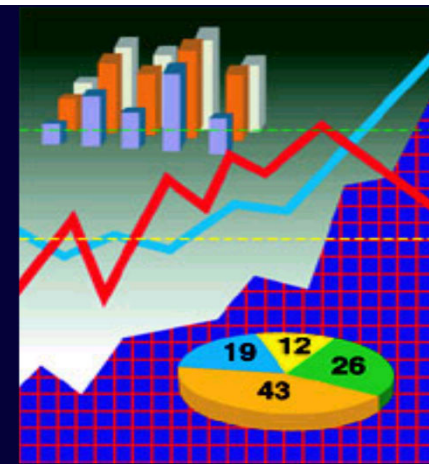


Business Outlook

Global Electronics Industry

(with emphasis on Europe)



Custer Consulting Group
www.custerconsulting.com
October 2020

2020 Concerns

Global manufacturing decline made worse by Corona virus driven shutdowns

Tariffs, trade and Brexit issues continue

Geopolitical concerns remain very significant

Automotive and aerospace production hit hard

Manufacturing is recovering but service/travel sectors remains in major recession

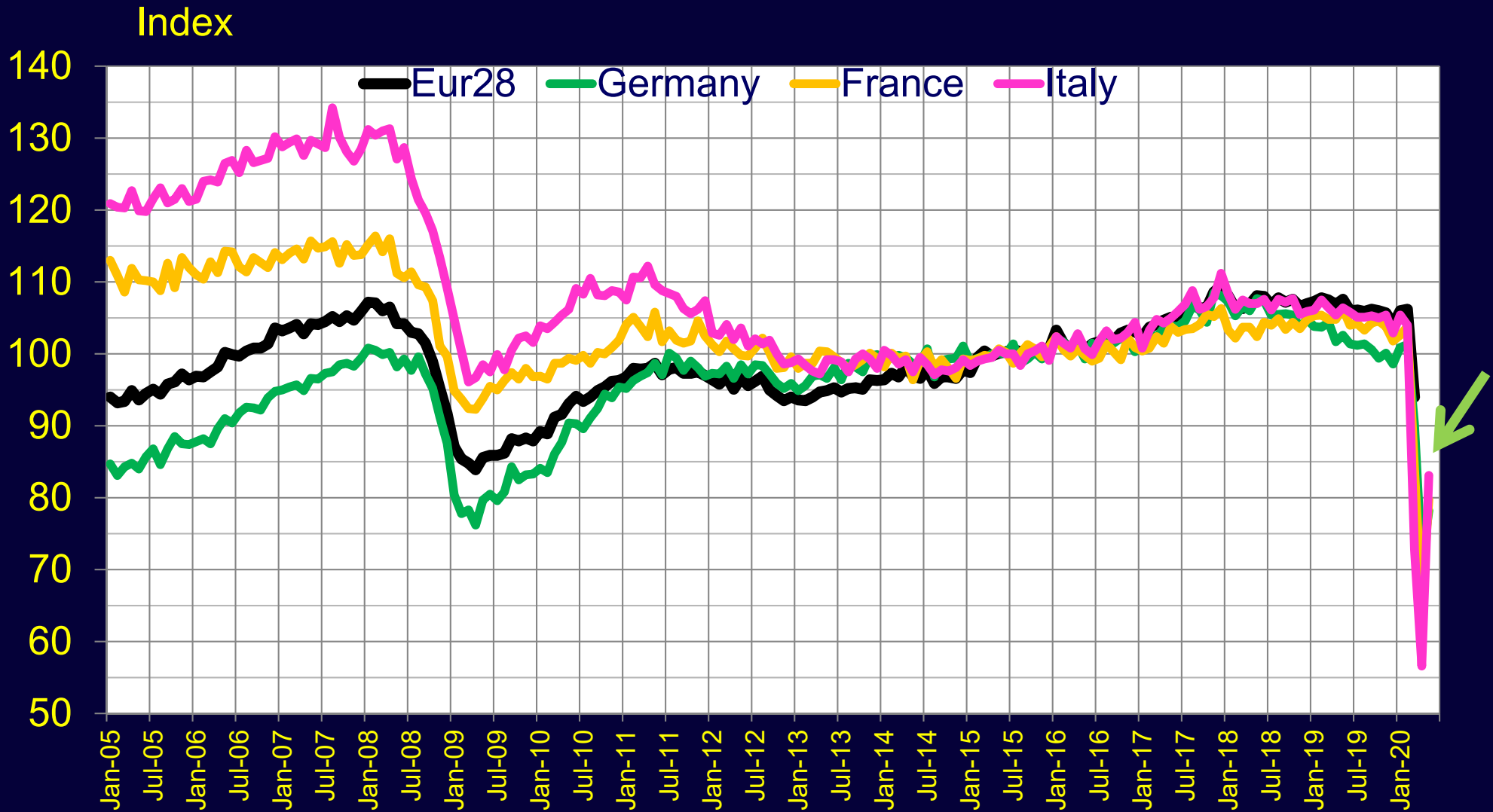
But NOW . . .

**European
business conditions
are improving!**

European Industrial Production

Industrial Production – Europe Manufacturing

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

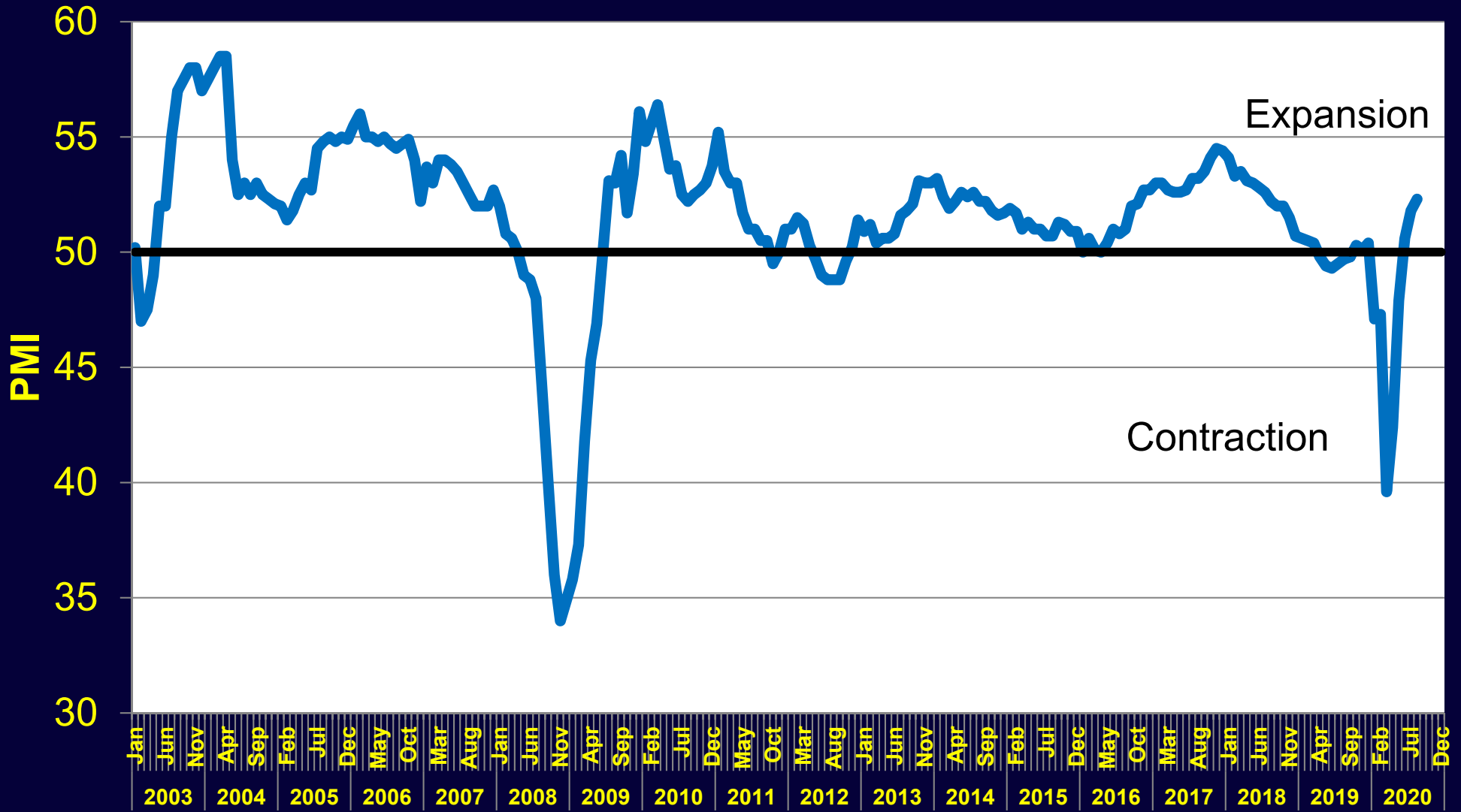


Purchasing Managers Indices

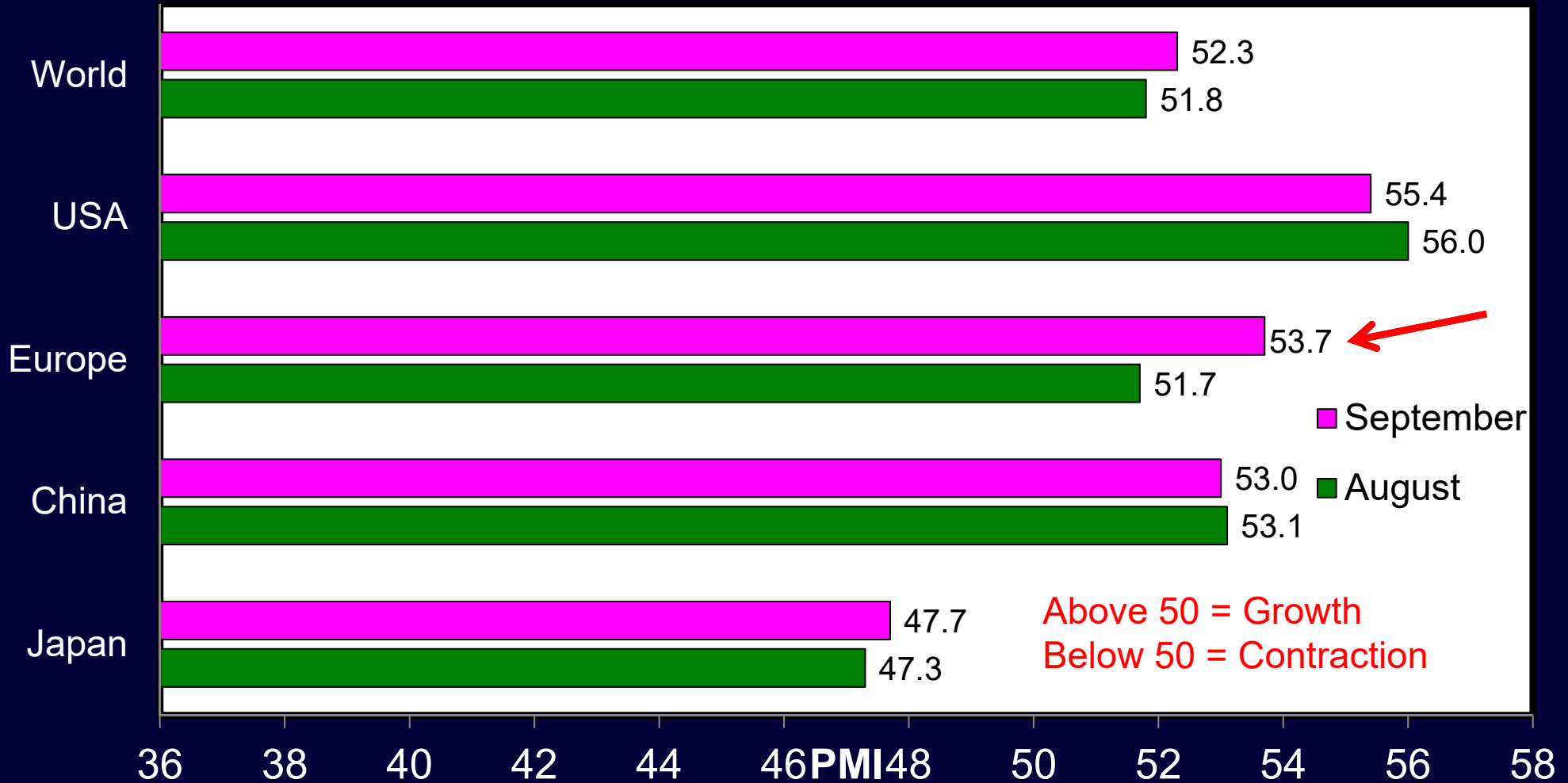
**Useful & Timely
Leading Indicators**

Global "Purchasing Managers" Index

Diffusion Index, >50 = Growth

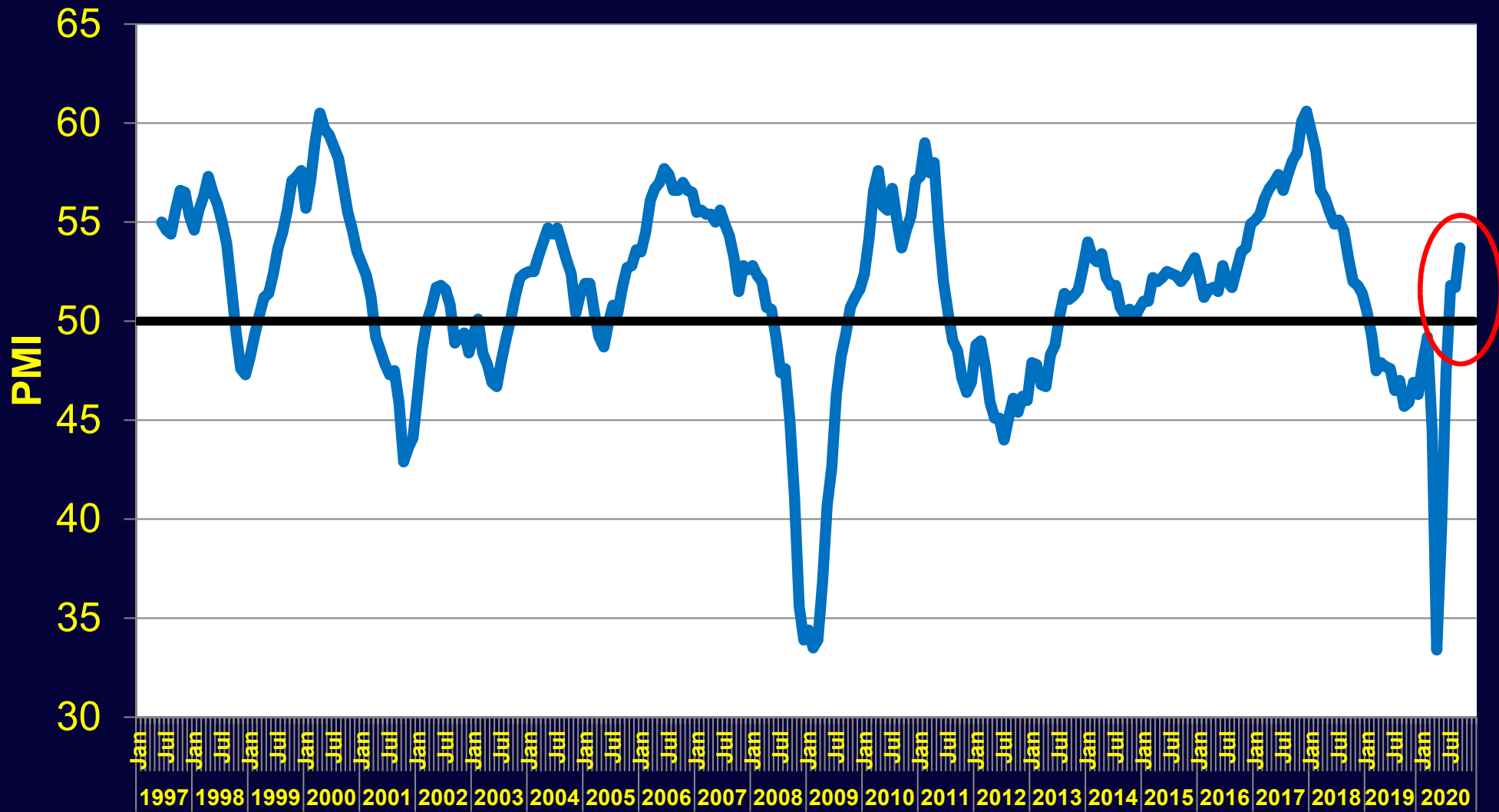


Purchasing Managers' Indices September vs. August 2020



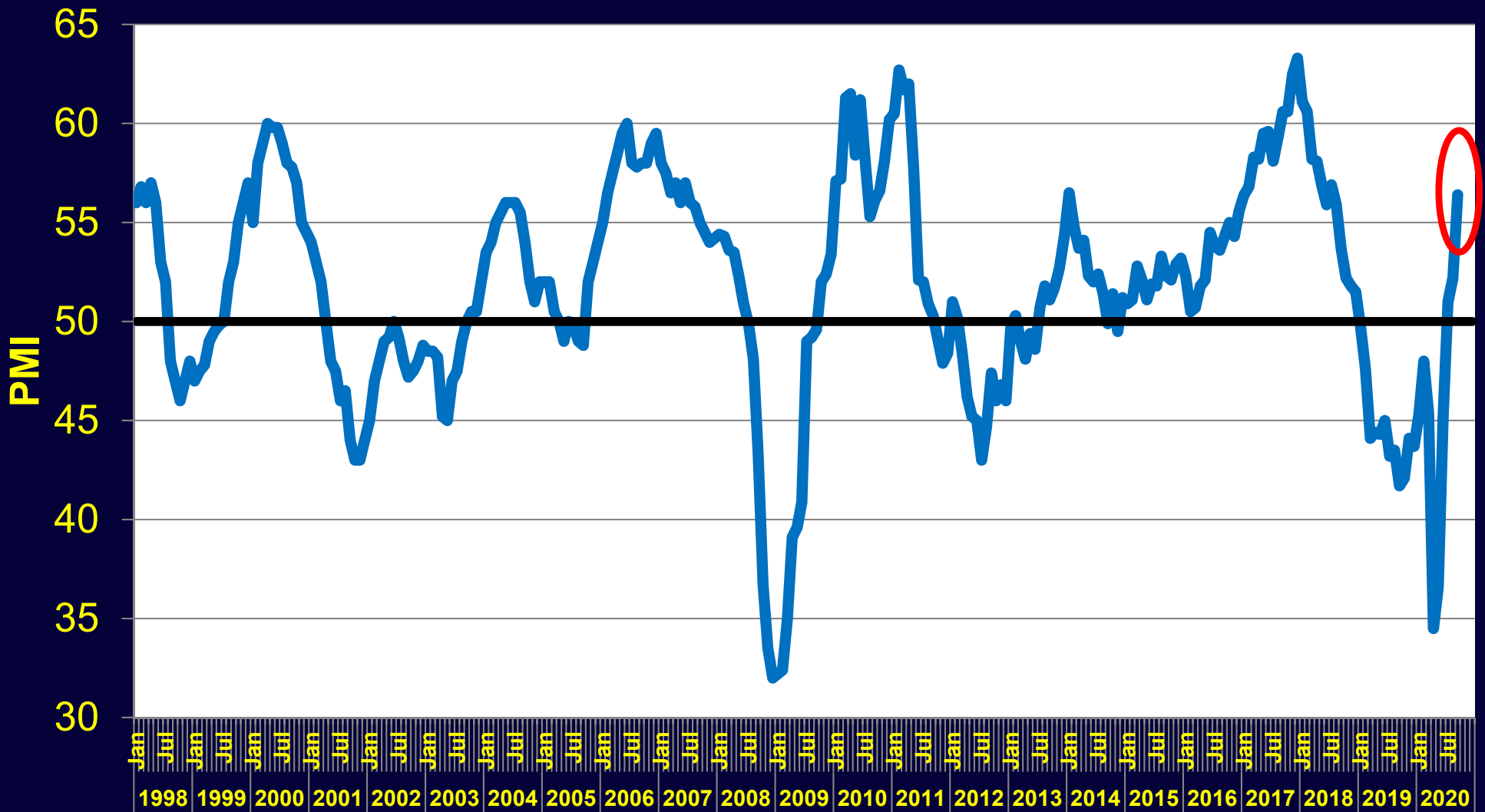
Eurozone Manufacturing "Purchasing Managers" Index

Diffusion Index, >50 = Growth



Germany Manufacturing "Purchasing Managers" Index

Diffusion Index, >50 = Growth



Eurozone Manufacturing PMI

September 2010

Eurozone manufacturing growth strongest in over two years

Key findings:

- Final Eurozone Manufacturing PMI at 53.7 in September
- Output and new orders both up sharply, supported by resurgence in export trade
- Growth in region led by strong manufacturing upturn in Germany.

