

# Is participation in global value chains driving income convergence in developing Asia? A task-based accounting approach

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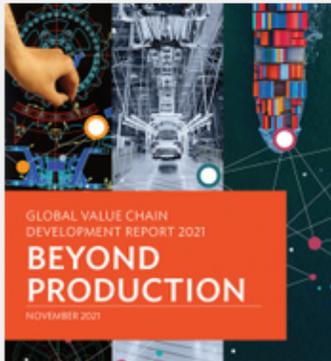
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# Global Value Chain Development Report 2021: Beyond Production

Publication | November 2021



**This joint report explores the transformation of global value chains as they expand beyond manufacturing to services and intangible assets. It highlights opportunities for services-led development and discusses policy considerations.**

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# Motivation

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- GVC participation has been touted as a powerful driver of growth, productivity, and job creation:
  - Knowledge flows and technology transfer within GVCs can facilitate the transition from assembly to higher value-added exports.
- In 2019, Asia's GVC participation\* was 67.4%, making it a key player.
- However, income per capita in developing Asian economies is still about one third of the level in OECD countries.
- Why is income per capita convergence incomplete?

\* This measure of GVC participation is the share of gross exports of value added used for further processing through cross-border production networks.

# Research questions

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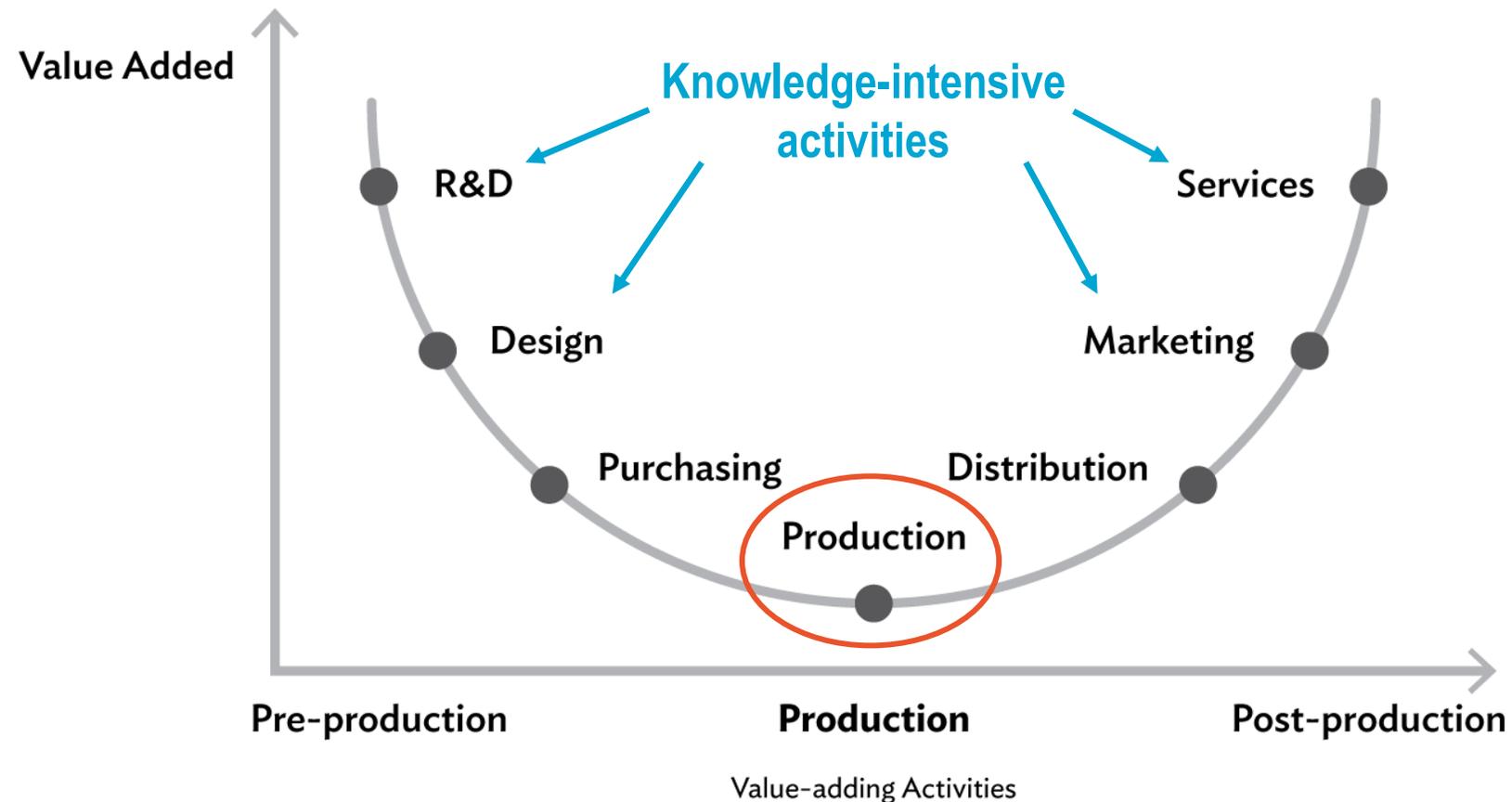
- What are the drivers of income convergence in developing Asia?
- Is there evidence of upgrading:
  - *within* activities, i.e., product or process upgrading.
  - *across* activities, from a lower value-added activity to a higher one, i.e., functional upgrading (Gereffi, 1999).

# Roadmap

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- Overview
- Related literature
- Methodology and Data
- Findings
- Conclusion

# Breakdown of activities on manufacturing value chains



# GVC income

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- We focus on (manufacturing) **GVC income**, i.e., the value added generated within an economy for the worldwide production of manufactured goods (Timmer et al. 2013).
  - this is only a part of a country's gross domestic product.
- GVC income includes value added from nonmanufacturing activities, such as business services, transport, finance, and the production of raw materials.
  - For example, a firm in the Philippines might be involved in business processing, such as data entry, or accounting, for the final manufacturing product of a firm in Germany.



