Data and Methodologies Used to Decipher the Contribution of Services to Growth in South Asia

By: Sebastian Franco-Bedoya, Yi Li, and Valerie Mercer-Blackman
South Asia Department
The World Bank

October 7, 2021

The contribution of services to economic activity is difficult to measure, particularly in South Asia where the informal economy is large. This note provides additional information about methodology and supplementary results presented in Chapter 3 of the South Asia Economic Focus Fall 2021 edition entitled: "Shifting Gears: Digitization and Services-Led Development." The note focuses on the techniques used to derive the value or contribution of services to other sectors—particularly to manufacturing. It also explains the process used to analyze the extent to which services workers make up the labor force.

Contents

1. Using input-output analysis to tease out value-added contribution of services

The analysis of sectoral changes and composition, calculations of value-added contributions, and direct and indirect effects use the Asian Development Bank's Multi-Regional Input-Output Tables database (ADB MRIO), with the latest derivations available in ADB (2021). Table 1.1 shows the sector groups at different levels of aggregation, the share of their value-added in GDP, and the share of direct gross exports from each sector across countries.

Table 1.1. Sector classification used in analysis and 2019 shares, South Asia excluding Afghanistan

MRIOT No.	Sector name using MRIOT classification	GDP share	Export share 1/	Analytical sector classification (GDP share in parenthesis)	Broad sector	GDP share	Export share 1/
1	Agriculture, Hunting, Forestry, and Fishing	18.1	2.4	Primary production (20.1)	Agriculture and natural resource extraction	20	3
2	Mining and Quarrying	2.0	1.1				
3	Food, Beverages, and Tobacco	2.0	4.5	Low-tech manufacturing (5.2)	Manufacturing	15	59
4	Textiles and Textile Products	2.4	15.5				
5	Leather, Leather, and Footwear	0.2	1.5				
6	Wood and Products of Wood and Cork	0.1	0.1				
7	Pulp, Paper, Paper, Printing, and Publishing	0.4	0.4				
8	Coke, Refined Petroleum, and Nuclear Fuel	0.6	5.3	Medium-tech manufacturing (6.9)			
9	Chemicals, Chemical Products and pharmaceuticals	2.2	8.4				
10	Rubber and Plastics	0.5	1.1				
11	Other Non-Metallic Mineral products	1.1	0.9				
12	Basic Metals and Fabricated Metal	1.7	5.7				
13	Machinery, Not elsewhere specified	0.8	2.8				
14	Electrical and Optical Equipment	0.7	2.6	High-tech manufacturing (2.9)			
15	Transport Equipment	1.8	3.8				
16	Manufacturing, other; Recycling	0.5	6.3				
17	Electricity, Gas, and Water Supply Utilities	2.4	0.1	Construction and infrastructure (9.5)	Construction and utilities	9	1
18	Construction Construction	7.1	0.7				
19	Sale, Maintenance, and Repair of Motor Vehicles and Motorcycles (MV&M); Sale of Fuel	0.5	0.2	Trade-related services (12.2)	Services	55	37
20	Wholesale Trade and Commission Trade except MV&M	4.3	1.5				
21	Retail Trade except MV&M; Repair of Household Goods	7.3	0.3				
22	Hotels and Restaurants Tourism	1.2	2.2	Other market services (15.7)			
23	Inland Transport	4.6	1.6	Transport, telecommunicvations and financial intermediation--enabling services (12.4)			
24	Water Transport	0.1	0.9				
25	Air Transport	0.2	2.3				
26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	0.7	1.2				
27	Post and Telecommunications ICT services	1.5	3.9				
28	Financial Intermediation Finance and Insurance Services	5.3	1.6				
29	Real Estate Activities and property services	6.8	0.4	Other market services (15.7 - rept)			
30	Renting of Machinery and Equipment; Other Business Activities ('**business services**')	7.8	17.8				
31	Public Administration and Defense; Compulsory Social Security	6.1	0.4	Public services (12.1)			
32	Education	4.3	0.3				
33	Health and Social Work	1.8	0.3				
34	Other Community, Social, and Personal Services	2.7	2.0	Personal and community services (3.1)			
35	Private Households with Employed Persons	0.3	0.1				
	TOTAL	100.0	100.0			100.0	100.0

Source: ADB MRIO database, accessed September 22, 2021, using authors' classification.

Note**:** Sector number corresponds to ADB MRIO ordering, following International Standard Industry Classification (ISIC) revision 3.1. Countries included: Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. All shares are based on data originally expressed in millions of 2019 current dollars. Export shares include intraregional exports. GDP is at factor cost (excludes taxes and subsidies).

Deriving production links from the MRIO

The ADB MRIO provides a rich tool for looking at global inter-sectoral effects. Production is disaggregated into 35 economic sectors. The difference between the MRIO table and regular input-output tables of an individual economy is that all countries are stacked and linked, which means that each element of the matrix refers to supply and uses of one country-sector to another country-sector. This annual data has been updated to 2020—though it is most accurate through 2018—and is reported globally for 62 countries and "Rest of the World" (RoW), which denotes the sum of all other countries. All South Asian countries are featured individually in the ADB MRIO for the years 2000, 2005, and 2010-2020, except Afghanistan.

The MRIO extends the national input-output framework to all countries. Figure 1.1 shows the global accounting matrix structure for a given year, illustrated in an example of two countries (A and B) and two sectors (1 and 2). The intermediate input-output matrix is thus expanded and has the elements Z_{ij} for *I = {A1, A2, B1, B2}* producing (supplying) sectors and *j={A1, A2, B1, B2}* consuming (demanding) sectors. The elements typically contained in a national input-output matrix are illustrated in the orange-shaded boxes. The sum of the four elements of the column corresponding to sector 1 in country A represents the amount of intermediate input (in millions of USD) that country-sector A1 demands from all countries and all sectors. The methodology is described in detail in ADB (2015).

Figure 1.1. Structure of a hypothetical (2 by 2) multi-country input-output matrix

			Intermediate use (per Country and sector)				**Final use**		**Total Demand**
			Country A		**Country B**		**Country A**	**Country B**	
		sectors	**1**	2	**1**	**2**			
Intermediate use (per Country and sector)	**Country A**	**1**	**Intermediate use of domestic output by Country A (Z_{AA})**		Intermediate use by Country B of exports from Country A (Z_{AB})		**Final use of Country A domestic output**	Final use by Country B of Country A output	Demand for Country A output
		2							
	Country B	**1**	Intermediate use by Country A of exports from Country B (Z_{BA})		**Intermediate use of domestic output by Country B (Z_{BB})**		Final use by Country A of Country B output	**Final use of Country B domestic output**	Demand for Country B output
		2							
Value-added (VA)			VA in Country A		VA in Country B				
Total Output (Y)			Output in Country A		Output in Country B				

Source: Authors, based on ADB (2015).

Given an input-output table (either single- or multi-country) one can derive the Technical Coefficients matrix from the Intermediate Use Matrix Z. Table 1.2 shows the illustration for the two-country, two-sector case.

Table 1.2. Direct requirements to produce output x_1 are illustrated in the first column

Technical Coefficients or Direct Requirements Matrix, D		Use by sector	
		1	2
Production by sector	1	$d_{11} = z_{11}/x_1$	$d_{12} = z_{12}/x_2$
	2	$d_{21} = z_{21}/x_1$	$d_{22} = z_{22}/x_2$

Define $x_j = \sum_{i=1}^{35} z_{ij}$ as gross output of sector j (column j). Then $d_{ij} = {}^{z_{ij}}/_{x_j}$ denotes the amount of input needed from each sector i to produce a unit of output in sector j. Since there are the same number of demanding country-sectors as supplying country-sectors in the MRIO global matrix (35x63=2205), the square [2205x2205] matrix with the elements, denoted $\boldsymbol{D}$, describes the production technology in each sector, assumed to be fixed every year.

