

Innovation Review from EU and Japan

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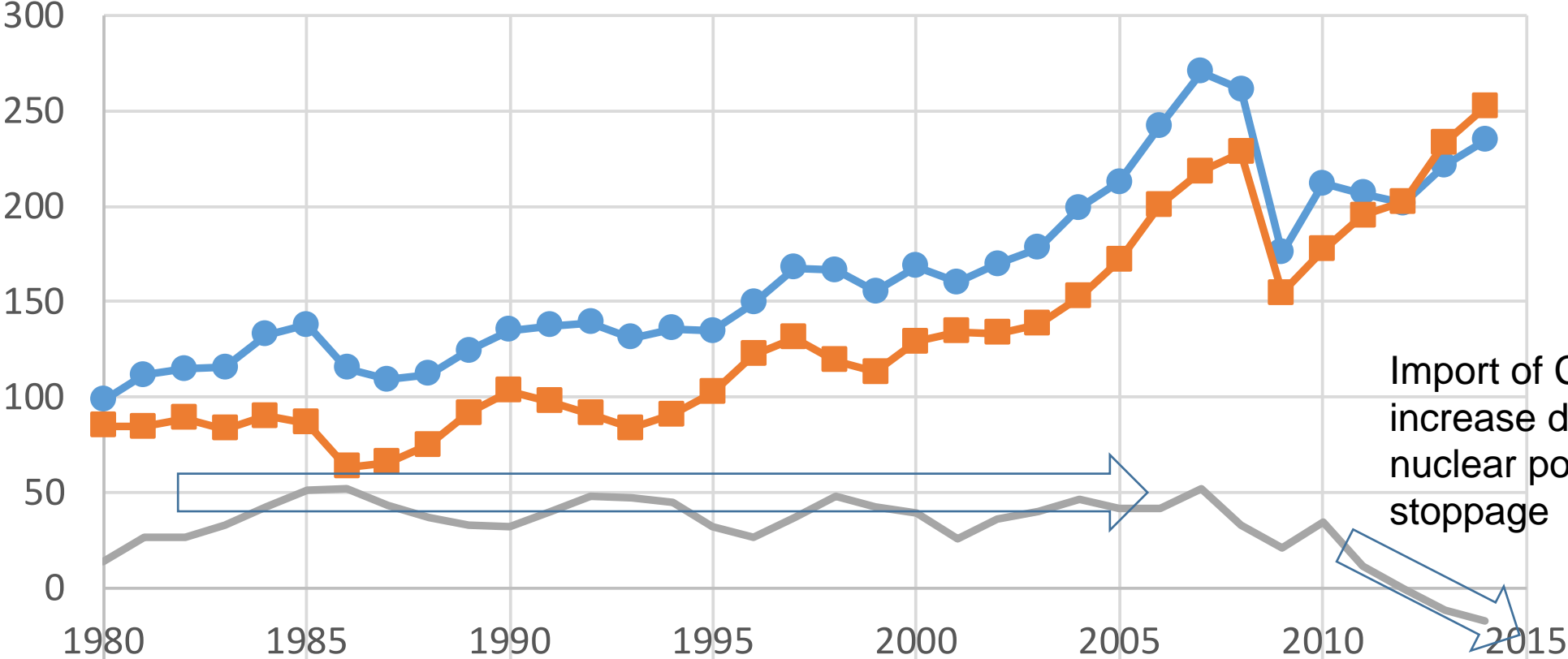
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1 International Competitiveness

- Trade balance is deteriorating due to stoppage of nuclear power plant.
- Traditionally, machinery industries have been leading trade balance
- However, international competitiveness of electric equipment and precision instruments become worsen.
- Is this a lack of innovation?

