

Supplementary Information

1
2
3 **Table S1. The consumption-based and production-based steel recycling performance versus GDP**
4 **per capita in 25 countries.**

Country	GDP per capita, PPP (current international \$)	Consumption-based recycled content	Recycling input rate
India	6183	10%	8%
Indonesia	10936	29%	37%
China	14244	22%	22%
Brazil	14525	29%	25%
Mexico	19721	46%	51%
Russia	25926	31%	31%
Greece	28605	49%	99%
Slovakia	30062	33%	20%
Poland	30065	40%	51%
Czech Republic	38825	24%	22%
Spain	39529	46%	66%
South Korea	40957	44%	36%
Japan	41505	42%	31%
Italy	41581	54%	70%
France	44577	36%	32%
United Kingdom	46372	27%	23%
Finland	47570	50%	37%
Canada	48317	45%	45%
Australia	48399	32%	32%
Belgium	50442	48%	39%
Sweden	51948	35%	34%
Germany	53071	37%	36%
Austria	54173	28%	20%
Netherlands	55089	27%	13%
United States	60110	50%	65%

7 **Table S2. The impact of international trade on steel recycling performance for 25 countries.**

Country	Consumption-based recycled content	Recycling input rate	Impact of international trade
Greece	49%	99%	-50%
Spain	46%	66%	-20%
Italy	54%	70%	-16%
United States	50%	65%	-14%
Poland	40%	51%	-11%
Indonesia	29%	37%	-8%
Mexico	46%	51%	-5%
Australia	32%	32%	0%
Russia	31%	31%	0%
Canada	45%	45%	0%
China	22%	22%	0%
Sweden	35%	34%	0%
Germany	37%	36%	1%
Czech Republic	24%	22%	2%
India	10%	8%	2%
France	36%	32%	3%
Brazil	29%	25%	4%
United Kingdom	27%	23%	5%
Austria	28%	20%	7%
South Korea	44%	36%	8%
Belgium	48%	39%	9%
Japan	42%	31%	11%
Finland	50%	37%	12%
Slovakia	33%	20%	13%
Netherlands	27%	13%	14%

