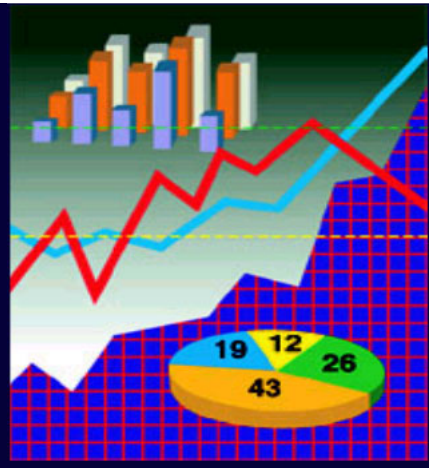


Business Outlook
Global Electronics Industry
(with emphasis on Europe)

Custer Consulting Group
www.custerconsulting.com
June 2019

2019 Situation

Global manufacturing growth is slowing based on PMI data.

Most sectors of the world electronic supply chain are now expanding slower or contracting.

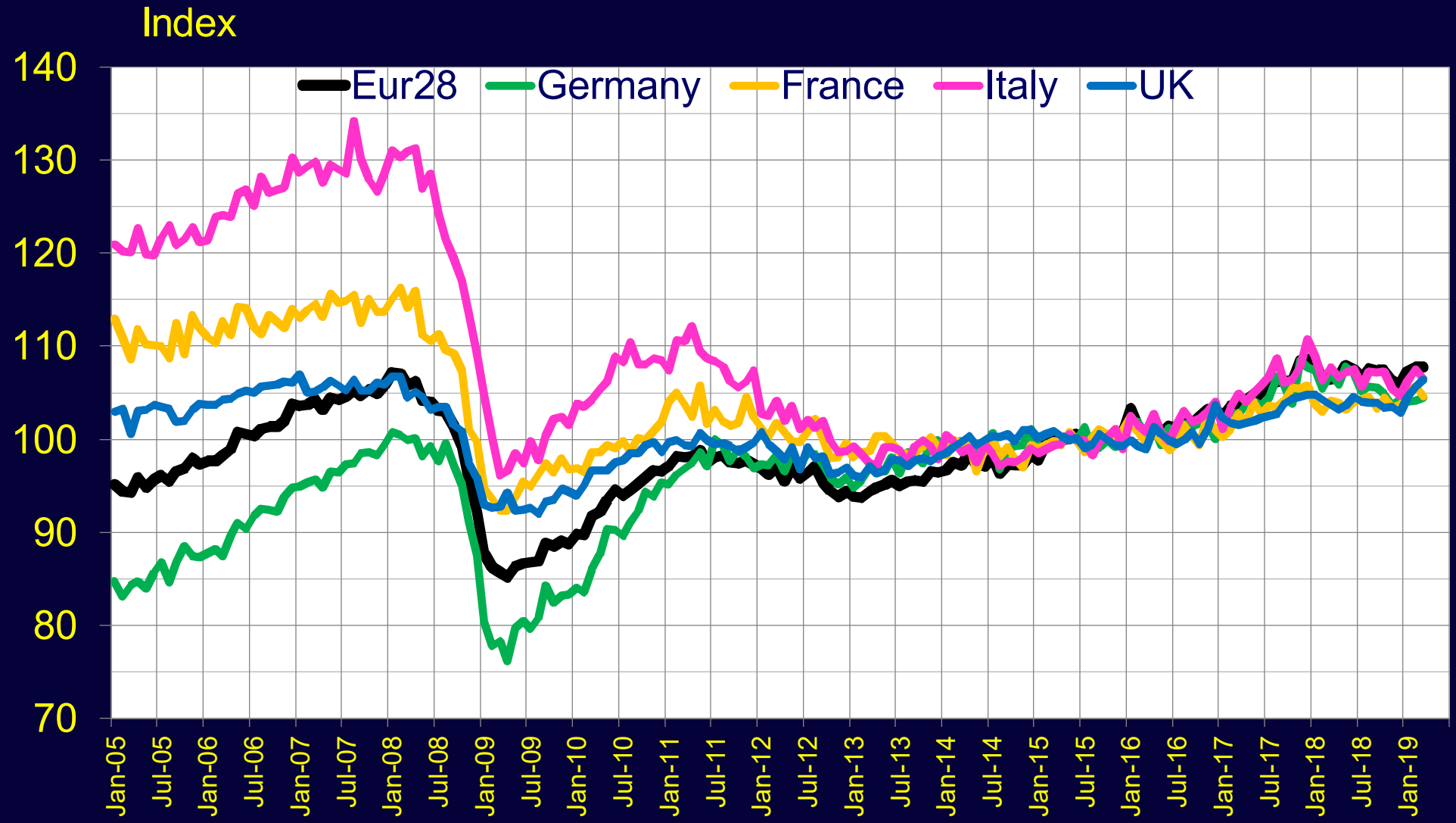
Tariffs, trade disputes and Brexit/EU are key issues

Geopolitical concerns remain very significant.

20190515

Industrial Production – Europe Manufacturing

Index (2015 Avg. Month = 100, Seasonally Adjusted)



Eurostat

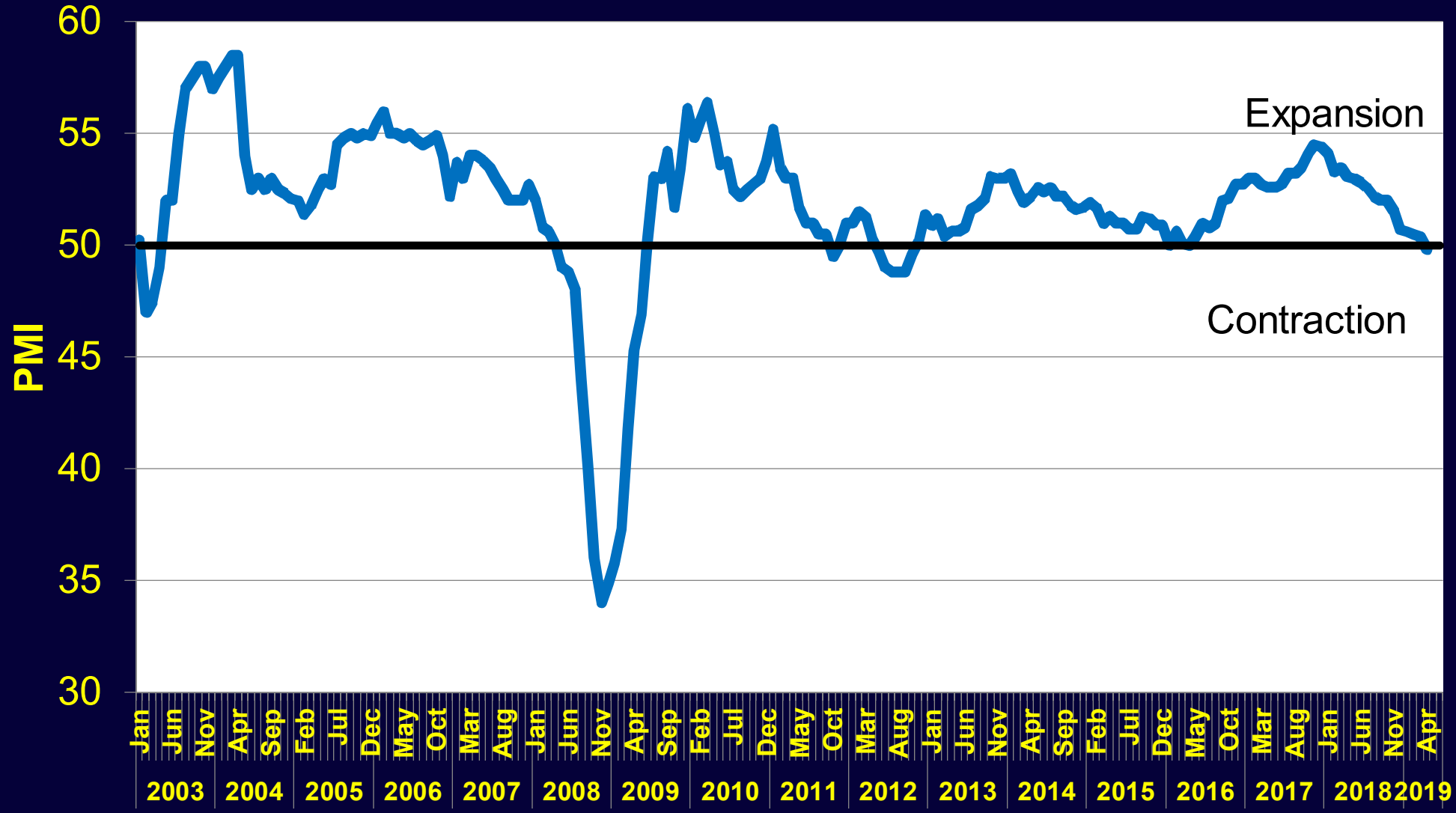
Purchasing Managers Indices

Useful but Sobering Leading Indicators

20190603

Global "Purchasing Managers" Index

Diffusion Index, >50 = Growth

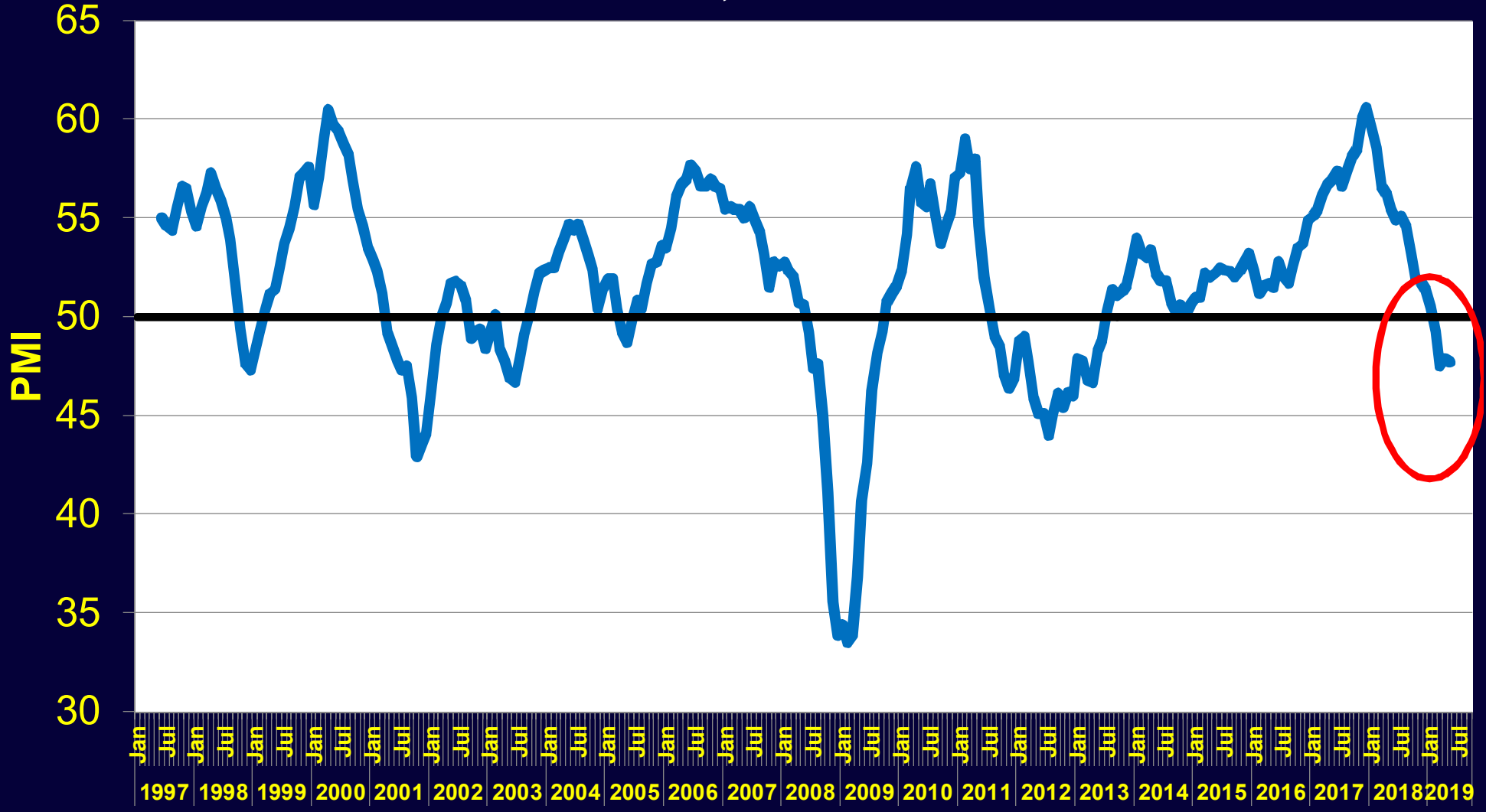


Markit Economics

20190603

Eurozone Manufacturing "Purchasing Managers" Index

Diffusion Index, >50 = Growth

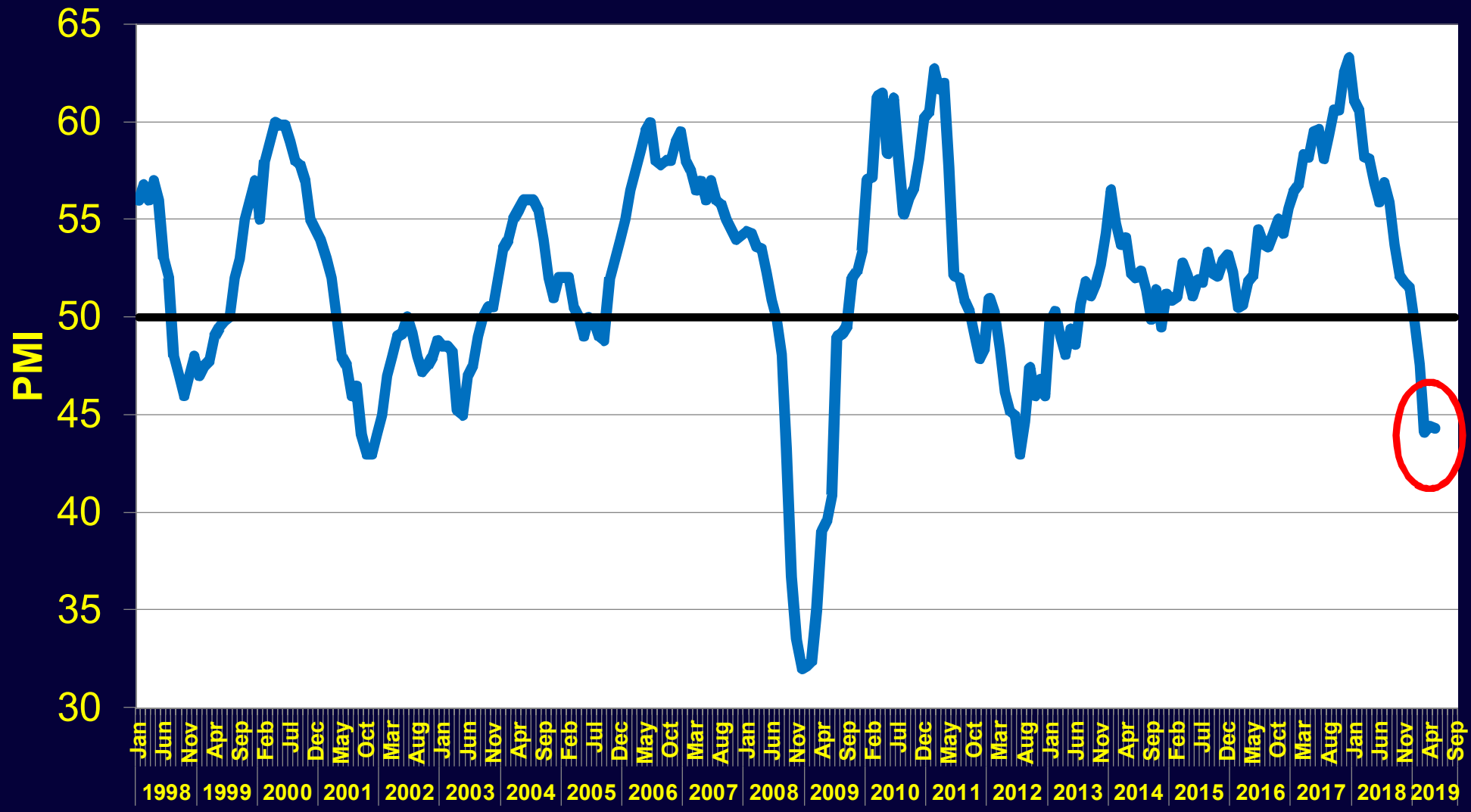


Markit Economics

20190603

Germany Manufacturing "Purchasing Managers" Index

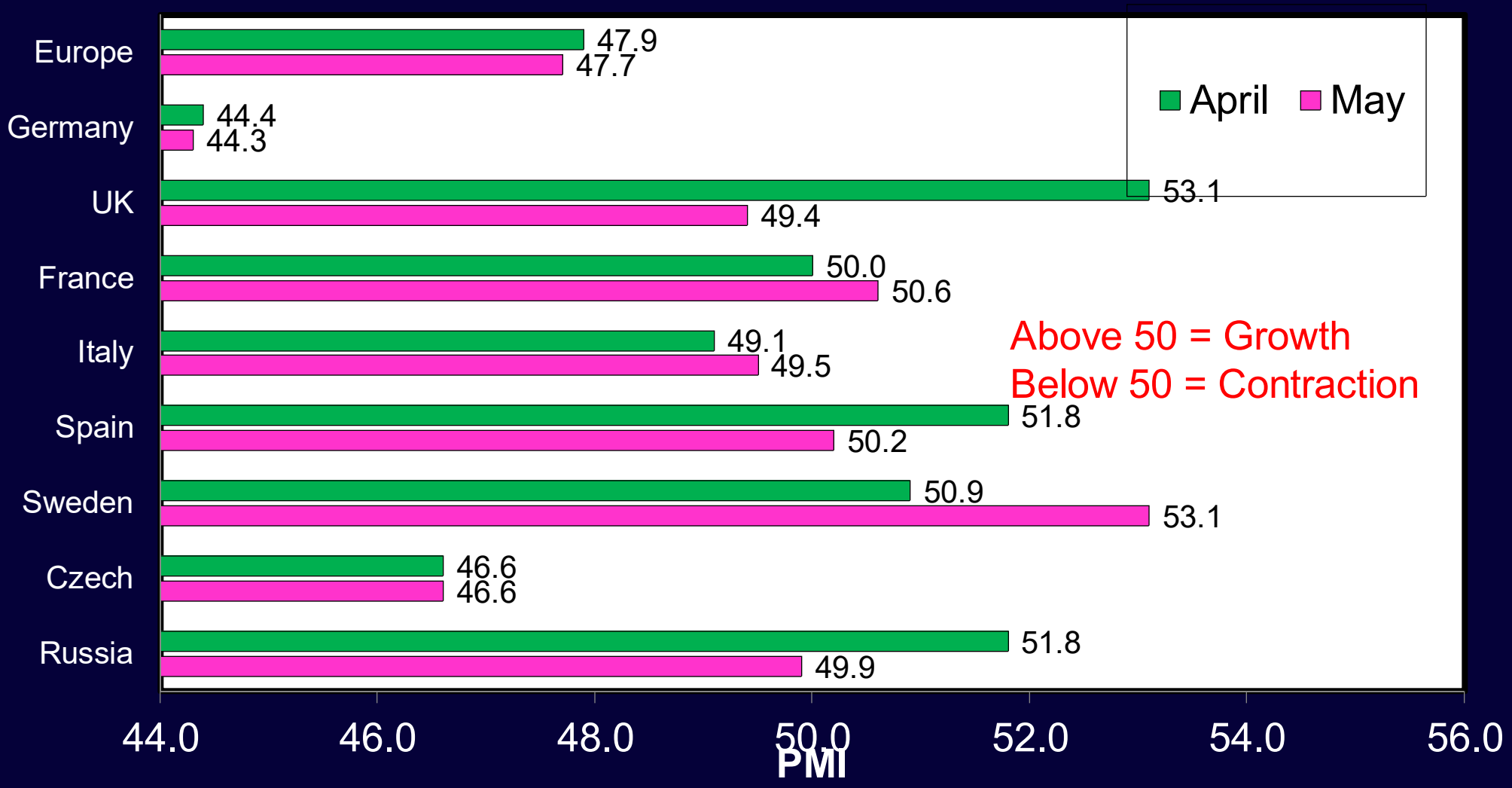
Diffusion Index, >50 = Growth



Markit Economics

European Purchasing Managers' Indices
May vs April 2019

20190603



Markit Economics

Electronic Equipment

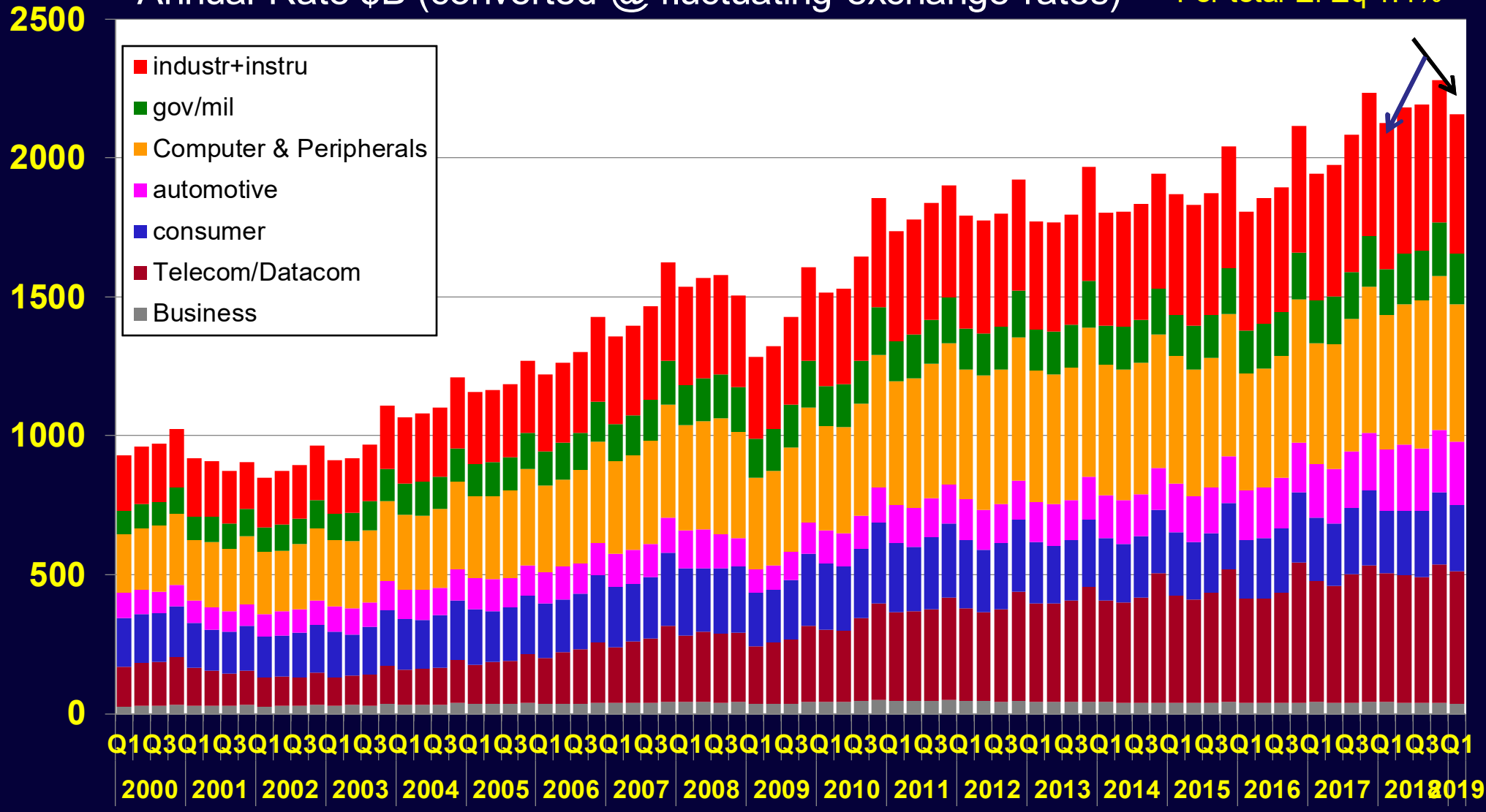
World

World Electronic Equipment Production By Type

201900601

Preliminary 1Q'19 est
Weighted avg
For total El Eq 1.4%

Annual Rate $B (converted @ fluctuating exchange rates)

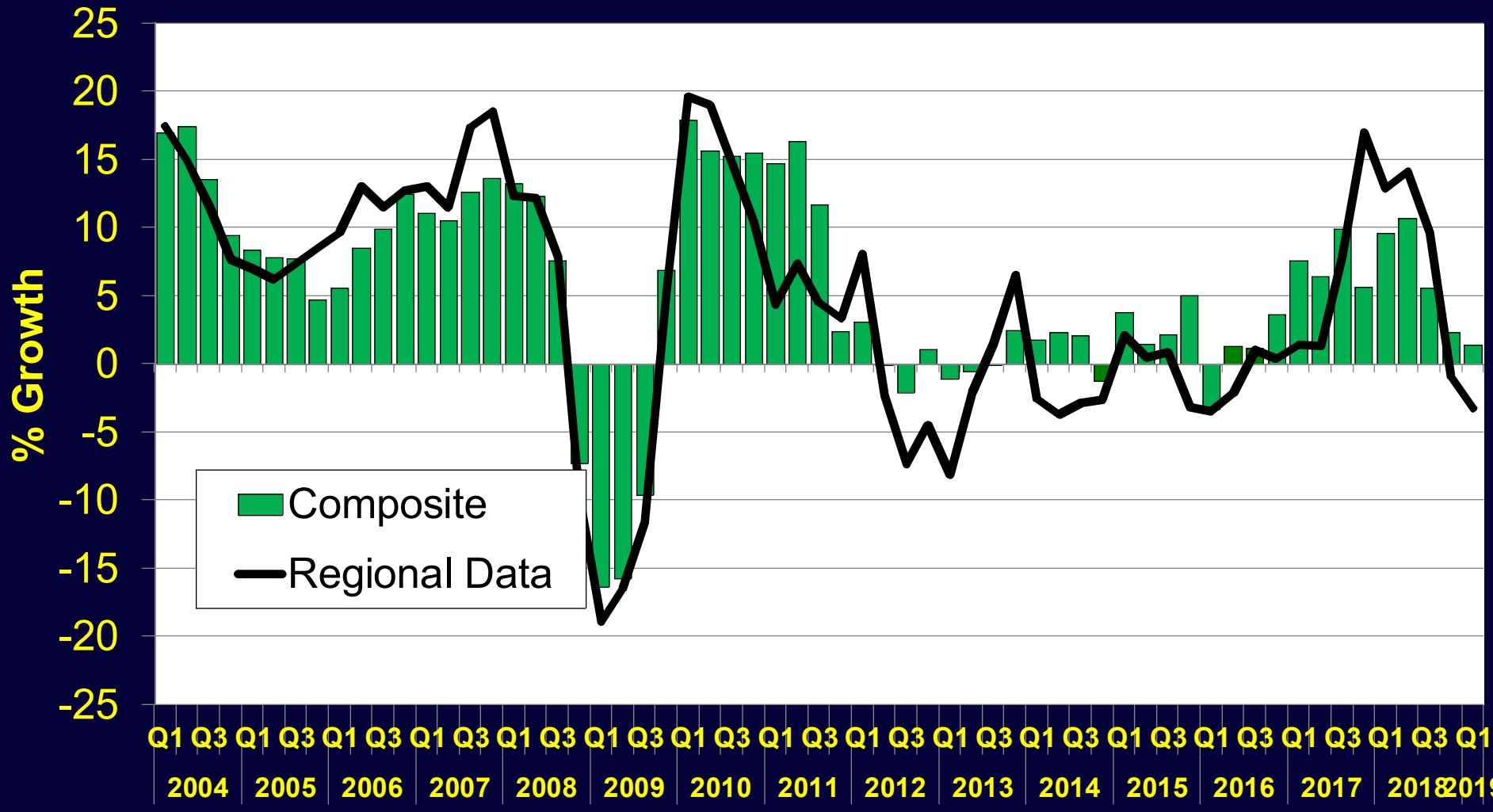


20190605

Electronic Equipment Sales

Weighted Average vs. Regional Model @ Fluctuating Exchange

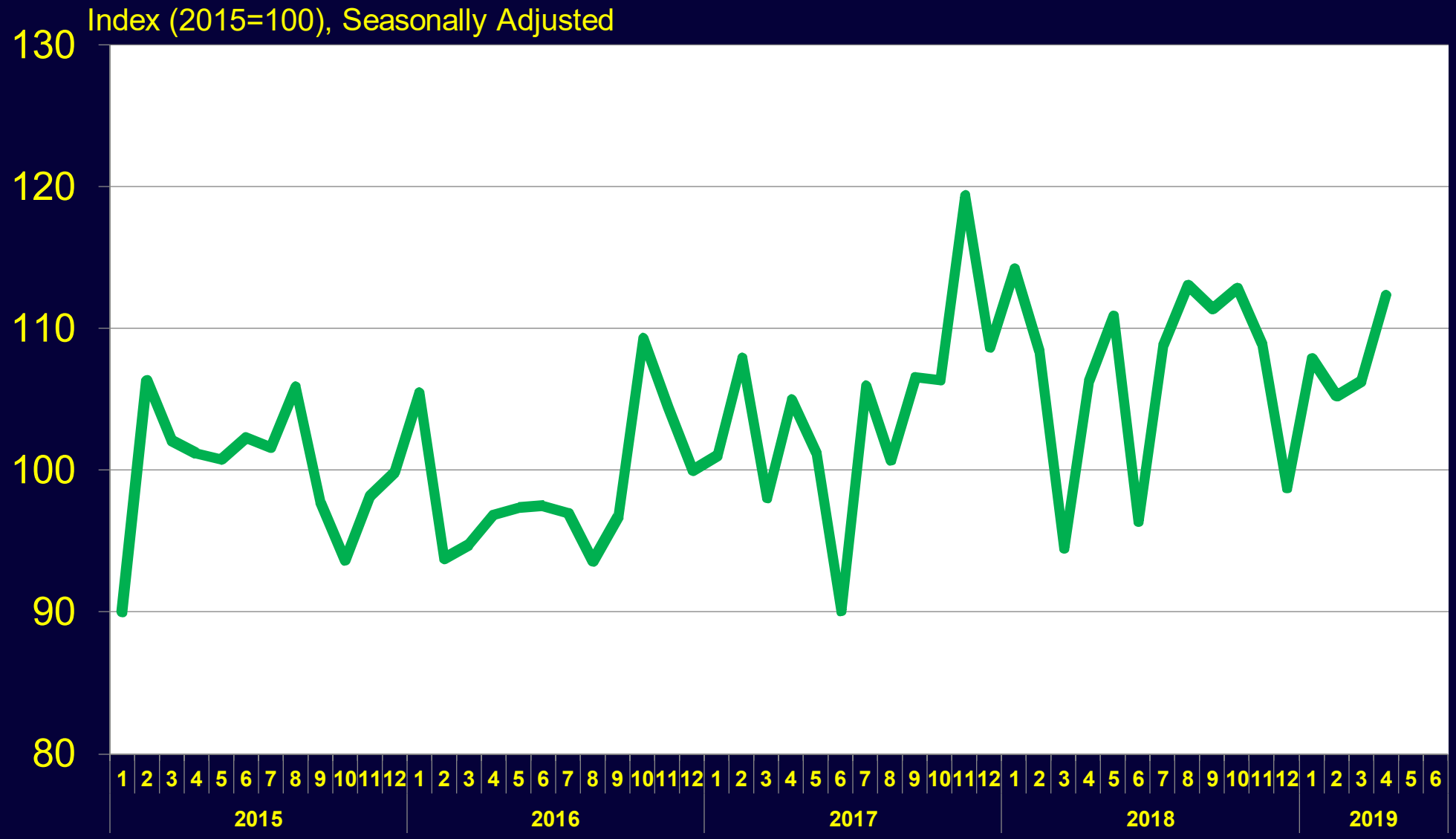
Quarterly Revenue Growth



213 OEM company sales composite (converted to weighted average by product sector) vs. Regional electronic equipment shipment model