Economy as a whole

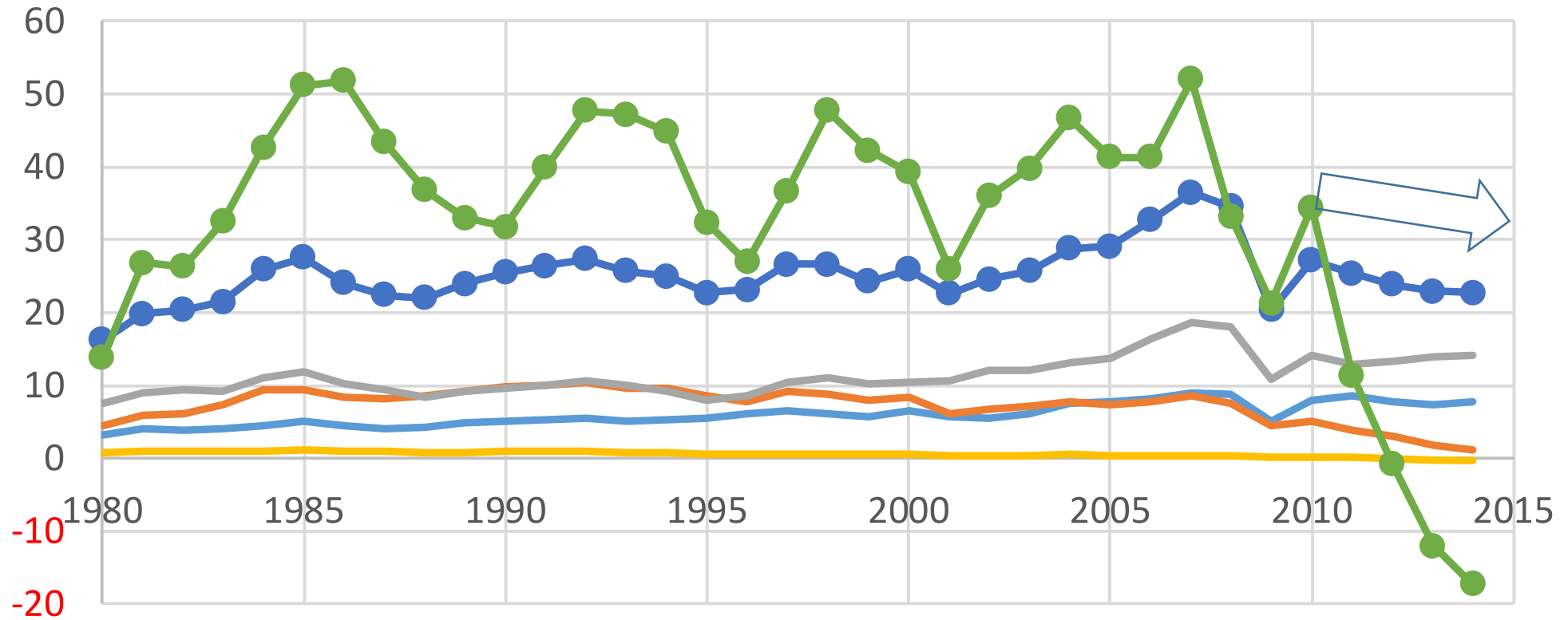
Trillion Yen



Import of Crude Oil increase due to nuclear power plant stoppage

● Export ■ Import — E-M

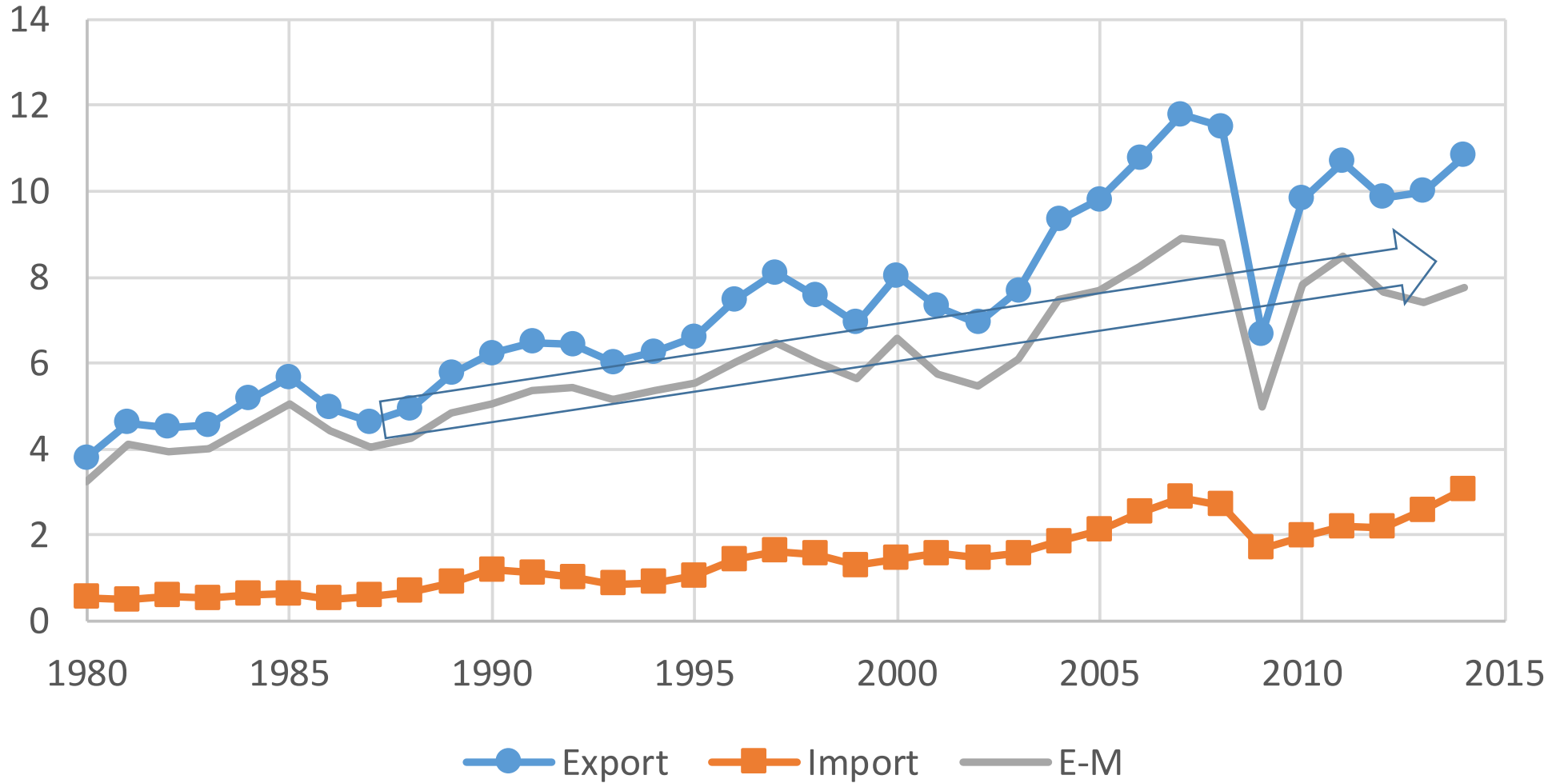
E-M



— General Machinery — Electric Machinery — Transport Machinery
— Precision Instruments ● Sum of 4 Machineries ● Whole Economy