# GVC jobs

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- GVC jobs are defined as jobs related to activities that are directly and indirectly involved in the production of final manufactured goods:
  - this is not the classic definition of manufacturing jobs, because it includes jobs in nonmanufacturing activities if they contribute to final manufacturing output.
- One of the main advantages of the concept of GVC jobs is that it captures outsourced jobs:
  - the outsourcing of business services previously done in-house creates the impression of shrinking manufacturing employment when it is simply a reallocation of tasks to domestic services firms.

# Contribution

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- We use a GVC income accounting framework to examine the role of scale and productivity effects in driving income per capita convergence in developing Asian economies to OECD levels:
  - **Scale** refers to the share of workers from developing Asian countries involved in GVCs of manufactured products.
  - **Productivity** refers to the productivity level of carrying out tasks in the GVC.
- We include developing Asian economies for which hardly any such analysis is ever performed.

# Findings

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- Ongoing convergence to OECD levels of productivity in production and knowledge-intensive activities for developing Asia, but from low initial starting points.
- Rapid expansion in the scale of production activities.
- Slow expansion in the scale of knowledge-intensive activities.
- The findings suggest the expansion in the scale of production activities has been driving income convergence.



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# Literature review

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- Longitudinal studies
  - Brancati et al. (2017, JOEG)
  - Belderbos et al. (2016, OECD)
- Input-output studies
  - Pahl and Timmer (2020, JDS)
- Comparative case analyses
  - Awate et al. (2012, GSJ)
  - Xing and Huang (2021, SCED)

# Lessons from the literature

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- Despite the diversity in methodological approaches, the literature converges on a number of key points:
  - There is a positive association between GVC participation and labor productivity in developing economies.
  - However, catching up with industry leaders in terms of product portfolio is one thing; catching up in terms of innovation capabilities is another, and emerging economy multinational enterprises have a long way to go.
  - Alternative upgrading patterns are emerging, such as building a strong brand name, while the returns from innovation capabilities are more uncertain and may be realized in the long run.

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# Data: ADB MRIOT (2000, 2007-2018)

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- The Multiregional Input–Output (MRIO) Database of the Asian Development Bank comprises national input-output tables connected by means of bilateral international trade flows.
- They provide comprehensive summaries of all transactions in the global economy between industries and final users of goods and services across countries in a given year.
- The input-output tables are in current US dollars based on exchange rate conversion of data in national currencies:
  - To compare real GVC income across countries, we adjust GVC income by activity for each country such that it is at US dollar PPPs (Purchaser Power Parities) in constant 2011 prices;
  - We use the price levels of output-side real GDP relative to the USA from the Penn World Tables, version 9.0 (Feenstra et al. 2015).



# The structure of a multiregional input-output table

	Intermediate use				Final use				Gross output
	1	2	...	c	1	2	...	c	
1	$Z_{11}$	$Z_{12}$	...	$Z_{1c}$	$f_{11}$	$f_{12}$	...	$f_{1c}$	$Y_1$
2	$Z_{21}$	$Z_{22}$	...	$Z_{2c}$	$f_{21}$	$f_{22}$	...	$f_{2c}$	$Y_2$
...	...	...	...	...	...	...	...	...	...
c	$Z_{c1}$	$Z_{c2}$	...	$Z_{cc}$	$f_{c1}$	$f_{c2}$	...	$f_{cc}$	$Y_c$
Value added	$v'_1$	$v'_2$	...	$v'_c$					
Gross output	$Y'_1$	$Y'_2$	...	$Y'_c$					

# The structure of a multiregional input-output table

	Intermediate use				Final use				Gross output
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1	$Z_{11}$	$Z_{12}$	...	$Z_{1c}$	$f_{11}$	$f_{12}$	...	$f_{1c}$	$Y_1$
2	$Z_{21}$	$Z_{22}$	...	$Z_{2c}$	$f_{21}$	$f_{22}$	...	$f_{2c}$	$Y_2$
...	...	...	...	...	...	...	...	...	...
c	$Z_{c1}$	$Z_{c2}$	...	$Z_{cc}$	$f_{c1}$	$f_{c2}$	...	$f_{cc}$	$Y_c$
Value added	$v'_1$	$v'_2$	...	$v'_c$					
Gross output	$Y'_1$	$Y'_2$	...	$Y'_c$					

Rows show how gross output of country-industries are distributed across country-industries worldwide

# The structure of a multiregional input-output table

Columns show how gross output of each country-industry is produced

	Intermediate use				Final use				Gross output
	1	2	...	$c$	1	2	...	$c$	
1	$Z_{11}$	$Z_{12}$	...	$Z_{1c}$	$f_{11}$	$f_{12}$	...	$f_{1c}$	$Y_1$
2	$Z_{21}$	$Z_{22}$	...	$Z_{2c}$	$f_{21}$	$f_{22}$	...	$f_{2c}$	$Y_2$
...	...	...	...	...	...	...	...	...	...
$c$	$Z_{c1}$	$Z_{c2}$	...	$Z_{cc}$	$f_{c1}$	$f_{c2}$	...	$f_{cc}$	$Y_c$

<b>Value added</b>	$v'_1$	$v'_2$	...	$v'_c$
<b>Gross output</b>	$Y'_1$	$Y'_2$	...	$Y'_c$

Rows show how gross output of country-industries are distributed across country-industries worldwide

