

# **Use of Input Output Data in Building Evidence for Trade Policy Making**

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# Central Theme of the Discussions

## Session 7

- Economic measurement using input output framework

## Session 8

- Utility of the input output framework in trade policy making

## Key Issues

- SDGs linked to trade policy
- Contribution of trade policy to the achievement of the SDGs

# Part 1: Introduction to Input Output Framework

- IO framework provides information on
  - Production
  - Consumption
  - Income
  - Supply
  - Use
  - Employment
  - Environment
  - Sub-national

# Indicators of Economic Status and Development

- What are the principal indicators in your country?
- How are they measured?
- How often are they measured?
- How reliable are the measures?
- Do they form the basis for government economic policies?

# IO Based Key Economic Indicators

- How much income is generated in the economy?
  - Gross Domestic Product (GDP)
- How is the income generated in the economy?
  - Sector specific GDP
- How is the income distributed among factors of production?
  - Value Added attributable to labor, capital, government and entrepreneur
- Why are these measures important in your country context?

# Income-GDP-Value Added

- Income is the “value added” generated by productive activities
- “Value added” is the economic value placed on the “effort” required to produce a good or service
- The “effort” is principally provided by labor, capital, entrepreneurship and government

# Components of Value Added

	Agriculture	Manufacturing	Services	Government
Labor	70	75	180	75
Capital	15	85	25	10
Entrepreneurship	10	45	45	0
Government	5	20	25	5

Value Added	100	225	275	90
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GDP 690

**How is value added generated in the economy or in any given sector?**

# Generation of Value Added

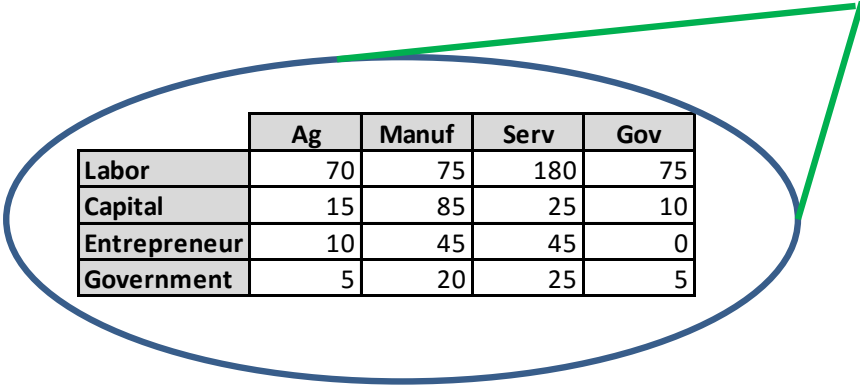
- Value added (and hence, income) is generated through productive processes undertaken in an economy

	Ag	Manuf	Ser	Gov
Ag	500	5	5	2
Manuf	50	300	10	3
Serv	100	50	600	10
Gov	25	10	20	400

VA	100	225	275	90
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Output	775	590	910	505
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VA Ratio	13%	38%	30%	18%
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	Ag	Manuf	Serv	Gov
Labor	70	75	180	75
Capital	15	85	25	10
Entrepreneur	10	45	45	0
Government	5	20	25	5

**VA Ratio:** Shows the proportion of value added in a \$1 allocation to produce a sector's product

**Policy Question:** Should the economy concentrate its resources on the sector that produces the highest VA ratio and rely on imports to meet the demand for other goods and services?



# The Production Process

- Why does an economy engage in productive processes?
- How resources are allocated to various processes?

	Ag	Manuf	Ser	Gov
Ag	500	5	5	2
Manuf	50	300	10	3
Serv	100	50	600	10
Gov	25	10	20	400
VA	100	225	275	90

**Allocation of Resources: Stage 2**  
Sector and product specific  
production technology

Output	775	590	910	505
Demand	775	590	910	505

**Allocation of Resources: Stage 1**  
Supply = Output = Demand = Use

# The Demand Side

- What constitute the demand?

Intermediate Demand

	Ag	Manuf	Ser	Gov
Ag	500	5	5	2
Manuf	50	300	10	3
Serv	100	50	600	10
Gov	25	10	20	400

+ + + +

VA	100	225	275	90
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= = = =

Output	775	590	910	505
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Final Demand

Household Consumption [C]	Investment [I]	Government Consumption [G]
200	50	13
150	60	17
100	10	40
45	1	4

=

=

=

=

Total Demand
775
590
910
505

Input-Output Table of a closed economy

# Excess Demand, Excess Supply

- What happens if there is excess demand for, or excess supply of, a product during any given reference period?

## (1) Inventory withdrawal or addition

Intermediate Demand					Final Demand				Total Demand
	Ag	Manuf	Ser	Gov	Household Consumption [C]	Investment [I]	Government Consumption [G]	Change in Inventory	
Ag	500	5	5	2	210	50	13	-10	775
Manuf	50	300	10	3	130	60	17	20	590
Serv	100	50	600	10	100	10	40	0	910
Gov	25	10	20	400	45	1	4	0	505
VA	100	225	275	90					
Output	775	590	910	505					

## (2) Price adjustment

### Point of discussion:

- How are supply-demand mismatches in services resolved?
- Does modern technology enable storage of services?

# Excess Demand, Excess Supply

- What happens if there is excess demand for, or excess supply of, a product during any given reference period?