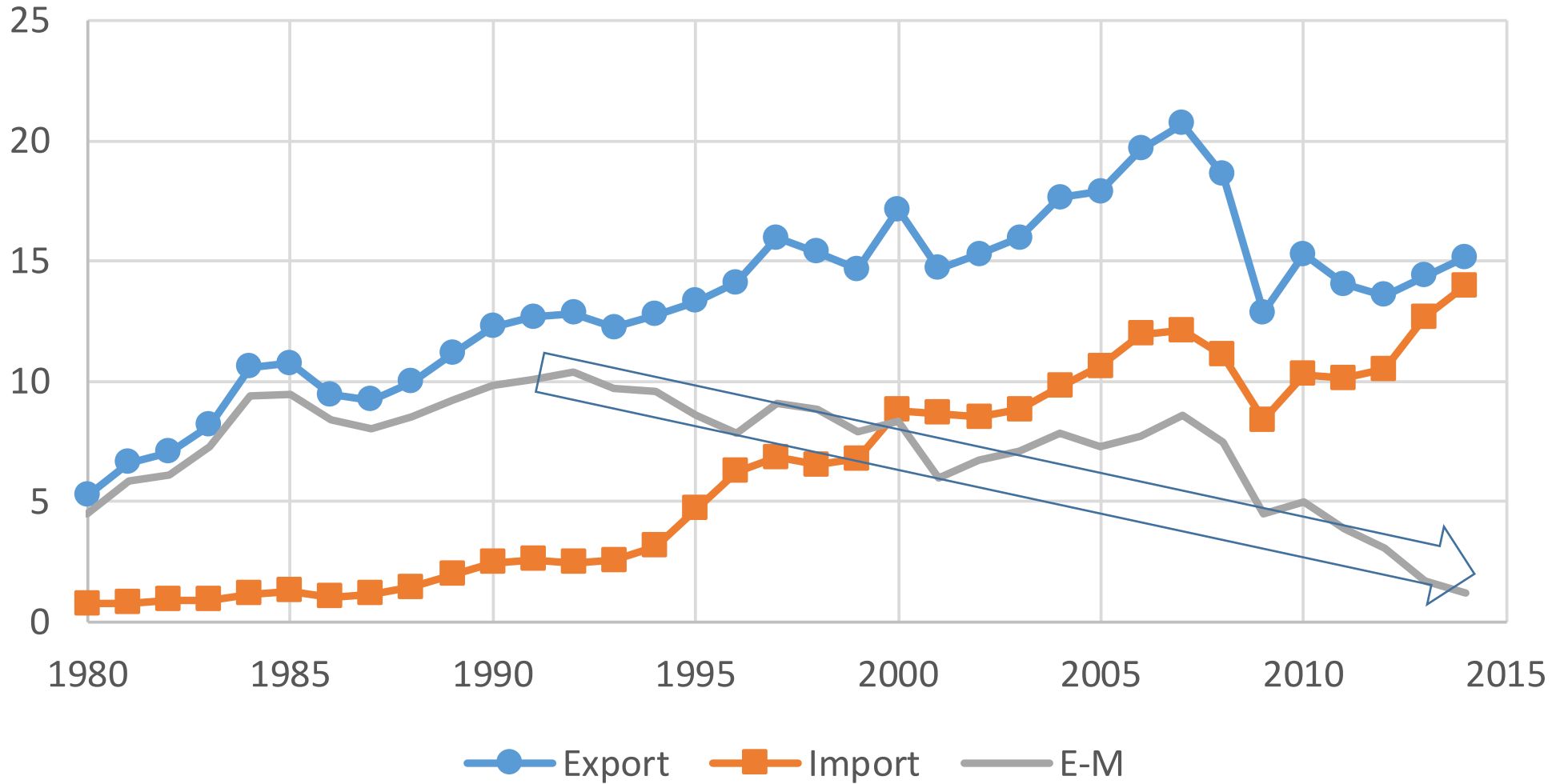
General Machinery

Trillion Yen



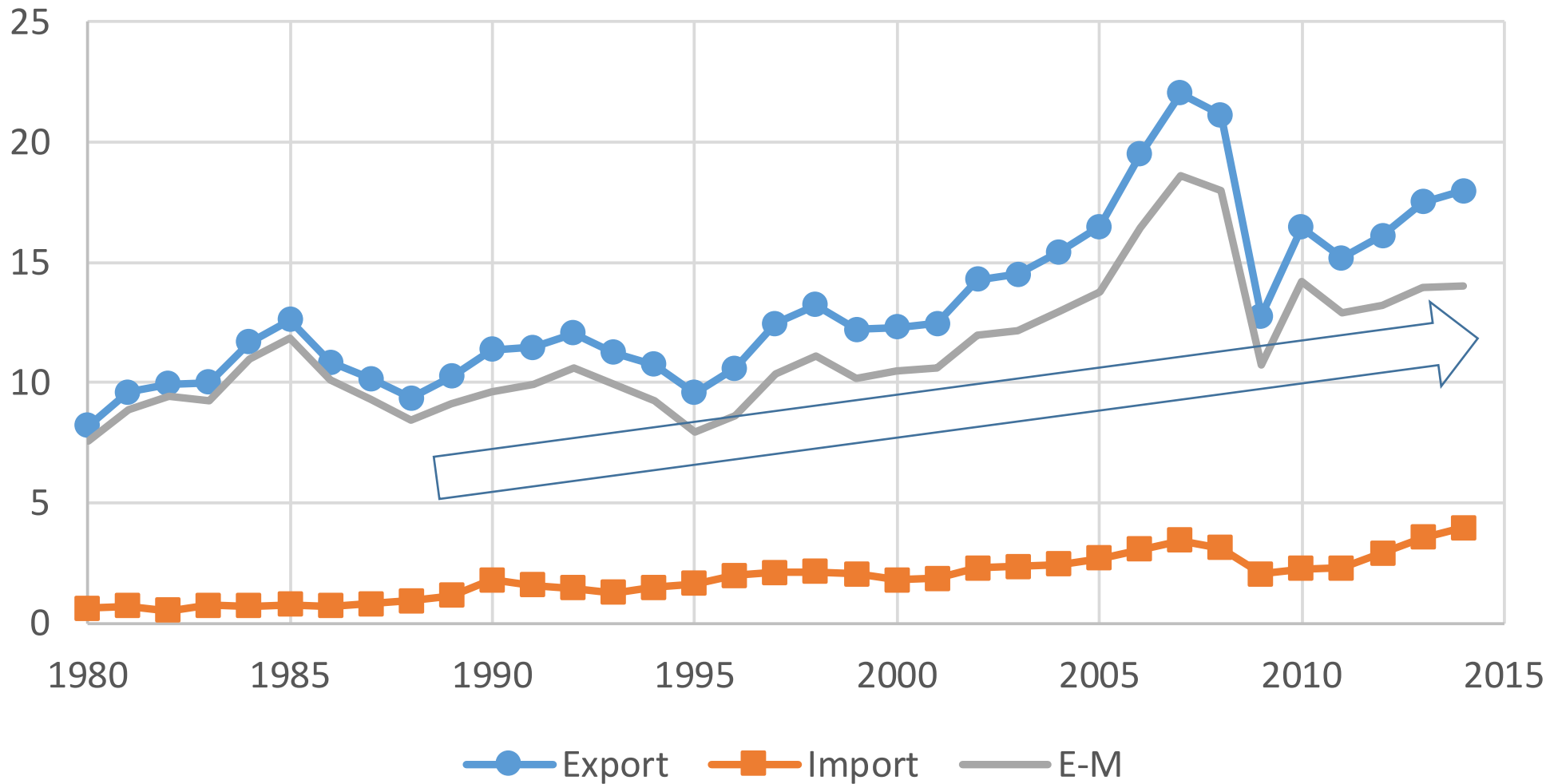
Electric Machinery

Trillion Yen