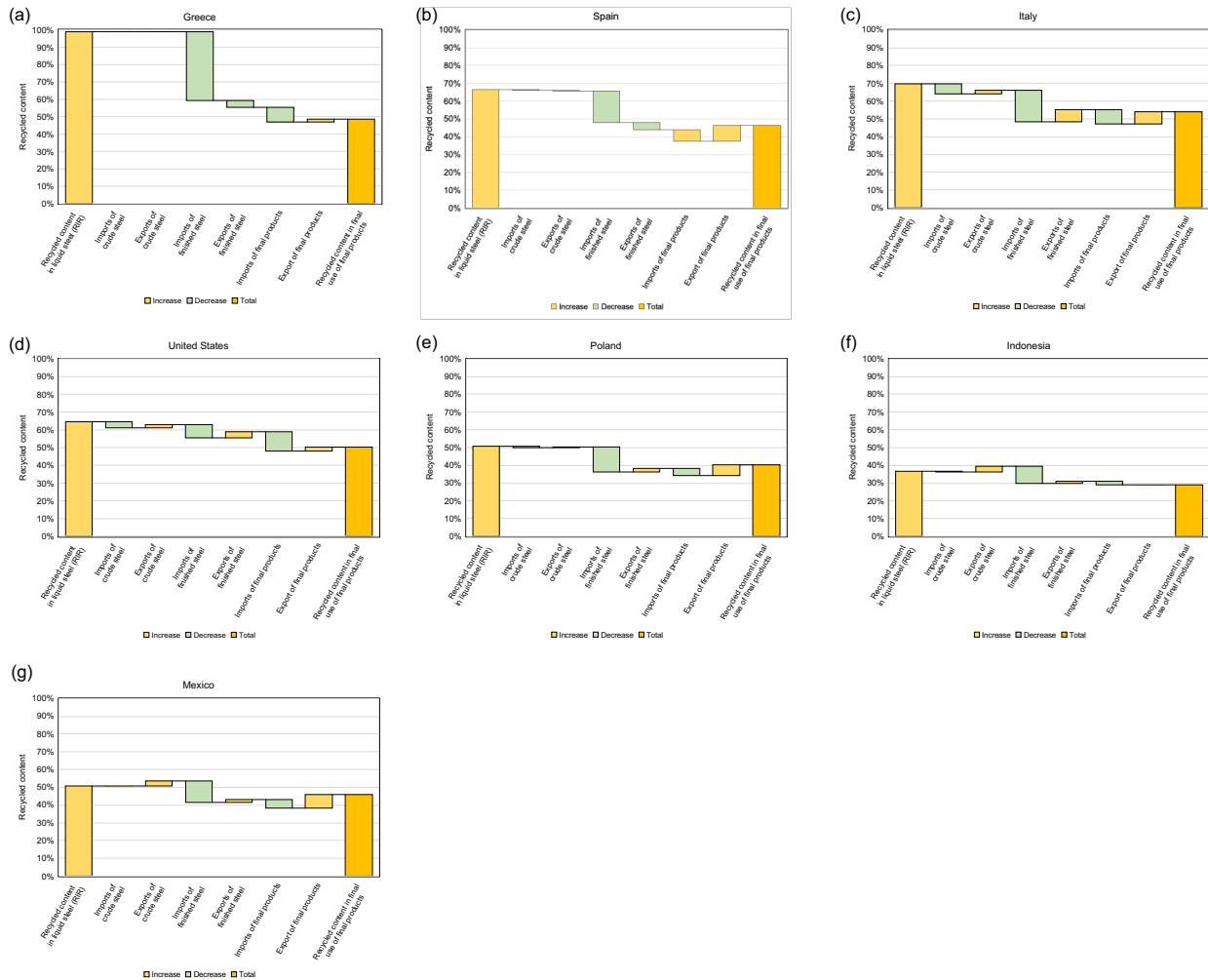
8

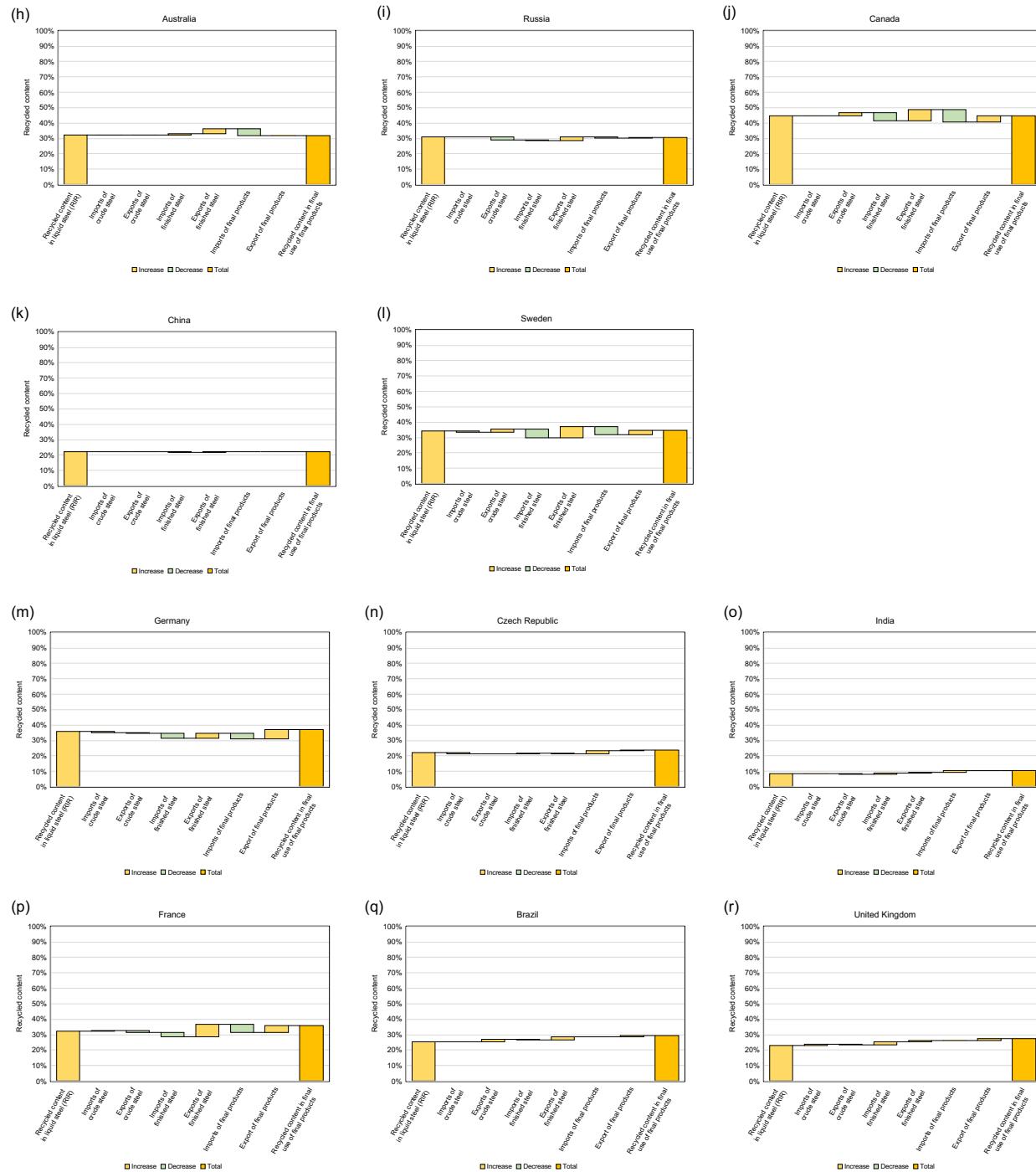
9

