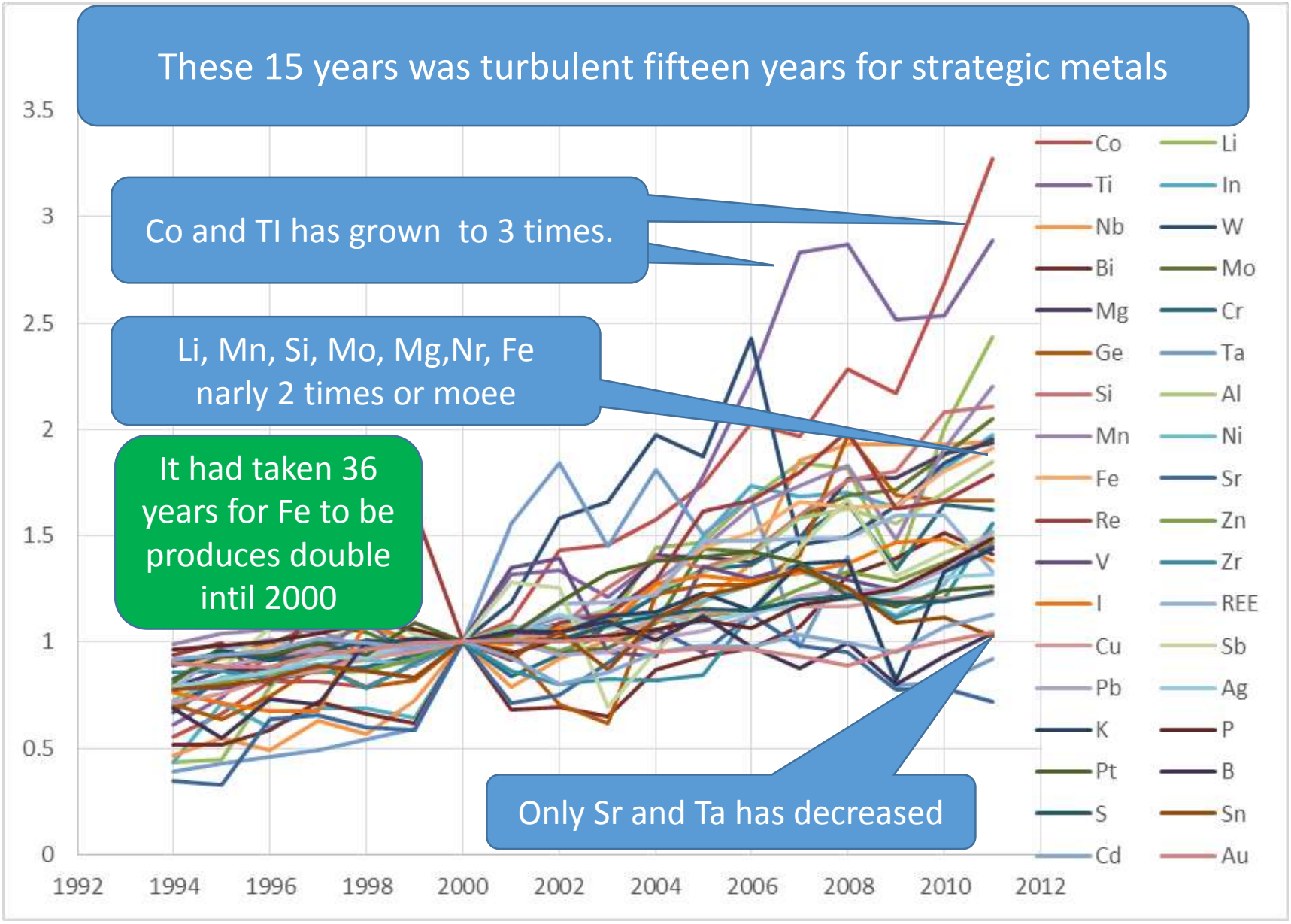
Historic Move of Current Global Flow of Strategic Metals

Kohmei HALADA

iron
Base metals
Precious metals
Important minor metals

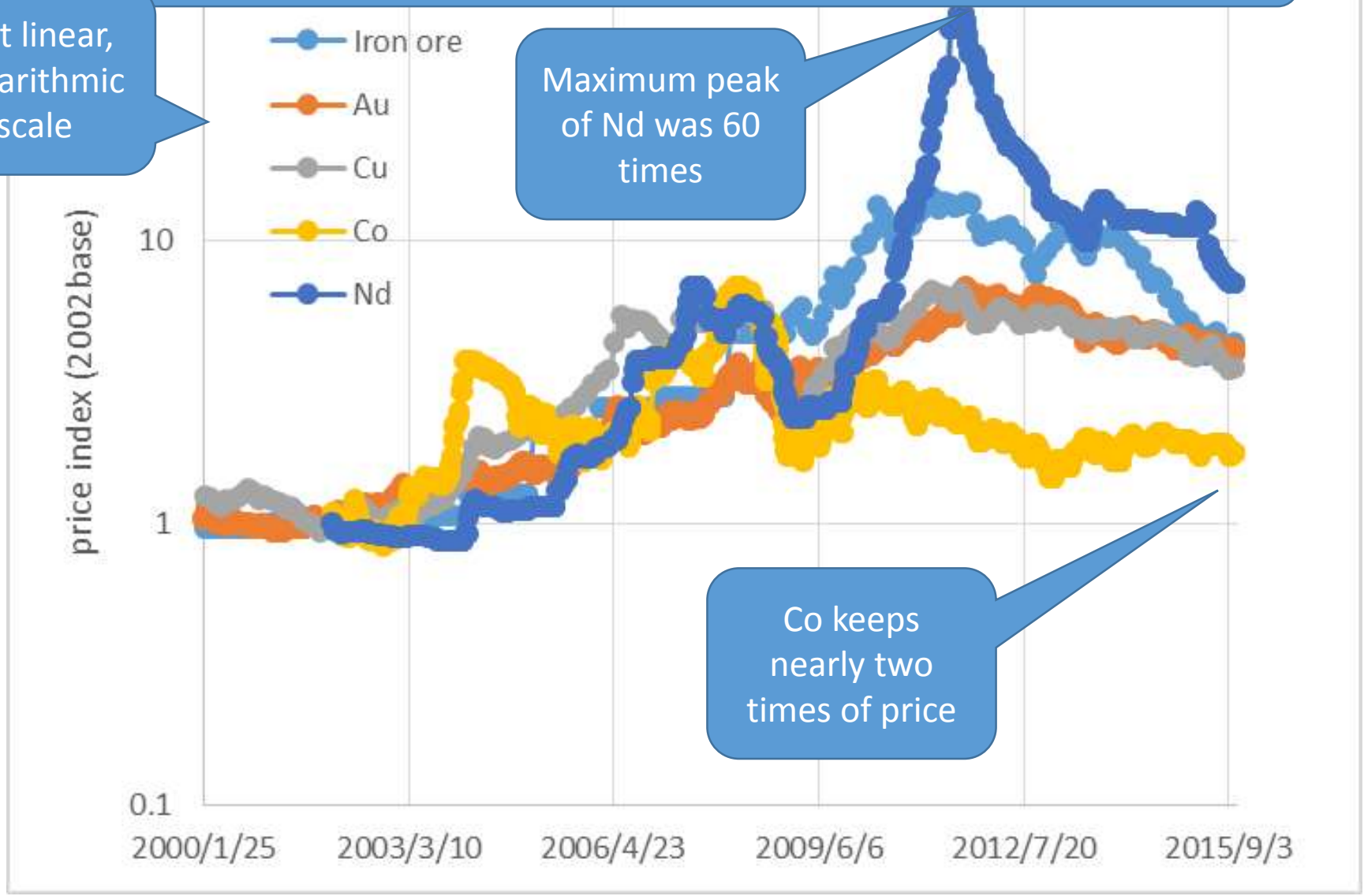

These 15 years was turbulent fifteen years for strategic metals
Co and TI has grown to 3 times.
Li, Mn, Si, Mo, Mg,Nr, Fe narly 2 times or moee
It had taken 36 years for Fe to be produces double intil 2000
Only Sr and Ta has decreased
3.5
3
2.5
2
1.5
1
0.5
0
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Co
Li
Ti
In
Nb
W
Bi
Mo
Mg
Cr
Ge
Ta
Si
Al
Mn
Ni
Fe
Sr
Re
Zn
V
Zr
I
REE
Cu
Sb
Pb
Ag
K
P
Pt
B
S
Sn
Cd
Au

Prices have changed more drastically

Not linear, Logarithmic scale

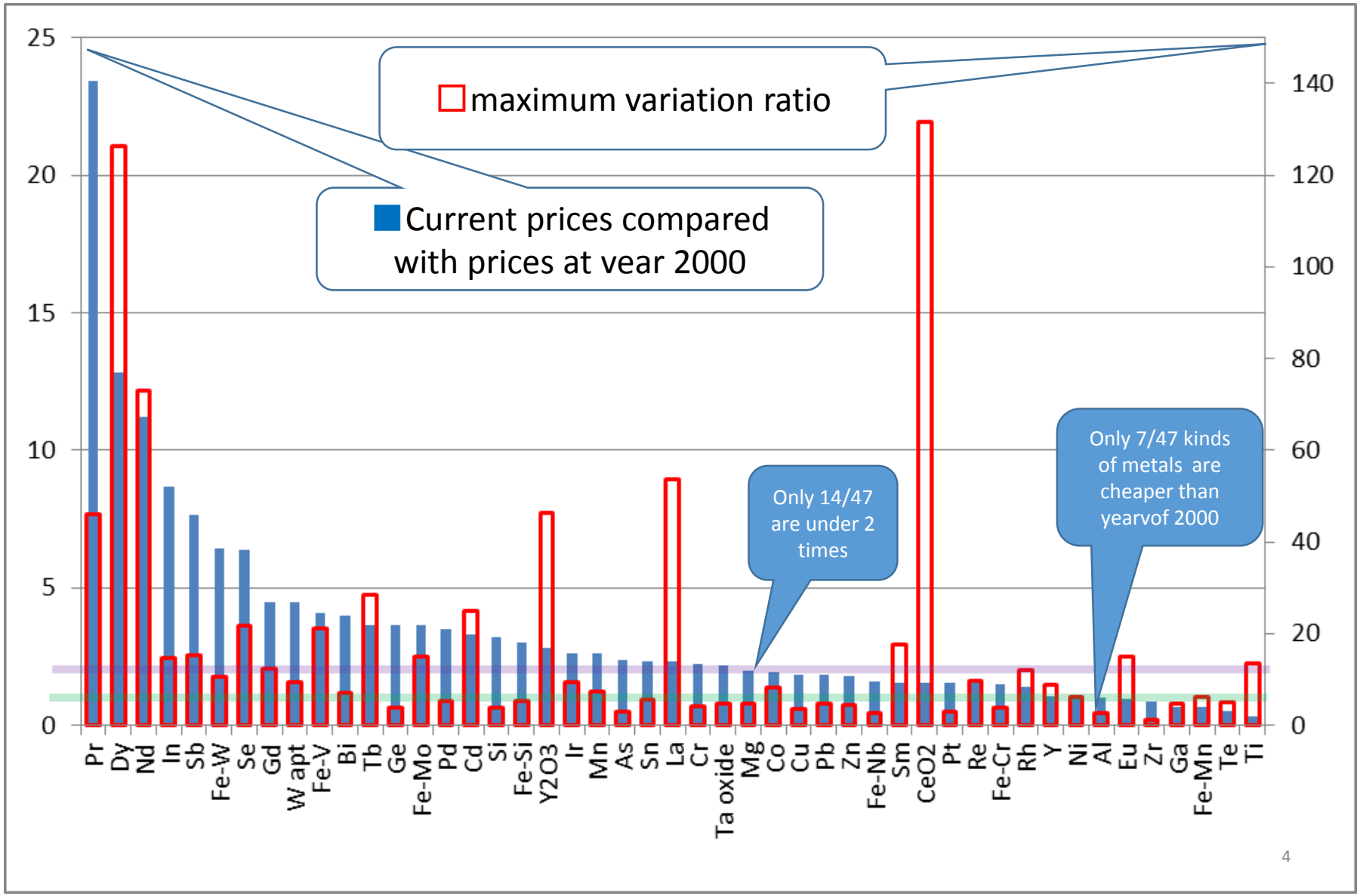
Maximum peak of Nd was 60 times

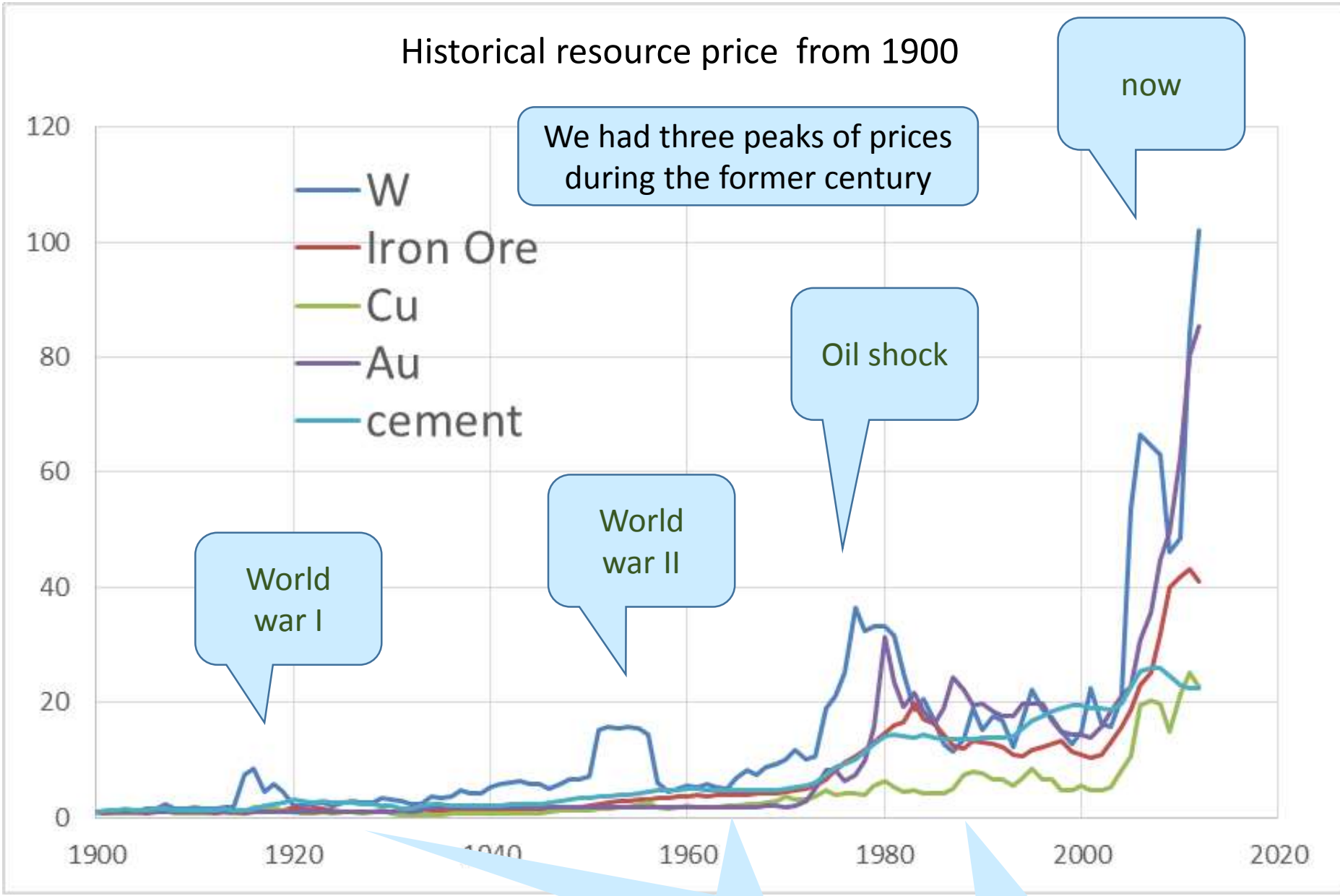
Co keeps nearly two times of price



From several dozens times to more than a hundred times of price swing occurred In these 15 years.

