Estimation of Global Iron and Steel Cycle

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1 . Background

➢Decoupling of “Energy consumption” and “Material consumption” is essential to realize Low Carbon Society.

➢ Especially, it is important to introduce countermeasures for use of energy intensive law materials such as steel and cement.

➢We need to know the relationship between economic activities and material use.

➢But we don’t grasp the whole material flow; a domestic flow and global flow.

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Due to a lack of data: physical and monetary data

Estimation of global iron and steel flow is required.

2. Objective and Description

Objective : Estimation of Iron and Steel Flow Between

1) Economic sectors [economic activities]
2) Regions [international trade]
3) Environment and economic activities
[extraction and discharge]

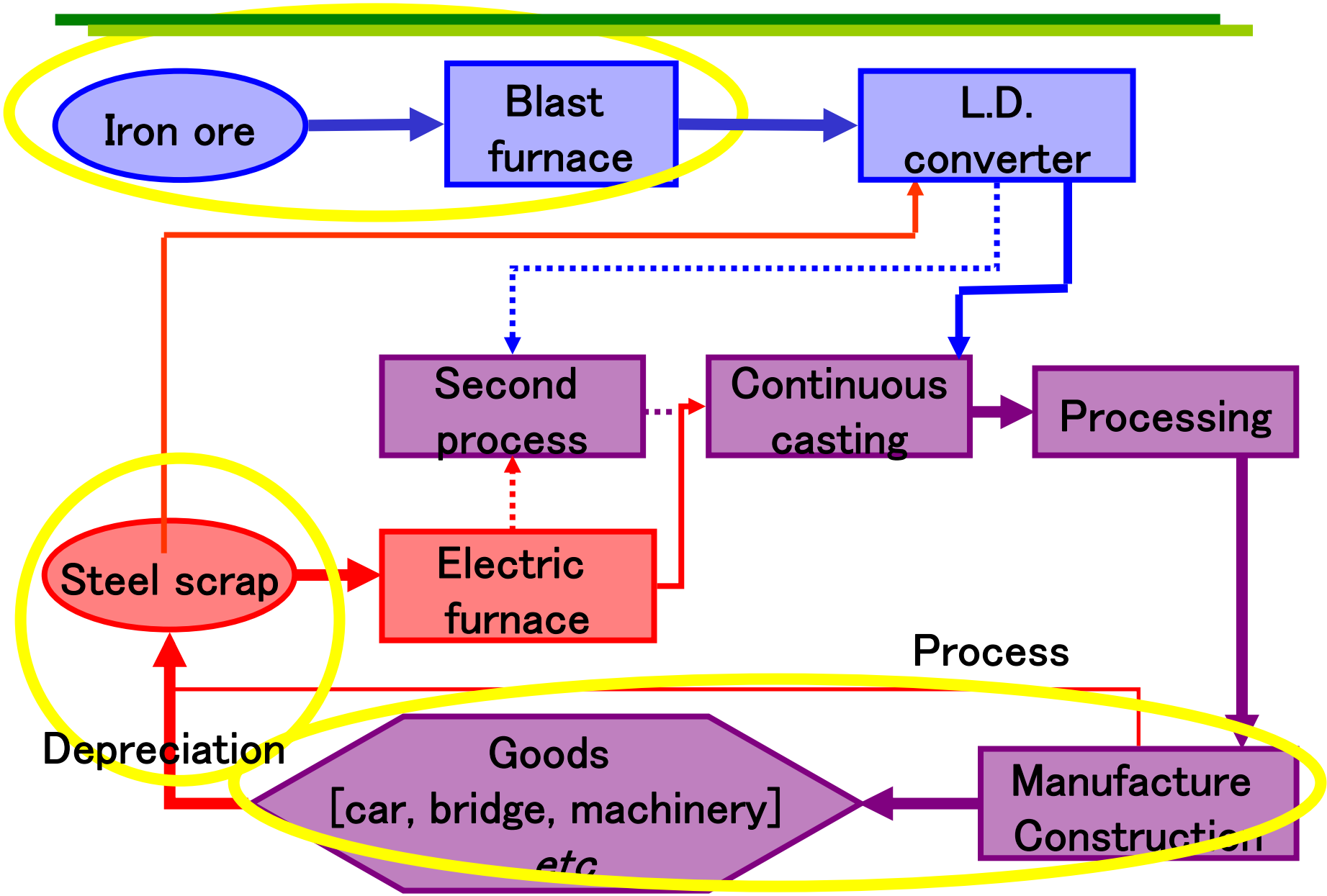
Point :

