}$$

TYPE 2B Multiplier

$$Type\ 2B = \frac{total\ multiplier\ -\ initial}{initial}$$

OUTPUT MULTIPLIER: MODEL D (2018-19)

	Initial Effects	First Round Effects	Industrial Support Effects	Production Induced Effects	Consumption Induced Effects	Simple Multiplier	Total Multiplier	Type 1A	Type 1B	Type 2A	Type 2B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	1.0000	0.1608	0.0832	0.2441	0.3142	1.2441	1.5583	1.1608	1.2441	1.5583	0.5583
Mining and Quarrying	1.0000	0.4002	0.2803	0.6805	0.5673	1.6805	2.2478	1.4002	1.6805	2.2478	1.2478
Manufacturing	1.0000	0.5050	0.3622	0.8671	0.3253	1.8671	2.1924	1.5050	1.8671	2.1924	1.1924
Construction	1.0000	0.4468	0.3304	0.7772	0.6755	1.7772	2.4527	1.4468	1.7772	2.4527	1.4527
Trade and Transportation	1.0000	0.3894	0.2757	0.6651	0.4752	1.6651	2.1403	1.3894	1.6651	2.1403	1.1403
Service Industries	1.0000	0.3490	0.2318	0.5808	0.7051	1.5808	2.2858	1.3490	1.5808	2.2858	1.2858
Public Administration and Defence	1.0000	0.2322	0.1257	0.3579	1.4751	1.3579	2.8330	1.2322	1.3579	2.8330	1.8330

INCOME MULTIPLIER: MODEL D (2018-19)

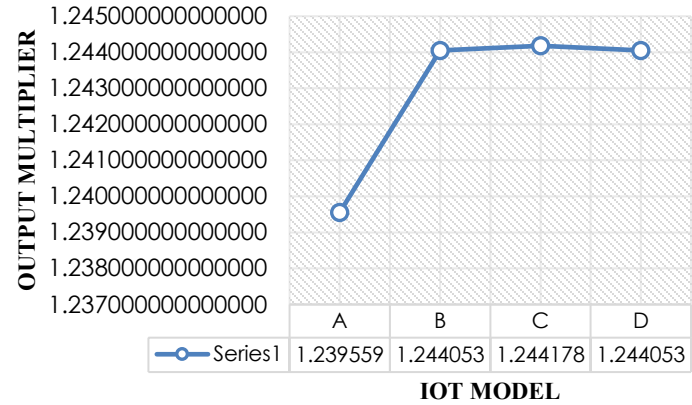|	Initial Effects	First Round Effects	Industrial Support Effects	Production Induced Effects	Consumption Induced Effects	Simple Multiplier	Total Multiplier	Type 1A	Type 1B	Type 2A	Type 2B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	0.1191	0.0236	0.0115	0.0351	0.0467	0.1542	0.2009	1.1978	1.2945	1.6862	0.6862
Mining and Quarrying	0.1687	0.0712	0.0384	0.1097	0.0842	0.2784	0.3626	1.4223	1.6501	2.1494	1.1494
Manufacturing	0.0578	0.0557	0.0462	0.1018	0.0483	0.1596	0.2080	1.9625	2.7606	3.5960	2.5960
Construction	0.2355	0.0537	0.0423	0.0960	0.1003	0.3315	0.4318	1.2280	1.4078	1.8338	0.8338
Trade and Transportation	0.1374	0.0585	0.0373	0.0958	0.0706	0.2332	0.3038	1.4257	1.6970	2.2105	1.2105
Service Industries	0.2531	0.0605	0.0324	0.0929	0.1047	0.3460	0.4507	1.2392	1.3670	1.7807	0.7807
Public Administration and Defence	0.6756	0.0312	0.0172	0.0483	0.2191	0.7239	0.9430	1.0461	1.0715	1.3958	0.3958

GVA MULTIPLIER: MODEL D (2018-19)

	Initial Effects	First Round Effects	Industrial Support Effects	Production Induced Effects	Consumption Induced Effects	Simple Multiplier	Total Multiplier	Type 1A	Type 1B	Type 2A	Type 2B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	0.7968	0.0973	0.0403	0.1376	0.1670	0.9343	1.1013	1.1221	1.1726	1.3822	0.3822
Mining and Quarrying	0.6295	0.1998	0.1291	0.3289	0.3015	0.9584	1.2598	1.3174	1.5225	2.0014	1.0014
Manufacturing	0.2361	0.2110	0.1629	0.3739	0.1729	0.6101	0.7830	1.8937	2.5835	3.3156	2.3156
Construction	0.3642	0.1779	0.1493	0.3272	0.3590	0.6914	1.0504	1.4884	1.8983	2.8838	1.8838
Trade and Transportation	0.6235	0.1886	0.1270	0.3156	0.2526	0.9391	1.1917	1.3025	1.5062	1.9113	0.9113
Service Industries	0.6458	0.1852	0.1086	0.2938	0.3747	0.9397	1.3143	1.2868	1.4550	2.0351	1.0351
Public Administration and Defence	0.7736	0.1403	0.0599	0.2002	0.7839	0.9738	1.7577	1.1814	1.2588	2.2722	1.2722

IMPORTS MULTIPLIER: MODEL D (2018-19)