Prices stays higher level comparing the prices at the beginning of this century

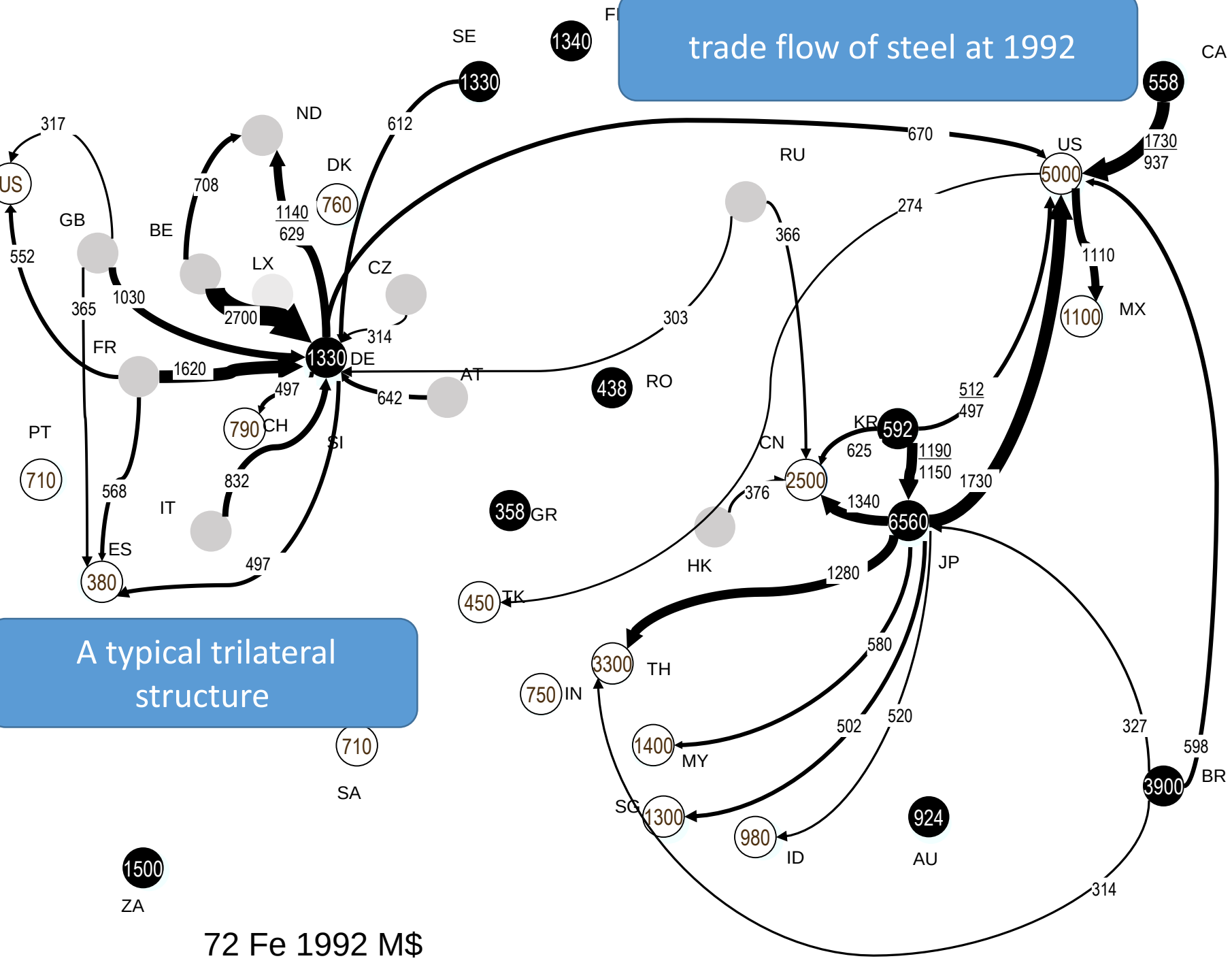


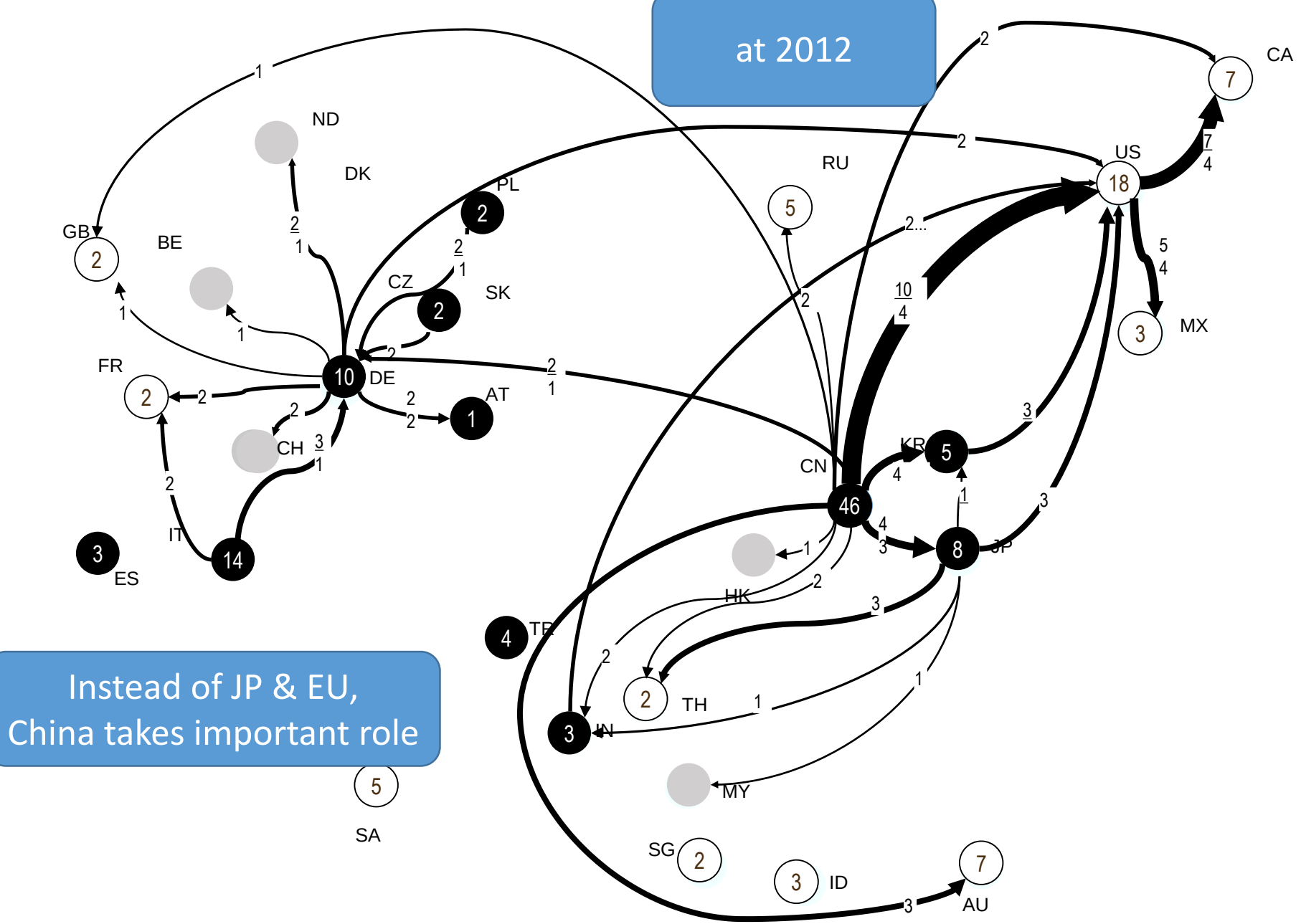

Historical resource price from 1900
now
We had three peaks of prices during the former century
W
Iron Ore
Cu
Au
cement
Oil shock
World war II
World war I
120
100
80
60
40
20
0
1900
1920
1960
1980
2000
2020
After the peak, prices shifted higher levels

What is happening ? What will come after?

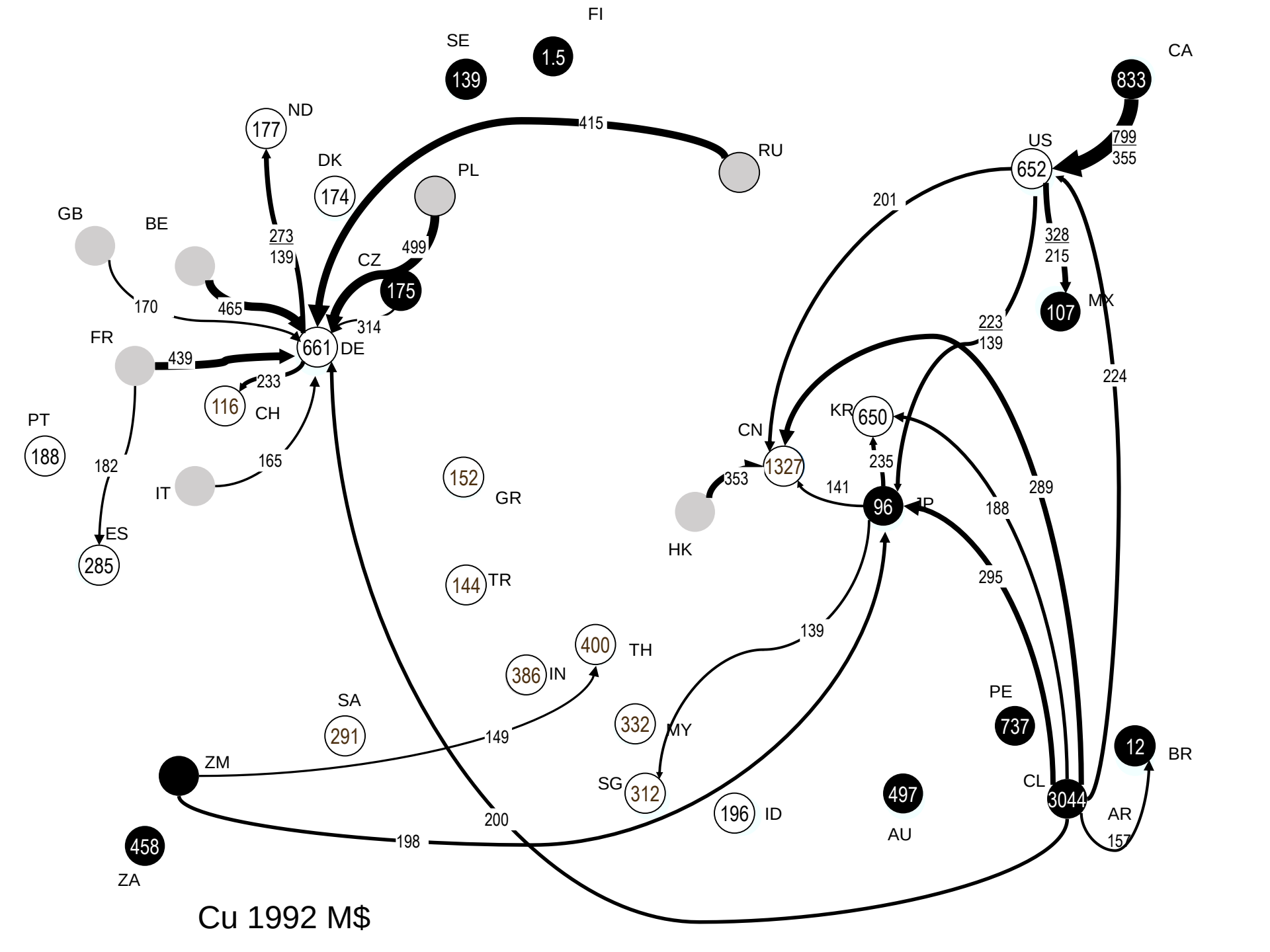
Shift form the structure of the 20th century to the 21th century.

From trilateral structure of EU, US, JP to *universal power economy* through "the factory of the world"

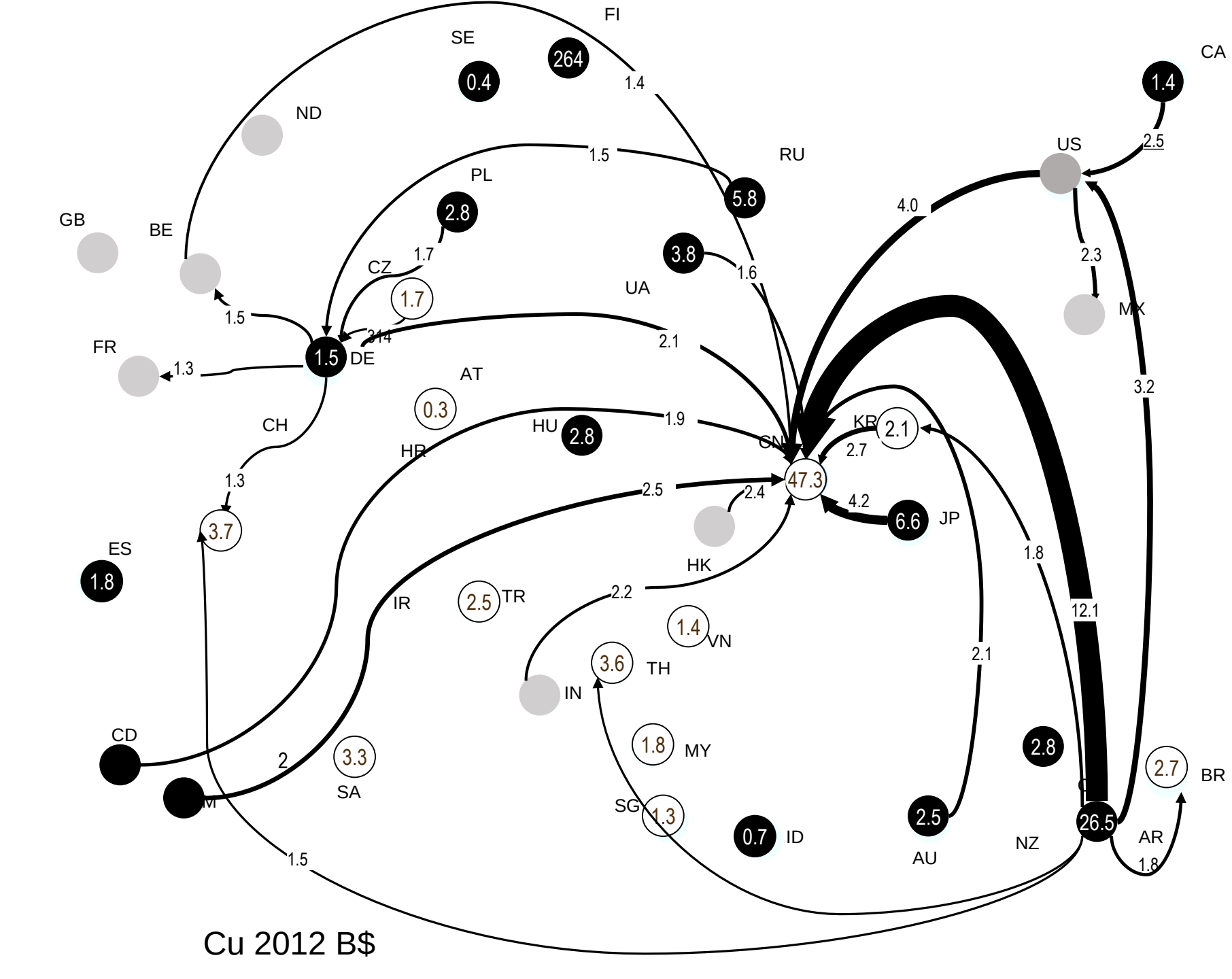

trade flow of steel at 1992
A typical trilateral structure
72 Fe 1992 M$
SE
1340
1330
CA
558
ND
612
317
670
US
1730
937
RU
5000
DK
760
708
1140
629
US
GB
BE
LX
CZ
552
365
1030
2700
366
274
1110
1100
MX
303
314
FR
1330
DE
1620
AT
497
642
438
RO
512
497
KR
592
790
CH
SI
CN
625
1190
1150
PT
710
568
832
IT
2500
376
1340
1730
358
GR
6560
ES
380
497
HK
JP
1280
450
TK
580
3300
TH
750
IN
710
SA
1400
MY
502
520
327
598
3900
BR
SG
1300
980
ID
924
AU
1500
ZA
314