In matrix notation, one can express relationships embedded in input-output tables via the Leontief equation: $\boldsymbol{x} = \boldsymbol{Dx} + \boldsymbol{F}$**,** where: ***D*** = technical coefficients matrix; ***x*** = [1x2205] gross output vector; and ***F*** is the final demand vector. Deriving demand shock effects and rearranging matrices yields: $\Delta\boldsymbol{x} = (\boldsymbol{1} - \boldsymbol{D})^{-1}\Delta\boldsymbol{F} \cong \boldsymbol{L}\Delta\boldsymbol{F}$**.** The matrix $\boldsymbol{L}$ denotes the Leontief inverse matrix. Its elements l_{ij} show by how much output in sector ***i*** will change in response to a $1 change in final demand for sector ***j.***

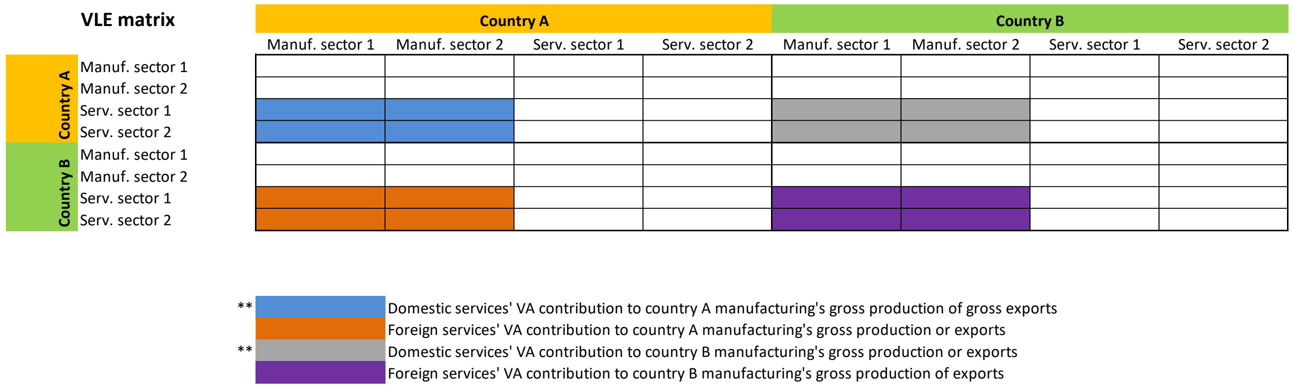
Measuring value-added contribution

To compute the value-added contribution of services to exports, we use the VLE matrix, computed as follows: $VLE\ matrix = \widehat{\boldsymbol{V}}\boldsymbol{L}\widehat{\boldsymbol{E}}$, where:

- $\widehat{\boldsymbol{V}}$ is the diagonalized value added coefficient vector
- $\boldsymbol{L}$ is the global Leontief inverse
- $\widehat{\boldsymbol{E}}$ is the diagonalized gross exports vector

From a column perspective, VLE tells us from which sector the value added embedded in exports is sourced. From a row perspective, it tells us to which exporter sector a particular source sector's value added is supplied. We aggregate the colored elements as in the illustrative figure where the world is composed of two countries, A and B, and four sectors. If country A is a South Asian country, then the sum of the blue and orange divided by growth exports of goods and services underlie Figure 3.5, left panel.

Figure 1.2. Illustrative example of capturing value added using ADB MRIO



The same method can be used to capture the value-added contribution of all services, or specific services, to manufacturing output. The denominator is output. The numerator in this case would be $\boldsymbol{VL\hat{O}}$**,** where the matrix

$\boldsymbol{\hat{O}}$ is the diagonalized gross output or production vector.

To compute country A's value-added contribution to domestic manufacturing output using the example illustrated in Figure 1.2, only the sum of blue cells would be included. Country A's services contribution to foreign output would correspond to the blue cells in country B. The resulting number would be divided by the total manufacturing output (whether domestic or foreign). Table 1.3 shows the results for South Asian countries, with their relative ranks and rank changes compared to 62 other MRIO countries.

Table 1.3. Change in value-added contribution of services

	to domestic manufacturing output			To foreign manufacturing output		
All services, by producing country	2020 value (percent)	2020 rank (out of 62 countries)	Rank change since 2010 1/	2020 value (percent)	2020 rank (out of 62 countries)	Rank change since 2010 1/
Manufacturing dependent countries: services inputs						
India	13.1	27	1	14.4	14	2
Pakistan	13.8	25	-10	0.4	51	-3
Sri Lanka	13.0	28	9	0.3	52	1
Bangladesh	10.4	37	-6	0.2	53	2
Services-dependent countries: services inputs						
Nepal	11.6	33	-14	0.1	56	
Bhutan	11.0	53	14	0.0	62	
Maldives	6.9	39	19	0.1	55	
Memo item: Global unweighted average, excluding South Asia	17.5			12.9		

1/ Positive change in rank denotes comparative improvement.
Source: ADB MRIO and authors' calculations.

Direct and indirect spillover effects of services inputs.

The indicators use the ADB MRIO to extract elements from the matrices $\boldsymbol{D}$ and $\boldsymbol{L}$ above to capture the effects from an increase in services production not just at home, but abroad, using insights from input-output and GVC analysis.

Denote: d_{ij}^{A} = direct effect.

This is the technical coefficient or direct requirements element as explained above. Then summing across all services (***i*** =1-17 from Table 1.1) for each manufacturing sector column (***j*=**1-14 as shown in Table 1.1) yields the total dollars in domestic (country A's) inputs across all services used to produce an additional dollar of output in global manufacturing. This is also known as the first-round, or direct effect. In the analysis we use it as a proxy for the level of outsourcing because sector i—services in this case—is different from sector j.[1]

From the global Leontief inverse matrix, L, l_{ij}^{A} denotes the total multiplier effect from an increase in sector *j*'s demand in country A and sector *i*. Then

$$S_{ij}^{A} = l_{ij}^{A} - d_{ij}^{A} \text{=indirect effect.}$$

It is defined as the industrial support effect, denoted as the indirect "spillover" impact on the rest of the economy from sector ***j***'s demand for sector ***i***'s inputs in country A. To measure the impact of all services sectors output (forward linkages), the multiplier effect is the sum across all services sectors in the MRIO. We can measure the changes in response to an increase in $1 of all domestic manufacturing demand or all foreign demand. To compare the same sectors across countries, we take a simple average multiplier of each country, as they are all responding to the same $1 demand[2] across sub-sectors. Mercer-Blackman and Ablaza (2019) analyze global changes using this method.

Revealed comparative advantage in value added

The traditional measure of revealed comparative advantage (TRCA) follows Balassa (1965). The measure is obtained by dividing the share of an economy-sector's gross exports with the sector's gross exports from all economies as a share of world total gross exports. More formally, TRCA can be expressed as:

$$TRCA_i^r = \frac{\left(\frac{e_i^r}{\sum_{i=1}^{N} e_i^r}\right)}{\left(\frac{\sum_{k=1}^{G} e_i^k}{\sum_{i=1}^{N}\sum_{k=1}^{G} e_i^k}\right)}$$

where e_i^r is economy *r*'s exports of products from sector i, N is the number of products (or industries in the input-output setting), and G is the number of economies in the world economy. Economy *r* is said to have a comparative advantage (with respect to the world) in the production of product i if $TRCA_i^r > 1$. Otherwise, it is said to have a comparative disadvantage in product i.