1) Satisfy with material balance
2) Estimate the flow which cannot be obtained from statistics directly
3) Consistency with a lot of statistics

Base year : 2001

Target area : World ---67 regions
[based on GTAP regional disaggregation]

3. Iron and Steel Flow



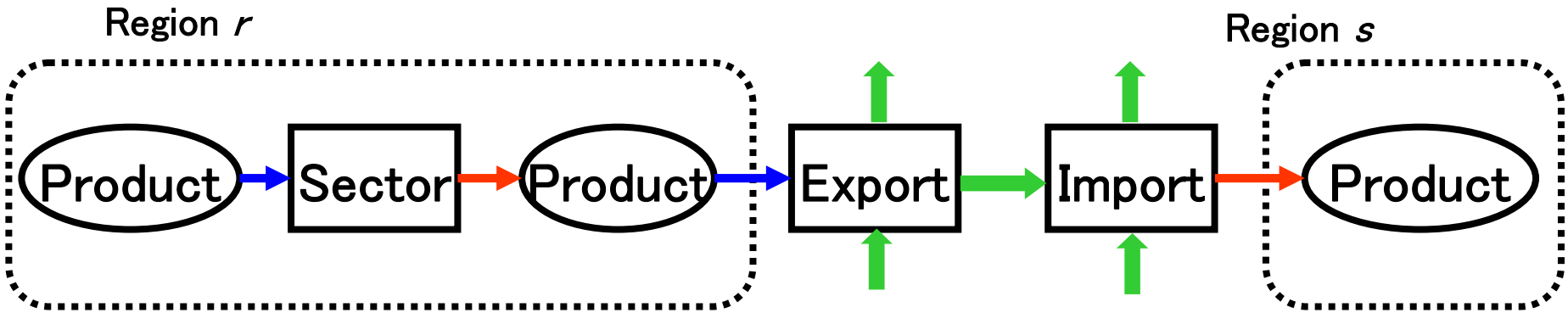
4. Global Iron and Steel Accounting Table