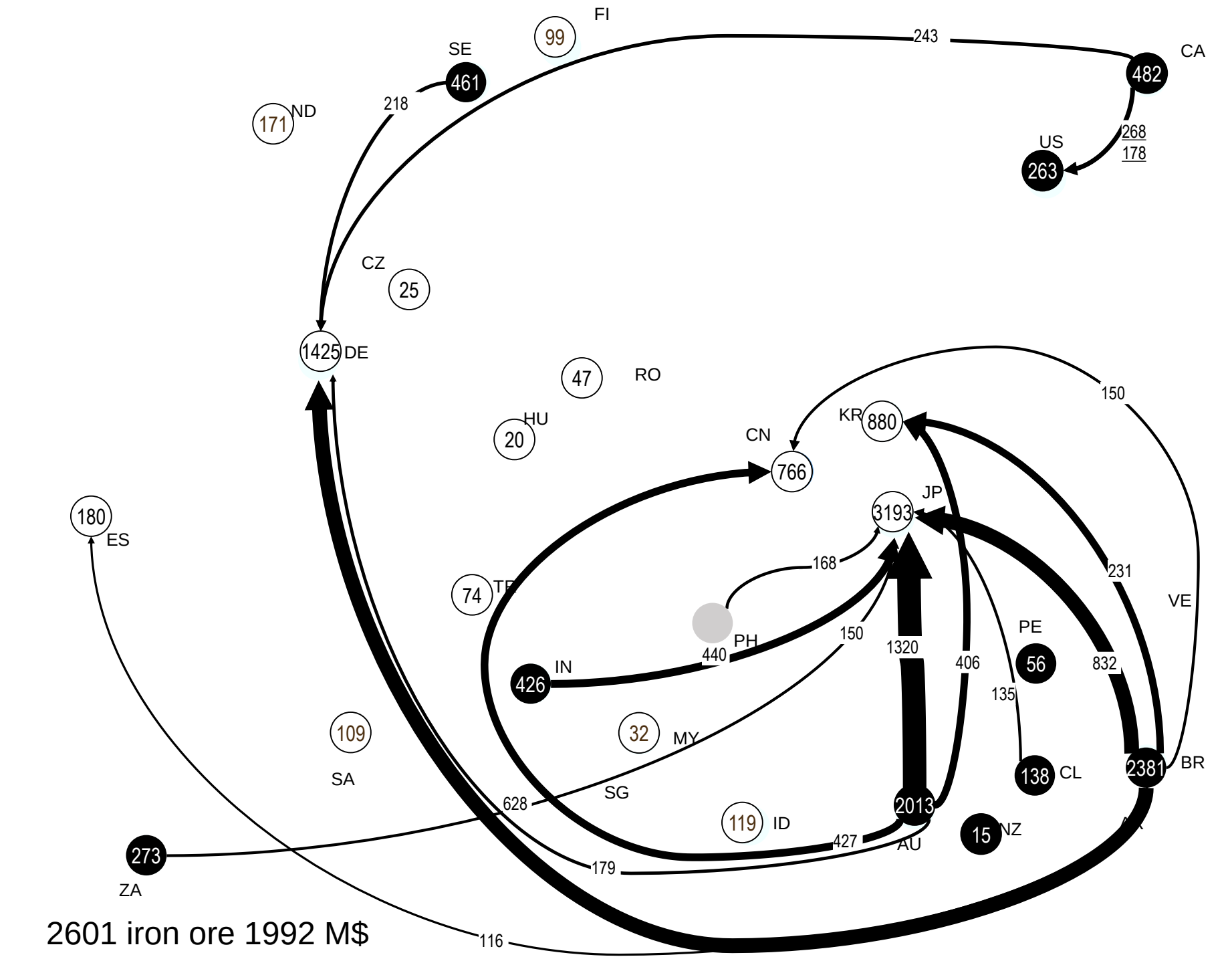

at 2012
Instead of JP & EU,
China takes important role
ND
DK
PL
GB
BE
CZ
SK
FR
DE
AT
CH
IT
ES
RU
US
CA
MX
CN
KR
JP
HK
TR
TH
IN
MY
SG
ID
AU
SA

72 Fe 2012 B$

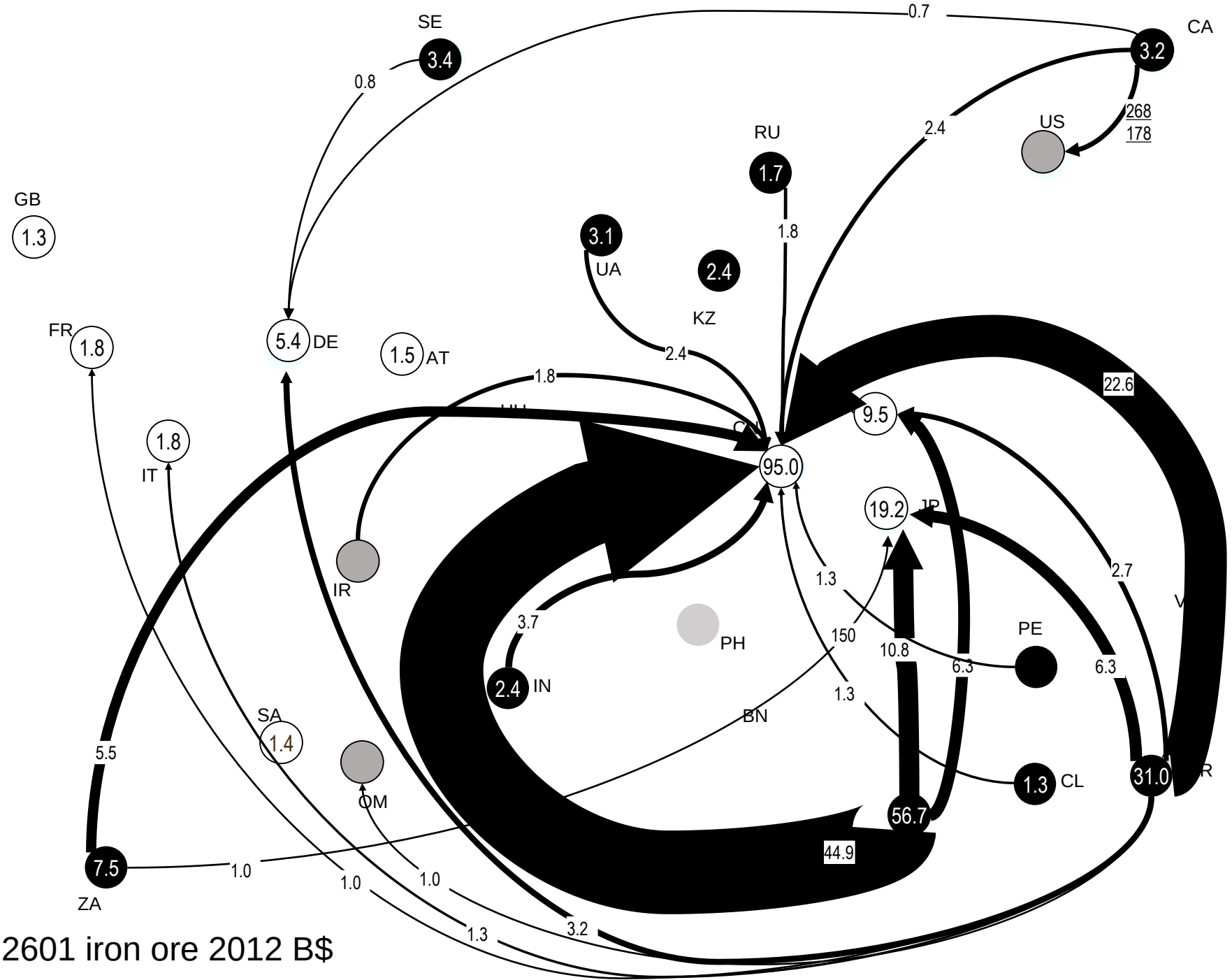

FI
SE
1.5
139
CA
833
ND
177
415
RU
799
355
US
652
DK
174
PL
201
GB
BE
273
139
CZ
499
175
328
215
MX
107
170
465
314
223
139
FR
661
DE
439
224
233
116
CH
KR
650
PT
188
CN
182
165
1327
235
353
141
96
IP
289
188
IT
152
GR
HK
ES
285
144
TR
295
139
400
TH
386
IN
SA
PE
737
291
332
MY
149
12
BR
ZM
SG
312
CL
3044
497
AR
200
196
ID
AU
198
458
ZA
157

Cu 1992 M$

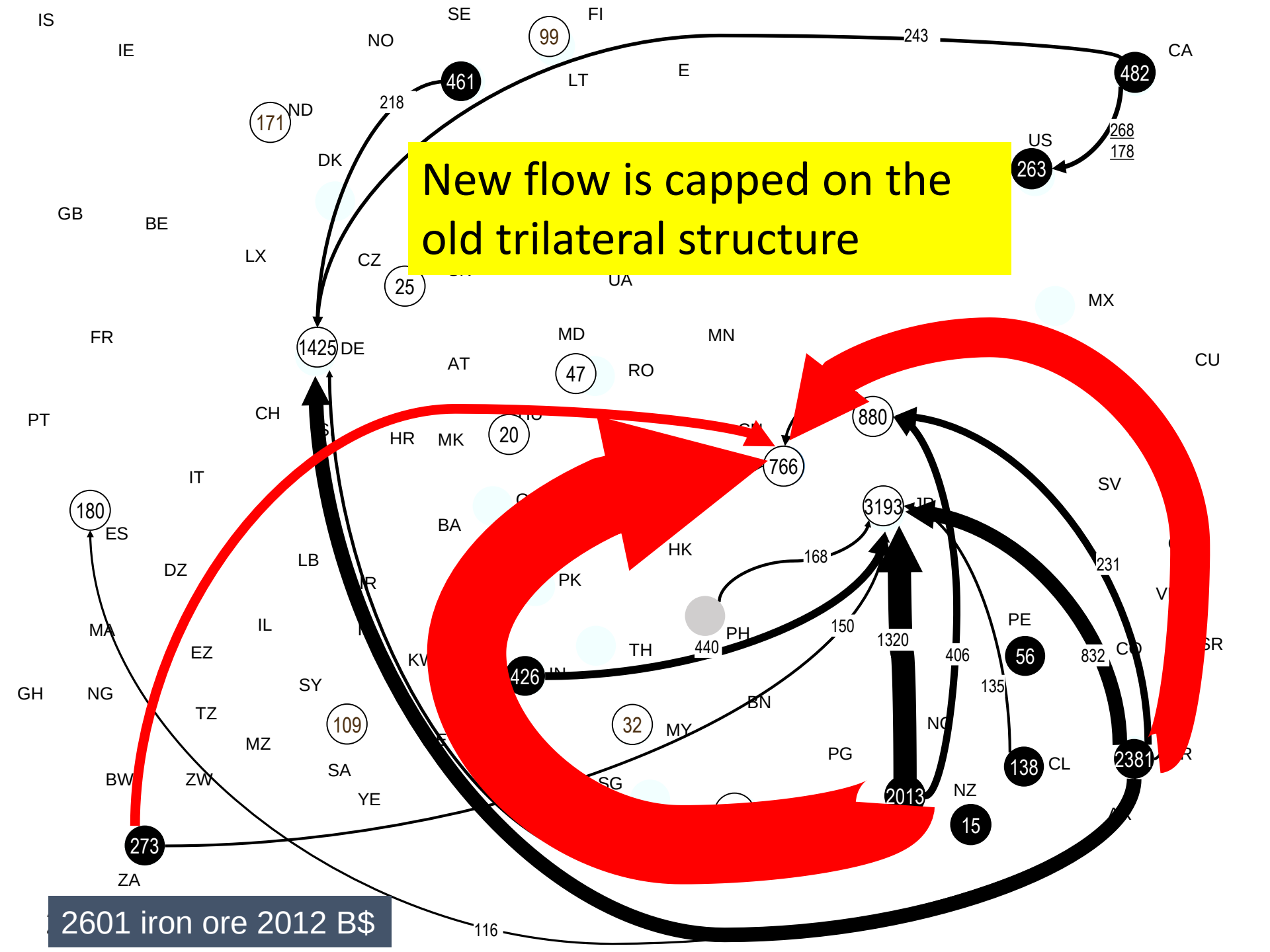

FI
SE
264
0.4
1.4
CA
1.4
ND
RU
1.5
US
2.5
PL
5.8
2.8
GB
BE
4.0
3.8
1.6
2.3
CZ
1.7
UA
MX
1.7
1.5
2.1
FR
1.5
DE
1.3
AT
3.2
0.3
CH
HU
2.8
1.9
KR
2.1
HR
CN
2.7
1.3
47.3
2.5
2.4
4.2
6.6
JP
3.7
ES
1.8
HK
1.8
IR
2.5
TR
2.2
12.1
1.4
VN
3.6
TH
2.1
IN
CD
1.8
MY
2.8
2.7
BR
2
3.3
SA
SG
1.3
2.5
26.5
AR
0.7
ID
AU
NZ
1.8
1.5
Cu 2012 B$