20190

European Computer, Electronic & Optical Products Production

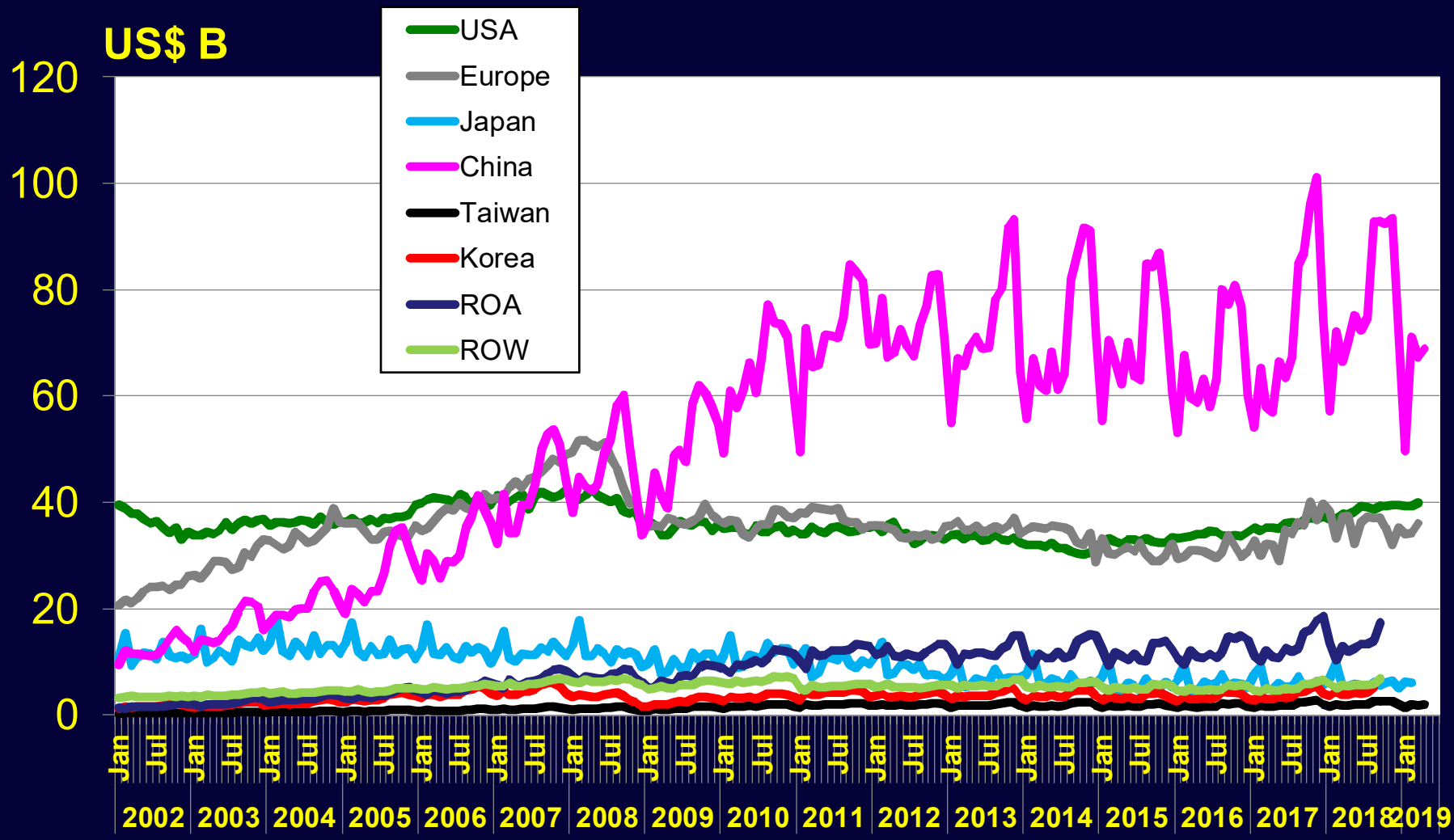


Eurostat, C26 category, EU 28 countries

World Electronic Equipment Monthly Shipments

20190611

Converted @ Fluctuating Exchange Rates

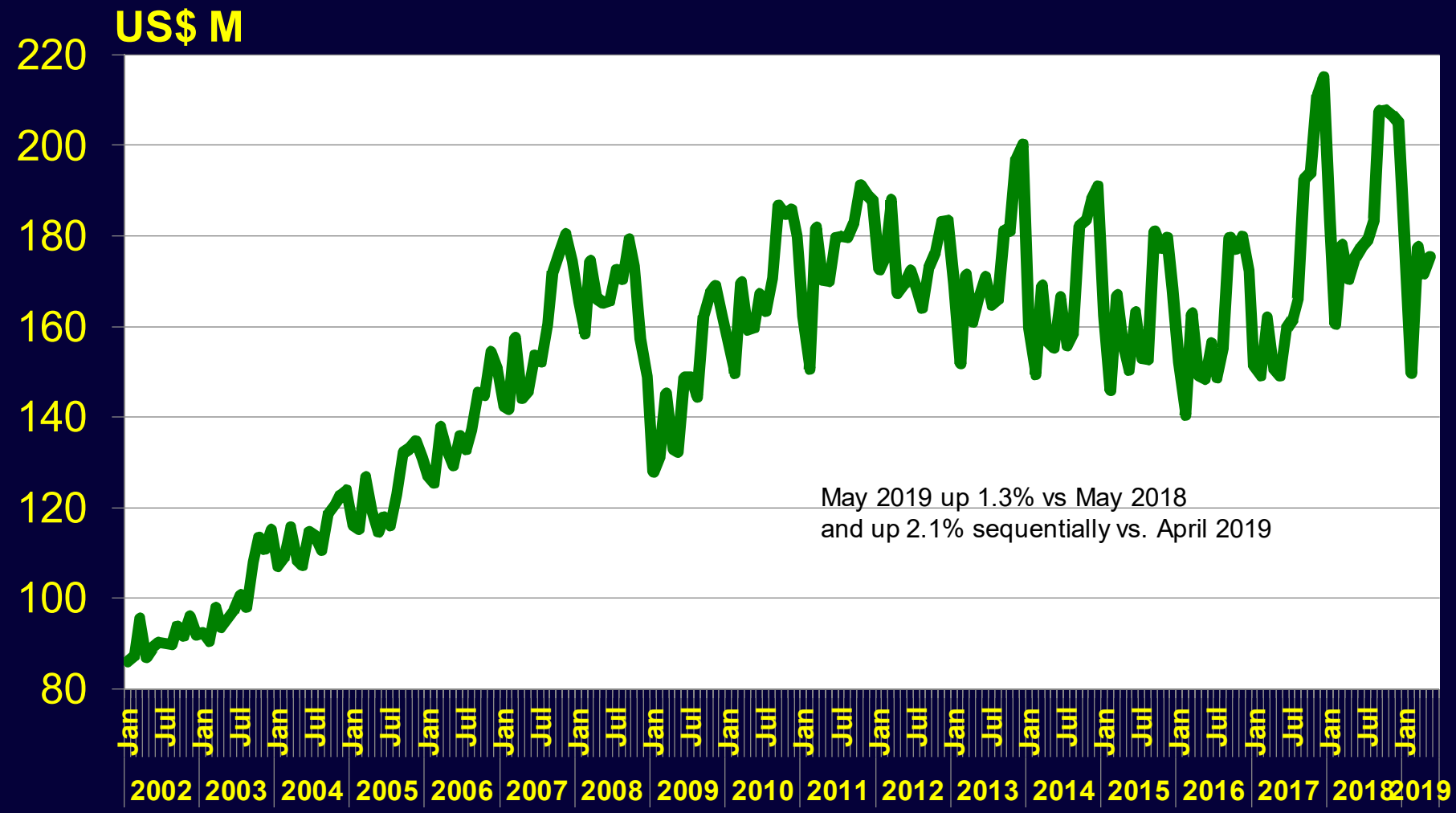


Source: Custer Consulting Group

20190614

World Electronic Equipment Monthly Shipments

Converted @ Fluctuating Exchange Rates



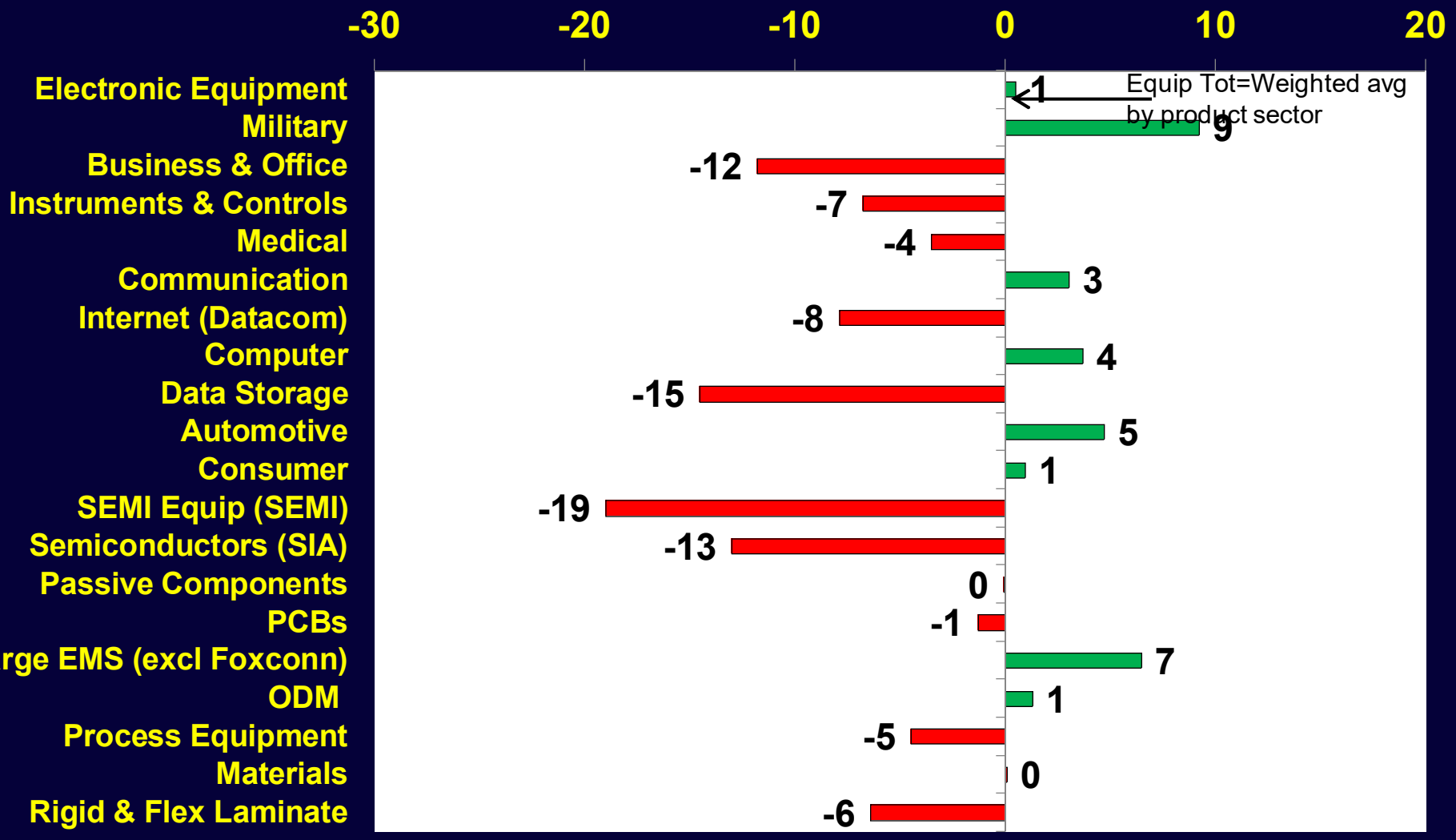
Source: Custer Consulting Group

Electronic Supply Chain Growth

Europe & World

World Electronic Supply Chain Growth
1Q'19 vs. 1Q'18

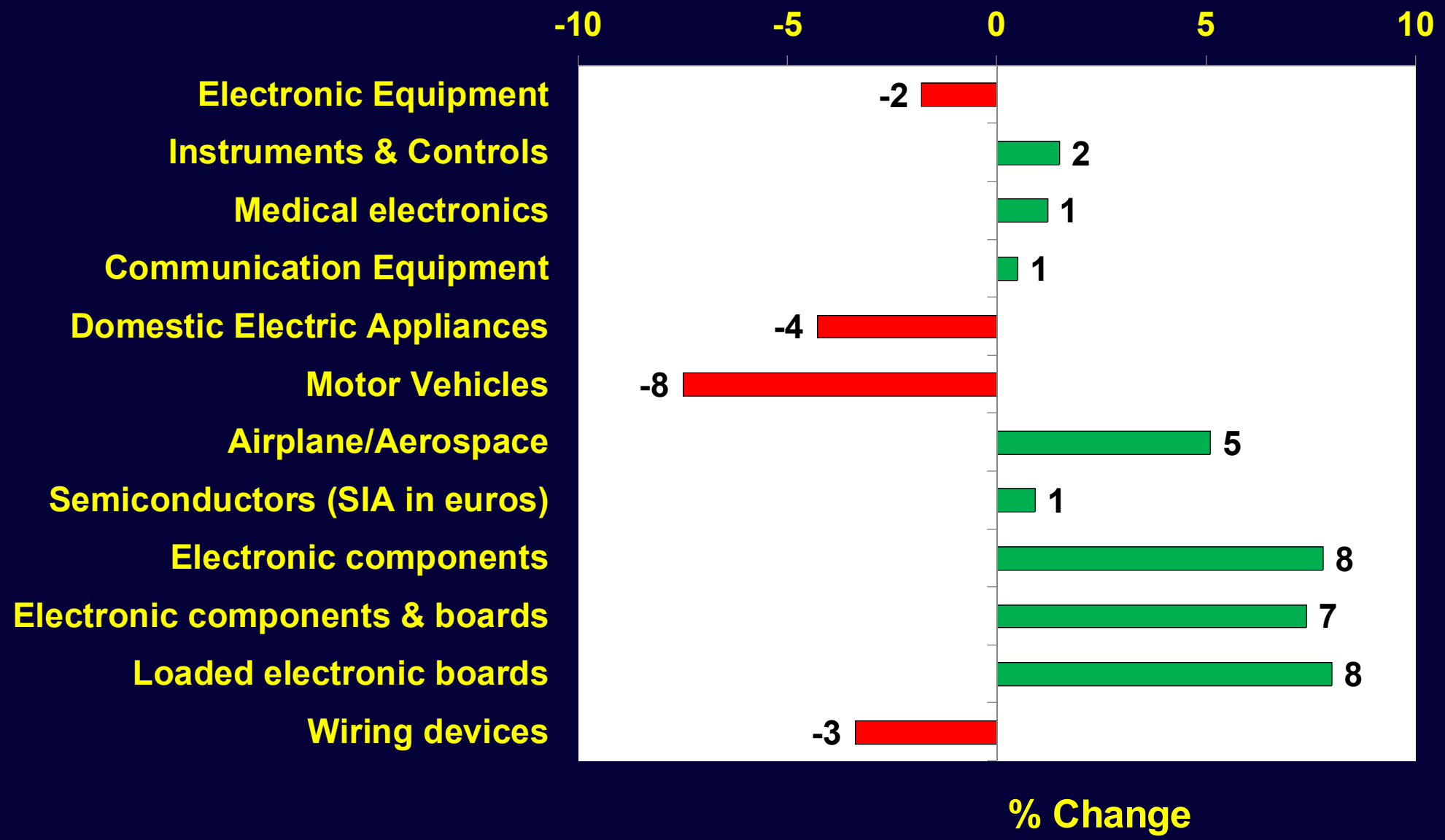
20190601



US$ equivalent at fluctuating exchange; based upon industry composites including acquisitions

European Electronic Supply Chain Growth
1Q'19 vs 1Q'18

20190213

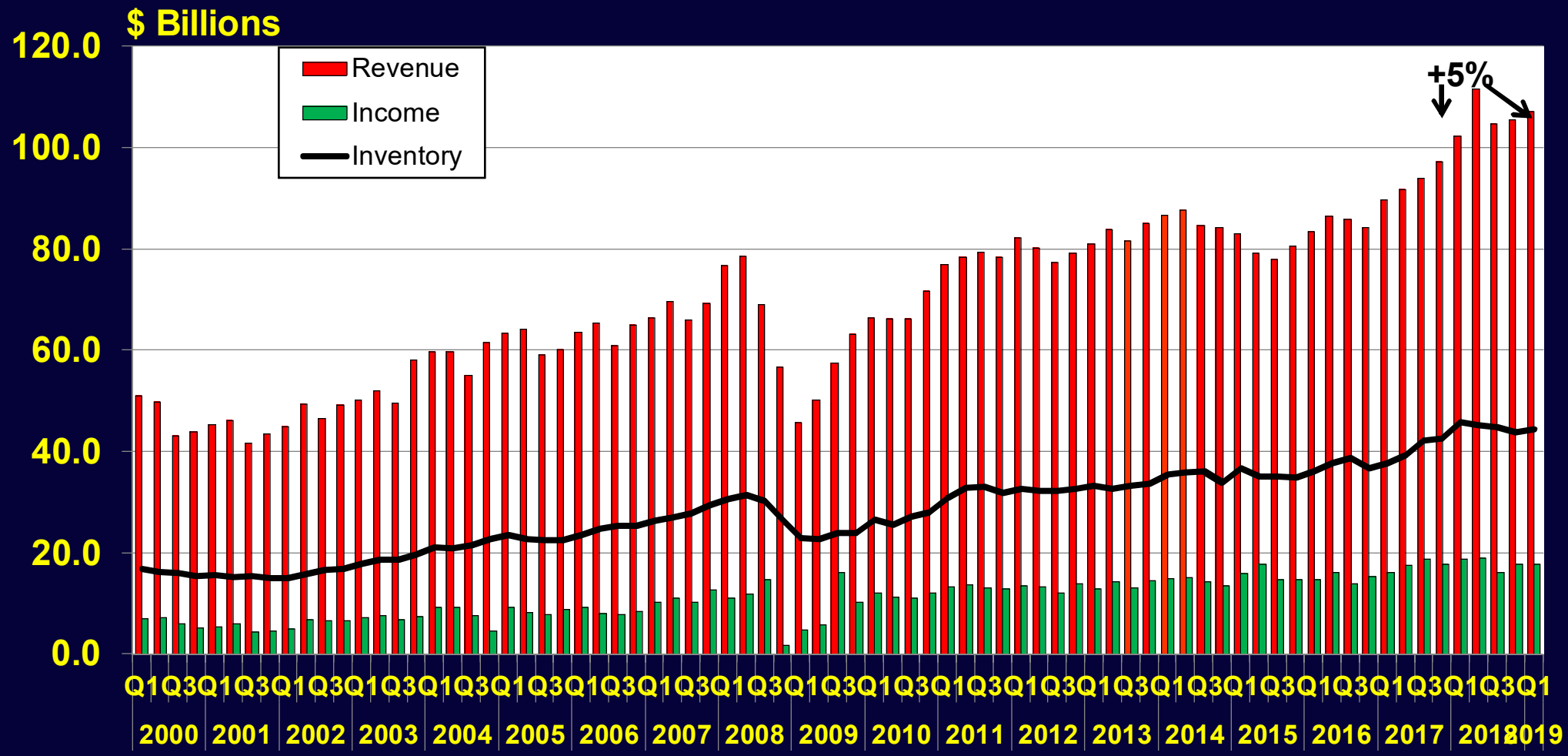


Euro denominated growth rates; Eurostat, SIA & Custer Consulting Group

Markets of European Focus

20190601

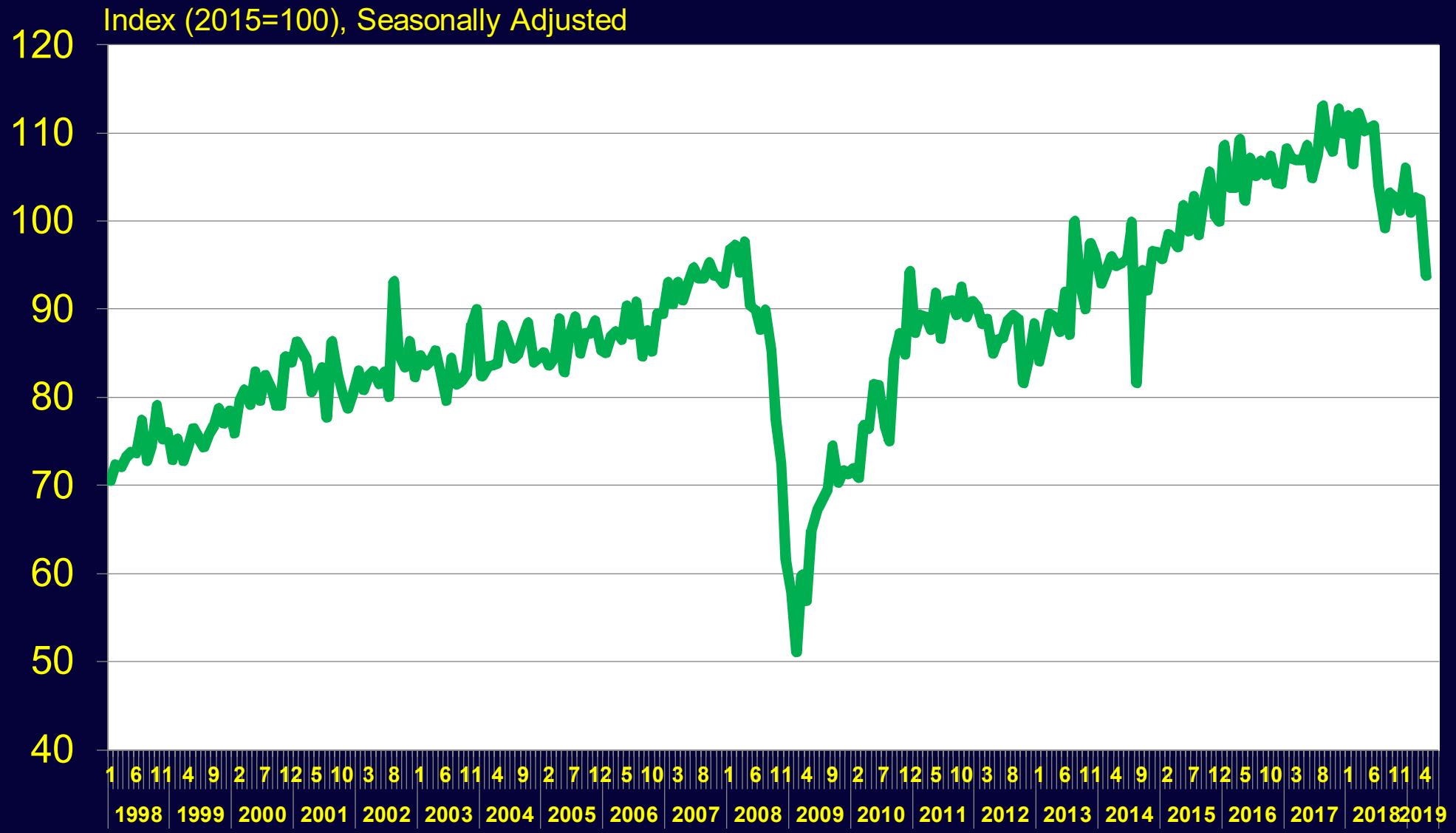
Automotive Equipment Suppliers
Composite of 15 Public Companies
Revenue, Net Income & Inventory



Autoliv, Borg Warner, Continental AG, Delphi, Denso, Federal Mogul, Gentex, Hella, Johnson Controls, Lear, Magna, TRW Automotive, Valeo, Visteon, ZF Friedrichshafen