Global Iron and Steel Accounting Table

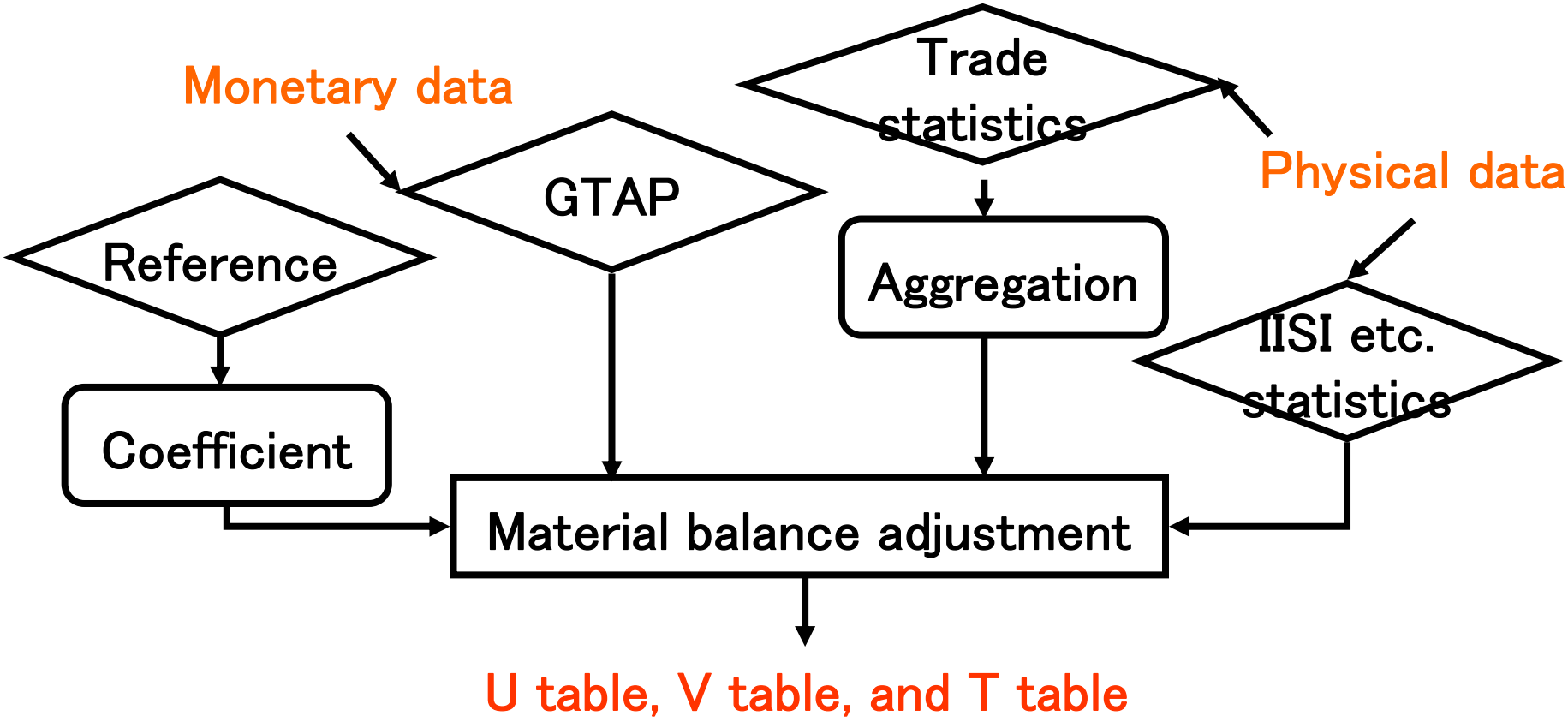
Material input table (U table)

Material output table (V table)

Material trade table (T table)