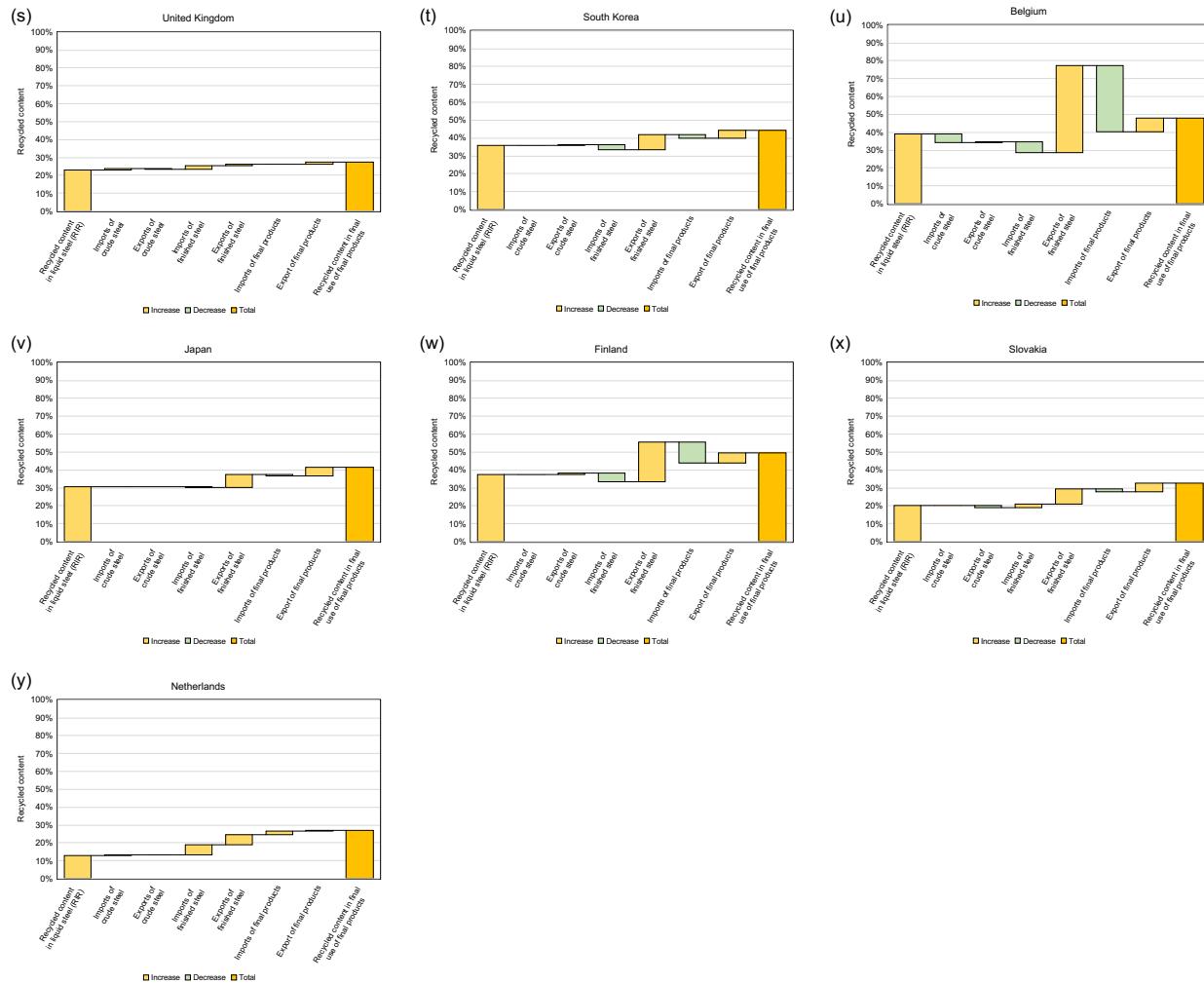
10

11

12







17

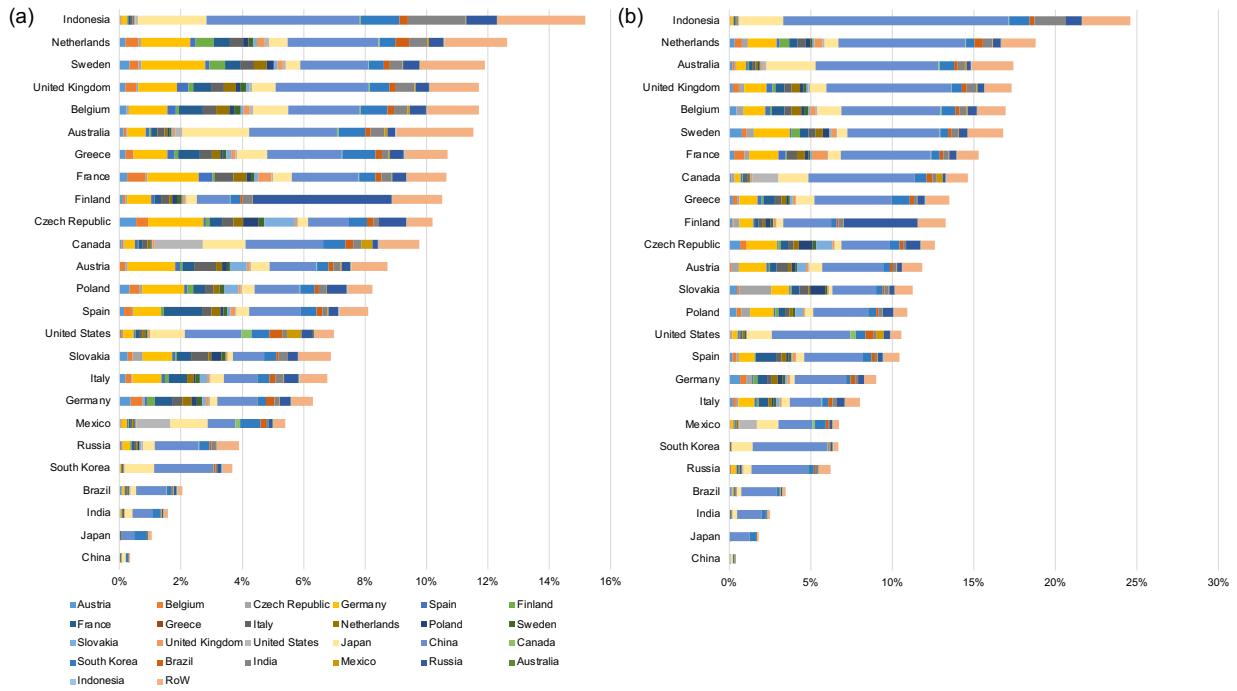
18 **Fig. S1. The impacts of international trades on recycled contents for 25 countries.**