20190614

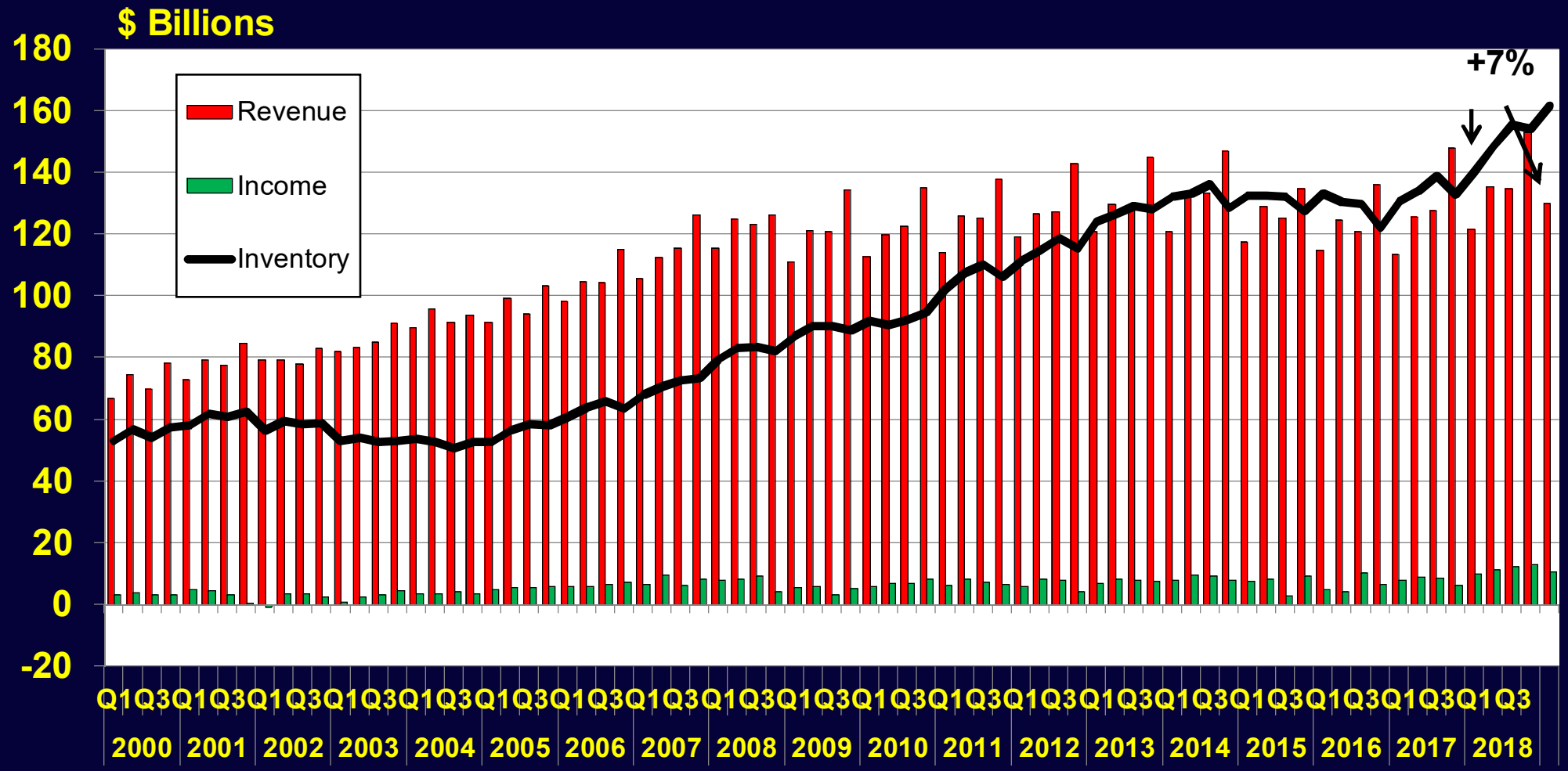
European Motor Vehicle Production



Eurostat, C291 category, EU 27 countries

20190601

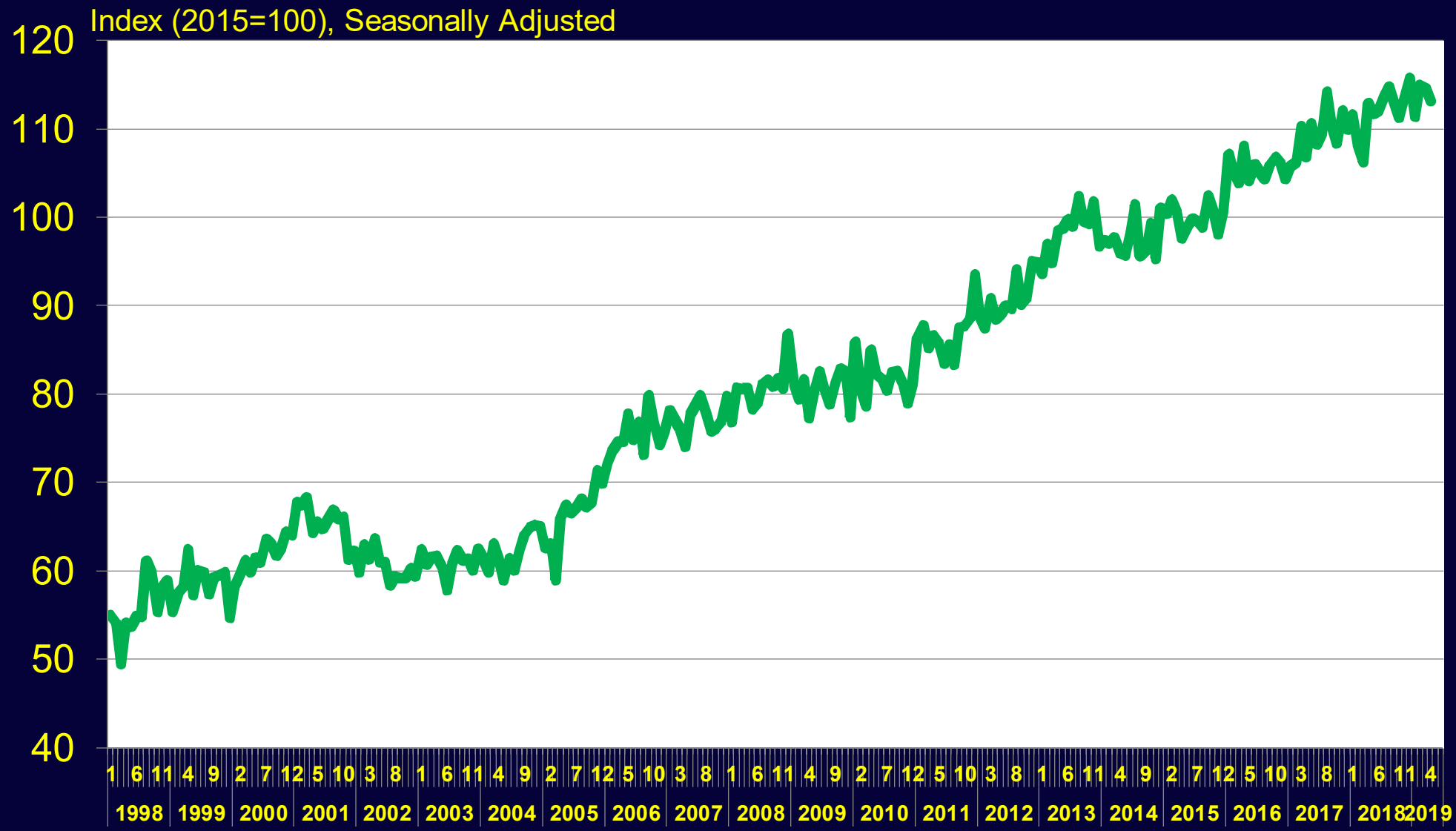
Military & Aerospace
Composite of 22 Public Companies
Revenue, Net Income & Inventory



Boeing, Bombadier, EADS (Airbus), Finmeccinica,General Dynamics, Halliburton, Harris, Honeywell (military portion), L-3 Communications, Lockheed, Moog, Northrop Grumman, Raytheon, Rockwell Collins, Textron, Thales, United Technology

European Production - Aircraft, Spacecraft & Related Equipment

20190614

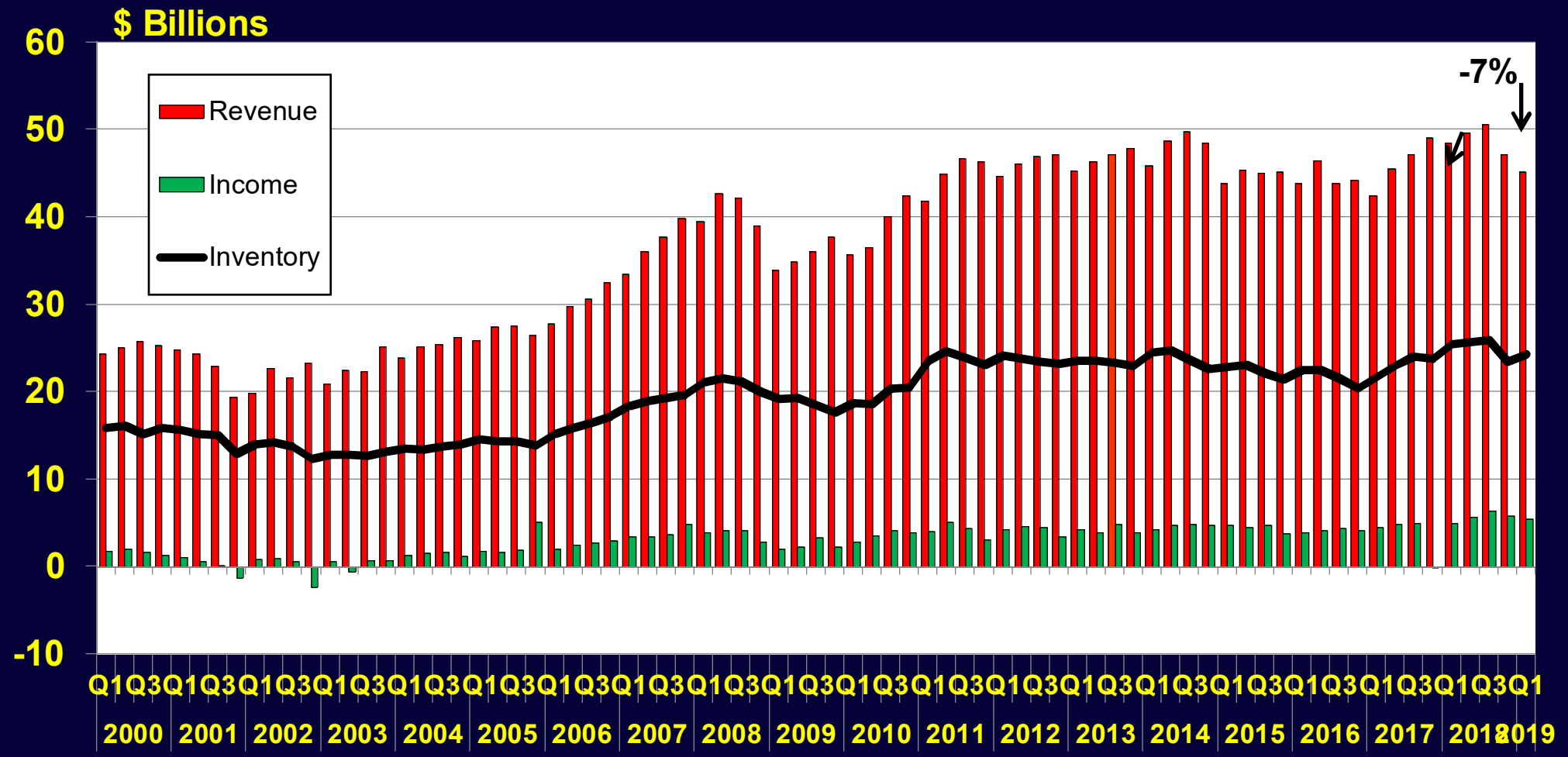


Eurostat, C303 category, EU 27 countries

2010-0601

Instruments & Control Equipment Composite of 16 Public Companies

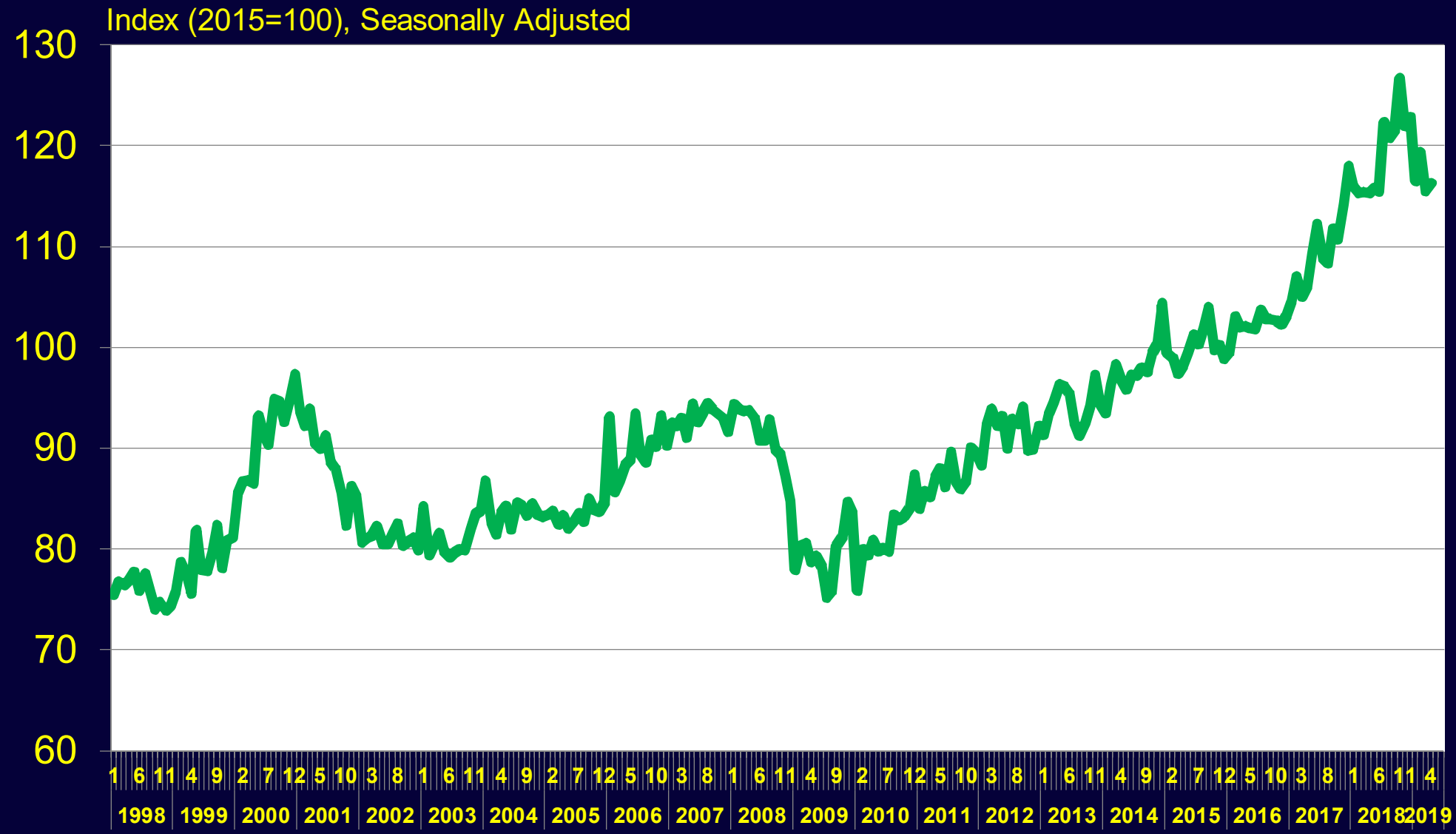
Revenue, Net Income & Inventory



ABB, Agilent, Ametek, Emerson, Itron, Keysight, National Instruments, PerkinElmer, Rockwell Automation, Rotork, Teledyne, ThermoFisher, Woodward Govenor

20190614

European Production - Instruments & Appliances for Measuring, Testing & Navigation

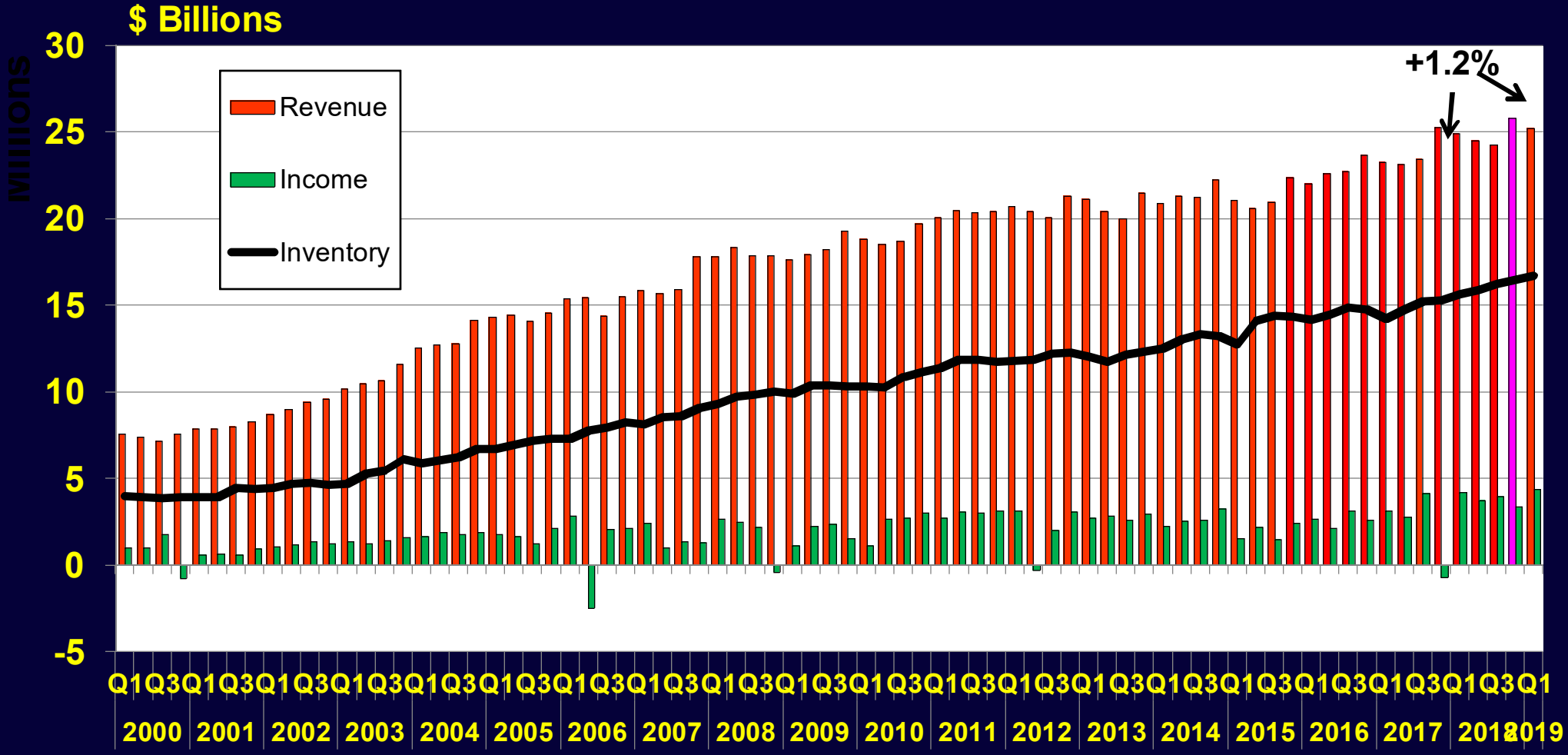


Eurostat, C2651 category, EU 27 countries

20190601

Medical Equipment Composite of 21 Public Companies

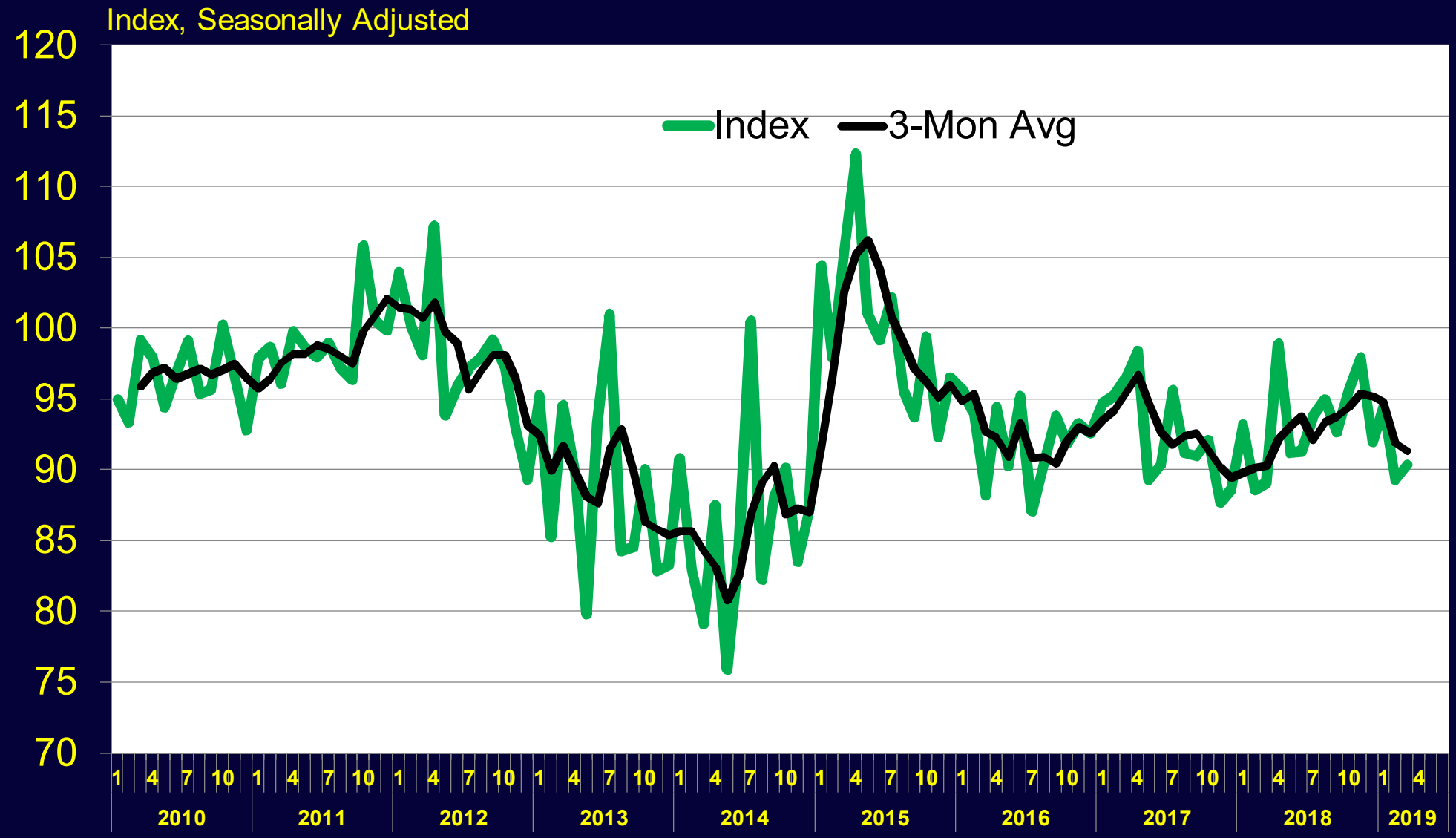
Revenue, Net Income & Inventory



Analogic, Bio-Rad Laboratories, Boston Scientific, Bruker, CareFusion, Covidien, Draeger, Guidant, Hill-Rom, Intuitive Surgical, Invacare, Medtronic, ResMed, St Jude Medical, Smith & Nephew, STERIS, Stryker, Varian Medical, Waters, Zimmer

20190515

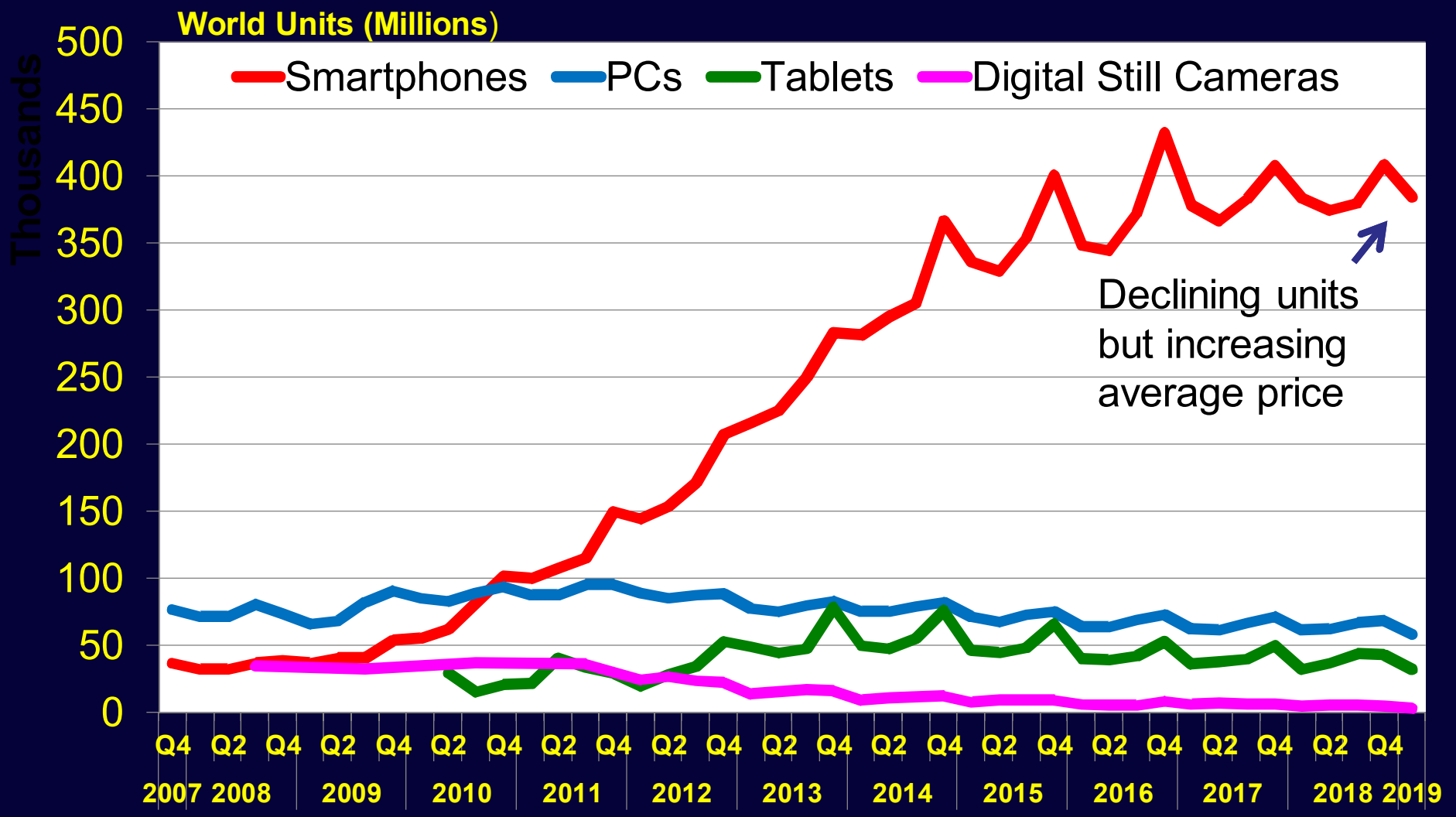
European Production - Irradiation, Electromedical & Electrotherapeutic Equipment



Eurostat, C266 category, EU 27 countries

20190515

Volume Markets are Flat



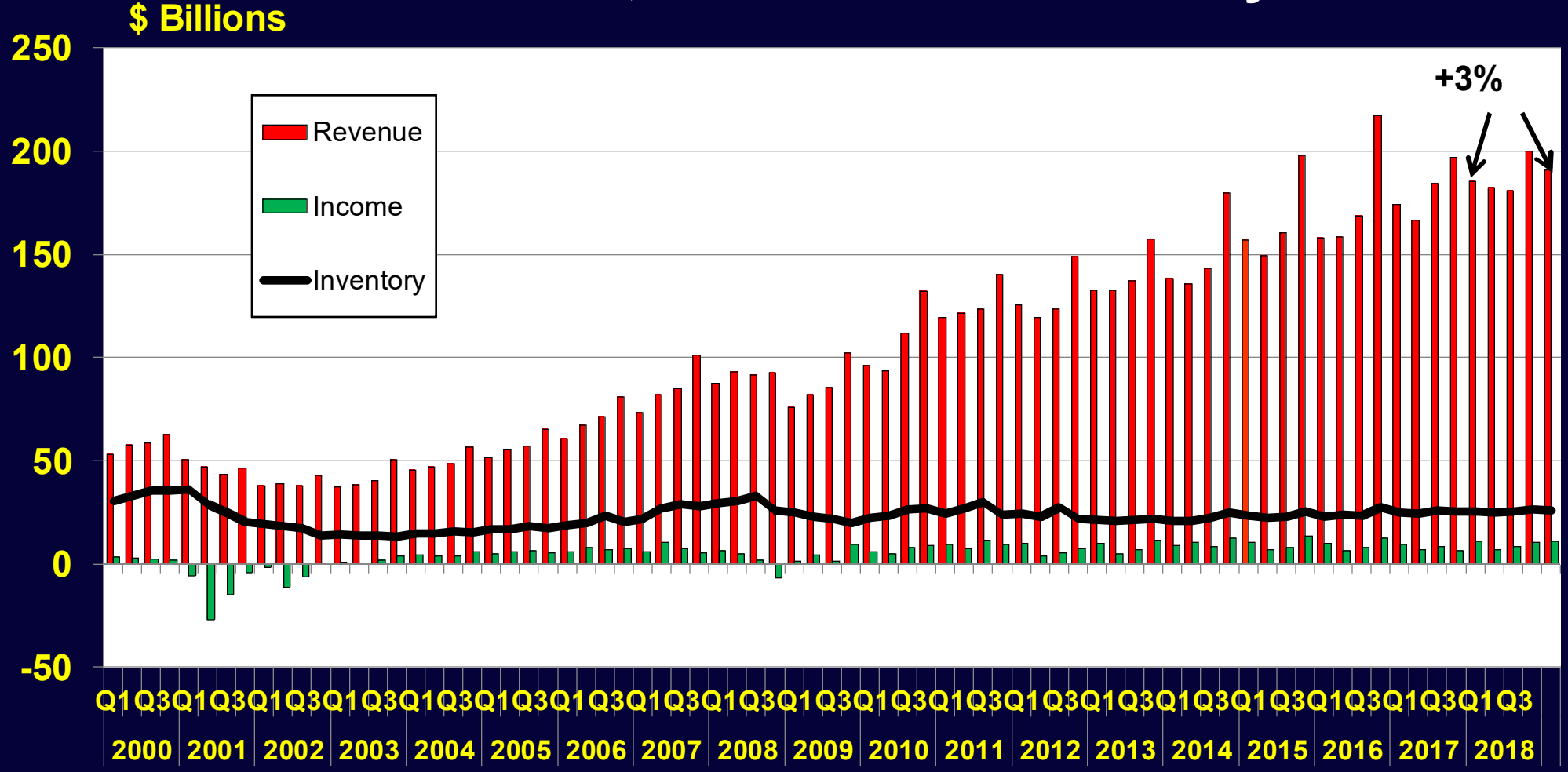
www.gartner.com; www.cipa.jp/; www.icinsights.com; www.idc.com; www.digitimes.com

20190601

Communication Equipment Suppliers
Composite of 30 Companies

10 mobile phone makers, 20 other telecom equipment makers plus estimate of other mobile makers