# The structure of a multiregional input-output table

	Intermediate use				Final use				Gross output
	1	2	...	c	1	2	...	c	
1	$Z_{11}$	$Z_{12}$	...	$Z_{1c}$	$f_{11}$	$f_{12}$	...	$f_{1c}$	$Y_1$
2	$Z_{21}$	$Z_{22}$	...	$Z_{2c}$	$f_{21}$	$f_{22}$	...	$f_{2c}$	$Y_2$
...	...	...	...	...	...	...	...	...	...
c	$Z_{c1}$	$Z_{c2}$	...	$Z_{cc}$	$f_{c1}$	$f_{c2}$	...	$f_{cc}$	$Y_c$
Value added	$v'_1$	$v'_2$	...	$v'_c$					
Gross output	$Y'_1$	$Y'_2$	...	$Y'_c$					
Value added per gross output	$r'_1$	$r'_2$	...	$r'_c$					
Employment per value added	$e'_1$	$e'_2$	...	$e'_c$					

# Occupations Database

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- The Occupations Database, introduced in Reijnders and de Vries (2018), provides information on employment and the labor income share by occupation-country-sector-year.
- Sectors are classified based on ISIC rev. 3.1.
- The original occupation dataset includes 40 economies, including the PRC, India, Indonesia, and Taipei, China. For the analysis in this paper, an additional 11 developing Asian economies have been added to the set.

# Building the Occupations Database

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- Procure nationally representative labor force surveys (LFS) or population censuses.
- Harmonize them to ISCO and ISIC.
- Check for internal, intertemporal, international consistency.
- Break it down by:
  - production activities: workers with occupations involved in the physical transformation process.
  - knowledge-intensive activities: workers with occupations involved in pre- and post-fabrication.

# Developing Asian and OECD economies included

<b>Developing Asia</b>	<b>OECD countries</b>	
Bangladesh	Australia	Latvia
Cambodia	Austria	Lithuania
Fiji	Belgium	Luxembourg
India	Canada	Mexico
Indonesia	Czech Republic	Netherlands
Kyrgyz Republic	Denmark	Poland
Mongolia	Estonia	Portugal
Nepal	Finland	Republic of Korea
Pakistan	France	Slovenia
People's Republic of China	Germany	Spain
Philippines	Greece	Sweden
Sri Lanka	Hungary	Turkey
Taipei, China	Ireland	United Kingdom
Thailand	Italy	United States
Viet Nam	Japan	



# Mapping of occupations to activities

Type of activity	Example tasks	Example occupations (ISCO-08)	ISCO-08 codes included
Knowledge-intensive activities	R&D, design, commercialization, engineering, marketing, advertising and brand management, specialized logistics, and after-sales services.	Professionals; Technicians and associate professionals; Clerks; Senior officials and managers.	11-14, 17-18, 21-26, 29, 31-35, 40-44, 51-54, 56-59, 91, 94-95
Production activities	Assembly, parts and components manufacturing, standardized services.	Plant and machine operators and assemblers; Craft and related trades workers; Service workers and shop and market sales workers; Elementary occupations.	1-3, 61-63, 69, 71-75, 79, 81-83, 85-86, 92-93, 96, 99

*Note:* Occupation descriptions based on the International Standard Classification of Occupations 2008 (ISCO 08).



# Roadmap

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# First-level disaggregation of GVC income per capita

$$\frac{Y_c}{P_c} = \frac{L_c}{P_c} \times \frac{Y_c}{L_c}$$

We derive the following relative measures:

$$\left(\frac{Y_c}{P_c}\right) / \left(\frac{Y_{OECD}}{P_{OECD}}\right)$$

*Income ratio* (GVC income per head of population for country *c* relative to the OECD average)

$$\left(\frac{L_c}{P_c}\right) / \left(\frac{L_{OECD}}{P_{OECD}}\right)$$

*Scale ratio* (GVC workers per head of population for country *c* relative to the OECD average)

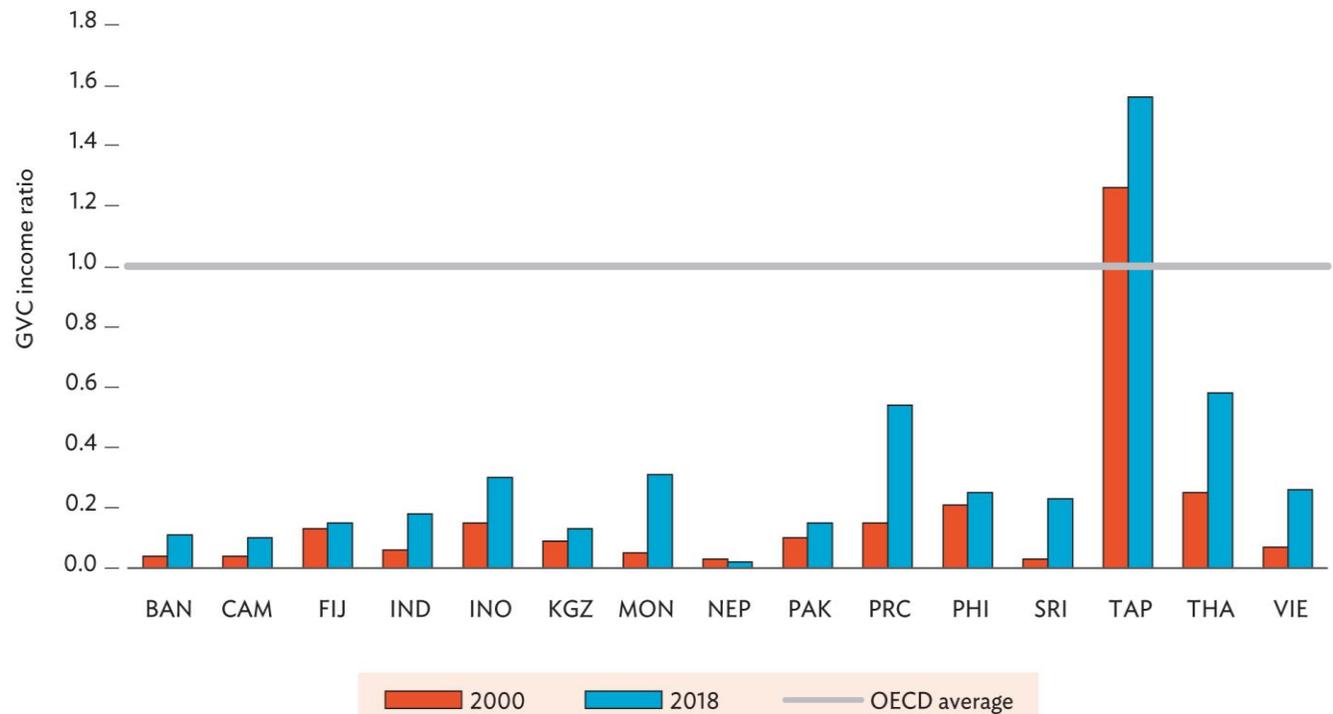
$$\left(\frac{Y_c}{L_c}\right) / \left(\frac{Y_{OECD}}{L_{OECD}}\right)$$