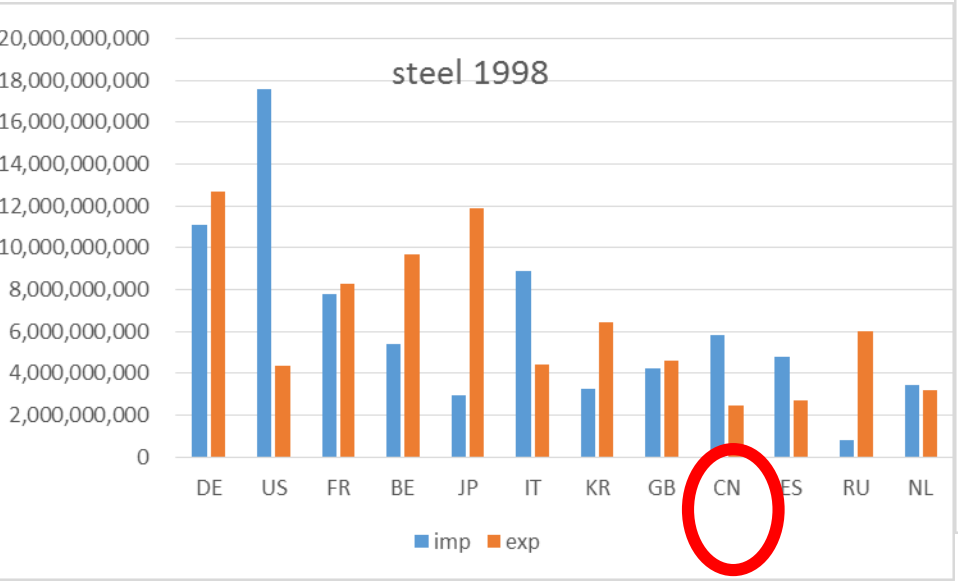


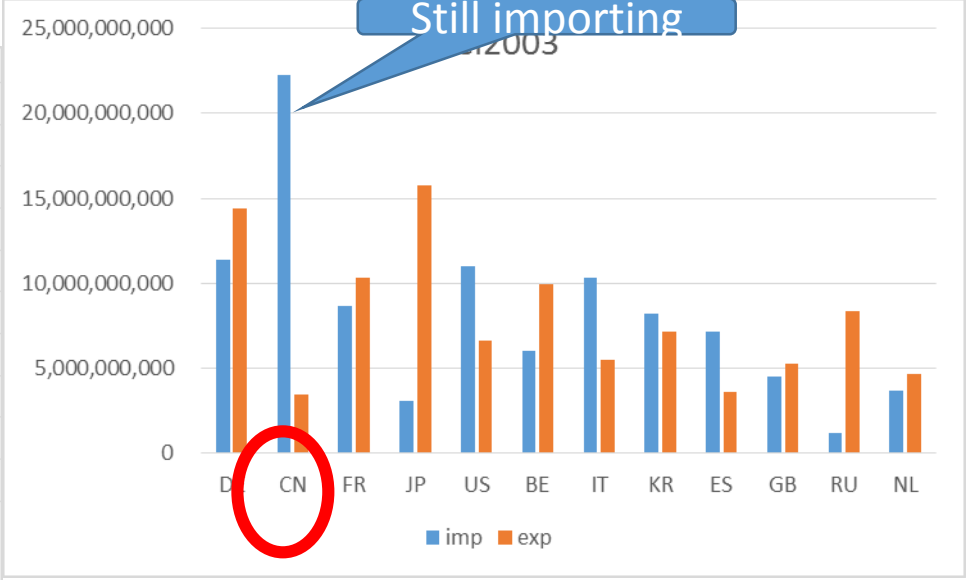
2601 iron ore 1992 M$

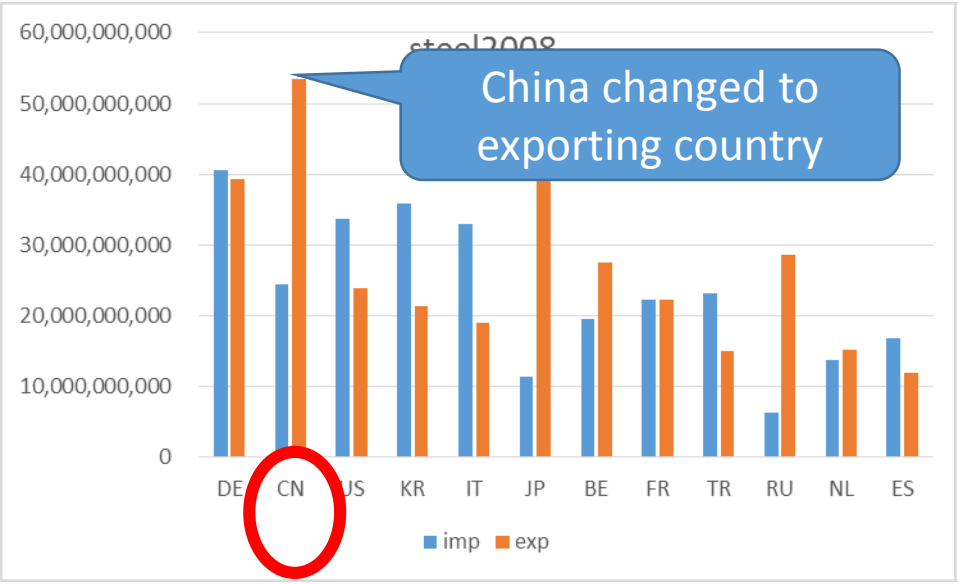


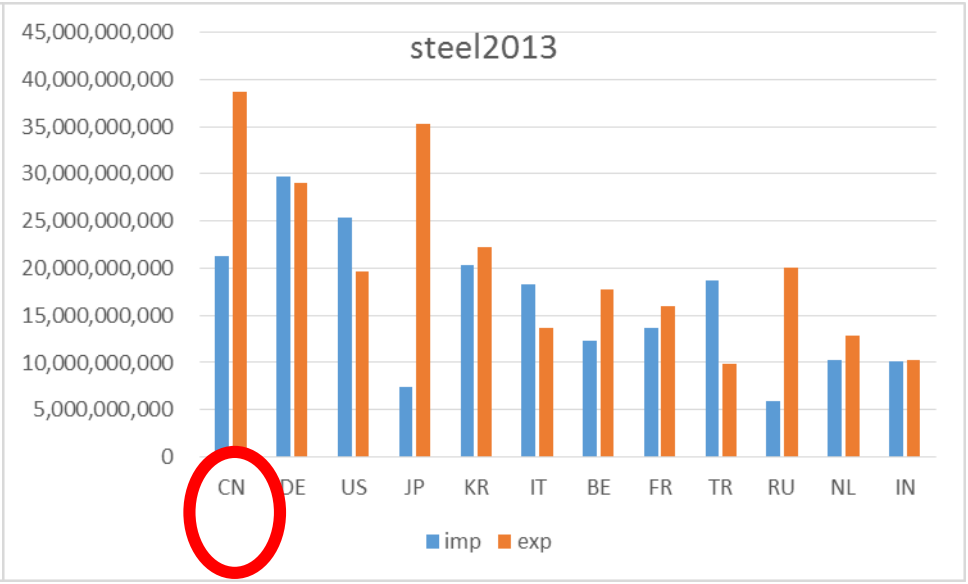
2601 iron ore 2012 B$

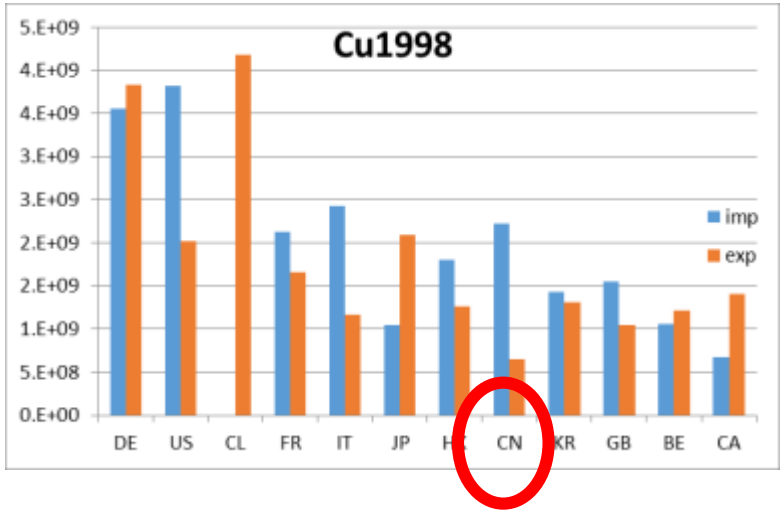

New flow is capped on the old trilateral structure
2601 iron ore 2012 B$
IS
IE
SE
NO
FI
99
243
CA
482
461
218
LT
E
171
ND
DK
US
263
268
178
GB
BE
LX
CZ
25
UA
MX
FR
1425
DE
MD
MN
CU
AT
47
RO
PT
CH
880
HR
MK
20
766
IT
SV
180
3193
ES
BA
HK
168
231
DZ
LB
PK
MA
IL
PE
150
1320
406
56
832
EZ
KV
426
TH
440
PH
GH
NG
SY
135
TZ
109
32
MY
BN
MZ
PG
138
CL
2381
BW
ZW
SA
SG
2013
NZ
YE
15
273
ZA
116

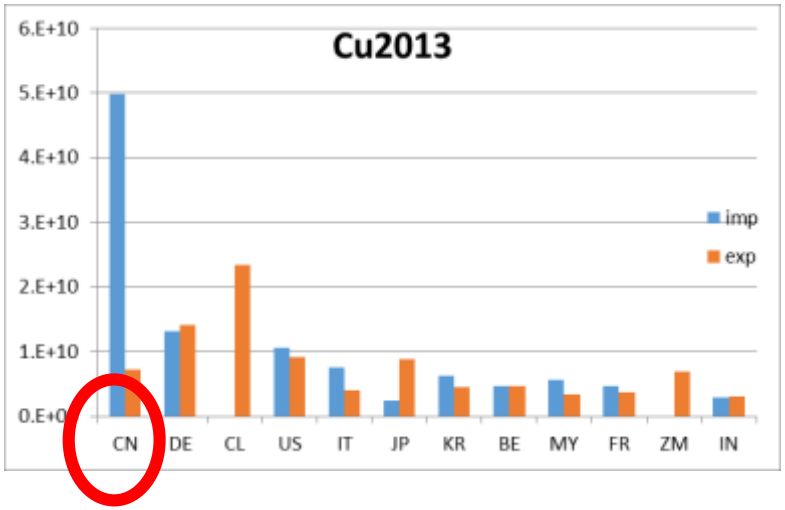

steel 1998
20,000,000,000
18,000,000,000
16,000,000,000
14,000,000,000
12,000,000,000
10,000,000,000
8,000,000,000
6,000,000,000
4,000,000,000
2,000,000,000
0
DE US FR BE JP IT KR GB CN ES RU NL
imp exp

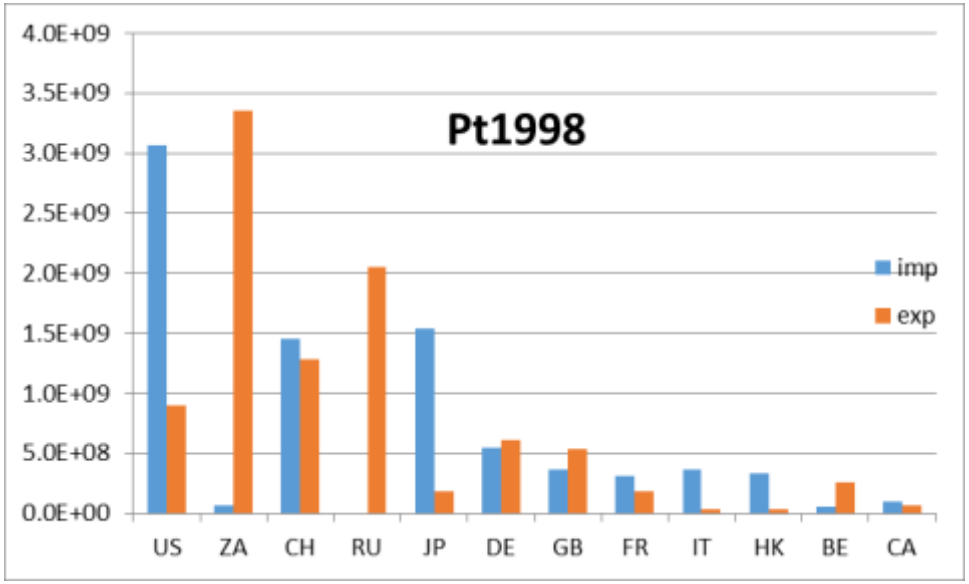

Still importing
25,000,000,000
20,000,000,000
15,000,000,000
10,000,000,000
5,000,000,000
0
CN FR JP US BE IT KR ES GB RU NL
imp exp

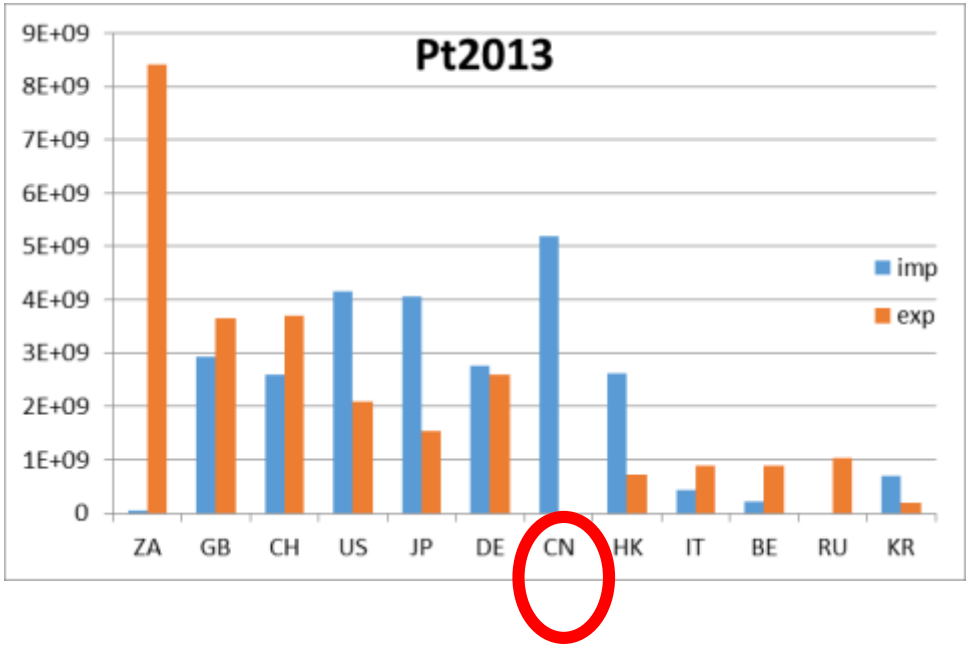

60,000,000,000
50,000,000,000
40,000,000,000
30,000,000,000
20,000,000,000
10,000,000,000
0
China changed to exporting country
DE CN US KR IT JP BE FR TR RU NL ES
imp exp


steel2013
45,000,000,000
40,000,000,000
35,000,000,000
30,000,000,000
25,000,000,000
20,000,000,000
15,000,000,000
10,000,000,000
5,000,000,000
0
CN DE US JP KR IT BE FR TR RU NL IN
imp exp


