



Double-hit scenario of Covid-19 and global value chains

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Abstract

Due to the Covid-19 pandemic, labor force is greatly confined by quarantine (social distancing), and limited units of labor and capital are available at the workplace. Millions of employees have lost their jobs and are facing financial hardships. Likewise, capital owners have become illiquid and possibly insolvent within months. This cycle seems to continue for other factors of production as well. Even after lifting quarantines, the global trade might take months (years) to return to its actual potential. Using the GTAP-VA model, the present study simulates the impact of the double-hit scenario of Covid-19 on the global value chains and identifies production losses in different sectors of the world economy.

Keywords Covid-19 · Economy · Global value chains

1 Introduction

Global trade is rapidly transforming in the coronavirus era. OECD (2020) states that the economic cost of the ongoing pandemic can range between 2.47% (China) to 14.36% (Spain) in terms of gross domestic product (GDP) in the second phase of this pandemic. It will have a devastating impact on the world trade, and there is a need of more robust global supply chains, with more stable bilateral and multilateral trade systems. On the other hand, many global leaders are questioning the role of increasing economic ties beyond the national borders.

Amid growing uncertainty, there is a need to find collective solutions to recover from this ongoing crisis and rebuild a better post-Covid world, which, however, depends on many aspects. For instance, rebuilding such a post-Covid world requires a deeper understanding of trade flows. In the absence of this knowledge, national governments will find it much difficult to reform a more resilient post-pandemic trade era.

The Covid-19 virus grows at the exponential rate, and the rising uncertainty leads to the loss of investment and escalates fluctuations in international trade (Ozili and Arun 2020). Service-oriented economies, particularly dependent on tourism industry, are more affected such as Greece, Spain and Portugal, where the economic losses are even

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higher than 15% of GDP (Fernandes 2020). The present crisis is creating a spillover effect throughout supply chains, and countries dependent on global trade face severe economic turbulences.

Over 50% of the global trade occurs in intermediate products, and most of the countries use the foreign goods as inputs to boost their exports (Zeshan 2019). The fragmented production via intermediate products passes through numerous borders, sometimes more than once. Hence, the global economy is steadily shaping in global value chains (GVCs). However, the traditional trade data are limited, unable to assess the original contribution of domestic output in global trade since the value-added content in gross exports of a region does not truly represent total value of gross exports because the gross exports also comprise value-added contribution from various other countries. Further, trade deficit of a nation might get lower if stated in value-added terms instead of gross trade. This phenomenon is much apparent in case of high-tech goods (Xing and Detert 2010); many components of such goods are imported globally where tracing back the actual producer is almost impossible.

To examine the effect of Covid-19 pandemic on global trade, the present study introduces the impact of the Covid-19 pandemic in the GTAP-VA model by reducing the supply of factors of production (such as labor force, capital stock and land rents) caused by the pandemic. More specifically, it simulates the impact of a second outbreak of the pandemic on GVCs in 2020. For this purpose, it uses a global input–output table of 140 regions representing more than 98% of global GDP. Finally, it splits the gross trade flows in domestic and foreign value-added, in direct and indirect value-added from exporting and supporting industries, and in bilateral and multi-lateral value-added.

The rest of the study is as follows. The research methodology is provided in the next section. Section 3 provides simulation design and data, whereas Sect. 4 describes simulation results. Conclusion and policy recommendations are provided in Sect. 5. Finally, Sect. 6 provides the limitations of this research work.

2 Research methodology

Following the GTAP-VA framework, the following equation describes the value of industry j in region r , which is equal to the sum of intermediate inputs i (Z_{ij}^{sr}) and value-added (VA_j^r), for details see Antimiani et al. (2018).

$$VOM_j^r = \sum_i \sum_s Z_{ij}^{sr} + VA_j^r \quad (1)$$

The intermediate inputs can be described as follows:

$$A_{ij}^{sr} = \frac{Z_{ij}^{sr}}{VOM_j^r} \quad (2)$$

where A_{ij}^{sr} represents the share of intermediate inputs i manufactured in region s , consumed by sector j in country r in the production process. In a country r , shares of sectoral value-added become:

$$VSH_j^r = \frac{VA_j^r}{VOM_j^r} \quad (3)$$

Further transformation leads to value-added created (in sector i) in country t , rooted in the exports (VXE_j^{sr}) of the country s (sector j) to country r (TVA_{ij}^{tsr}) and becomes:

$$TVA_{ij}^{tsr} = V\hat{S}H_i^t L_{ij}^{ts} * VXE_j^{sr} \quad (4)$$

Equation (4) indicates the value-added within the gross traded goods that are rooted in all the inputs acquired locally or imported.