Electronic Equipment

World

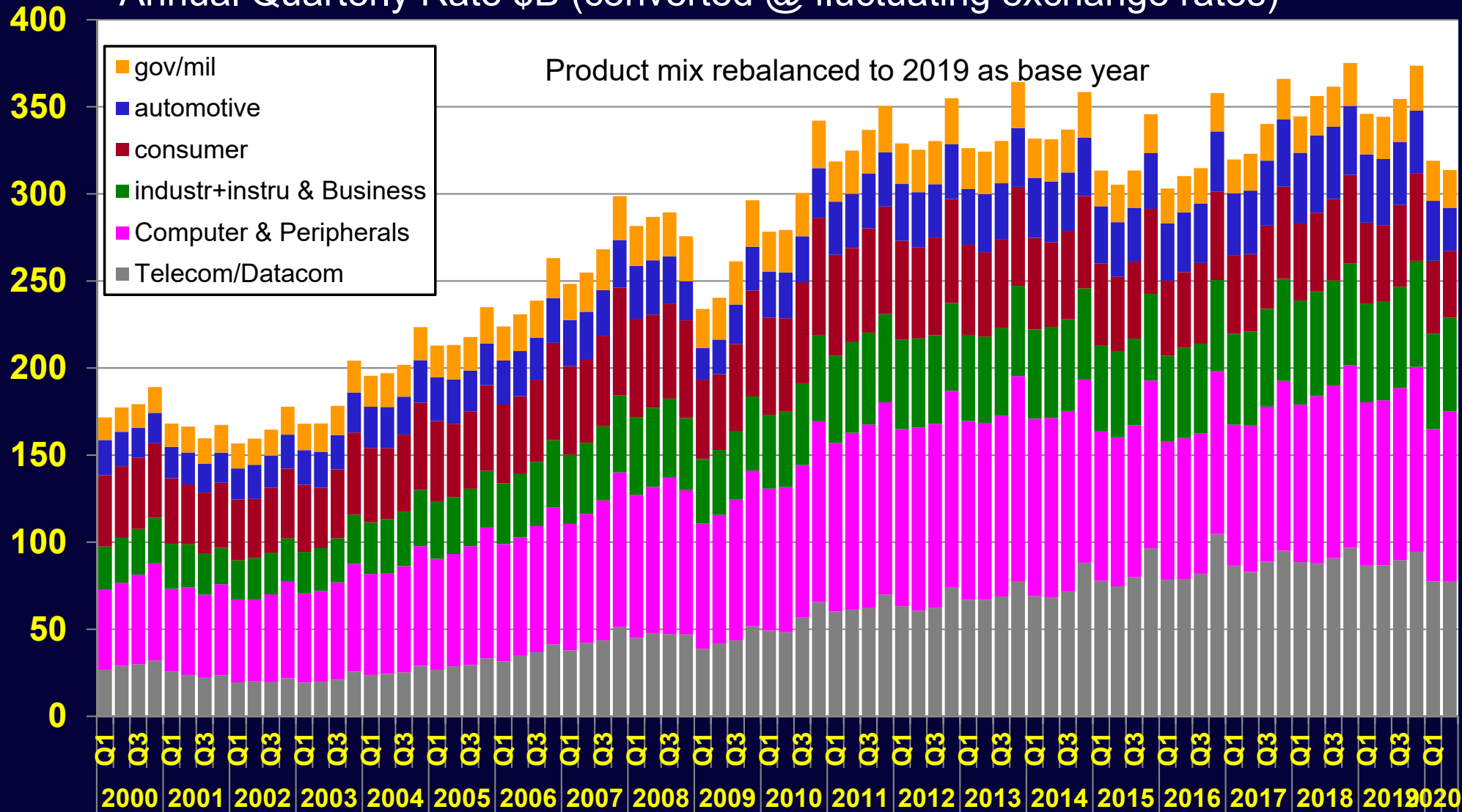
Measuring industry growth

- Combined company sales by equipment type**
- Geographical data**

World Electronic Equipment Production By Type

20200920

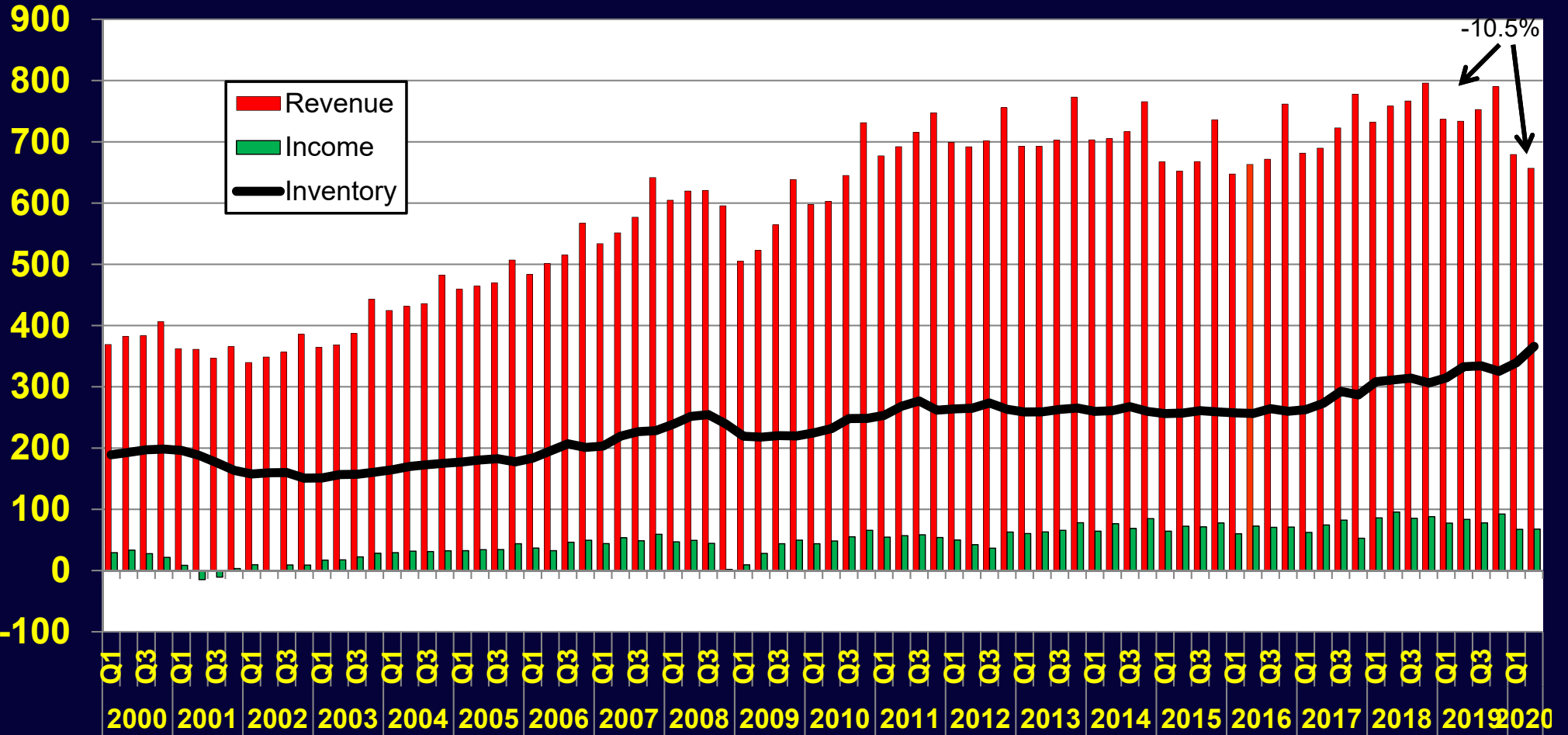
Annual Quarterly Rate \$B (converted @ fluctuating exchange rates)



Electronic Equipment Suppliers

Composite of 213 Public Companies

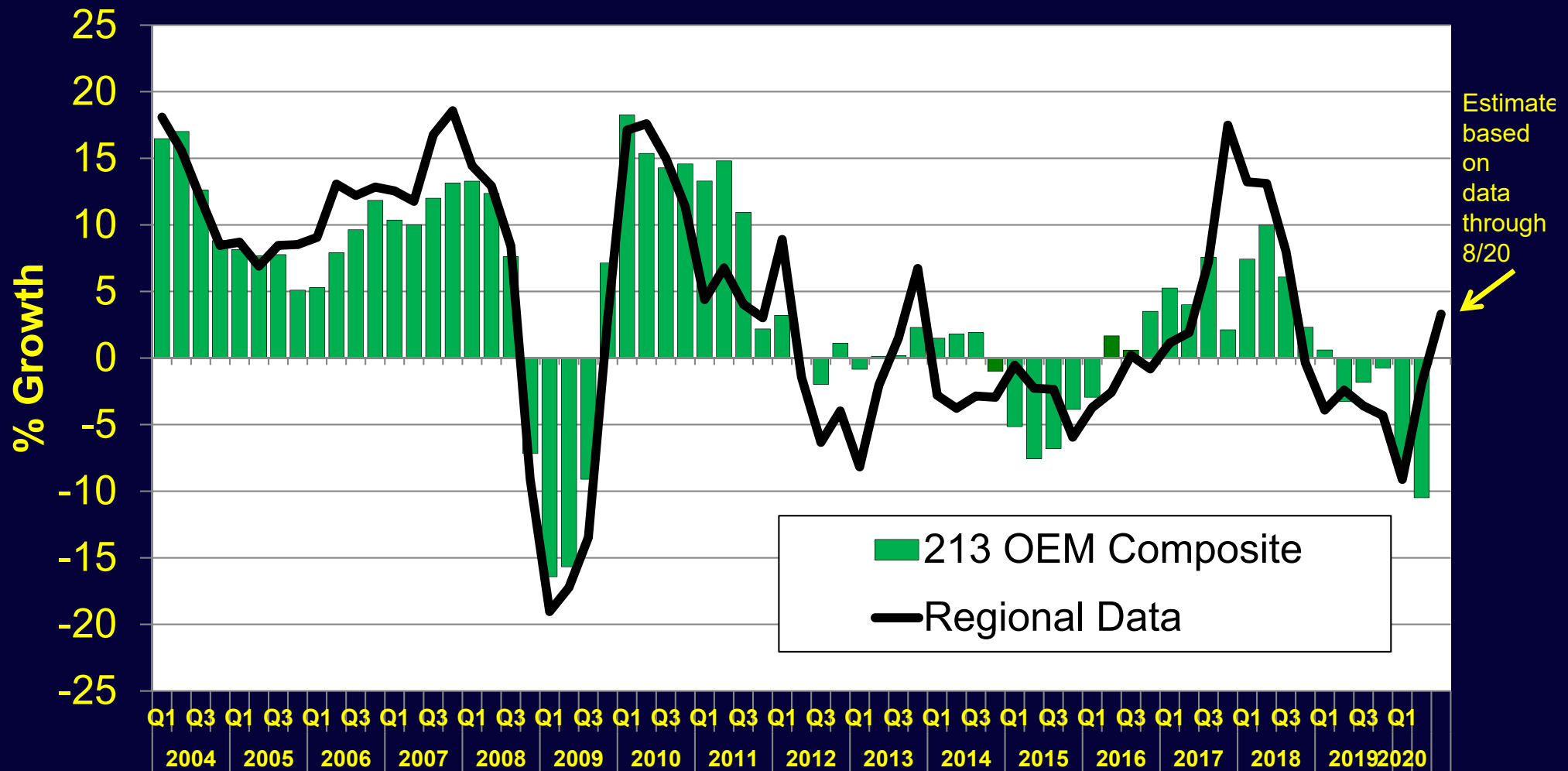
Revenue, Net Income & Inventory



Computer 13, Internet 13, Storage 17, Communication 30, SEMI 40, Medical 21, Instruments 16, Military 21, Business & Office 6, Consumer 21, Automotive 15

Electronic Equipment Sales

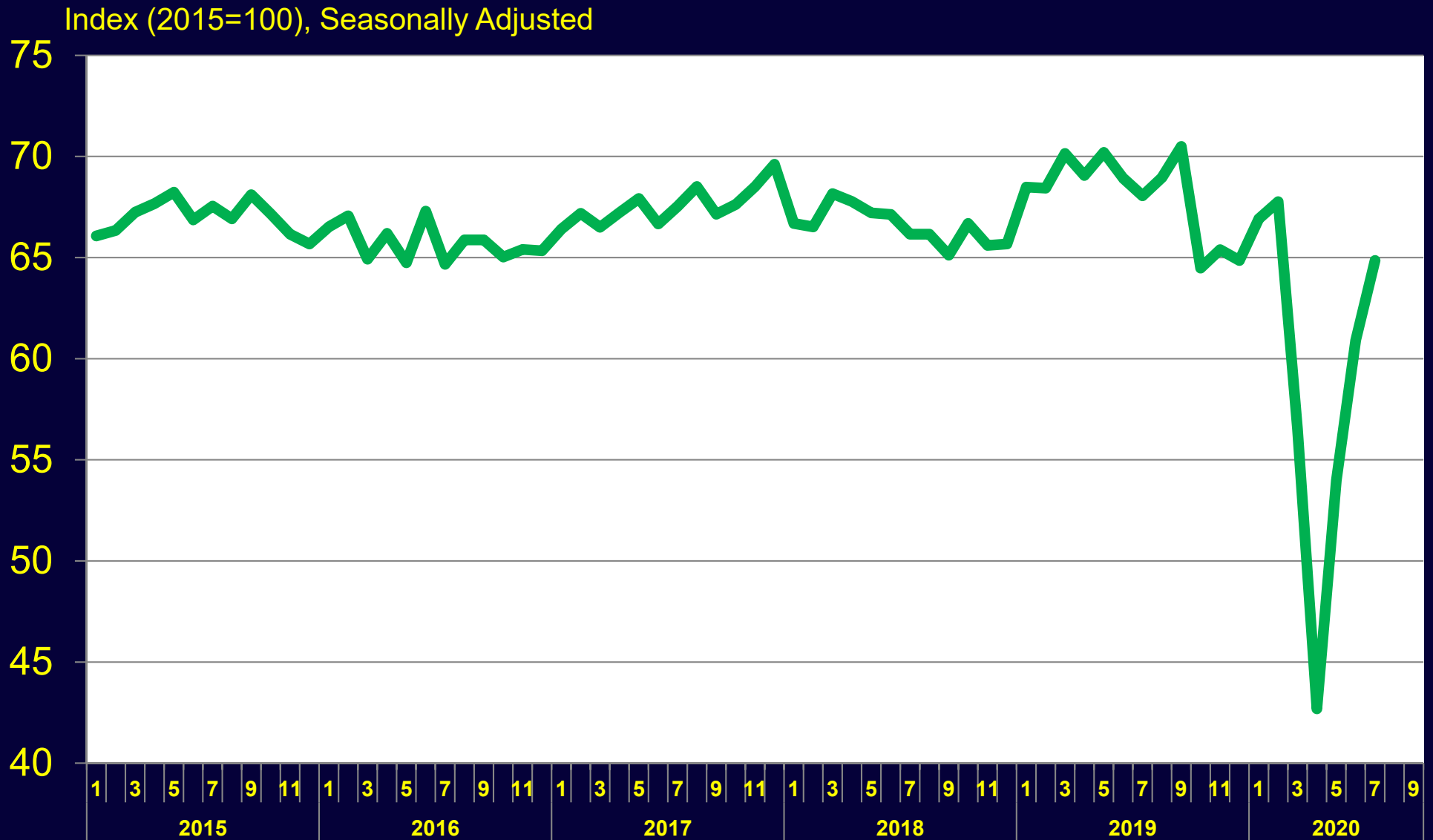
Quarterly Revenue Growth



**213 OEM company sales composite
vs. Regional electronic equipment shipment model**

Regional Data

European Electronic Products Production

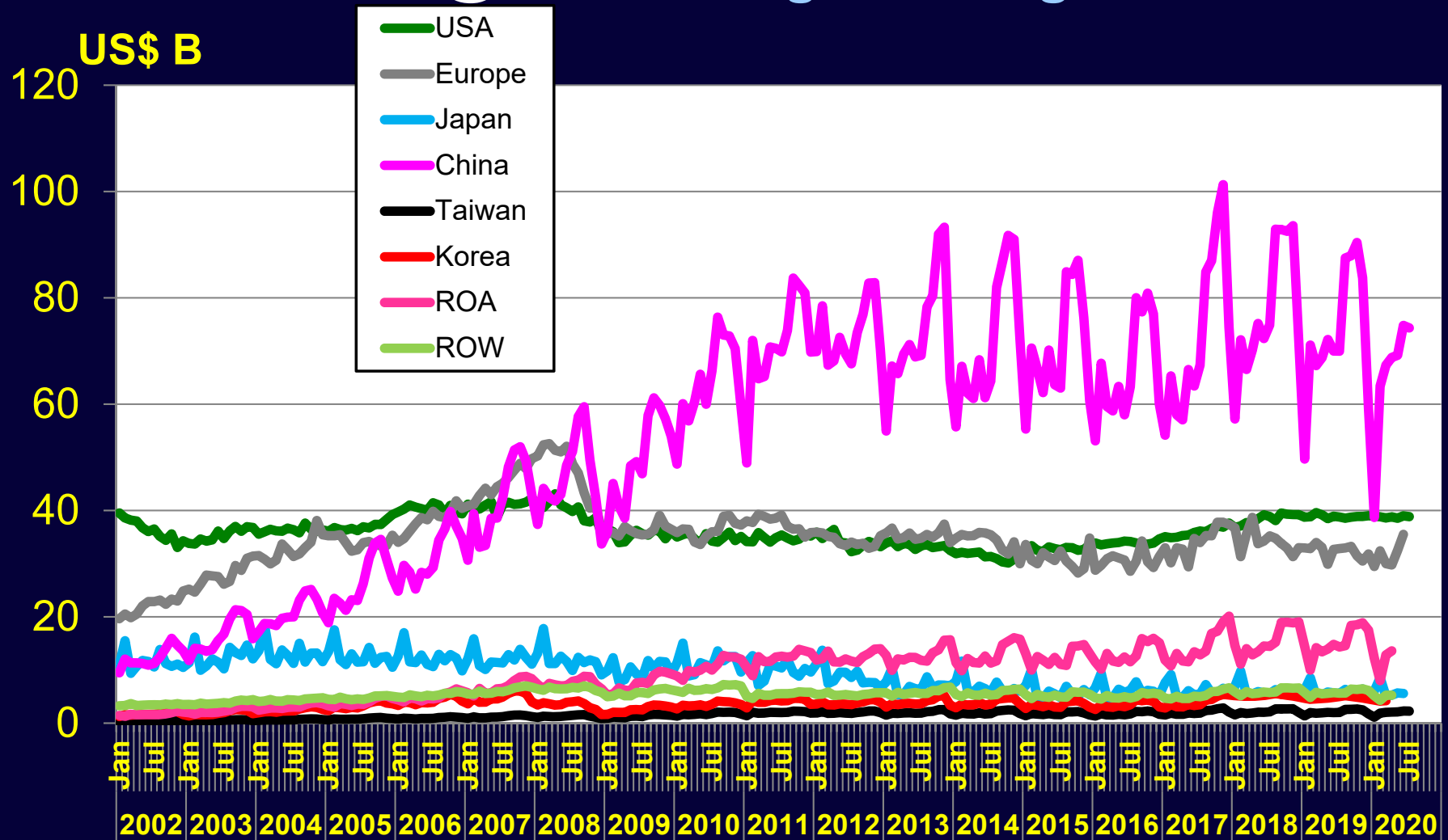


Eurostat, Average of C263, C2651, C266, C2751 & C291
Communication, Instruments, electromedical, domestic appliance, motor vehicles

World Electronic Equipment Monthly Shipments

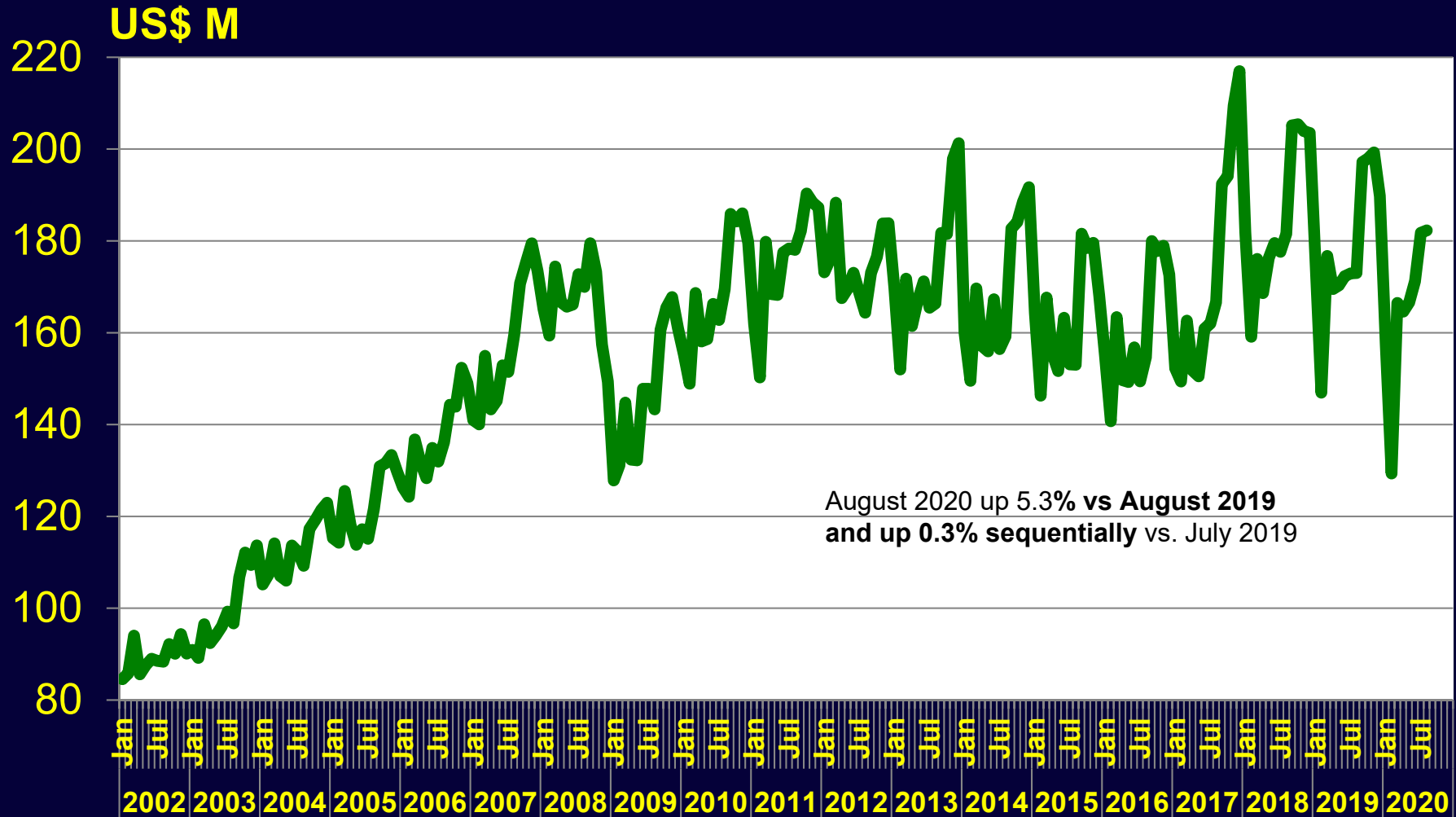
2020915

Converted @ Fluctuating Exchange Rates



World Electronic Equipment Monthly Shipments

Converted @ Fluctuating Exchange Rates

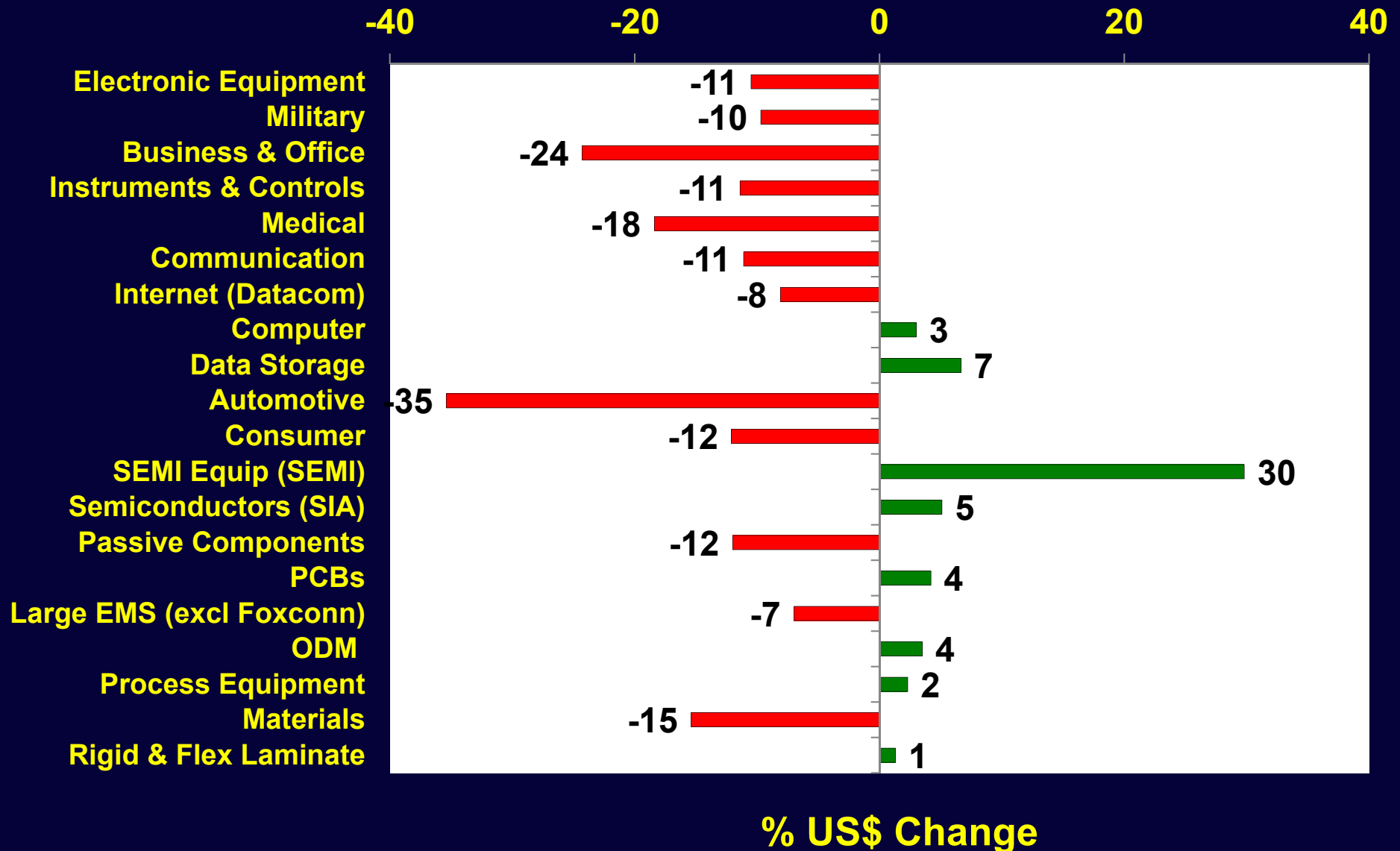


Electronic Supply Chain Growth (from company data)