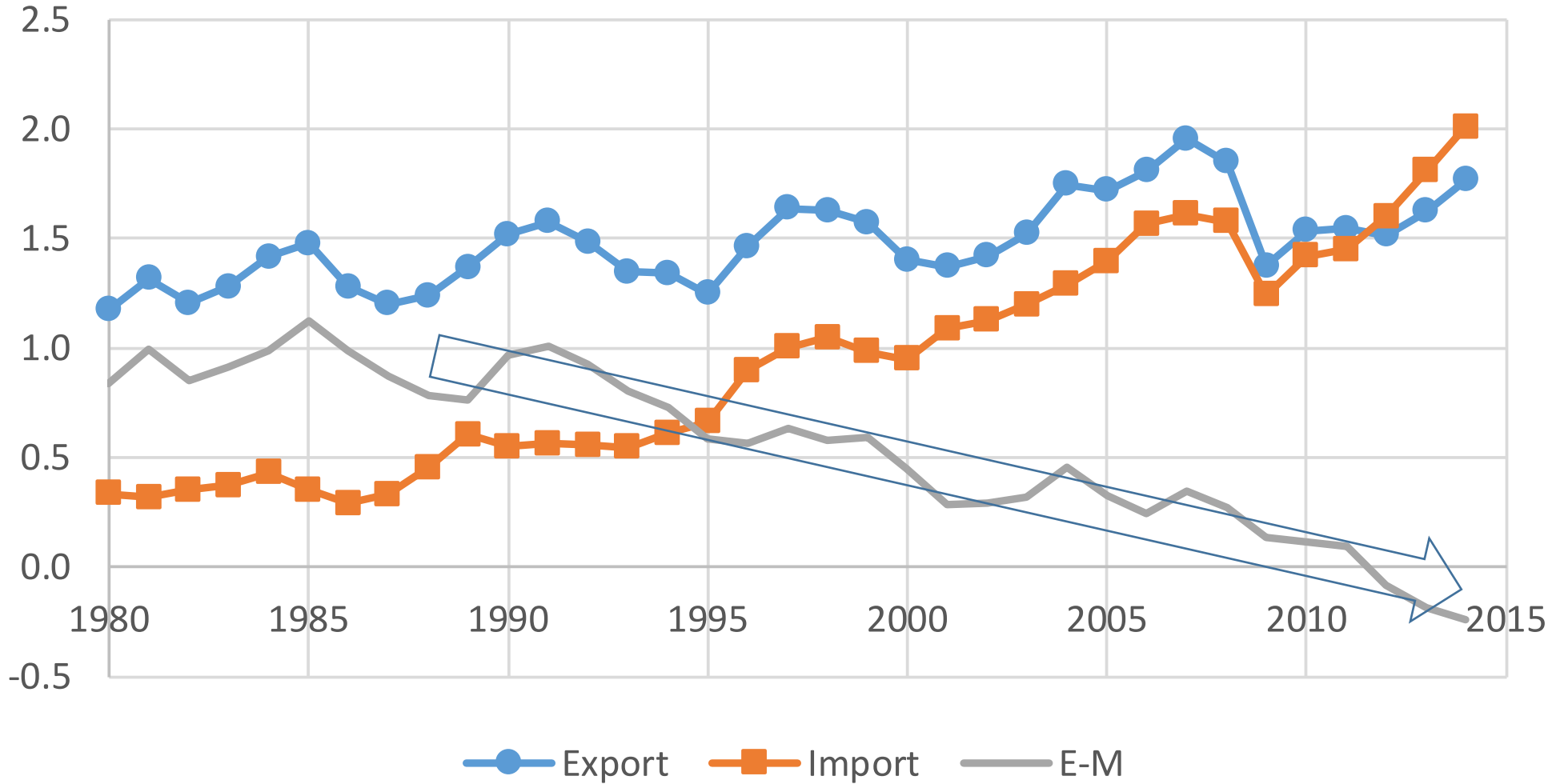
Transport Equipment

Trillion Yen



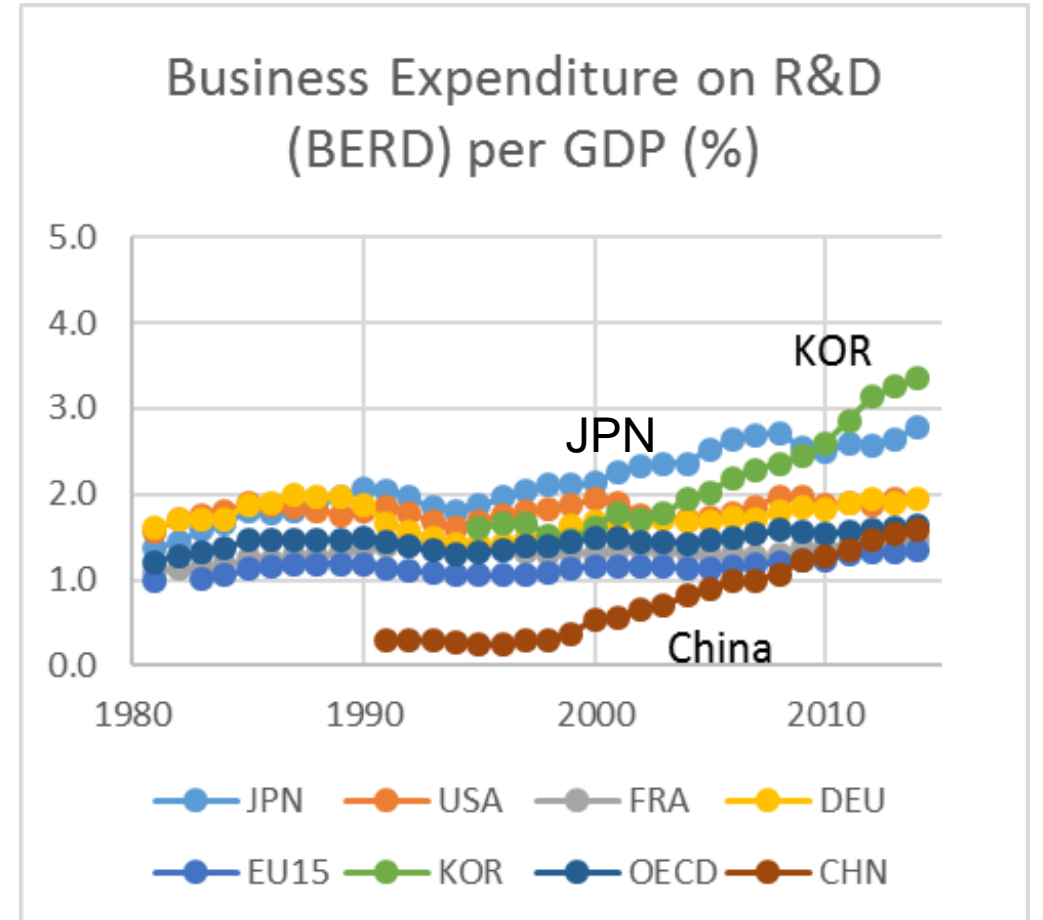
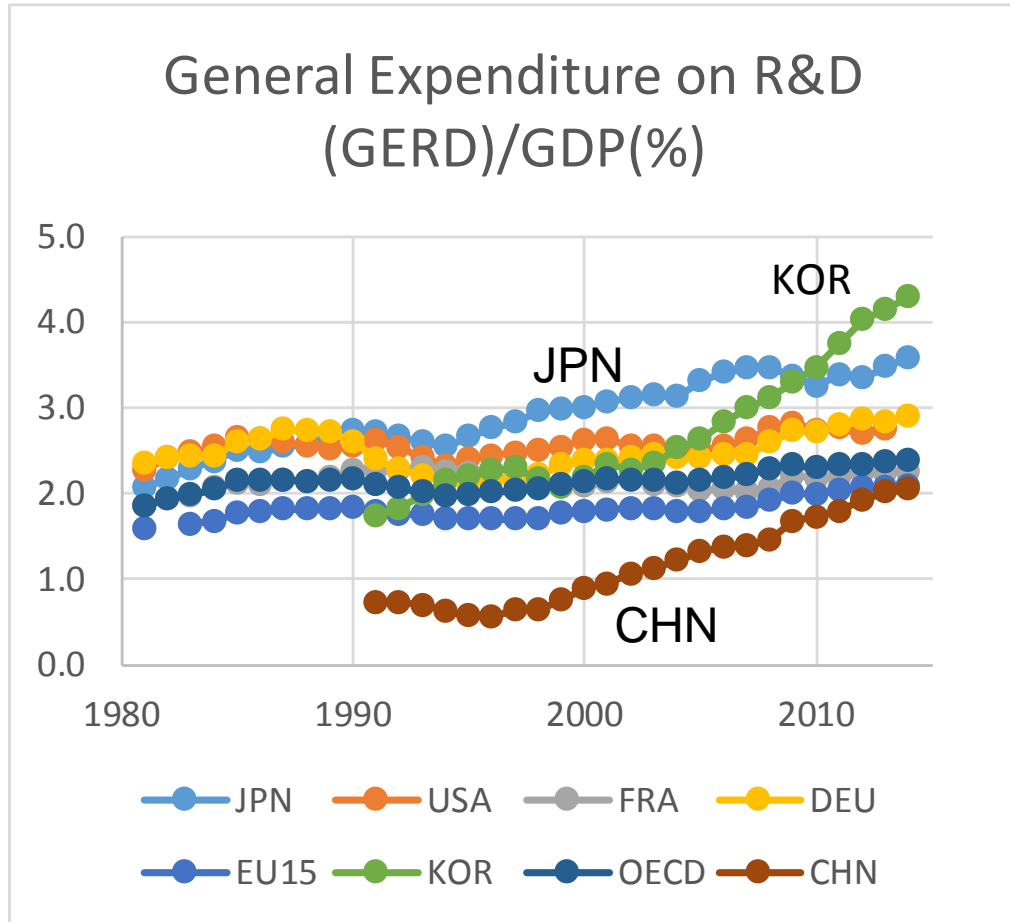
Precision Instrument

