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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Evaluation of Economic Impacts from Flood Damages Using Hybrid Input-Output Analysis" *by* Cholapat Jongdeepaisal et al.

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(1) Equation 2 is incomplete. What is needed is the specification of the full IO table with the two virtual industries (garbage cleaning and reconstruction), which is only partially done in Table 2. In Section 4 and Table 2 it is explained rightly that garbage cleaning inter alia needs manpower, which is taken from the manpower row of existing industries. Amongst others, this is absent in (2).

REPLY: I will add the hybrid I-O table which includes garbage cleaning services and manpower sector.

(2) The cut-off method for resources described on p.3 is too rude. Equation 3 implies that structure of the use of resources from the rest of the economy by the new industry Cu is equal to the structure of the aggregate use of those resources in the rest of the economy Mi, where i is a summation vector with ones. This a highly unrealistic assumption because the new virtual industries take care of garbage cleaning and reconstruction, which both have cost structures that will be quite different from the cost structure of the rest of the Kochi economy that is dominated by services. In fact, Section 3, describing the details of the procedure for garbage cleaning and reconstruction activities, is contradictory to (3), but more realistic. The cut-off method for products also described on p.3 is imprecise and not convincing.

REPLY: We made an assumption that all industries will try to minimize the stress of each industry or the focal damage on one industry sector so they will simultaneously adjust the damage share among industries. There is no certain way to obtain the real damage data for each industry. Furthermore, the data is based on each scenario. For example, even though there are two flood scenarios in the same province but the locations of bank break are different. The characteristic of the flood damage will be different. Therefore, we made this assumption to forecast the prior outcome of each scenario.

(3) Equation 4 that should describe the structure of Cd is lacking. The most plausible solution would be to assume that the new industries do not deliver intermediate products (i.e. Cd is zero), but only deliver final products to fP, which goes at the cost of the final demand for products from the rest of the economy fM. As a consequence of the inconsistency of equation 5 (see Major details) Table 3 delivers nonsense.

REPLY: Cd is not lacking. The garbage cleaning service delivers their products to agriculture, public works and final demand.

(4) Equation 5 can only be used to establish the overall total of z12 (i.e. a small case as it is not a matrix, but a column). Instead of Table 3, the structure of the inputs to the

manpower sector should resemble the structure of the household consumption part of the final demand column (see Oosterhaven, Rethinking IO Analysis, Springer 2019, ch. 4). The procedure that describes from which sectors the manpower of garbage cleaning is taken should be specified independently. It is not related with the structure of household consumption demand.

REPLY: Z21 and Z22 are shifted from the value-added row for manpower sector row. The equation 5 shows how we constructs the manpower column Z12 and Z22. When the conventional I-O table is constructed, the summation of inter-industry row and column is equal as well as the summation of value-added and final demand. What is the meaning behind this? The money that is use for satisfying the final demand actually come from the value-added. Likewise, the manpower row is taken from the value-added and the manpower column is based on equation 4 and 5. Lastly, we put on the table 3 to give an example of how the manpower column, however you can see it clearly since the whole hybrid I-O table will be added to the appendix. Major details:

âAËŸ c P.1-2 & p.12-14. This article does not mention the direct los of output ′ of industries that have to partially or entirely close down due to the simulated flood nor does it mention the indirect impacts of these close down in the rest of the economy nor does it mention the cost in the rest of the economy of raising the money for the cleaning and reconstruction activities.

REPLY: Loss of opportunity or opportunity cost is not included in this analysis. It is our next step to implement the method since the opportunity cost requires more data and some methodologies to identify it.

The article, consequently, presents a far too optimistic view of the effects of the simulated flood for Kochi. If the authors believe their own results, they should advocate to have regular floods in Kochi. âAËŸ c P.7, l.12. The matrix ′ dimensions of equation 4 and 5 are inconsistent. In (4), first row, unity columns should be added behind the Z-matrices. In (4), second row, unity rows should be added in front of the Z-matrices.

Consequently, (5) is inconsistent at the matrix level. It is only correct for the overall matrix totals. âAËŸ c P.3, l.7 & elsewhere.

REPLY: It is certain that if your house, barn or car are damaged by flood, you need to maintain or fix it for your daily use. Some materials have to be purchased to ease the damage so the economy is benefited through an additional demand.

Write input coefficients instead of ′ technical coefficients, because you are dealing with an open economy in which: input coefficients = trade origin ratios * technical coefficients (see Oosterhaven, 2019, ch. 2). âAËŸ c P.8, l.17. As a consequence of the above misuse of the term technical, it ′ is incorrectly stated that input coefficients change only gradually due to technological advancement. In fact, they also change much faster due to spatial substitution. Not taking this into account leads to overestimation of the indirect damages of garbage cleaning in Section 4.3.