19

20 **Table S3. The CB-RCs and impacts of factors on promotion of CB-RC for 25 countries**

Country	Consumption-based recycled content (CB-RC) under baseline scenario	CB-RC under hypothetical scenario 1	CB-RC under hypothetical scenario 2	CB-RC under hypothetical scenario 3	Impact of scrap unavailability and contaminations, $\Delta CB-RC1$	Impact of portfolio of steelmaking facilities, $\Delta CB-RC2$	Impact of demand for high-quality steel products, $\Delta CB-RC3$	Impact of international trade, $\Delta CB-RC4$
India	10%	58%	58%	93%	48%	0%	34%	7%

China	22%	37%	63%	98%	14%	26%	35%	2%
Brazil	29%	47%	62%	90%	18%	15%	28%	10%
Russia	31%	46%	46%	83%	16%	0%	36%	17%
Slovakia	33%	40%	40%	74%	8%	0%	34%	26%
Japan	42%	55%	63%	95%	13%	9%	32%	5%
South Korea	44%	58%	58%	83%	13%	0%	25%	17%
Czech Republic	24%	28%	50%	53%	4%	22%	2%	47%
Netherlands	27%	32%	36%	50%	5%	5%	14%	50%
United Kingdom	27%	34%	38%	49%	6%	5%	11%	51%
Austria	28%	35%	43%	63%	7%	8%	20%	37%
Indonesia	29%	34%	34%	41%	5%	0%	6%	59%
Australia	32%	36%	40%	54%	5%	3%	14%	46%
Sweden	35%	41%	41%	51%	7%	0%	9%	49%
France	36%	43%	43%	55%	7%	0%	12%	45%
Germany	37%	46%	47%	71%	9%	1%	23%	29%
Poland	40%	45%	52%	61%	5%	7%	9%	39%
Canada	45%	53%	53%	62%	8%	0%	9%	38%
Mexico	46%	70%	70%	75%	24%	0%	6%	25%
Spain	46%	51%	51%	62%	5%	0%	10%	38%
Belgium	48%	50%	50%	52%	2%	0%	2%	48%
Greece	49%	49%	49%	49%	0%	0%	0%	51%
Finland	50%	55%	55%	56%	5%	0%	2%	44%
United States	50%	58%	58%	69%	8%	0%	11%	31%
Italy	54%	65%	65%	67%	11%	0%	2%	33%



22

23 **Fig. S2. The potential promotions of steel recycling performance caused by national steel recycling**
 24 **promotion strategies in upstream countries. (a) Effects of maximizing scrap input by steelmaking furnace**
 25 **type in upstream countries. (b) Effects of maximizing the capacity of EAFs to produce all long steel**
 26 **products alongside maximum scrap input in upstream countries.**

27

28 **Table S4. Descriptions for 47 states.**

Layer code	Layer	State code	State	Description in MRMF table of iron and steel
1	Natural resource (N)	1	Iron ore	Form of iron and steel
2	Raw material (M)	2	Pig iron	Form of iron and steel
2	Raw material (M)	3	Direct reduction iron (DRI)	Form of iron and steel
2	Raw material (M)	4	Steel scrap	Form of iron and steel
3	Liquid steel (D)	5	BOF liquid steel	Form of iron and steel
3	Liquid steel (D)	6	OHF liquid steel	Form of iron and steel
3	Liquid steel (D)	7	EAF liquid steel	Form of iron and steel