Trillion Yen



- Electric industry and precision instruments is losing international competitiveness.
- Can general machinery and transport equipment keep competitiveness?

2 R&D Expenditure



- R&D intensity in Japan is still high, even though overtaken by Korea
- Due to slow growth, amount of R&D expenditure is not so growing fast.
- Individual companies are performing high R&D (EU R&D Scoreboard 2015)

	GERD	BERD
JPN	3.6	2.8
USA	2.7	1.9
FRA	2.3	1.5
DEU	2.9	2.0
EU15	2.1	1.3
KOR	4.3	3.4
OECD	2.4	1.6
CHN	2.0	1.6

EU R&D Scoreboard 2015 : World – 2500 companies ranked by R&D

rank	Name	Nat	Industrial sector (ICB-3D)	R&D (€mil.)	R&D int (%)
1	VOLKSWAGEN	DE	Automobiles & Parts	13,120	6.5
2	SAMSUNG	KR	Electronic & Electrical Equipment	12,187	7.9
3	MICROSOFT	US	Software & Computer Services	9,922	12.9
4	INTEL	US	Technology Hardware & Equipment	9,503	20.6
5	NOVARTIS	CH	Pharmaceuticals & Biotechnology	8,218	16.7
6	GOOGLE	US	Software & Computer Services	8,098	14.9
7	ROCHE	CH	Pharmaceuticals & Biotechnology	7,422	18.8
8	JOHNSON & JOHNSON	US	Pharmaceuticals & Biotechnology	6,996	11.4
9	TOYOTA	JP	Automobiles & Parts	6,858	3.7
10	PFIZER	US	Pharmaceuticals & Biotechnology	6,845	16.8
11	GENERAL MOTORS	US	Automobiles & Parts	6,095	4.7
12	MERCK US	US	Pharmaceuticals & Biotechnology	6,056	17.4
13	FORD	US	Automobiles & Parts	5,683	4.8
14	DAIMLER	DE	Automobiles & Parts	5,650	4.4
15	HUAWEI	CN	Financial Services	5,441	14.0
16	CISCO SYSTEMS	US	Technology Hardware & Equipment	5,112	12.6
17	ROBERT BOSCH	DE	Automobiles & Parts	5,042	10.3
18	APPLE	US	Technology Hardware & Equipment	4,976	3.3
19	SANOFI	FR	Pharmaceuticals & Biotechnology	4,812	14.2
20	HONDA	JP	Automobiles & Parts	4,577	5.0

EU R&D Scoreboard 2015 : World – 2500 companies ranked by R&D

rank	Name	Nat	Industrial sector (ICB-3D)	R&D (€mil.)	R&D int (%)
21	BMW	DE	Automobiles & Parts	4,566	5.7
22	ORACLE	US	Software & Computer Services	4,550	14.5
23	QUALCOMM	US	Technology Hardware & Equipment	4,511	20.7
24	SIEMENS	DE	Electronic & Electrical Equipment	4,377	6.1
25	IBM	US	Software & Computer Services	4,336	5.7
26	ASTRAZENECA	UK	Pharmaceuticals & Biotechnology	4,164	19.4
27	GLAXOSMITHKLINE	UK	Pharmaceuticals & Biotechnology	4,002	13.5
28	ERICSSON	SE	Technology Hardware & Equipment	3,857	15.9
29	BAYER	DE	Pharmaceuticals & Biotechnology	3,689	8.7
30	FIAT CHRYSLER	NL	Automobiles & Parts	3,665	3.8
31	AIRBUS	NL	Aerospace & Defence	3,616	6.0
32	AMGEN	US	Pharmaceuticals & Biotechnology	3,499	21.2
33	GENERAL ELECTRIC	US	General Industrials	3,487	2.8
34	NISSAN	JP	Automobiles & Parts	3,456	4.4
35	BRISTOL-MYERS SQUIBB	US	Pharmaceuticals & Biotechnology	3,426	26.2
36	ELI LILLY	US	Pharmaceuticals & Biotechnology	3,249	20.1
37	SONY	JP	Leisure Goods	3,170	5.7
38	PANASONIC	JP	Leisure Goods	3,122	5.9
39	EMC	US	Technology Hardware & Equipment	2,916	14.5
40	HEWLETT-PACKARD	US	Technology Hardware & Equipment	2,839	3.1