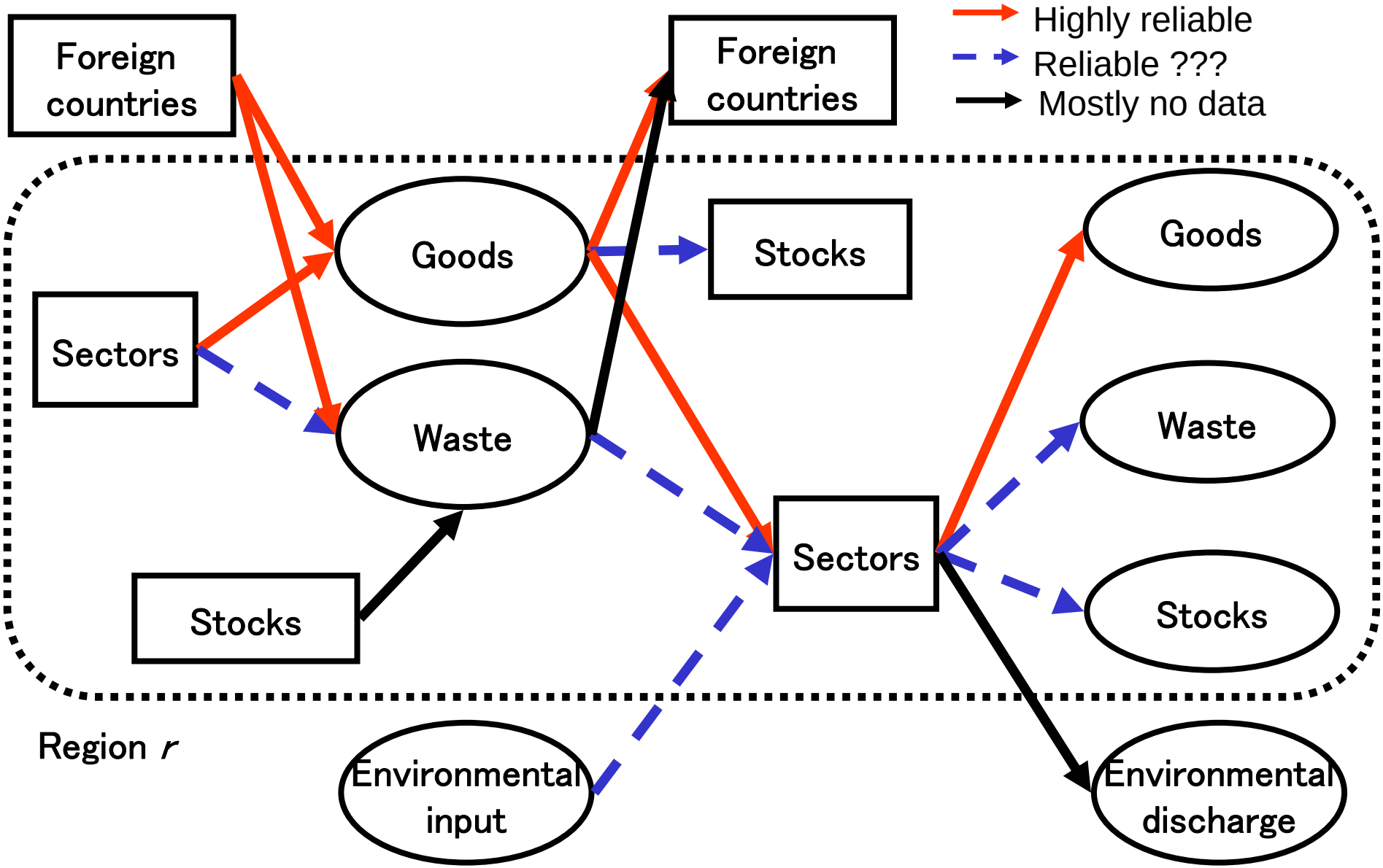


5. Estimation method



By using iron physical data issued by international organizations and monetary data of GTAP, the material balance adjustment calculation is conducted.