## (3) Trade

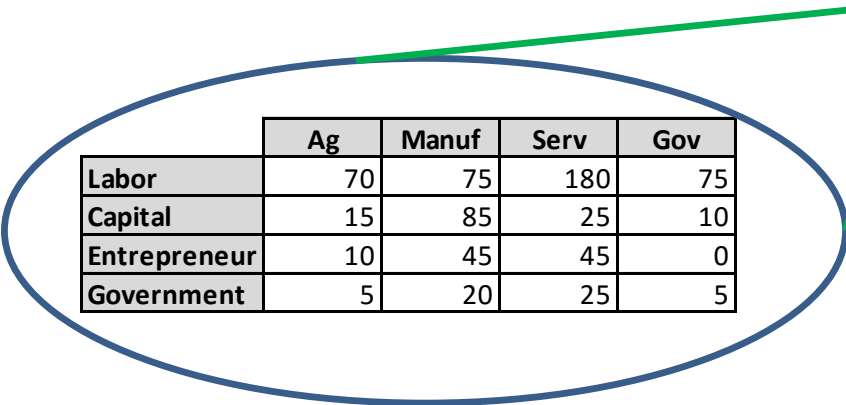
Intermediate Demand					Final Demand						Total Demand
	Ag	Manuf	Ser	Gov	Household Consumption [C]	Investment [I]	Government Consumption [G]	Change in Inventory [ $\Delta$ INV]	Export [X]	Import [M]	
Ag	500	5	5	2	200	50	13	-10	30	-20	775
Manuf	50	300	10	3	130	45	17	20	25	-10	590
Serv	100	50	600	10	100	10	30	0	15	-5	910
Gov	25	10	20	400	41	1	4	0	5	-1	505
VA	100	225	275	90							
Output	775	590	910	505							

### Discussion Points:

- Why is M always negative in the IO framework?
- Why would a country export and import the same product?

# Gross Domestic Product (GDP): Income Approach

- GDP = income generated in the economy through productive activities



	Ag	Manuf	Serv	Gov
Labor	70	75	180	75
Capital	15	85	25	10
Entrepreneur	10	45	45	0
Government	5	20	25	5

VA	100	225	275	90
	+	+	+	+
VAT	26	23	15	5
	=	=	=	=
GDP	126	248	290	95

Total GDP	759
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## Questions:

- Why the terms “Gross” and “Domestic”?
- Why should final consumption taxes such as VAT be added?
- Why are other types of income such as transfers not included?

# Gross Domestic Product (GDP): Expenditure Approach

- GDP = final expenditure on domestically produced goods and services

Final Demand									
Household Consumption [C]	Investment [I]	Government Consumption [G]	Change in Inventory [ $\Delta$ INV]	Export [X]	Import [M]		VAT	Total Expenditure	Total GDP
200	50	13	-10	30	-20	+	26	289	759
130	45	17	20	25	-10	+	23	250	
100	10	30	0	15	-5	+	15	165	
41	1	4	0	5	-1	+	5	55	

## Questions:

- Why VAT needs to be added?
- Why exports are counted fully in GDP?
- Why imports are excluded from GDP?

# GDP and Trade

- $\text{GDP} = C + I + G + \Delta \text{INV} + (X - M)$
- $\text{Trade} = X - M$
- X, M include intermediate and final products

## Questions:

- What is the impact of trade on GDP?
- Would an increase in M decrease GDP?
- When can trade decrease GDP?

# Trade in the Modern World

- Trade between nations existed from ancient times: what is different now?
- How has international trade evolved since the 1970s and 1980s?
- Evolution since the 1990s?
- Factors driving the changes?
- “Evolution” till “perfect specialization” based on factor advantages?
- From a country’s perspective, is there a critical balance between trade and domestic production (economically and politically)?



Questions?

## Part 2: Discerning Value Added Trade through IO Framework

- IO framework can provide information on
  - Gross trade (imports, exports, re-exports)
  - Cross country production sharing arrangements
  - Import content (foreign value added) of exports
  - Value added attributable to each country-sector
  - Distribution of value added among the primary factors