Europe & World

Global Electronic Supply Chain Growth 2Q'20 vs. 2Q'19

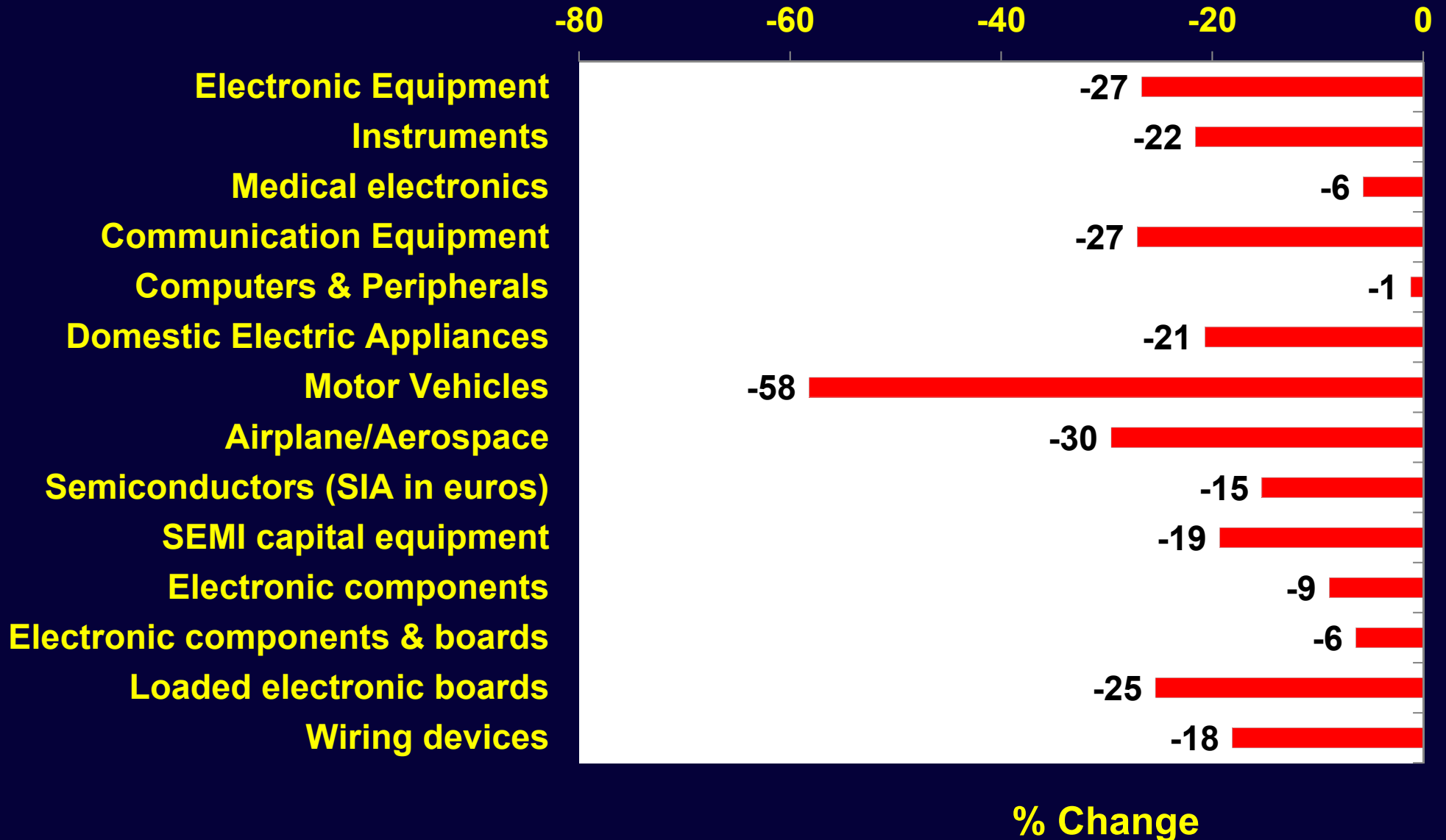
20200920



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

European Electronic Supply Chain Growth 2Q'20 vs 2Q'19

20200812



Euro denominated growth rates; Eurostat EU27, SIA & Custer Consulting Group

Present Growth Rates (%)

European Electronics Industry

	Latest Month	Annualized Growth Rate	3-Month Growth Rate
ELECTRONIC EQUIPMENT SHIPMENTS			
(Index CY 2010 =100)			
Computer, Electronic & Optical Eq	7/20	-8.0	-13.2
Components & Boards	7/20	1.2	-1.8
Components	7/20	0.9	-4.9
Wiring Devices	7/20	-8.9	-15.6
Loaded Electronic Boards	7/20	-1.6	-14.8
Communication Equipment	7/20	-6.6	-18.8
Electric Domestic Appliances	7/20	-7.7	-0.8
Instr & Appl for Measure, Test & Navigation	7/20	-9.0	-15.9
Medical Electronic Instruments	7/20	7.7	1.0
Motor Vehicles	7/20	-24.7	-34.5
Air & Space Aircraft	7/20	-11.1	-28.3
Semiconductor Shipments (Eur) to Europe	7/20	-4.5	-15.3
Industrial Production	7/20	-6.2	-14.7

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

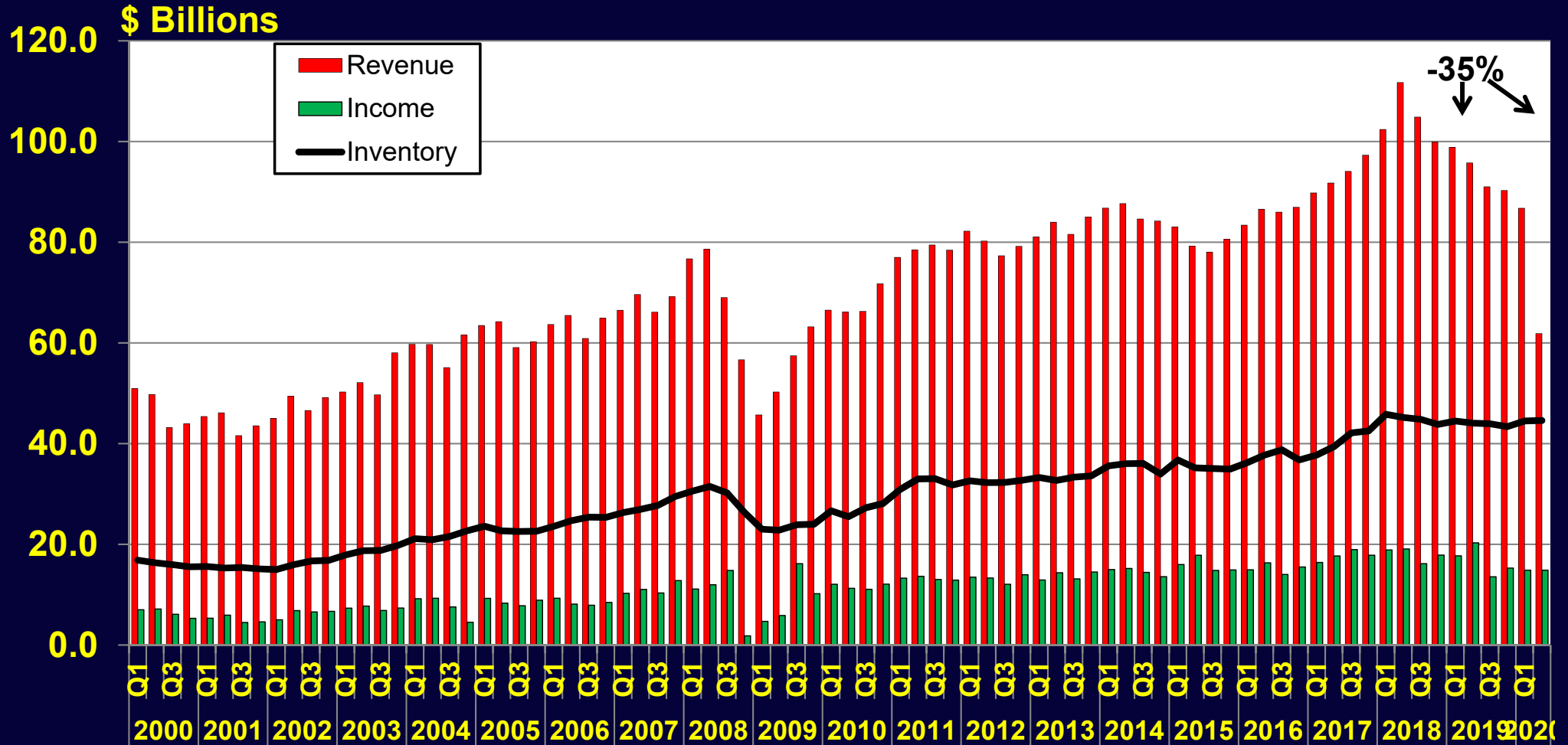
Markets of European Focus

Automotive Equipment Suppliers

Composite of 15 Public Companies

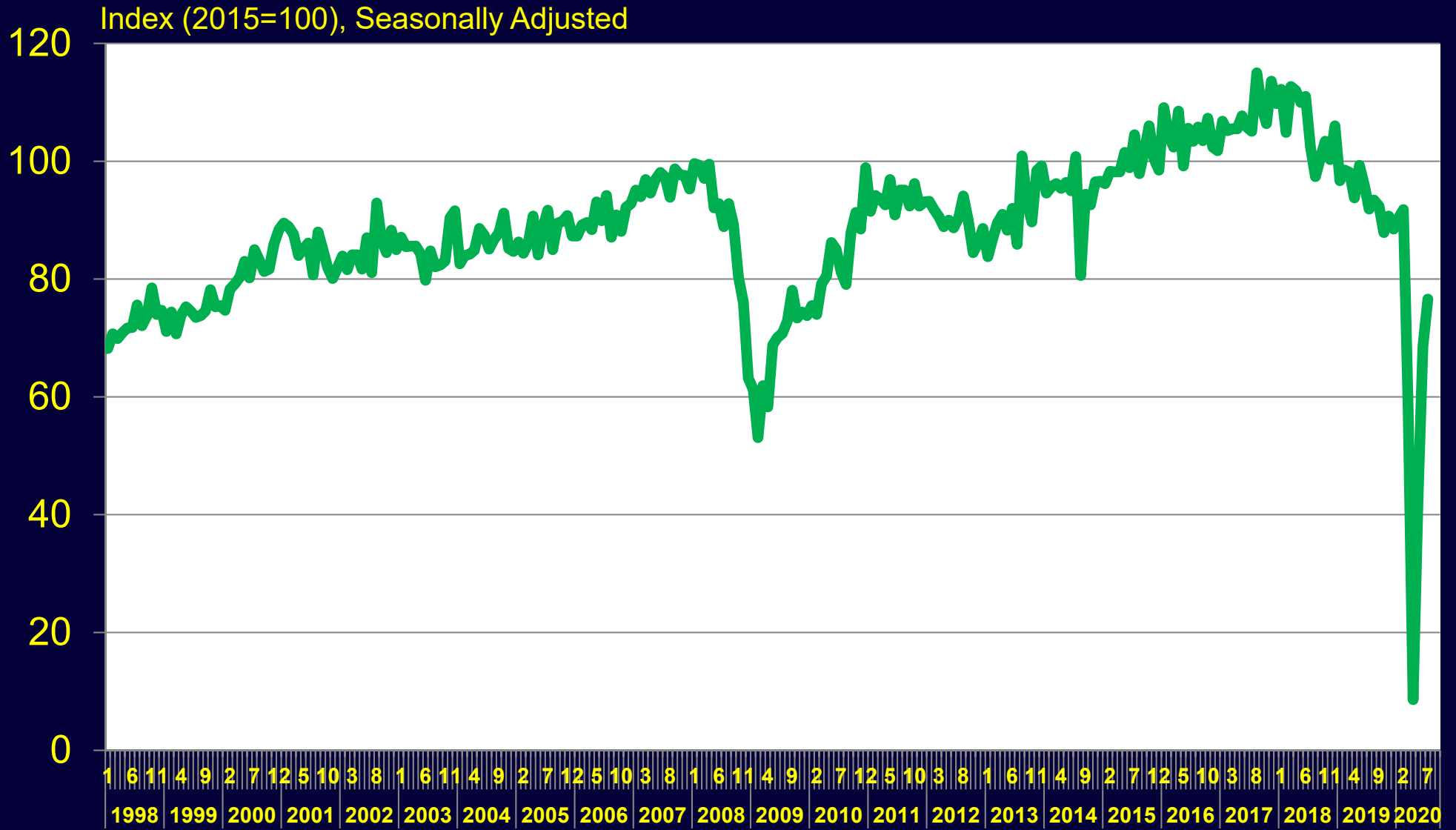
Revenue, Net Income & Inventory

2020920

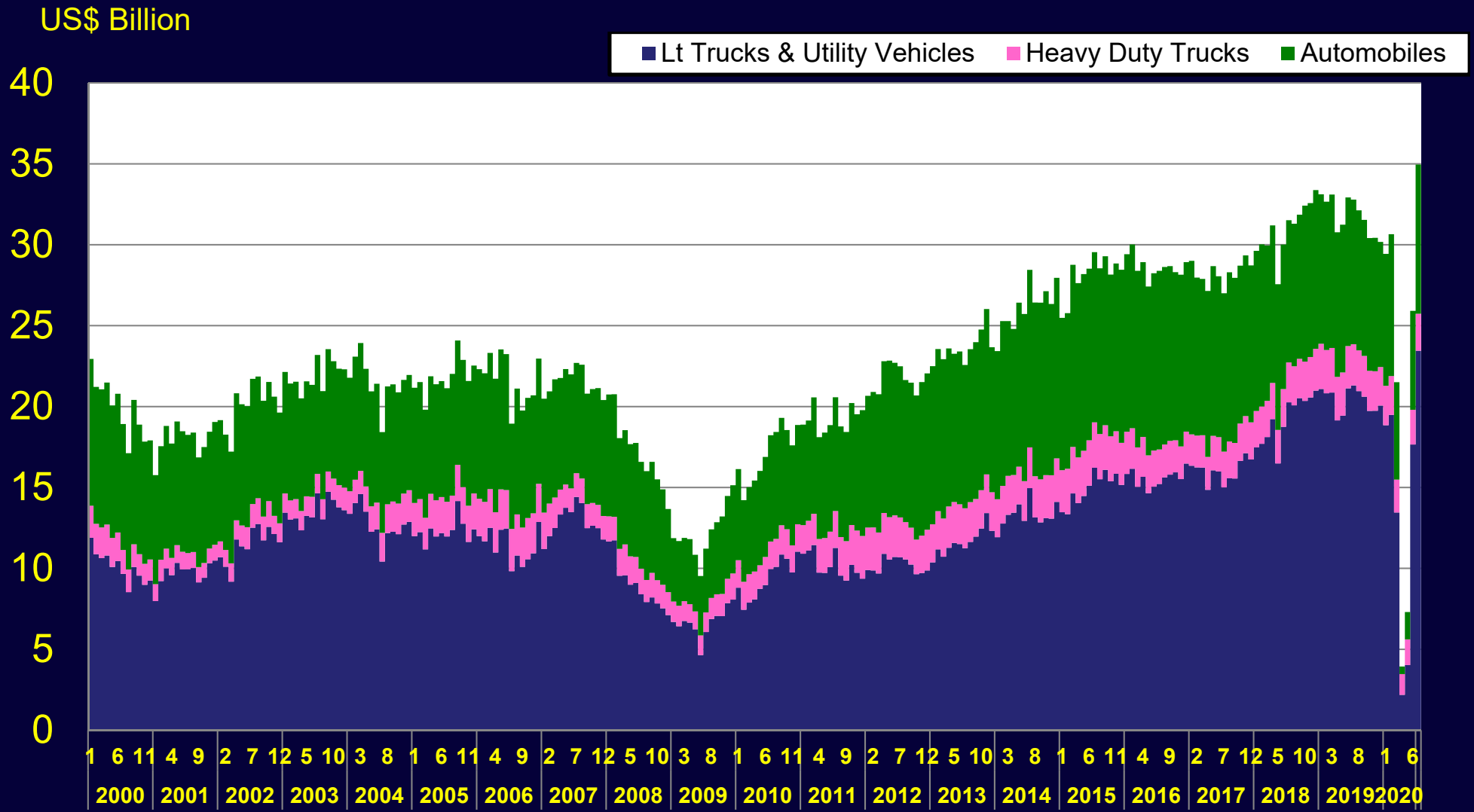


Autoliv, Borg Warner, Continental AG, Delphi, Denso, Federal Mogul, Gentex, Hella, Johnson Controls, Lear, Magna, TRW Automotive, Valeo, Visteon, ZF Friedrichshafen