6. Material balance adjustment calculation



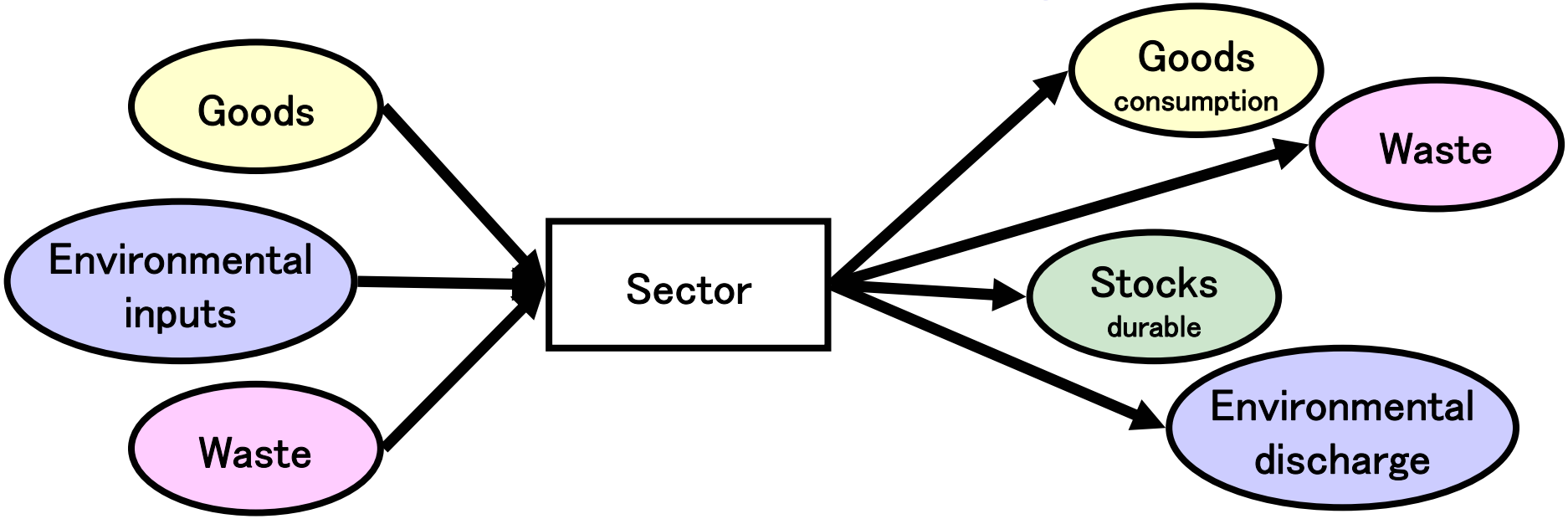
7. Material balance of Sectors

$$\sum_i M\_VAFM_{i,j,r} + \sum_n M\_ENVI_{n,j,r} + \sum_k M\_TWST_{k,j,r}$$

Goods　　Environmental inputs　　Waste

$$= \sum_i M\_VOM_{i,j,r} + \sum_k M\_GWST_{k,j,r} + \sum_l M\_ENVO_{l,j,r} + \sum_p M\_STKF_{p,j,r}$$

Goods　　Waste　　Environmental discharge　　Stocks



8. Material balance

<Goods>

$$\sum_j M\_VOM_{i,j,r} + M\_VIMS_{i,r}$$

Input from sectors

Import

$$= \sum_j M\_VAFM_{i,j,r} + M\_VXMD_{i,r} + M\_STKC_{i,r}$$

Input to sectors

Export

To stocks

<Waste>

$$\sum_s M\_SCRIMP_{r,s} + \sum_j ISS_{j,r} + M\_STKC\_IN_r$$

Import

Input from sectors

From stocks

$$= M\_SCR\_IN_r + \sum_s M\_SCREXP_{r,s}$$

Input to sectors

Export

9. Formulation

➢Use of physical data

$$\text{Production} = \boxed{\text{Physical statistics}} \times (1 + \boxed{\text{Error}})$$

➢Use of monetary data

$$\text{Production} = \boxed{\text{Output (GTAP)}} \times (d\_out,i)$$

$$\text{Other flows} = \boxed{\text{Transaction (GTAP)}} \times (d\_other\ k,i)$$

Material density
[Mt/$]

Intermediate, Import, Export

$$\sum_k (d\_out,i - d\_other\ k,i) = \boxed{\text{Difference of material density}}$$

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Minimize

10.Results(U table)

2001:world

Goods \ Sector		Sector											Final demand			Ex	TOT
		MIN	Steel	Metal products	CAR	TNS eq	ELE eq	Machine	OTH eq	Construction	Waste	OTH	HUS	GOV	CAP		
Goods	MIN		556													317	873
	Steel		402	216	80	33	27	189	17	163		100				233	1461
	Metal products		4	19	13	5	7	24	4	51	4	42	15	1	18	28	233
	CAR				19			1			1	8	18		20	18	86
	TNS eq				1	5		1			2	7	3	1	10	7	36
	ELE eq				1		6	1		1		4	3		6	8	31
	Machine		1	1	4	2	8	31	1	11	5	22	12	3	61	55	215
	OTH eq								1	1	1	3	5		2	3	18
	Construction									3	4	10	1	1	120		139
Waste	Scrap		82														82
Env. discharge																	
Env. Inputs		556															556
Stock			218														218
Total		556	1263	236	118	45	49	246	24	230	16	197	57	6	235	669	3948

Electric furnace

Civil engineering
Building, Housing

Depreciation

(Mt)

11. Results (T table)

2001:world

		Import regions								Export total	Net import
		Oceania	Asia	North America	Middle South America	Europe	F.S.U	Middle East	Africa		
Export regions	Oceania	9	90	0	0	11	0	0	0	111	−95
	Asia	4	82	15	2	15	2	5	5	130	153
	N. America	1	12	27	4	14	0	1	1	61	3
	M. S. America	0	48	12	18	40	2	4	3	128	−100
	Europe	1	16	8	4	137	5	5	4	180	82
	F.S.U	0	18	1	0	30	23	14	3	89	−56
	Middle East	0	4	0	0	1	1	4	0	11	23
	Africa	0	13	1	0	13	0	0	2	30	−11
Import total		16	283	64	28	262	33	34	19	740	

(Mt)

With a change of world steel demand, the world iron and steel flow will change; not only goods but also iron scrap.