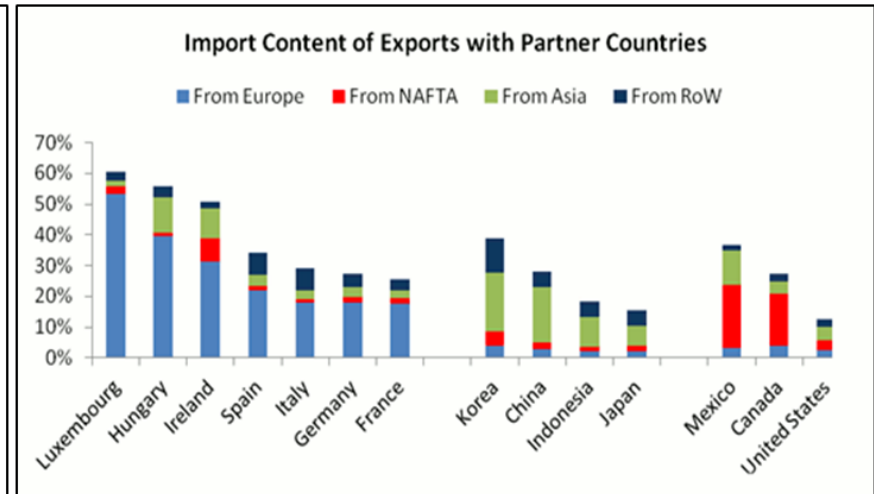
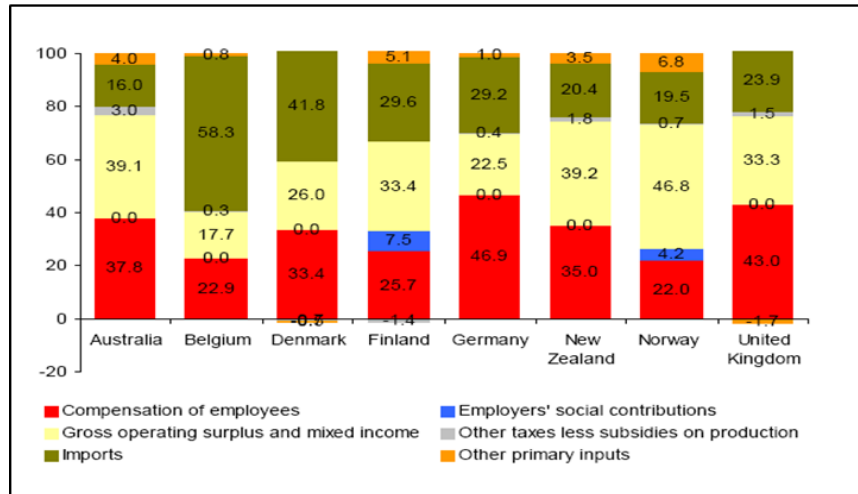
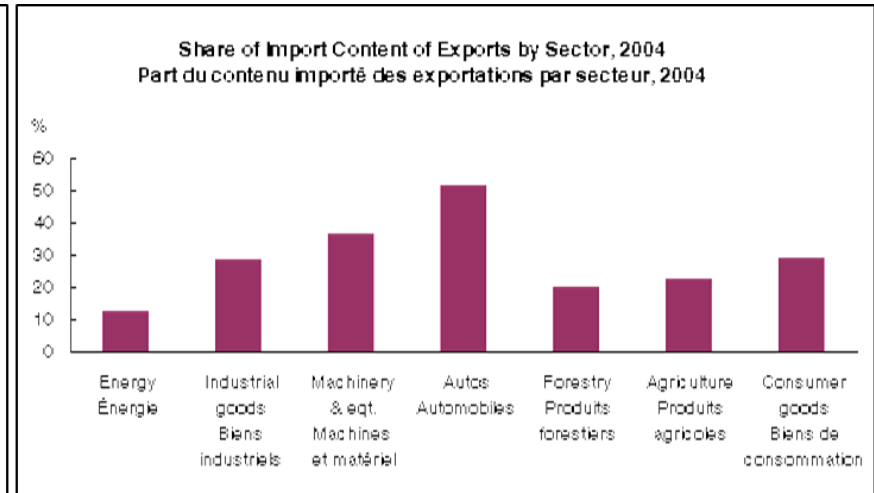
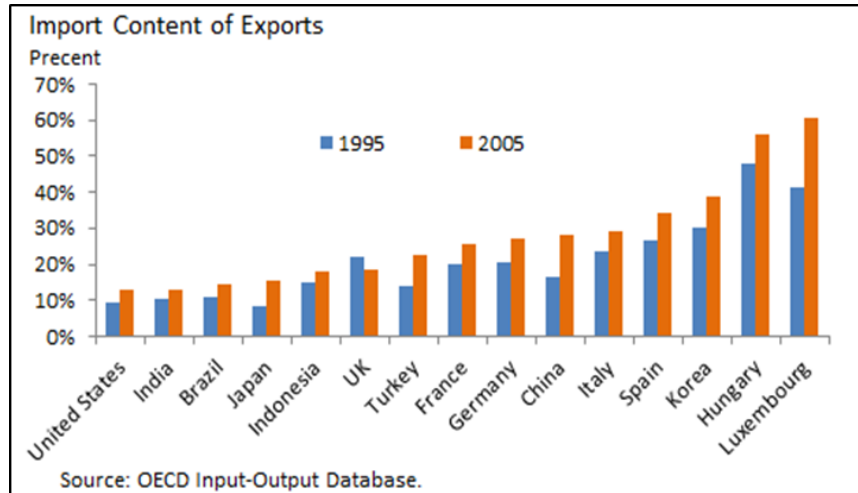
# Conventional Approaches to Presenting Trade Statistics

- **Broad aggregates**
  - Imports
  - Re-exports
  - Exports
  - Re-imports
- **Indicators related to trade**
  - **Key Indicators for Asia and the Pacific**
    - Merchandise exports and imports (levels and growth)
    - Direction of trade: Merchandise exports (imports) to (from) specific economy or region (percentage of total)
    - Trade in goods (imports plus exports as a percentage of GDP)
    - Trade in services balance (percentage of GDP)
    - Trade in goods balance (percentage of GDP)
    - Current account balance (percentage of GDP)
  - **Asian Economic Integration Monitor**
    - Intra-sub regional trade (as a proportion of the sub-region's total trade with the world)
    - Inter-sub regional trade (as a proportion of the sub-region's total trade with the world)
    - Intraregional trade intensity  $((X_{ii}+M_{ii})/(X_{iw}+M_{iw}))/((X_{iw}+M_{iw})/(X_{ww}+M_{ww}))$
    - Intraregional trade shares  $((X_{ii}+M_{ii})/(X_{iw}+M_{iw}))$
    - Trade intensity or trade bias  $(T_{ij}/T_i)/(T_j/T_w)$
    - Total trade (levels: intra-sub regional, inter-sub regional, total trade with Asia, total trade with the world)
  - **Asian Development Outlook**
    - Net exports (contribution to growth)
    - Change in export value (percentage, year on year)