Cu1998
5.E+09
4.E+09
4.E+09
3.E+09
3.E+09
2.E+09
2.E+09
1.E+09
5.E+08
0.E+00
imp
exp
DE
US
CL
FR
IT
JP
CN
GB
BE
CA


Cu2013
6.E+10
5.E+10
4.E+10
3.E+10
2.E+10
1.E+10
0.E+0
imp
exp
CN
DE
CL
US
IT
JP
KR
BE
MY
FR
ZM
IN


Pt1998
4.0E+09
3.5E+09
3.0E+09
2.5E+09
2.0E+09
1.5E+09
1.0E+09
5.0E+08
0.0E+00
US
ZA
CH
RU
JP
DE
GB
FR
IT
HK
BE
CA
imp
exp

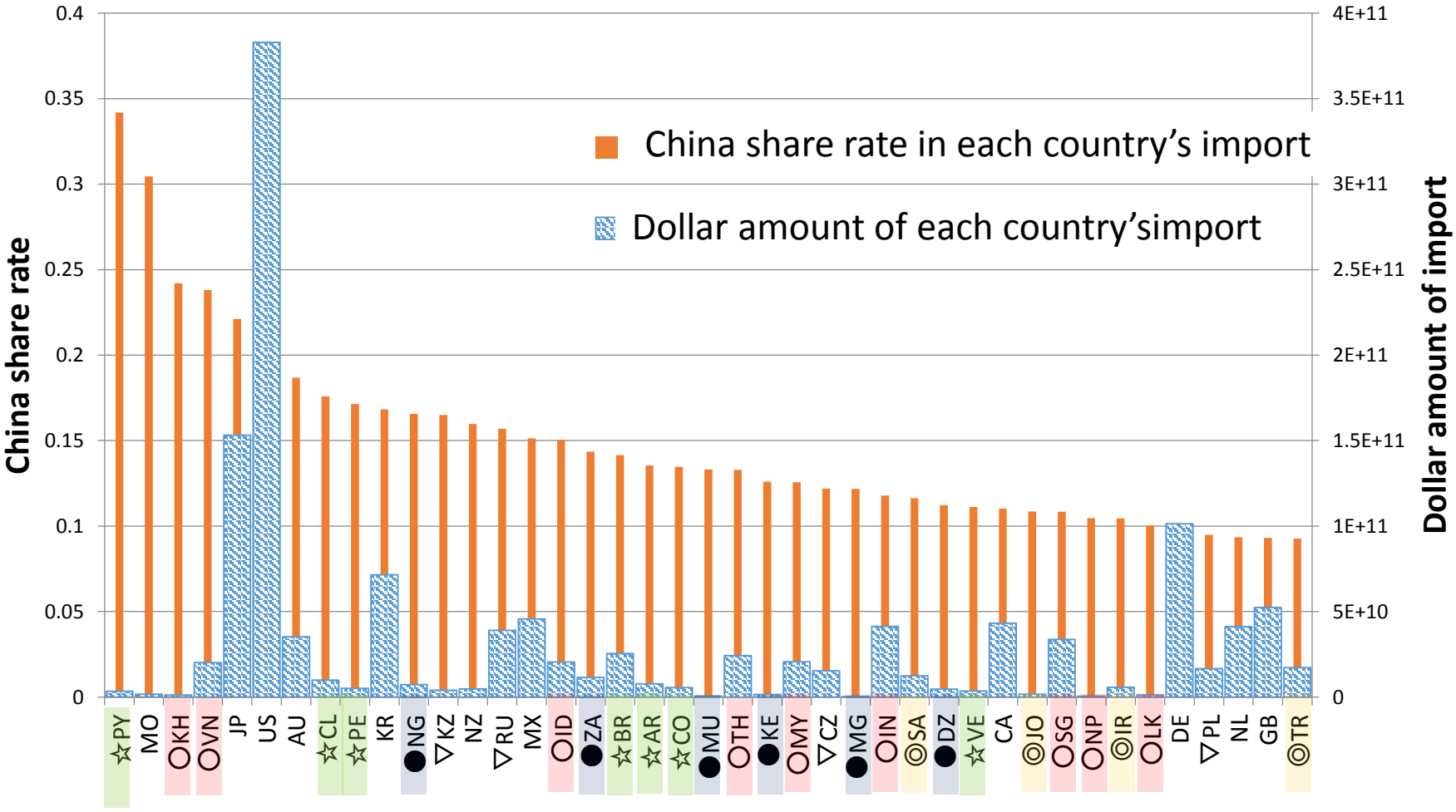

Pt2013
9E+09
8E+09
7E+09
6E+09
5E+09
4E+09
3E+09
2E+09
1E+09
0
ZA
GB
CH
US
JP
DE
CN
HK
IT
BE
RU
KR
imp
exp

	Import		Export			Import		Export	
	1998	2013	1998	2013		1998	2013	1998	2013
Fe	US		JP	**CN**	W	DE	DE	US	**CN**
Cu	US	**CN**	CL	CL	Mo	DE	KR	AT	**CN**
Ni	US	**CN**	CA	CA	Ta	MX	US	US	CN
Al	US			**CN**	Co	US	**CN**	CA	
Zn	US	**CN**	CA	CA	Au		**HK**	KR	GB
Pb	US	US	AU	AU	Ag	GB	(IN)		(MX)
Mg	US		CN	**CN**	Pt	US	**CN**	ZA	ZA

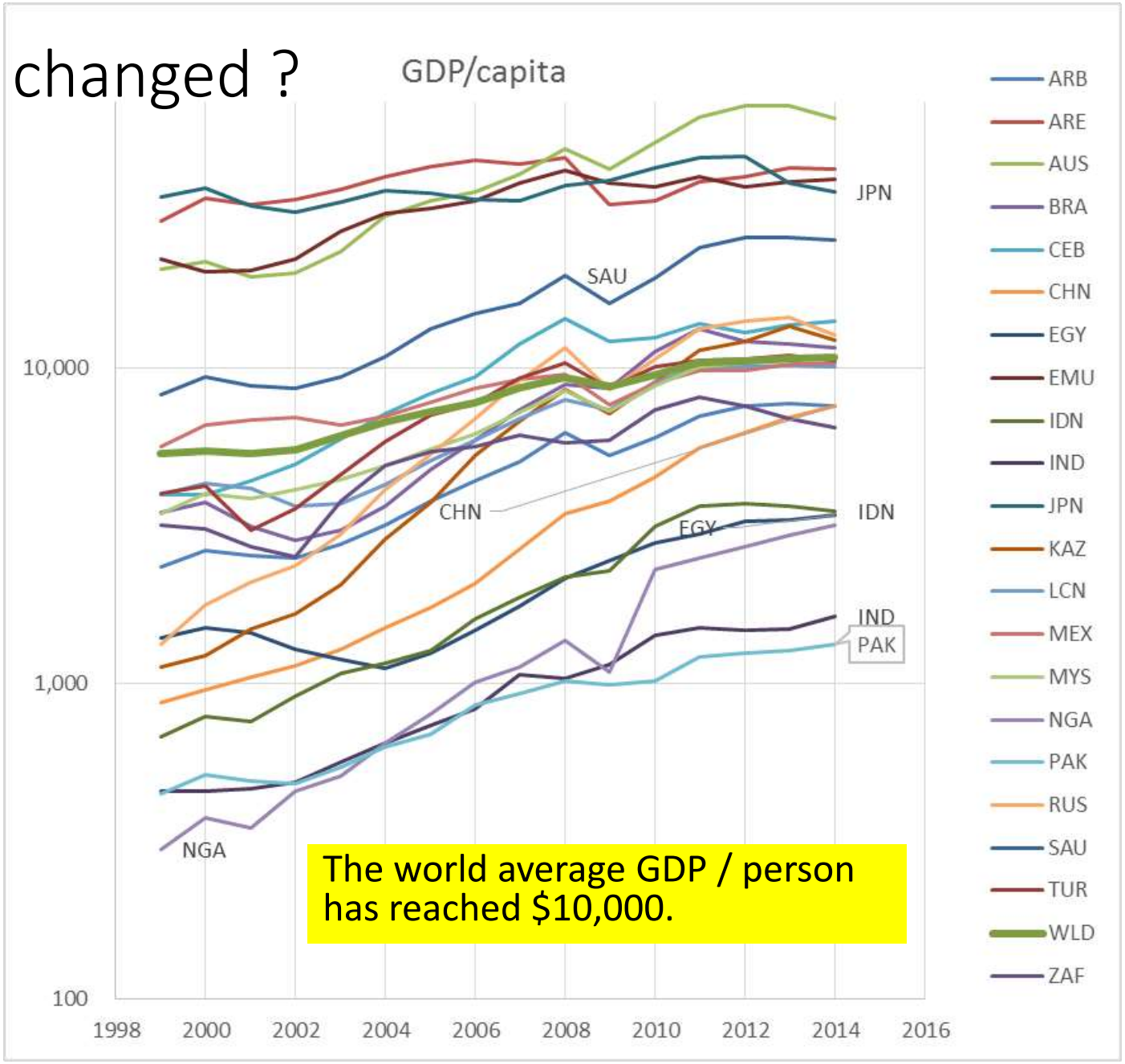
Table 1: change of leading country of each metal trade from 1998 to 2013

China exports products to developing countries all over the world as “the factory of the world.

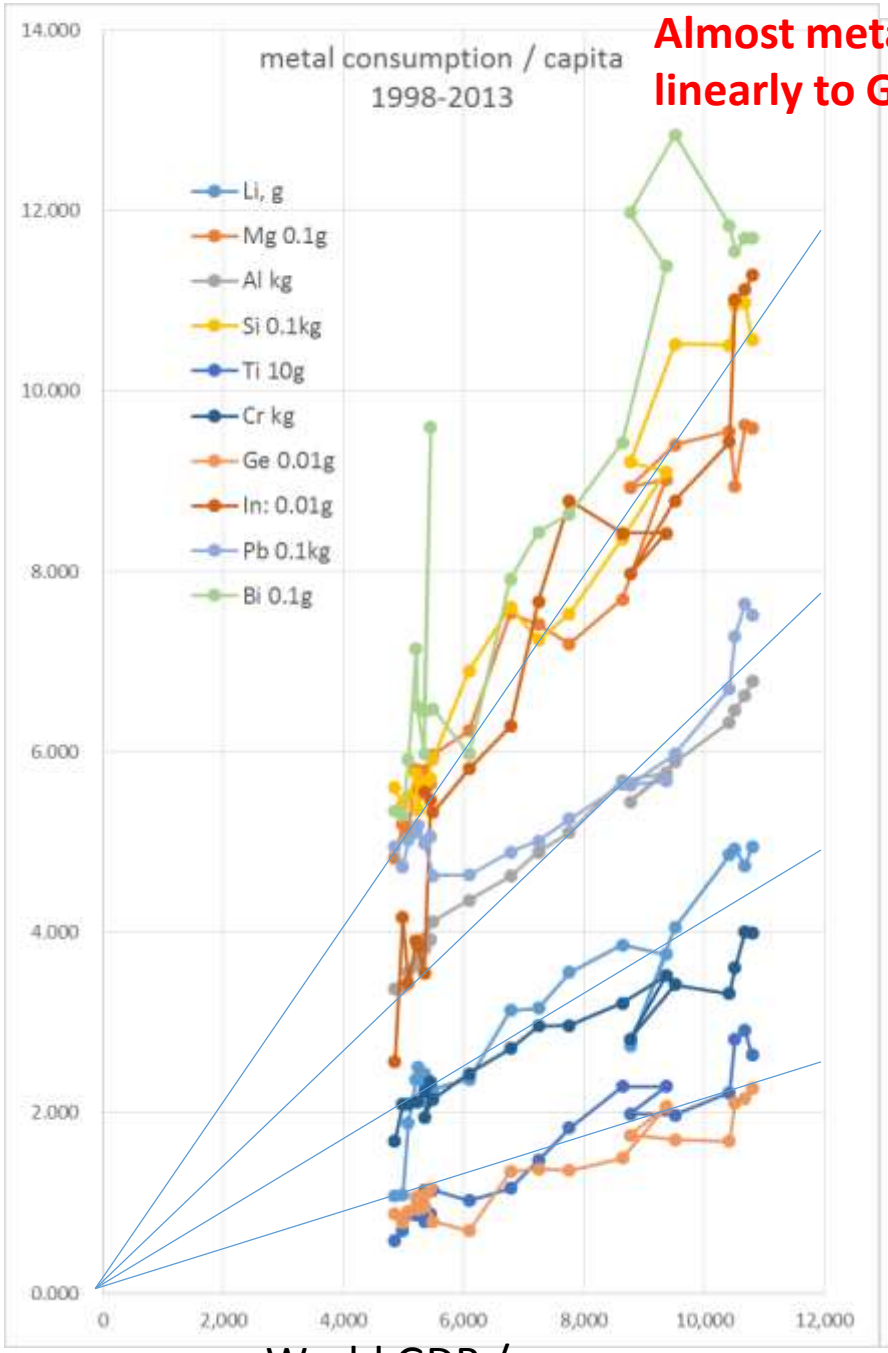
Behind the concentration of resources to China, the requirement of developing countries exists widely.

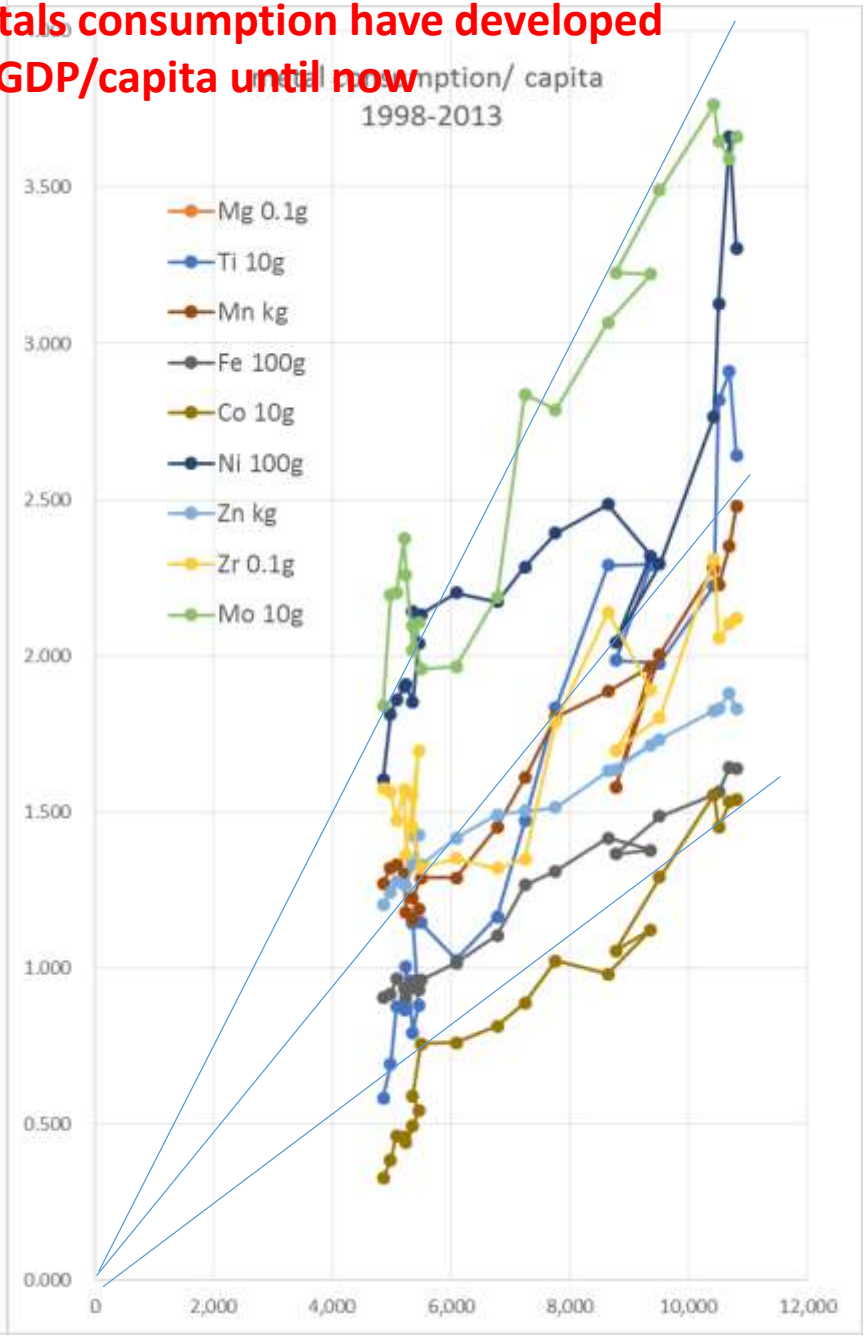


What has changed ?