	Initial Effects	First Round Effects	Industrial Support Effects	Production Induced Effects	Consumption Induced Effects	Simple Multiplier	Total Multiplier	Type 1A	Type 1B	Type 2A	Type 2B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	0.0133	0.0085	0.0064	0.0149	0.0207	0.0282	0.0489	1.6358	2.1169	3.6711	2.6711
Mining and Quarrying	0.0290	0.0267	0.0231	0.0498	0.0374	0.0788	0.1162	1.9216	2.7166	4.0059	3.0059
Manufacturing	0.1415	0.0476	0.0310	0.0786	0.0214	0.2201	0.2416	1.3367	1.5556	1.7072	0.7072
Construction	0.0791	0.0449	0.0281	0.0730	0.0445	0.1520	0.1966	1.5680	1.9231	2.4864	1.4864
Trade and Transportation	0.0377	0.0290	0.0227	0.0517	0.0313	0.0894	0.1207	1.7699	2.3714	3.2029	2.2029
Service Industries	0.0351	0.0218	0.0186	0.0403	0.0465	0.0754	0.1219	1.6202	2.1489	3.4733	2.4733
Public Administration and Defence	0.0127	0.0117	0.0099	0.0216	0.0972	0.0343	0.1315	1.9182	2.6985	10.3524	9.3524

TTM MULTIPLIER: MODEL D (2018-19)

	Initial Effects	First Round Effects	Industrial Support Effects	Production Induced Effects	Consumption Induced Effects	Simple Multiplier	Total Multiplier	Type 1A	Type 1B	Type 2A	Type 2B
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture	0.0227	0.0024	0.0018	0.0042	0.0016	0.0269	0.0285	1.1055	1.1842	1.2566	0.2566
Mining and Quarrying	-0.0800	0.0003	0.0062	0.0065	0.0030	-0.0735	-0.0705	0.9961	0.9183	0.8813	-0.1187
Manufacturing	0.0908	0.0222	0.0112	0.0334	0.0017	0.1242	0.1259	1.2448	1.3685	1.3873	0.3873
Construction	0.0835	0.0195	0.0099	0.0294	0.0035	0.1129	0.1165	1.2335	1.3519	1.3941	0.3941
Trade and Transportation	-0.0716	0.0011	0.0063	0.0075	0.0025	-0.0641	-0.0617	0.9843	0.8958	0.8611	-0.1389
Service Industries	-0.0480	-0.0021	0.0046	0.0026	0.0037	-0.0454	-0.0417	1.0429	0.9464	0.8696	-0.1304
Public Administration and Defence	-0.0272	0.0012	0.0027	0.0039	0.0077	-0.0233	-0.0156	0.9552	0.8556	0.5722	-0.4278

Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture

	A	B	C	D
Series1	1.239559	1.244053	1.244178	1.244053

Mining and Quarrying

	A	B	C	D
Series1	1.679058	1.718602	1.679058	1.680531

Manufacturing

	A	B	C	D
Series1	1.883106	1.867007	1.868549	1.867132

Construction

	A	B	C	D
Series1	1.781132	1.780060	1.781132	1.777197

Trade and Transport

	A	B	C	D
Series1	1.667384	1.688139	1.664159	1.665053

Service Industries

	A	B	C	D
Series1	1.579234	1.581362	1.579490	1.580750
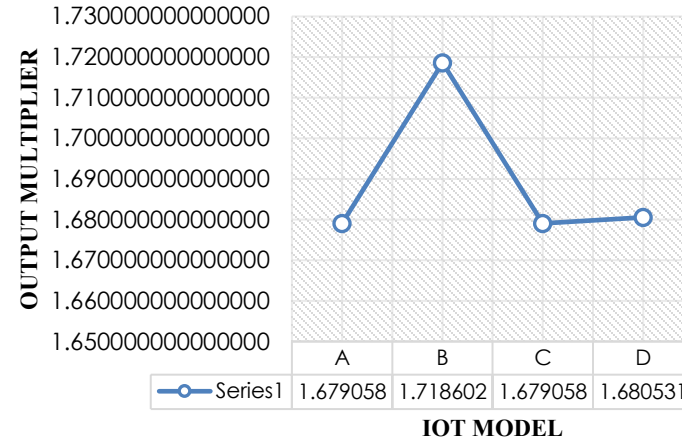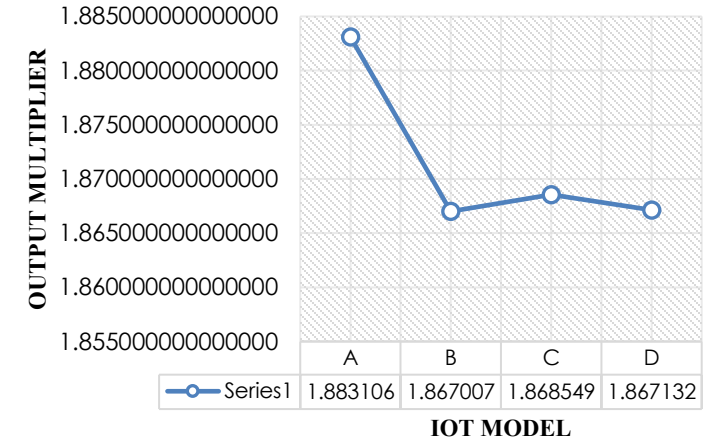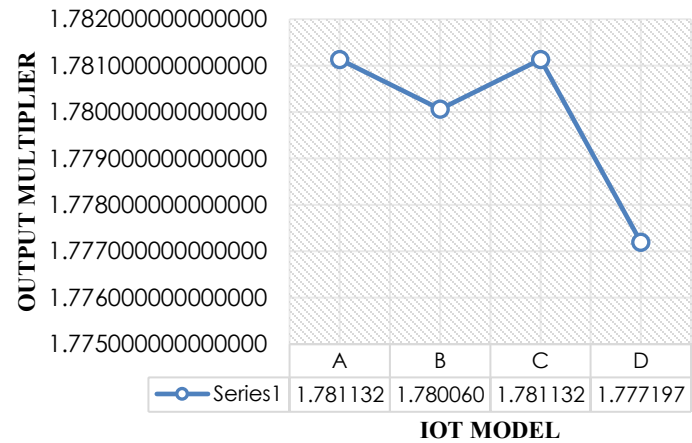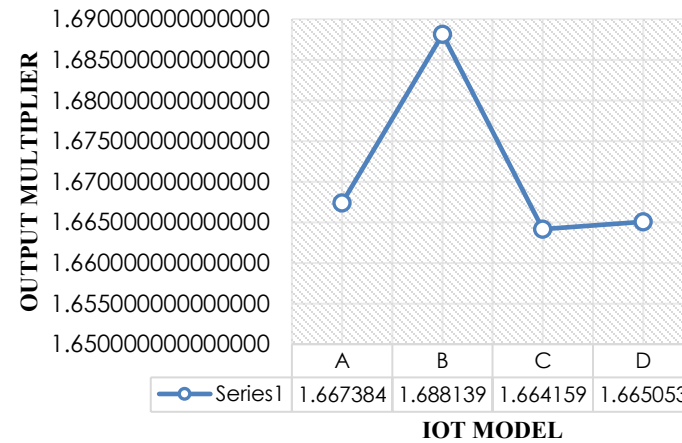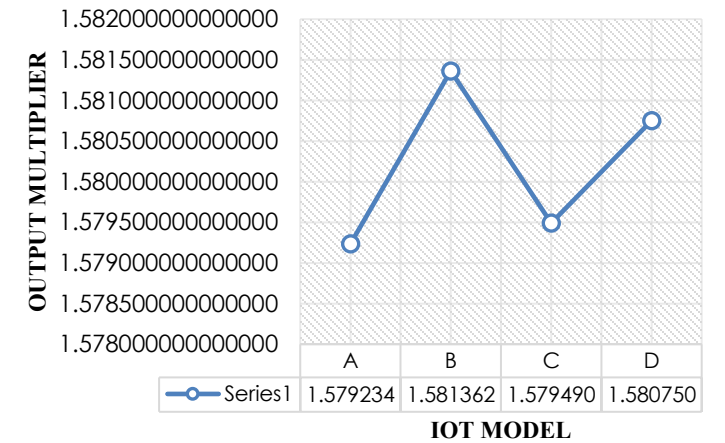
GRAPH: INCOME MULTIPLIER