**All measures are based on gross trade data**

# Conventional Approaches to Presenting Trade Statistics

## Useful information concealed: Composition of exports



Sources: OECD, Statistics Canada, Statistics New Zealand

# Conventional Approaches to Presenting Trade Statistics

Critical information concealed: How trade works through different economies

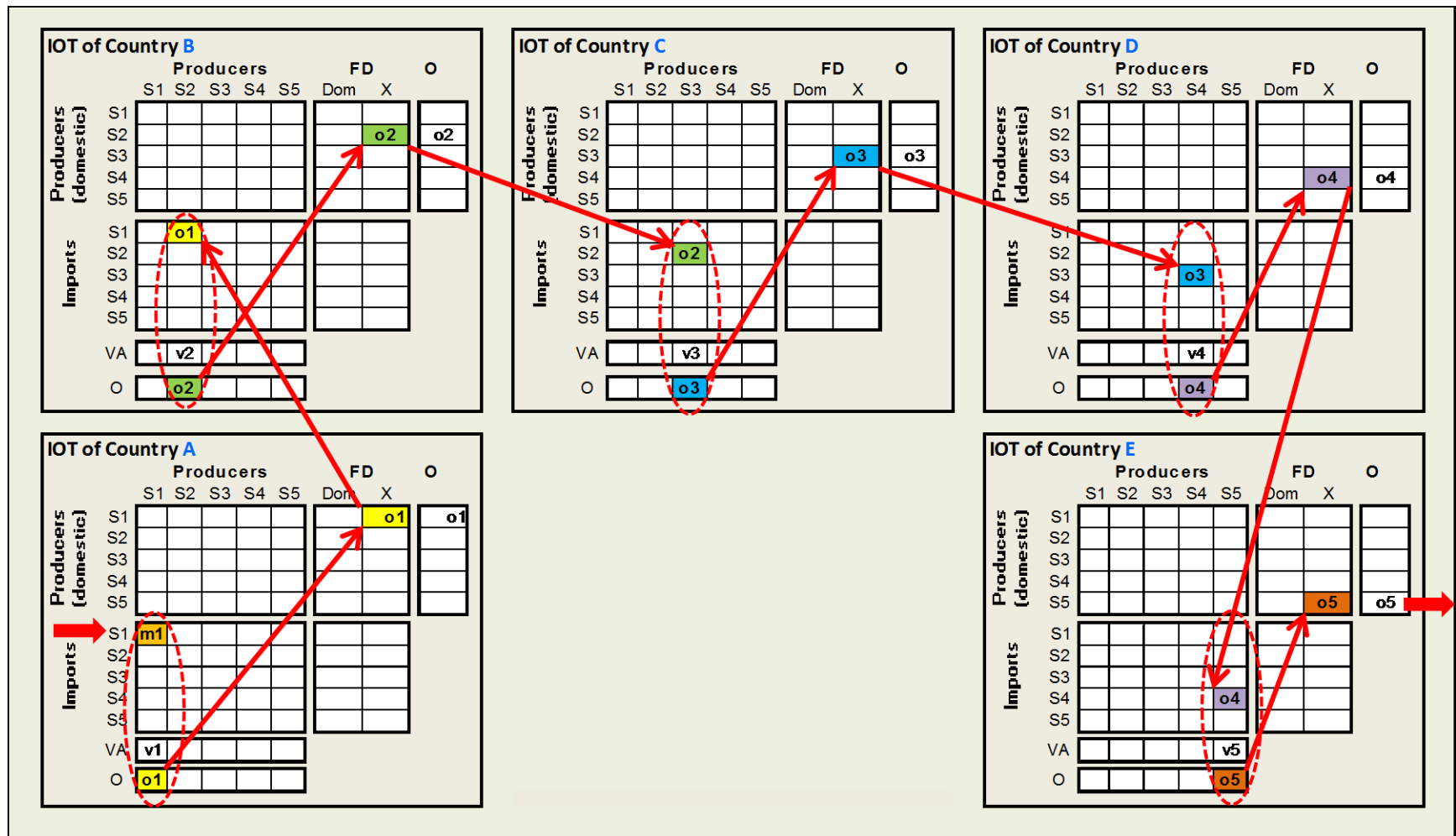
Input-Output Table									
		Producers as Consumers					Final Demand		Output
		S1	S2	S3	S4	S5	Domestic	Exports	
Producers (domestic)	S1		o1						o1
	S2			o2					o2
	S3				o3				o3
	S4					o4			o4
	S5							x5	o5
Imports	S1	m1							
	S2								
	S3								
	S4								
	S5								
Value Added		v1	v2	v3	v4	v5			
Output		o1	o2	o3	o4	o5			

- Transactional linkages among the sectors
- Value added by the producing sectors

Intermediate Inputs + Value Added = Output = Intermediate Inputs + Final Demand

- Column: Composition of inputs required by an industry to produce its output
- Row: Demand for a producer's output

# Studying Production and Trade through Input Output Framework



- IO framework details
  - Production structures
  - Production sharing and trade patterns

# Studying Production and Trade through Input Output Framework

## Discerning direct and indirect transactions through IO framework

Direct Effects		A					B					C					D					E				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
A	1	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Direct and Indirect Effects		A					B					C					D					E				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
A	1	1	0	0	0	0	0	0.25	0	0	0	0	0.06	0	0	0	0	0	0	0.02	0	0	0	0	0.004	0
	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	1	0	0	0	0	0.25	0	0	0	0	0	0	0.06	0	0	0	0	0	0.016
	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0.25	0	0	0	0	0	0.063
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
D	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0.25
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
E	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

- Linkages (dependencies) discerned through Leontief's insight
- Leontief insight is rooted in the total requirement matrix,  $(I - A)^{-1}$
- Matrix A details sector specific production structure through factor coefficients

# Value Added Approach to Analyzing Trade Data

	A					B					C					D					E					DF	FF	OUT	
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5				
A	1						50																				100	50	200
	2																												
	3																												
	4																												
	5																												
B	1																												
	2																												
	3																												
	4																												
	5																												
C	1																												
	2																												
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	4																												
	5																												
D	1																												
	2																												
	3																												
	4																												
	5																												
E	1																												
	2																												
	3																												
	4																												
	5	50																											
VA	150					150					150					150					150								
OUT	200					200					200					200					200								
VAR	0.75					0.75					0.75					0.75					0.75								

**A:**  $m[E] + v[A] = o[A]$

**B:**  $m[A] + v[B] = o[B]$

**C:**  $m[B] + v[C] = o[C]$

**D:**  $m[C] + v[D] = o[D]$

**E:**  $m[D] + v[E] = o[E]$

**A:**  $p o[E] + v[A] = o[A]$

**B:**  $p o[A] + v[B] = o[B]$

**C:**  $p o[B] + v[C] = o[C]$

**D:**  $p o[C] + v[D] = o[D]$

**E:**  $p o[D] + v[E] = o[E]$

**E(1):**  $p^1 o[D] + v[E] = o[E]$

**E(2):**  $p^2 o[C] + p^1 v[D] + v[E] = o[E]$

**E(3):**  $p^3 o[B] + p^2 v[C] + p^1 v[D] + v[E] = o[E]$

**E(4):**  $p^4 o[A] + p^3 v[B] + p^2 v[C] + p^1 v[D] + v[E] = o[E]$

**E(5):**  $p^5 o[E] + p^4 v[A] + p^3 v[B] + p^2 v[C] + p^1 v[D] + v[E] = o[E]$

$p < 1$

- Output, exports and imports can be completely decomposed into value added terms
- The length of the production chain can be determined through the decomposition
- Value added decomposition reveals the position of a country (sector) in the production chain
- Distribution of benefits of production and trade by country (sector)