EU R&D Scoreboard 2015 : World – 2500 companies ranked by R&D

rank	Name	Nat	Industrial sector (ICB-3D)	R&D (€mil.)	R&D int (%)
41	NOKIA	FI	Technology Hardware & Equipment	2,718	17.9
42	ABBVIE	US	Pharmaceuticals & Biotechnology	2,716	16.5
43	DENSO	JP	Automobiles & Parts	2,699	9.2
44	BOEHRINGER INGELHEIM	DE	Pharmaceuticals & Biotechnology	2,654	19.9
45	TAKEDA	JP	Pharmaceuticals & Biotechnology	2,609	21.5
46	LG	KR	Leisure Goods	2,597	5.9
47	TOSHIBA	JP	General Industrials	2,408	5.3
48	GILEAD SCIENCES	US	Pharmaceuticals & Biotechnology	2,351	11.5
49	TATA S	IN	Automobiles & Parts	2,346	6.9
50	SAP	DE	Software & Computer Services	2,307	13.1
51	HITACHI	JP	Electronic & Electrical Equipment	2,286	3.4
52	BOEING	US	Aerospace & Defence	2,272	3.0
53	PEUGEOT	FR	Automobiles & Parts	2,260	4.2
54	ALCATEL-LUCENT	FR	Technology Hardware & Equipment	2,250	16.5
55	FACEBOOK	US	Software & Computer Services	2,196	21.4
56	CONTINENTAL	DE	Automobiles & Parts	2,196	6.4
57	UNITED TECHNOLOGIES	US	Aerospace & Defence	2,170	4.0
58	CANON	JP	Technology Hardware & Equipment	2,110	8.3
59	EBAY	US	General Retailers	1,973	13.4
60	BROADCOM	US	Technology Hardware & Equipment	1,955	28.2

Number of top 500 R&D performing companies by industry

Industry	Tot	USA	JPN	DEU	CHN	FRA	GBR	TWN	NLD	KOR
Total	500	173	86	36	34	31	26	16	14	12
Technology Hardware & Equipment	81	44	8	1	5	1	1	11	3	1
Pharmaceuticals & Biotechnology	54	21	7	4		4	3		1	
Automobiles & Parts	53	8	16	9	7	4	2		1	3
Software & Computer Services	45	31	2	1	4	2	1		1	
Electronic & Electrical Equipment	39	8	15	1	1	2	1	5	2	2
Industrial Engineering	31	9	5	2	3	1			1	1
Chemicals	25	5	8	3		1	1		2	
Aerospace & Defence	19	8				4	2		1	
Health Care Equipment & Services	19	11	2	4			1			
Banks	15			2	1	1	4			
General Industrials	15	3	6	3	1	1			1	
Oil & Gas Producers	13	3			3	1	2			
Construction & Materials	11	1	1		6	1				
Leisure Goods	10	3	5							1

Includes Panasonic,
Sony and Nikon

R&D performance

- Among top 2500 R&D companies, Japan has strength in Automobile and Electronics
- On the other hand, weak areas are:
 - “Software & Computer Services”
 - (like Microsoft, Google, etc.) Fujitsu, NEC
 - “Technology Hardware & Equipment”
 - (Intel, Cisco, Qualcomm, etc.) Canon
- “Aerospace & Defense” and “Pharmaceuticals & Biotechnology” are traditionally weak

3 Patenting Activity

- Top patenting companies (applied to USPTO)
- “Computer, Electronic and Optical Product”

Company	2000-04	2005-09	2010-14
computer, electronic and optical products			
JP:SONY CORPORATION	13,127	21,171	28,518
JP:TOSHIBA CORPORATION	12,454	22,616	27,851
JP:FUJITSU LIMITED	12,472	17,617	18,021
JP:SEIKO EPSON CORPORATION	7,303	15,404	16,104
US:APPLE INC.	801	3,605	15,344
US:INTEL CORP	11,781	17,260	12,018
JP:SHARP CORPORATION	5,392	7,830	11,246
SE:TELEFONAKTIEBOLAGET LM ERICSSON	3,468	3,625	10,841
JP:NEC CORPORATION	12,849	7,833	8,718
CN:HUAWEI TECHNOLOGIES CO., LTD.	89	1,830	7,405
FI:NOKIA OYJ	4,148	8,574	7,195
JP:KYOCERA CORPORATION	743	2,559	4,586
US:RAYTHEON COMPANY	1,243	1,700	3,455
JP:MURATA MANUFACTURING CO. LIMITED	3,177	1,772	3,429
CN:ZTE CORP.	5	112	3,397
JP:TDK CORPORATION	2,029	3,813	2,479
US:EMC CORP	739	1,363	2,182
JP:KONICA MINOLTA, INC.	1,784	1,279	1,607
JP:OMRON CORPORATION	609	1,182	1,189
US:WESTERN DIGITAL TECHNOLOGIES INC	205	412	880

Data retrieved via Orbis (Bureau van Dyke)
 Industry classification NACE is different from
 2500 R&D companies

Patenting

- “Electrical Equipment”

electrical equipment			
Company	2000-04	2005-09	2010-14
JP:PANASONIC CORPORATION	16,265	23,590	27,314
NL:KONINKLIJKE PHILIPS N.V.	6,860	10,984	11,535
JP:HITACHI LTD	14,836	15,631	11,277
JP:MITSUBISHI ELECTRIC CORPORATION	9,518	6,391	8,269
US:WHIRLPOOL CORP	363	980	1,967
JP:FUJ ELECTRIC CO., LTD.	599	383	1,368
DE:BSH HAUSGERAETE GMBH	398	1,130	1,316
JP:STANLEY ELECTRIC CO LTD	166	352	782
DE:EPCOS AG	138	341	537
US:HUBBELL INC	325	327	504
CN:BYD COMPANY LIMITED	2	137	448
DE:HELLA KGAA HUECK & CO.	68	56	218
FR:SEB S.A.	125	203	205
BR:WHIRLPOOL S.A.	34	84	198
JP:BROTHER INDUSTRIES LTD	111	337	167
SE:AB ELECTROLUX	130	108	159
TR:AR ELIK ANONIM SIRKETI	5	13	77
US:A.O. SMITH CORPORATION	48	119	50
US:AMETEK INC	49	37	28
JP:GS YUASA CORPORATION	9	64	23

Patenting

- “Machinery and Equipment”

machinery and equipment n.e.c.			
Company	2000-04	2005-09	2010-14
JP:CANON INC.	17,968	25,414	35,507
US:GENERAL ELECTRIC COMPANY	8,515	12,579	19,172
JP:RICOH CO LTD	4,508	9,602	12,275
DE:SIEMENS AG	6,547	8,936	9,289
US:BAKER HUGHES INC	1,280	2,479	4,361
US:CATERPILLAR INC	1,861	2,343	3,340
JP:MITSUBISHI HEAVY INDUSTRIES LTD	1,301	1,078	3,067
US:ILLINOIS TOOL WORKS INC	1,628	2,313	2,243
US:DEERE & CO	1,138	1,729	1,940
GB:ROLLS-ROYCE PLC	474	1,060	1,879
JP:JTEKT CORP.	525	1,244	1,717
JP:DAIKIN INDUSTRIES LIMITED	550	998	1,567
JP:NTN CORPORATION	530	765	1,209
CN:FUTAIHUA INDUSTRIAL (SHENZHEN) CO.,	0	0	1,124
JP:KOMATSU LTD	726	645	967
US:NCR CORP	1,046	835	841
SE:SKF AB	79	207	664
US:CAMERON INTERNATIONAL CORPORATION	126	202	637
JP:HITACHI CONSTRUCTION MACHINERY CO.,	168	225	636
JP:IHI CORP.	165	279	612