4	Crude steel (C)	8	Slabs	Form of iron and steel
4	Crude steel (C)	9	Billets	Form of iron and steel
4	Crude steel (C)	10	Blooms	Form of iron and steel
4	Crude steel (C)	11	Ingots	Form of iron and steel
5	Finished steel (F)	12	Hot rolled coil-sheet-strip	Form of iron and steel
5	Finished steel (F)	13	Welded tubes	Form of iron and steel
5	Finished steel (F)	14	Electrical sheet and strip	Form of iron and steel
5	Finished steel (F)	15	Tinmill products	Form of iron and steel
5	Finished steel (F)	16	Other metal coated sheet and strip	Form of iron and steel
5	Finished steel (F)	17	Other non-metal coated sheet and strip	Form of iron and steel
5	Finished steel (F)	18	Hot rolled plate	Form of iron and steel
5	Finished steel (F)	19	Seamless tubes	Form of iron and steel
5	Finished steel (F)	20	Heavy sections	Form of iron and steel
5	Finished steel (F)	21	Railway track material	Form of iron and steel
5	Finished steel (F)	22	Light sections	Form of iron and steel
5	Finished steel (F)	23	Concrete reinforcing bars	Form of iron and steel
5	Finished steel (F)	24	Hot rolled bars other than concrete reinforcing bars	Form of iron and steel
5	Finished steel (F)	25	Wire rod	Form of iron and steel
5	Finished steel (F)	26	Forgings	Form of iron and steel
5	Finished steel (F)	27	Castings	Form of iron and steel
6	Final steel product (P)	28	Fabricated metal products, except machinery and equipment	Form of iron and steel

6	Final steel product (P)	29	Machinery and equipment	Form of iron and steel
6	Final steel product (P)	30	Office machinery and computers	Form of iron and steel
6	Final steel product (P)	31	Electrical machinery and apparatus	Form of iron and steel
6	Final steel product (P)	32	Radio, television and communication equipment and apparatus	Form of iron and steel
6	Final steel product (P)	33	Medical, precision and optical instruments, watches and clocks	Form of iron and steel
6	Final steel product (P)	34	Motor vehicles, trailers and semi-trailers	Form of iron and steel
6	Final steel product (P)	35	Other transport equipment	Form of iron and steel
6	Final steel product (P)	36	Furniture; other manufactured goods	Form of iron and steel
6	Final steel product (P)	37	Construction work	Form of iron and steel
7	Final use of final product (U)	38	Final use of fabricated metal products, except machinery and equipment	Item of boundary output
7	Final use of final product (U)	39	Final use of machinery and equipment	Item of boundary output
7	Final use of final product (U)	40	Final use of office machinery and computers	Item of boundary output
7	Final use of final product (U)	41	Final use of electrical machinery and apparatus	Item of boundary output
7	Final use of final product (U)	42	Final use of radio, television and communication equipment and apparatus	Item of boundary output
7	Final use of final product (U)	43	Final use of medical, precision and optical instruments, watches and clocks	Item of boundary output
7	Final use of final product (U)	44	Final use of motor vehicles, trailers and semi-trailers	Item of boundary output

7	Final use of final product (U)	45	Final use of other transport equipment	Item of boundary output
7	Final use of final product (U)	46	Final use of furniture; other manufactured goods	Item of boundary output
7	Final use of final product (U)	47	Final use of construction work	Item of boundary output

29

30 **Table S5. The name and code for each economy.**

Code	Economy
1	Austria
2	Belgium
3	Czech Republic
4	Germany
5	Spain
6	Finland
7	France
8	Greece
9	Italy
10	Netherlands
11	Poland
12	Sweden
13	Slovakia
14	United Kingdom
15	United States
16	Japan
17	China
18	Canada
19	South Korea
20	Brazil
21	India
22	Mexico
23	Russia
24	Australia
25	Indonesia
26	Taiwan, China
27	Rest of world

31

32