12.Validation

Import of iron scrap

Country	Estimation	IISI	Difference (%)
China	9,562	9,787	−2
Turkey	5,090	9,850	−48
Spain	6,098	6,291	−3
S Korea	6,731	6,069	11
Belgium	2,709	5,604	−52
Italy	4,393	4,349	1
Malysia	3,064	3,804	−19
Germany	3,780	3,560	6
France	2,908	2,977	−2
America	2,743	2,630	4
Mexico	1,559	1,547	1
Indonesia	1,439	1,438	0
Netherlands	1,296	1,307	−1
India	2,851	1,100	159
Canada	1,097	1,097	0
Total	70,731	69,879	1

1000 ton

Export of iron scrap

Country	Estimation	IISI	Difference (%)
FSU	14,884	10,599	40
America	8,242	7,444	11
Germany	8,302	6,599	26
Japan	5,699	6,151	−7
U.K.	5,131	4,817	7
France	4,812	4,329	11
Netherlands	3,768	3,213	17
Belgium	1,348	1,952	−31
Canada	1,827	1,933	−5
Australia	1,191	1,034	15
Total	70,731	54,206	30

1000 ton

IISI: International Iron and Steel Institute

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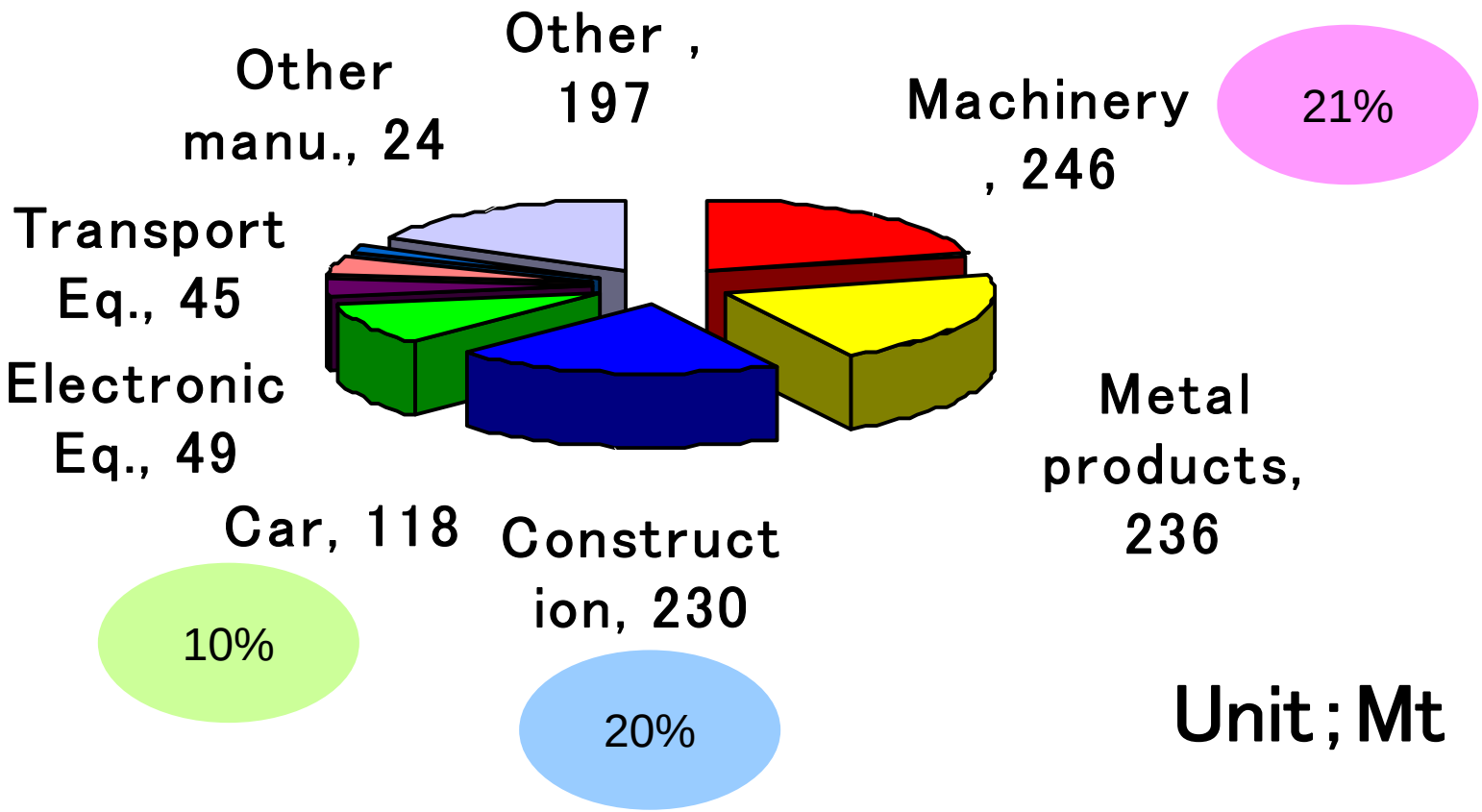
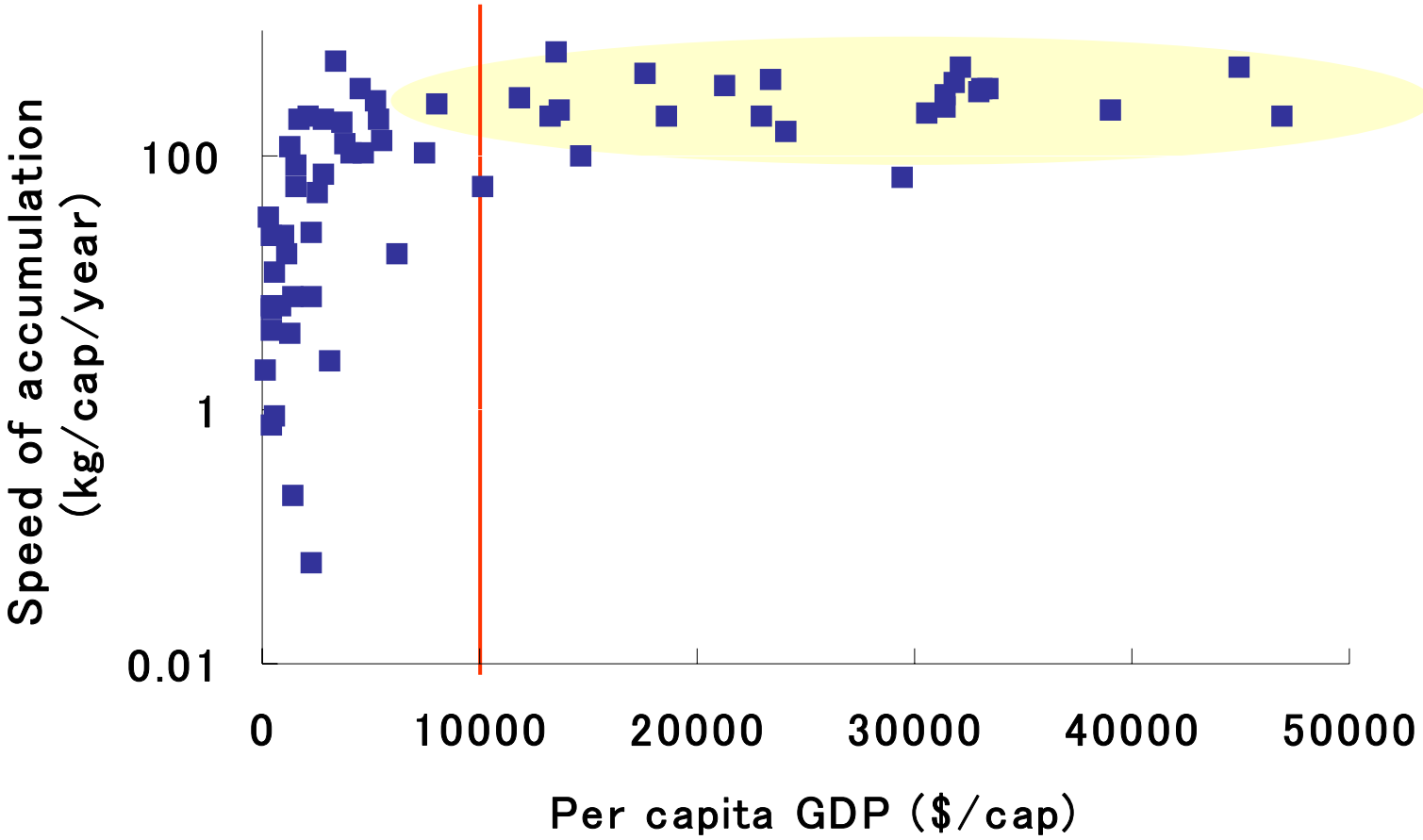
UN Publication statistics

13. Sector-wise steel inputs



Steel is mainly input to production sectors of durable goods.