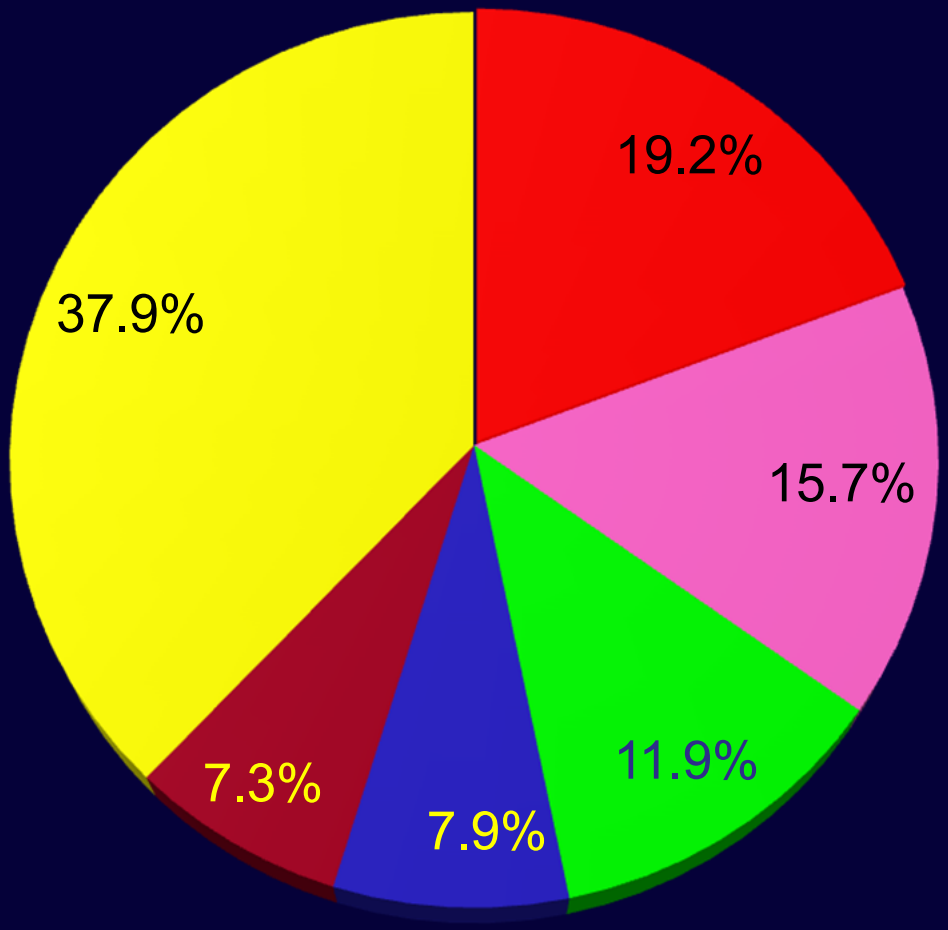
Revenue, Net Income & Inventory



3COM, ADC Telecom, Alcatel+Lucent, Ciena, Ericsson, Motorola Solutions,, Nokia, Polycom, TellLabs, Palm, Adva Optical Networking,Arris Group,AudioCodes,Broadsoft,Fabrinet,Gigamon,Infinera,Ixia,Neophotonics,Radware ; Apple iPhone, HTC, Huawei Device, LG, Motorola Mobility, Nokia, RIM, Samsung, Sony Mobility, ZTE; Euros & Krona converted at fluctuating exchange; mobile phone volumes from company reports & Gartner Dataquest quarterly unit shipment estimates; historical data included for acquired companies

World Smartphone Sales by End Users
1Q'19

20190203



1Q'18
383.5M

1Q'19 TOTAL: 373 Units

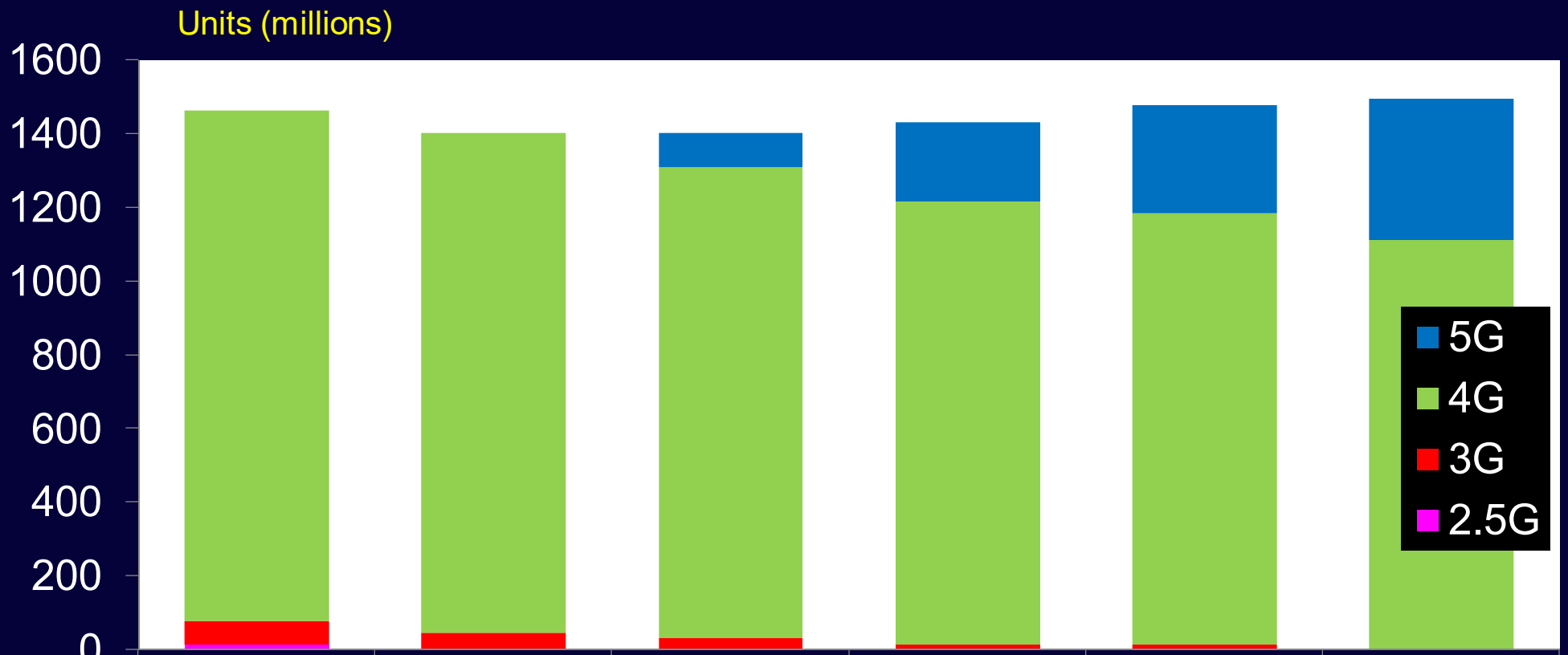
Gartner 5/19

Emerging Volume Markets

- Autonomous cars
- Internet of Things (IoT)
- Industrial Internet of Things (IIoT)
- Cloud storage
- 5G Handsets & Infrastructure
- Virtual & Augmented Reality
- AI/Machine Learning
- Smart Cities, Smart Agriculture
- Drones
- Robots
- Wearables
- 3D Printing
- Health Care

20190602

World Smartphone Forecast by Generation



	2018	2919	2020	2021	2022	2023
5G	0	0	92	216	293	385
4G	1386	1355	1278	1201	1170	1109
3G	62	46	31	15	15	3
2.5G	15	0	0	0	0	0

IDC 6/19

Semiconductors

Monthly Semiconductor Shipments
$ Billions (3-month avg in US$)

20190501

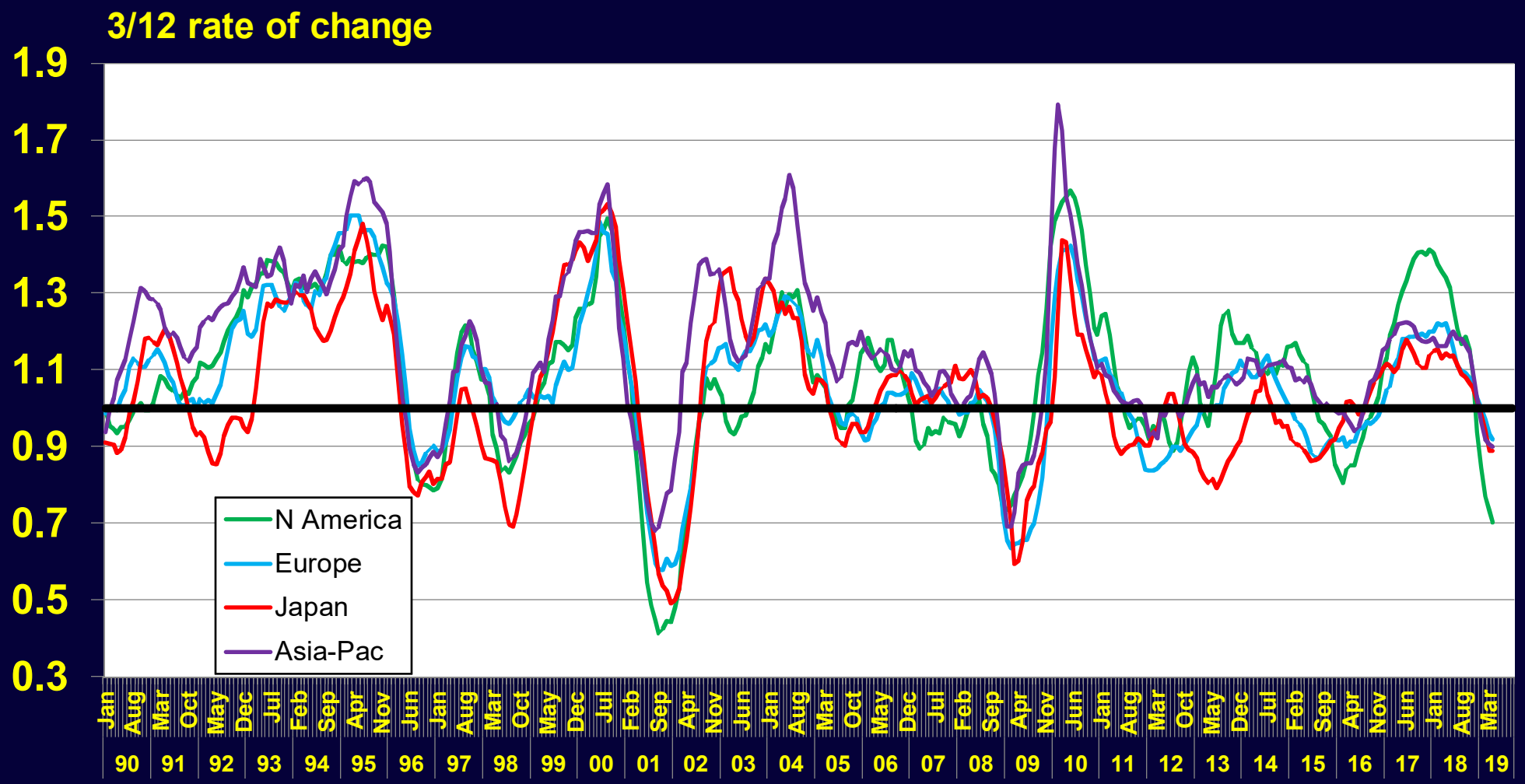
	4/18	4/19	% CH
Americas	8.16	5.75	- 29.5%
Europe	3.65	3.36	- 8.0%
Japan	3.29	2.93	- 10.9%
China	12.38	11.04	- 10.9%
Asia Pacific / All Other	10.13	9.05	- 10.7%
Total	37.61	32.13	- 14.6%

SIA www.semiconductors.org/

Semiconductor Growth Rates

20190605

Total $ Shipments to an Area

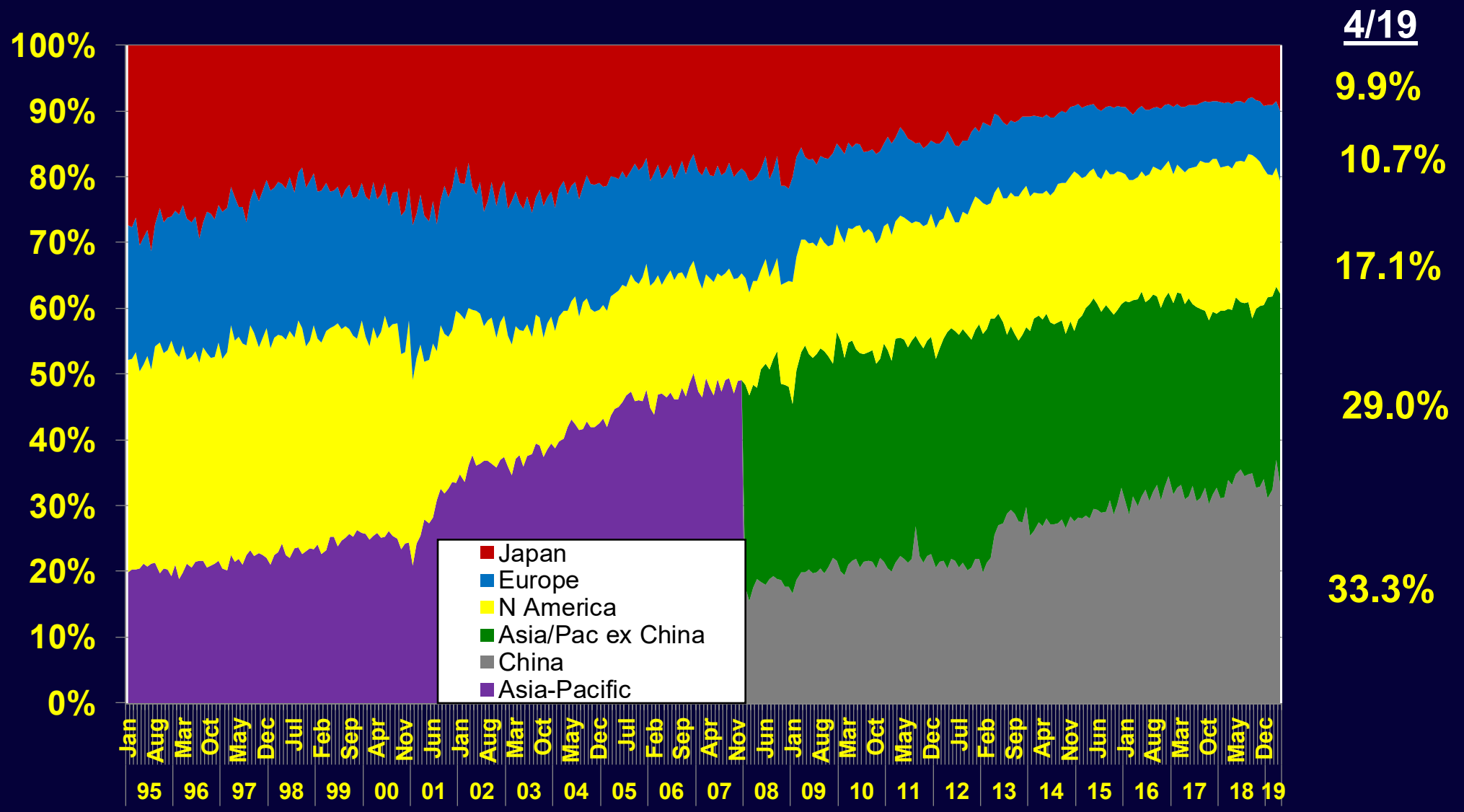


Total $ Shipments from All Countries to an Area
SIA website: www.semiconductors.org/

20190501

Total Semiconductor Shipments to an Area

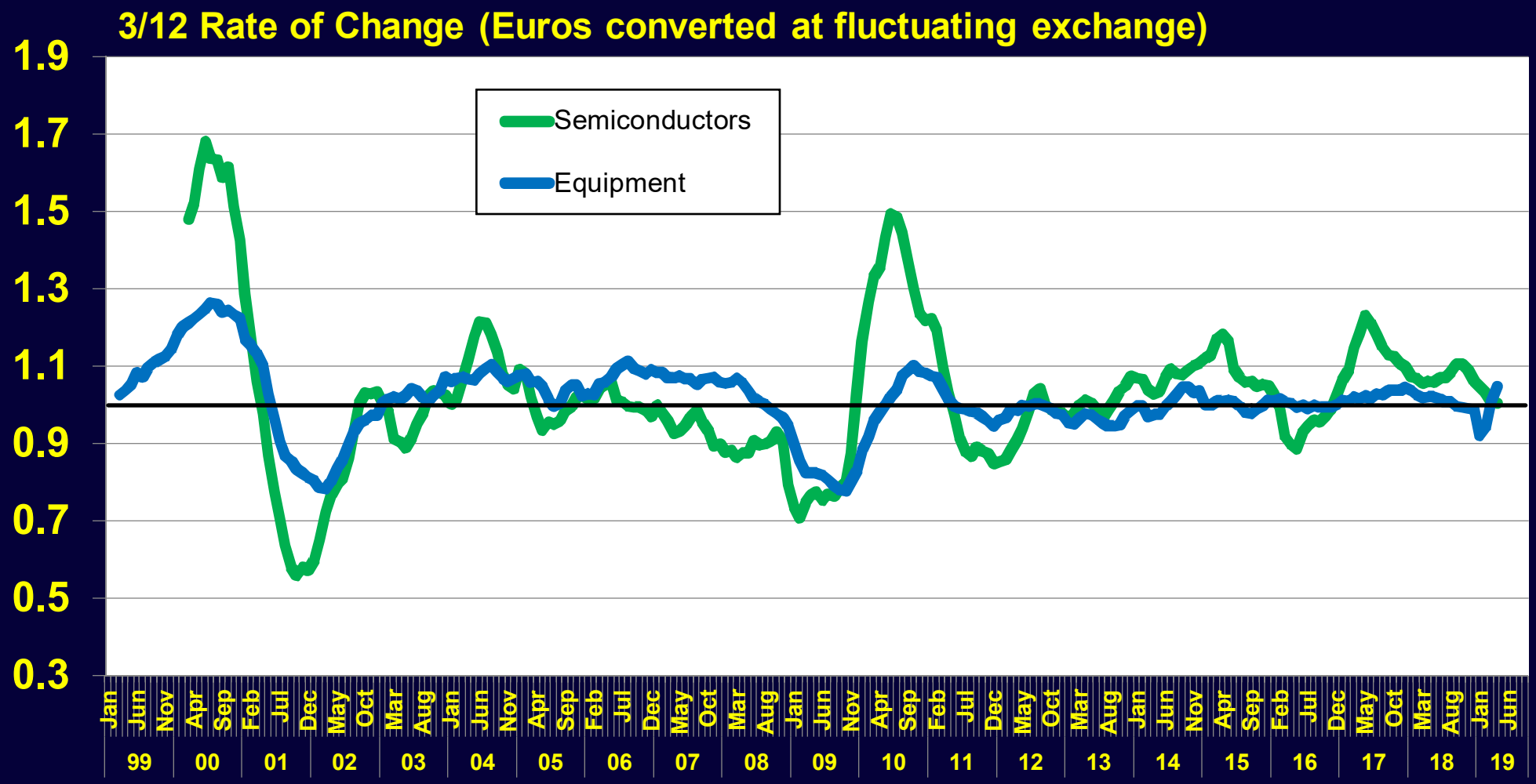
Monthly Shipments - Reporting Firms (showing China)



SIA website: www.semiconductors.org/

20190614

Semiconductor Shipments to Europe vs. European Electronic Equipment Production

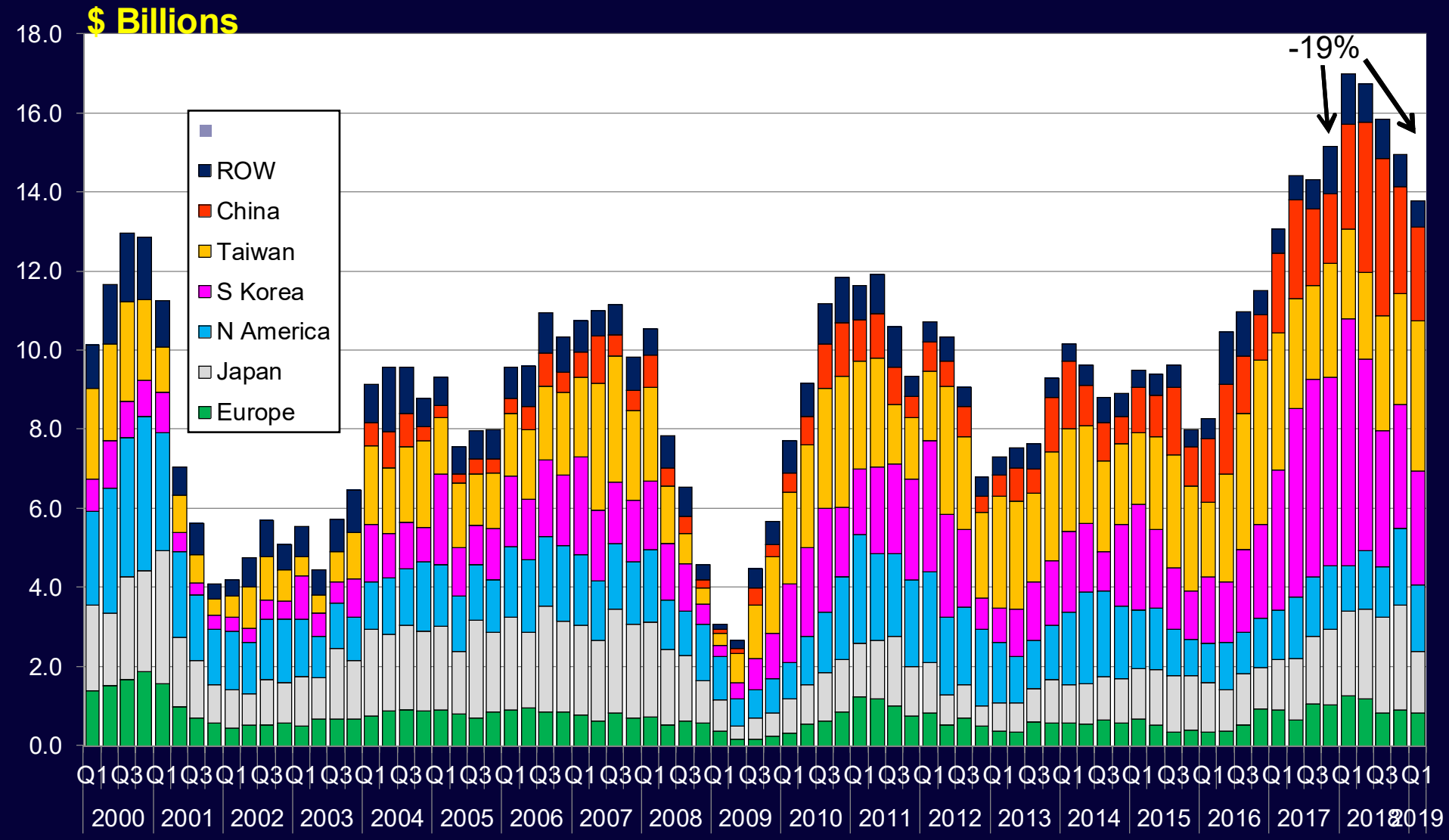


Total $ Semiconductor Shipments from All Countries to Europe www.sia-online.org/,
Eurostat class C26, EU27, European Computer, Electronic & Optical products Production

Semiconductor Capital Equipment

20190603

Semiconductor Capital Equipment Shipments by Area

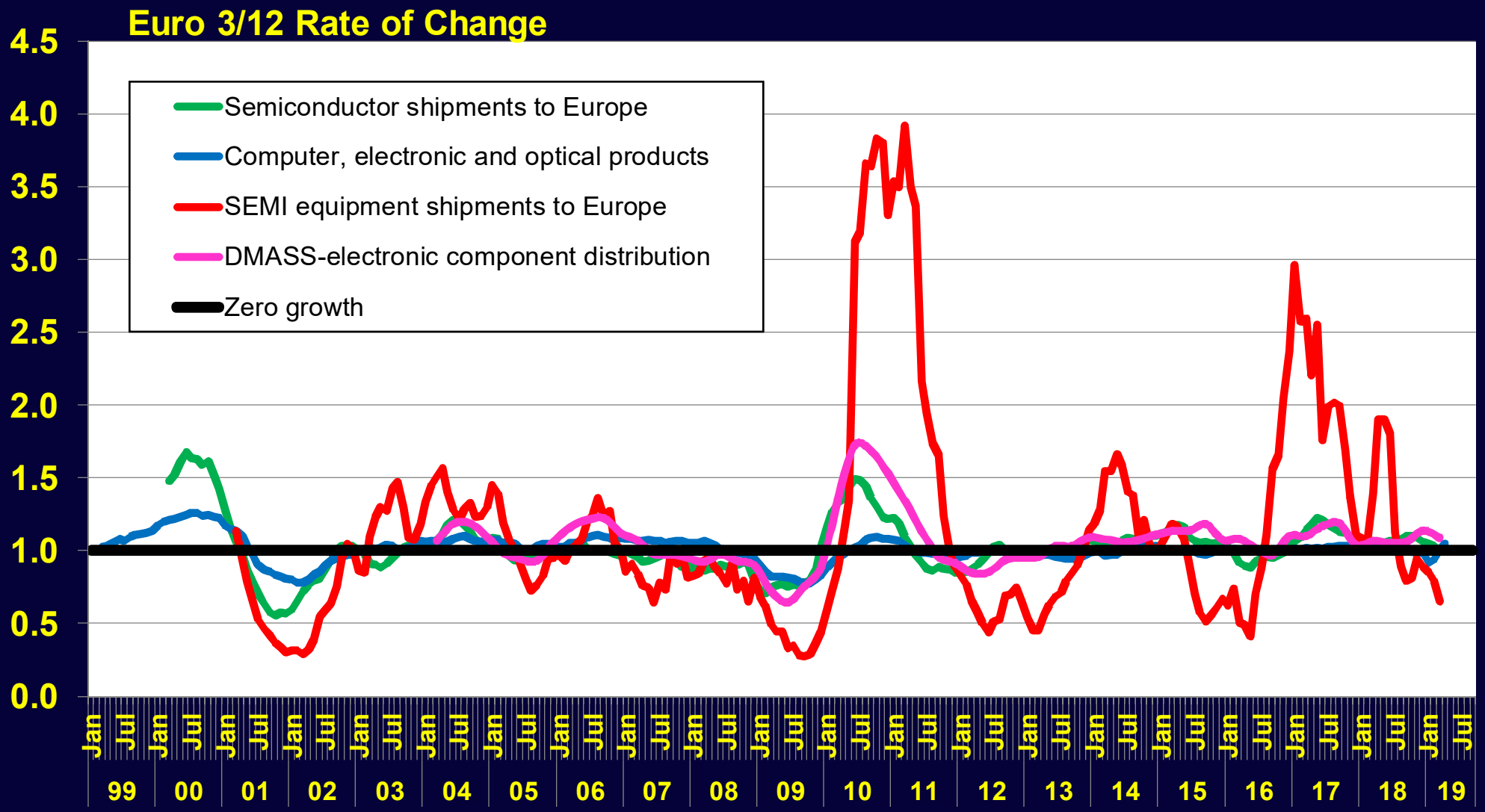


SEMI

Europe
Supply Chain

European Computer, Electronic and Optical Products, Semiconductors, & SEMI Equipment Shipments

20190614

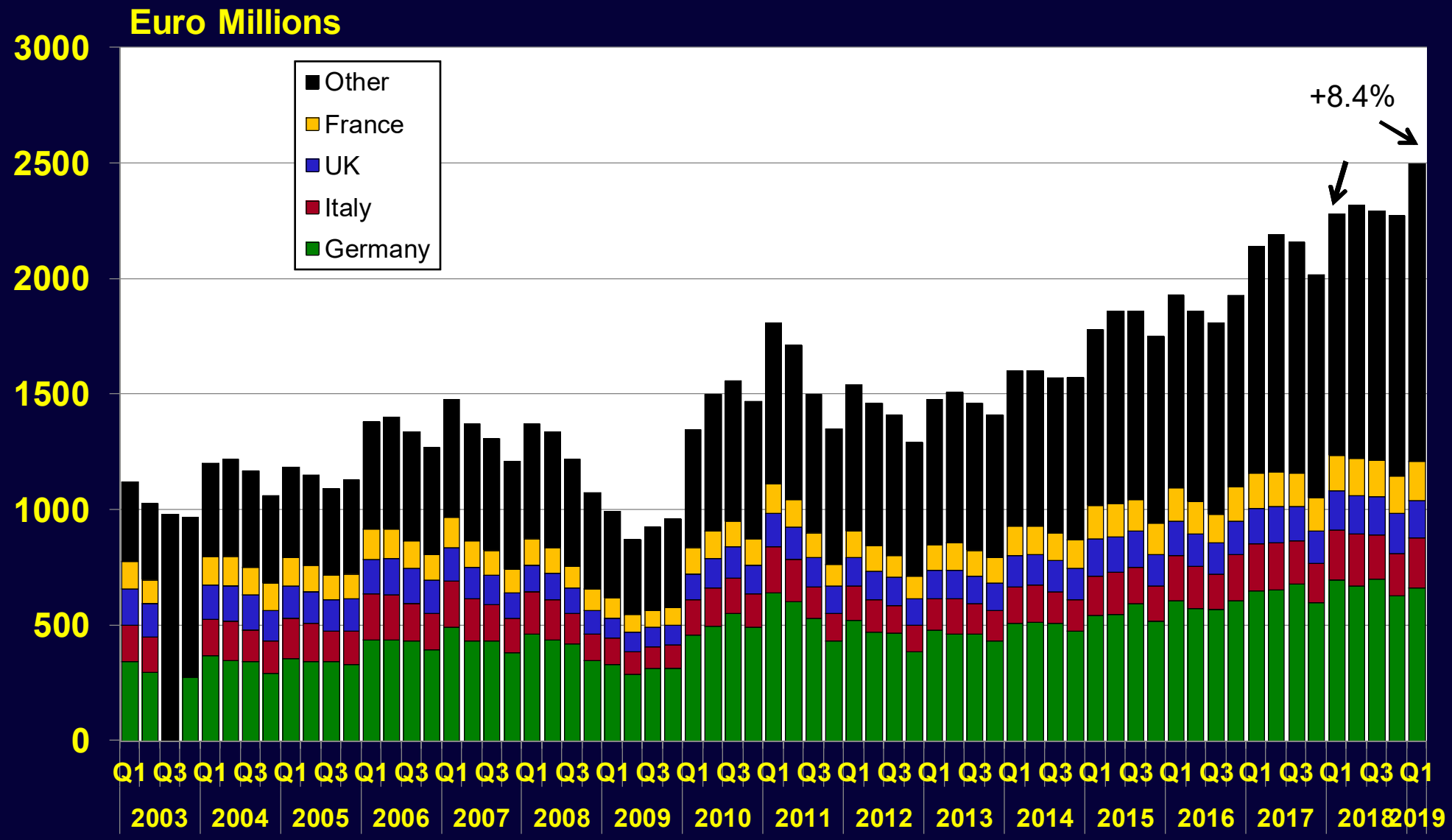


Total $ Semiconductor Shipments from All Countries to Europe www.sia-online.org/,
Eurostat class C26 & SEMI, CCG Extrapolation of SEMI growth