REPLY: I will change this term in accordance with the paper and add citation.

The authors might want to have a look at Oosterhaven and Többen (Spatial Econ An, 2017) for a solution to this problem. Minor details: âAËŸ c P.2, l.14. These costs are only part of the total impact. So, better ′ call them total direct impact. âAËŸ c P.3, l.5.

REPLY: I will change accordingly.

Write Miller and Blair, 2009. â ′ AËŸ c Figure ′ 2. The pre-process related to garbage cleaning, not to reconstruction. âAËŸ c The text ′ around Figure 2 fails to discuss how it differs from the quite comparable approaches of Hallegate and others (see also Koks et al, in Okuyama & Rose, Springer, 2019).

REPLY: I will add the full hybrid I-O table in the appendix.

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Hybrid I-O Table	Truck	Manpower	Garbage Cleaning	Agricultural	Livestock	Forestry	Fishery	Mining	Food and Beverage	Textile	Lumber, Wood Product and Furniture	Pulp, Paper and Paper Product	Print Plate Making and Book Binding	Chemical Product	Petroleum and Coal	Ceramic, Stone and Clay
Truck (hr)	-322,588		322,588													
Manpower (hr)		-57,545	57,545													
Garbage cleaning service (yen)				138												
Agricultural				2,995	946	19	0	0	12,694	99	0	322	2	0	1	27
Livestock				3,684	1,209	1	0	0	7,330	20	0	0	0	0	0	0
Forestry				24	0	2,535	9	1	43	0	6,144	0	2	0	0	0
Fishery				0	0	0	1,376	0	16,192	0	0	0	0	0	0	0
Mining				0	0	6	0	191	5	0	0	678	183	126	0	4,988
Food/Beverage				490	2,661	93	4,808	0	18,548	4	5	159	14	0	0	19
Textile				277	14	24	1,088	81	100	2,393	44	772	6	0	6	102
Lumber, Wood Product and Furniture				5	12	22	105	18	122	14	1,093	54	6	0	7	65
Pulp, Paper and Paper Product				3,561	261	32	83	0	1,459	144	144	19,475	160	0	45	456
Chemical Product				6,858	339	19	577	305	833	2,261	239	2,700	2,365	74	1,517	490
Petroleum and Coal				2,865	61	260	4,706	610	469	75	79	459	203	754	11	1,357
Plastic and Rubber				1,604	65	146	814	112	1,820	285	155	2,303	203	2	1,772	265
Ceramic, Stone and Clay				207	30	6	3	2	203	20	85	109	209	24	35	5,281
Iron, Steel and Non-Ferrous				15	0	0	18	10	157	5	42	32	209	0	29	596
Metal Product				96	6	12	102	182	755	43	122	77	113	0	14	262
General Machinery				0	0	0	0	7	0	0	33	0	0	0	3	58
Electrical Machinery				0	0	2	0	17	0	0	1	0	0	0	22	88
Information/Communication Equipment				0	17	1	1	0	0	0	0	0	0	0	0	0
Electronic Component				0	0	0	0	2	0	0	0	0	0	0	0	0
Transport Machinery				1	1	1	65	16	1	0	2	1	0	0	0	5
Precision Machinery				0	0	0	2,520	0	0	0	0	0	0	0	0	0
Other Manufacturing				56	11	15	408	87	962	214	426	935	81	3	109	541
Construction				1,289	61	39	111	104	145	79	28	794	78	20	53	814
Public Work				0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity, Gas and Heat				831	285	62	288	904	1,383	291	212	5,561	385	40	154	4,677
Water Supply				30	37	5	17	45	288	14	10	128	32	1	10	72
Waste Treatment				0	14	0	0	8	64	1	10	12	14	0	0	115
Trading				5,790	548	237	3,088	436	10,368	2,087	1,911	5,087	612	107	582	2,095
Financial and Insurance				378	89	106	493	791	448	266	202	414	161	4	19	506
Real Estate				73	109	9	46	79	237	59	41	124	55	4	26	176
Transportation	921			4,506	632	774	2,136	6,670	3,323	496	848	1,663	272	132	139	3,880
Telecommunication				207	69	36	362	260	517	129	95	315	83	9	38	327
Public Services				0	0	0	0	0	0	0	0	0	0	0	0	0
Education and Research				12	2	32	99	95	514	294	41	936	646	3	158	1,578
Medical and Healthcare				0	19	0	0	0	0	0	0	0	0	0	0	0
Other Public Services				0	4	0	1,514	76	79	29	13	50	59	2	3	79
Business Services				1,255	427	489	628	863	3,197	471	557	1,163	571	93	259	2,694
Personal Services				0	8	5	60	4	552	2	2	6	0	0	0	4
Office Supplies				21	12	30	65	48	64	19	8	38	8	1	1	51
Unknown				1,284	185	251	825	141	303	34	106	77	69	32	9	412
Manpower		460		6,158	2,584	4,632	10,963	5,031	22,463	5,389	3,699	7,055	1,548	232	1,199	10,773