There are better indicators. Wang, Wei, and Zhu (2018) argue that $TRCA$ may not be the most appropriate measure of comparative advantage in a global value chain world characterized by intensive and extensive networks of trade in intermediates. There are at least two reasons for this. First, $TRCA$ ignores the fact that an economy-sector's value added may be exported indirectly via the economy's exports in other sectors. Hence, a more conceptually correct measure should be able to account for value added exported indirectly across economy-sectors. Second, $TRCA$ neglects the fact that an economy-sector's gross exports may at least partly carry foreign value-added. Therefore, a conceptually correct measure should exclude foreign value-added embedded in exports. Using the forward-linkage based on domestic value added in

[1] Note that if we wanted to see the impact of a sector on itself, the element d_{ij}^{A} =1 $if\ i = j$ by definition, because $1 must be produced to satisfy the $1 additional demand.

[2] Performing the same exercise with a more disaggregated input-output framework could yield slightly different results because the more disaggregated the data, the better the economic effects within a sector can be captured. Note also that we cannot compute general equilibrium effects without a full model with factor markets and prices, though we take as a given that the change in matrix structure from year to year reflects an adjustment due to relative price changes and technology impacts. In any case, relative prices of services are difficult to estimate or calibrate. Also, substitution effects within a sector are not properly captured.

exports (DVA_F) instead of gross exports, Balassa's index is altered to better capture patterns of specialization. Here, the new revealed comparative advantage of economy *r* in product *i* is obtained using the following formula:

$$NRCA_i^r = \frac{\left(\frac{DVA\_F_i^r}{\sum_{i=1}^{N} DVA\_F_i^r}\right)}{\left(\frac{\sum_{k=1}^{G} DVA\_F_i^k}{\sum_{i=1}^{N}\sum_{k=1}^{G} DVA\_F_i^k}\right)}$$

As in $TRCA$, economy r is said to have a comparative advantage (with respect to the world) in the production of good i if $NRCA_i^r > 1$. Otherwise, it is said to have a comparative disadvantage in product i.

Spillover effects and per-capita GDP Figure 3.10 shows that indirect effects from business services links to manufacturing and GDP are related. To test the statistical significance of the relationship, Table A3.4 shows the results from a fixed effects panel regression.

$$BSMFG_{i,t,} = \beta_0 + \beta_1 lnGDPpc_{i,t-n} + \beta_2 BSMFG_{i,t-n} + \gamma T + u_{i,t}$$

$BSMFG_{i,t}$ is the indirect contribution of business services to manufacturing for each country i.
$\boldsymbol{X_{i,t}}$ = represents the independent variables, where $lnGDPpc_{i,t}$ = ln per capita GDP in nominal US$ and $BS\_MFG_{i,t-1}$ is the 1-period lag of $BSMFG$. T refers to a vector of time dummies. $u_{i,t}$ is the error term.
In terms of the subscripts, t = 2010 to 2018, and n = lag from time 0 to 2. The same specification was used but using the direct effects as dependent variable. The results show GDP per-capita, contemporaneous, and lagged as significant. The World Bank Governance indicators were also included as institutional variables but were not significant, and likely correlated to per-capita GDP.

Table 1.4. Panel regression results on business services' indirect contribution to $1 demand for manufacturing

	(1)	(2)	(3)	(4)
Dependent variable: indirect, "industrial support" effect, business services.				
ln(GDPpc)	0.401*	0.247*	0.213**	0.327***
	(0.204)	(0.128)	(0.0953)	(0.0968)
BSMFG(-1) Lagged dependent variable			0.655***	0.666***
			(0.130)	(0.135)
2011.year	-0.0566**			
	(0.0244)			
2012.year	-0.0513**		0.00976	0.0277
	(0.0203)		(0.0108)	(0.0178)
2013.year	-0.0393	-0.00572	0.0292**	0.0407**
	(0.0283)	(0.0343)	(0.0144)	(0.0168)
2014.year	-0.0248	0.0132	0.0290*	0.0436**
	(0.0303)	(0.0258)	(0.0157)	(0.0204)
2015.year	0.0646*	0.0792**	0.0860***	0.114***
	(0.0351)	(0.0303)	(0.0252)	(0.0286)
2016.year	0.0433	0.0580	0.0325	0.0455*
	(0.0351)	(0.0466)	(0.0250)	(0.0233)
2017.year	-0.0229	0.0220	-0.00916	-0.00253
	(0.0442)	(0.0444)	(0.0298)	(0.0324)
ln(GDPperK--lag 1)		0.0311		-0.142
		(0.239)		(0.0878)
ln(GDPperK--lag2)		0.211		
		(0.257)		
Constant	-2.697	-3.568	-1.671*	-1.434
	(1.945)	(2.243)	(0.874)	(0.897)
Observations	480	360	420	420
R-squared	0.114	0.117	0.423	0.425
Number of countries	60	60	60	60

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

2. Firm-level analysis using Orbis dataset

The Orbis global database from Bureau van Dijk (BvD)—a Moody's Analytics company—is the largest cross-country firm-level database covering firms' financial statements and their production activity. It includes public and private firms' balance sheets and income statements. The Orbis database is used in many research papers, but data samples downloaded from this database are often not nationally representative due to less coverage of small and less productive firms (Kalemli-Ozcan et al. 2019). For this reason, Orbis is more suitable for studies that analyze top performers and multinationals rather than underperforming firms, analyses focused on mean performance or within-firm changes rather than on the entire firm distribution, or entry and exit (Bajgar et al. 2020). We kept these caveats in mind as we used the Orbis data for some of our analysis in Chapter 3 of World Bank (2021).

Out of the almost 122,000 firms in the ORBS dataset, 64 percent are services firms. Out of those services firms, 28 percent have an owner in the manufacturing sector (manufacturing Global Ultimate Owner (GUO), and 8.2 percent have a foreign GUO from any sector. For the small sample of services firms with a GUO in the electrical equipment sector, more than half of the owners are foreign (Table 2.1).

Table 2.1. Number and characteristics of South Asian firms in Orbis

	Total		Service Firms		
Country	Number of firms in ORBIS	service firm share	Share with GUO	Share with foreign GUO	Share of manufacturing GUO
Afghanistan	15	100	27	0	0
Bangladesh	324	48	37	1.9	0
Bhutan	22	50	27	9.1	0
India	119985	64	28	8.3	2.8
Sri Lanka	428	63	67	5.2	1.5
Maldives	6	100	50	33	0
Nepal	121	94	35	1.8	0
Pakistan	1098	41	34	6	2.2
South Asia	**121,999**	**64**	**28**	**8.2**	**2.8**

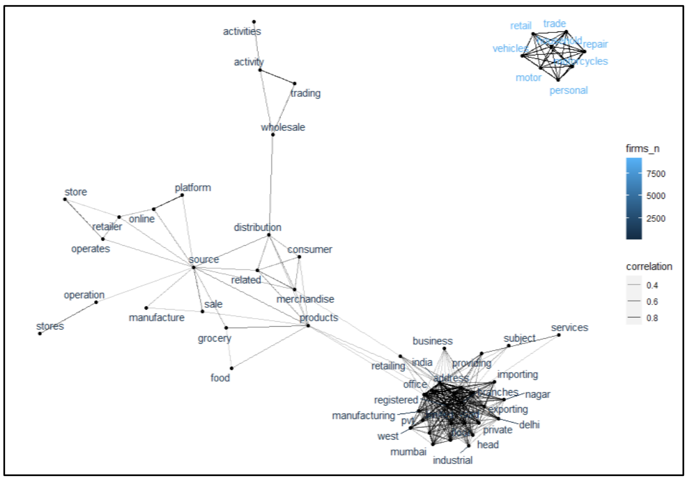
One of the first variables we used from Orbis was firms' trade description. We used this information in our exploratory analysis to gain insight into the way firms operate and to get a first idea on how they carry out activities related to other sectors. The way we structured this exploratory analysis was with a text mining exercise as illustrated in Figure 2.1. This figure plots the correlation for words in the trade description data in four industries of interest.[3] By setting a minimum threshold of correlation of 0.2 between words we create a network showing the intensity of the linkage between words. We also add the frequency with which words tend to appear in the trade description to uncover the importance of each word. In the example shown, the "Architectural and engineering activities" sector shows strong links with manufacturing activities or firms engaged in manufacturing (Figure 2.1.d). As a second step, the trade description variable included in Orbis is also used to determine the service and manufacturing content of different industries, independent of whether they

[3] We did some data cleaning before plotting the network. We deleted connection words, articles, and words that did not add important information. For instance, if a firm said: "This firm is located in Mumbai", the only word with some meaningful information would be "Mumbai." Some contributions to the literature are limited to counting certain words. See, for instance, Cadestin and Miroudot (2020).