14. Speed of accumulation



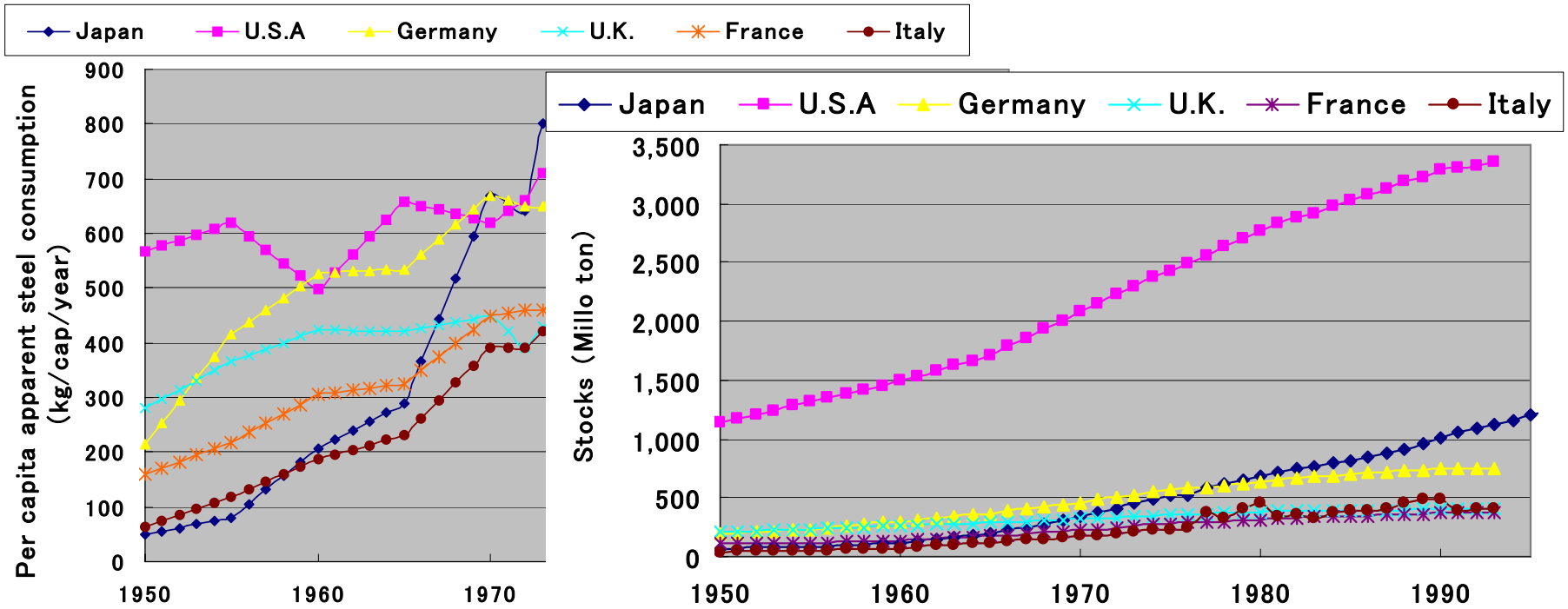
The speed of accumulation becomes peak around 10,000 $ of per capita GDP.

15. Future task

<Last year>

One country Material Stock and Flow Model (MSFM) ;

which analyzes the mechanism of changes in material stocks and flow, and the effect of recycling materials in the future society, and looks for the measures towards the LCS in connection with material consumption.



16. Future task

(1) Expand “Global Iron and Steel Accounting Table” to the past periods.

(2) By combining MSFM, estimate iron and steel demand, detailed consumption and stocks based on trend of the past iron and steel consumption.

(3) Estimate environmental loads derived from future iron and steel demand and generation of iron scrap from “Stocks”.

(4) Apply Global Material Accounting Table and MSFM to other materials ; aluminum, cement,,,,etc

Thank you