Agriculture, Livestock, Forestry, Logging, Fishing and Aquaculture
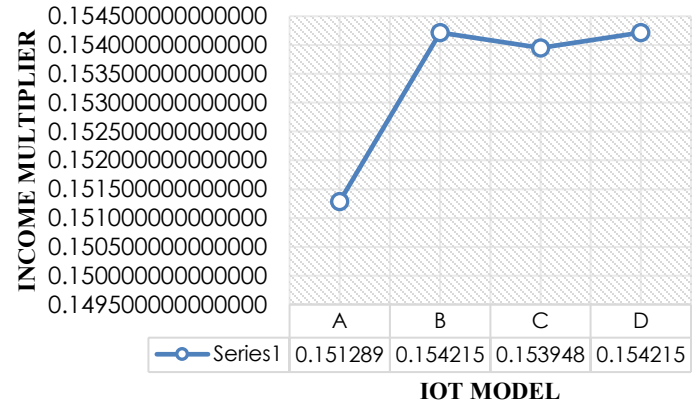
	A	B	C	D
Series1	0.151289	0.154215	0.153948	0.154215

Mining and Quarrying

	A	B	C	D
Series1	0.279204	0.254164	0.279204	0.278390

Manufacturing

	A	B	C	D
Series2	0.151240	0.159729	0.158915	0.159648
Series1	0.151240	0.159729	0.158915	0.159648