European Motor Vehicle Production



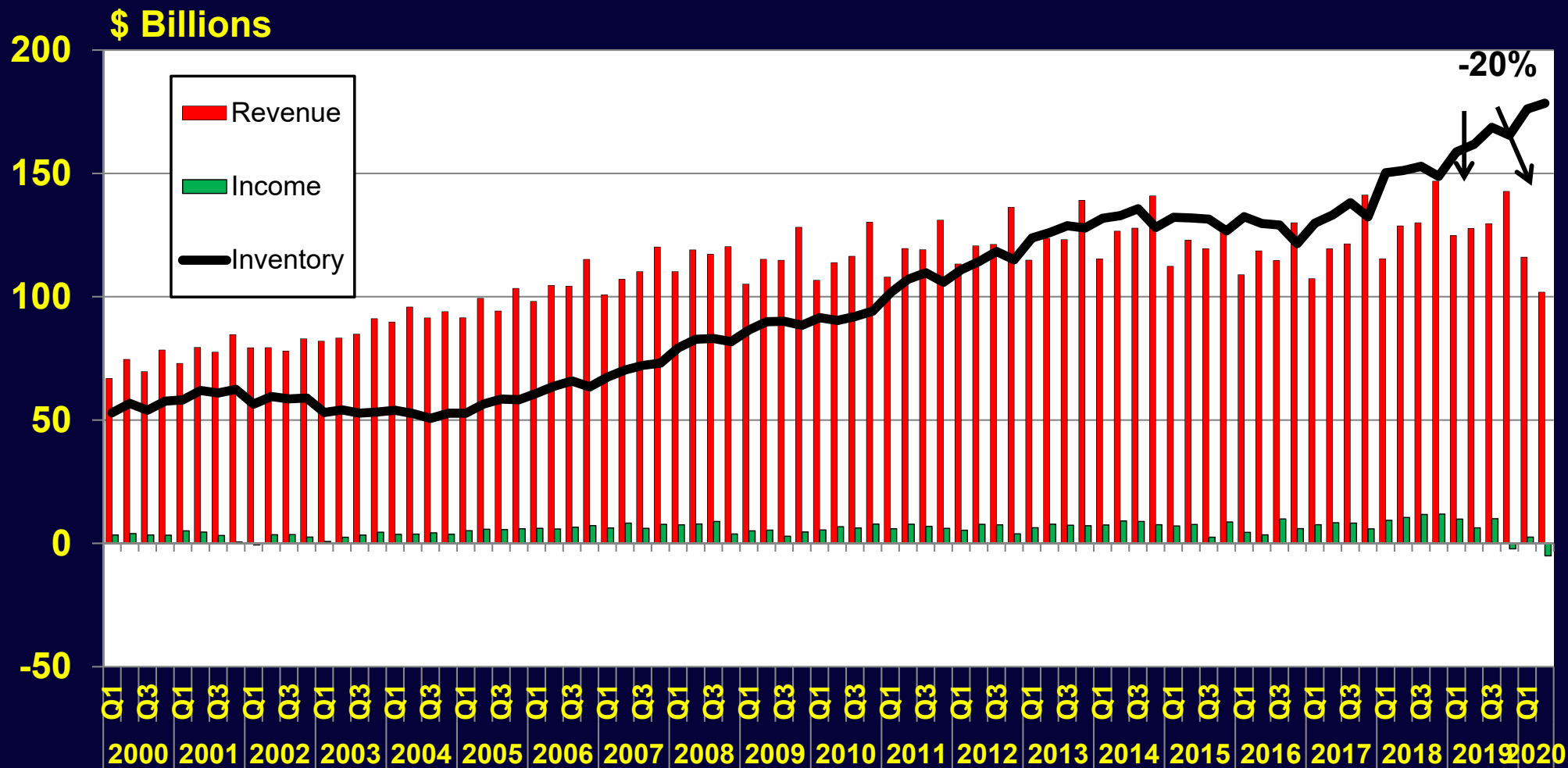
U.S. Vehicle Shipments



Military & Aerospace

Composite of 22 Public Companies

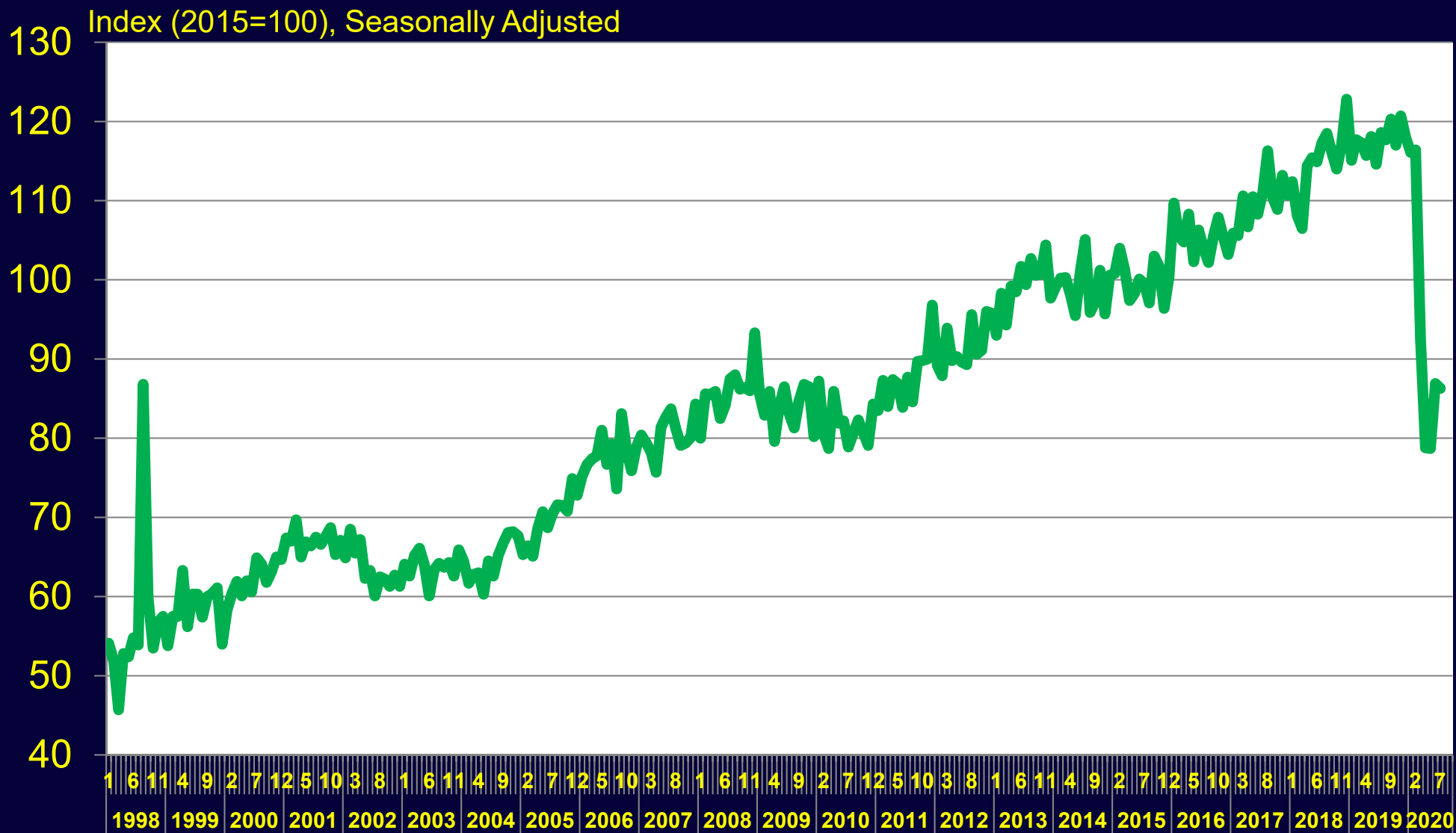
Revenue, Net Income & Inventory



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

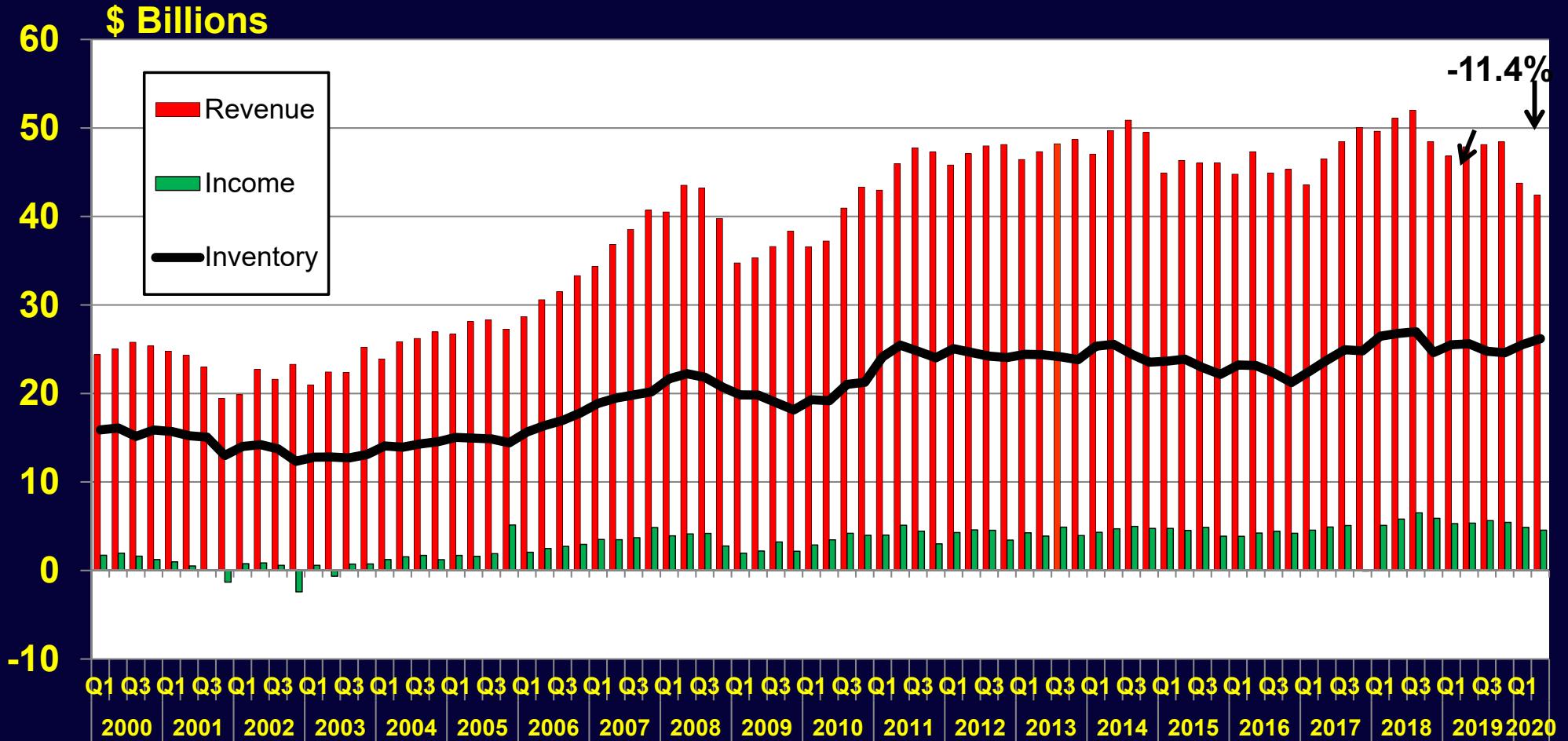
European Production - Aircraft, Spacecraft & Related Equipment

20200915



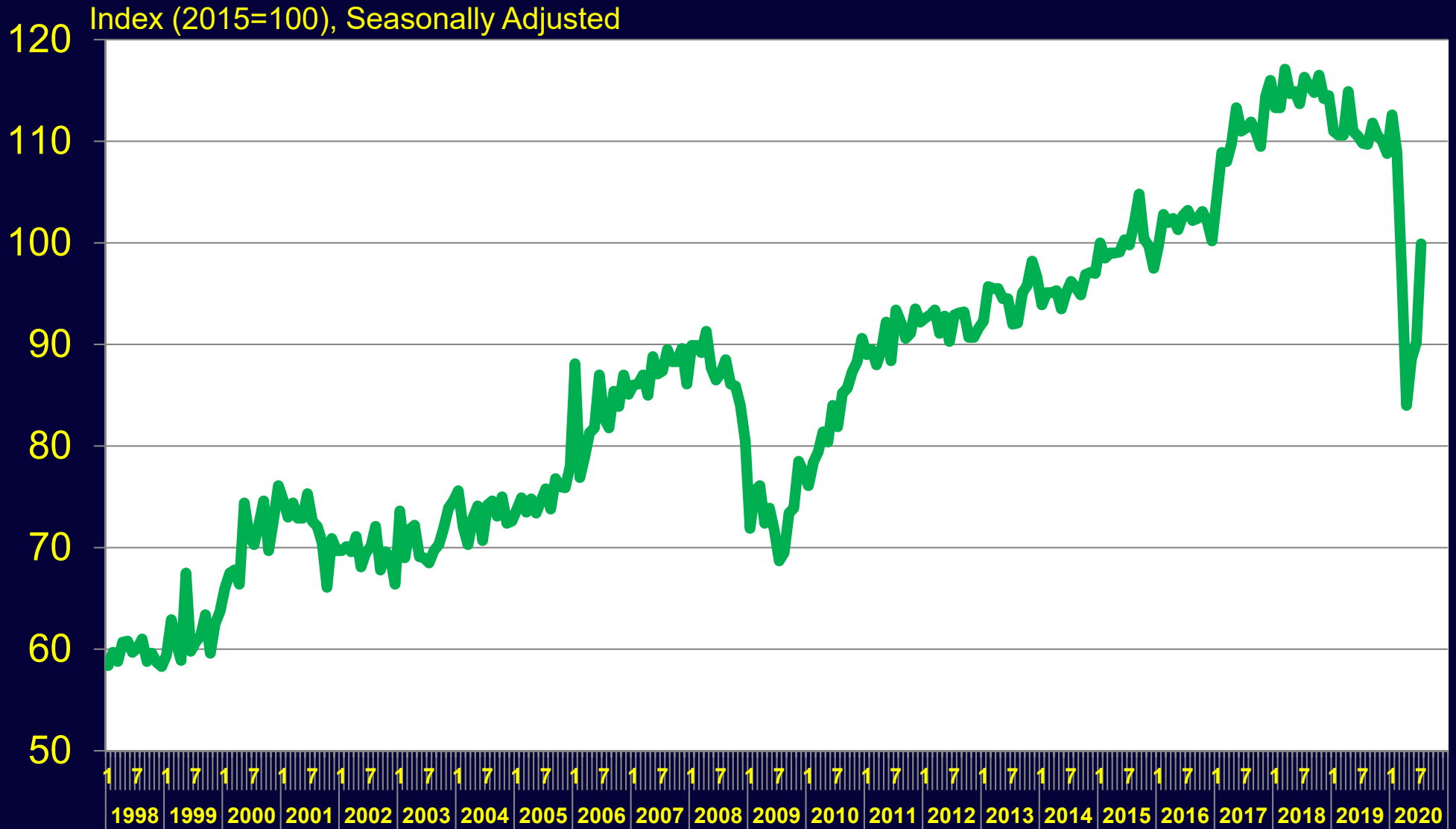
Instruments & Control Equipment Composite of 16 Public Companies

Revenue, Net Income & Inventory

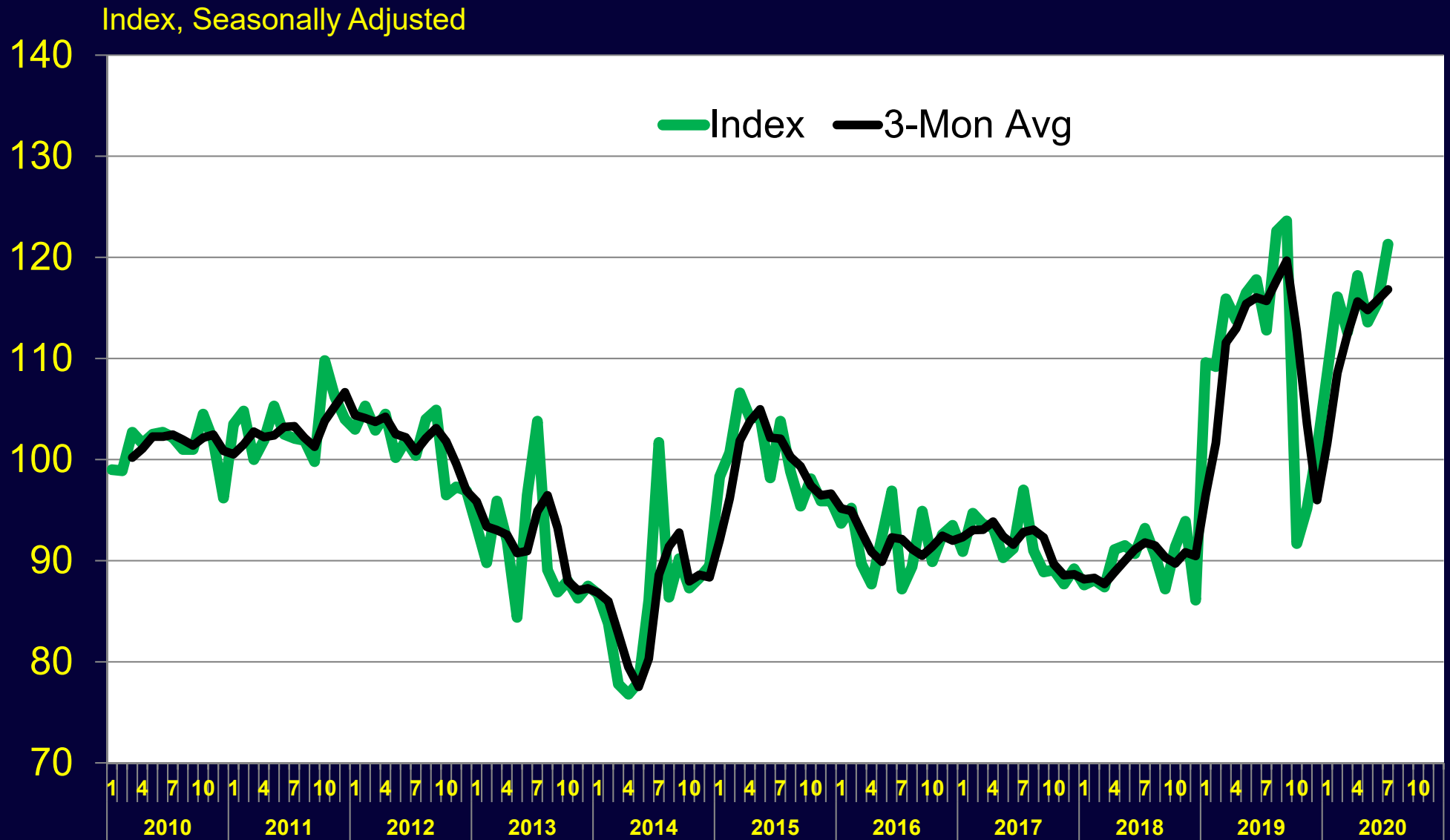


ABB, Agilent, Ametek, Emerson, Itron, Keysight, National Instruments, PerkinElmer, Rockwell Automation, Rotork, Teledyne, ThermoFisher, Woodward Governor

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



European Production - Irradiation, Electromedical & Electrotherapeutic Equipment



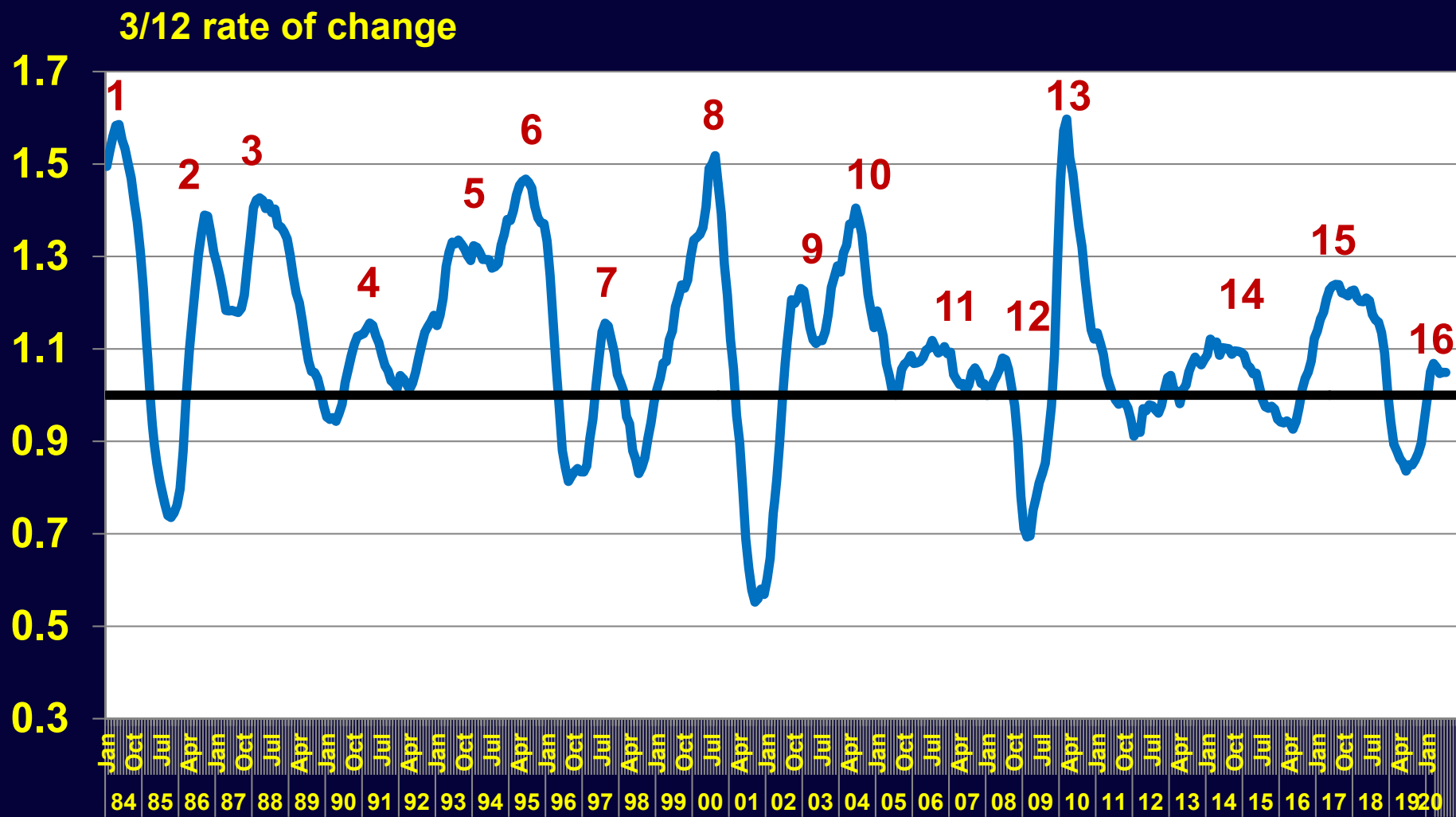
Conclusion

**First half 2020 was
bad
but conditions
began to improve in
3Q'20**

Semiconductors

Global Semiconductor Shipments

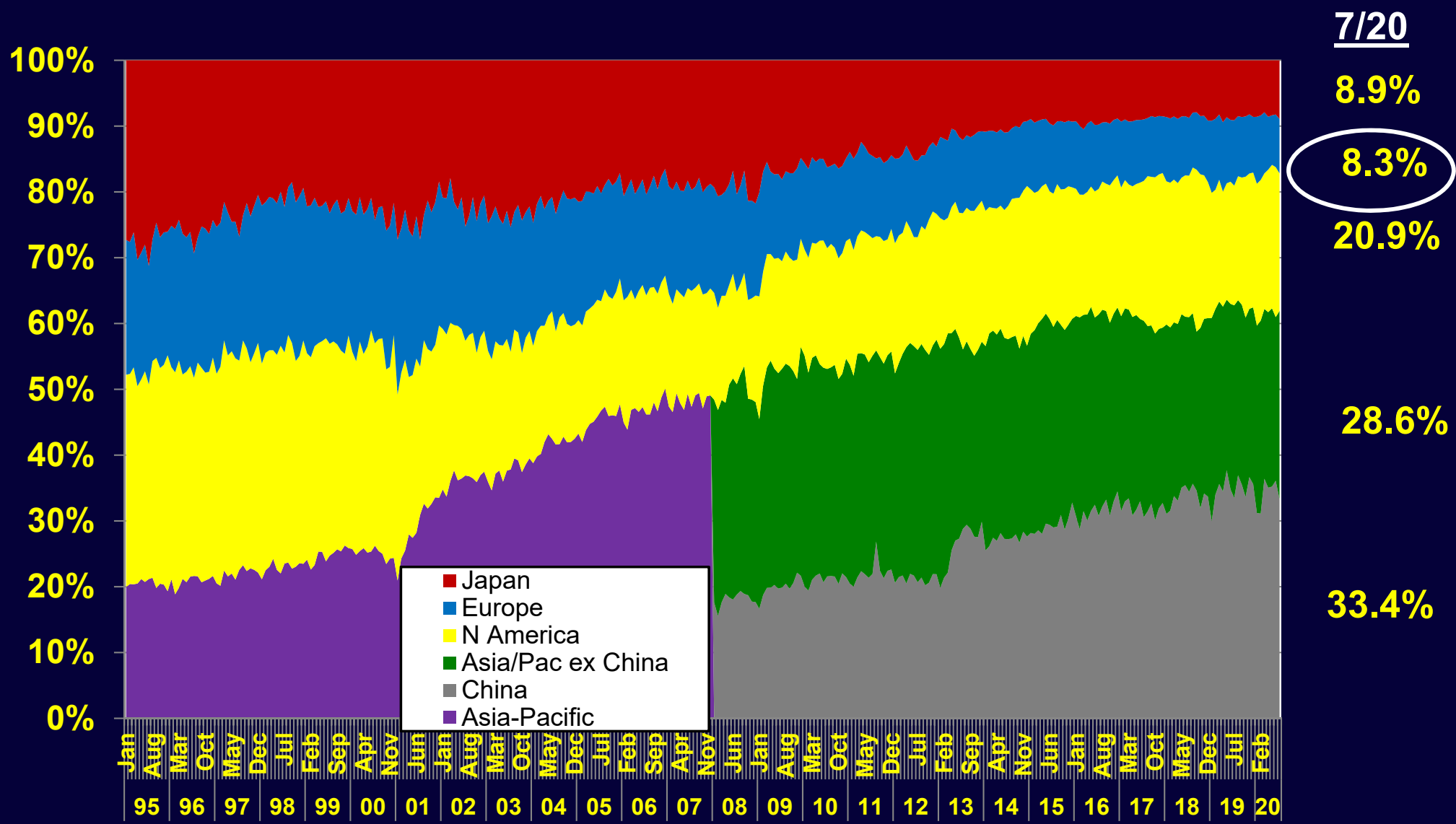
3-Month Growth Rates on \$ Basis



Total \$ Shipments from All Countries to an Area
 SIA website: www.sia-online.org/