*Productivity ratio* (GVC income per GVC worker for country *c* relative to the OECD average)

# First-level disaggregation results by economy

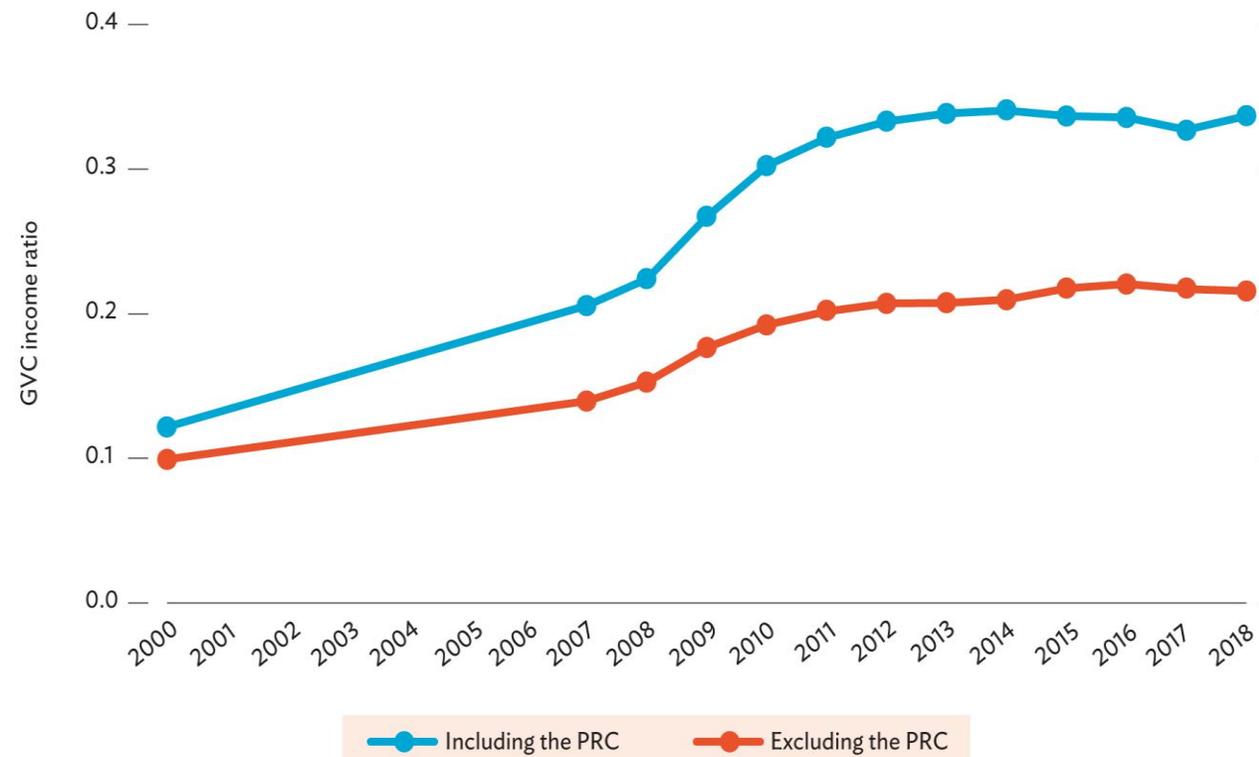
	GVC income ratio		Scale ratio		Productivity ratio	
	2000	2018	2000	2018	2000	2018
Bangladesh	0.04	0.11	0.61	1.28	0.07	0.09
Cambodia	0.04	0.10	0.87	1.80	0.05	0.05
Fiji	0.13	0.15	0.32	0.42	0.42	0.34
India	0.06	0.18	1.14	1.81	0.05	0.10
Indonesia	0.15	0.30	1.60	1.99	0.09	0.15
Kyrgyz Rep.	0.09	0.13	1.29	0.65	0.07	0.20
Mongolia	0.05	0.31	0.62	1.38	0.08	0.23
Nepal	0.03	0.02	0.80	0.82	0.04	0.03
Pakistan	0.10	0.15	1.01	1.33	0.10	0.11
PRC	0.15	0.54	1.63	2.23	0.09	0.24
Philippines	0.21	0.25	1.26	1.34	0.16	0.18
Sri Lanka	0.03	0.23	0.55	1.02	0.06	0.22
Taipei,China	1.26	1.56	1.94	2.25	0.65	0.69
Thailand	0.25	0.58	2.09	1.99	0.12	0.29
Viet Nam	0.07	0.26	1.20	2.79	0.06	0.09