# Value Added Approach to Analyzing Trade Data

**A's export to B** 100.00

<b>Final Demand</b>		50.00							
	DVA		37.50						
	FVA		12.50						
		DVA[A]		0.04					
		FVA		12.46					

Repeat counting of the same value added terms

<b>Intermediate Inputs</b>		50.00							
	DVA		37.50						
		DVA_DF_BB		18.75					
		DVA_FF_BC		9.38					
		DVA_INT_BC		9.38					
			DVA_DF_CC		4.69				
			DVA_FF_CD		2.34				
			DVA_INT_CD		2.34				
				DVA_DF_DD		1.17			
				DVA_FF_DE		0.59			
				DVA_INT_DE		0.59			
					DVA_DF_EE		0.29		
					DVA_FF_EA		0.15		
					DVA_INT_EA		0.15		
						DVA_DF_AA		0.07	
						DVA_FF_AB		0.04	
						DVA_INT_AB		0.04	
	FVA		12.50						
		DVA[E]_EA		9.38					
			DVA[D]_DE		2.34				
				DVA[C]_CD		0.59			
					DVA[B]_BC		0.15		
						DVA[A]_AB		0.04	

DVA[E]_EA	9.38				
	FVA_DF_BB	4.69			
	FVA_FF_BC	2.34			
	FVA_INT_BC	2.34			
		FVA_DF_CC	1.17		
		FVA_FF_CD	0.59		
		FVA_INT_CD	0.59		
			FVA_DF_DD	0.29	
			FVA_FF_DE	0.15	
			FVA_INT_DE	0.15	
				FVA_DF_EE	0.07
				FVA_FF_EA	0.04
				FVA_INT_EA	0.04

# An Accounting Framework for International Production Sharing

Leontief Insight

$$\hat{V}B\hat{Y} = \begin{bmatrix} v_1^s & 0 & 0 & 0 \\ 0 & v_2^s & 0 & 0 \\ 0 & 0 & v_1^r & 0 \\ 0 & 0 & 0 & v_2^r \end{bmatrix} \begin{bmatrix} b_{11}^{ss} & b_{12}^{ss} & b_{11}^{sr} & b_{12}^{sr} \\ b_{21}^{ss} & b_{22}^{ss} & b_{21}^{sr} & b_{22}^{sr} \\ b_{11}^{rs} & b_{12}^{rs} & b_{11}^{rr} & b_{12}^{rr} \\ b_{21}^{rs} & b_{22}^{rs} & b_{21}^{rr} & b_{22}^{rr} \end{bmatrix} \begin{bmatrix} y_1^s & 0 & 0 & 0 \\ 0 & y_2^s & 0 & 0 \\ 0 & 0 & y_1^r & 0 \\ 0 & 0 & 0 & y_2^r \end{bmatrix}$$

$$= \begin{bmatrix} v_1^s b_{11}^{ss} y_1^s & v_1^s b_{12}^{ss} y_2^s & v_1^s b_{11}^{sr} y_1^r & v_1^s b_{12}^{sr} y_2^r \\ v_2^s b_{21}^{ss} y_1^s & v_2^s b_{22}^{ss} y_2^s & v_2^s b_{21}^{sr} y_1^r & v_2^s b_{22}^{sr} y_2^r \\ v_1^r b_{11}^{rs} y_1^s & v_1^r b_{12}^{rs} y_2^s & v_1^r b_{11}^{rr} y_1^r & v_1^r b_{12}^{rr} y_2^r \\ v_2^r b_{21}^{rs} y_1^s & v_2^r b_{22}^{rs} y_2^s & v_2^r b_{21}^{rr} y_1^r & v_2^r b_{22}^{rr} y_2^r \end{bmatrix}$$



Origin of value added



Forward linkage



Backward linkage

# An Accounting Framework for International Production Sharing

## Limitation of the Leontief Insight

Computes value added in gross exports ultimately absorbed abroad

Cannot decompose intermediate trade into value added and double-counted terms

$$\begin{aligned}
 E(1): & \quad p^1 o[D] + v[E] = o[E] \\
 E(2): & \quad p^2 o[C] + p^1 v[D] + v[E] = o[E] \\
 E(3): & \quad p^3 o[B] + p^2 v[C] + p^1 v[D] + v[E] = o[E] \\
 E(4): & \quad p^4 o[A] + p^3 v[B] + p^2 v[C] + p^1 v[D] + v[E] = o[E] \\
 E(5): & \quad p^5 o[E] + p^4 v[A] + p^3 v[B] + p^2 v[C] + p^1 v[D] + v[E] = o[E] \\
 & \quad p < 1
 \end{aligned}$$

$$p^5 o[E] + p^4 v[A] + p^3 v[B] + p^2 v[C] + p^1 v[D] + v[E] = o[E]$$

		A					B					C					D					E				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
A	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
B	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
C	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
D	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
E	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0
	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0

E		
5	V	VB
0.00391007	0.75	0.00293255
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0.01564027	0.75	0.01173021
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0.06256109	0.75	0.04692082
0	0	0
0	0	0
0	0	0
0	0	0
0.25024438	0.75	0.18768328
0	0	0
0	0	0
0	0	0
0	0	0
1.00097752	0.75	0.75073314
1		1

To better understand different types of cross-country production sharing arrangements, one needs to quantify the structure of domestic value added and other components of gross exports at the sector, bilateral, and bilateral sector levels<sup>1</sup>.