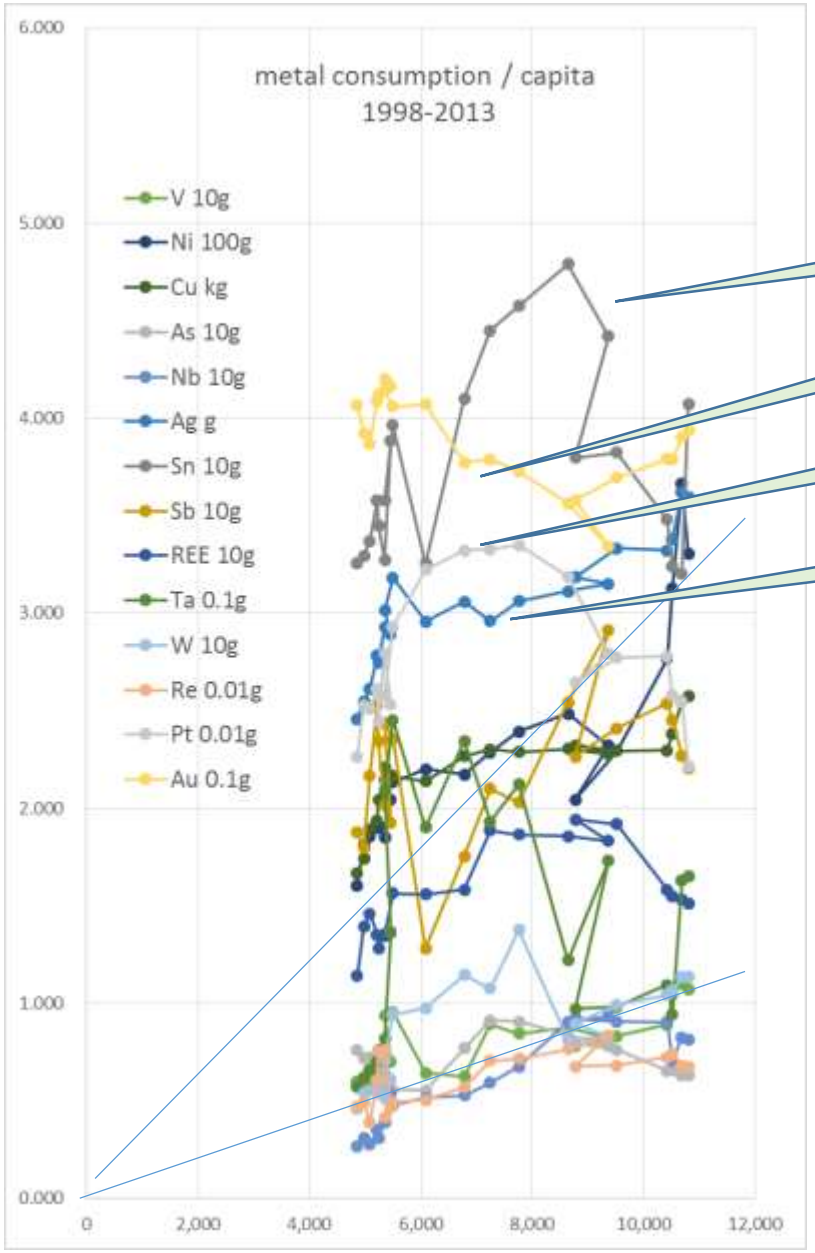


Almost metals consumption have developed linearly to GDP/capita until now





World GDP / person



Sn

AU

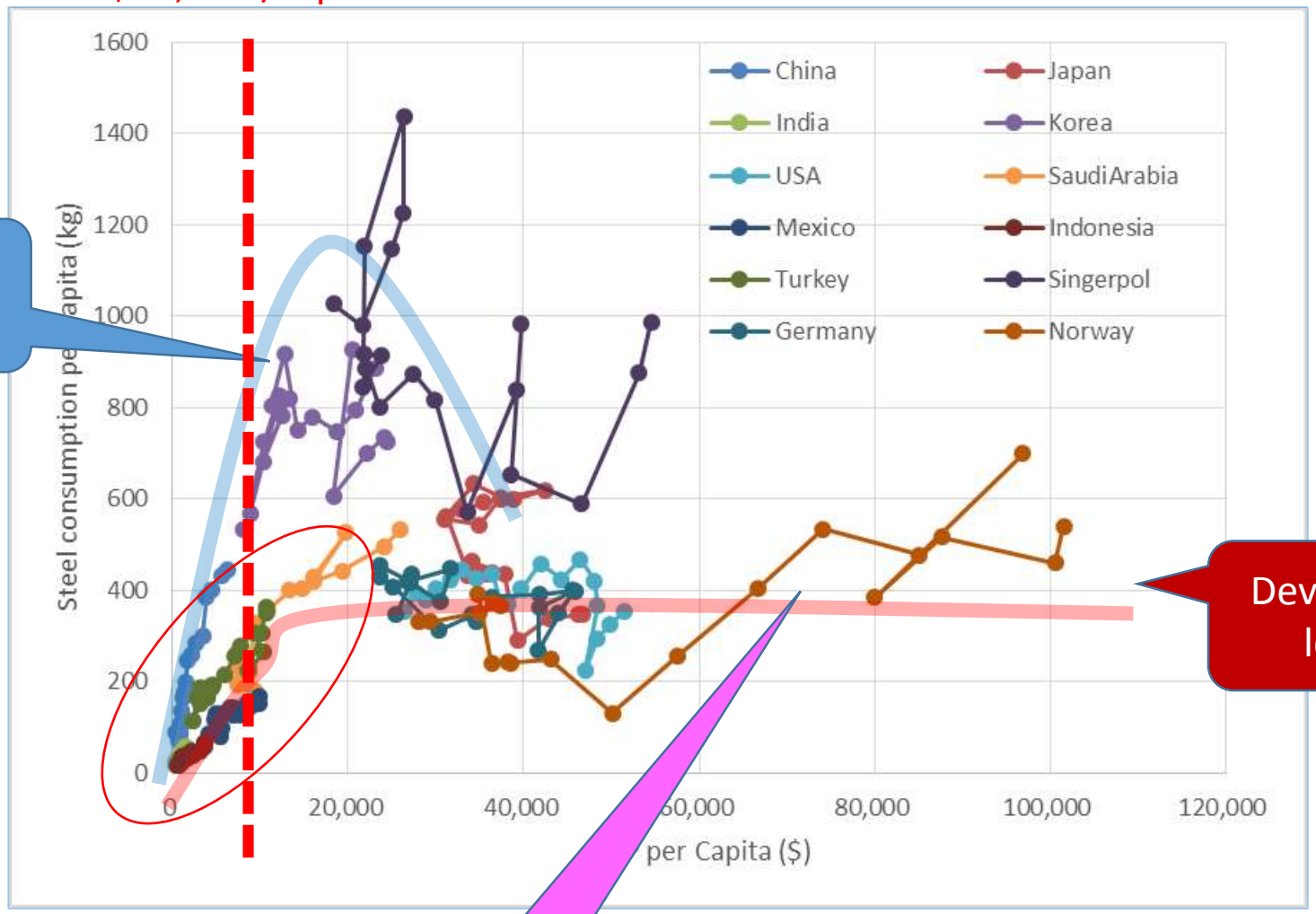
Pt

Ag

There are some exceptions.
They had reached independent level of consumption per person

Fe consumption / capita v.s. GDP/ capita from 1994 to 2014

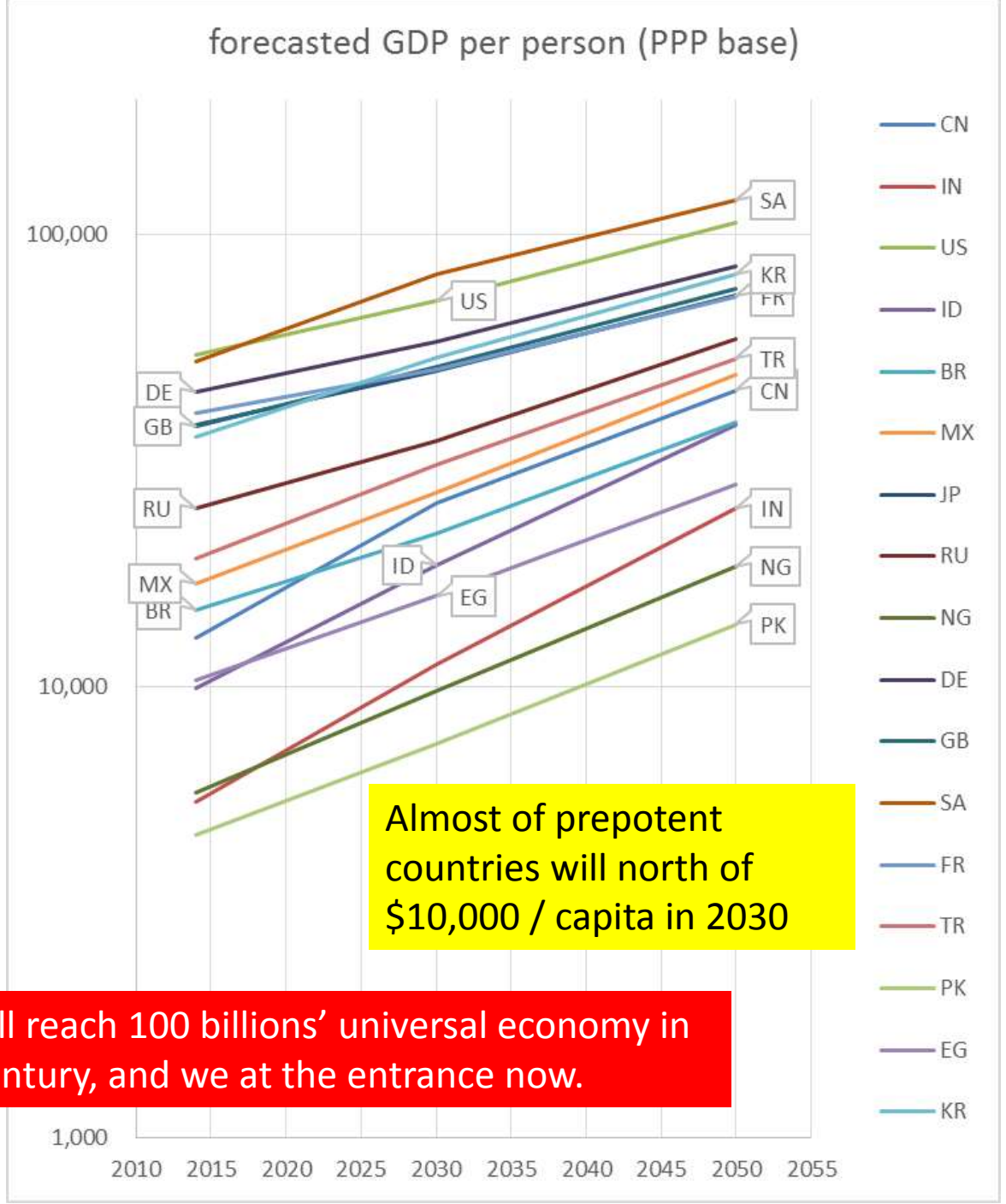
$10,000 /capita



Exporting countries

Developed level

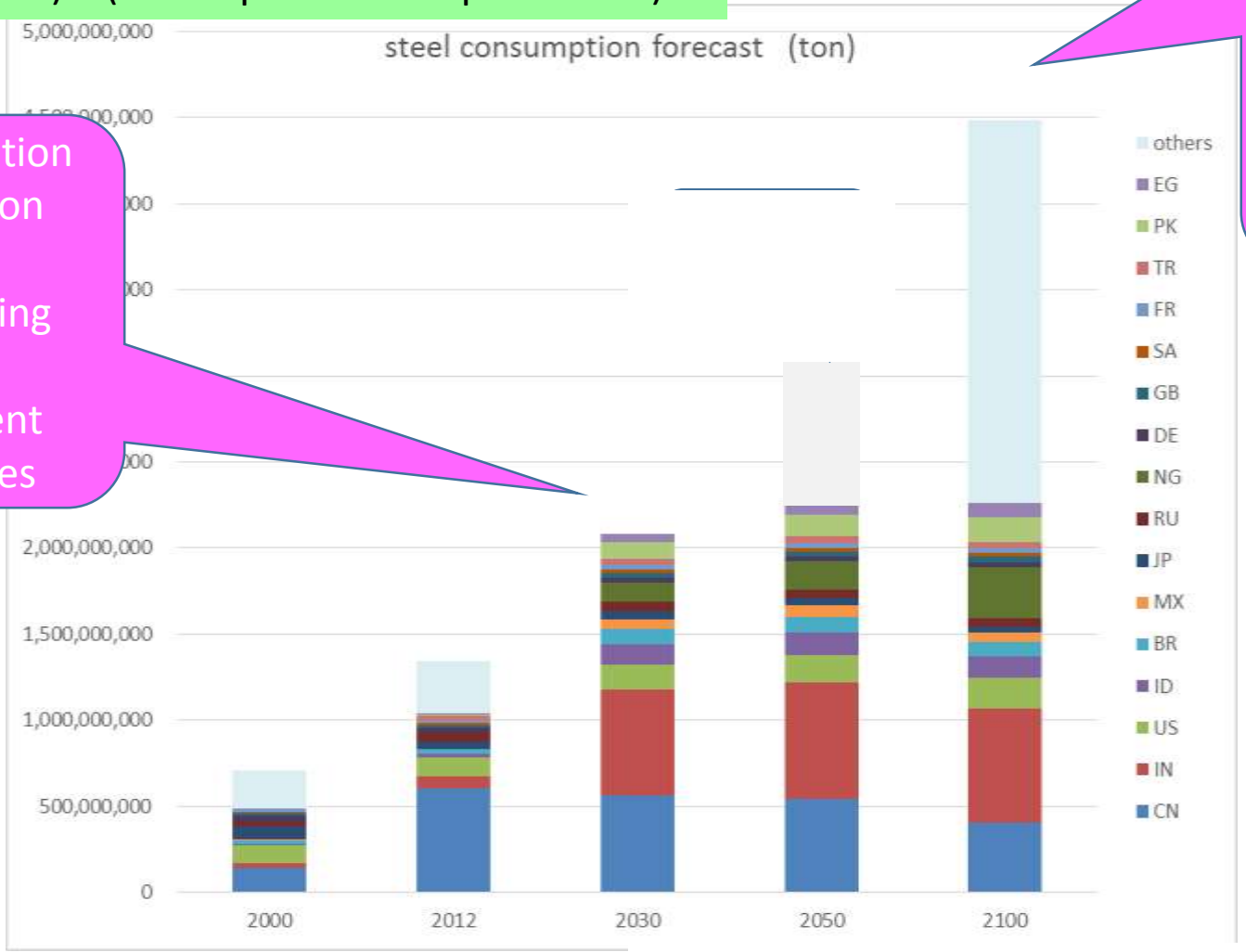
Consuming countries


forecasted GDP per person (PPP base)
100,000
10,000
1,000
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
SA
US
KR
FR
TR
CN
DE
GB
RU
IN
ID
MX
BR
EG
NG
PK
CN
IN
US
ID
BR
MX
JP
RU
NG
DE
GB
SA
FR
TR
PK
EG
KR
Almost of prepotent countries will north of $10,000 / capita in 2030
We will reach 100 billions' universal economy in this century, and we at the entrance now.