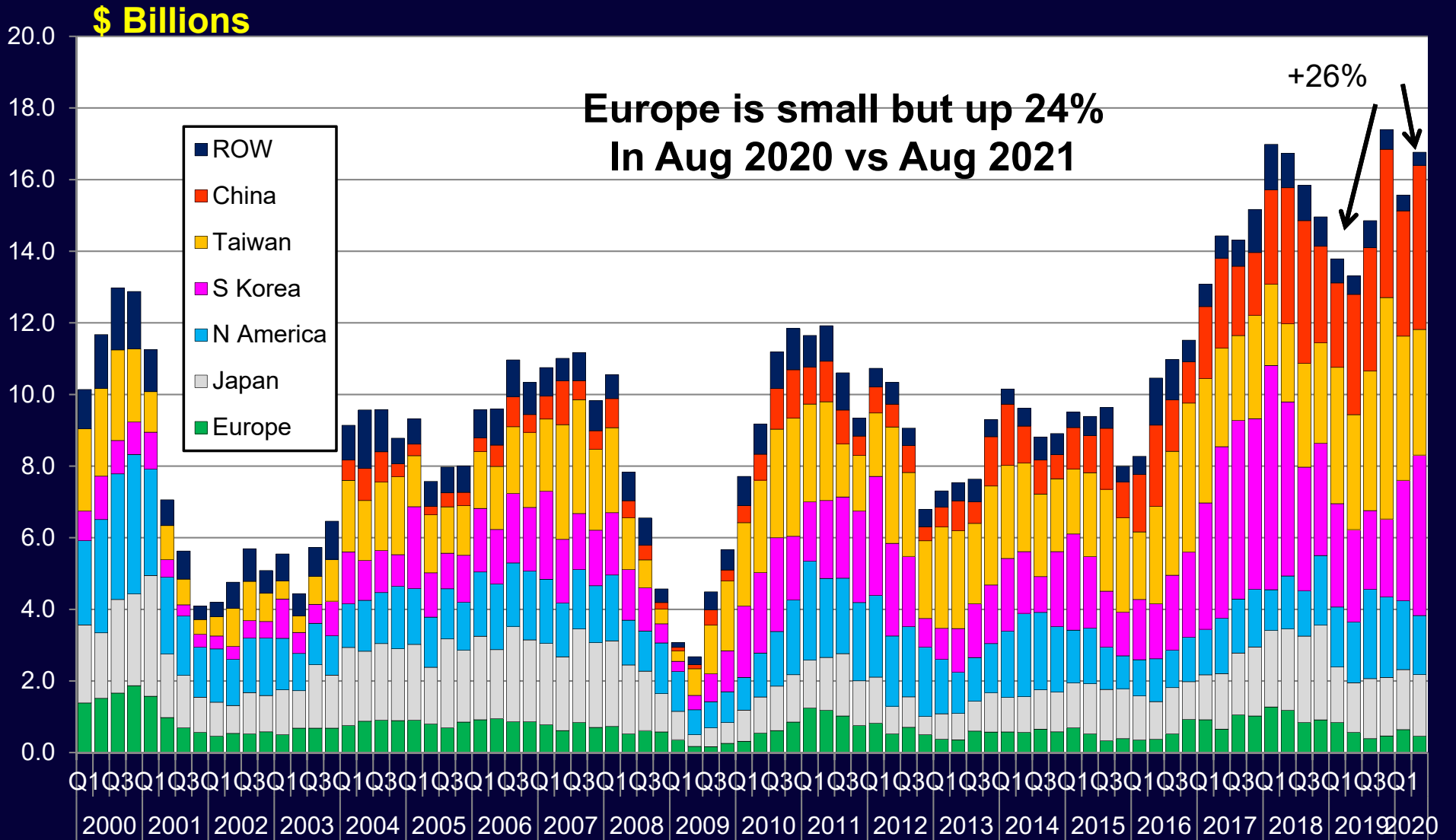
Total Semiconductor Shipments to an Area

Monthly Shipments - Reporting Firms (showing China)



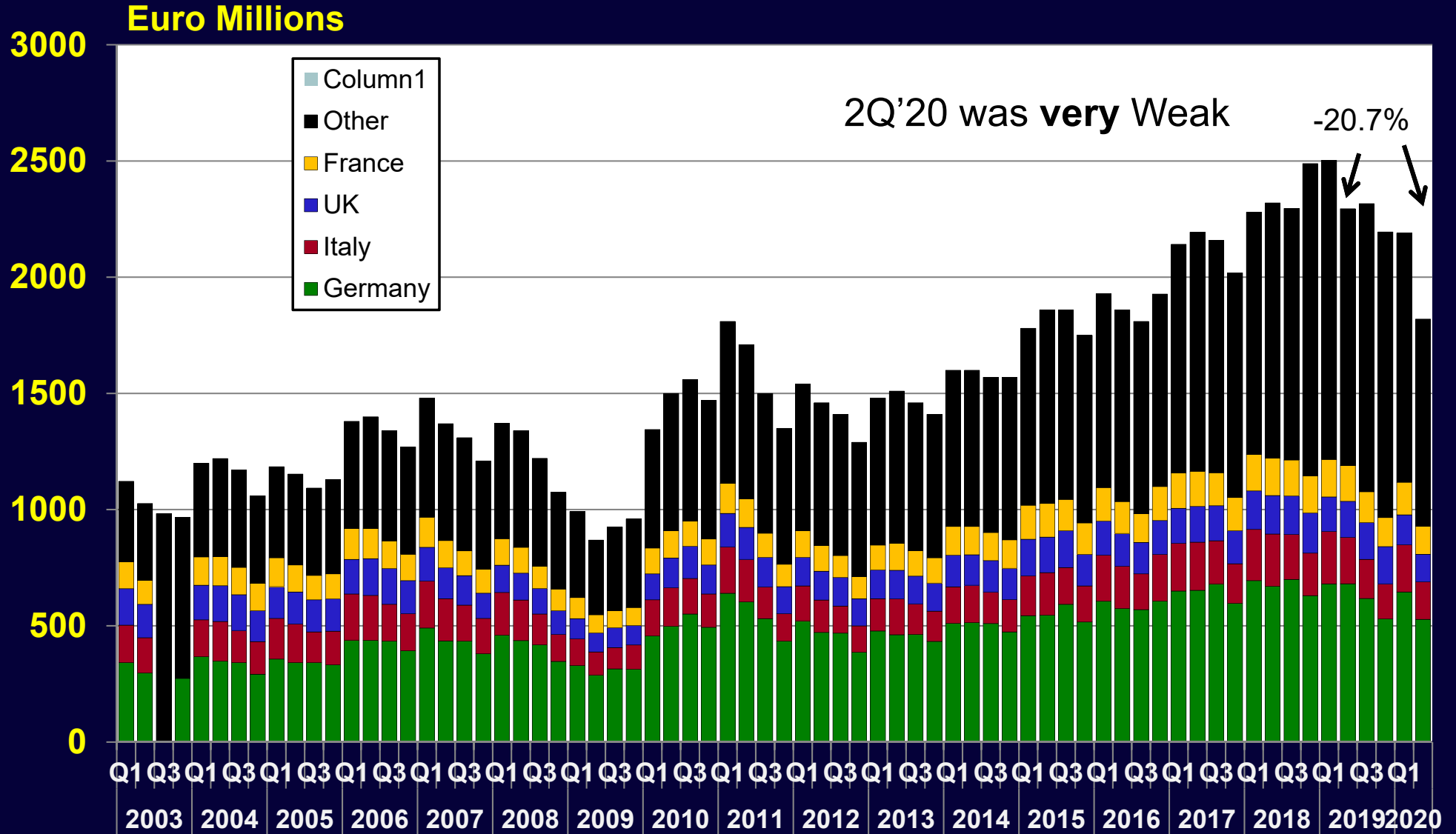
Semiconductor Capital Equipment

Semiconductor Capital Equipment Shipments by Area



European Component Shipments by Country

DMASS - European Semiconductor Distribution Industry



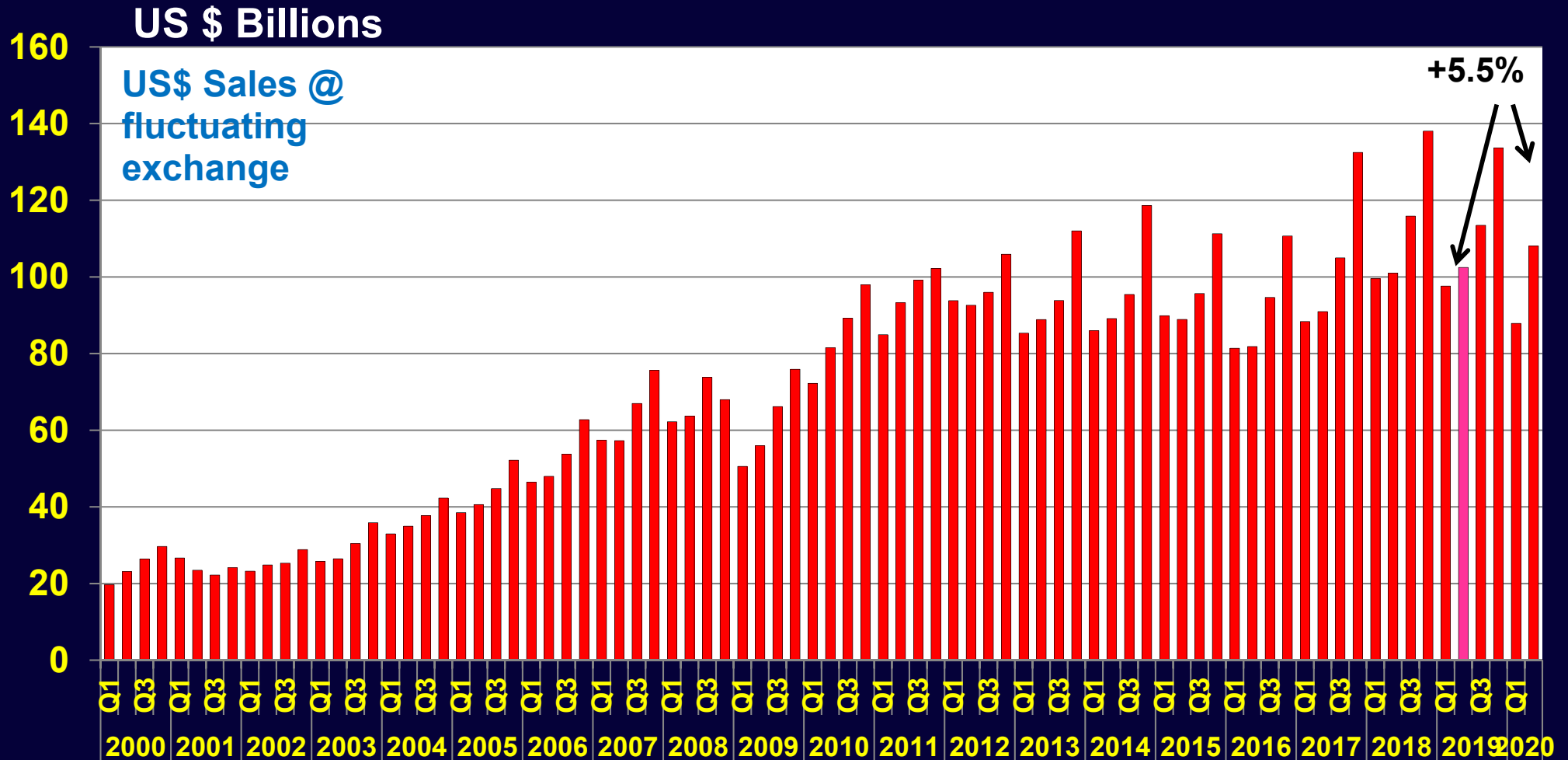
Europe Supply Chain

EMS & ODM Companies

Global EMS & ODM Companies

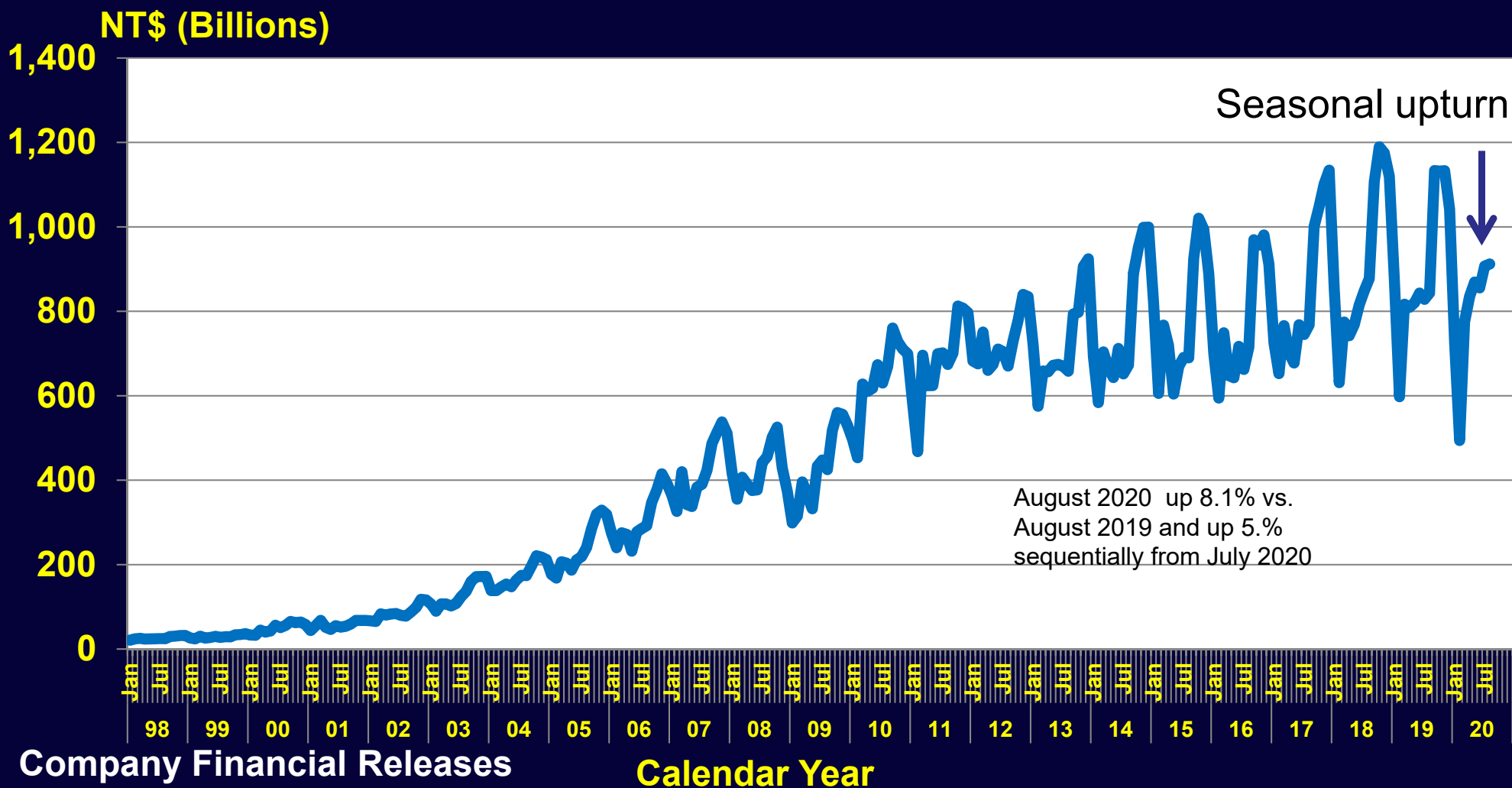
Composite of 52 Public Companies

Revenue



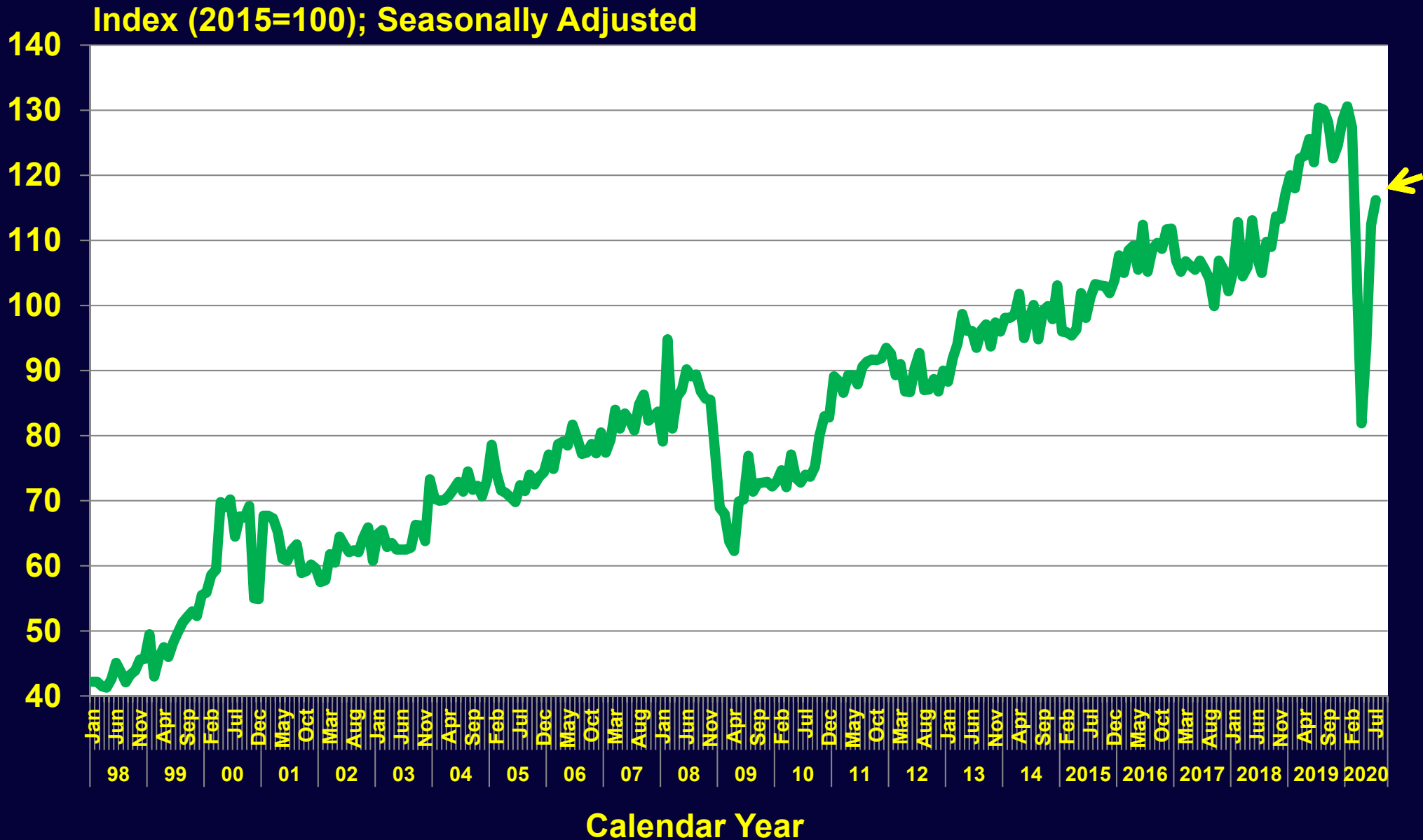
Taiwan ODM Companies

Composite Sales of 11 Large Manufacturers



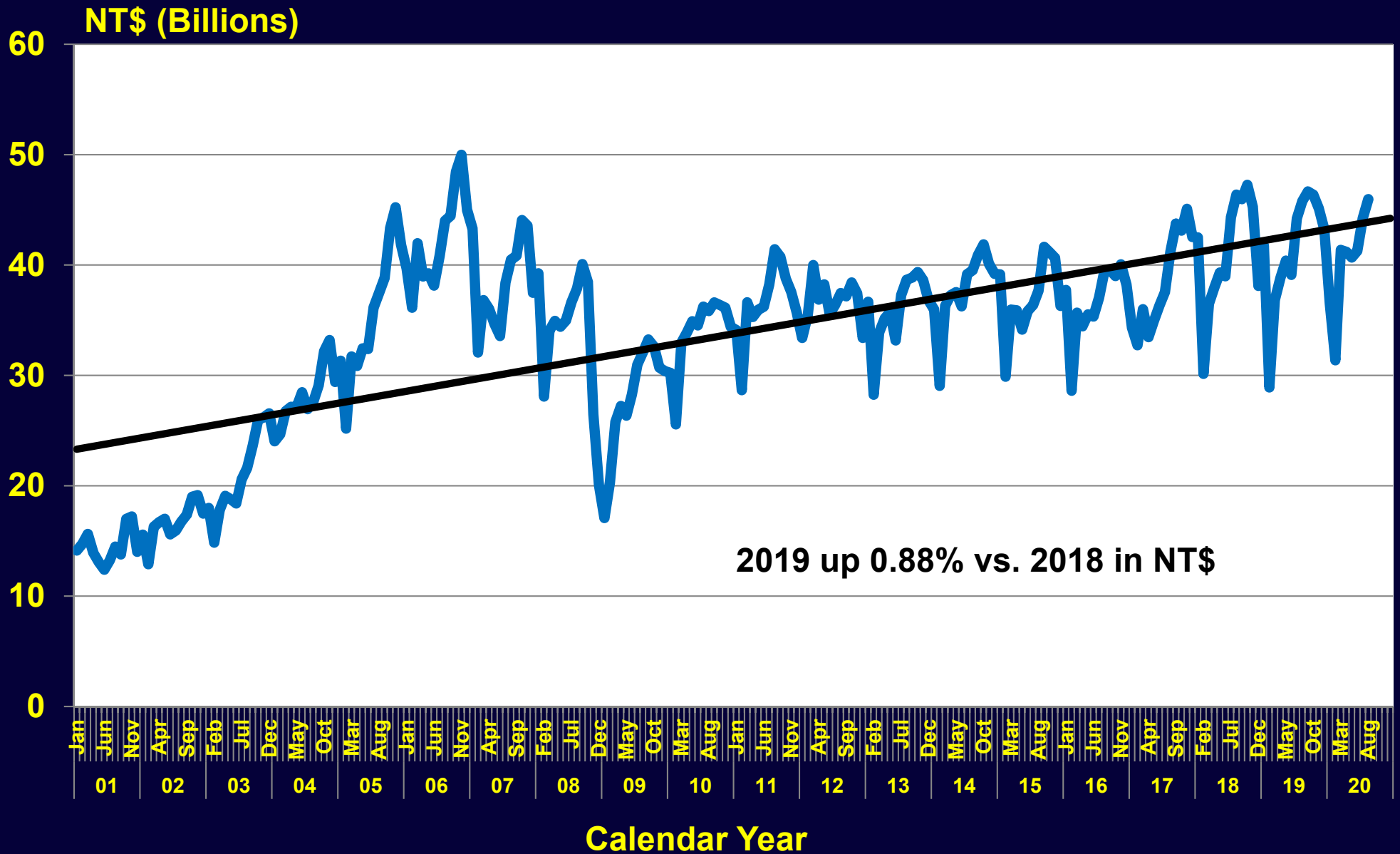
Asustek Computer, Chei Mei, Compal Electronics, Foxconn, Chimei Innolux, Inventec, Inventec Appliance, Lite On Technology, Mitac International, Pegatron, Quanta Computer, Wistron, Chei Mei Display replacing Chei Mei & Innolux Display 3/10 & later