# GVC income ratio by economy, 2000 and 2018



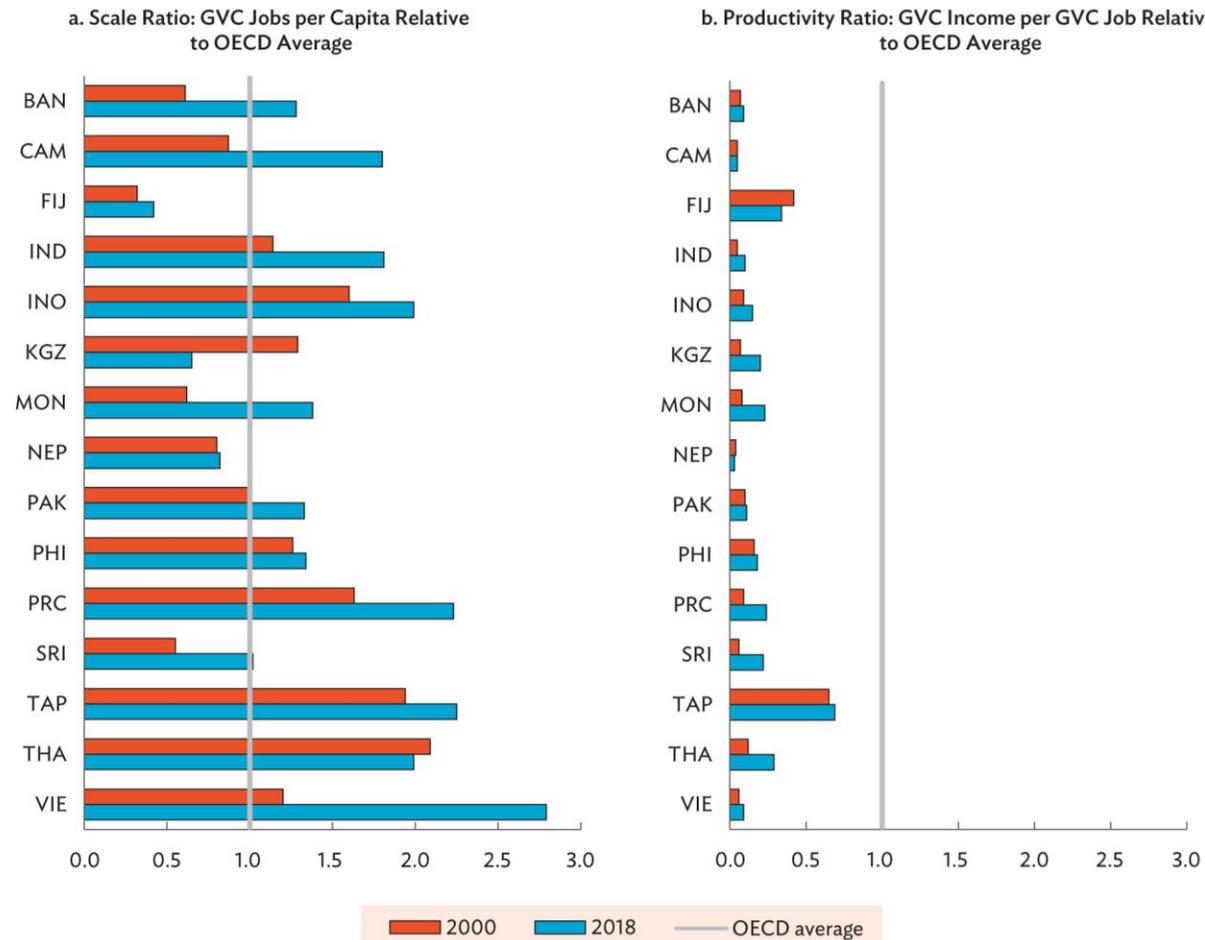
BAN = Bangladesh, CAM = Cambodia, FIJ = Fiji, GVC = global value chain, IND = India, INO = Indonesia, KGZ = Kyrgyz Republic, MON = Mongolia, NEP = Nepal, OECD = Organisation for Economic Co-operation and Development, PAK = Pakistan, PRC = People's Republic of China, PHI = Philippines, SRI = Sri Lanka, TAP = Taipei,China, THA = Thailand, VIE = Viet Nam.

# Aggregate GVC income ratio, 2000-2018



GVC = global value chain, PRC = People's Republic of China.

# Scale ratio and productivity ratio, 2000 and 2018



BAN = Bangladesh, CAM = Cambodia, FIJ = Fiji, GVC = global value chain, IND = India, INO = Indonesia, KGZ = Kyrgyz Republic, MON = Mongolia, NEP = Nepal, OECD = Organisation for Economic Co-operation and Development, PAK = Pakistan, PRC = People's Republic of China, PHI = Philippines, SRI = Sri Lanka, TAP = Taipei, China, THA = Thailand, VIE = Viet Nam.