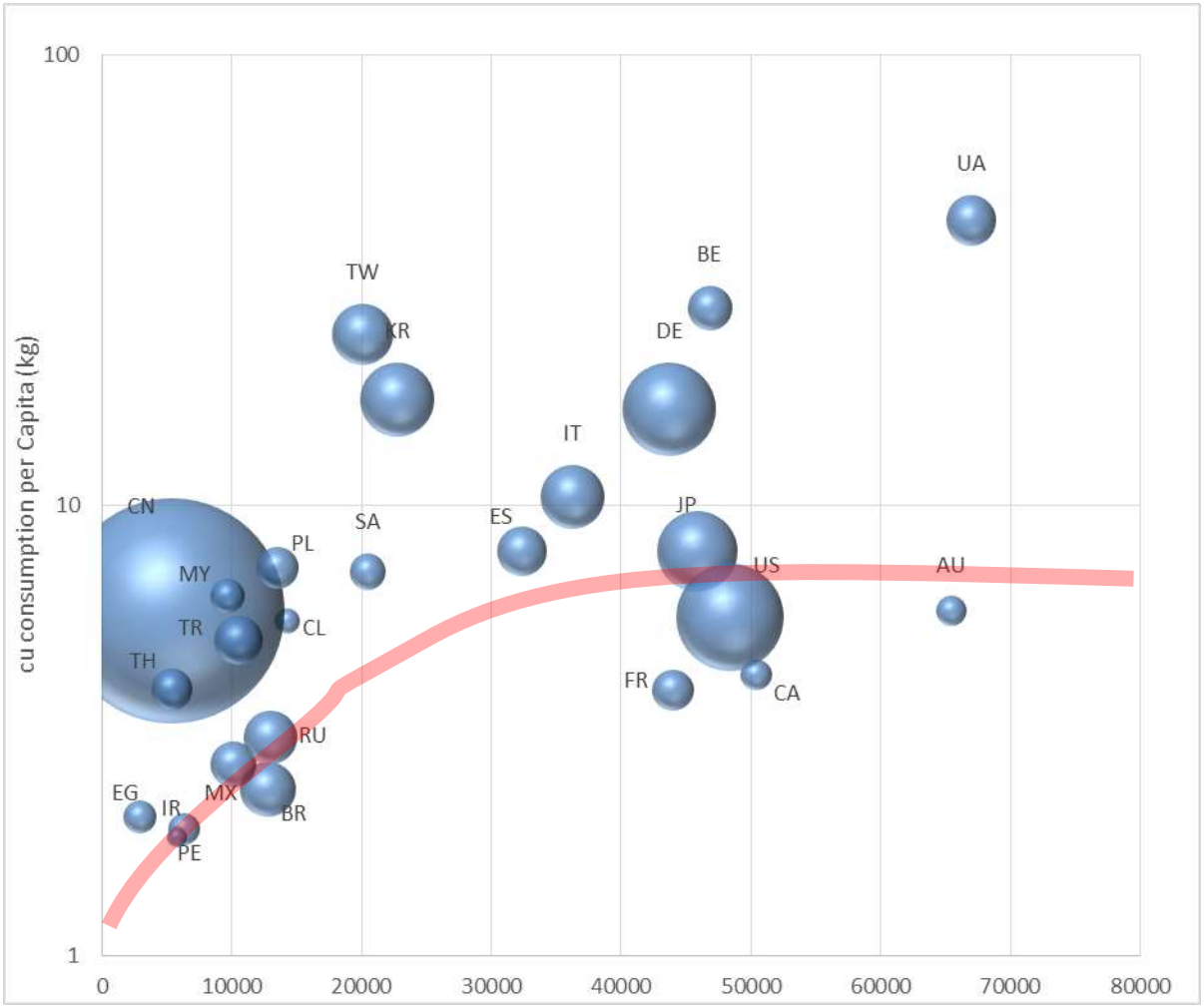
Rough forecast gets to be simpler,
(population) x (developed consumption level)

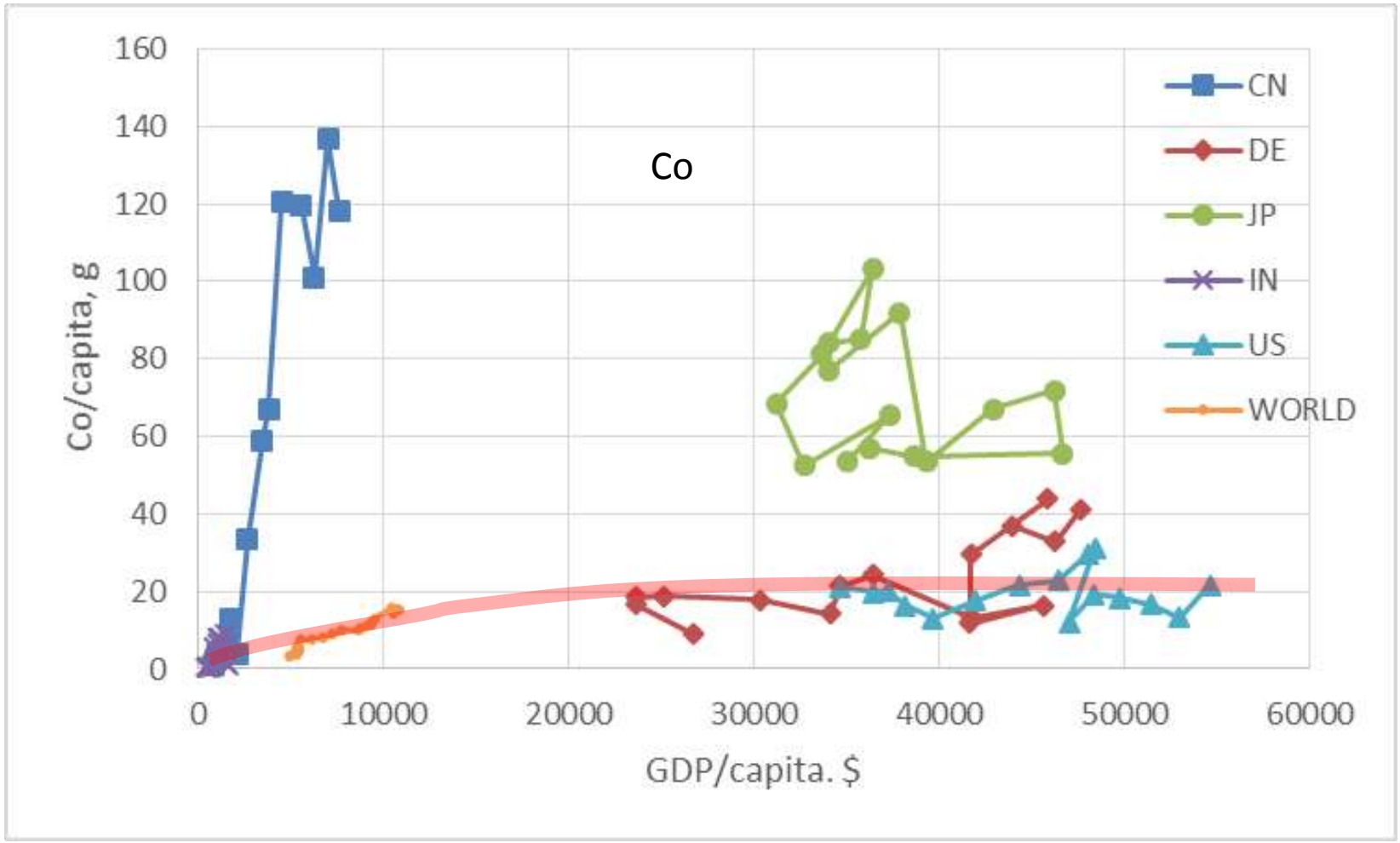
Every country reaches developed level of consumption per capita

Consumption prediction with concerning only prepotent countries



metal	Fe
Consumption/year at 10Gperson world	4.5Gton/year
Reserve	87Gton


100
10
1
cu consumption per Capita (kg)
0
10000
20000
30000
40000
50000
60000
70000
80000
UA
BE
TW
KR
DE
IT
CN
SA
ES
JP
PL
MY
US
AU
TR
CL
TH
FR
CA
RU
EG
MX
IR
BR
PE

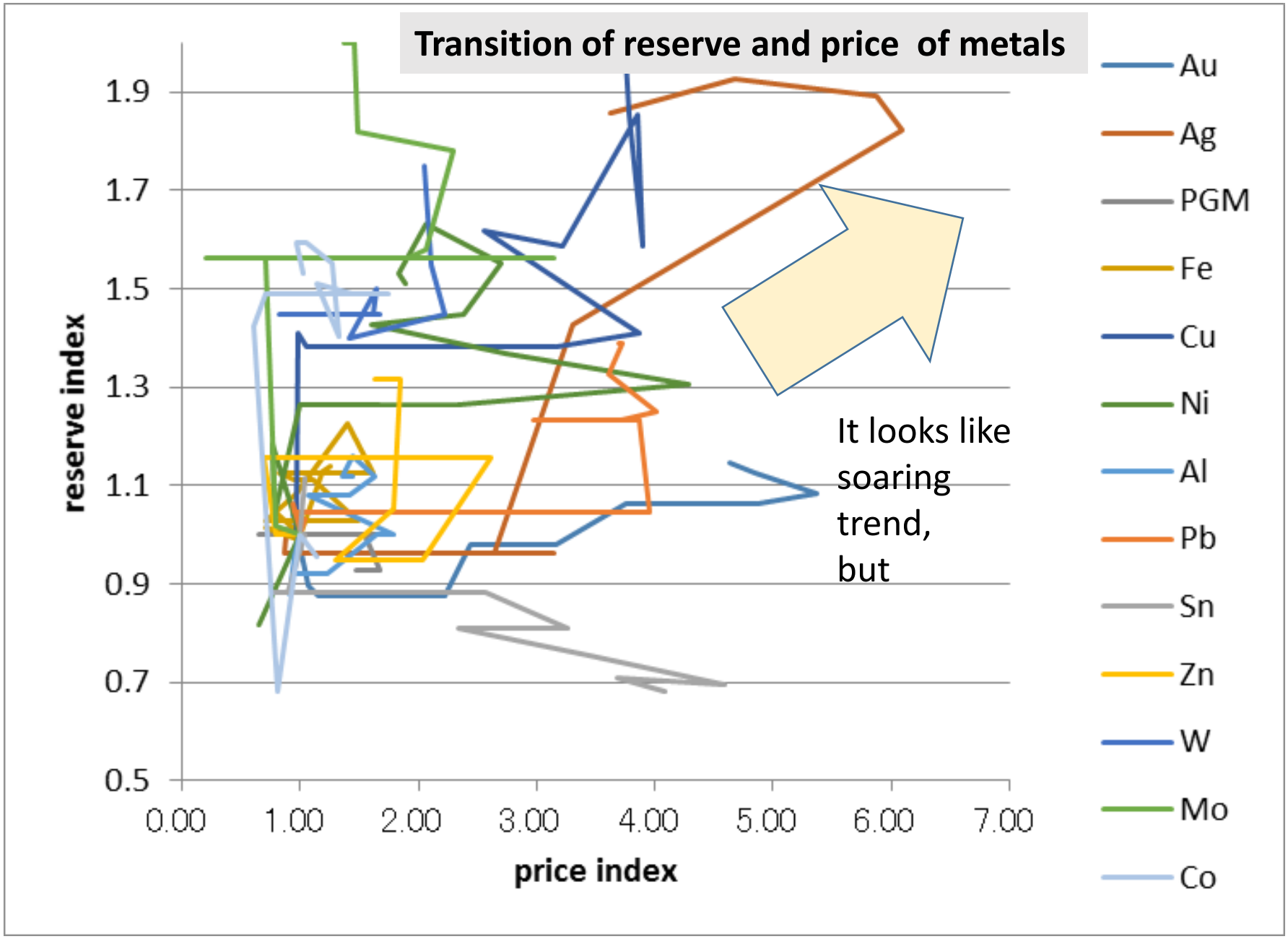

Co
Co/capita, g
GDP/capita. $
0
20
40
60
80
100
120
140
160
0
10000
20000
30000
40000
50000
60000
CN
DE
JP
IN
US
WORLD

Are the reserves enough for the 100 billions’ universal economy?