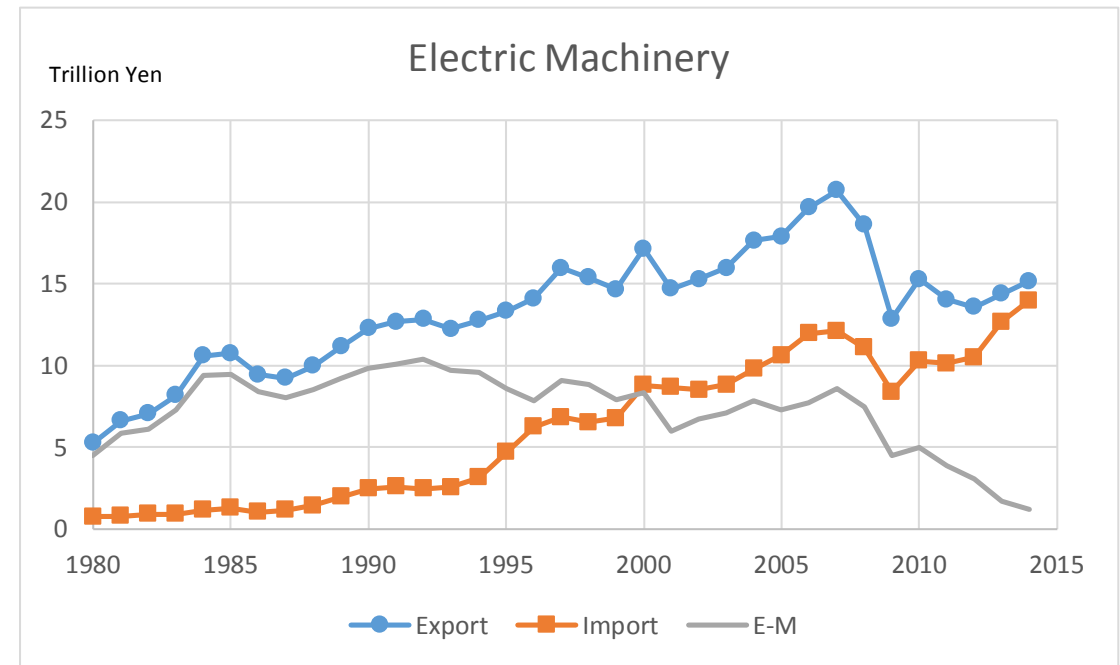
Patenting

- “Motor Vehicles, Trailers and Semi-Trailers”

Company	2000-04	2005-09	2010-14
DE:ROBERT BOSCH GESELLSCHAFT MIT BESCHRAENKT	6,042	6,152	9,727
JP:DENSO CORPORATION	5,340	9,216	8,277
US:HONEYWELL INTERNATIONAL INC	3,722	7,822	8,047
JP:NISSAN MOTOR CO LTD	2,630	3,242	2,315
JP:AISIN SEIKI CO LTD	1,079	1,339	1,802
DE:DAIMLER AG	2,525	2,328	1,419
DE:BAYERISCHE MOTOREN WERKE AG	606	1,197	1,353
DE:AUDI AKTIENGESELLSCHAFT	87	198	841
US:LEAR CORP	671	1,353	757
JP:SUZUKI MOTOR CORPORATION	423	221	709
JP:MAZDA MOTOR CORPORATION	502	652	699
US:BORGWARNER INC	461	632	680
US:GENERAL MOTORS COMPANY	2,235	2,747	635
US:FORD MOTOR CO	394	592	612
DE:VOLKSWAGEN AG	360	380	527
JP:TAKATA CORPORATION	473	810	352
JP:NOK CORPORATION	117	243	283
JP:ISUZU MOTORS LIMITED	304	234	249
FR:PEUGEOT CITROEN AUTOMOBILES SA	69	283	228
SE:SCANIA CV AKTIEBOLAG	81	105	213

4 Why Electronics Industry is losing competitiveness

- Japanese Electronics Companies spent large amount of R&D and apply many patents.
- But trade balance has been deteriorating gradually since early 1990's and sharply since 2008.



4-1 Possible explanation

- Exchange rate and FDI:
 - appreciation of the yen worsen Japanese exporter competitiveness
 - in face to appreciation of the yen, Japanese companies move their production to abroad
- But, automobile industry faces the same challenge.
- Why Japanese electronics companies lost competitiveness?
 - Japanese companies exit from liquid crystal TV
 - Sharp was bought by Hon-Hai
 - Only electronic component companies with high quality have competitiveness (ex. Murata). Half component of iPhone is made by Japanese companies

4-2 Fail to get global standard

“Galapagos Syndrome”

- Innovation cumulated within Japan and original products evolved, but in different direction from world trend
- Case: Mobile phone
 - Frequency band allocation was auctioned in many countries. Providers suffered from huge amount of payment. They chose cheap low quality communication system. GSM widespread including developing countries.
 - In Japan, government lend frequency band freely. Providers could choose high quality communication system. This led to original evolution but Japanese mobile phone technology went far from global standard.
 - Usage of mobile phone as browser (“i-mode”) was introduced in 1999, first in the world. But it could not get global standard.

4-3 Pursuit of too high quality

Change in DRAM situation:

- DRAM for mainframe computer required long life.
- On the contrary, PC change model frequently and become outdated quickly due to software (incl. OS) evolution.
- DRAM for PC does not require long life as mainframe.
- Samsung adjusted and produce low quality and low price.
- Japanese manufacturer stick to high quality.
- Then lost competitiveness

4-4 Fabless vs. EMS

- Module production becomes dominant, in which components following technical standard are produced by different companies and assembled
- Separation of design and production becomes dominant
 - fabless and EMS(electronics manufacturing service
 - ex. Apple and Hon-Hai
- Japanese companies stick to integration of design and production. They could not specialize to design company nor production company.