European Component Shipments by Country

20190608

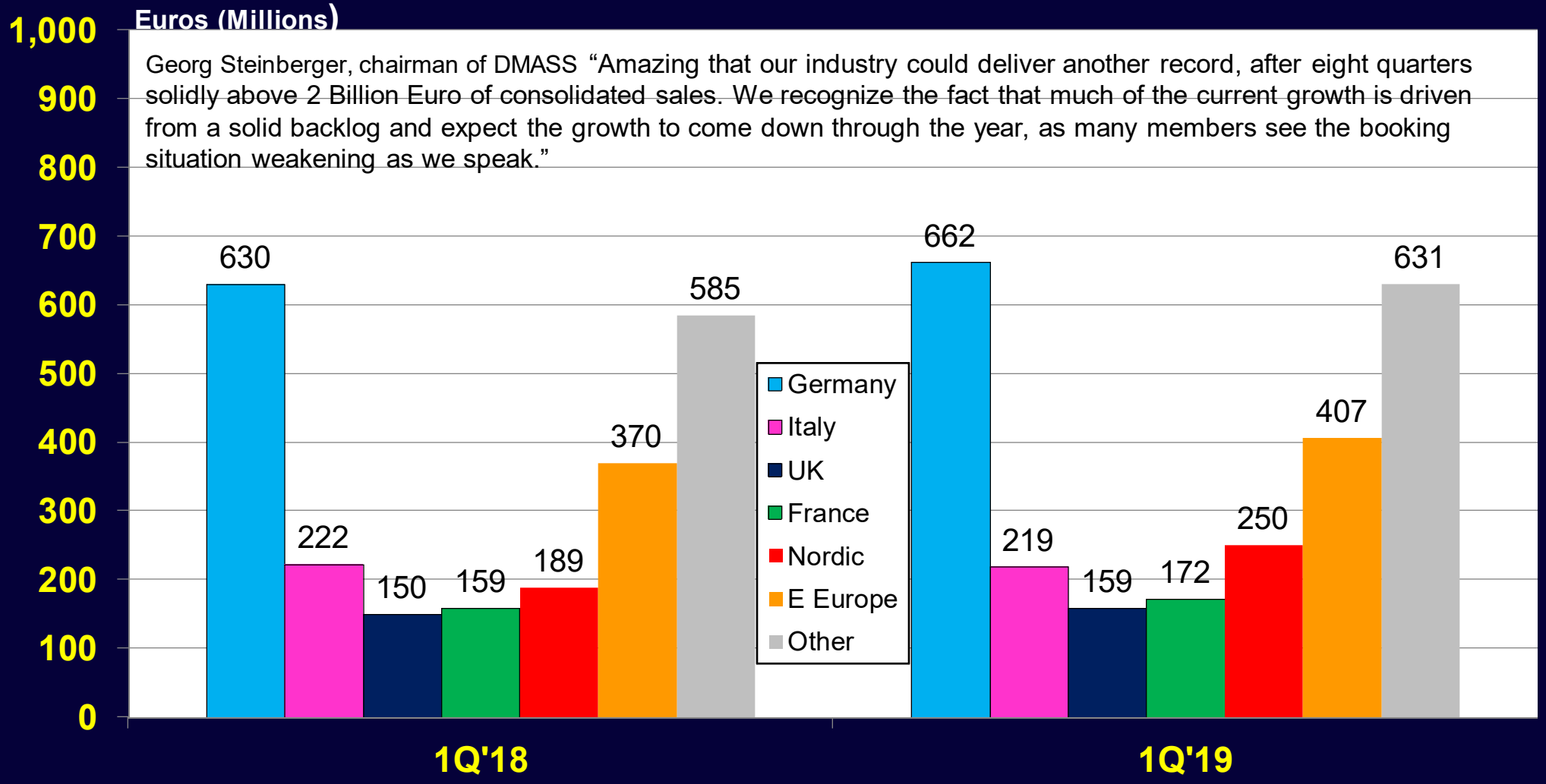
DMASS - European Semiconductor Distribution Industry



20190608

DMASS

European Semiconductor Distribution Industry



Georg Steinberger: "The numbers show some unusual effects in various countries with a significant contract manufacturing business, but in general it looks like the major economies are taking the lion's share of the current slowdown effects. If this is a trend for the rest of the year remains to be seen."

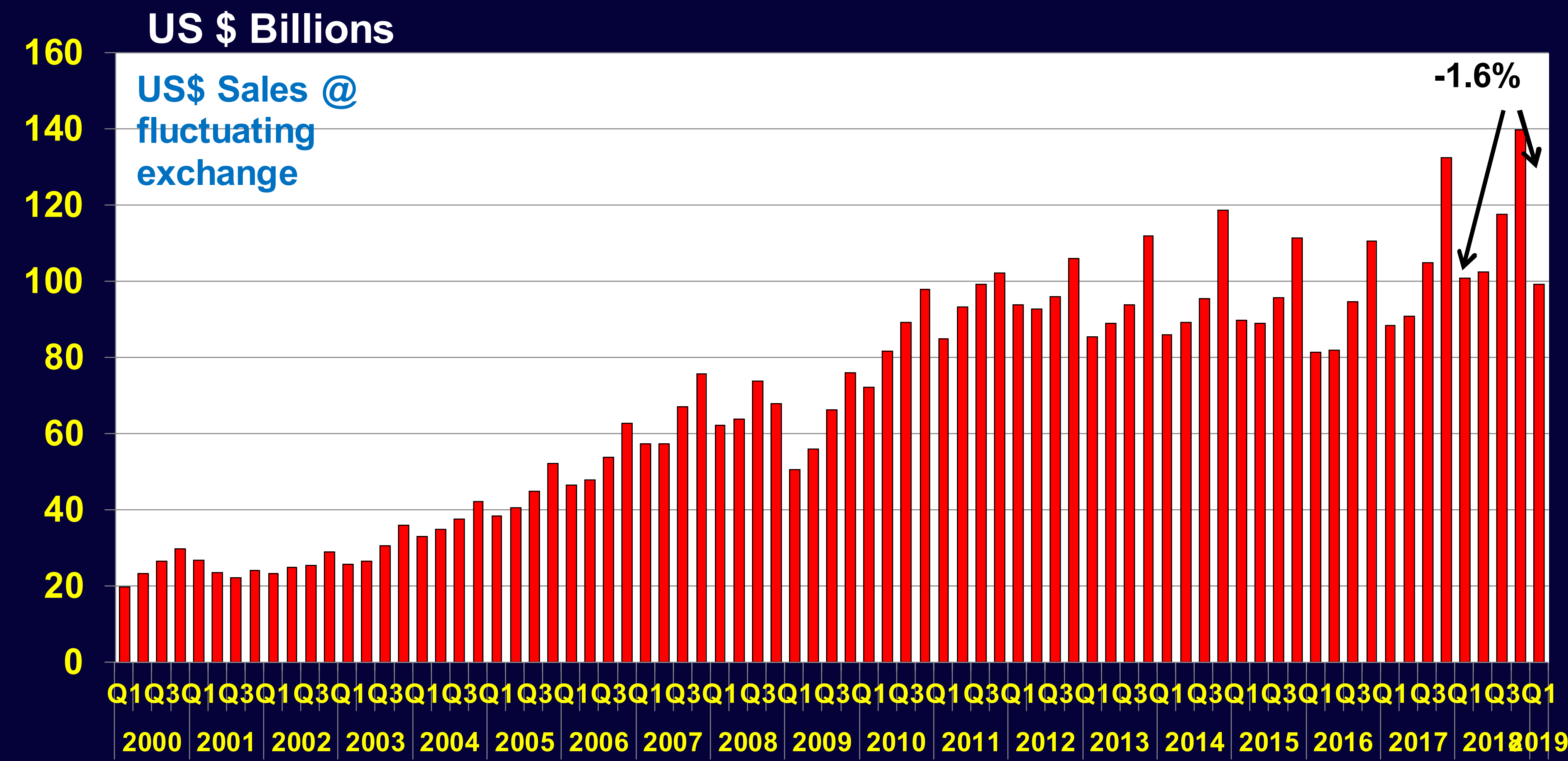
DMASS 6/19; http://dmass.com/

EMS & ODM Companies

20190519

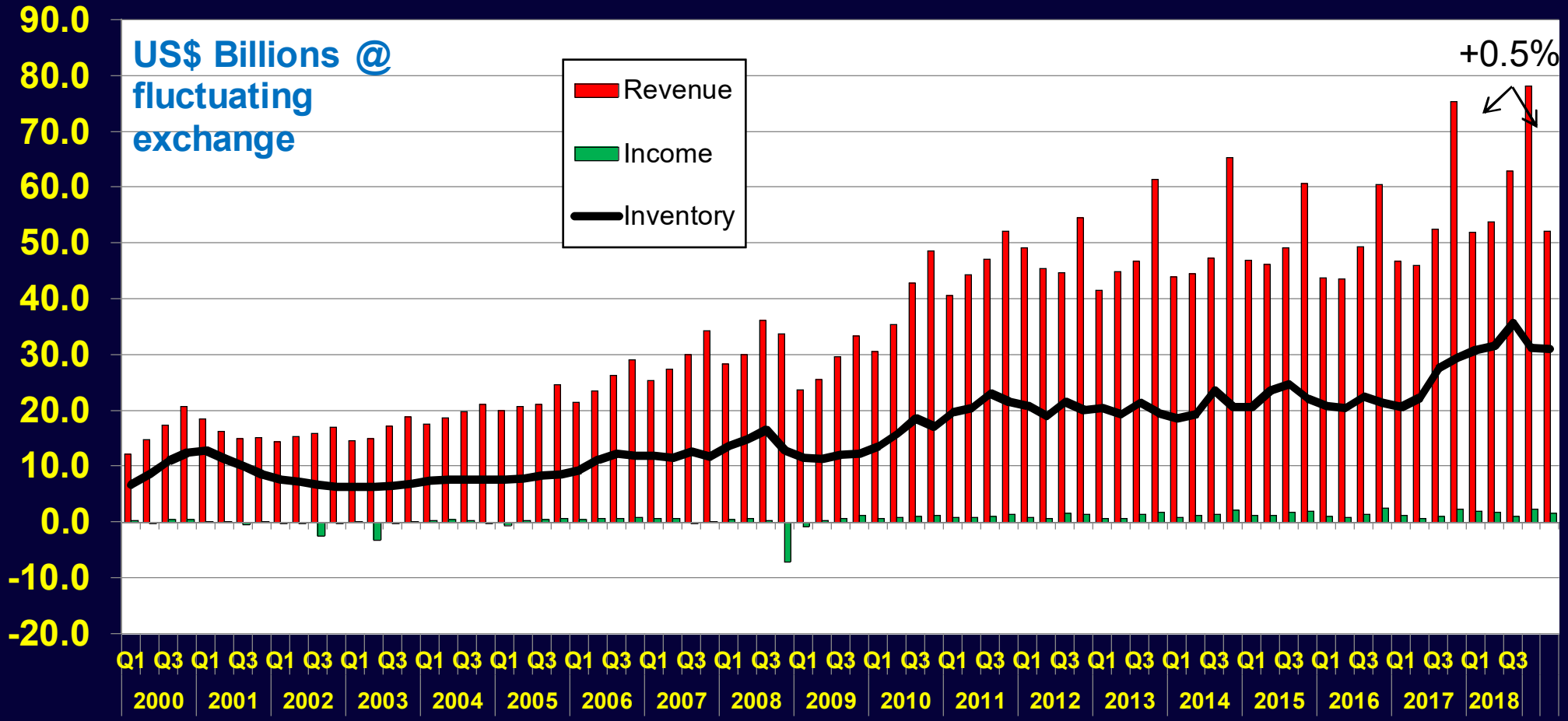
Global EMS & ODM Companies Composite of 52 Public Companies

Revenue



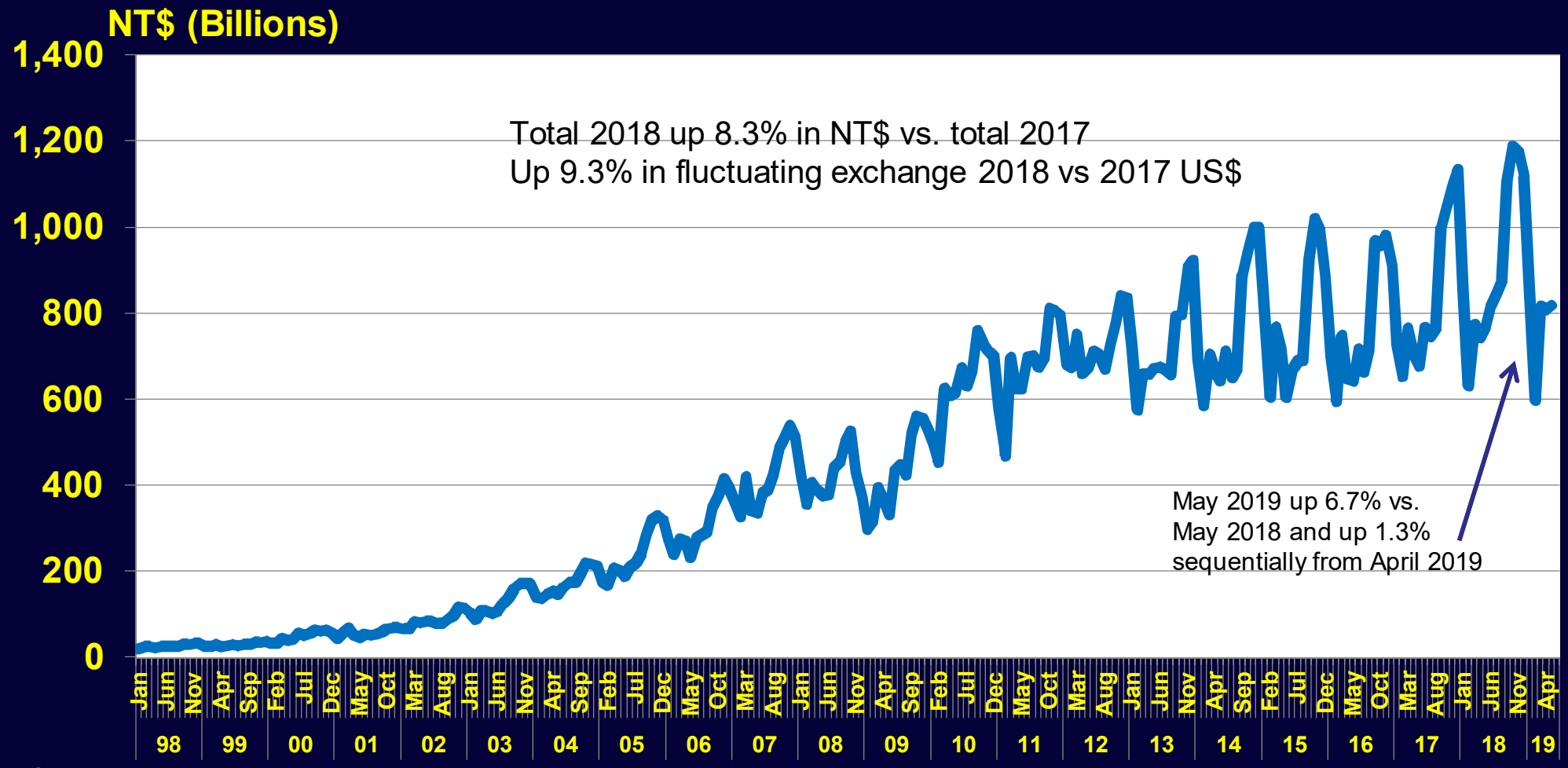
20190519

Large EMS Providers
Composite of 9 Public Companies
Revenue, Net Income & Inventory



Benchmark+Pemstar, Celestica, Flextronics+Solectron, Foxconn, Jabil, Plexus, Sanmina, Sypris, Venture Mfg

Taiwan ODM Companies
Composite Sales of 11 Large Manufacturers

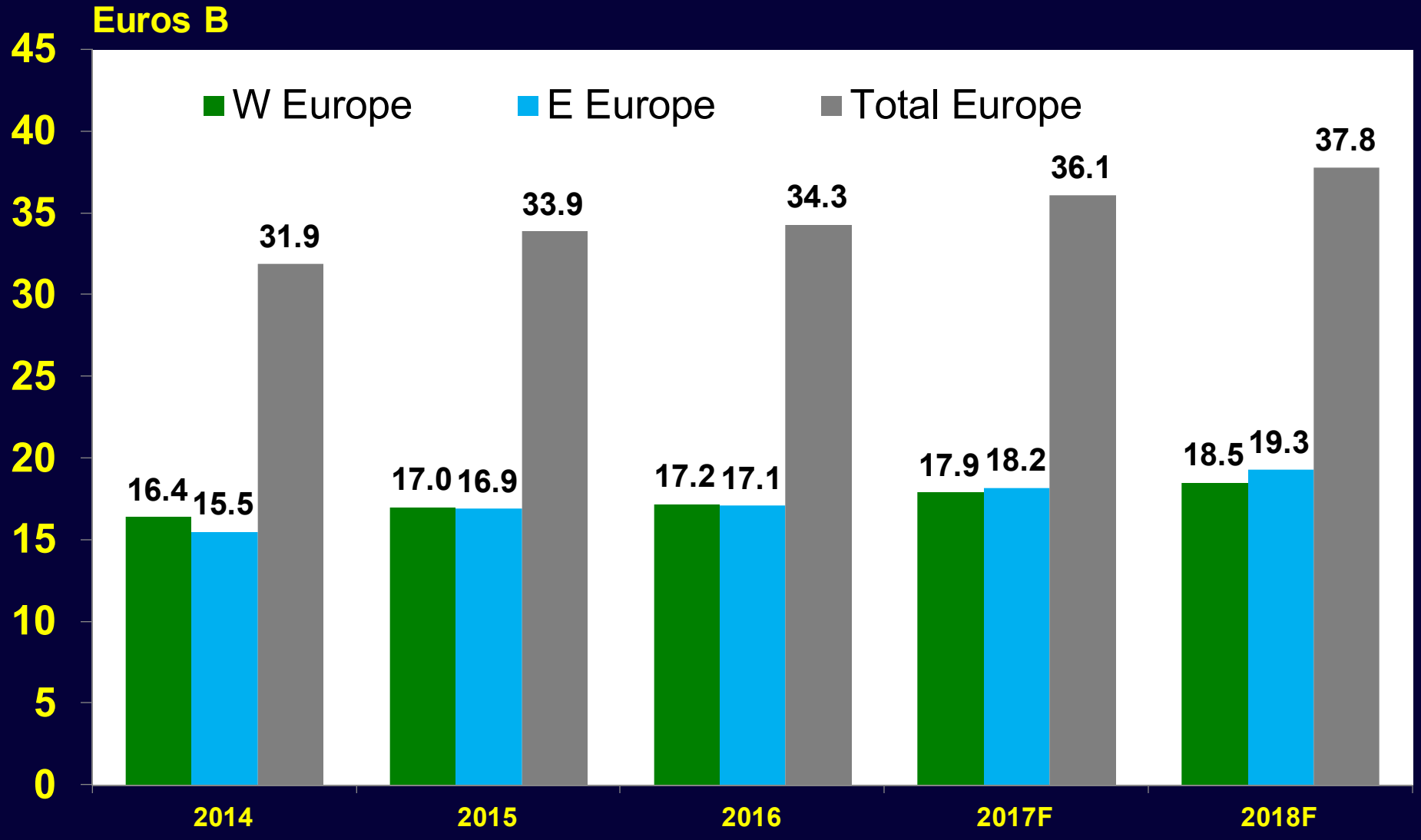


Company Financial Releases

Asustek Computer, Chei Mei, Compal Electronics, Foxconn, Chimei Innolux , Inventec, Inventec Appliance, Lite On Technology, Mitac International, Pegatron, Quanta Computer, Wistron, Chei Mei Display replacing Chei Mei & Innolux Display 3/10 & later

20180125

European EMS Market
Western Europe and Eastern Europe

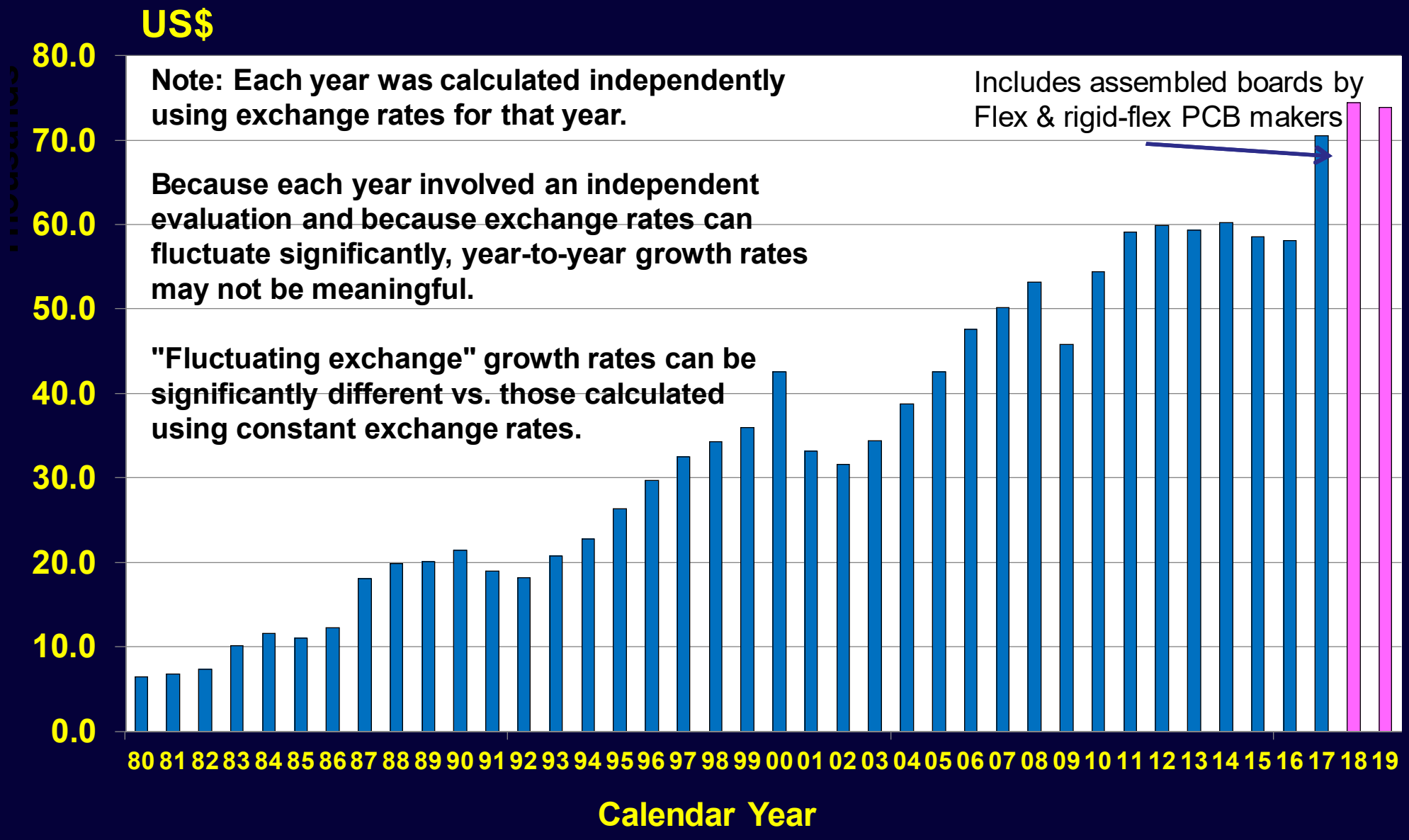


Source: In4ma d.g.weiss@gmx.de

Summary of 1,576 individual EMS entities plus 2.9% added to estimate to bring Europe 35.5 billion Euro for 2016. MENA not included

PCB Market

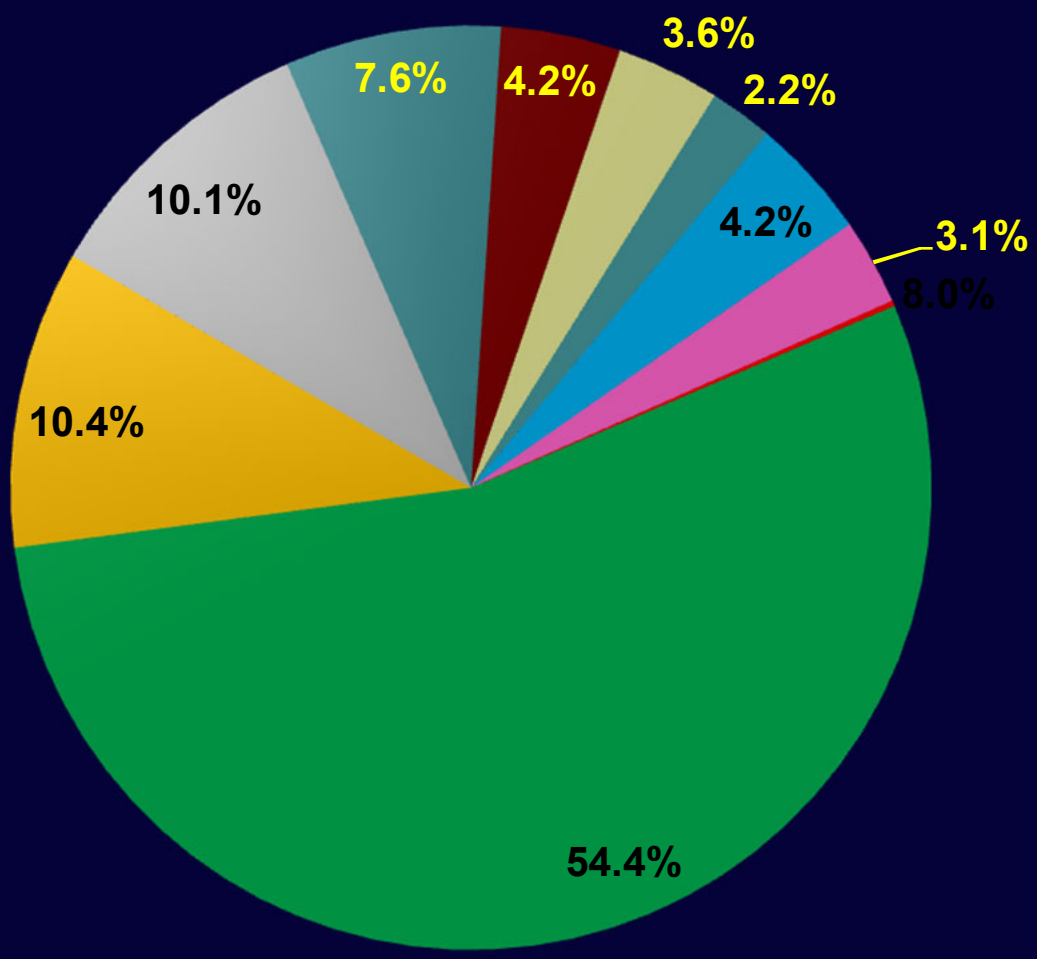
World PCB Production 1980-2019



IPC: World PCB Production Report 2016 + Nakahara estimates for 2018 & 2019

20190611

2018 World Total PCB Production by Geographical Area



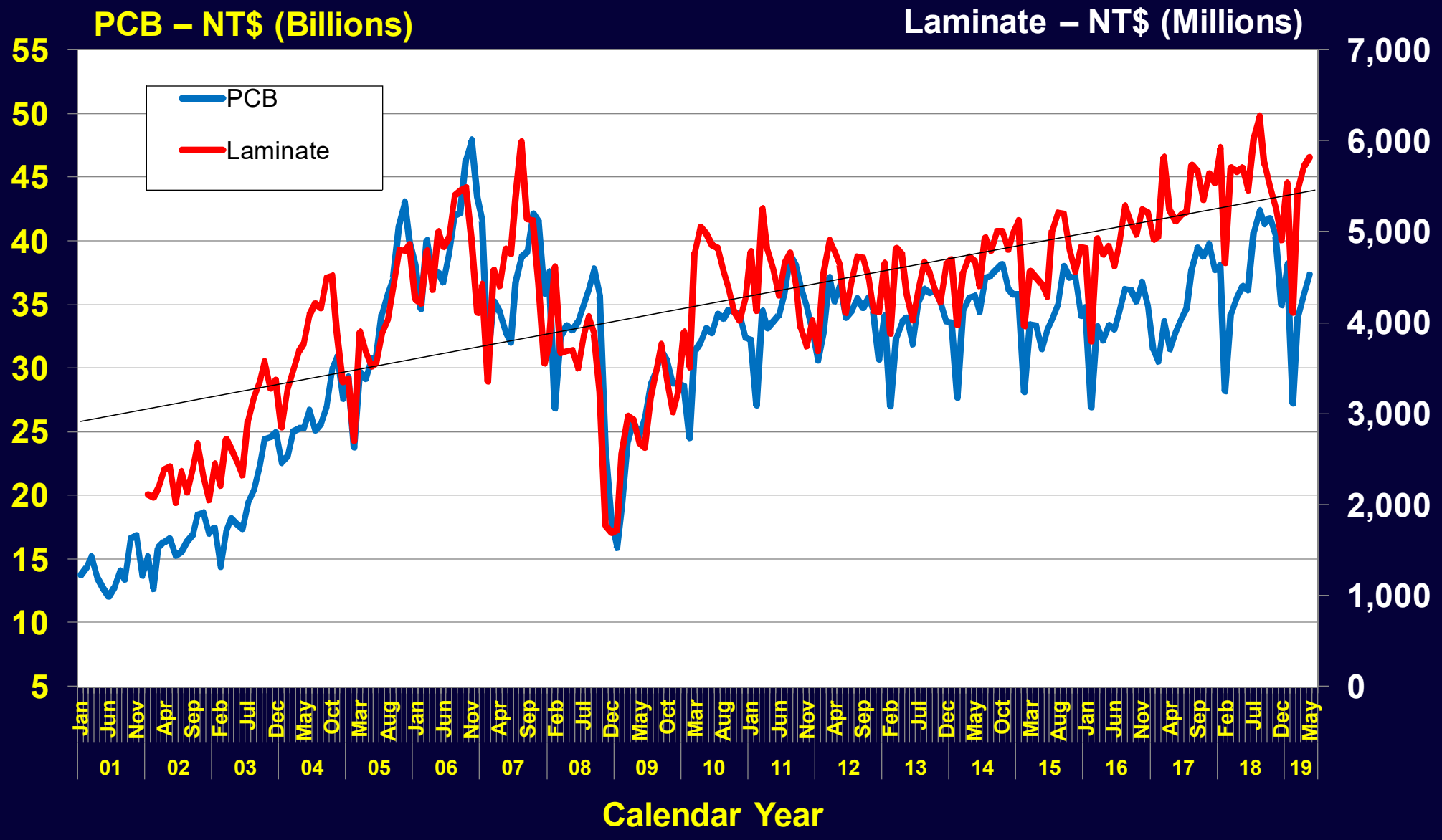
- America
- Europe
- Africa &Mid East
- China
- Taiwan
- S Korea
- Japan
- Thailand
- Vietnam
- Other Asia