<sup>1</sup> Wang, Wei and Zhu (2013)

# An Accounting Framework for International Production Sharing

## Wang, Wei and Zhu Decomposition Framework

$$\begin{aligned}
 E^{ZF} = & \underbrace{(V^Z B^{ZZ})^T \# Y^{ZF}}_{(1)-DVA\_FIN} + \underbrace{(V^Z L^{ZZ})^T \# (A^{ZF} B^{ZF} Y^{ZF})}_{(2)-DVA\_INT} \\
 & + \underbrace{(V^Z L^{ZZ})^T \# \left[ A^{ZF} \sum_{i=1, r}^G B^{ri} Y^{ri} + A^{ZF} B^{ZF} \sum_{i=1, r}^G Y^{ri} + A^{ZF} \sum_{i=1, r}^G \sum_{n=1, j}^G B^{ri} Y^{jn} \right]}_{(3)-DVA\_INTrex} \\
 & + \underbrace{(V^Z L^{ZZ})^T \# \left[ A^{ZF} B^{ZF} Y^{ZF} + A^{ZF} \sum_{i=1, r}^G B^{ri} Y^{ri} + A^{ZF} B^{ZF} Y^{ZF} \right]}_{(4)-RDV} \\
 & + \underbrace{(V^Z L^{ZZ})^T \# (A^{ZF} \sum_{i=1}^G B^{ri} Y^{ri}) + (V^Z B^{ZZ} - V^Z L^{ZZ})^T \# (A^{ZF} X^r)}_{(5)-DDC} \\
 & + \underbrace{(V^r B^{rz})^T \# Y^{ZF} + (\sum_{i=1, r}^G V^i B^{iz})^T \# Y^{ZF}}_{(6)-FVA\_FIN} \\
 & + \underbrace{(V^r B^{rz})^T \# (A^{ZF} L^{ZF} Y^{ZF}) + (\sum_{i=1, r}^G V^i B^{iz})^T \# (A^{ZF} L^{ZF} Y^{ZF})}_{(7)-FVA\_INT} \\
 & + \underbrace{(V^r B^{rz})^T \# (A^{ZF} L^{ZF} E^{r*}) + (\sum_{i=1, r}^G V^i B^{iz})^T \# (A^{ZF} L^{ZF} E^{r*})}_{(8)-FDC}
 \end{aligned}$$

E = exports

V = Value added

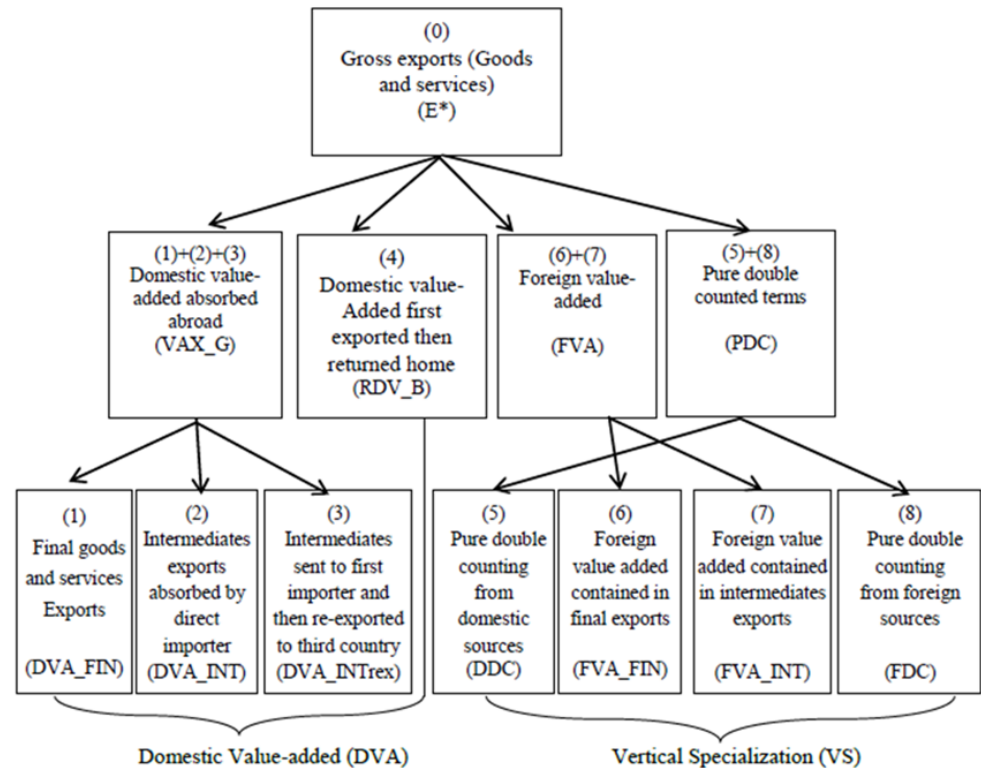
A = Coefficient matrix

B = Global total requirement matrix

L = Country level total requirement matrix

Y = Final demand

Figure 1 Gross trade accounting: Conceptual framework



source: Wang, Wei and Zhu (2013)

# An Accounting Framework For International Production Sharing

## Key Indicators from the WWZ framework

• VAX\_G



$$\begin{aligned} VAX\_G^{sr} = & (V^s B^{ss})^T \# Y^{sr} + (V^s L^{ss})^T \# (A^{sr} B^{rr} Y^{rr}) \\ & + (V^s L^{ss})^T \# (A^{sr} \sum_{t=s}^G B^{rt} Y^{rt}) + (V^s L^{ss})^T \# (A^{sr} B^{rr} \sum_{t=s, r}^G Y^{rt}) \\ & + (V^s L^{ss})^T \# (A^{sr} \sum_{t=s}^G \sum_{u=s, t}^G B^{rt} Y^{tu}) \end{aligned}$$

• DDC

$$\left[ (V^s L^{ss})^T \# (A^{sr} \sum_{t=s}^G B^{rt} Y^{rt}) + (V^s B^{ss} - V^s L^{ss})^T \# (A^{sr} X^r) \right]$$

• FDC

$$\left[ (V^r B^{rs})^T \# (A^{sr} L^{rr} E^{rs}) + \left( \sum_{t=s, r}^G V^t B^{ts} \right)^T \# (A^{sr} L^{rr} E^{rs}) \right]$$

• RDV

$$(V^s L^{ss})^T \# \left[ A^{sr} B^{rr} Y^{rs} + A^{sr} \sum_{t=s, r}^G B^{rt} Y^{ts} + A^{sr} B^{rs} Y^{ss} \right]$$