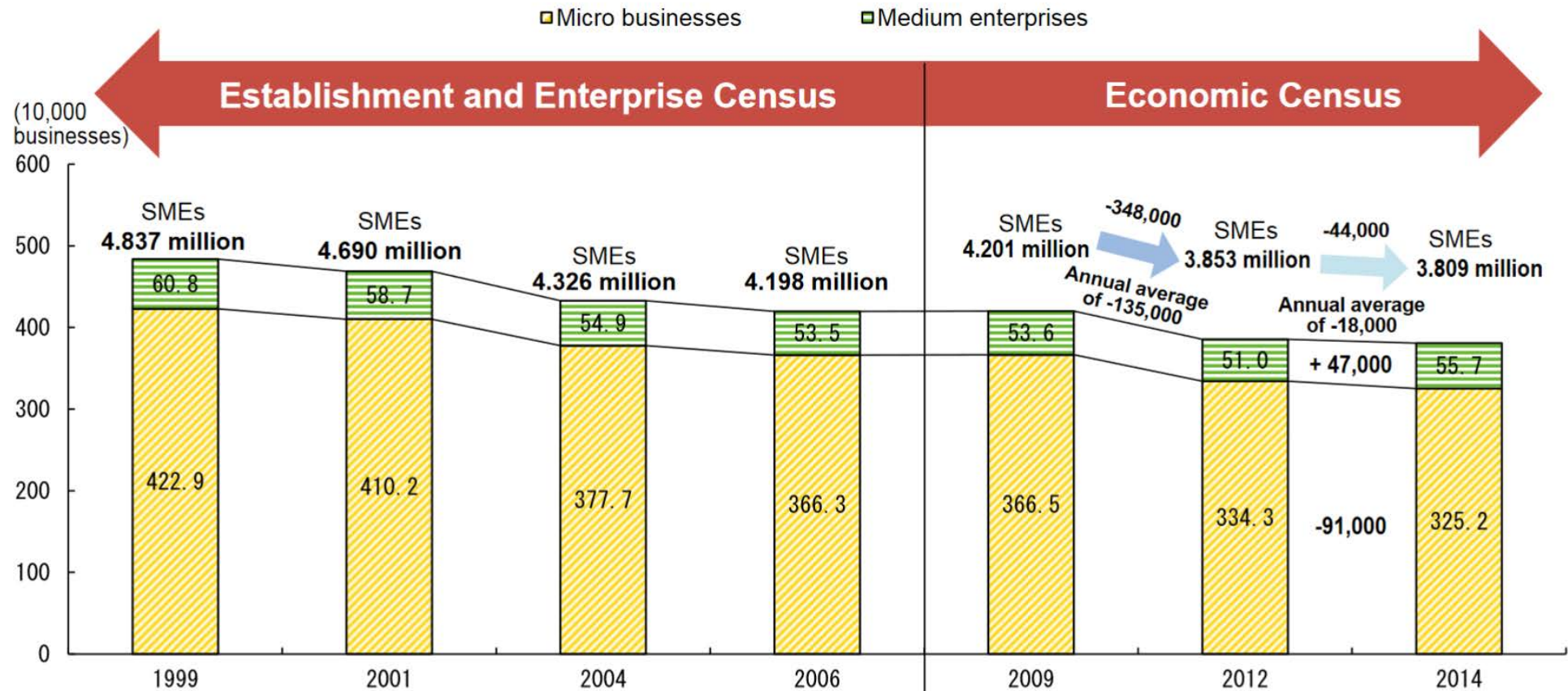
5 How about Automobile Industry?

- Automobile is said to be “integral production technology” (Fujimoto)
 - compared to module production, adjustment between component and total balance are important.
- However, common use of component is required to cut cost and importance of module production is increasing.
- IoT will make another trend. Shift from hardware to software like in computer.
- Essence of automobile may shift from vehicle to software.
- Then, current major car maker may disappear.

6 Other Issue: SME in Japan

- Number of SMEs is decreasing since 1980's

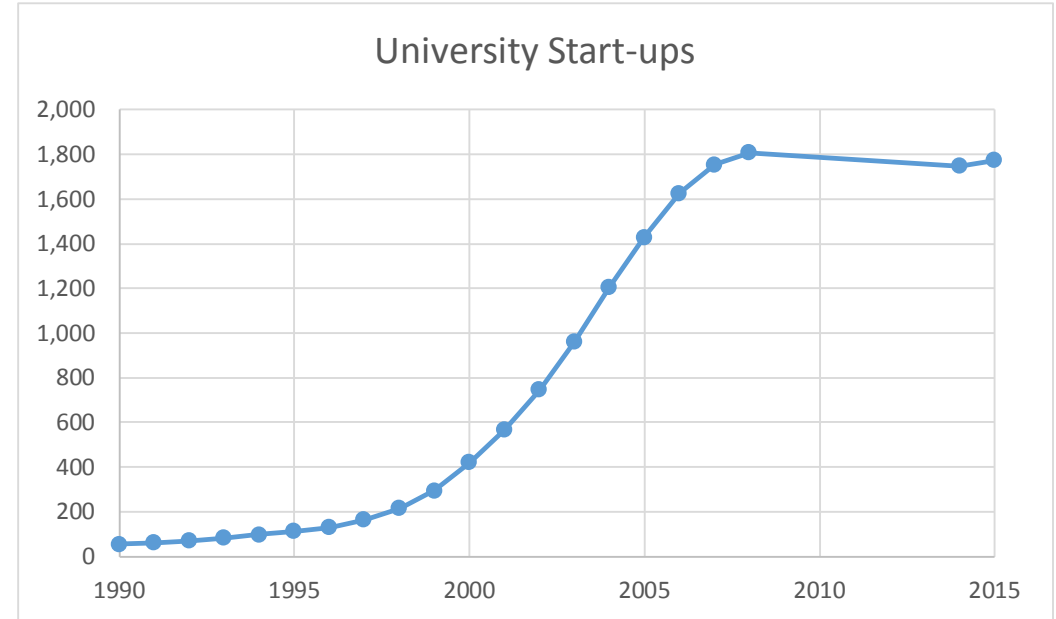
Fig. 1-2-1 Numbers of SMEs



- Technological ability of SME is said to be strong, which is basis of Japanese technology.
- But the number of SME is decreasing.
- Small number of entry comes from
 - Lack of entrepreneurship
 - High risk in face to failure (difficulty to challenge again)
 - Various regulation to create new business
- SME should be vitalize

University Start-ups

- METI promoted to increase Univ. Start-Ups 2001-2004
- Univ. Start-Ups increased but seems matured
- Venture capital allowed to invest to Univ. Start-Ups in 2014



7 Conclusion

- Electronics industry is losing competitiveness.
 - Failure in getting global standard
 - Failure in catching market needs
 - Failure in shifting to fabless
- While automobile industry has competitiveness at this moment, IoT may destroy current situation
- Stimulating new entry is important.

Thank you for your attention