Fig. 1.

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Iron, Steel and Non-Ferrous	Metal Product	General Machinery	Electrical Machinery	Information Communication Equipment	Electronic Component	Transport Machinery	Precision Machinery	Other Manufacturing	Construction	Public Work	Electricity, Gas and Heat	Water Supply	Waste Treatment	Trading	Financial and Insurance	Real Estate	Transportation
										691							
0	0	0	0	0	0	0	0	44	129	442	0	0	0	50	0	1	11
0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	9	2	10	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	268	0	0	0	0	0	0	0	0	1
6,190	0	0	4	4	0	0	0	23	261	804	2,990	0	0	0	0	0	0
0	0	0	0	0	0	0	0	7	0	10	0	0	0	54	0	0	57
25	9	7	34	27	179	29	113	419	626	221	17	10	41	2,738	324	5	404
16	10	4	19	22	40	8	256	101	10,981	337	61	20	60	806	489	127	183
7	16	4	26	201	85	40	3	1,759	767	0	0	2	16	2,354	319	19	188
122	121	26	126	347	523	81	417	1,190	911	464	23	178	345	4	4	9	62
714	27	8	53	58	87	8	52	83	622	8,036	476	170	304	1,159	108	186	28,316
44	33	149	1,088	1,137	980	231	509	1,199	2,117	2,306	0	508	226	2,867	578	202	683
349	43	66	99	54	744	38	101	217	8,794	14,452	8	55	12	86	2	24	9
6,933	3,073	1,196	4,222	1,833	1,405	765	7,402	824	5,461	5,729	37	10	0	5	0	0	13
132	531	186	1,091	303	433	223	1,012	192	18,007	7,435	55	17	3	969	19	113	222
18	12	1,154	1,431	97	58	103	653	1	1,119	711	0	56	0	2	0	0	8
14	5	47	5,472	4	91	13	20	0	7	24	0	2	0	2	0	0	10
0	0	35	161	244	2	4	68	1	46	8	0	1	1	363	2	0	6
0	10	188	157	4,898	9,765	584	71	46	86	9	0	0	0	10	5	0	1
0	6	162	532	172	689	1,049	771	48	2,007	1,073	1	1	1	269	37	24	73
0	0	0	27	0	0	0	7,937	0	0	0	0	0	0	0	0	0	2,827
712	16	10	67	78	195	43	52	1,488	523	573	263	43	98	3,755	4,064	11	350
1,184	68	31	130	70	120	24	58	99	290	180	2,402	1,116	141	2,911	903	15,042	2,140
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4,069	139	69	274	166	1,014	45	400	353	961	674	15,127	496	904	7,808	613	1,169	950
51	6	4	20	12	48	4	23	27	153	96	67	2,030	229	592	299	112	459
0	0	1	0	2	18	0	18	4	44	639	63	30	0	534	429	2	321
1,222	712	444	1,764	1,247	1,590	442	2,374	2,688	16,696	11,821	227	289	334	8,656	1,204	507	6,504
218	109	59	210	242	212	30	306	364	1,926	3,666	1,610	67	174	6,577	8,957	23,441	4,206
78	55	34	77	25	53	19	63	74	1,271	331	720	34	55	11,141	2,184	8,240	5,295
1,207	337	193	663	416	628	142	654	3,421	7,919	8,688	784	226	1,265	21,132	5,539	760	24,303
129	73	85	319	164	294	75	121	192	1,375	1,820	902	547	204	14,490	8,366	1,117	2,271
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1,125	94	223	1,444	1,758	3,022	439	596	1,008	253	503	753	4	5	1,935	144	0	300
0	0	0	0	0	0	0	0	0	0	0	0	5	0	9	24	2	55
20	10	12	39	17	26	2	22	29	180	514	408	791	45	784	1,703	370	216
2,084	248	538	1,251	522	1,592	265	715	1,204	15,891	27,655	9,626	1,653	1,133	21,194	14,341	5,152	29,471
4	0	0	1	2	7	1	2	3	38	77	8	4	1	599	40	218	74
9	3	11	28	32	19	7	17	52	79	407	7	10	70	930	681	91	353
179	24	112	299	41	31	21	208	50	2,632	2,242	150	136	26	3,057	878	1,780	1,148
3,792	2,429	2,518	8,202	3,240	3,106	1,024	4,999	6,976	63,578	68,102	12,212	2,162	10,240	181,109	61,074	18,298	53,516

Fig. 2.