European Loaded Electronic Board Production



PCB Market

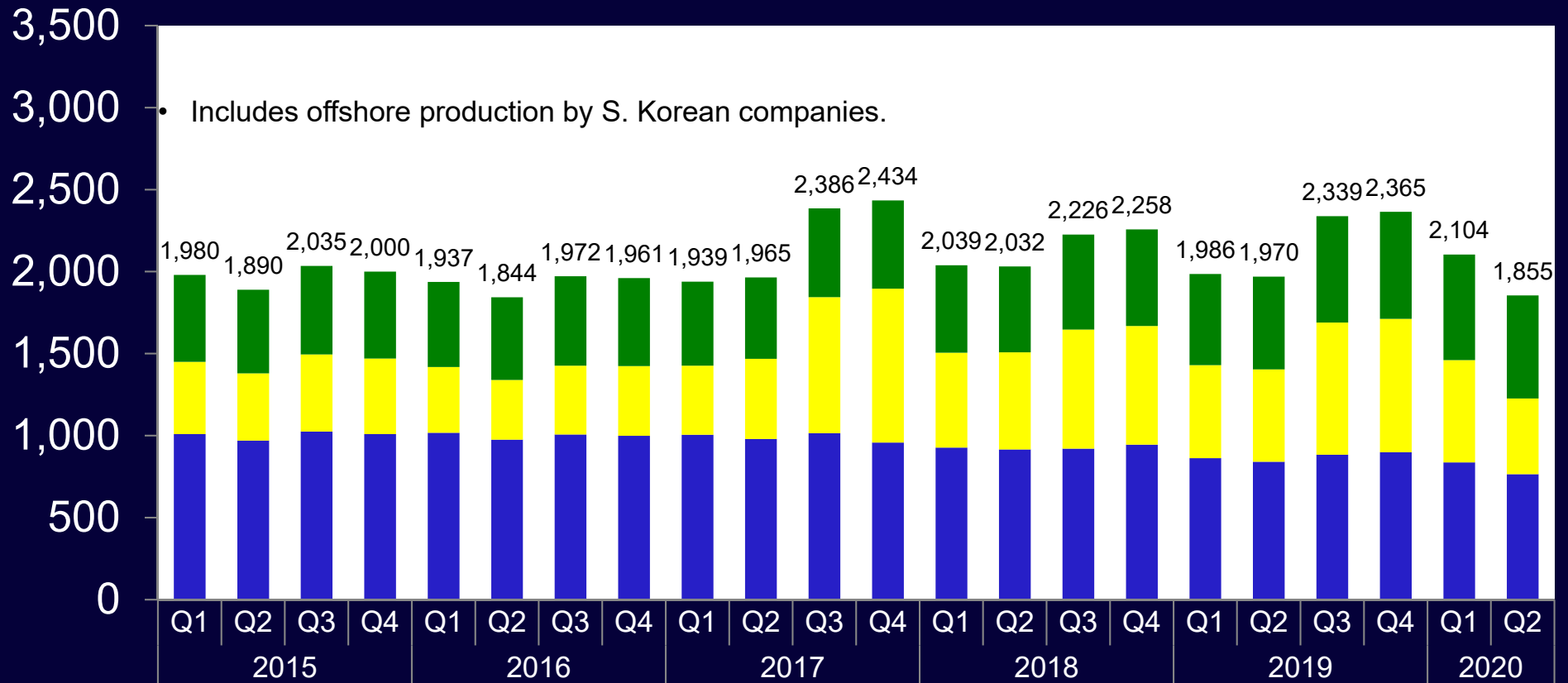
Taiwan Rigid & Flex PCB Shipments Broad Composite of 46 Taiwan-listed Manufacturers



S Korean Companies' Global PCB Production

20200831

US\$ millions (converted at 1150 won/\$)



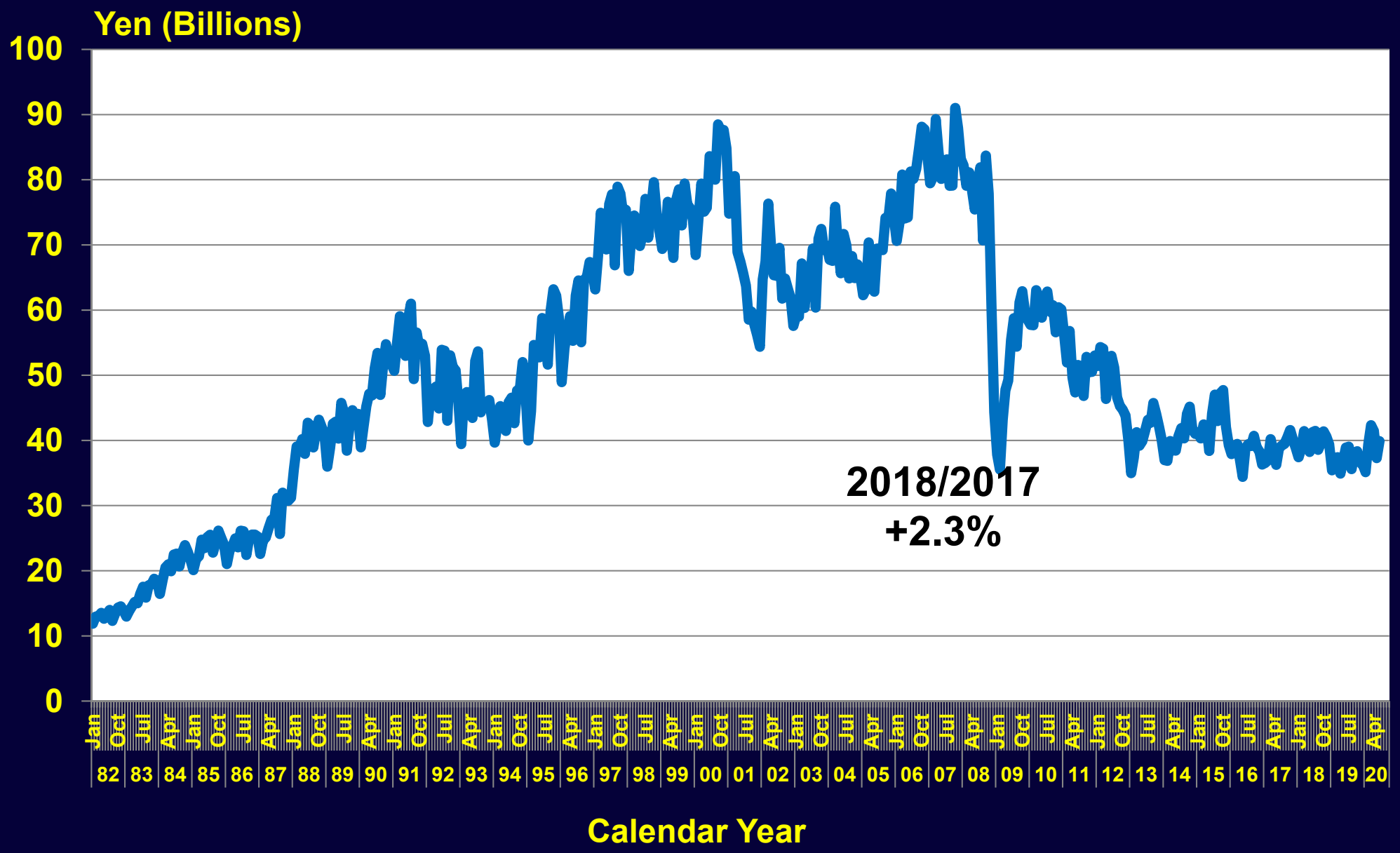
	2015				2016				2017				2018				2019				2020	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Total	1,9	1,8	2,0	2,0	1,9	1,8	1,9	1,9	1,9	1,9	2,3	2,4	2,0	2,0	2,2	2,2	1,9	1,9	2,3	2,3	2,1	1,8
IC Substrate	530	510	540	530	518	504	545	537	512	496	541	538	533	524	579	589	556	566	648	653	643	628
Flex	440	410	470	460	401	364	420	425	421	489	830	938	579	592	726	724	567	563	806	813	624	462
Rigid	101	970	102	101	101	976	100	999	100	980	101	958	927	916	921	945	863	841	884	899	837	765

-We are in the 2.5 phase, which is between lossy lock-down and strict lock-down since Korea is in the middle of the second wave of the pandemic.

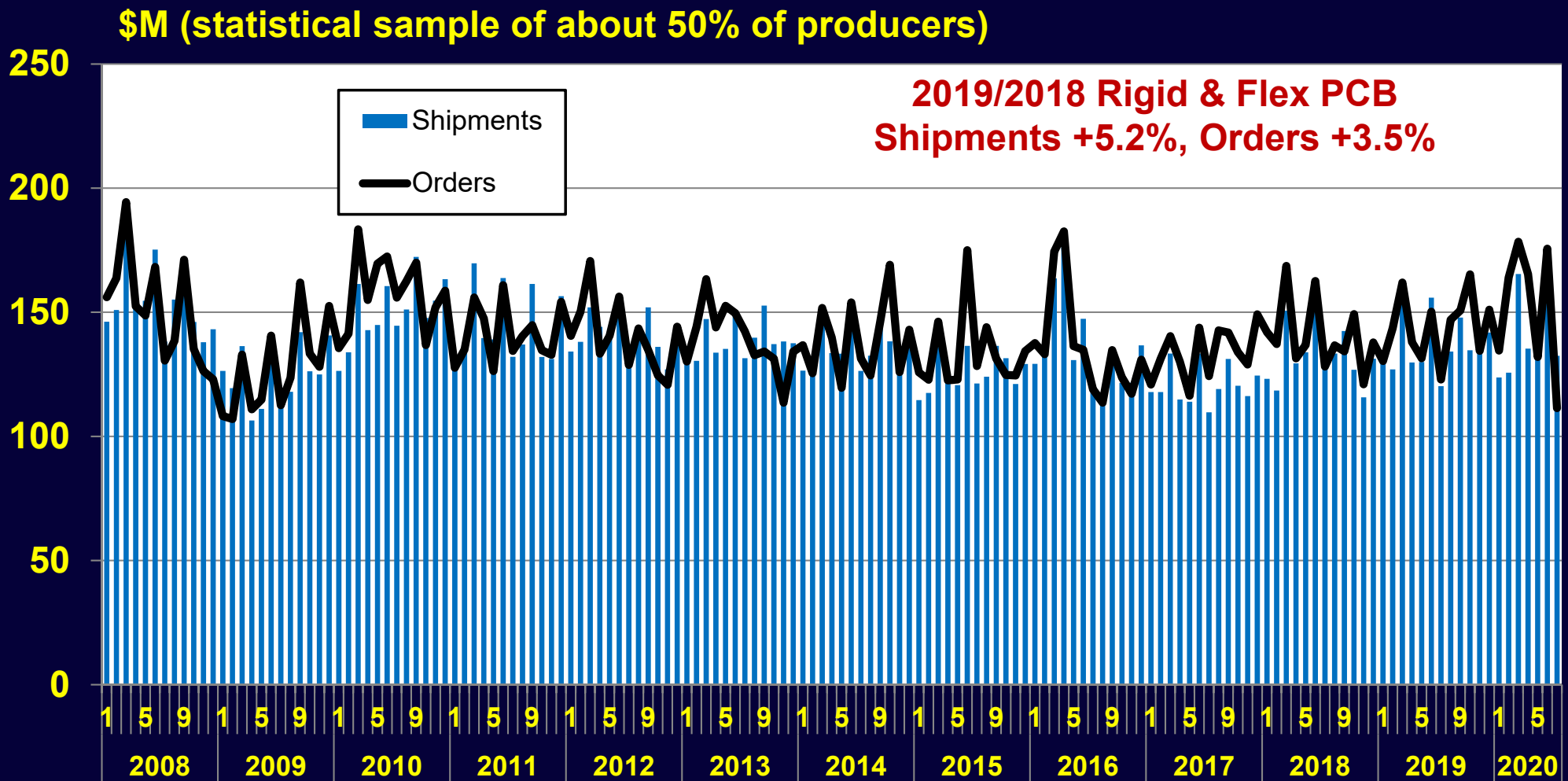
The Korean PCB industry felt quite an impact from the pandemic in Q2. 8/31/20

Private communication from industry source

Japan PCB Production



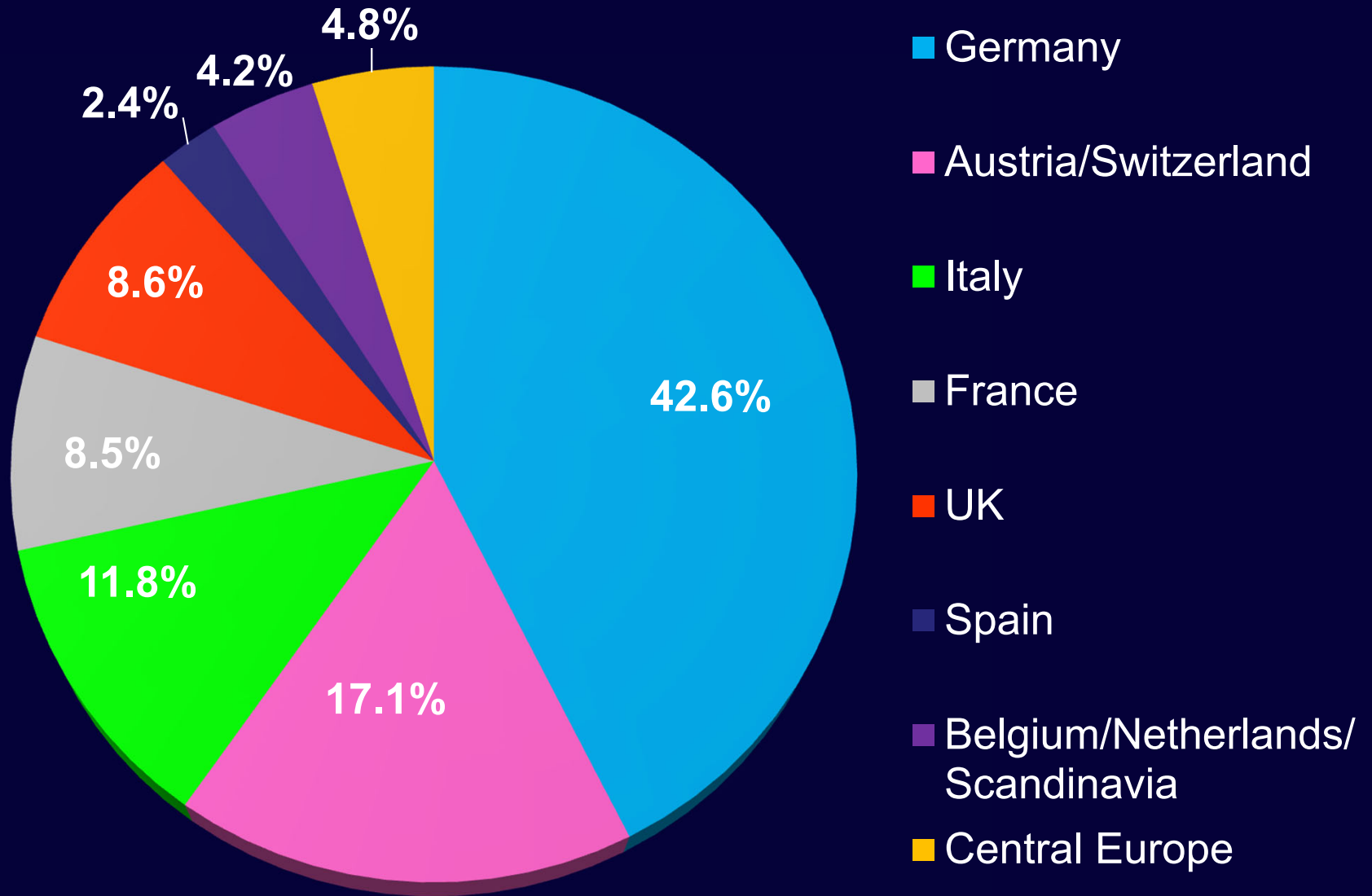
N American Rigid & Flexible PCB Shipments & Orders



Note: IPC survey captures "market" not domestic production. About 15% of the above represents imported boards resold by N American PCB producers in survey.