Construction

	A	B	C	D
Series1	0.329748	0.325935	0.329748	0.331502

Trade and Transportation

	A	B	C	D
Series1	0.229032	0.224944	0.233343	0.233225

Service Industries

	A	B	C	D
Series1	0.346855	0.342303	0.346654	0.346011

Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture

	A	B	C	D
Series1	0.933536	0.934320	0.933656	0.934320

Mining and Quarrying

	A	B	C	D
Series1	0.961387	0.887297	0.961387	0.958352

Manufacturing

	A	B	C	D
Series1	0.584466	0.610221	0.607936	0.610077

Construction

	A	B	C	D
Series1	0.684993	0.688836	0.684993	0.691407

Trade and Transportation

	A	B	C	D
Series1	0.941255	0.901304	0.941296	0.939099

Service Industries

	A	B	C	D
Series1	0.942370	0.938435	0.942148	0.939656

60
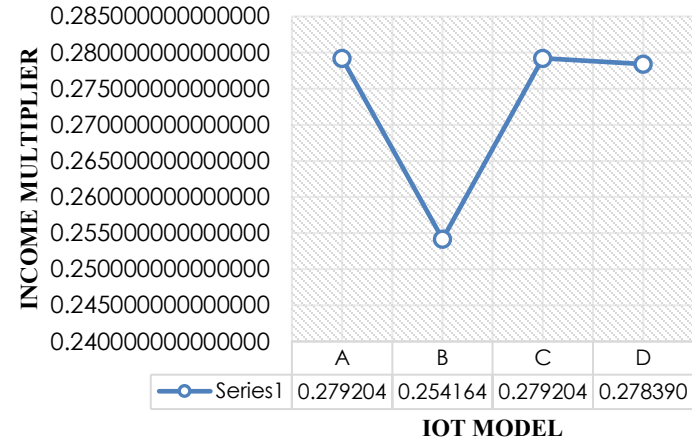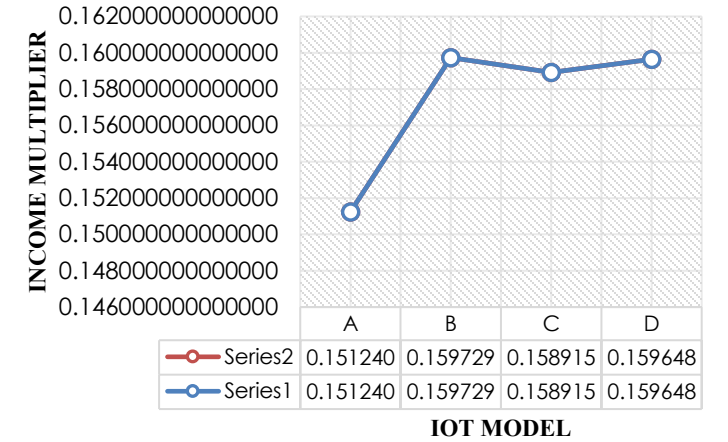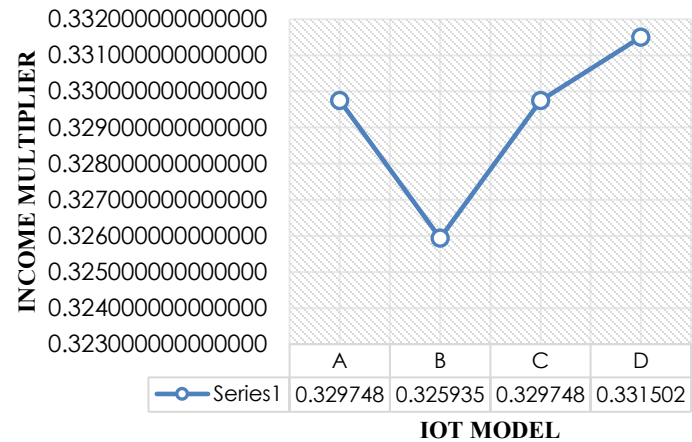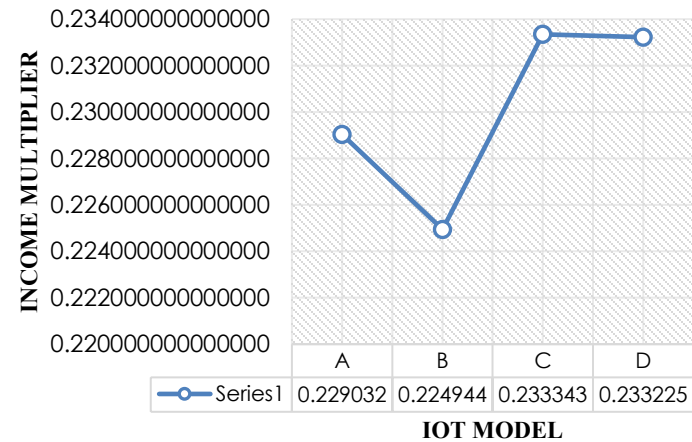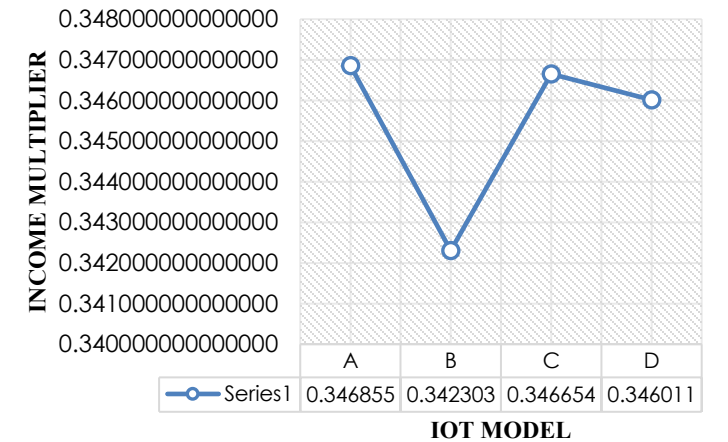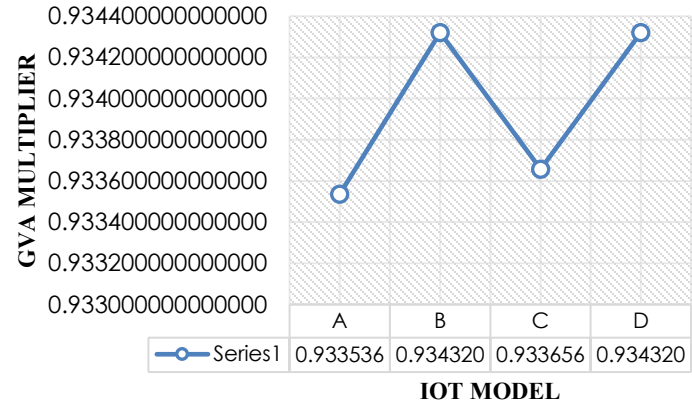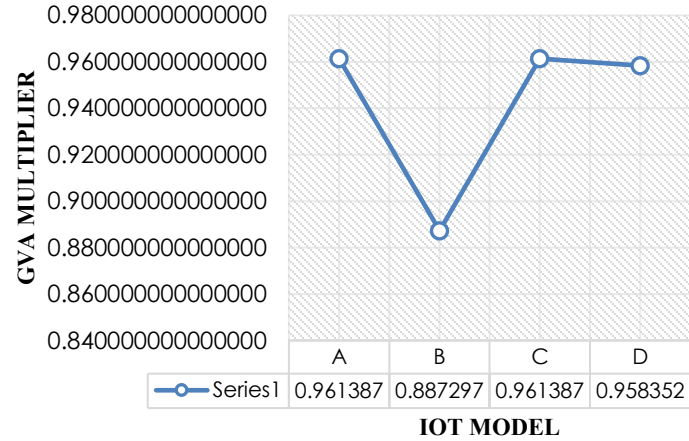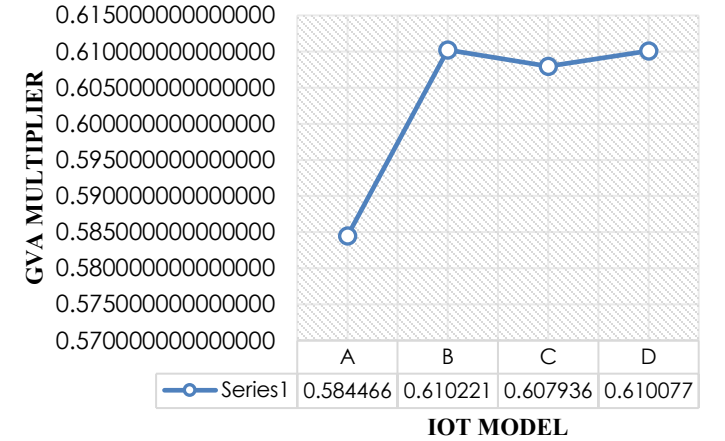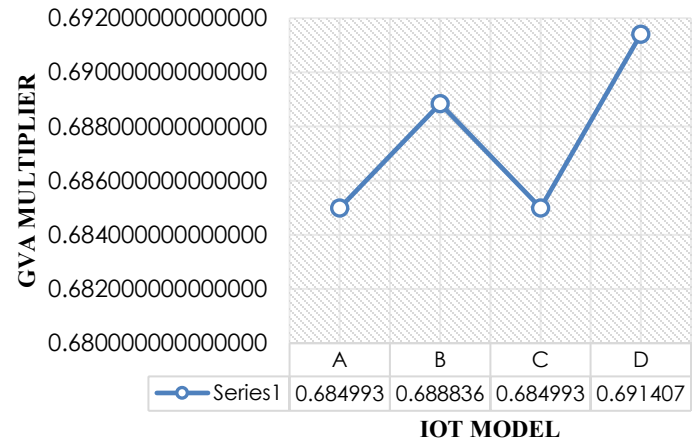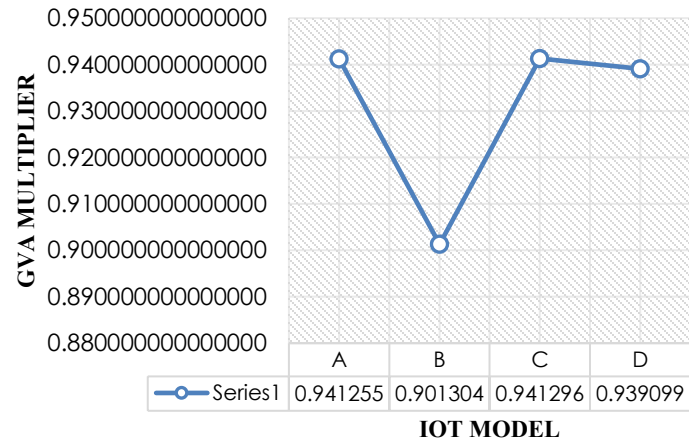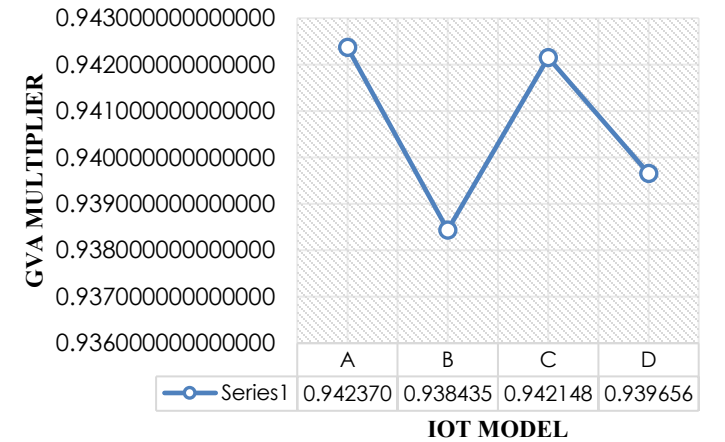
GRAPH: IMPORTS MULTIPLIER

Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture
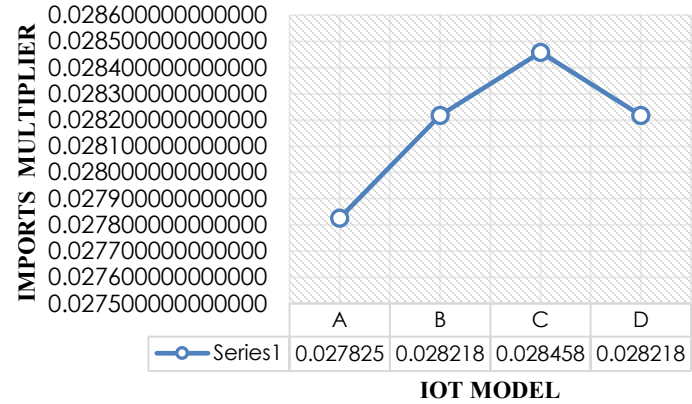
| Series1 | 0.027825 | 0.028218 | 0.028458 | 0.028218 |

Mining and Quarrying

| Series1 | 0.077614 | 0.107630 | 0.077614 | 0.078794 |

Manufacturing

| Series1 | 0.230817 | 0.220074 | 0.221032 | 0.220137 |

Construction

| Series1 | 0.154717 | 0.154234 | 0.154717 | 0.152047 |

Trade and Transportation

| Series1 | 0.089124 | 0.104354 | 0.088583 | 0.089352 |

Service Industries

| Series1 | 0.074361 | 0.075918 | 0.074465 | 0.075420 |
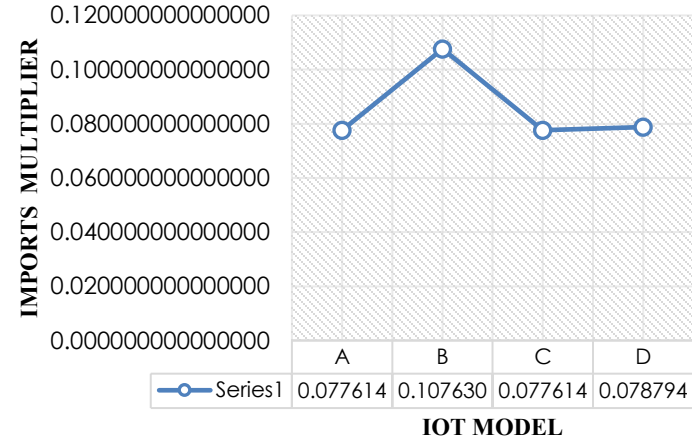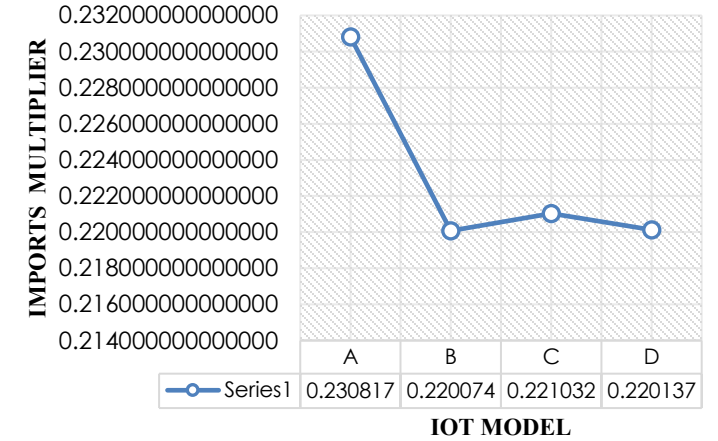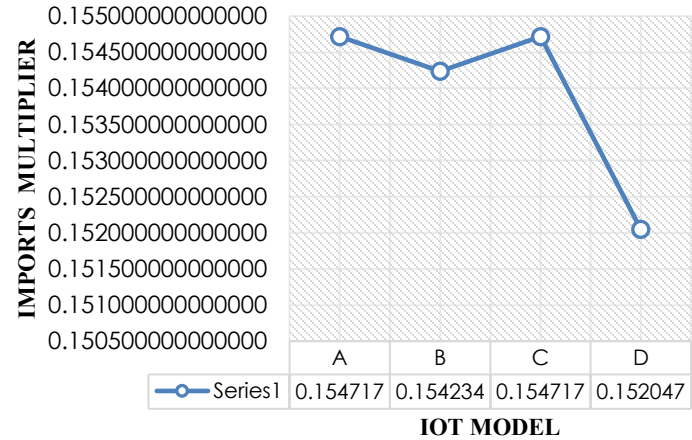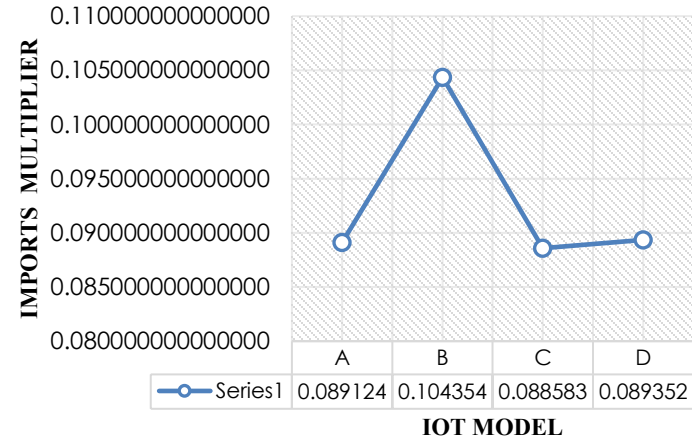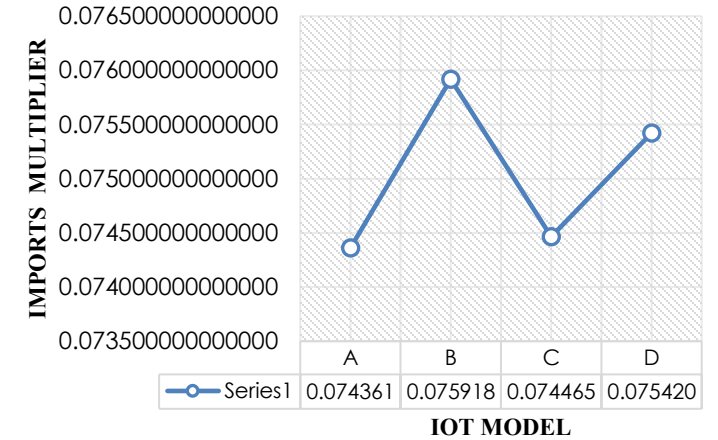
GRAPH: TTM MULTIPLIER