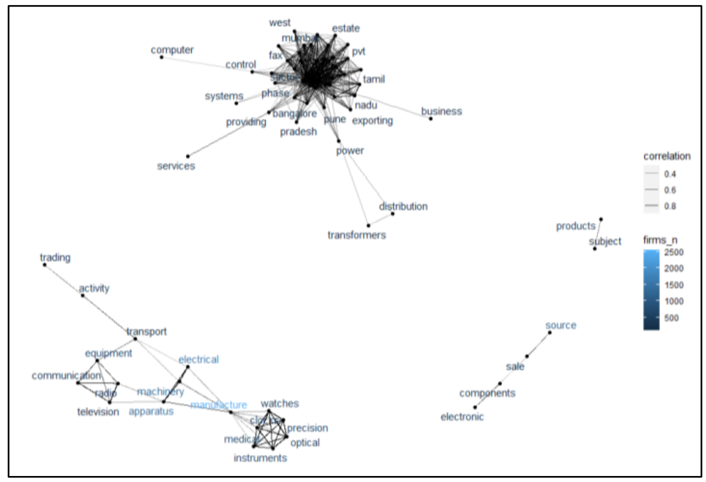
are service or manufacturing industries. This allows for a different way to gauge the extent of servitization of manufacturing through linkages of service sectors with manufacturing activities (see Figure 2.2).

Figure 2.1. Text mining of the trade description in Orbis database

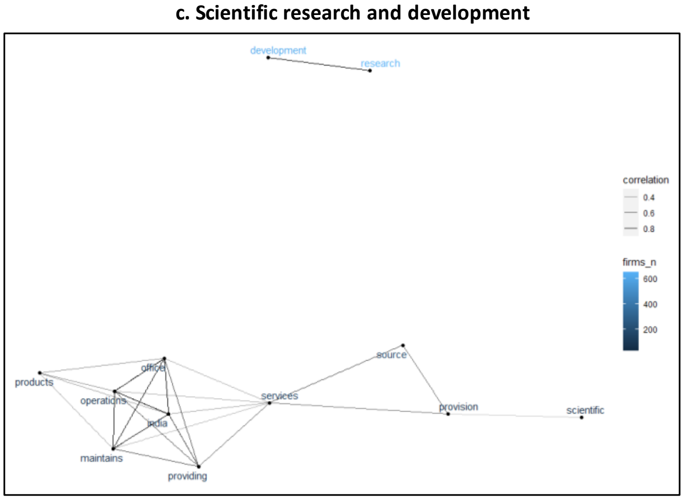
a. Retail and repair, except motor vehicles and motorcycles



b. Electrical and optical equipment



c. Scientific research and development



d. Architectural and engineering activities; technical and analysis

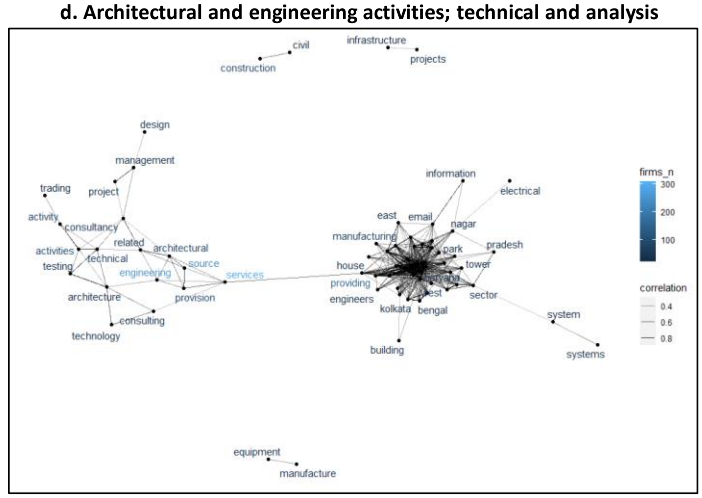
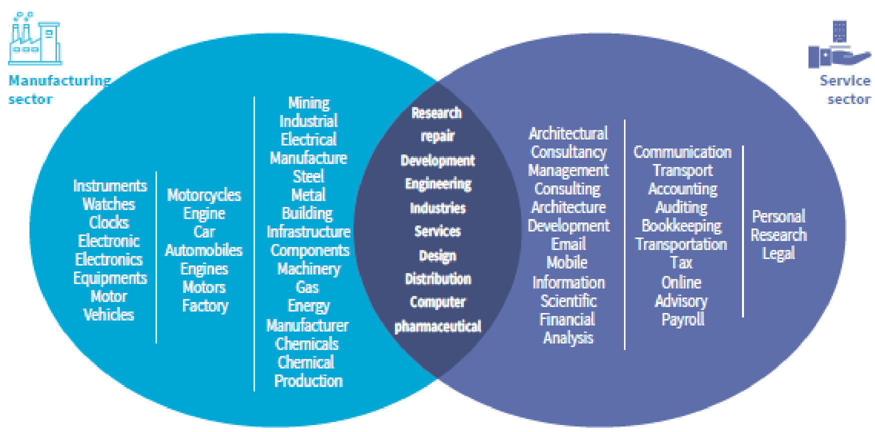


Figure 2.2. South Asian firms in both sectors engage in activities or relate to other firms according to a text analysis of the firms' trade description

Crossover words describing activities of firms



Source: Authors' analysis based on ORBIS database.

Measuring servitization

Table 2.2 reports results of determinants of servitization using the same methodology used by Cadestin and Miroudot (2020), which looked at the likelihood of being servitized for a set of OECD and middle-income countries. The results are of the same sign and significance as for South Asia, except the values are slightly smaller.

Table 2.2. Characteristics of servitized firms, South Asia and other countries

Regression of manufacturing servitization (bundled = 1). Each coefficient can be read as the increase in probability that a manufacturing firm will be servitized due to a 1 percentage point change in each determinant.

Dependent variable: servitization=1	(a)	(b)	(c)	OECD and EMDEs 1/
Intangible share assets	0.423***			0.0044***
	(0.151)			(0.001)
Log(revenue)		0.069***		0.0123***
		(0.003)		(0.002)
Log (sales)			0.082***	0.0046**
			(0.004)	(0.002)
Constant	-0.521	-1.252***	-1.934***	[0.124-0.219]**
	(0.435)	(0.436)	(0.441)	range
Observations	108,464	104,374	95,895	454,773
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Note: Shaded right-hand column reports the results from the same specifications performed by Cadestin and Miroudot (2020) using ORBIS data, which found somewhat smaller coefficients. The countries covered are Australia, Chile, Colombia, Costa Rica, the Czech Republic, Luxembourg, Norway, Portugal, Slovenia, South Africa, Sweden, the United Kingdom, and the United States.