3 Simulation design and dataset

In the current Covid-19 pandemic, labor force is greatly confined by quarantine (social distancing), reducing wages and returns on investment. Thus, less labor and capital units are available at the workplace. Millions of employees have lost their jobs and are facing financial hardship. Likewise, capital owners have become illiquid and possibly insolvent within months. Both labor force and capital stock have reduced, and the link between them is clear. This cycle seems to continue for some time even after lifting quarantines, and the economy might take months (years) to return to its actual potential. In the GTAP-VA model, manufacturers pay land rents to regional households, who own the endowments. Hence, the reducing demand for land shrinks its rent causing a loss of revenue to a regional household during the time of crisis.

The above-mentioned changes are introduced in the GTAP-VA model by reducing levels of factors of production, also known as endowments, such that the loss of GDP in our model is approximately equal to the estimates provided by OECD (2020). Given the odd level of uncertainty triggered by the Covid-19 pandemic, it estimates that impact of a second outbreak of the pandemic on the GDP of all the countries worldwide in the year 2020.

For this purpose, the present study uses the GTAP database version 9 (Aguilar et al. 2016). It combines the input–output tables of all the 140 countries/regions under analysis and links them through trade flows resulting in a global input–output table. All the countries/regions in the database are grouped into 15 countries/regions, and all the sectors are grouped into 10 sectors. The most detailed description of the dataset is provided in “Appendix.”

4 Simulation results

The simulation results indicate that the Covid-19 pandemic has a negative impact on all the sectors of the global economy (Fig. 1). The most affected sectors comprise textiles and clothing, light manufacturing and heavy manufacturing, whereas the most affected countries/regions include Oceania, Nepal, North America, EU_28 and MENA. The production losses in the global economy reduce the welfare level and the GDP worldwide. The highest losses are witnessed in EU_28 and North America (Fig. 2), where welfare and GDP losses are USD 1517 billion and 10% in EU_28, while the respective losses are 1433 billion and 10% in North America.

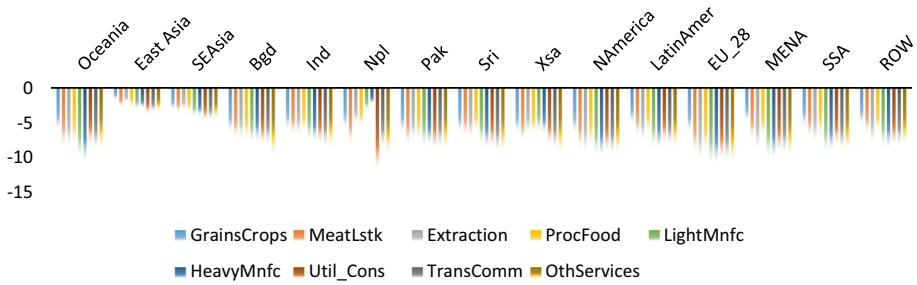


Fig. 1 Production losses (%)

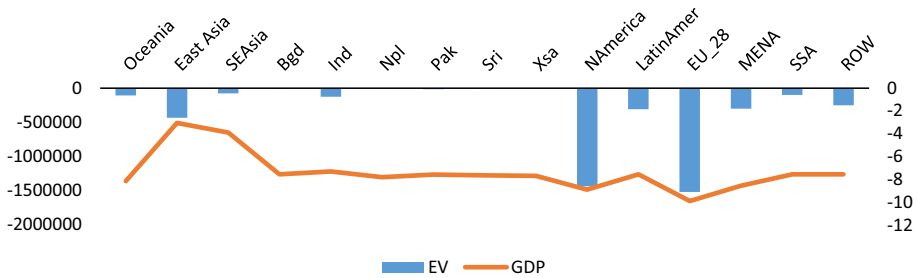


Fig. 2 Welfare losses (USD million) and real GDP (%)

Overall, the simulation results reveal that global welfare losses are going to be around 4.6 trillion (5.2% of global GDP), which is consistent with The World Bank (2020). To recover from such huge economic downfall, there is a need to focus on the most devastated sectors of the global economy by strengthen the backward and forward production linkages. It can be done through a timely and targeted fiscal stimulus in a coordinated way where suitable public resources can be employed to healthcare sector as well as to economic sectors. Besides, there is a need to provide extra liquidity to the small and medium labor-intensive enterprises.