European PCB Data

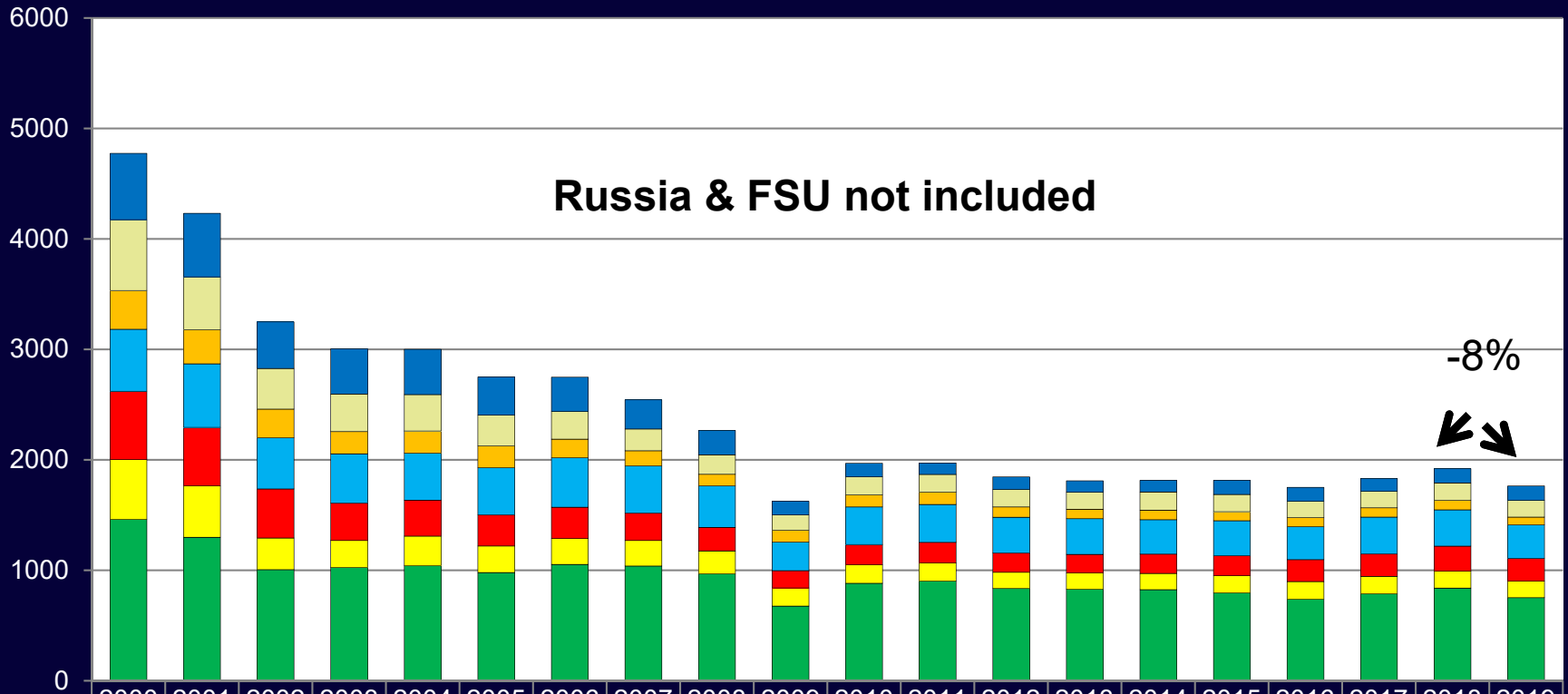
2019 European PCB Production



EUR 1764 million

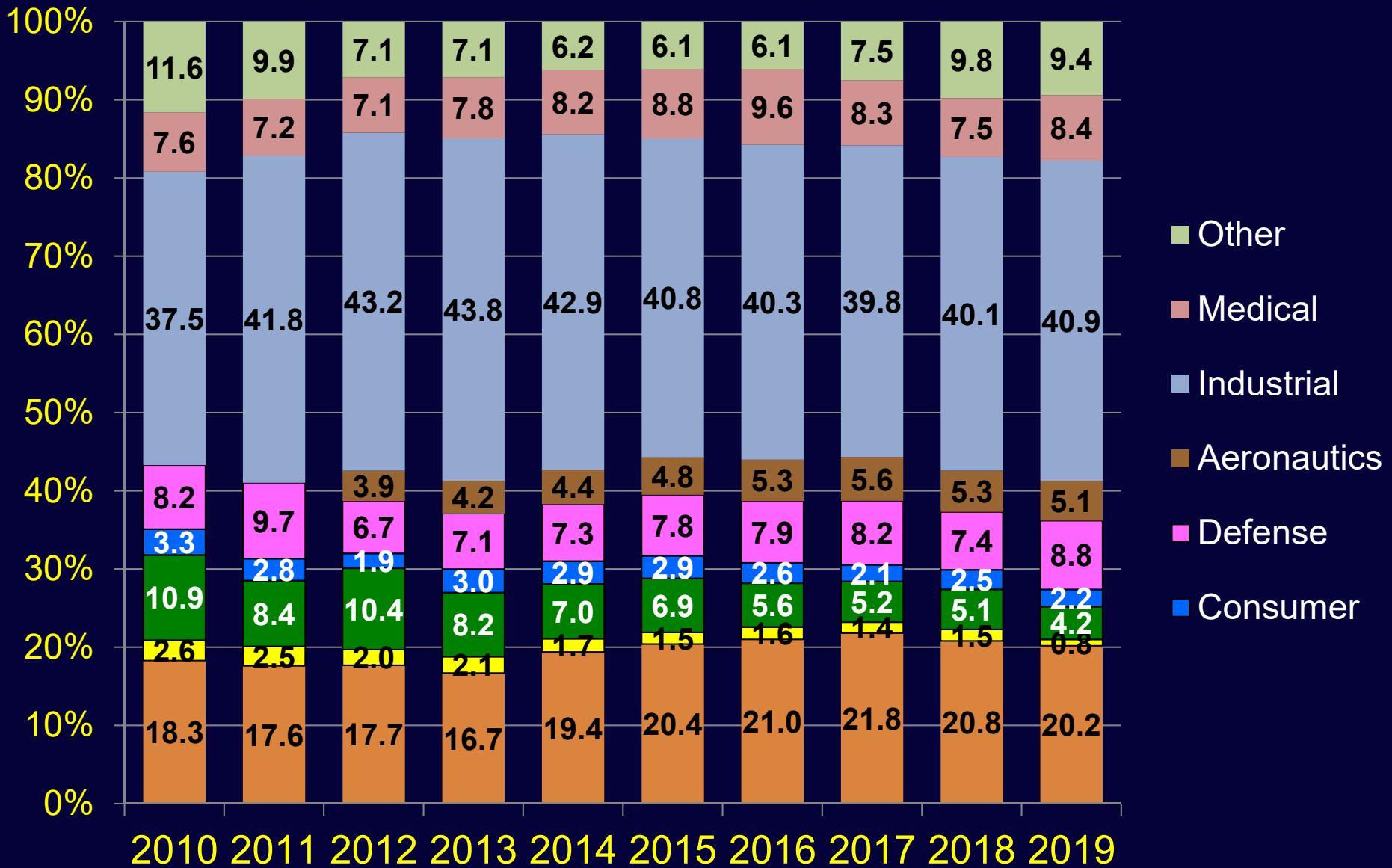
European PCB Production

Euros (Millions)



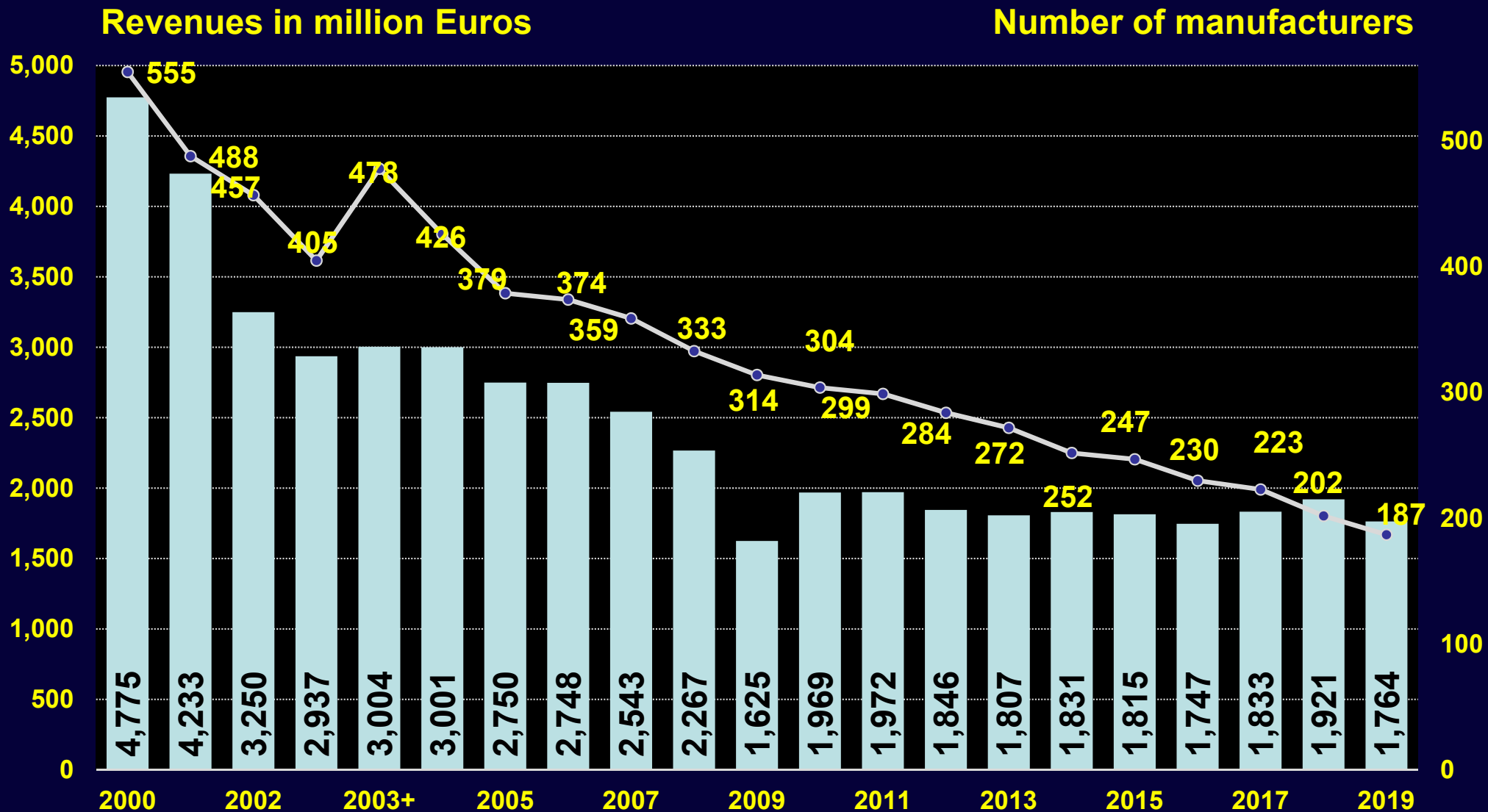
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Other	601	577	422	408	410	346	309	264	221	124	122	103	114	105	106	128	124	116	130	130
UK	641	478	368	340	330	278	252	197	177	137	165	161	158	153	165	157	151	150	158	152
Scandinavia	351	309	260	201	200	198	169	137	103	109	108	111	93	86	85	81	80	84	86	71
Austria/Switzerland	561	575	463	447	427	427	447	427	378	258	341	343	325	323	312	315	299	332	329	302
Italy	619	530	444	338	324	281	284	248	212	156	181	186	174	168	174	181	198	206	226	207
France	541	465	287	244	266	240	234	231	206	165	170	166	147	148	148	157	159	156	154	150
Germany	1461	1300	1006	1027	1044	981	1054	1039	970	676	883	902	835	828	825	796	740	788	839	752

European PCB Production by End Market



PCB industry in Europe 2000 – 2018

Revenues & Number of Manufacturers



* 2003+ = incl. Central Europe

Europe's Top 41 PCB Companies Ranked by 2019

<u>Rank</u>	<u>Company</u>	<u>Rank</u>	<u>Company</u>
1	Würth-group	22	Rohde & Schwarz
2	AT&S AG	23	Cicor Group
3	KSG-group	24	Polytron Print GmbH
4	Schweizer Electronic AG	25	Lüberg
5	Elvia	26	Tecnomaster Group
6	Mektec Europe	27	Graphic plc
7	Unimicron	28	Eleprint srl
8	SoMaCis SpA	29	MOS
9	Dyconex	30	Cipsa
10	GS Swiss PCB AG	31	Ilfa
11	Cistelaier-Group	32	Eltos
12	EES-group	33	Merlin-Group
13	ACB Group	34	tw-elektric
14	Elco Group	35	LAB Circuits
15	hmp Heidenhain	36	Elekonta Marek GmbH
16	Invotec	37	Schaltungsdruck Storz
17	Aspocomp Oy	38	Garner Osborne
18	Cimulec Group	39	Intec TIV
19	Eurocircuits Group	40	TCL-Group
20	Varioprint AG	41	Technoservice
21	Optiprint AG		

Europe Comments – Michael Gasch

Challenges of 2020 / 2021

Corona will remain for quite some time and it won't help the people and the economy if politicians are downplaying the danger. The US has about 4% of the global population but more than 20% of all infections and fatalities. Just 4 states (California, Illinois, Michigan and Texas) have > 27% of all cases but almost half of the US PCB-production

In Europe, France, German speaking countries and UK have 28% of all Corona-cases but they make 84% of all PCBs in Europe

As soon as the situation will come closer to a “kind of normalisation” we will see a wave of bankruptcies, a huge wave of mass lay-offs and an economic crisis all over the world *)

The outcome of the US elections will have – either way – an influence on the world economy. The US trade war induces cost to the US-economy of billions of dollars

Michael Gasch 9/20

Europe Comments – Michael Gasch

The Chinese attempt to manipulate and to dominate other countries. During 40 years China has established a strong position in almost all economic segments but the West has no answer to this

If China wishes to hit back, it may have just to levy export taxes on pharmaceutical raw materials bound for the USA (or to stop supplies altogether, in which case the US health system will collapse within weeks, if not in days **)

Brexit induces additional cost to the UK. Rising protectionism, agreements and contracts have no value anymore.

All principal industrial segments served by European PCB manufacturers are under pressure: industrial electronics in Europe will decline in 2020 by 20%, the global automotive market will lose 24%, new aircraft are no longer needed (large 2nd hand market)

Michael Gasch 9/20

Europe Comments – Michael Gasch

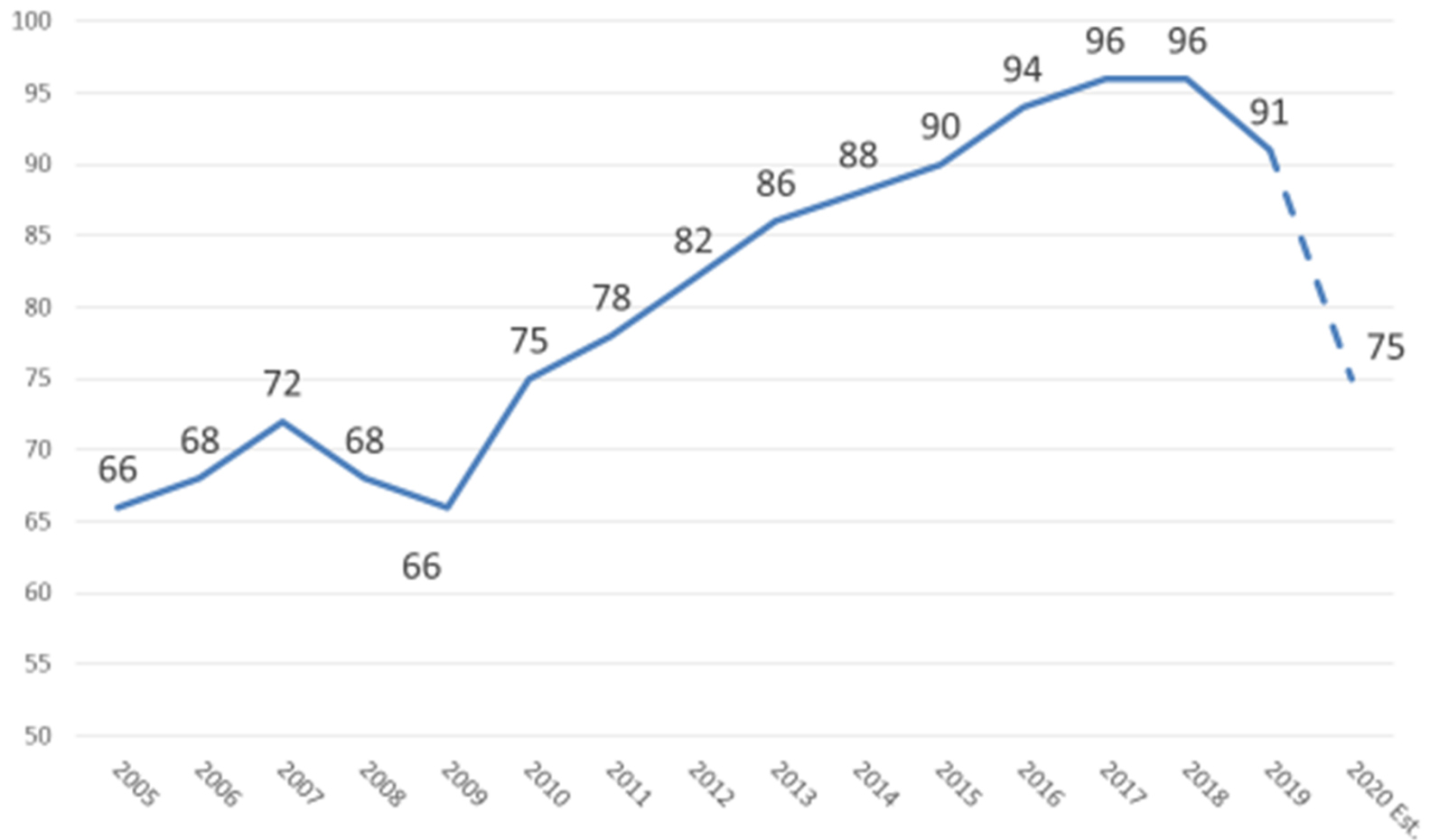
The European PCB industry in 2020 may reach just 1,950 million USD, down 10-13% versus 2019 and 6% BELOW the 2009 output

All these experiences lead to realignment of supply chains. Cheap labour is no longer in China and S. E. Asia may follow soon.

Political decisions and relocating in S.E. Asia postpones the problems and will increase cost. A better decision will be relocating closer to the markets thus increasing flexibility and security of supply. Furthermore certain costs may not arise at all.

Europe Comments – Hans Friedrichkeit

Global vehicle market- Million units sold all types



28.09.2020

| PCB | NETWORK |

Data: OICA 9-2020

2

Europe Comments – Hans Friedrichkeit

Automotive Industry

Bad News

**Situation at automotive suppliers remains very tense:
Corona accelerates relocation of production and job cuts**

Every second supplier in automotive industry expects that pre-crisis level will not be reached again until 2022, every tenth even until 2023.

Six out of ten supplier companies planning staff cuts due to the Corona crisis.

Continental has been cutting 13,000 jobs, Schaeffler 4,400; Bosch 2,000.

Europe Comments – Hans Friedrichkeit

Automotive (continued)

Extension of the government-financed short-time work option to 24 months helps to slow down the loss of more jobs.

In Germany, 65% of car manufacturers and suppliers introduced short-time working in August. However, mechanical engineering is also at 61%. The industry average is 53% of all manufacturing companies.

Number of short-time workers in Germany fell to 3.7 million in September, down from 4.7 million in August

Employment in industry continued its upward trend. However, there is always even more likelihood to dismiss employees than hire them.

Europe Comments – Hans Friedrichkeit

“No Deal” Brexit disaster

New calculations show the catastrophic impact of ‘no deal’ with WTO tariffs putting production of some 3 million EU and UK built cars and vans at risk over next five years.

‘No deal’ would mean combined EU-UK trade losses worth up to €110 billion to 2025, on top of around €100 billion in lost production value so far this year because of coronavirus crisis.

Europe Comments – Hans Friedrichkeit

Good News

In August, new registrations of electric cars in Germany rose 308% to 33,203 vehicles. This means that they reached a share of the total market of 13.2%, a new record.

In the first eight months, new registrations amounted to 163,139 electric cars (+151%).

This corresponds to an e-market share of 9.2% of all new passenger car registrations.

Plug-in hybrids (PHEVs) developed particularly dynamically in August, with growth of 448% to 17,095 units.

Europe Comments – Hans Friedrichkeit

Optimism is growing among German exporters

The upturn in industrial production in many important customer countries will benefit the German export industry.

In the chemical industry, significantly more companies expect their exports to grow in the fourth quarter increase. The same applies to manufacturers of electrical equipment. The automotive industry is also expecting with sales growth in foreign business.

By contrast, the mechanical engineering sector does not expect any major jumps, there the enterprises show themselves rather reservedly.

Europe Comments – Hans Friedrichkeit

PCB Manufacture

In first quarter 2020, printed circuit board manufacturers in Germany, Austria and Switzerland (DACH) region reported 7.5% sales drop compared to 2019.

In 2Q 2020, German printed circuit board manufacturers had a 17.4% drop in sales compared to 2Q19.

Staff reductions

- Schweizer Electronic AG: total ~80; -60 in 2020 plus -22 in 2021
- Wuerth Schopfheim Plant: total ~100
- Fuba Tunisia: total ~190 (2019/2020)

German PCB production has shrunk about 10.4% to 752 million euros in 2019, following 839 million euros in 2018 and 788 million euros in 2017

For year 2020 as a whole, sales loss of -18% for Germany can be assumed, which corresponds to about €620 million.

Europe Comments – Hans Friedrichkeit

AT&S

Thanks to its global diversification in high-end PCB sector, AT&S is one of the few PCB manufacturers to come through the crisis relatively well. In 2Q 2020 turnover grew 11.3% vs. previous year with EBITDA of 15.9%.

AT&S's current expectations for individual segments are currently as follows:

- In mobile devices, uncertain consumer behavior and low visibility may lead to delays in new product start-ups.
- In automotive sector, it is to be assumed that the automotive market will not recover quickly to pre-crisis levels.
- From today's perspective, the Industrial segment will develop similarly to the previous year.
- Slight growth is expected for medical technology applications for the year as a whole.
- According to available forecasts, demand for IC substrates will remain strong.

Europe Comments – Hans Friedrichkeit

Outlook 2020/21

Despite lowered economic forecasts, the global megatrends in the electronics industry as a whole remain intact - particularly due to ongoing digitization, the new 5G mobile phone standard and the rapidly growing data volume.