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Telecom munication	Public Services	Education and Research	Medical and Healthcare	Other Public Services	Business Services	Personal Services	Office Supplies	Unknown	Manpower	Final demand	Total Production
										0	0
										0	0
										552	1,381
0	4	9	767	47	2	2,799	0	0	-17,004	82,252	86,658
0	0	78	116	0	0	769	0	0	5,077	-4,678	13,610
0	1	0	30	0	0	150	0	0	3,691	6,568	19,219
0	1	0	225	0	0	1,323	0	0	-7,029	39,589	51,946
0	1	3	0	0	0	-3	0	2	4,291	1,053	21,800
0	74	108	3,527	36	1	26,058	0	29	-26,413	92,743	123,092
104	1,621	60	1,638	1,676	330	897	105	17	6,735	-4,944	18,374
286	343	270	1,517	590	214	1,078	0	4	6,667	-7,030	19,002
2,145	95	522	1,266	147	455	723	2,735	48	-4,682	23,887	58,967
256	262	378	58,365	86	620	1,299	102	307	78,404	-152,789	10,820
154	2,513	753	1,768	219	508	1,997	0	782	59,639	-118,561	2,148
240	447	297	869	251	2,033	603	478	193	24,792	-47,554	7,052
1	59	295	308	17	263	284	35	185	734	22,000	55,548
14	40	4	610	8	148	98	6	461	14,555	-12,035	43,930
52	972	22	143	92	218	579	2	100	29,117	-54,667	9,357
1	57	0	0	0	1,018	2	0	0	1,544	273	8,419
0	3	0	0	0	1,677	2	0	0	-13,605	40,453	34,371
17	1,685	0	4,435	0	901	1,753	165	0	-4,278	13,396	19,035
107	362	66	2	0	1,957	2	187	0	-5,435	16,818	29,898
62	474	128	76	4	1,426	87	0	33	4,563	-7,163	6,698
0	1,760	10	0	0	12,259	4	0	0	2,330	3,336	33,010
2,994	3,283	2,446	2,056	1,691	1,528	1,780	897	40	15,414	-20,053	28,265
1,088	6,746	2,026	2,364	172	405	1,300	0	0	-57,549	194,142	181,218
0	0	0	0	0	0	0	0	0	-101,957	290,009	188,052
1,029	1,627	3,697	4,805	127	963	4,123	0	232	30,122	-26,105	70,924
379	776	1,470	2,612	83	122	2,342	0	78	4,272	-402	16,653
495	7,403	749	1,205	1	43	3,707	0	94	10,347	-5,857	20,530
1,803	3,274	2,019	24,961	1,584	4,336	22,630	1,486	364	36,284	210,888	401,298
748	10,750	170	2,586	1,738	1,690	1,797	0	115	23,589	73,002	172,436
2,249	312	663	8,570	749	1,186	3,276	0	933	-9,999	276,599	315,325
3,281	7,435	3,916	6,611	1,188	2,504	8,372	313	1,959	27,836	24,590	191,753
24,514	6,759	2,762	6,308	2,508	8,560	5,779	0	1,013	30,457	6,420	130,071
0	0	0	0	0	0	0	0	5,247	-67,994	323,311	260,564
2,295	34	426	1,881	0	407	144	0	922	-9,615	161,242	175,752
82	5	0	12,426	0	2	11	0	77	-167,494	600,057	445,280
227	1	121	1,347	0	356	2,920	0	48	-4,150	25,706	33,672
15,286	12,932	7,192	14,097	2,775	14,596	7,919	0	1,262	160,719	-232,478	151,502
1,670	168	169	10,103	116	230	4,018	0	72	-93,298	330,294	255,264
264	813	445	1,009	169	211	427	0	4	0	0	6,514
894	149	2,466	1,608	192	1,373	517	3	0	9,323	-9,329	23,938
26,095	94,253	120,285	215,915	16,091	53,686	82,063	0	882	0	0	1,197,573

Fig. 3.