• VAX\_F

$$VAX\_F^{sr} = \hat{V}^s B^{ss} Y^{sr} + \hat{V}^s B^{sr} Y^{rr} + \hat{V}^s \sum_{t=s, r}^G B^{st} Y^{tr}$$

$$\begin{aligned} VAX\_B^{sr} = & (V^s B^{ss})^T \# Y^{sr} + (V^s L^{ss})^T \# (A^{sr} B^{rr} Y^{rr}) \\ & + (V^s L^{ss})^T \# (A^{sr} \sum_{t=s, r}^G B^{rt} Y^{tr}) + (V^s L^{ss})^T \# \left( \sum_{t=s, r}^G A^{st} B^{tr} Y^{tr} \right) \\ & + (V^s L^{ss})^T \# \left( \sum_{t=s, r, u=s, t}^G A^{st} B^{tu} Y^{ur} \right) \end{aligned}$$

• VAX\_B



• RCA

$$TRCA_i^r = \frac{e_i^{rs}}{\sum_{i=1}^n e_i^{rs}} \bigg/ \frac{\sum_t e_i^{rs}}{\sum_{i=1}^n \sum_t e_i^{rs}} \quad NRCA_i^r = \frac{dvix\_f_i^r}{\sum_{i=1}^n dvix\_f_i^r} \bigg/ \frac{\sum_t dvix\_f_i^r}{\sum_{i=1}^n \sum_t dvix\_f_i^r}$$

# Empirical Results of the Application of the Framework

Low-tech industries		India	PRC	Japan	Indonesia	Korea	Bangladesh	Malaysia	Philippines	Thailand	Vietnam	Taipei, China
		(% of total export)										
VAX-G	2000	86.19%	83.22%	89.94%	78.66%	75.02%	84.25%	61.60%	83.91%	71.99%	62.12%	72.60%
	2005	71.55%	80.65%	86.95%	78.20%	74.34%	80.36%	65.46%	83.70%	68.12%	64.49%	66.86%
	2011	64.64%	83.52%	82.63%	80.35%	65.99%	81.94%	71.47%	87.00%	74.34%	59.88%	59.76%
RDV_B	2000	0.10%	0.39%	2.63%	0.10%	0.27%	0.02%	0.09%	0.03%	0.16%	0.02%	0.21%
	2005	0.19%	0.41%	2.31%	0.14%	0.37%	0.02%	0.10%	0.05%	0.17%	0.03%	0.19%
	2011	0.20%	0.77%	1.60%	0.24%	0.37%	0.02%	0.10%	0.05%	0.17%	0.06%	0.13%
FVA	2000	12.13%	14.18%	5.27%	17.19%	19.19%	13.80%	32.06%	14.67%	24.42%	33.97%	21.21%
	2005	25.73%	16.12%	7.10%	16.92%	18.73%	16.80%	27.23%	14.42%	26.39%	30.70%	23.63%
	2011	32.64%	13.23%	10.60%	15.32%	25.21%	15.28%	22.68%	11.21%	20.39%	35.09%	29.65%
PDC	2000	1.57%	2.21%	2.16%	4.05%	5.52%	1.93%	6.26%	1.39%	3.43%	3.89%	5.98%
	2005	2.54%	2.83%	3.64%	4.75%	6.56%	2.82%	7.20%	1.83%	5.33%	4.78%	9.32%
	2011	2.52%	2.49%	5.17%	4.09%	8.44%	2.76%	5.75%	1.74%	5.10%	4.97%	10.46%

Services		India	PRC	Japan	Indonesia	Korea	Bangladesh	Malaysia	Philippines	Thailand	Vietnam	Taipei, China
		(% of total export)										
VAX-G	2000	91.64%	88.99%	91.56%	84.32%	82.12%	96.73%	69.10%	86.51%	83.10%	77.38%	80.55%
	2005	90.40%	84.34%	89.87%	84.33%	77.35%	96.14%	80.21%	90.00%	79.10%	85.90%	73.71%
	2011	91.36%	84.86%	88.41%	86.90%	72.01%	84.23%	82.84%	92.07%	83.63%	84.26%	72.14%
RDV_B	2000	0.21%	0.75%	1.87%	0.21%	0.36%	0.03%	0.15%	0.07%	0.20%	0.04%	0.26%
	2005	0.39%	1.26%	1.80%	0.27%	0.46%	0.03%	0.12%	0.07%	0.24%	0.03%	0.19%
	2011	0.20%	2.03%	1.19%	0.15%	0.31%	0.07%	0.14%	0.10%	0.22%	0.08%	0.13%
FVA	2000	6.24%	7.86%	4.94%	12.35%	13.60%	2.96%	25.78%	11.46%	14.41%	18.71%	15.33%
	2005	7.08%	10.77%	5.85%	11.38%	16.16%	3.46%	15.61%	8.31%	17.31%	12.62%	19.44%
	2011	6.79%	9.44%	8.51%	9.71%	19.55%	12.55%	14.06%	6.07%	13.44%	14.14%	20.21%
PDC	2000	1.91%	2.39%	1.63%	3.13%	3.92%	0.28%	4.97%	1.97%	2.29%	3.87%	3.85%
	2005	2.13%	3.63%	2.49%	4.03%	6.02%	0.38%	4.06%	1.62%	3.35%	1.44%	6.65%
	2011	1.65%	3.67%	1.89%	3.24%	8.13%	3.14%	2.96%	1.76%	2.71%	1.52%	7.52%