# Second-level disaggregation of GVC income per capita

$$\frac{Y_c^K}{P_c} + \frac{Y_c^F}{P_c} = \frac{L_c}{P_c} \times \left[ \frac{L_c^K}{L_c} \times \frac{Y_c^K}{L_c^K} + \frac{L_c^F}{L_c} \times \frac{Y_c^F}{L_c^F} \right]$$

We derive the following relative measures:

$$\left( \frac{Y_c^K}{P_c} \right) / \left( \frac{Y_{OECD}^K}{P_{OECD}} \right)$$

*Knowledge income ratio* (GVC income from knowledge-intensive activities per capita for country  $c$  relative to the OECD average)

$$\left( \frac{L_c^K}{L_c} \right) / \left( \frac{L_{OECD}^K}{L_{OECD}} \right)$$

*Specialization in knowledge ratio* (GVC jobs in knowledge-intensive activities per total GVC jobs in country  $c$  relative to the OECD average)

$$\left( \frac{Y_c^K}{L_c^K} \right) / \left( \frac{Y_{OECD}^K}{L_{OECD}^K} \right)$$

*Productivity in knowledge ratio* (GVC income from knowledge-intensive activities per GVC job in knowledge-intensive activities in country  $c$  relative to the OECD average)

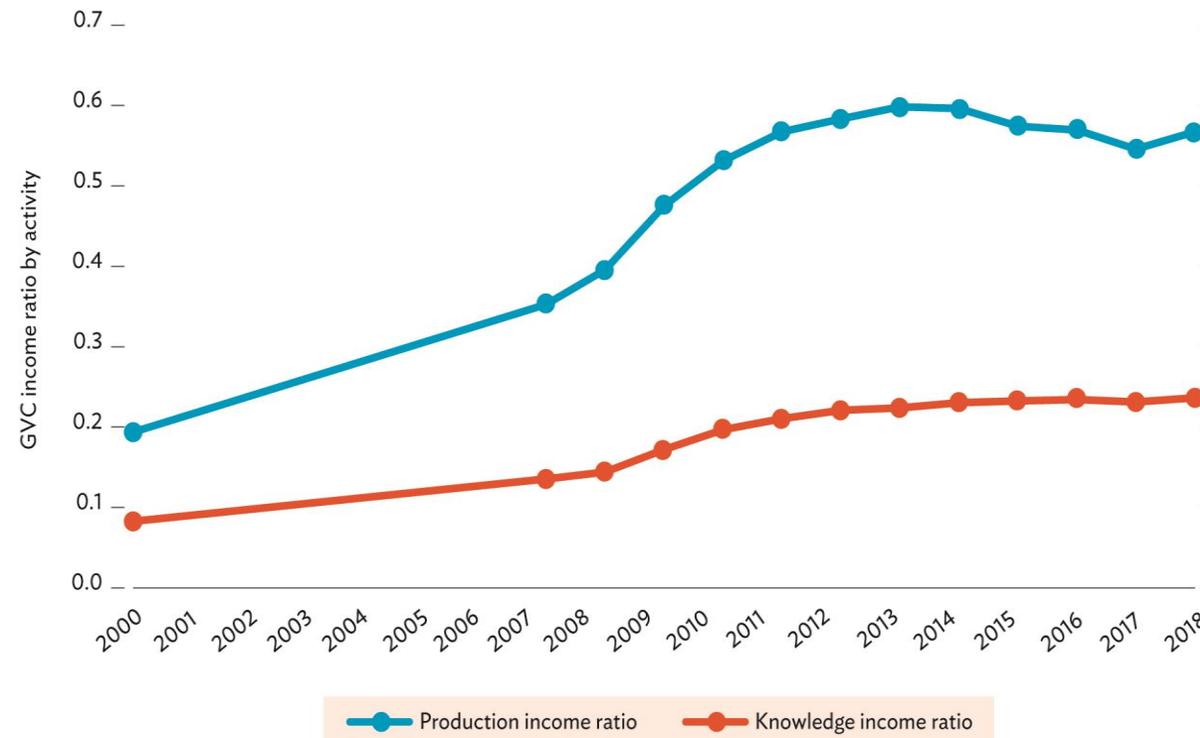
# Second-level disaggregation results by activity, 2008

	Production income ratio	Specialization in production ratio	Productivity in production ratio	Knowledge income ratio	Specialization in knowledge ratio	Productivity in knowledge ratio	Scale ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bangladesh	0.07	1.57	0.07	0.02	0.38	0.10	0.61
Cambodia	0.08	1.55	0.06	0.02	0.41	0.04	0.87
Fiji	0.18	1.21	0.47	0.11	0.77	0.44	0.32
India	0.06	1.54	0.03	0.06	0.41	0.13	1.14
Indonesia	0.26	1.43	0.12	0.09	0.54	0.10	1.60
Kyrgyz Rep.	0.11	0.89	0.09	0.08	1.12	0.05	1.29
Mongolia	0.09	1.33	0.11	0.03	0.64	0.08	0.62
Nepal	0.05	1.70	0.04	0.01	0.25	0.08	0.80
Pakistan	0.18	1.53	0.11	0.07	0.43	0.15	1.01
PRC	0.28	1.42	0.12	0.09	0.55	0.09	1.63
Philippines	0.33	1.38	0.19	0.14	0.59	0.19	1.26
Sri Lanka	0.04	1.51	0.05	0.02	0.45	0.10	0.55
Taipei,China	1.37	1.01	0.70	1.20	0.99	0.63	1.94
Thailand	0.31	1.55	0.10	0.22	0.41	0.26	2.09
Viet Nam	0.15	1.65	0.08	0.03	0.30	0.08	1.20

# Second-level disaggregation results by activity, 2018

	Production income ratio	Specialization in production ratio	Productivity in production ratio	Knowledge income ratio	Specialization in knowledge ratio	Productivity in knowledge ratio	Scale ratio
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Bangladesh	0.20	1.72	0.09	0.07	0.38	0.15	1.28
Cambodia	0.21	1.63	0.07	0.05	0.45	0.06	1.80
Fiji	0.19	1.20	0.37	0.13	0.82	0.36	0.42
India	0.17	1.54	0.06	0.19	0.54	0.19	1.81
Indonesia	0.54	1.60	0.17	0.19	0.48	0.20	1.99
Kyrgyz Rep.	0.15	1.05	0.22	0.12	0.95	0.20	0.65
Mongolia	0.40	1.20	0.24	0.27	0.83	0.24	1.38
Nepal	0.04	1.60	0.03	0.01	0.48	0.04	0.82
Pakistan	0.25	1.82	0.10	0.11	0.29	0.28	1.33
PRC	1.06	1.43	0.33	0.31	0.63	0.22	2.23
Philippines	0.31	1.43	0.16	0.22	0.62	0.26	1.34
Sri Lanka	0.41	1.71	0.24	0.14	0.39	0.37	1.02
Taipei,China	1.73	0.86	0.89	1.49	1.11	0.59	2.25
Thailand	0.70	1.49	0.24	0.52	0.57	0.45	1.99
Viet Nam	0.52	1.88	0.10	0.14	0.24	0.21	2.79