Total: $74.5 Billion (includes assembly by PC makers, particularly FPC)

H Nakahara

20190611

Taiwan Listed Vendor Shipments
42 Rigid PCB & 8 Laminate Manufacturers

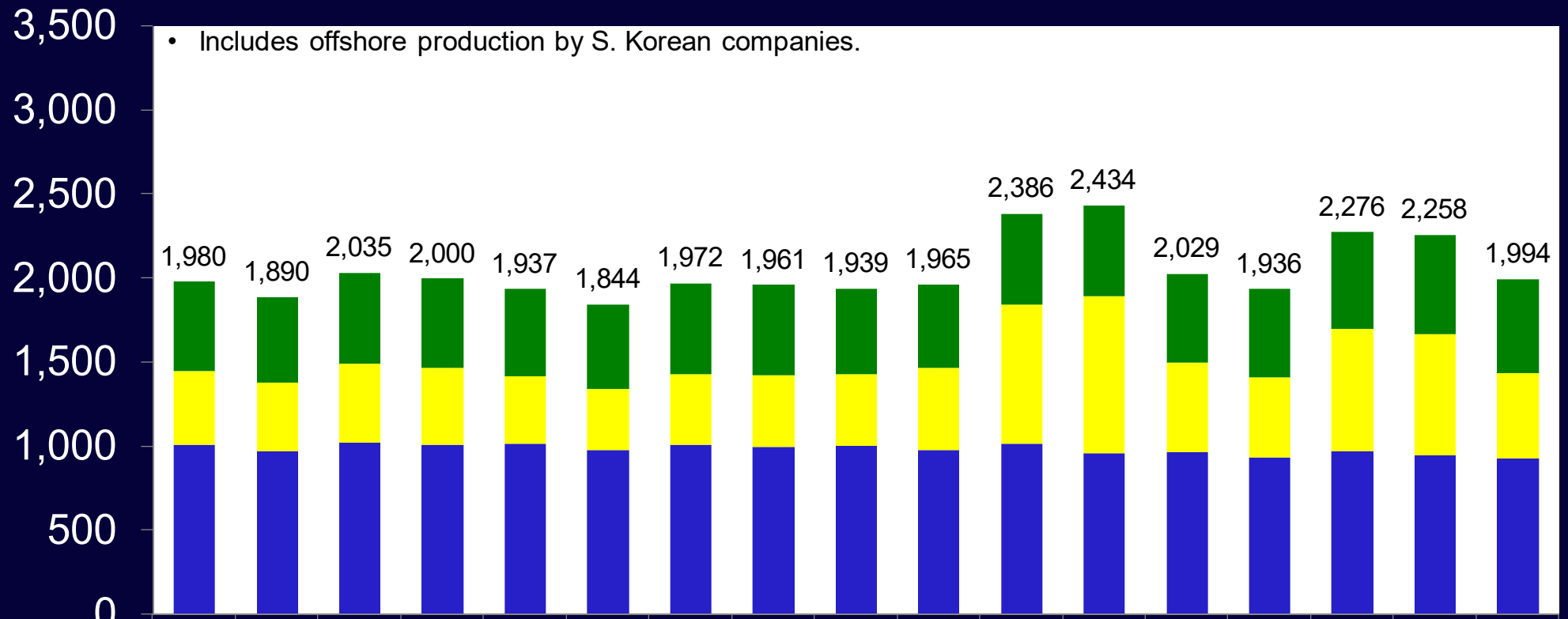


Company Financial Releases

S Korean Companies' Global PCB Production

20190504

US$ millions (converted at 1150 won/$)

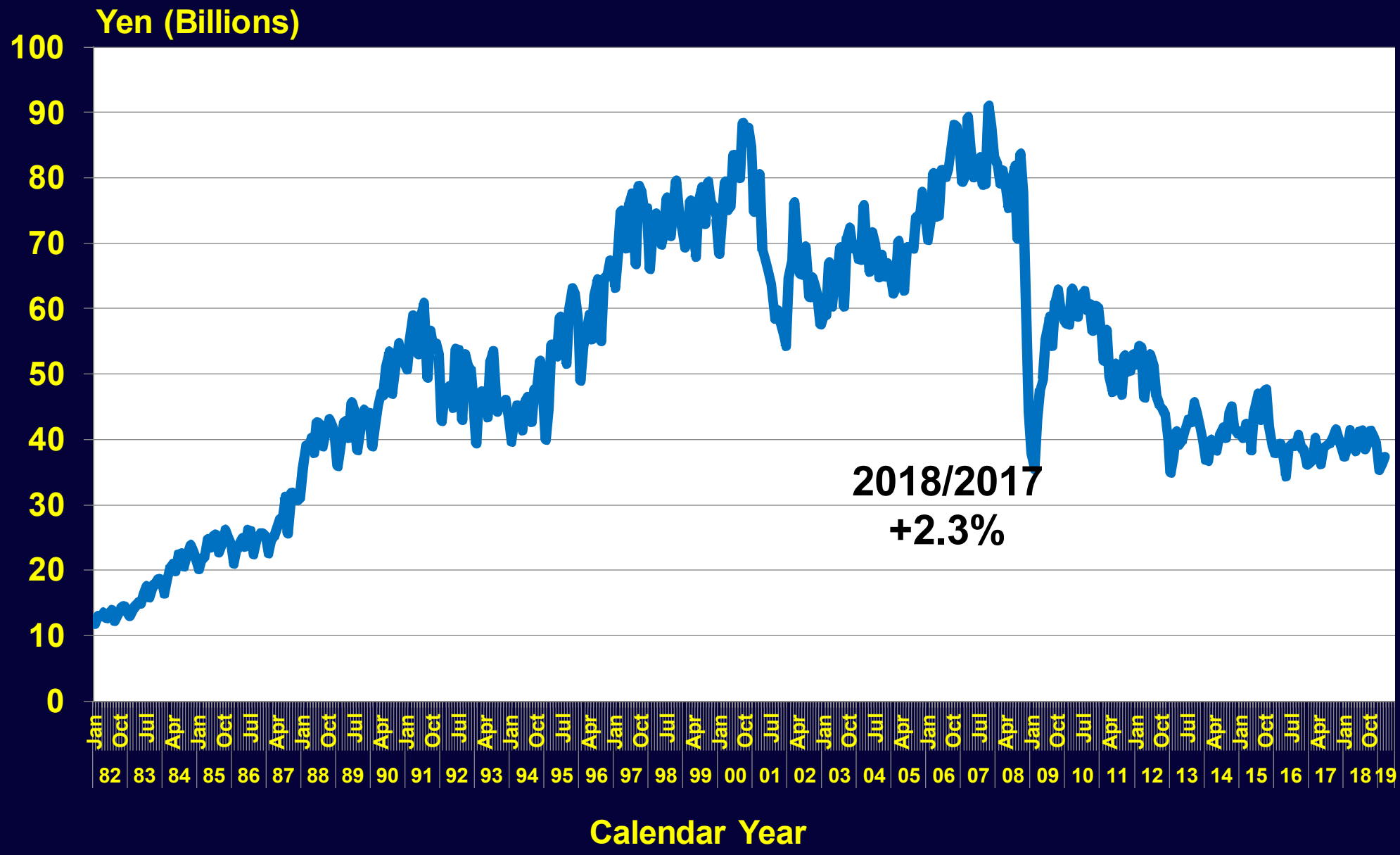


	Q1 2015	Q2 2015	Q3 2015	Q4 2015	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Q1 2019
Total	1,980	1,890	2,035	2,000	1,937	1,844	1,972	1,961	1,939	1,965	2,386	2,434	2,029	1,936	2,276	2,258	1,994
IC Substrate	530	510	540	530	518	504	545	537	512	496	541	538	533	524	579	589	556
Flex	440	410	470	460	401	364	420	425	421	489	830	938	529	476	726	724	507
Rigid	1010	970	1025	1010	1018	976	1007	999	1006	980	1015	958	967	936	971	945	931

Private communication from industry source

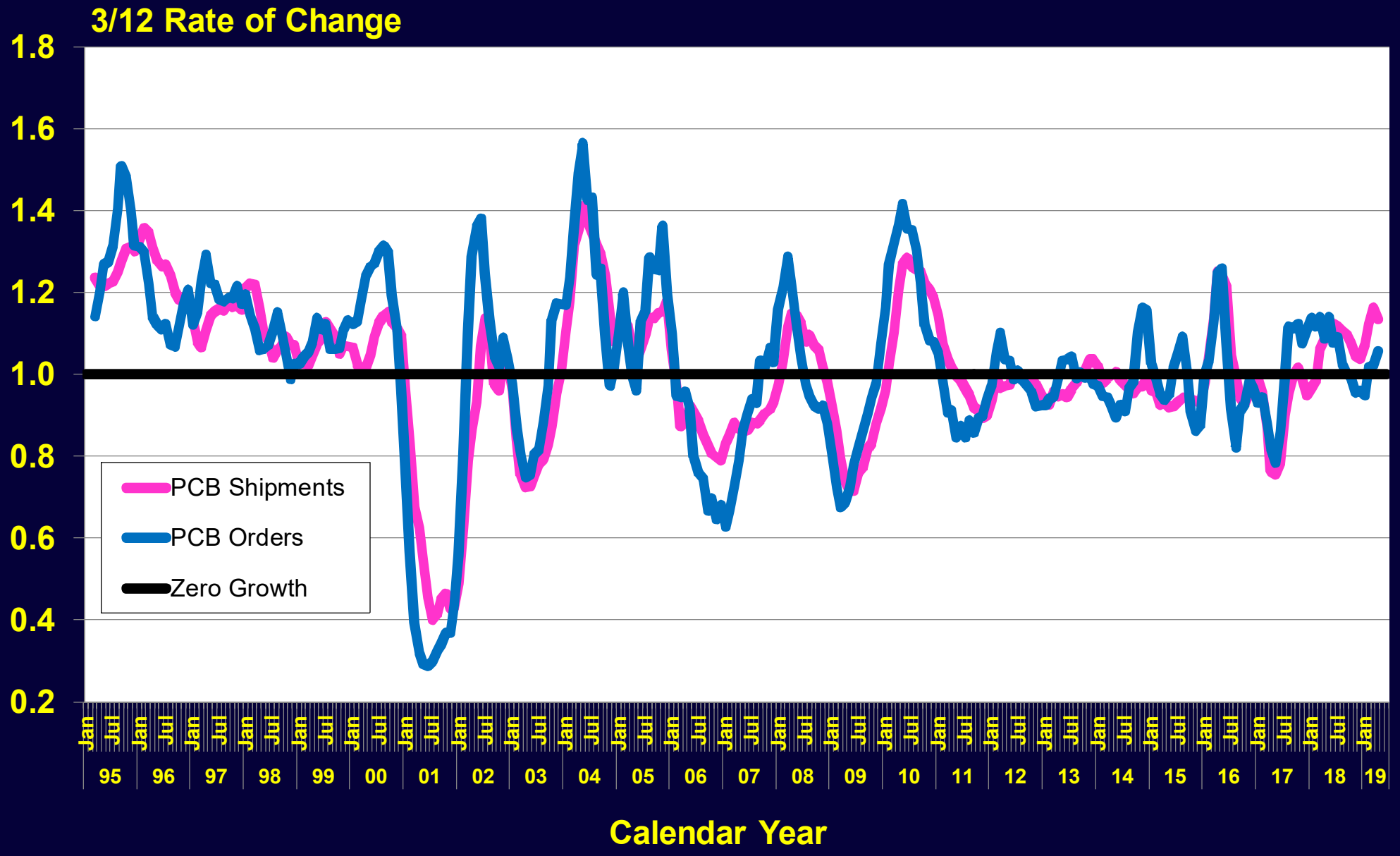
20190605

Japan PCB Production



JEITA

N. America Rigid & Flexible PCB Orders & Shipments



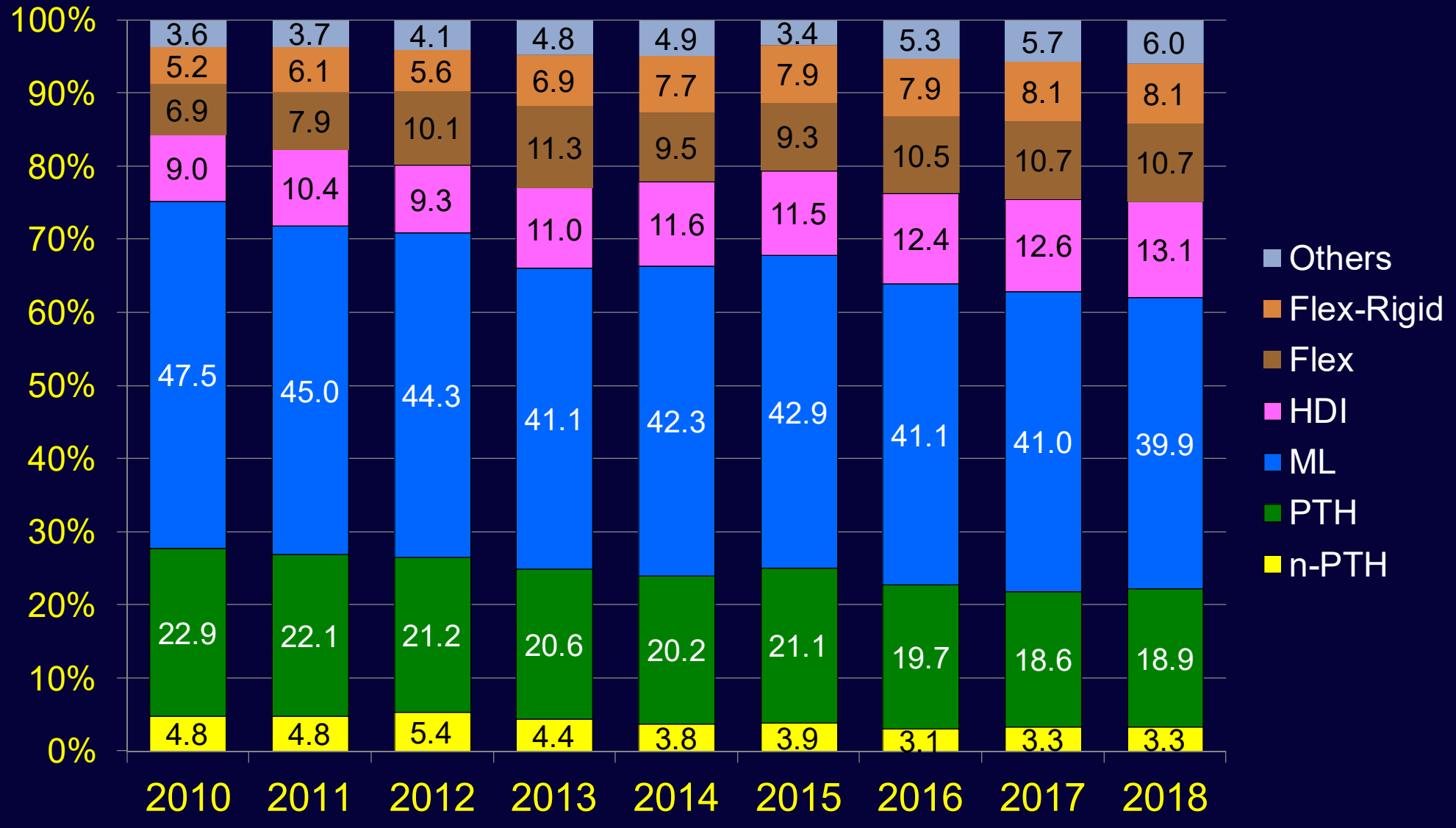
Data: IPC T/MRC & http://www.census.gov/indicator/www/m3/

Europe

Special thanks to
Michael Gasch
&
Hans Friedichkeit

20190609

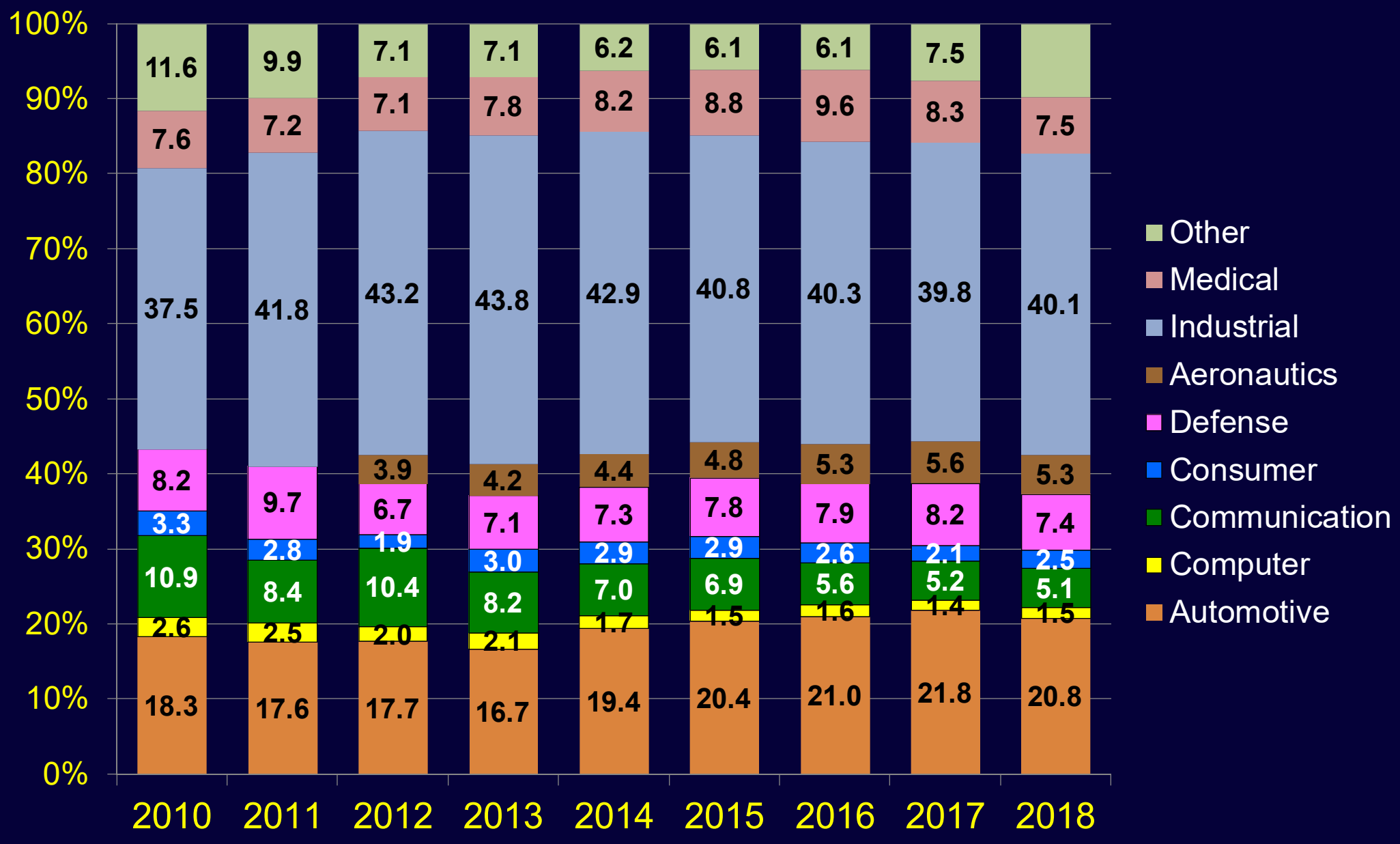
European PCB Production by Technology



Data4PCB 4/19

20190609

European PCB Production by End Market



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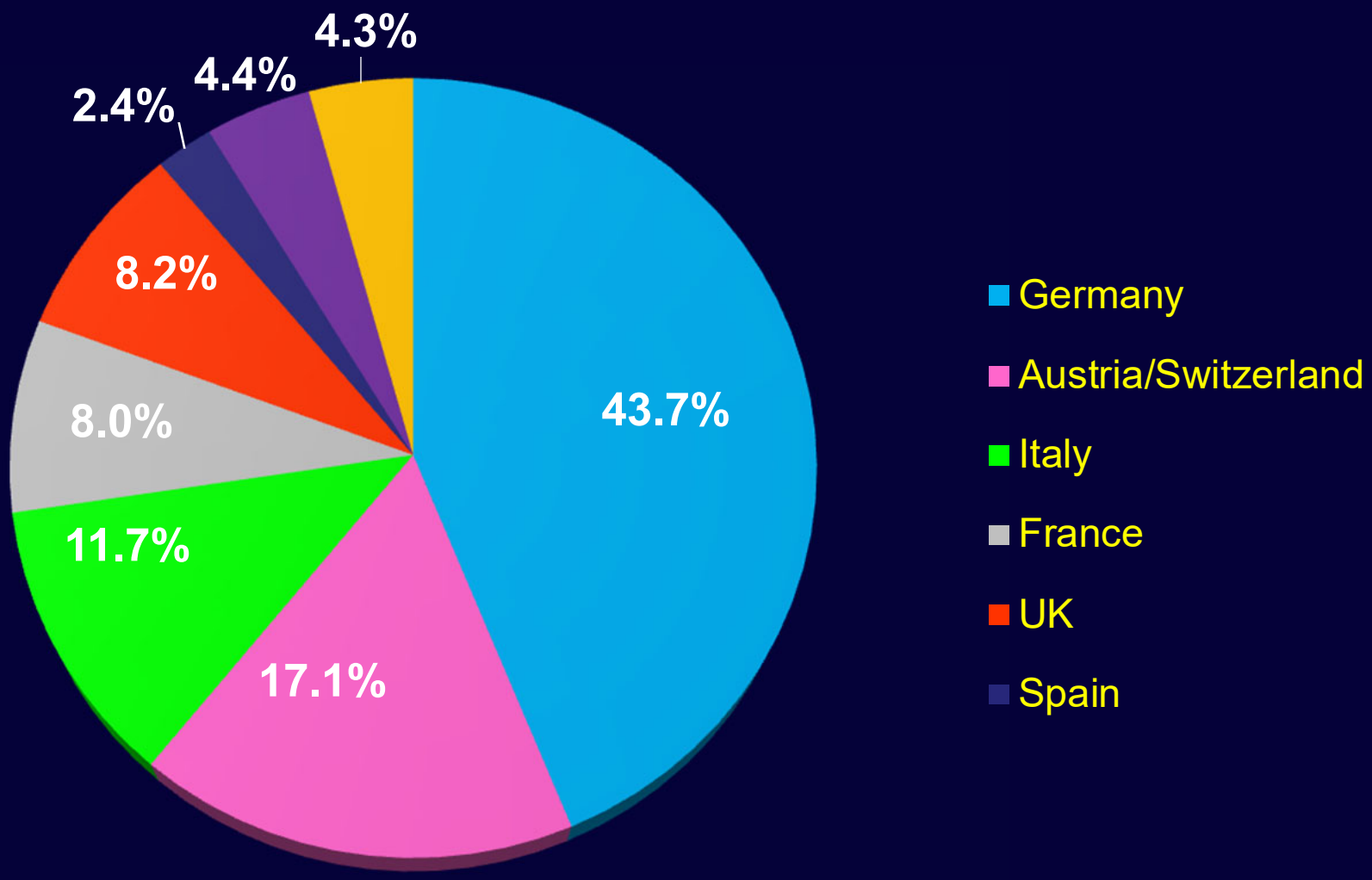
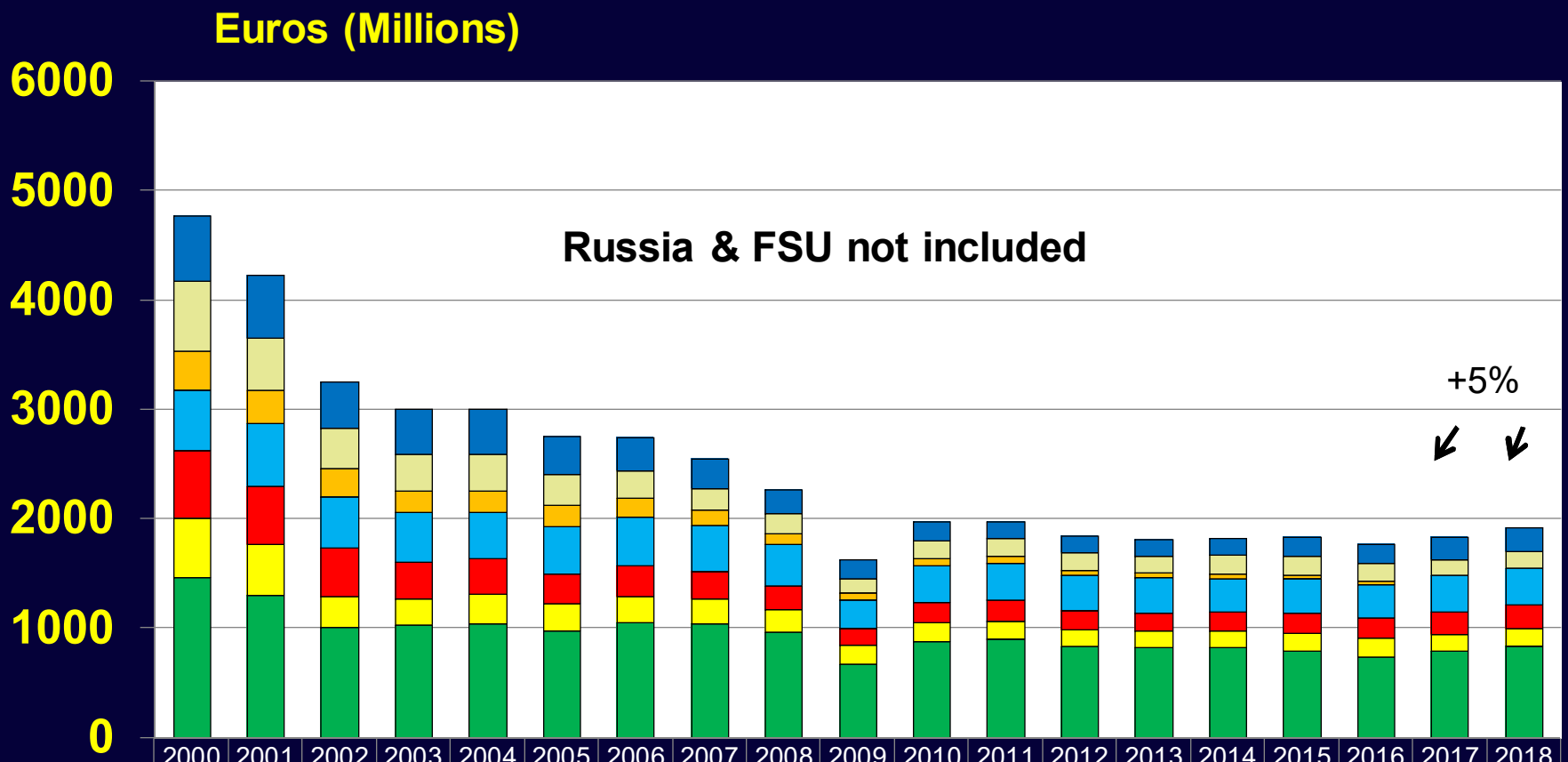
2018 European PCB Production