# Empirical Results of the Application of the Framework

Low-tech industries		India	PRC	Japan	Indonesia	Korea	Bangladesh	Malaysia	Philippines	Thailand	Vietnam	Taipei, China
		(\$ millions)										
Exports	2000	29,614	93,488	26,282	25,158	30,165	4,691	16,191	5,379	26,149	4,337	31,093
	2005	56,333	210,862	36,856	29,968	28,127	6,933	19,859	7,909	35,720	8,112	28,268
	2011	111,049	505,159	57,047	64,714	38,763	15,550	44,340	10,548	62,024	18,094	34,846
DVA_B	2000	25,551	78,108	24,342	19,806	22,707	3,953	9,988	4,514	18,866	2,694	22,639
	2005	40,371	170,655	32,916	23,465	21,009	5,573	13,020	6,624	24,387	5,232	18,950
	2011	71,938	425,179	48,083	52,135	25,722	12,744	31,730	9,181	46,216	10,840	20,862
VAX_F	2000	10,888	49,403	31,282	11,996	17,595	1,918	5,789	3,656	11,602	1,554	12,423
	2005	18,669	107,227	37,561	14,317	19,444	2,612	8,777	3,962	13,626	2,740	10,140
	2011	32,348	275,628	46,267	29,785	26,596	5,761	10,690	5,579	25,100	5,987	10,629
VAX_B	2000	25,525	77,799	23,637	19,790	22,631	3,952	9,973	4,513	18,825	2,694	22,573
	2005	40,305	170,055	32,044	23,434	20,910	5,571	13,000	6,620	24,331	5,232	18,901
	2011	71,778	421,901	47,139	51,999	25,579	12,742	31,691	9,176	46,109	10,836	20,823

Services		India	PRC	Japan	Indonesia	Korea	Bangladesh	Malaysia	Philippines	Thailand	Vietnam	Taipei, China
		(\$ millions)										
Exports	2000	8,727	46,848	90,290	5,817	34,713	1,242	13,014	3,897	15,064	3,128	18,076
	2005	40,213	125,012	115,749	10,393	48,328	1,390	16,729	6,323	21,766	4,353	18,617
	2011	76,339	290,648	174,856	23,250	86,011	182	36,096	18,656	46,774	17,617	23,514
DVA_B	2000	8,017	42,079	84,434	4,917	28,653	1,202	9,023	3,373	12,554	2,422	14,616
	2005	36,522	107,299	106,215	8,791	37,638	1,337	13,445	5,695	17,279	3,741	13,764
	2011	69,901	253,263	156,721	20,235	62,237	154	29,954	17,197	39,230	14,857	16,997
VAX_F	2000	19,570	67,749	182,141	9,666	47,954	2,677	15,092	5,440	17,975	3,249	46,963
	2005	58,066	176,912	225,489	15,324	72,731	3,471	24,295	9,100	26,657	6,092	53,005
	2011	125,060	490,124	317,316	33,574	118,124	6,323	45,003	20,195	49,849	20,453	76,656
VAX_B	2000	7,998	41,692	82,667	4,905	28,508	1,202	8,993	3,371	12,518	2,421	14,561
	2005	36,351	105,431	104,022	8,764	37,381	1,336	13,419	5,690	17,218	3,739	13,723
	2011	69,740	246,632	154,584	20,204	61,933	153	29,903	17,176	39,116	14,844	16,964

Questions?



# Part 3: SDGs via Trade

## Exercise

- Have increasing international production sharing arrangements (and therefore, increase in trade) resulted in substantial economic progress during the last 25 years?
- Growth in trade since 1990
- Growth in real GDP and real income since 1990
- Growth in domestic C, I and G since 1990
- What contributed most to the growth in GDP since 1990
- How much of the growth in C, I and G could be attributed to growth in trade?
- How much has globalization helped your country?
- What policy measures were taken in your country to increase its participation in global production processes?

# Targets

- Trade affects
  - Income
  - Employment
  - Infrastructure development
  - Environment
  - Education and skill development

## Questions

- Which SDGs trade can help achieve and how?
- How can your country measure the contribution of trade to the attainment of SDGs?

# Measurement

## Key Questions

- How much of the value added created in the economy (by sector) is attributable to trade?
- What is the growth rate of trade driven value added creation and how does it compare with growth attributable to other drivers (C, I, G)?
- What is the distribution among various primary factors of production (labor, capital, entrepreneurship and government) of the value added created by trade?
- How much of the employment created or destroyed in the economy-sector is attributable to trade?
- How much of the environmental impact of economic activity undertaken can be attributable to trade?

# Measurement Tools

- The IO analysis framework is an ideal measurement tool

Leontief's Insight and "Effect" Coefficients					Trade	
	Ag	Manuf	Ser	Gov	Export [X]	Import [M]
Agriculture	$l_{aa}$	$l_{am}$	$l_{as}$	$l_{ag}$	$\Delta x_a$	$\Delta m_a$
Manufacturing	$l_{ma}$	$l_{mm}$	$l_{ms}$	$l_{mg}$	$\Delta x_m$	$\Delta m_m$
Services	$l_{sa}$	$l_{sm}$	$l_{ss}$	$l_{sg}$	$\Delta x_s$	$\Delta m_s$
Government	$l_{ga}$	$l_{gm}$	$l_{gs}$	$l_{gg}$	$\Delta x_g$	$\Delta m_g$
Value Added	$va_a$	$va_m$	$va_s$	$va_g$		
Output	$o_a$	$o_m$	$o_s$	$o_g$		
Employment	$emp_a$	$emp_m$	$emp_s$	$emp_g$		
Environment	$env_a$	$env_m$	$env_s$	$env_g$		

# Issues

- The need for the development of inter-country IOTs and SUTs
- The requirement for high quality source data
- The necessity to maintain the tool and update source data
- The duty to measure the variables correctly
- The obligation to use the indicators for monitoring
- The importance of international agreement on the indicators

# Current Initiatives

- A number of ICIO databases are being developed
  - OECD TiVA
  - WIOD
  - ADB MRIO
- ADB MRIO aims to cover all the economies in the region by 2020
- Countries need to provide relevant source data
- Time series of ICIOs need to be produced for effective analysis and monitoring
- Specific indicators can already be developed for a number of countries

# Critical Challenges

- Data
  - Surveys
  - Administrative data
  - Big data
- Financial and human resources
  - Multilateral organizations
  - NSOs
  - Governments
- International agreement
  - Indicators
- Plan for action
  - Steps
  - Targets
  - Timelines

Questions?