The production losses caused by the Covid-19 pandemic disrupt global trade. Nearly 50% of the world trade occurs in intermediate imports as most of the countries use foreign intermediate inputs in exporting industries. Decomposing the gross trade flows in local and overseas value-added contents describes a clear picture of the world economy. Hence, gross trade is divided into several types of value-added contents such as domestic contribution (DVA), foreign contribution (FVA),¹ direct domestic contribution from exporting industries (DVA_dir), indirect contribution from supporting industries (DVA_indir),² direct contribution in bilateral (DVA_blt) trade and contribution in multilateral trade (DVA_mlt).³

¹ DVA indicates the domestic contribution in gross domestic exports, whereas the rest comes from FVA.

² DVA_dir shows the output generated directly by domestic exporting sector, whereas DVA_indir specifies the output manufactured by domestic supporting industries.

³ DVA_blt indicates domestic value-added in bilateral exports, whereas DVA_mlt characterizes the value-added content of a country (A) integrated in exports from a third countries (C) to a country (B).

Analysis of DVA indicates that extraction, light manufacturing and heavy manufacturing are the most affected sectors worldwide (Table 3). The extraction sector is affected the most in MENA region where the DVA reduces by around USD 52 billion, while the highest loss to DVA in light manufacturing industry is around 21 billion and 43 billion in East Asian and EU_28. Further, the heavy manufacturing sector bears the highest losses in North America and EU_28, which are 53 billion and 88 billion, respectively. The similar trend is witnessed in case of FVA (Table 4). It specifies that the exporting industry is heavily dependent on both domestic and foreign value-added contents. However, the volume of FVA content is much smaller than the DVA content.

Further analysis of the simulation results indicates that the exporting industries use inputs directly and indirectly from different countries and sectors (Tables 5 and 6). The DVA_dir shows the same pattern as DVA, which portrays that DVA_dir has a high contribution in DVA. Further, DVA_indir shows heavy losses in transport and communication sectors along with the previously mentioned sectors. Hence, many industries are indirectly affected when there is a decrease in DVA due to the Covid-19 pandemic.

The losses to value-added content are quite alarming in the bilateral as well as multi-lateral trade (Tables 7 and 8). In case of former, EU_28 witnesses the highest loss (199 billion), whereas the South Asian region bears the lowest losses (20.7 billion). Extraction, light manufacturing and heavy manufacturing industries face the highest losses. In case of the latter, MENA region experiences the highest losses, whereas South Asian region experiences the lowest level of losses (2.8 billion). Extraction, heavy manufacturing and other services face the highest losses.

5 Conclusion and discussion

The recent Covid-19 pandemic has challenged the global economy and even triggered a trade war between USA and China. In China, the provinces accountable for more than 90% exports have closed their production units or running at a low production capacity (Sohrabi et al. 2020). However, preparing and in-time viral response standard before the general public might have saved many lives. Millions of workers are out of work because exporting industries face severe barriers.

Rebuilding a better post-Covid world requires a deeper understanding of lost trade flows. In the absence of such knowledge, national governments will face many difficulties to build a more resilient post-pandemic trade era. To examine the impact of Covid-19 pandemic on global trade, the present study simulates how a second outbreak of the Covid-19 pandemic might shake the global value chains in 2020.

Analysis of simulation results indicates that DVA in extraction, light manufacturing and heavy manufacturing export industries are affected the most globally. The extraction sector faces the worst hit in MENA region where the DVA reduces by around USD 52 billion, while the highest loss to DVA in light manufacturing industry is around 21 billion and 43 billion in East Asian and EU_28, respectively. Further, the heavy manufacturing sector bears the highest output losses in North America and EU_28 and the similar trend is witnessed in case of FVA. Exporting sectors use inputs directly from exporting industries and indirectly from supporting industries. In case of export supporting industries, Covid-19 causes heavy losses to transport and communication sectors. Based on the simulation results, the present study suggests the following policy recommendations:

- There is a need of a timely and targeted fiscal stimulus in a coordinated way.
- Direct public resources to healthcare sector as well as to economic sectors.
- Extra liquidity is needed to target small and medium labor-intensive enterprises.
- Develop country specific short-term, medium-term and long-term initiatives for economic stimulus and market stability.