Table 2.3 reports the results from a panel estimation over 2011-2020 on servitization determinants, where the independent variable takes a value of one if it produces both goods and services, and zero if it only produces services (is a manufacturing firm).

Table 2.3 Servitization determinants

Fixed effects panel estimation of servitized firms vs. pure manufacturing firms

	intangible share	log sales	log value added	Δlog value added	log (value added/employees)
Servitization (bundled firms=1)	0.001***	0.363***	0.401***	-0.017*	-0.136*
	(0.000)	(0.019)	(0.023)	(0.009)	(0.078)
Constant	0.001	17.115***	8.708***	0.103	2.387***
	(0.001)	(0.125)	(0.074)	(0.198)	(0.152)
Observations	108,732	96,147	69,200	52,052	1,782
R-squared	0.006	0.029	0.032	0.002	0.206
Country FE	Yes	Yes	Yes	Yes	Yes
Country-sector FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Note: Servitized manufacturing firms are defined as those that also produce or are engaged in services. Few firms in Orbis report employment numbers, which explains why the number of observations declines significantly for the labor productivity regressions. We also find that bundled firms are more likely to have a manufacturing GUO. Robust standard errors in parentheses. FE=fixed effects. Time period 2011 to 2020, annual. *** p<0.01, ** p<0.05, * p<0.1

Arms-length servitization of manufacturing through ownership

Comprehensive information on ownership linkages between firms is available.[4] It has been extensively used in the literature on measures of vertical integration (for instance, Alfaro et al. 2018). Orbis contains information on both ownership linkages between shareholders and subsidiaries and the ultimate owners of subsidiaries calculated by Bureau van Dijk at the end of each calendar year. The ultimate owners are calculated by following the ownership pyramid beyond the immediate direct owners to their owners, and so on. Importantly, this information is contained on the "global ultimate owner" variable of each firm in the database. This information enables us to build links between affiliates of the same firm, including cases in which the affiliates and the parent are in different countries. To analyze multinationals, we must use the "unconsolidated" accounts of each firm, since the "consolidated" accounts may include operating revenue of the foreign affiliates.

We find that services firms with a manufacturing global owner in the manufacturing sector have slightly more intangible assets, are more than two and a half times larger in terms of revenues (coefficient is 1.587), are more than twice as large in terms of net income or value added, have grown on average 6.4 percent faster, and are 55 percent more productive, though the sample size is significantly smaller when measuring labor productivity. The bottom part of the table reports results

[4] This analysis was carried out together with Wei Xiang (Yale University, former World Bank consultant).

only for services firms with owners in the high-tech electrical equipment sector. Though not reported, additional results showed that services firms owned by an electrical equipment GUO tended to grow more slowly than pure service firms after controlling for size, implying a slight advantage for small pure services firms.

Table 2.4. Regression results from services firms with a manufacturing global owner (versus stand-alone services firms) for India

A. Characteristics of services firms in South Asia with owner headquartered in the manufacturing sector (vs. pure services firms).

Test	Dep. Variable	*GUO_manuf=1*	Constant	Observations	R-squared
Innovation/R&D	Share of intangible assets to total assets	0.007***	0.003**	111,407	0.021
size	Log (revenues)	1.587***	17.087***	103,479	0.067
income	Log (value added)	1.023***	13.792***	51,079	0.069
Growth of net income	Δlog (revenue)	0.064***	0.131***	81838	0.004
Productivity	log (value added/employees)	0.549*	3.402***	703	0.293

B. Characteristics of services firms in South Asia with owner headquartered in the electrical and electronics sector (vs. pure services firms).

Test	Dep. Variable	*GUO_Elect=1*	Constant	Observations	R-squared
Innovation/R&D	Share of intangible assets to total assets	0.013***	0.003**	107,324	0.021
size	Log (revenues)	1.491***	17.082***	99,538	0.058
income	Log (value added)	1.254***	23.796***	83,281	0.070
Growth of net income	Δlog (revenue)	0.849***	13.760***	48,623	0.064
Productivity	log (value added/employees)	-1.945***	3.412***	681	0.304

Note: Few firms in Orbis report employment numbers, which also explains why the number of observations declines significantly for the labor productivity regressions. We also observe that bundled firms are more likely to have a manufacturing GUO. Coefficients from regression results including country-sector, country, and year (2010-2020, annual) fixed effects. *** p<0.01, ** p<0.05, * p<0.1. The vast majority are Indian. Capital expenditures are not available for most firms. GUO=global ultimate owner's sector.
Source: Author calculations using ORBIS.

3. Employment and occupations analysis

Analysis in terms of occupations provides a very different view of the employment structure compared to the typical analysis, which looks at the number of workers in each sector, regardless of what they do. In the traditional analysis, the service sector tends to be a residual, for workers who cannot be classified elsewhere. Table 3.1 shows the employment shares in each sector of economic activity.

Table 3.1. Employment by sector of economic activity according to the latest labor force surveys show most workers still work in the agricultural sector

Countries	Afghanistan	Bangladesh	India	Maldives	Nepal	Pakistan	Sri Lanka
Survey name	Living conditions survey	Quarterly labor force survey	Periodic labor force survey	Household Income & Expenditure Survey	Labor force survey	Labor force survey	Labor force survey
Last survey year	2016-2017	2015-2016	2018-2019	2019	2017-2018	2017-2018	2019
Agriculture and primary product	44.5	43.0	40.6	7.6	22.5	37.7	26.1
Manufacturing	8.1	14.4	12.4	10.4	15.4	16.2	18.4
Construction and infrastructure	9.8	5.9	12.6	7.4	14.7	8.4	8.4
Market services	17.9	25.4	23.6	34.7	32.2	26.0	30.2
Public services	19.7	11.3	10.8	39.9	15.1	11.7	17.0
Total employed (million)	***6.2***	***59.1***	***354.7***	***0.2***	***7.0***	***53.8***	***8.2***

Classification of employed by occupations

The analysis in section 3.4 on employment and skills of World Bank 2021 is based on data from the labor force surveys and their equivalents for each South Asian country[5] (Table 3.2). The surveys collect questions on the employment status,[6] main occupation, and sector of economic activity. This allows us to classify each employed person by sector and occupation. To examine the changing occupational patterns, we use the earliest year around 2010 or before and the latest available survey year[7] for each South Asian country to maximize the period covered.[8] The results for the United States are based on the estimates of employment from the Occupational Employment and Wage Statistics (OWES)[9] in 2011 and 2019, Bureau of Labor Statistics.

Table 3.2. Labor force surveys used for analysis and occupation classifications

Survey name	Country	Survey year	Occupation code
NSSO (key indicators on employment and unemployment)	India	2009-2010	NCO 2004
Periodic Labor Force Survey (PLFS)		2018-2019	NCO 2004
Quarterly Labor Force Survey (QLFS)	Bangladesh	2005-06	BSCO following ISCO-88
		2015-2016	BSCO-2012 following ISCO-08
Labor Force Survey (LFS)	Pakistan	2008-2009	PSCO-94 following ISCO-88
		2017-2018	PSCO-15 following ISCO-08
Labor Force Survey (LFS)	Sri Lanka	2006	SLSCO following ISCO-88
		2019	SLSCO following ISCO-08
Labor Force Survey (LFS)	Nepal	2008	NSCO following ISCO-88
		2017-2018	NSCO following ISCO-08
Occupational Employment and Wage Statistics (OEWS)	United States	2011	Standard Occupational Classification (SOC)
		2019	

For each selected South Asian country except India, the national occupation code had changed between two surveys reflecting the changes in international standard classifications of occupations from ISCO-88 to ISCO-08 (ILOSTAT). The overall system of different levels of groups in ISCO-88 has been retained in ISCO-08. However, ISCO-88 at 2-, 3-, and 4-digit levels have been split, merged, or moved to reflect occupational and technological change in the labor market. Moreover, new categories in ISCO-08 have been created to adapt to the emerging occupational groups (Table 3.3).