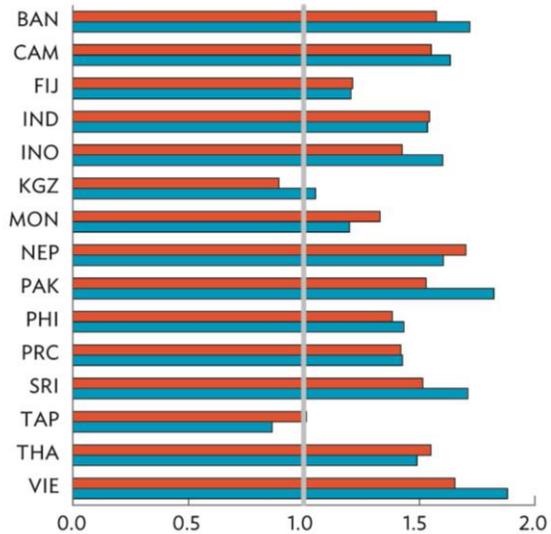
# Aggregate GVC income ratio by activity, 2000-2018



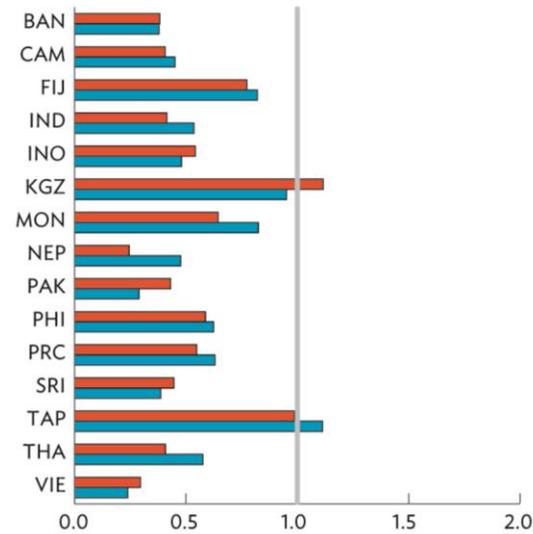
GVC = global value chain, OECD = Organisation for Economic Co-operation and Development.

# Second-level disaggregation of GVC income per capita

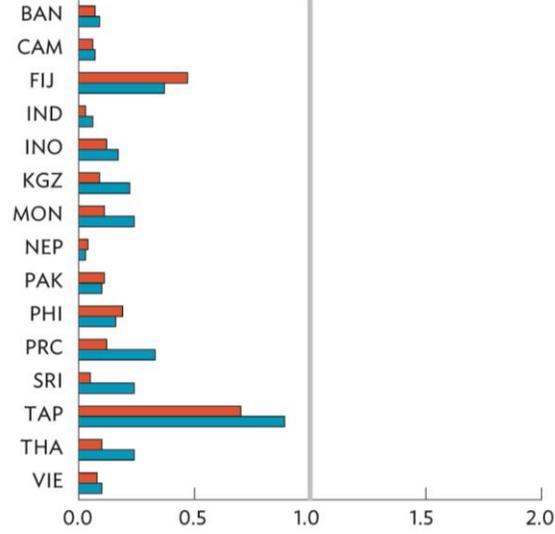
a. Specialization in Production: Production Jobs per GVC Jobs



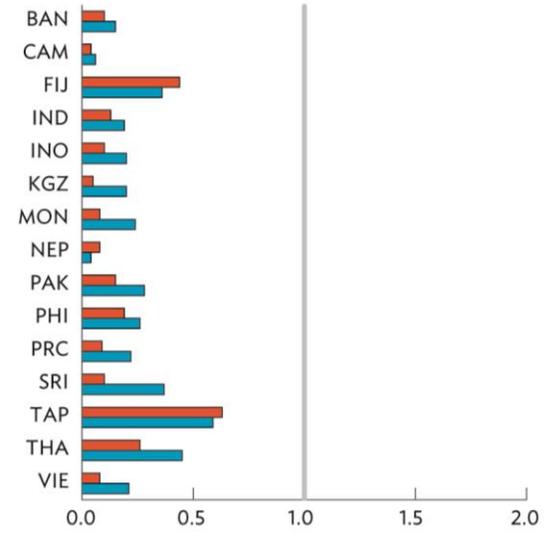
b. Specialization in Knowledge: Knowledge Jobs per GVC jobs



c. Productivity in Production: Production Income per Production Job



d. Productivity in Knowledge: Knowledge Income per Knowledge Job



2000 2018 OECD average

BAN = Bangladesh, CAM = Cambodia, FIJ = Fiji, GVC = global value chain IND = India, INO = Indonesia, KGZ = Kyrgyz Republic, MON = Mongolia, NEP = Nepal, PAK = Pakistan, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China, PHI = Philippines, SRI = Sri Lanka, TAP = Taipei, China, THA = Thailand, VIE = Viet Nam.