6 Limitations

- This research work employs a static CGE framework for the short-run analysis. However, a dynamic CGE framework can provide a better long-run analysis.
- The (sector and country/region) aggregation schemes offer a convenient way to discuss a global perspective; however, they are less useful for a country specific analysis.

Appendix: aggregation scheme

See Tables 1, 2, 3, 4, 5, 6, 7 and 8.

Table 1 Regional aggregation

S. no.	Code	Names	Description
1	Oceania	Australia, New Zealand	Australia, New Zealand, Rest of Oceania
2	EastAsia	East Asia	China, Hong Kong, Japan, Korea, Mongolia, Taiwan, Rest of East Asia, Brunei Darussalam
3	SEAsia	Southeast Asia	Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Singapore, Thailand, Viet Nam, Rest of Southeast Asia
4	BGD	Bangladesh	Bangladesh
5	IND	India	India
6	NPL	Nepal	Nepal
7	PAK	Pakistan	Pakistan
8	LKA	Sri Lanka	Sri Lanka
9	XSA	Rest of South Asia	Rest of South Asia
10	NAmerica	North America	Canada, USA, Mexico, Rest of North America
11	LatinAmer	Latin America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Rest of South America, Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Rest of Central America, Dominican Republic, Jamaica, Puerto Rico, Trinidad and Tobago, Rest of Caribbean
12	EU_28	European Union	Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, UK, Bulgaria, Croatia, Romania
13	MENA	Middle East and North Africa	Bahrain, Iran, Israel, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Turkey, United Arab Emirates, Rest of Western Asia, Egypt, Morocco, Tunisia, Rest of North Africa,
14	SSA	Sub-Saharan Africa	Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Nigeria, Senegal, Togo, Rest of Western Africa, Rest of Central Africa, Central Africa, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Tanzania, Uganda, Zambia, Zimbabwe, Rest of Eastern Africa. Botswana, Namibia, South Africa, Rest of South African Customs Union
15	ROW	Rest of World	Switzerland, Norway, Rest of European Free Trade Association, Albania, Belarus, Russian Federation, Ukraine, Rest of Eastern Europe, Rest of Europe, Kazakhstan, Kyrgyzstan, Rest of Former Soviet Union, Armenia, Azerbaijan, Georgia, Rest of the World

Table 2 Sectoral aggregation

S. no.	Code	Names	Description
1	GrainsCrops	Grains and crops	Paddy rice, wheat, cereal grains nec, vegetables, fruit, nuts, oil seeds, sugar cane, sugar beet, plant-based fibers, crops nec, processed rice
2	MeatLstk	Livestock and meat products	Bovine cattle, sheep and goats, horses, animal products nec, Raw milk, wool, silkworm, cocoons, bovine meat products, meat products nec
3	Extraction	Mining and extraction	Forestry, fishing, coal, oil, gas, minerals nec
4	ProcFood	Processed food	Vegetable oils and fats, dairy products, sugar, food products nec, beverages and tobacco products
5	TextWapp	Textiles and clothing	Textiles, wearing apparel
6	LightMnfc	Light manufacturing	Leather products, wood products, paper products, publishing, metal products, motor vehicles and parts, transport equipment nec, manufactures nec
7	HeavyMnfc	Heavy manufacturing	Petroleum, coal products, chemical, rubber, plastic products, mineral products nec, ferrous metals, metals nec, electronic equipment, machinery and equipment nec
8	Util_Con	Utilities and construction	Electricity, gas manufacture, distribution, water, construction
9	TransComm	Transport and communication	Trade, transport nec, water transport, air transport, communication
10	OthServices	Other services	Financial services nec, insurance, business services nec, recreational and other services, public administration, defense, education, health, dwellings

Table 3 Change in domestic value-added (DVA) in gross trade (USD million) (a positive value indicates losses, whereas a negative value indicates gains)