The variation in the detailed level of occupations between two occupational codes poses a challenge when constructing comparable time series across years for each country. The main reason is the reclassification of professional occupations—services and sales, in particular (Eurostat 2021). Moreover, it is not possible to have an exact concordance going from ISCO-88 to ISCO-08 classifications at the detailed 4-digit occupation levels, though it is possible the other way around (from the earlier ISCO-88 to ISCO-08). The reason is that a richer set of occupations was created in ISCO-08. Moreover, although national occupational codes were converted to a consistent international classification, the results are not comparable across countries at the detailed occupation levels because of different national contexts (Eurostat 2021). For example, "Garden and horticultural labourers" (occupation code 9214) in ISCO-08 can be classified as "Elementary farm-hands labourers" (occupation code 9211) in ISCO-88, or as "Agriculture and fishery workers" (occupation code 6113) in certain

5 Bhutan is not included in the analysis due to the anomalies in the main activity and occupation codes in the 2017 Living Standard Survey.

6 The identification of the broad activity status (employed) is based on the current weekly status (CWS) approach, which has a reference period of the last seven days preceding the date of the survey.

7 Though the latest release for India PLFS data is 2019-2020, we did not use the latest data to avoid COVID-related impacts on the labor force structure.

8 For India, both NSSO and PLFS are supposed to give representative estimates. However, there have been some changes in methodology in terms of employment, which has led to some differences in the estimation of total workers. (Kannan and Raveendran 2019).

9 The Occupational Employment and Wage Statistics (OEWS) program produces employment and wage estimates annually for nearly 800 occupations. These estimates are available for the nation as a whole, for individual states, and for metropolitan and nonmetropolitan areas; national occupational estimates for specific industries are also available.

national contexts in ISCO-88. Another example: “Construction supervisors” (occupation code 3123) in ISCO-08 can be classified as “Production and operations department managers in construction” (occupation code 1223) or “Building frame and related trades workers” (occupation code 7129) in ISCO-88.

As a result, not all South Asia data could be used. Both ISCO-08 and ISCO-88 have the same one-digit classification levels, though for specific occupations, we mapped ISCO-08 to the ISCO-88 classification at the four-digit level to ensure harmonization. Considering the discrepancy between ISCO-88 and ISCO-08 and the need to map to one classification system, we estimate about 8 percent of workers could not be properly classified by code numbers or according to the description when shifting from ISCO-08 to ISCO-88 in Bangladesh, Pakistan, Sri Lanka, and Nepal. Moreover, data from three countries could not be used. Bhutan’s 2017 survey data could not be used as it listed a significant number of sectors and occupations that were not mapped to either classification code. Maldives did not include resort workers in the labor force survey. Afghanistan’s earliest Living Conditions Survey is 2014.

Table 3.3. Classification of employment occupations and differences between ISCO-08 to ISCO-88 classification systems, types of job and corresponding skills levels

1-digit occupation code (ISCO-08, ISCO-88)	2-digit occupation code (ISCO-08) and type of activity	Substantial changes in classification from ISCO-88?	Broad skill level
1. Managers	11. Chief executives, senior officials and legislators (S) 12. Administrative and commercial managers (F and S) 13. & 14. Managers in services (S)	Managers of small entities were grouped according to area in ISCO-88.	Skill level 4 (high), requires professional training and handling of complex tasts.
2. Professionals	21. Science and engineering professionals (F and S) 22. Health professionals (S) 23. Teaching professionals (S) 24.25.& 26. Business and other professionals (S)	Smaller diversity of jobs in ISCO-88. For example, computer professionals and associates were disaggregated into more specific job types according to task.	
3. Technicians and associate professionals	31.& 35. Science and engineering associate professionals (F and S) 32. Health associate professionals (S) 33. Business and administration associate professionals (S) 34. Legal, social, cultural and related associate professionals (S)		Skill level 3 (semi-high) requires some professional and technical training.
4. Clerical support workers	41.43.& 44. General office clerks (S) 42. Customer services clerks (S)	No	Skill level 2 (medium) requires some trade skills to perform tasks.
5. Service and sales workers	51.53.& 54. Personal, care & protective services (S) 52. Sales workers (S)	No	
6. Skilled agricultural and fishery workers	61.62.&63. Agricultural workers (A)	Some subsistence agricultural workers in ISCO-88 grouped as elementary workers in ISCO-08, while more skilled workers included elsewhere in ISCO-08.	
7. Craft and related trades workers	71. Building and related trades workers, excluding electricians (F) 72.&74. Metal, machinery and electrical trades (F) 73. Handicraft and printing workers (F) 75. Food processing, wood working, gament and other craft and related trades (F)	No	
8. Plant and machine operators, and assemblers	81. Stationary plant and machine operators (F) 82. Assemblers (F) 83. Drivers and mobile plant operators (F)	No	
9. Elementary occupations	91,94.95 & 96. Cleaners, refuse, street and related service workers (S) 92. Agricultural, forestry and fishery labourers (A) 93. Labourers in mining, construction, manufacturing and transport (F)	No	Skill level 1 (low) requires minimal training or experience to perform tasks.

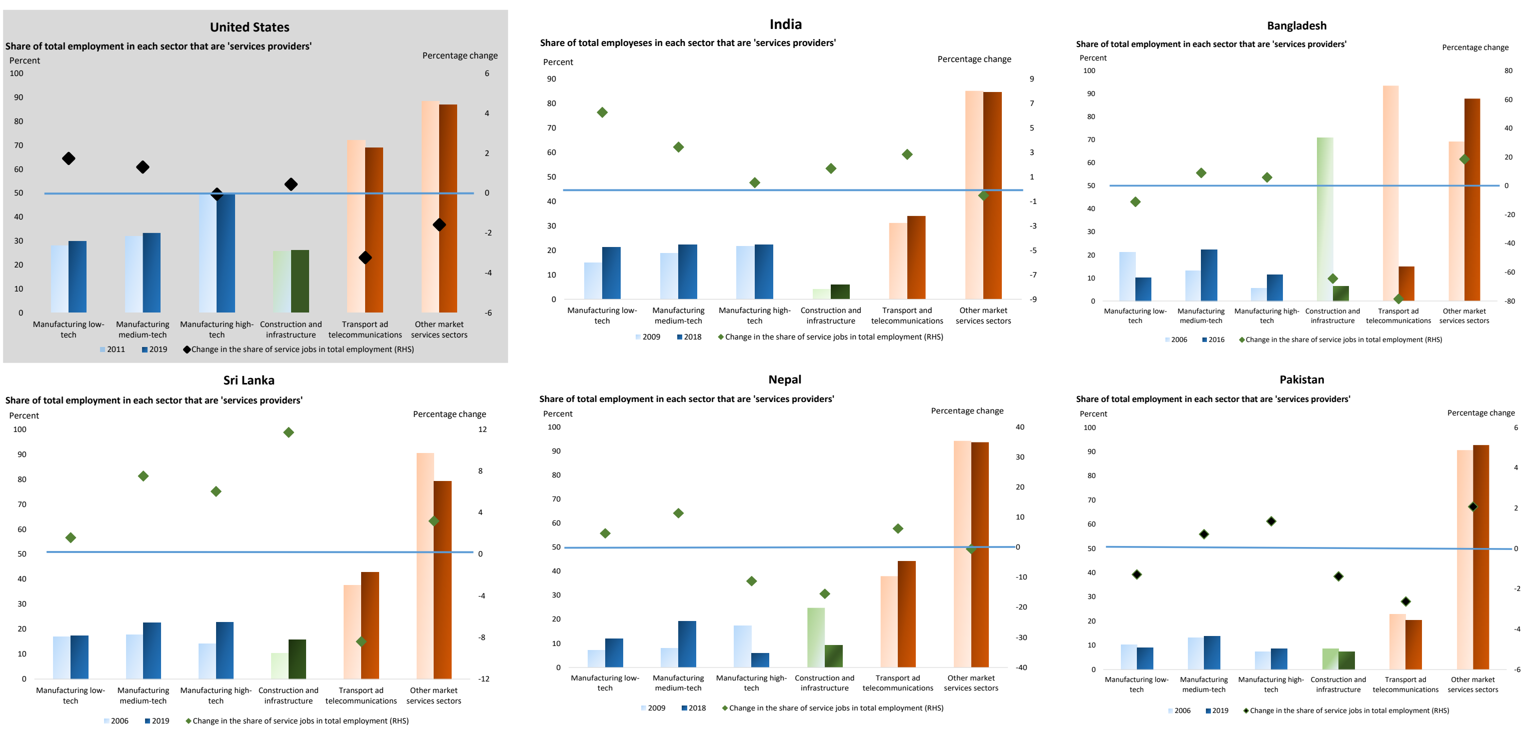
Note. Table and analysis exclude government officials and political appointees as well as armed forces. A= agricultural jobs, F=fabrication jobs and S=service provision jobs.
Source: Authors’ calculations, based on ILO (2012).