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# Conclusion

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- This paper uses a GVC perspective to investigate the drivers of income convergence in developing Asia.
- We find that the region experienced a rapid expansion in the scale of production activities between 2000 and 2018.
- We observe a slower expansion in the scale of knowledge-intensive activities.
- We find convergence in productivity levels to levels observed in OECD countries, but from low initial levels.
- We also show that, while there has been a lot of emphasis on functional upgrading as a driver of income convergence, in developing Asia the volume of activity matters just as much as the domestic share of value added.

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The End

- Thank you for your attention

# Measuring activities in GVCs

Assume  $c$  countries,  $s$  sectors

The  $cs \times 1$  vector of value added by country-sector is given by:

$$\mathbf{v} = \mathbf{R}(\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}$$

$$\mathbf{R} = \begin{bmatrix} \mathbf{R}_1 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \ddots & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{R}_c \end{bmatrix}$$

Value added coefficients diagonal matrix ( $cs \times cs$ )

$$\mathbf{R}_c = \begin{bmatrix} r_c^1 & 0 & 0 \\ 0 & r_c^i & 0 \\ 0 & 0 & r_c^s \end{bmatrix}$$

Value added to gross output ratio of sector  $i$  in country  $c$

$$\mathbf{A} = \begin{bmatrix} \mathbf{A}_{11} & \dots & \mathbf{A}_{1c} \\ \vdots & & \vdots \\ \mathbf{A}_{c2} & \dots & \mathbf{A}_{cc} \end{bmatrix}$$

Intermediate input coefficients matrix ( $cs \times cs$ )

$$\mathbf{A}_{mn} = \begin{bmatrix} a_{mn}^{11} & \dots & a_{mn}^{s1} \\ \vdots & a_{mn}^{ij} & \dots \\ a_{mn}^{s1} & \dots & a_{mn}^{ss} \end{bmatrix}$$

amount of good  $i$  from country  $m$  used in the production of one unit of good  $j$  from country  $n$

Final demand ( $cs \times 1$ )

$$\mathbf{f} = \begin{bmatrix} \mathbf{f}_1 \\ \vdots \\ \mathbf{f}_c \end{bmatrix}$$

$$\mathbf{f}_c = \begin{bmatrix} f_c^1 \\ \vdots \\ f_c^s \end{bmatrix}$$

final demand in country  $c$ , sector  $s$

Note:  $(\mathbf{I} - \mathbf{A})^{-1}$  is the (global) Leontief inverse

# Measuring activities in GVCs

Assume  $k$  activities,  $c$  countries,  $s$  sectors

Matrix of labor income per value added ( $k \times cs$ ) by activity  $k$ .

In this study,  $k=2$ . Let:  
F = fabrication activities,  
K = knowledge activities

$$\mathbf{B} = \begin{bmatrix} \mathbf{b}_1^F & \mathbf{b}_2^F & \dots & \mathbf{b}_c^F \\ \mathbf{b}_1^K & \mathbf{b}_2^K & \dots & \mathbf{b}_c^K \end{bmatrix}$$

$$\mathbf{b}_c^K = [b_c^{K1} \quad b_c^{K2} \quad \dots \quad b_c^{KS}]$$

Labor income from workers performing knowledge activities in sector  $s$  of country  $c$ , expressed as a share of value added in  $s$

The  $k \times cs$  matrix of **GVC income** (for each activity  $k$  by country-sector) is given by:

$$\mathbf{y} = \mathbf{BR}(\mathbf{I} - \mathbf{A})^{-1}\hat{\mathbf{f}}$$

Diagonal matrix ( $cs \times cs$ ) with final demand values in main diagonal

$$\hat{\mathbf{f}} = \begin{bmatrix} \hat{f}_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & \hat{f}_c \end{bmatrix}$$

$$\hat{f}_c = \begin{bmatrix} f_c^1 & 0 & 0 \\ 0 & f_c^i & 0 \\ 0 & 0 & f_c^s \end{bmatrix}$$

Final demand in country  $c$ , sector  $i$

Note:  $(\mathbf{I} - \mathbf{A})^{-1}$  is the (global) Leontief inverse

# Measuring activities in GVCs

Assume  $k$  activities,  $c$  countries,  $s$  sectors

Matrix of employment per value added ( $k \times cs$ ) by activity.

In this study,  $k=2$ . Let:  
F = fabrication activities,  
K = knowledge activities

$$\mathbf{E} = \begin{bmatrix} \mathbf{e}_1^F & \mathbf{e}_2^F & \dots & \mathbf{e}_c^F \\ \mathbf{e}_1^K & \mathbf{e}_2^K & \dots & \mathbf{e}_c^K \end{bmatrix}$$

$$\mathbf{e}_c^K = [e_c^{K1} \quad e_c^{K2} \quad \dots \quad e_c^{Ks}]$$

Number of workers performing knowledge activities in sector  $s$  of country  $c$ , expressed as a share of value added in  $s$

The  $k \times cs$  matrix of **GVC jobs** (for each activity  $k$  by country-sector) is given by:

$$\mathbf{z} = \mathbf{ER}(\mathbf{I} - \mathbf{A})^{-1}\hat{\mathbf{f}}$$

Diagonal matrix ( $cs \times cs$ ) with final demand values in main diagonal

$$\hat{\mathbf{f}} = \begin{bmatrix} \hat{\mathbf{f}}_1 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \ddots & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \hat{\mathbf{f}}_c \end{bmatrix}$$

$$\hat{\mathbf{f}}_c = \begin{bmatrix} f_c^1 & 0 & 0 \\ 0 & f_c^i & 0 \\ 0 & 0 & f_c^s \end{bmatrix}$$

Final demand in country  $c$ , sector  $i$

Note:  $(\mathbf{I} - \mathbf{A})^{-1}$  is the (global) Leontief inverse