	Oceania	East Asia	SEAsia	Bgd	Ind	Npl	Pak	Sri
GrainsCrops	473	-303	416	5	732	-15	48	92
MeatLstk	1118	-8	78	0	301	-1	9	1
Extraction	7830	223	1237	1	359	-4	1	13
ProcFood	1252	865	2438	28	761	-3	64	70
TextWapp	136	6983	1525	1174	2096	-24	1024	182
LightMnfc	1181	21,354	3013	39	3023	-8	153	37
HeavyMnfc	4600	43,287	12,066	25	4681	-3	179	83
Util_Cons	92	1150	260	2	52	-4	5	2
TransComm	2042	7561	3486	19	1051	-8	113	82
OthServices	2411	7063	3463	117	3832	-21	221	41
	Xsa	NAmerica	LatinAmer	EU_28	MENA	SSA	ROW	
GrainsCrops	3	3390	2330	685	278	501	644	
MeatLstk	1	984	1264	924	92	90	85	
Extraction	10	2592	9640	1425	51,992	14,034	21,266	
ProcFood	4	2129	4442	5432	719	592	1459	
TextWapp	1	1053	1259	4319	3218	275	432	
LightMnfc	2	18,962	3262	42,894	4367	1253	3486	
HeavyMnfc	15	53,331	13,140	87,595	23,148	4873	29,853	
Util_Cons	12	955	235	3096	924	161	1500	
TransComm	25	9499	3895	19,862	7062	1442	4993	
OthServices	24	25,658	4038	32,737	6749	1511	7118	

Own calculations

Table 4 Change in foreign value-added (FVA) in gross trade (USD million)

	Oceania	East Asia	SEAsia	Bgd	Ind	Npl	Pak	Sri
GrainsCrops	49	-5	71	2	92	0	13	10
MeatLstk	130	4	13	0	17	0	1	0
Extraction	639	43	183	0	43	0	0	1
ProcFood	167	199	635	13	116	0	7	11
TextWapp	26	1566	940	515	512	-13	295	107
LightMnfc	259	5366	1601	13	1206	-3	22	30
HeavyMnfc	1367	16,315	8464	11	3820	-6	71	81
Util_Cons	12	230	95	0	15	-1	2	0
TransComm	233	734	812	2	130	-2	13	10
OthServices	160	462	487	8	208	-3	21	2
	Xsa	NAmerica	LatinAmer	EU_28	MENA	SSA	ROW	
GrainsCrops	0	387	234	69	38	49	114	
MeatLstk	0	86	89	91	17	9	16	
Extraction	1	157	709	119	3631	1568	1873	
ProcFood	2	229	458	592	196	111	328	
TextWapp	1	190	226	691	946	65	191	
LightMnfc	1	2875	573	6697	1630	341	1110	
HeavyMnfc	15	12,258	2726	21,519	4736	1607	8850	
Util_Cons	2	84	27	385	226	36	246	
TransComm	3	628	288	1995	1032	236	673	
OthServices	3	1062	149	1634	543	164	653	

Own calculations

Table 5 Change in direct (DVA_dir) value-added in domestic value-added (USD million)

	Oceania	East Asia	SEAsia	Bgd	Ind	Npl	Pak	Sri
GrainsCrops	251	-249	319	1	506	-14	15	81
MeatLstk	568	-5	48	0	204	-1	5	1
Extraction	5291	114	970	0	282	-3	0	13
ProcFood	482	395	1295	11	254	-1	29	47
TextWapp	81	3468	1076	667	943	-12	213	126
LightMnfc	639	10,369	1819	15	1565	-3	30	26
HeavyMnfc	1911	25,835	7748	8	2451	-2	42	56
Util_Cons	48	520	145	2	31	-2	2	2
TransComm	1347	5433	2702	17	857	-6	98	71
OthServices	2091	5881	2997	88	3553	-16	153	34
	Xsa	NAmerica	LatinAmer	EU_28	MENA	SSA	ROW	
GrainsCrops	2	1421	1338	375	192	417	423	
MeatLstk	1	372	721	458	54	59	41	
Extraction	9	1874	6768	952	48,496	10,934	14,994	
ProcFood	3	979	1832	2681	358	261	662	
TextWapp	0	581	801	2560	1961	125	261	
LightMnfc	1	10,561	1811	23,417	2646	605	1900	
HeavyMnfc	8	28,858	6701	55,198	12,118	2280	12,745	
Util_Cons	7	557	150	1807	488	103	892	
TransComm	22	6713	2947	11,704	5322	1145	3869	
OthServices	21	22,033	3488	28,380	5817	1246	6024	

Own calculations

Table 6 Change in indirect value-added (DVA_indir) in domestic value-added (USD million)