Servitization of manufacturing through employment and business services.

To look at the share of people employed in manufacturing who have services occupations (see Figure 3.28 of World Bank (2021)), we classified occupations into three types of jobs: agricultural workers engaged, for example, in animal rearing, farming, and fisheries (A); fabrication workers or those directly engaged in the manufacturing process or operating machines (F); and service providers whose job it is to provide a service (S). In Table 3.3, the second column denotes, in parenthesis, the type of work for each occupation according to this classification and abbreviation. To distinguish certain occupations at the two-digit level, which could be associated with either fabrication or service provision, we distributed the number of employments to each type of work by using a weight of the share of workers in the manufacturing and services sector within each occupation for each country. The surveys also report the sector of economic activity where the survey respondent works. The structure of national industry classification codes also has changed between two surveys following the revision of the international standard industrial classification (ISIC). In particular, the ISIC structure changes are reflected in the increase in top-level categories and in overall detail (United Nations 2008). For comparability purposes, different versions of national industry classification codes were standardized to match the ADB MRIO sectors using the concordance tables provided by Eurostat (EUROSTAT).

Figure 3.1. Workers engaged in services jobs are increasingly found in all sectors of the economy—including manufacturing

Share of total employment in each sector that are service providers, United States, and larger South Asian countries



Note: Blue is manufacturing sector, brown is services sector, green is construction and utilities.
Source: Labor force surveys and its equivalent, various years for South Asian countries; U.S. Occupational Employment and Wage Statistics (OEWS), classified at the ISCO-88 codes. (See Table 3.2 for details)

Changes within and between sectors

A common methodology when looking at structural transformation is to understand how job profiles change within and between sectors of economic activity. We follow the approach of Berlingieri (2014) by decomposing the changes in employment in a given sector across time as follows:

$$\Delta\, L\, share_t = \underset{(Within)}{\sum_o \Delta\omega_t^o\, l_{t-1}^o} + \underset{(Between)}{\sum_o \omega_{t-1}^o\, \Delta l_t^o} + \underset{(Cross)}{\sum_o \Delta\omega_t^o\, \Delta l_t^o}$$

where ω_t^o represents for a given occupation ***o*** the share of workers that are employed in the industry and l_t^o is the share of occupation o in total employment. Time indices $t-1$ and t indicate quantities at the beginning and end of the period, respectively. The first term is a within-occupation component that captures how much of the increase in the sector's employment is due to workers within each occupation moving to the that industry, while the second term is a between-occupation component that captures the contribution of employment share reallocations among occupations in the same industry or sector.

To look at total employment occupation profiles and the shift of employees engaged in the professional and business sectors within occupations (Figures 3.27 and 3.29 in World Bank (2021)), we aggregated two-digit occupation codes from seven occupation groups with the breakdown at the ISCO-88 classification level aggregated, as shown in Table 3.4. Note that the occupation group shown as "Agriculture and elementary workers" includes both "Agriculture and fishery workers" and "Elementary workers," as listed in Table 3.4.

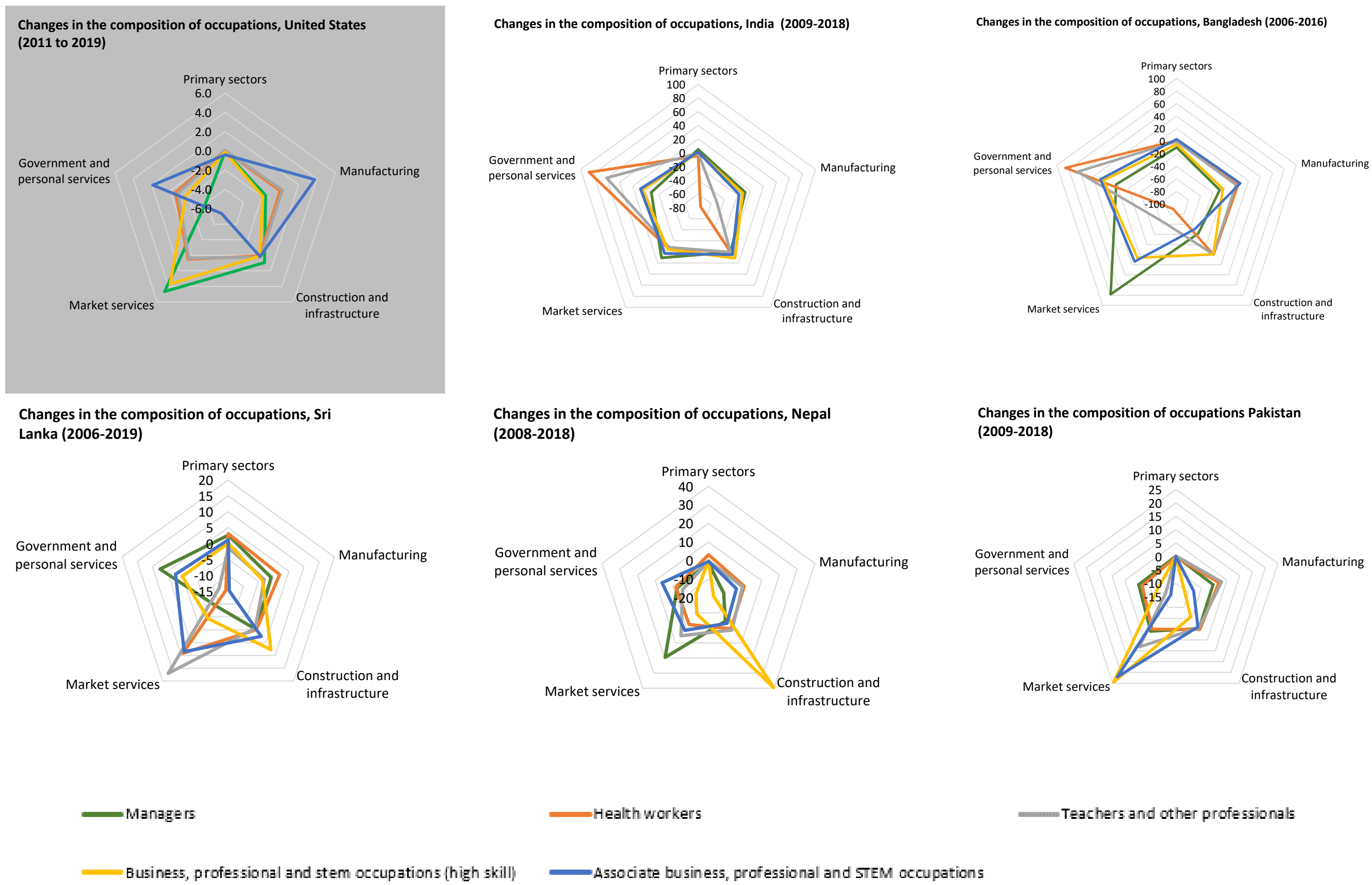
Table 3.4. Occupation classification groups used in the analysis