EUR 1921 million

20190609

European PCB Production



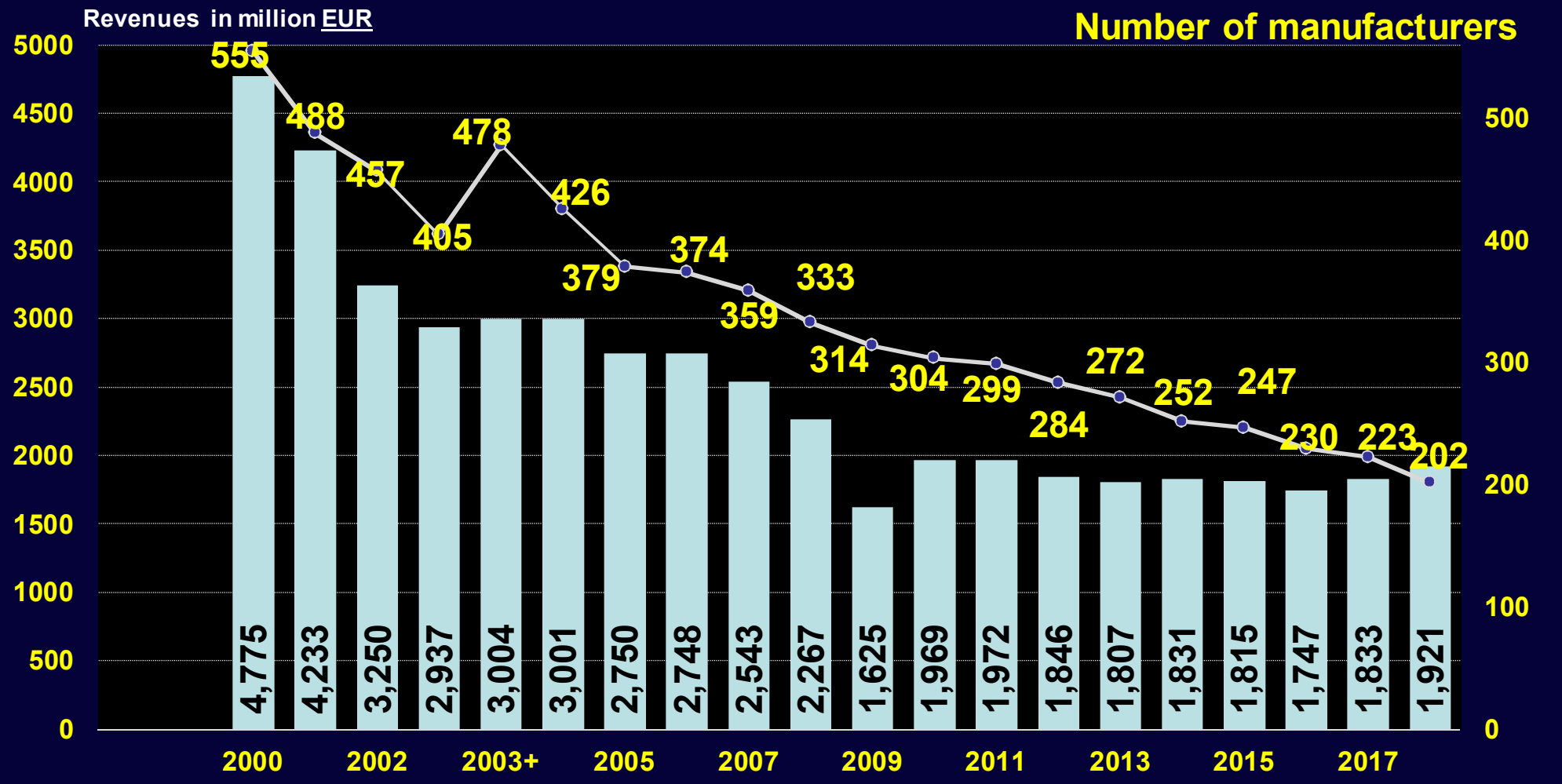
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Other	601	577	422	408	410	346	309	264	221	169	170	155	157	151	158	170	172	202	216
UK	641	478	368	340	330	278	252	197	177	137	165	161	158	153	165	173	163	149	158
Scandanavia	351	309	260	201	200	198	169	137	103	64	64	64	50	40	42	40	40		
Austria/Switzerland	561	575	463	447	427	427	447	427	378	258	341	343	325	323	312	315	299	332	329
Italy	619	530	444	338	324	281	284	248	212	156	181	186	174	168	174	181	188	206	226
France	541	465	287	244	266	240	234	231	206	165	170	166	147	148	148	157	168	156	154
Germany	1461	1300	1006	1027	1044	981	1054	1039	970	676	883	902	835	828	825	796	740	788	839

Data4PCB 4/19 & prior

PCB-Production in Europe 2018

summary	2012	2013	2014	2015	2016	2017	2018
revenues (million €)	1.846	1.807	1.831	1.815	1.747	1.833	1.921
staff	16.935	16.546	16.432	16.641	15.902	16.015	16.587
number of manufacturers per company size							
< 2 million €	125	125	113	109	94	87	66
2 – 10 million €	116	104	99	98	98	92	84
10 – 50 million €	38	37	34	34	32	38	46
> 50 million €	5	6	6	6	6	6	6
Total	284	272	252	247	230	223	202

PCB industry in Europe 2000 – 2018
Revenues & Number of Manufacturers



* 2003+ = incl. Central Europe

Data4PCB 4/19 & earlier

20190609

Europe's Top 41 PCB Companies Ranked by 2018 Revenues

Rank	Company	Rank	Company
1	AT&S AG	22	Cicor group
2	Würth-group	23	Polytron Print GmbH
3	KSG group	24	Rohde & Schwarz
4	Schweizer Electronic AG	25	Tecnomaster group
5	Elvia PCB	26	Schaltungsdruck Storz
6	Mektec Europa	27	Spirit group
7	Unimicron	28	Graphic plc
8	SoMaCis SpA	29	Eleprint srl
9	hmp Microprint	30	Ilfa
10	EES-group	31	Cipsa
11	Elco group	32	Eltos
12	GS SwissPCB AG	33	TW Elektronik Horst Müller
13	Optiprint AG	34	Elekonta Marek GmbH
14	Invotec	35	OMR Italia SpA
15	Varioprint AG	36	Piciesse elettonica s.r.l.
16	Dyconex AG	37	LAB Circuits S.A.
17	Cistelaier-group	38	Asetronic AG
18	groupe Cimulec	39	Jenaer Leiterplatten
19	ACB-group	40	Merlin (Falcon) group
20	Eurocircuits group	41	Precoplat
21	Aspocomp Oy		

Data4PCB 4/19

Europe Comments –Michael Gasch

In 2018 in Europe 21 companies closed but all were very small (total revenues combined: 20 million EUR, 300 jobs). During the first 5 months of 2019 already 3 companies with 3 million EUR & 44 jobs lost.

Revenues in Germany have been fairly stable so far (9% less than 2018) but order intake is about 20% less compared to 2018 and declining.

There are several reasons for this:

- Trump's actions to destroy decades of agreements & alliances with most of the important countries & economies. This now affects the world economy, creating supply chain insecurity.
- Competition of British politicians to destroy 40 years of economic ties under pretext that "afterwards all will be better".
- German automotive industry which created diesel scandal and did nothing to correct the affair in a proper way.
- Chinese companies having lost part of their business with USA now are pressing on the European market. The new rules for the PCB industry in China (effective Feb 1st, 2019) will reshuffle the supply base in the coming 3-5 years.

M Gasch, data4PCB 6/2019

Europe Comments – Hans Friedrichkeit

As PMI for Germany shows, the curve has been falling steadily since December 2017 and has fallen below the magic 50.

The German automotive industry with more than 800,000 direct jobs is trapped.

Reasons are

- EU's CO2 environmental requirements
- Court actions with driving bans for Diesel cars by associations such as of German Environmental aid; Diesel share had been 50% of sales but now its down to 30% and further shrinking
- Chinese requirement to produce more and more BEV and hybrid vehicles, but German car industry isn't ready before 2021
- German car makers are dependent on Chinese, Japanese and Korean battery cell production
- Threat of president Trump charging 25% duties on German cars

All of this is now topped by the Green Party, which lures many young voters with the issue of climate protection and green politics. Although no Green politician has yet shown how the promises are feasible in practice.

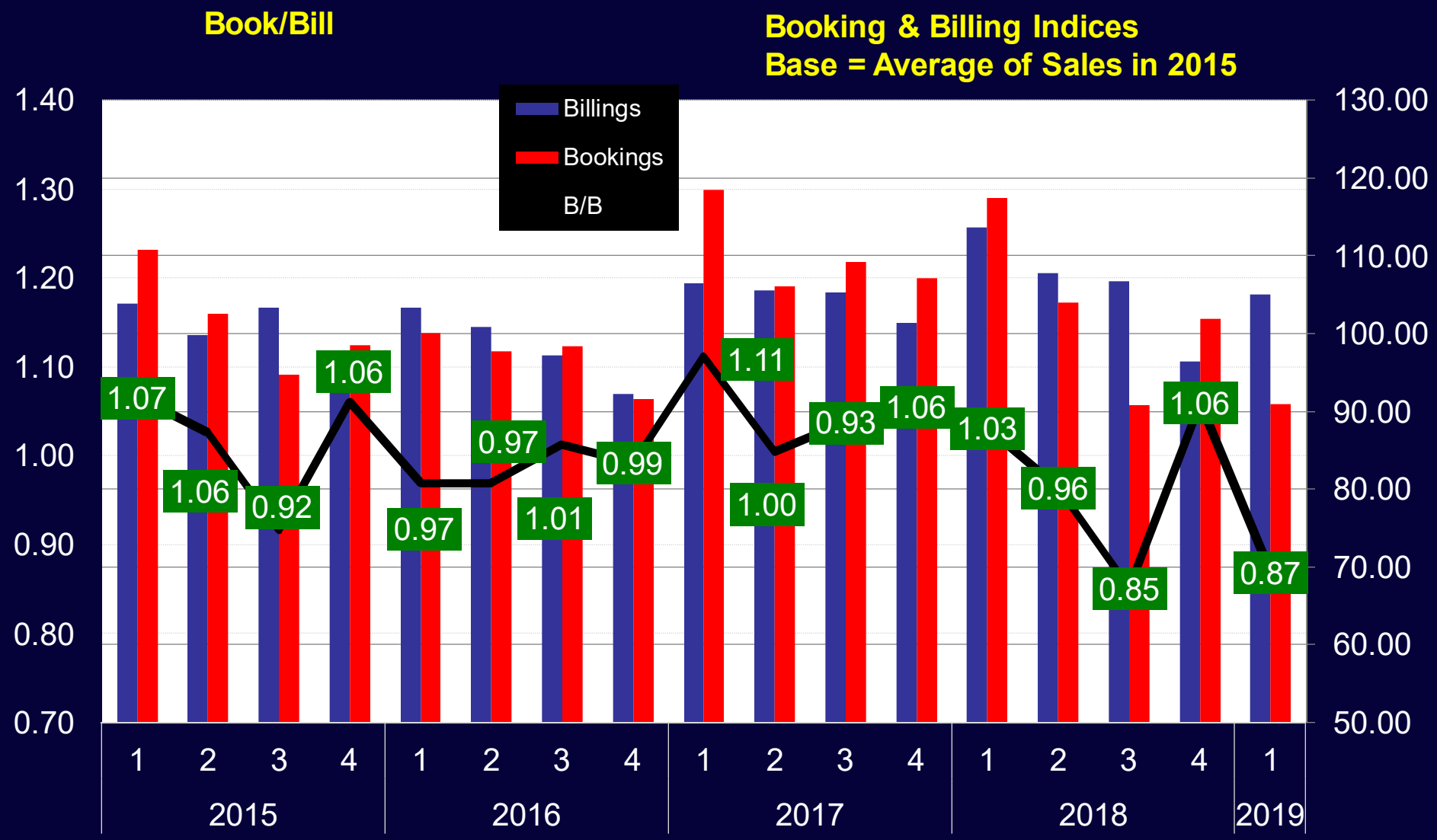
Several large PCB manufacturers have registered short-time work and have a hiring freeze. Current order intake approx. minus 20%.

Germany is on its way to seriously damaging its industry because people believe jobs, prosperity and security are self-evident.

Hans Friedrichkeit 6/19

201811
11

DACH PCB
Bookings, Billings & Book/Bill



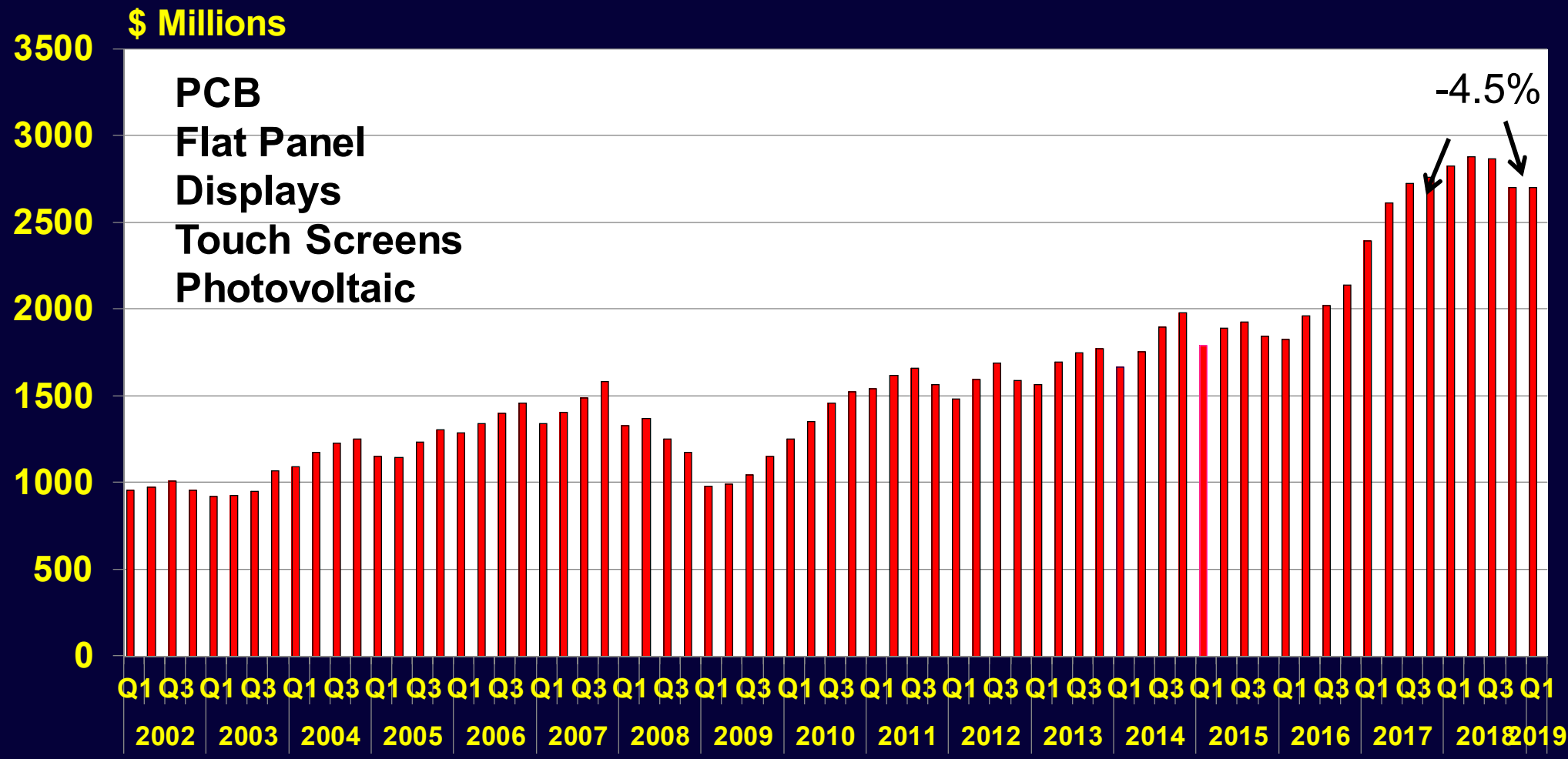
M Gasch based on ZVEI data 04/19

Process Equipment, Laminate & Materials Suppliers

20190601

Process Equipment Related Suppliers Composite of 12 Companies

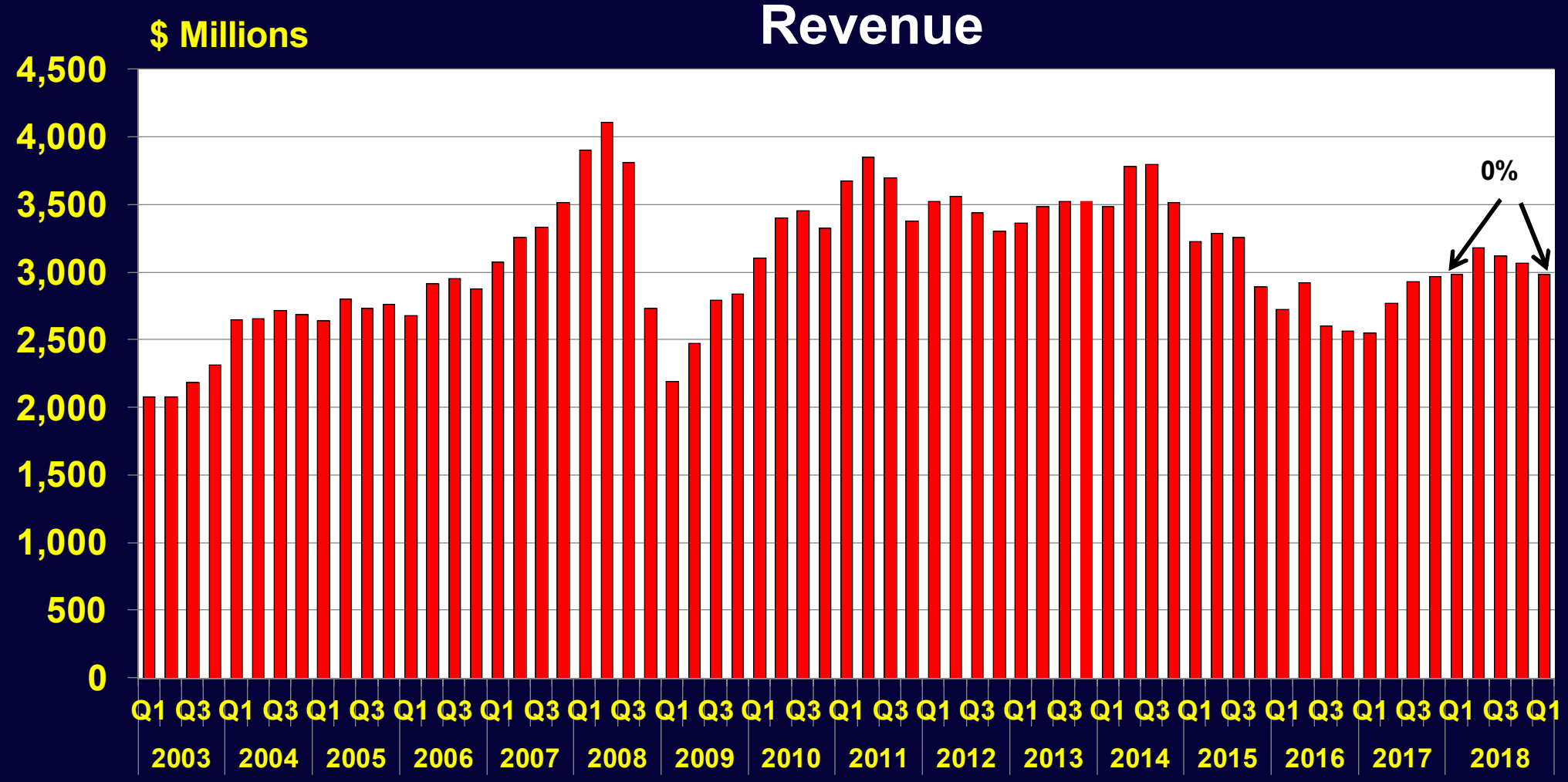
Revenue



C-Sun,Tailing Technology, Camtek, Cadence, ESI, GSI Group, Mentor Graphics, Nordson, Rofin-Sinar, Coherent, Orbotech, Data I/O

Material Suppliers (excluding laminate) Composite of 14 Companies

20190505



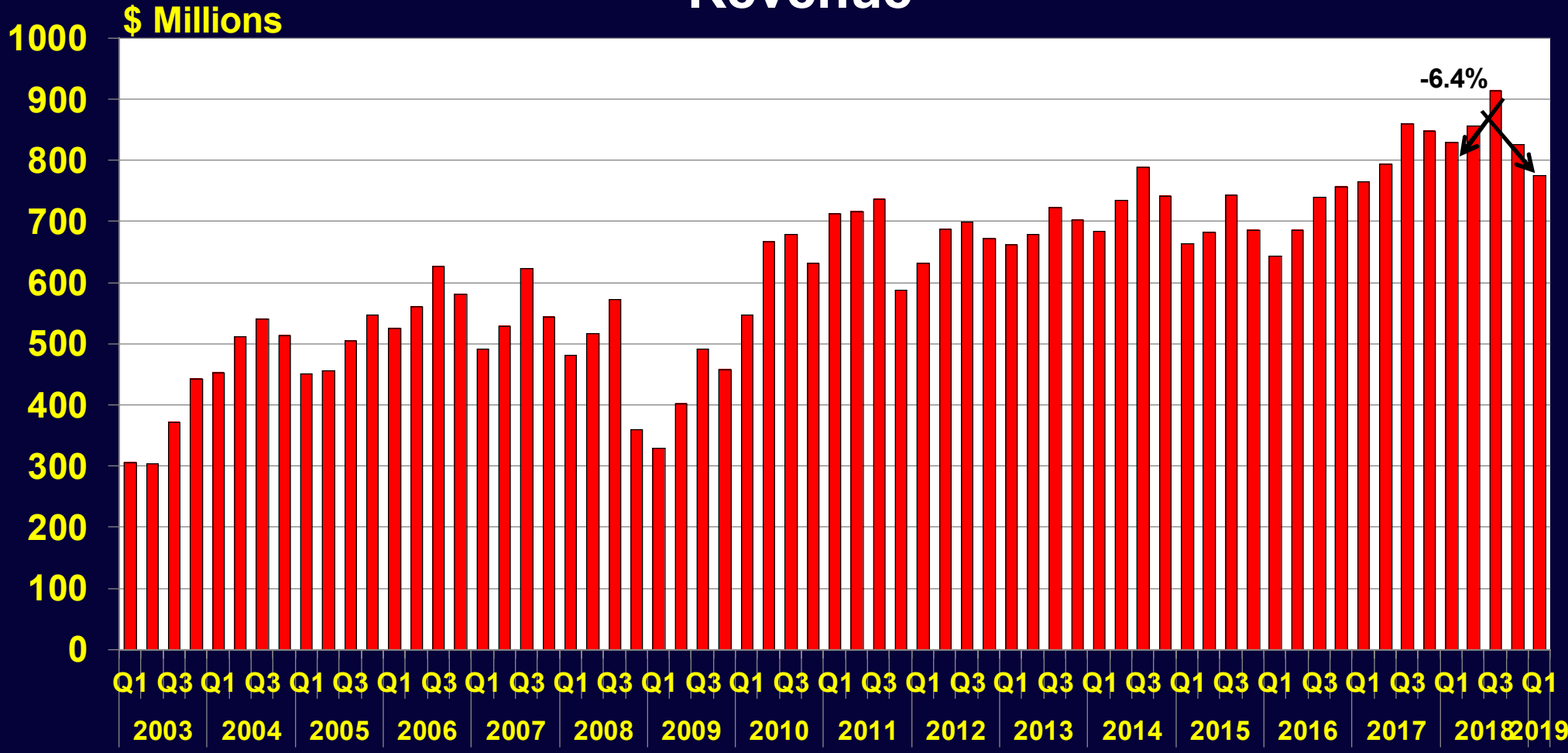
Momentive, OM Group, Taiwan Glass, Baotech, Glotech, Shenmao, Wahlee,Topoint, Cabot Micro, Cookson Elec, Eternal Chemical, Hexcel, Chang Wah, Platform Specialty Products

NT$ & GBP converted to US$ at fluctuating exchange

20190505

Rigid & Flex Laminate Suppliers
Composite of 13 Companies

Revenue

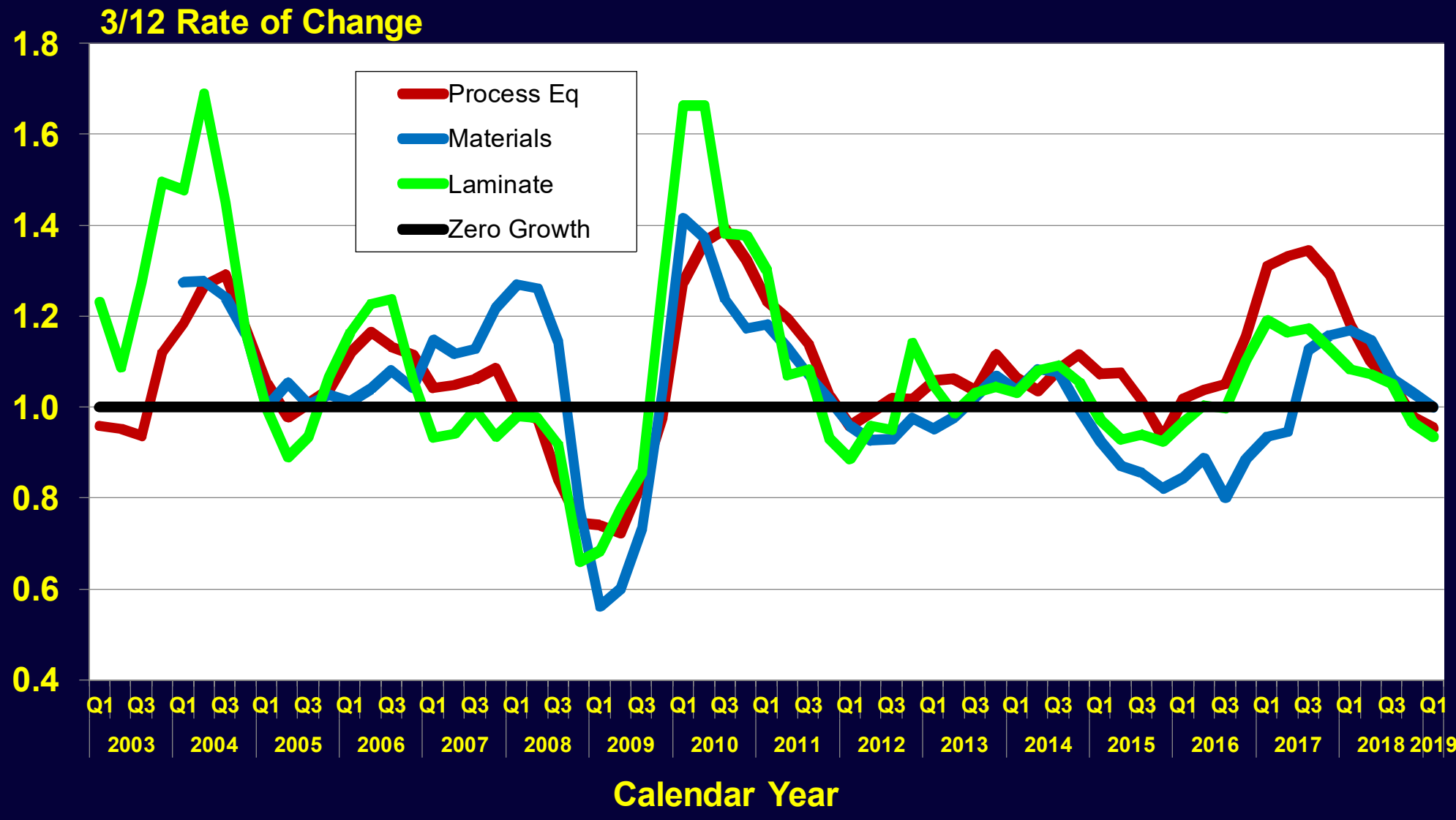


Arisawa, Arlon Electronic Materials, Elite Materials, Hwa Woei, Iteq, Microcosm, Park Electrochemical, Rogers, Shinemore, Taiflex, Thinflex, Top Union, Uniplus