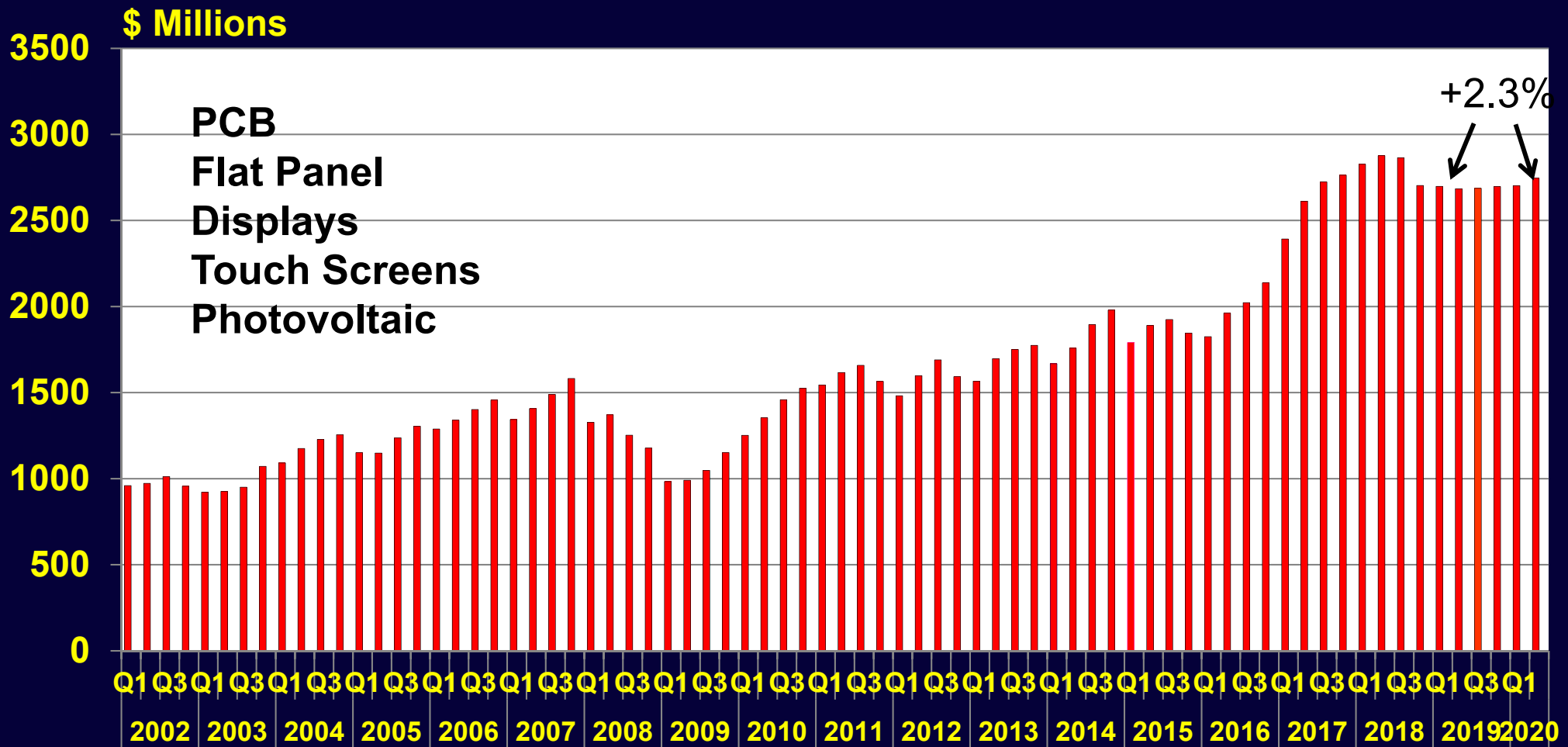
**Hans J. Friedrichkeit, PCB-Network 2020-10-01,
following**

**Process Equipment,
Laminate &
Materials Suppliers**

20200830

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

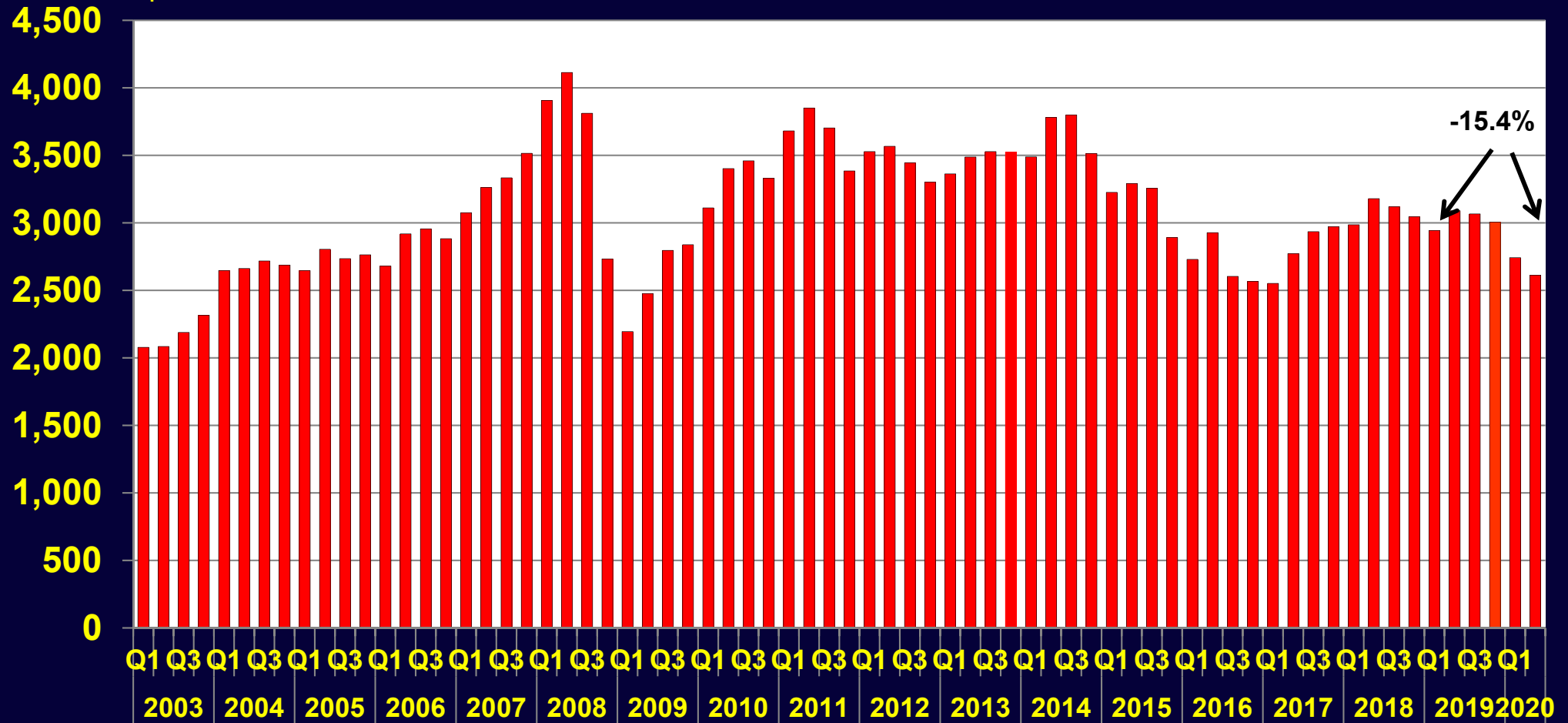
Material Suppliers (excluding laminate)

Composite of 14 Companies

20200812

\$ Millions

Revenue

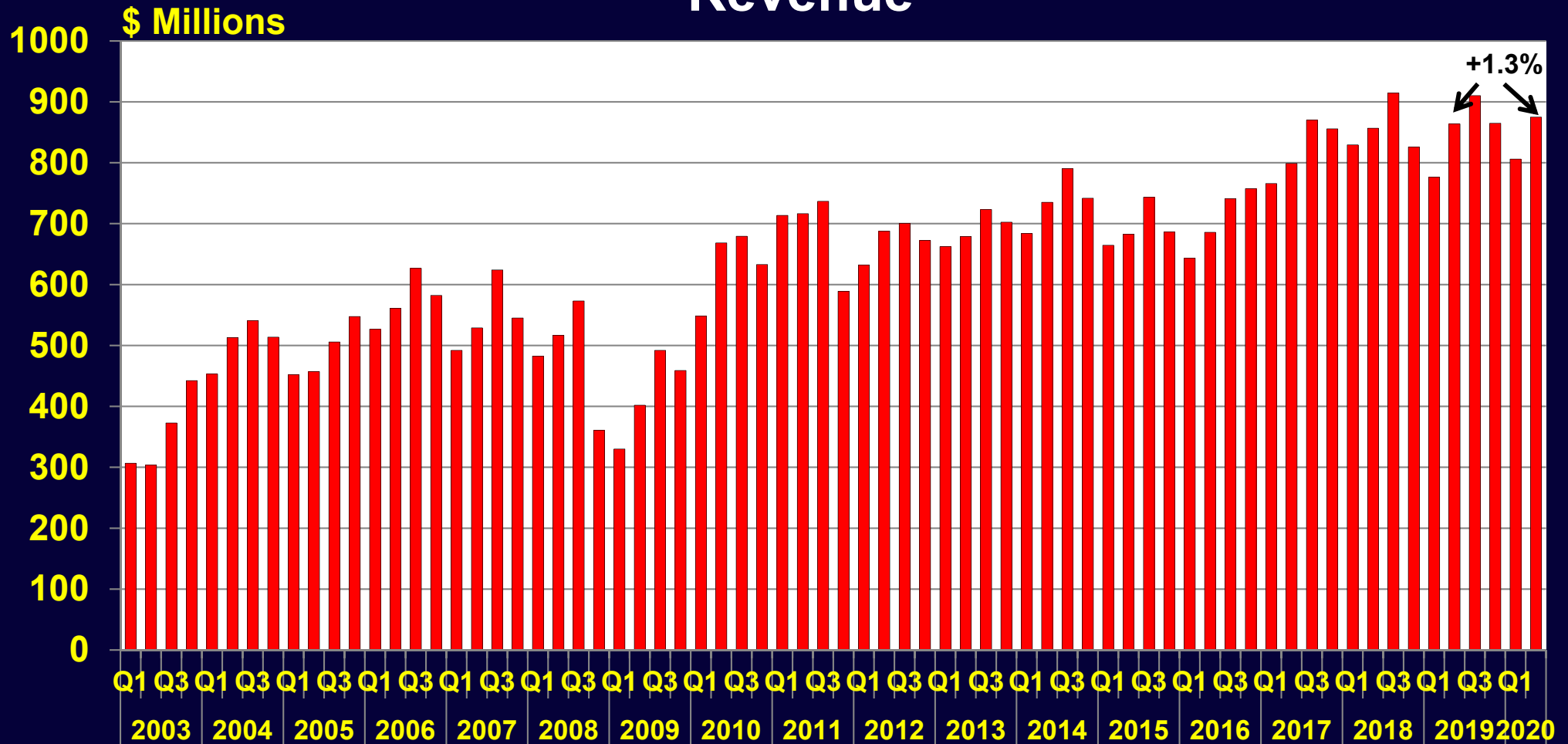


Momentive, OM Group, Taiwan Glass, Baotech, Glotech, Shenmao, Wahlee, Topoint, Cabot Micro, Cookson Elec, Eternal Chemical, Hexcel, Chang Wah, Platform Specialty Products

NT\$ & GBP converted to US\$ at fluctuating exchange

Rigid & Flex Laminate Suppliers Composite of 13 Companies

Revenue

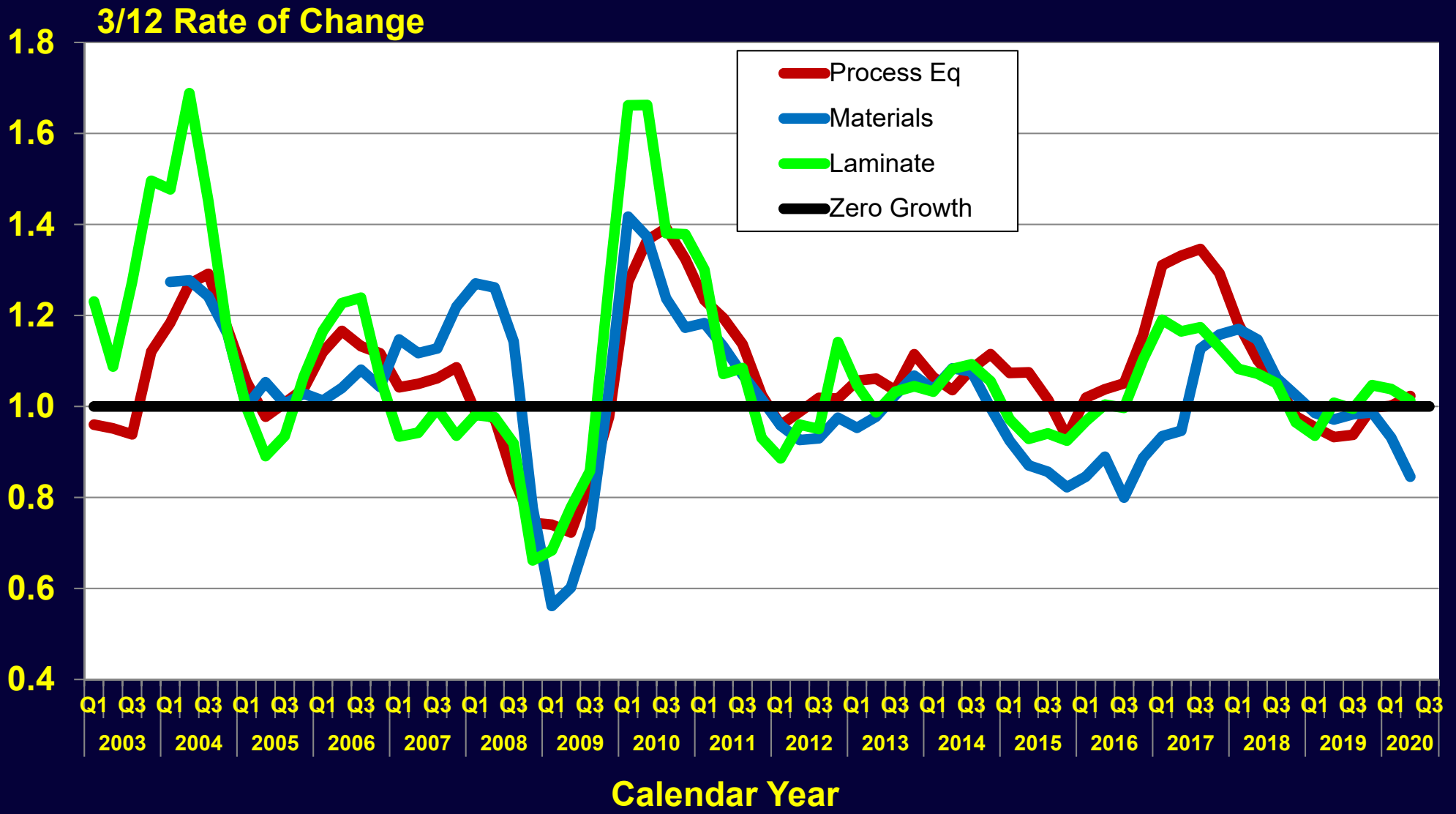


Arisawa, Arlon Electronic Materials, Elite Materials, Hwa Woei, Iteq, Microcosm, Park Electrochemical, Rogers, Shinemore, Taiflex, Thinflex, Top Union, Uniplus

NT\$ converted at fluctuating exchange

Global Growth Rates

Process Equipment, Materials & Laminate

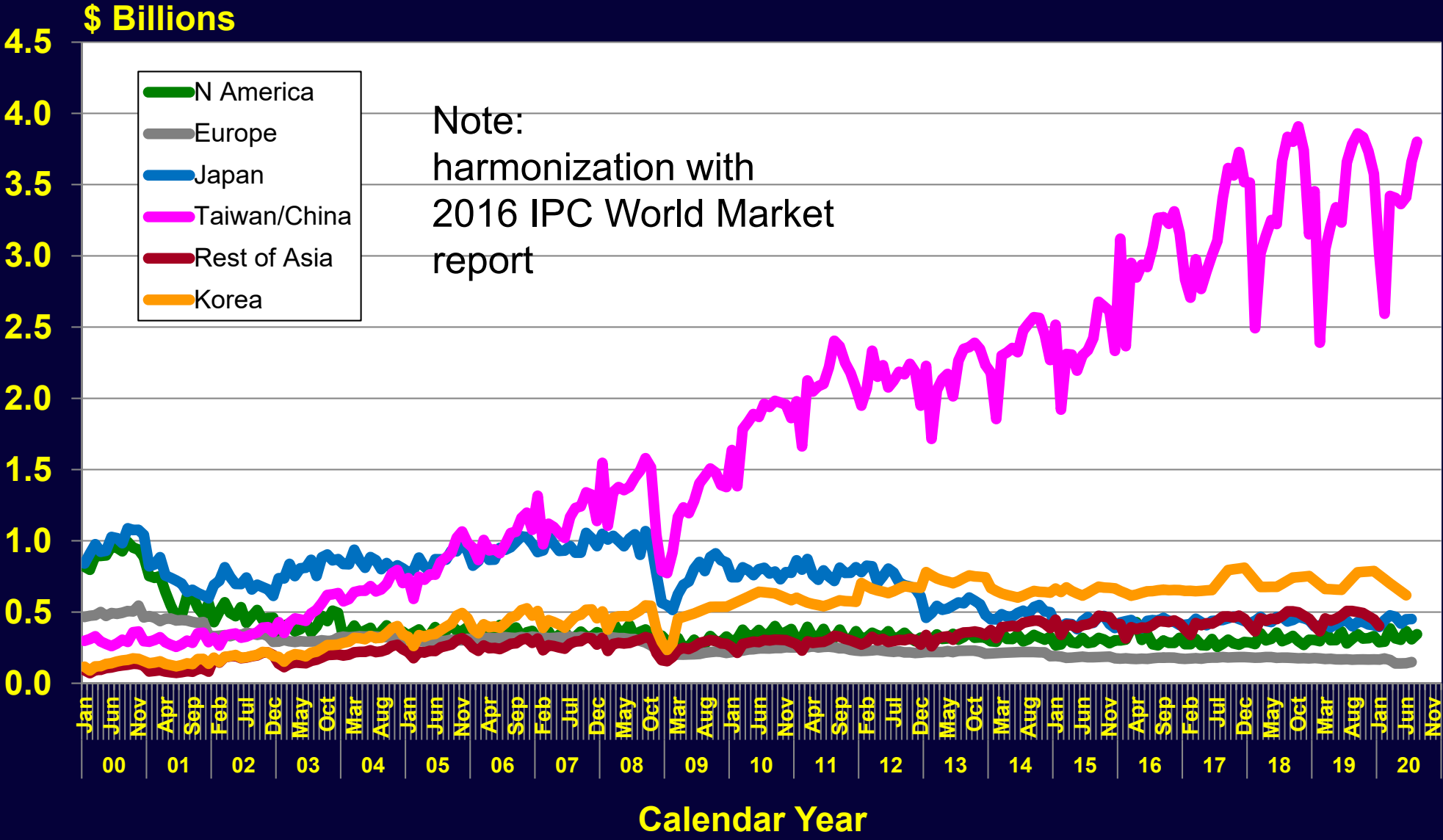


Company Financials of 12 Laminate suppliers, 13 material suppliers & 8 Process Equipment Suppliers

World PCB Model

World PCB Monthly Shipments

Converted @ Fluctuating Exchange Rates



Source: Custer Consulting Group

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

Forecasts

Real GDP Growth

Real Rates of Economic Growth

	2017	2018	2019e	2020f	2021f
World	3.3	3.0	2.4	-5.2	4.2
USA	2.4	2.9	2.3	-6.1	4.0
Euro Area	2.5	1.9	1.2	-9.1	4.5
Japan	2.2	0.3	0.7	-6.1	2.5
China	6.8	6.6	6.1	1.0	6.9
Emerging/Developing	4.5	4.3	3.5	-2.5	4.8

Present Growth Rates (%)

European Electronics Industry

	Latest Month	Annualized Growth Rate	3-Month Growth Rate
ELECTRONIC EQUIPMENT SHIPMENTS			
(Index CY 2010 =100)			
Computer, Electronic & Optical Eq	7/20	-8.0	-13.2
Components & Boards	7/20	1.2	-1.8
Components	7/20	0.9	-4.9
Wiring Devices	7/20	-8.9	-15.6
Loaded Electronic Boards	7/20	-1.6	-14.8
Communication Equipment	7/20	-6.6	-18.8
Electric Domestic Appliances	7/20	-7.7	-0.8
Instr & Appl for Measure, Test & Navigation	7/20	-9.0	-15.9
Medical Electronic Instruments	7/20	7.7	1.0
Motor Vehicles	7/20	-24.7	-34.5
Air & Space Aircraft	7/20	-11.1	-28.3
Semiconductor Shipments (Eur) to Europe	7/20	-4.5	-15.3
Industrial Production	7/20	-6.2	-14.7

2H'20 should be much better

2020 Concerns

Global manufacturing decline made worse by Corona virus driven shutdowns

Tariffs, trade and Brexit issues continue

Geopolitical concerns remain very significant

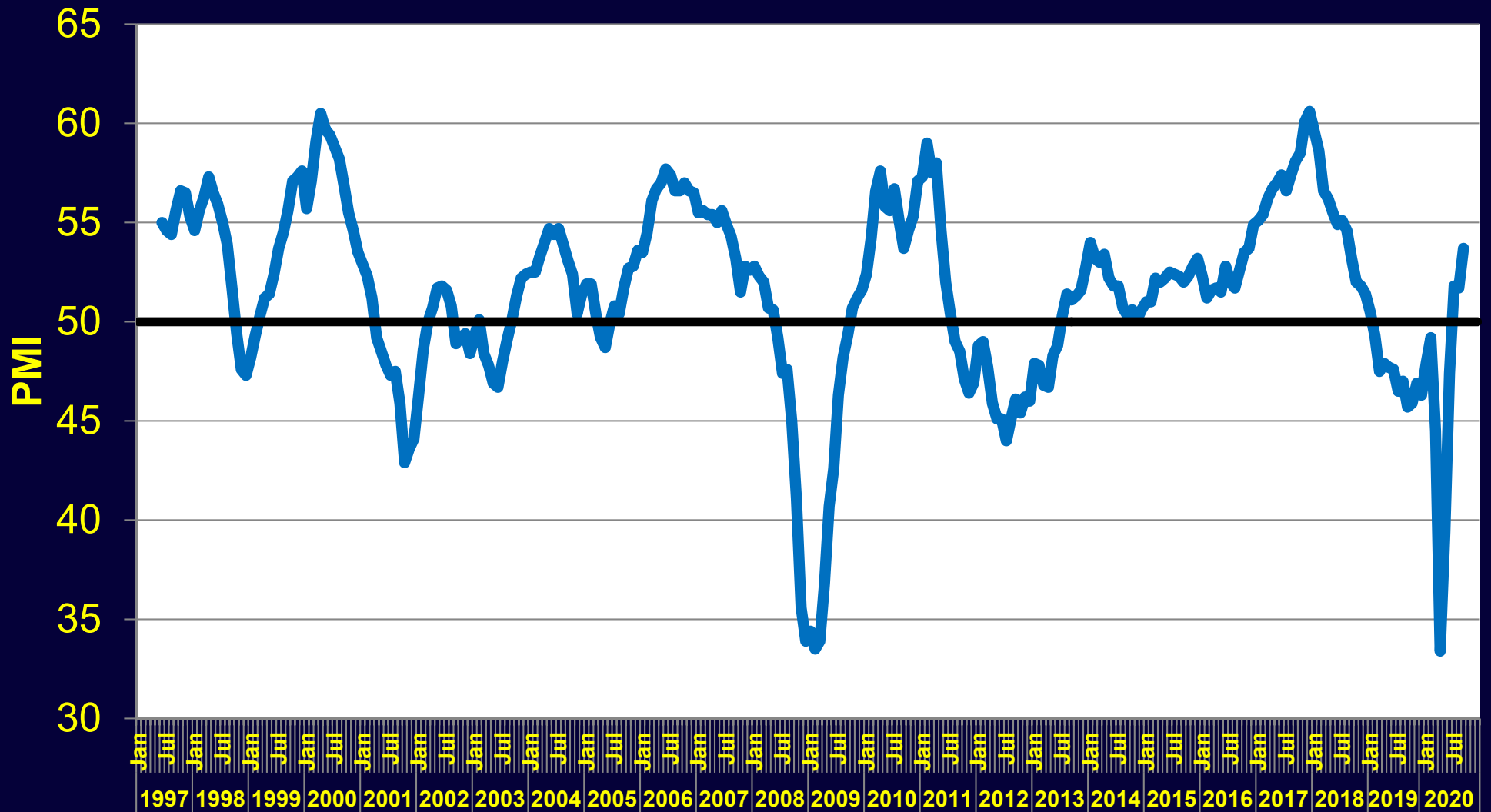
Automotive and aerospace production hit hard

Manufacturing is recovering but service/travel sectors remains in major recession

**European
Conditions are
improving**

Eurozone Manufacturing "Purchasing Managers" Index

Diffusion Index, >50 = Growth



**Special Thanks for their invaluable
contributions**

**Michael Gasch
Data4PCB**

**Hans Friedrichkeit
PCBNetwork**

**I have flooded you with data
but:**

**Data sources are given on
charts.**

**I would be happy to answer
questions**

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