Major occupation groups	ISCO-88 at the two-digit level
Managers	Legislators and Senior Officials; Corporate Managers; General Managers
Business professionals, technical and STEM workers	Physical, mathematical and engineering science professionals; Physical science and engineering associate professionals
Education, health and other professional occupations	Life science and health professionals; Teaching professionals; Other professionals; Life science and health associate professionals; Teaching associate professionals; Other associate professionals
Other services workers	Office clerks; Customer services clerks; Personal and protective services workers; Salespersons, demonstrators and models
Fabrication and construction workers	Extraction and building trades workers; Metal and machinery trades workers; Precision, handicraft, printing and related trades workers; Other craft and related workers; Industrial plant operators; Stationary machine operators and assemblers; Drivers and mobile machine operators
Agriculture and fishery workers	Market-oriented skilled agricultural and fishery workers; Subsistence agricultural, fishery and related workers
Elementary workers	Sales and services elementary occupations; Agricultural, fishery and related labourers; Labourers in mining, construction, manufacturing and transport

Figure 3.2 shows the shift of employment of workers in the most skill-intensive occupation categories within occupations but across sectors. Managers are also considered as a category, since they likely have special skills, including, by definition, leadership and people skills that can be critical for firm productivity. As before, the United States is included as a benchmark. First, it is noteworthy that in the past decade, teachers and health workers shifted into government services in India and Bangladesh, not into market services. This may reflect the scarce opportunities for these workers to find jobs that use their skills in the private sectors. The high skilled professionals have moved to construction in Sri Lanka and Nepal, and some have shifted to manufacturing. Pakistan, and to some extent Bangladesh, are the countries where the highest

skill professionals are shifting more into market services. For all other high-skilled occupations in other countries, there has not been much movement across sectors over the last decade.

Figure 3.2 Though some high-skilled occupations have moved into the market services sectors, a large shift of talent to the public sector has occurred over the last decade in India and Bangladesh



Note: National occupation codes are classified at 2-digit ISCO-88 level and national economic activity codes are classified at 35 sectors ADB MRIO.
Source: Labor force surveys and its equivalent, various years for South Asian countries; U.S. Occupational Employment and Wage Statistics (OEWS).

Skills upgrade

According to the definitions from the International Labour Organization (ILO 2012), the skill level is defined as a function of the complexity and range of tasks and duties to be performed in an occupation, and it's usually measured in three ways: (i) the nature of the work performed in an occupation; (ii) the level of formal education; and (iii) the amount of information on-the-job training and/or previous experience in a related occupation. ILO provides four skill levels based on the job description concerning the characteristic tasks and duties defined for each ISCO-88 skill level.

Ideally one would use average wage data per job as Autor and Dorn (2013) did for the United States to compare skills across occupations, but the level of informality and variation in hours worked in South Asia made it impossible to make such comparisons. Therefore, it is assumed that if a worker is performing a job that fits the occupation description, the worker possesses the commensurate skills, education, and experience to carry it out. As a robustness check, we cross-referenced skills growth with changes in education levels for India and found that skills improvement went hand in hand with higher levels of education. Comparability is best made within countries across time. The right-most column of Table 3.3 reports the assigned skill level for each one-digit occupation classification group.[10] To compute the skill index in Figure 3.31, we assign a score to each skill level, weighted by the share of occupation in each skill level: low-skilled=1; medium-skilled=2, semi-high skilled=3; high-skilled=4. The calculation of the skills index is as follows:

$$SkillsIndex_{i,t} = \sum_{j=1}^{4}(EmpShare_{i,t,j} \times SkillScore_{i,t,j})$$

Here $SkillsIndex_{i,t}$ is a measure of skills index for the country i in the survey year t. $EmpShare_{i,t,j}$ measures the share of the employment for the skill level j for each country i in the survey year t. $SkillScore_{i,t,j}$ is a skill score assigned to each skill level j in the country i and survey year t.

[10] Note that "Managers" in the first row of Table 3.3 are generally considered to be high-skilled by ILO, but not always. For example, a restaurant manager in a small village is unlikely to be as skilled as the Chief Executive Officer of a corporation.

References

ADB (Asian Development Bank). 2021. *Key Indicators for Asia and the Pacific, 52nd edition*. Manila, Philippines: Asian Development Bank.

ADB (Asian Development Bank). 2015. "Part IV Global Value Chains: Indicators for International Production Sharing." *Key Indicators for Asia and the Pacific 2015*. Manila, Philippines: Asian Development Bank.

Autor, David and David Dorn. (2013) "The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market," *American Economic Review*. 103 (5): 1553–1597.

Berlingieri, Giuseppe. 2014. "Outsourcing and the Rise in Services." Discussion Paper N1199, Centre for Economic Performance, London.

Cadestin, Charles, and Sébastien Miroudot. 2020. "Services Exported Together with Goods." OECD Trade Policy Papers 236, Organisation for Economic Co-operation and Development, OECD Publishing, Paris. http://dx.doi.org/10.1787/275e520a-en.

European Statistical Recovery Dashboard (database). 2021. "Classification Differences Between ISCO-08 and ISCO-88." Eurostat, Luxembourg City, Luxembourg (accessed September 28, 2021).
https://ec.europa.eu/eurostat/documents/1978984/6037342/Comparability_ISCO_08_ISCO_88.pdf

European Statistical Recovery Dashboard. *RAMON – Reference and Management of Nomenclatures.* EUROSTAT.
https://ec.europa.eu/eurostat/ramon/relations/index.cfm?TargetUrl=LST_REL

ILO (International Labour Organization). 2012. "International Standard Classification of Occupations: ISCO-08." International Labour Organization, Geneva.

ILOSTAT (International Labour Organization Statistics). *International Standard Classification of Occupations.* https://ilostat.ilo.org/resources/concepts-and-definitions/classification-occupation/

Kannan, Kappadath P., and Govindan Raveendran. 2019. "From Jobless Growth to Job-Loss Growth: India's Employment Performance During 2012-18." *Economic & Political Weekly* 54 (44).

Mercer-Blackman, Valerie, and Christine. Ablaza. 2019. "The Servicification of Manufacturing in Asia." In *Leveraging Services-Led Development: Prospects and Policies*, edited by Matthias Helble and Ben Shepherd, 112-155. Tokyo: Asian Development Bank Institute and Manila: Asian Development Bank.

Wang, Zhi, Shang-Jin Wei, and Kunfu Zhu. 2014. "Quantifying International Production Sharing at the Bilateral and Sector Levels." NBER Working Paper 19677. National Bureau of Economic Research, Cambridge, MA.

World Bank. 2021. *South Asia Economic Focus: Shifting Gears: Digitization and Services-Led Development.* Fall. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/36317