NT$ converted at fluctuating exchange

20190519

Global Growth Rates
Process Equipment, Materials & Laminate

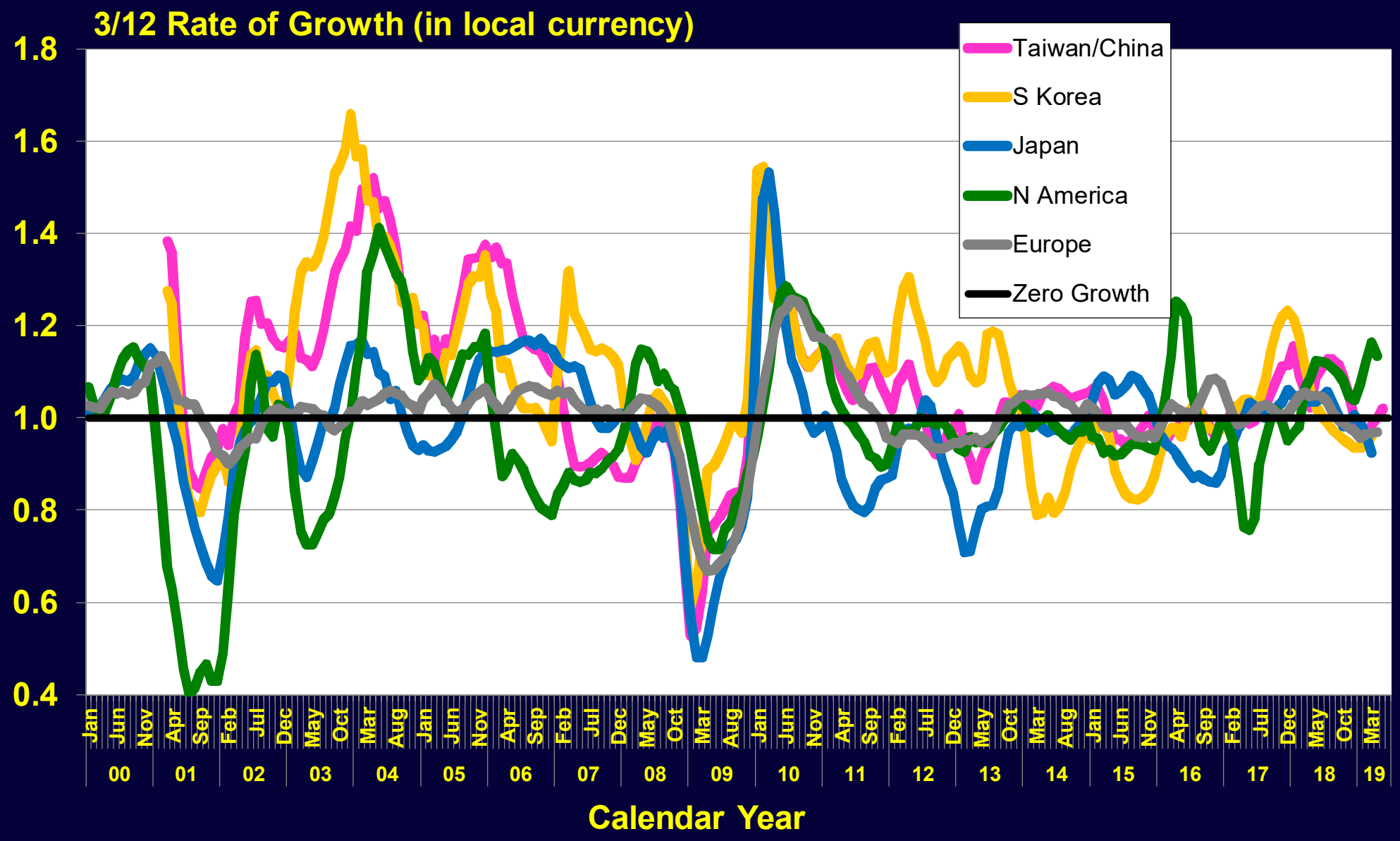


Company Financials of 12 Laminate suppliers, 13 material suppliers & 8 Process Equipment Suppliers

World PCB Model

20190614

Regional PCB Shipment Growth

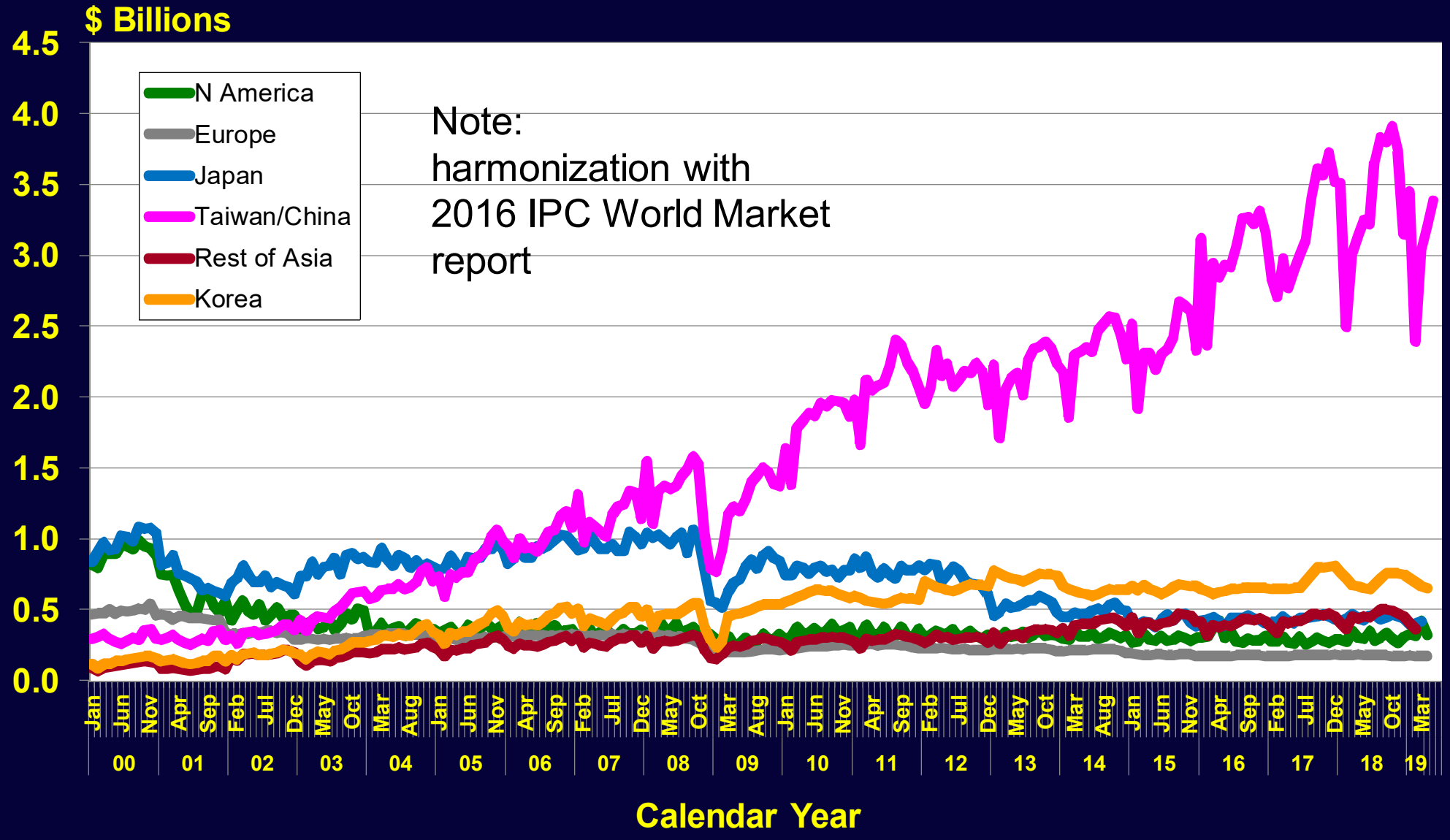


Sources: IPC, JPCA, Taiwan/China composite; Eurostat "wiring devices" for Europe

20190614

World PCB Monthly Shipments

Converted @ Fluctuating Exchange Rates



Source: Custer Consulting Group

20190614

World PCB Shipments

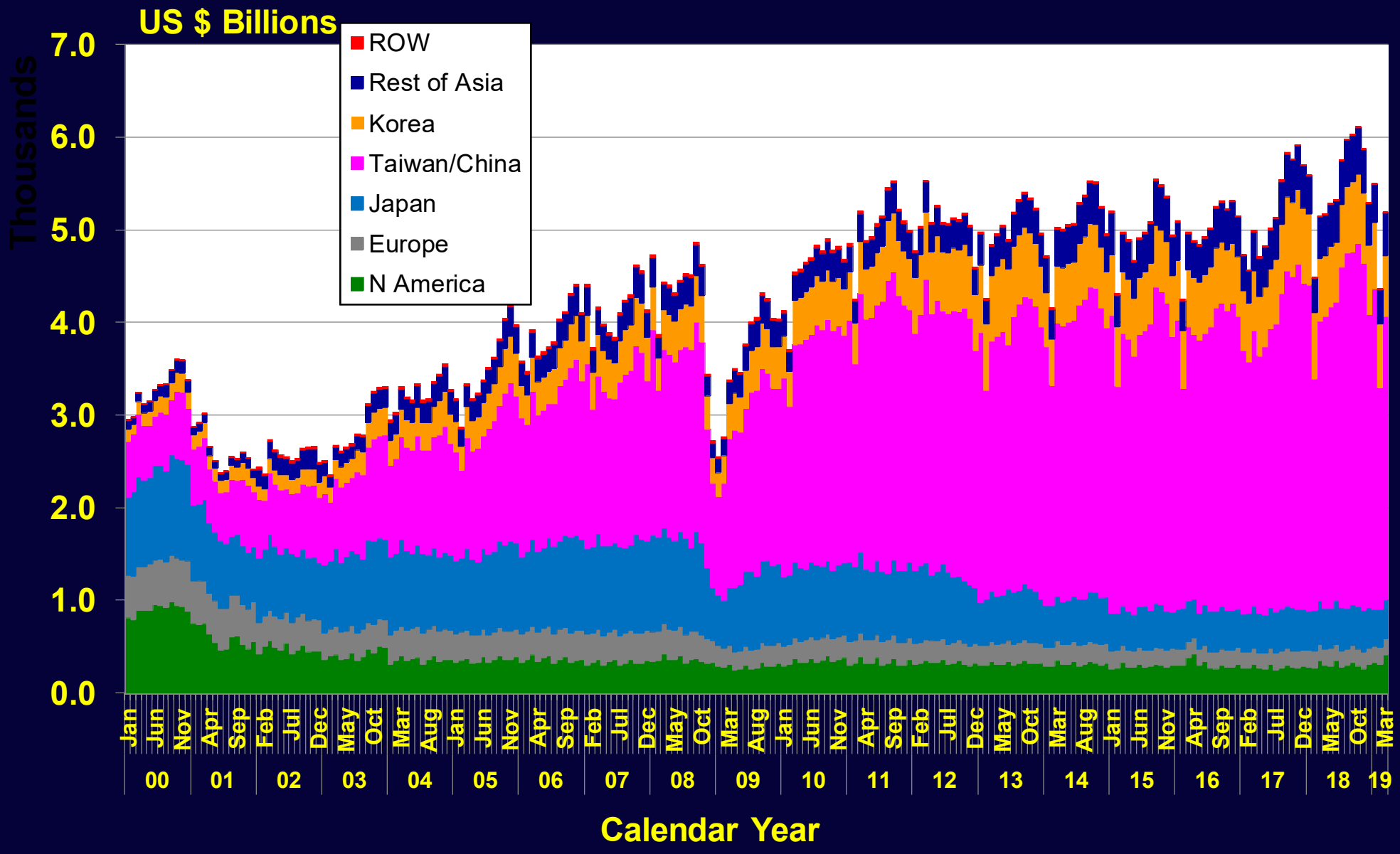
Converted @ Fluctuating Exchange Rates

Source: Custer Consulting Group - 2010 base year expanded by monthly growth of N. American, European, Japanese, Korean & Taiwan/China monthly PCB shipments

20190610

World PCB Monthly Shipments

Converted @ Fluctuating Exchange Rates



Source: Custer Consulting Group

Forecasts

20190614

Present Growth Rates (%)
European Electronics Industry

	Latest Month	Annualized Growth Rate	3-Month Growth Rate
ELECTRONIC EQUIPMENT SHIPMENTS (Index CY 2010 =100)			
Components & Boards	4/19	3.6	10.4
Components	4/19	3.4	11.6
Wiring Devices	4/19	-1.2	-2.9
Loaded Electronic Boards	4/19	6.4	9.4
Communication Equipment	4/19	-2.2	2.5
Electric Domestic Appliances	4/19	-5.0	-5.6
Instr & Appl for Measure, Test & Navigat	4/19	5.9	1.5
Medical Electronic Instruments	4/19	2.4	0.8
Motor Vehicles	4/19	-5.9	-9.1
Air & Space Aircraft	4/19	2.9	4.6
Semiconductor Shipments (Eur) to Europe	4/19	5.6	0.4
Industrial Production	4/19	0.7	0.9

NOTE: 3 month growth rates compare most recent 3 months to same 3 months one year earlier. Also called 3/12 growth

Sources: Eurostat & SIA

20190608

Real GDP Growth

Real Rates of Economic Growth

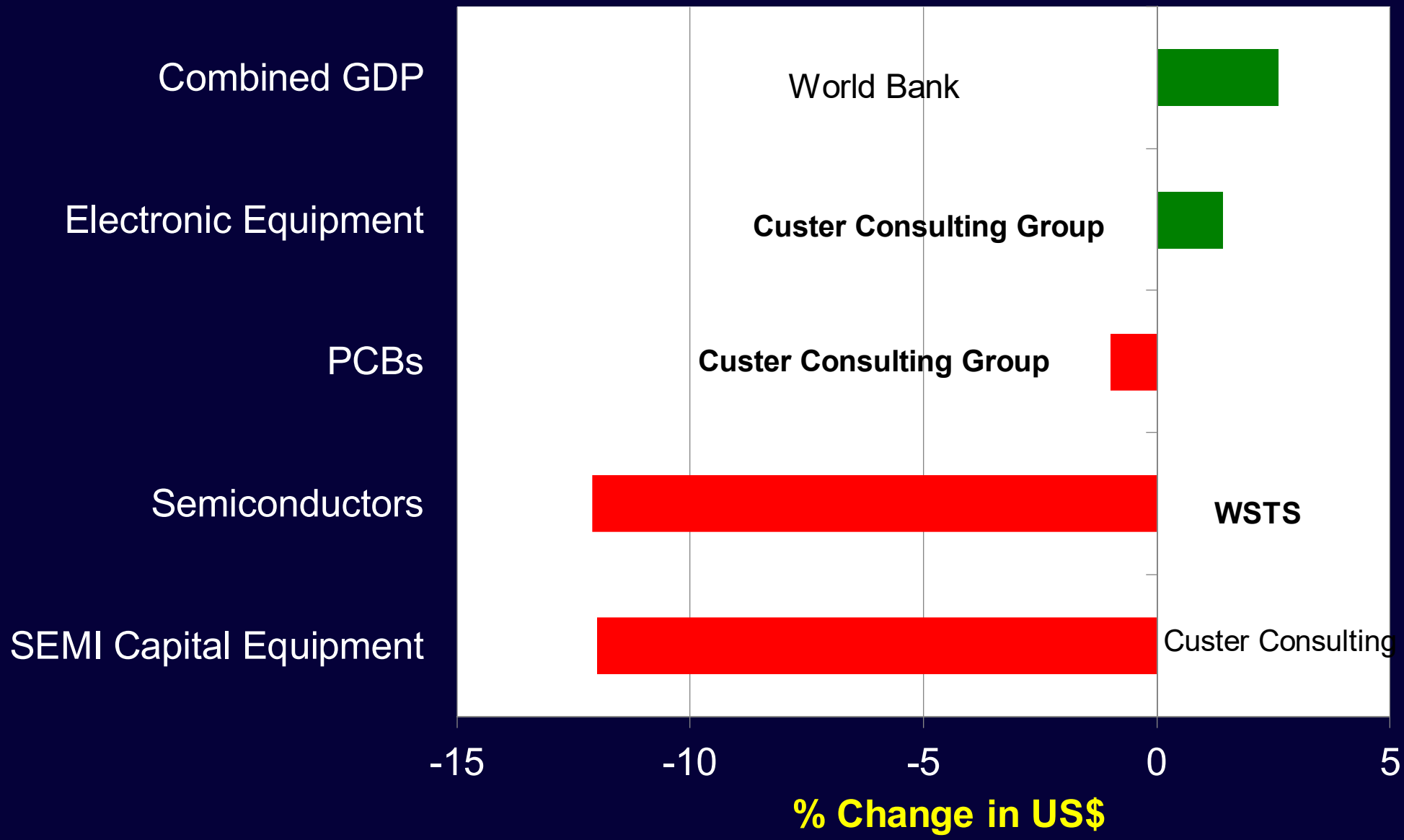
	2018	2019f	2020 f	2021f
World	3.0	2.6	2.7	2.8
USA	2.9	2.5	1.7	1.6
Euro Area	1.8	1.2	1.4	1.3
Japan	0.8	0.8	0.7	0.6
China	6.6	6.2	6.1	6.0
Emerging/Developing	4.3	4.0	4.6	4.6

Global Economic Prospects, World Bank 6/19
https://openknowledge.worldbank.org/bitstream/handle/10986/31655/9781464813986.pdf

20190608

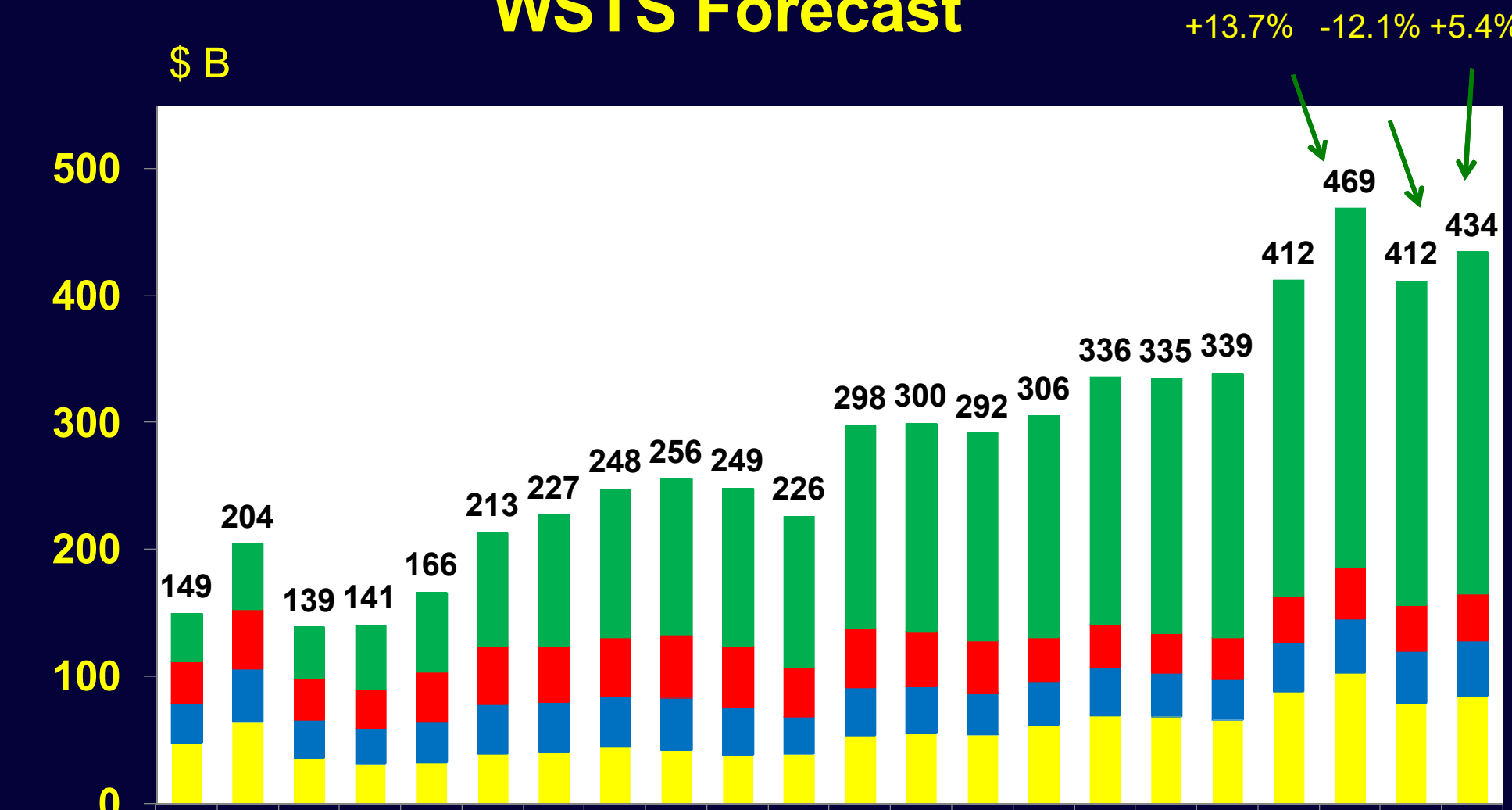
Global Electronic Supply Chain Forecast

2019 vs. 2018



20190604

Worldwide Semiconductor Market by Geography
WSTS Forecast

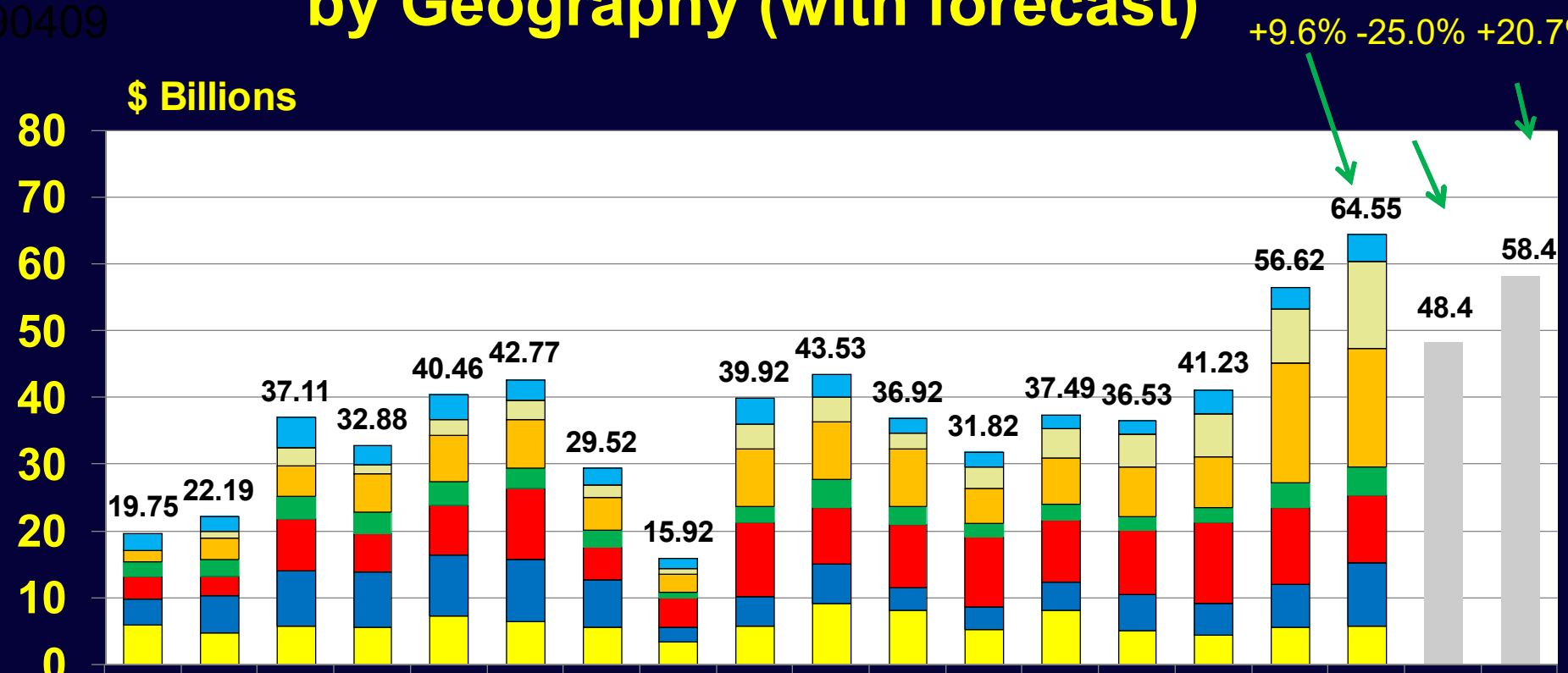


	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total	149.4	204.4	138.9	140.8	166.3	213.1	227.4	247.7	255.6	248.6	226.3	298.3	299.5	291.6	305.6	335.8	335.2	338.9	412.2	468.8	412.1	434.4
Asia Pacific	37.2	51.3	39.8	51.2	62.8	88.8	103.5	116.5	123.5	124.0	119.6	160.0	164.0	163.0	174.4	194.2	201.1	208.4	248.8	282.9	255.7	268.8
Japan	32.8	46.7	33.1	30.5	38.9	45.8	44.1	46.4	48.8	48.5	38.3	46.6	42.9	41.1	34.8	34.8	31.1	32.3	36.6	40.0	36.1	37.5
Europe	31.9	42.3	30.2	27.8	32.3	39.4	39.1	39.9	41.0	38.2	29.9	38.1	37.4	33.2	34.9	37.5	34.3	32.7	38.3	43.0	41.6	43.6
Americas	47.5	64.1	35.8	31.3	32.3	39.1	40.7	44.9	42.3	37.9	38.5	53.7	55.2	54.4	61.5	69.3	68.7	65.5	88.5	103.0	78.7	84.6

WSTS 6/19

Worldwide Semiconductor Capital Equipment Market by Geography (with forecast)

20190409



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019 F	2020 F
Total	19.7	22.1	37.1	32.8	40.4	42.7	29.5	15.9	39.9	43.5	36.9	31.8	37.4	36.5	41.2	56.6	64.5	48.4	58.4
SEA/ROW	2.69	2.10	4.49	2.86	3.71	3.05	2.61	1.44	3.84	3.41	2.10	2.08	2.15	1.97	3.55	3.20	4.04		
China		1.15	2.73	1.33	2.31	2.92	1.89	0.94	3.68	3.65	2.50	3.38	4.37	4.90	6.46	8.23	13.1		
S Korea	1.66	3.18	4.61	5.83	7.01	7.35	4.89	2.60	8.63	8.66	8.67	5.22	6.84	7.47	7.69	17.9	17.7		
Europe	2.11	2.56	3.44	3.26	3.59	2.94	2.45	0.97	2.33	4.22	2.55	1.92	2.38	1.94	2.18	3.67	4.22		
Taiwan	3.49	2.92	7.76	5.72	7.31	10.6	5.01	4.35	11.2	8.52	9.53	10.5	9.41	9.64	12.2	11.4	10.1		
Japan	3.89	5.55	8.27	8.18	9.21	9.31	7.04	2.23	4.44	5.81	3.42	3.38	4.18	5.49	4.63	6.49	9.47		
N America	5.91	4.73	5.81	5.70	7.32	6.55	5.63	3.39	5.75	9.26	8.15	5.27	8.16	5.12	4.49	5.59	5.83		

SEMI 4/19 & prior historical data (with 7/19 reports)

World PCB Production 2017-2019F

20170311

World PCB Production* by Region (US$ Million)

Region	2017	2018	YoY	2019F	YoY
America	3,037	3,158	4.0%	3,174	0.5%
Germany	960	994	3.5%	939	-6.0%
Other Europe	1,385	1,257	1.2%	1,270	1.0%
Africa & Middle East	142	143	0.0%	145	1.4%
West Total	5,524	5,552	3.1%	5,528	0.4%
China	37,200	40,510	8.9%	39,880	-1.5%
Taiwan	7,685	7,780	1.2%	7,690	-1.2%
S. Korea	7,215	7,515	4.1%	7,214	-4.0%
Japan	5,625	5,654	0.5%	5,796	-1.2%
Thailand	2,980	3,132	5.1%	3,160	0.9%
Vietnam	2,620	2,704	3.2%	2,905	3.7%
Other Asia	1,738	1,668	-4.0%	1,700	1.9%
Asia Total	65,063	68,963	6.0%	68,345	-0.9%
World Total	70,587	74,515	5.6%	73,873	-0.9%

(N.T. Information Ltd)

* Note; Production includes assembly by PCB makers, particularly FPC

H Nakahara 5/19

Summary

Slower growth

Trade disputes impact long standing regional alliances

Electronic assembly may shift globally to countries less affected by tariffs

Many good new electronic products are on the horizon but no large ones are imminent

5G offers exciting opportunities for next decade

20111007

Custer Consulting Group Products

Daily News Services (6 days/week)

- Global electronics supply chain
- Solar/Photovoltaic supply chain
- Automotive supply chain

Business Outlook

- Market charts & data
  - Global market
  - OEMs
  - Components, EMS, ODM, materials & process equip
  - Solar/Photovoltaic
- Weekly Market Comments with latest charts