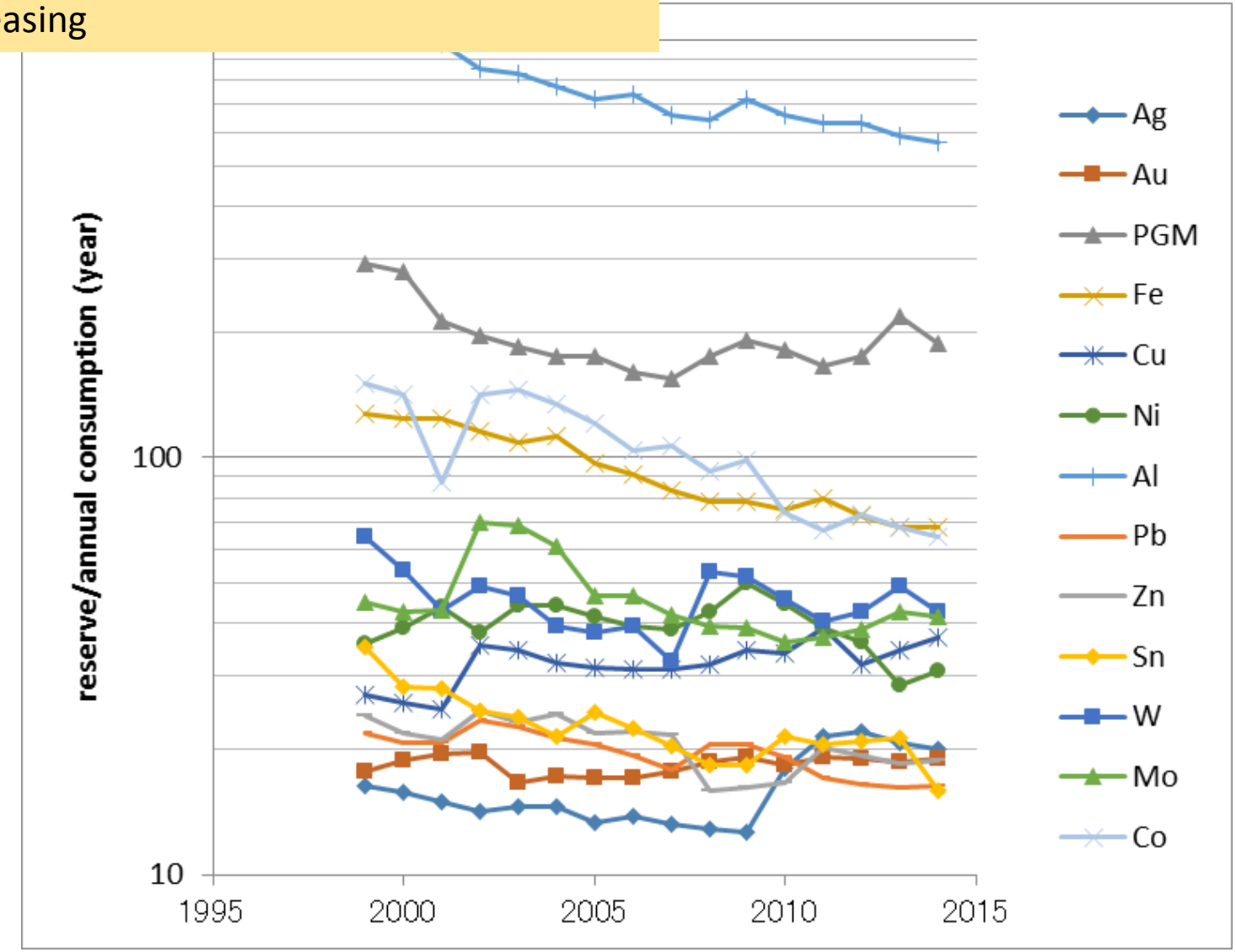
metal	Fe	Cu	Co
Consumption/year at 10Gperson world	4.5Gton/year	90Mt/year	224kt/year
Reserve	87Gton	700Mt	7.2Mt

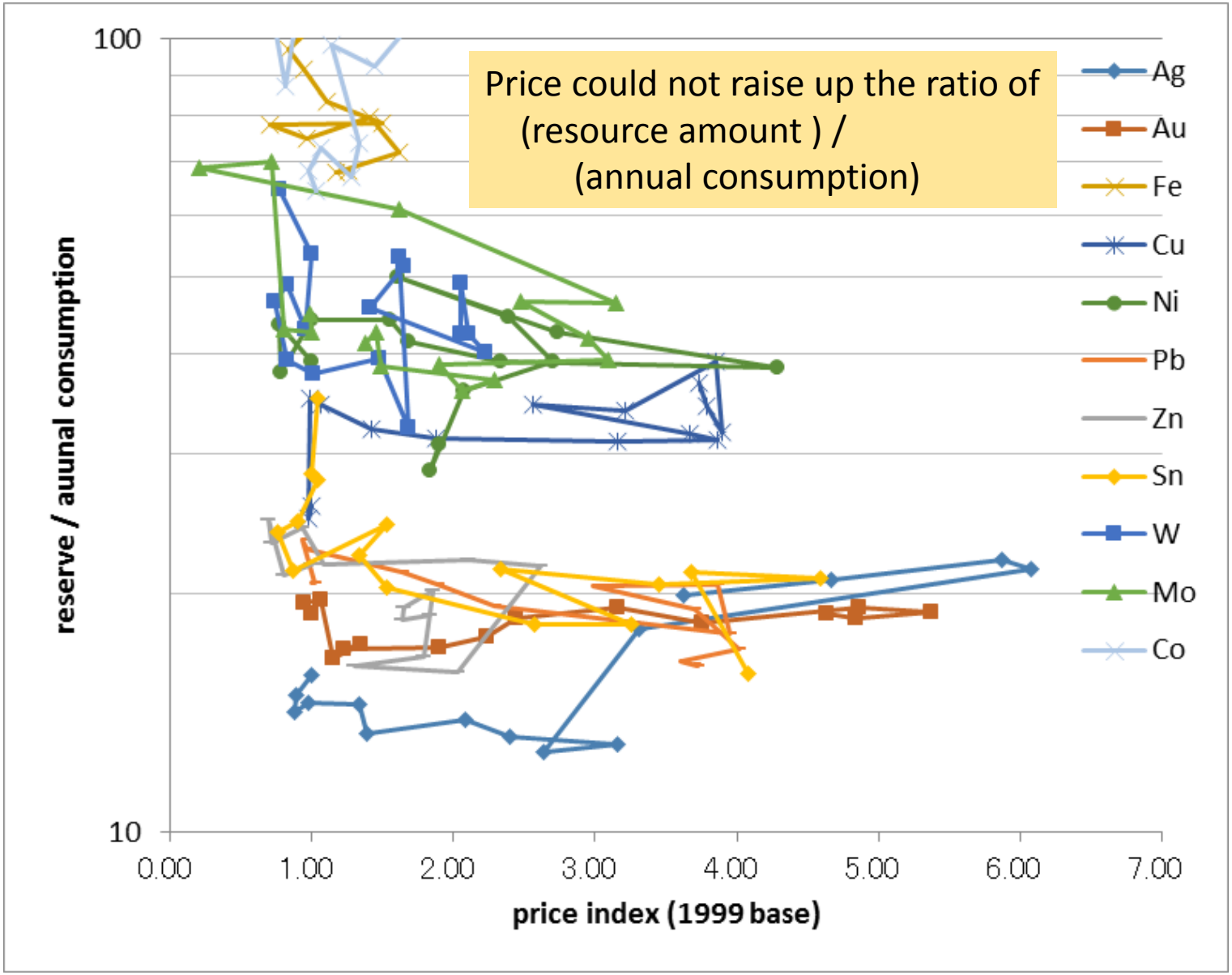
It is said that reserve increase when the price rises.

Prices had risen in these dozen of years.
How are reserves?

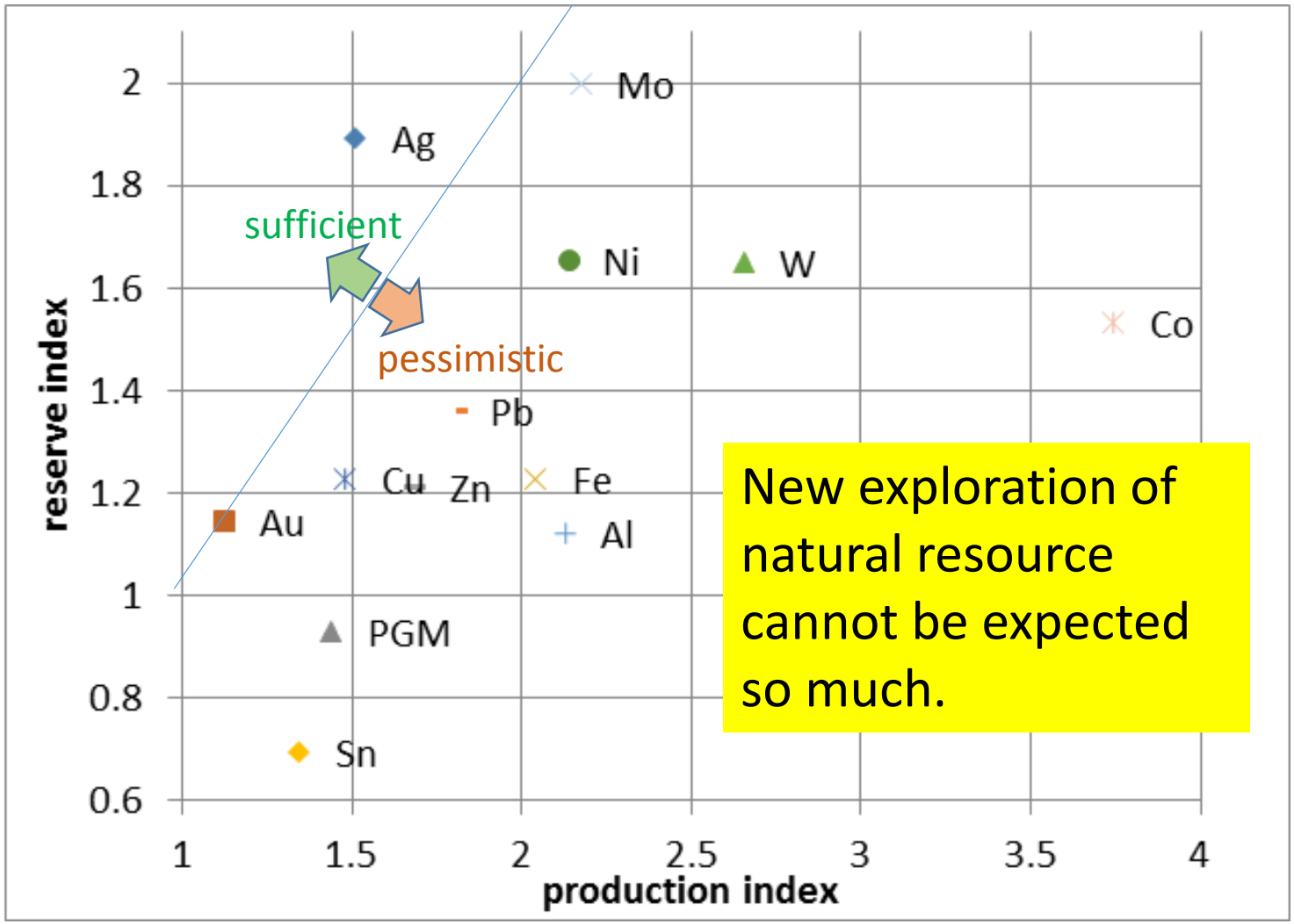

Transition of reserve and price of metals
reserve index
1.9
1.7
1.5
1.3
1.1
0.9
0.7
0.5
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
price index
It looks like soaring trend, but
Au
Ag
PGM
Fe
Cu
Ni
Al
Pb
Sn
Zn
W
Mo
Co

Reserve ratio to annual consumption is decreasing




Price could not raise up the ratio of
(resource amount) /
(annual consumption)
100
10
reserve / auunal consumption
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
price index (1999 base)
Ag
Au
Fe
Cu
Ni
Pb
Zn
Sn
W
Mo
Co

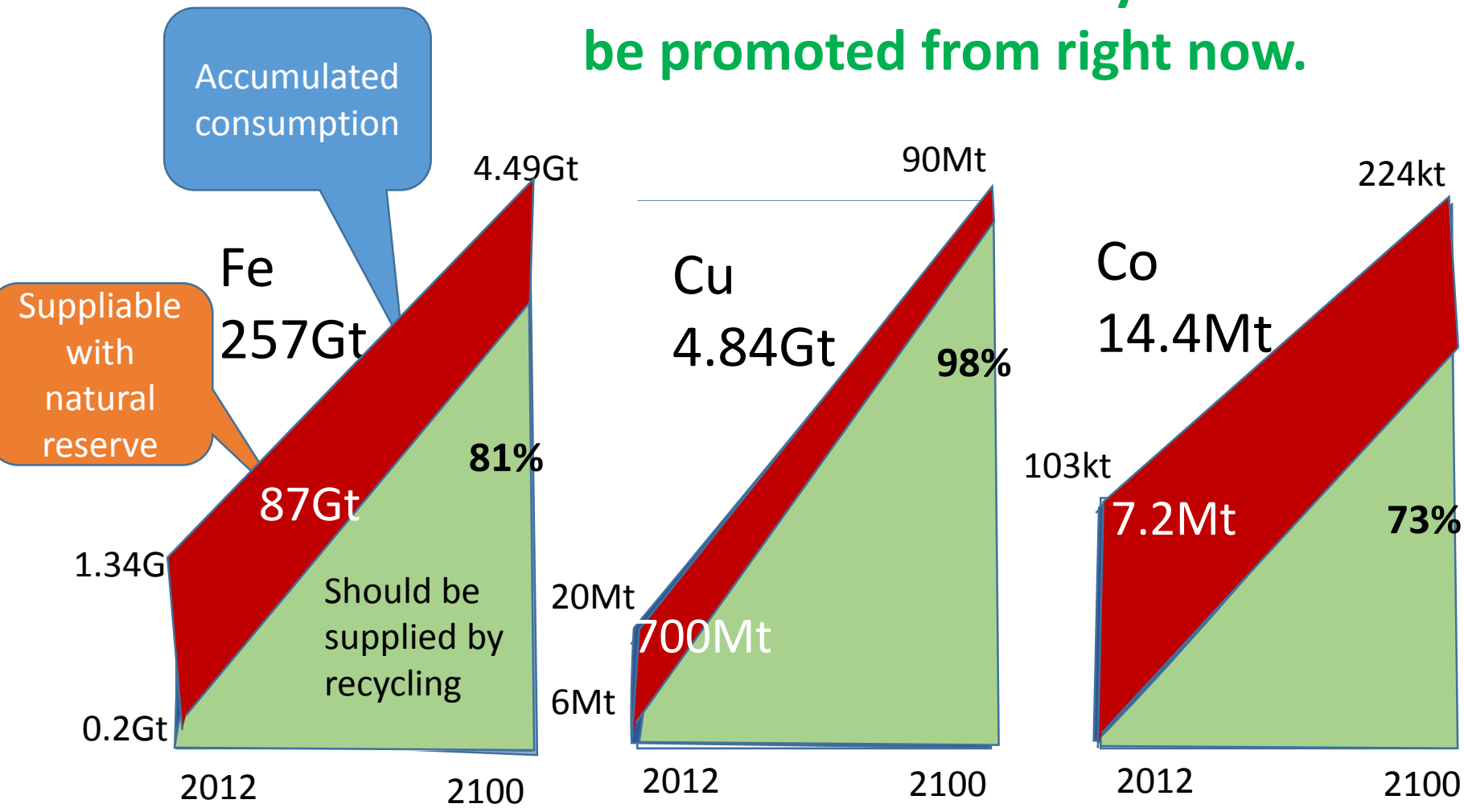
Sustainable reserve development line



New exploration of natural resource cannot be expected so much.

What can solve it?

The circulation society must be promoted from right now.



Estimated accumulated consumptions till 2100 with simple assumption of linear growth

conclusion

- Material flow has shifted from EU, Us, JP trilateral structure to the concentration to China as the Factory of the World

- Behind China, large demand of developing countries to growth exists, and the world average GDP/capita has reached $10,000.

- $10,000 GDP/capita is a transition point of metal consumption, where consumption/capita reaches to be developed level.

- We are now at the entrance of 100billions' universal economy which require a great amount of metals which cannot be supplied by natural resource.

- We have to rush to establish the circulation economy.

Thank you !

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