Agriculture, Livestock, Forestry, Logging, Fishing & Aquaculture
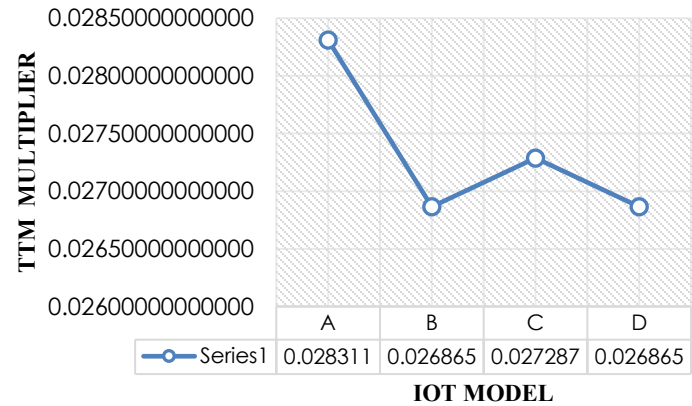
	A	B	C	D
Series1	0.028311	0.026865	0.027287	0.026865

Mining and Quarrying

	A	B	C	D
Series1	-0.07529	-0.03316	-0.07529	-0.07350

Manufacturing

	A	B	C	D
Series1	0.138382	0.124123	0.125385	0.124197

Construction

	A	B	C	D
Series1	0.116507	0.113265	0.116507	0.112942

Trade and Transportation

	A	B	C	D
Series1	-0.06622	-0.04247	-0.06552	-0.06413

Service Industries

	A	B	C	D
Series1	-0.04696	-0.04470	-0.04686	-0.04538