	Oceania	East Asia	SEAsia	Bgd	Ind	Npl	Pak	Sri
GrainsCrops	130	850	554	78	486	-5	90	15
MeatLstk	170	667	109	4	120	-2	36	5
Extraction	995	773	1327	21	518	-1	23	4
ProcFood	88	695	171	8	26	0	37	1
TextWapp	33	556	91	0	26	-1	1	1
LightMnfc	451	2779	552	16	249	-1	16	3
HeavyMnfc	480	5296	836	18	531	-1	30	12
Util_Cons	798	1818	574	60	673	-1	35	20
TransComm	1913	11,009	3023	356	2294	-12	531	72
OthServices	3368	11,975	1627	42	1320	-5	432	12
	Xsa	NAmerica	LatinAmer	EU_28	MENA	SSA	ROW	
GrainsCrops	1	227	918	684	350	195	217	
MeatLstk	1	168	335	496	157	61	141	
Extraction	3	6510	2428	3351	8721	608	7953	
ProcFood	1	398	286	1336	162	86	215	
TextWapp	0	349	144	601	163	56	92	
LightMnfc	1	3015	1045	6587	756	388	1147	
HeavyMnfc	1	4025	1643	10,018	2867	577	1269	
Util_Cons	1	3720	1126	5659	1206	417	3499	
TransComm	8	12,709	4976	11,097	3619	3157	8512	
OthServices	6	13,484	4051	31,606	3097	2011	5977	

Own calculations

Table 7 Change in bilateral (DVA_blt) value-added in domestic value-added (USD million)

	Oceania	East Asia	SEAsia	Bgd	Ind	Npl	Pak	Sri
GrainsCrops	473	-303	416	5	732	-15	48	92
MeatLstk	1118	-8	78	0	301	-1	9	1
Extraction	7830	223	1237	1	359	-4	1	13
ProcFood	1252	865	2438	28	761	-3	64	70
TextWapp	136	6983	1525	1174	2096	-24	1024	182
LightMnfc	1181	21,354	3013	39	3023	-8	153	37
HeavyMnfc	4600	43,287	12,066	25	4681	-3	179	83
Util_Cons	92	1150	260	2	52	-4	5	2
TransComm	2042	7561	3486	19	1051	-8	113	82
OthServices	2411	7063	3463	117	3832	-21	221	41
	Xsa	NAmerica	LatinAmer	EU_28	MENA	SSA	ROW	
GrainsCrops	3	3390	2330	685	278	501	644	
MeatLstk	1	984	1264	924	92	90	85	
Extraction	10	2592	9640	1425	51,992	14,034	21,266	
ProcFood	4	2129	4442	5432	719	592	1459	
TextWapp	1	1053	1259	4319	3218	275	432	
LightMnfc	2	18,962	3262	42,894	4367	1253	3486	
HeavyMnfc	15	53,331	13,140	87,595	23,148	4873	29,853	
Util_Cons	12	955	235	3096	924	161	1500	
TransComm	25	9499	3895	19,862	7062	1442	4993	
OthServices	24	25,658	4038	32,737	6749	1511	7118	

Own calculations

Table 8 Change in multilateral value-added (DVA_mlt) in domestic value-added (USD million)

	Oceania	East Asia	SEAsia	Bgd	Ind	Npl	Pak	Sri
GrainsCrops	71	146	120	8	146	-2	17	11
MeatLstk	86	99	19	0	37	0	5	0
Extraction	1950	229	599	2	177	-1	4	4
ProcFood	56	141	100	1	21	0	6	4
TextWapp	22	623	134	56	130	-1	30	11
LightMnfc	181	1401	285	3	204	-1	6	3
HeavyMnfc	556	5007	1563	3	559	-1	12	12
Util_Cons	195	328	106	6	110	0	5	3
TransComm	578	3137	1073	35	541	-2	85	17
OthServices	996	2428	575	13	521	-2	76	5
	Xsa	NAmerica	LatinAmer	EU_28	MENA	SSA	ROW	
GrainsCrops	1	211	304	89	76	106	76	
MeatLstk	0	53	94	71	20	16	20	
Extraction	3	1439	2302	606	15,679	3346	5051	
ProcFood	0	109	158	263	44	33	73	
TextWapp	0	103	66	282	165	23	37	
LightMnfc	0	1439	368	2483	386	153	394	
HeavyMnfc	1	5169	1404	8544	2863	635	2484	
Util_Cons	1	547	207	752	251	109	696	
TransComm	5	2538	1203	2974	1356	846	2307	
OthServices	3	3806	1036	5699	1060	613	1659	

Own calculations

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