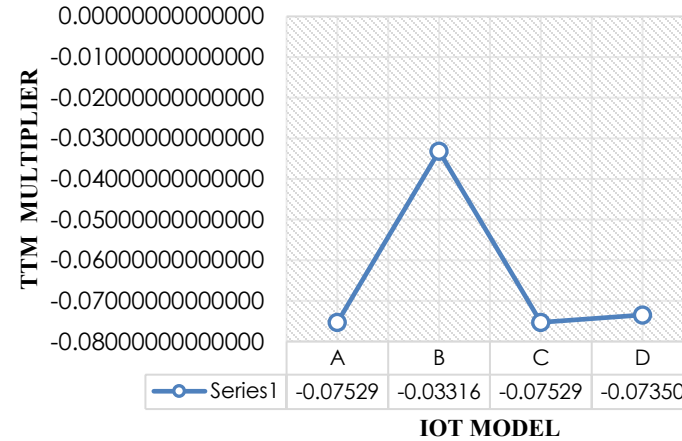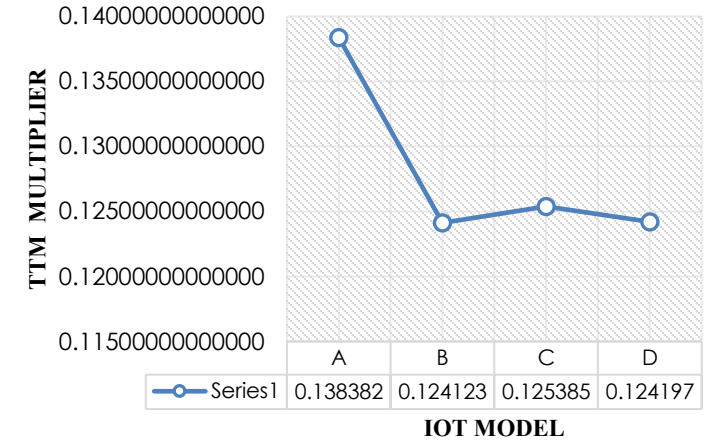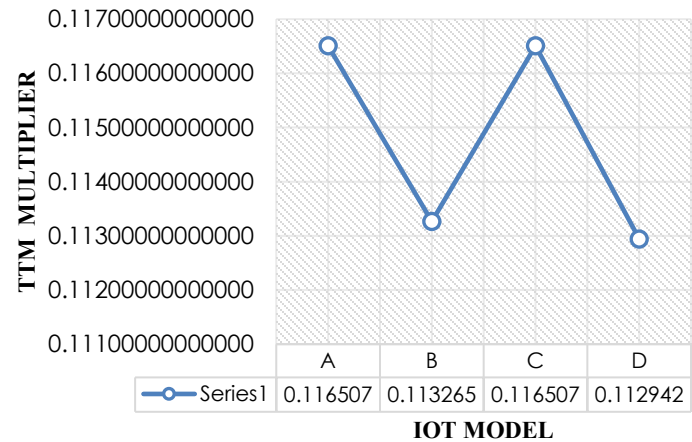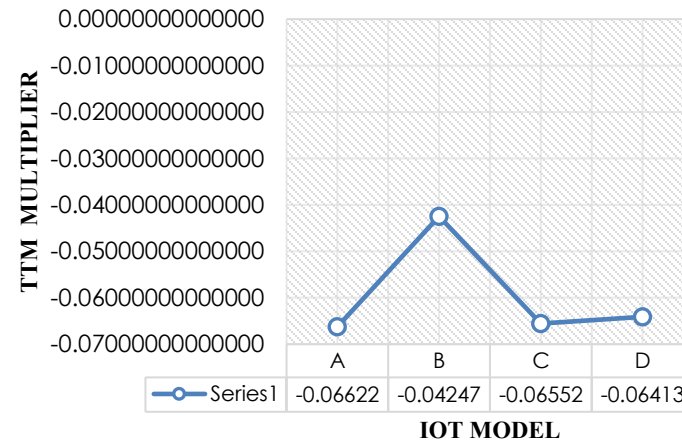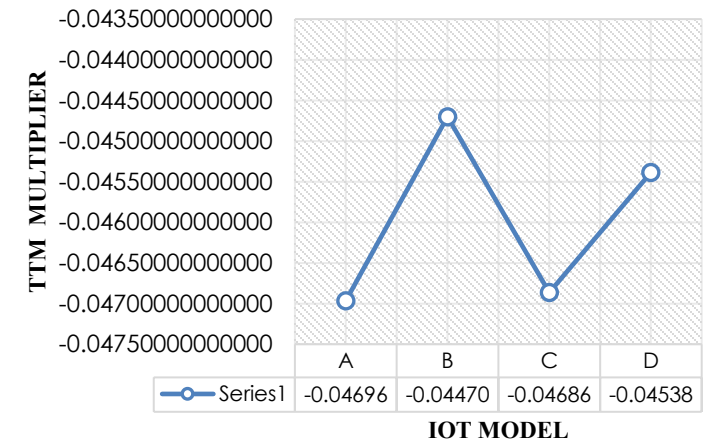
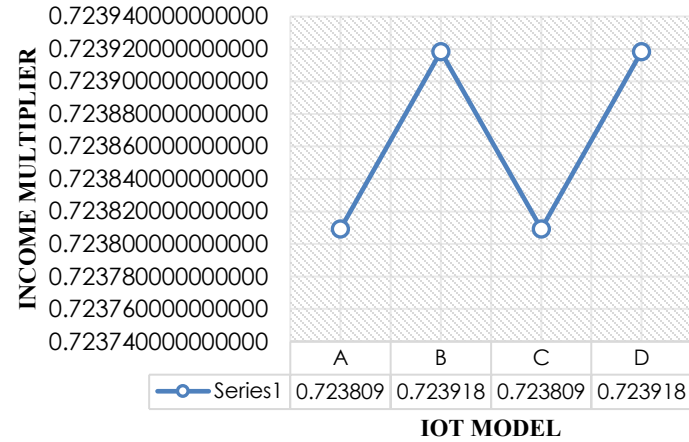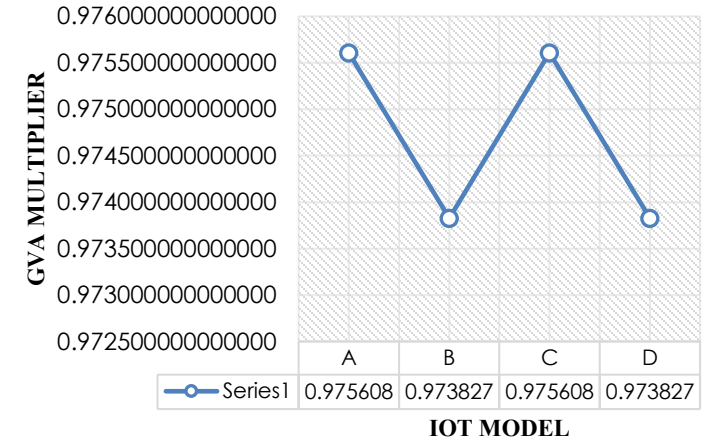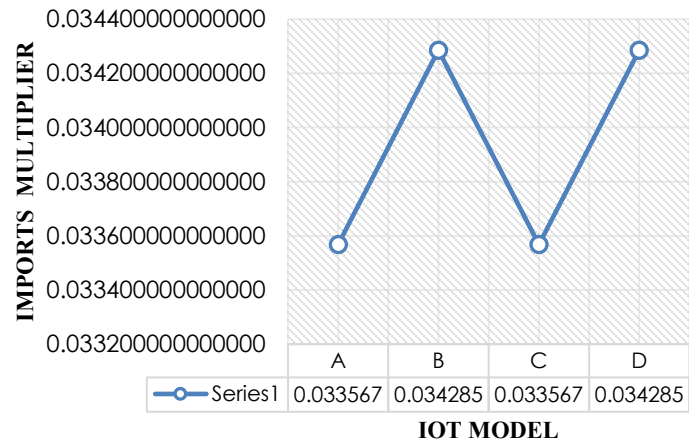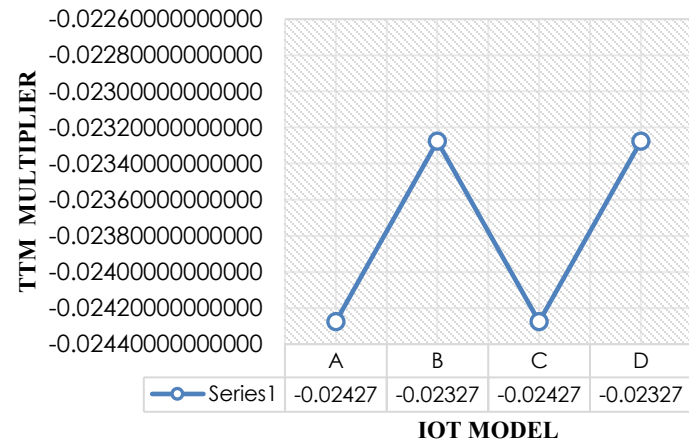Public Administration and Defence
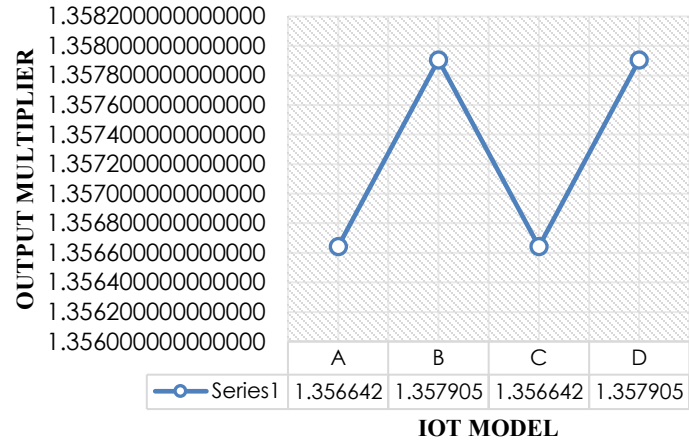
Public Adminitration and Defence

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THANK YOU!

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