The Aerospace & Defense Forum

"Defense and Aviation Markets: Navigating the Covid Aftermath"

June 11, 2021

- Please ensure your mike is muted and your video is off.
- Questions will be welcomed via the Chat function.
- The event will start at 8:00AM Pacific Time.

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The Aerospace & Defense Forum

Who We Are…

- An 11-year-old global aerospace and defense leadership community of over 2,400 professionals that facilitates communication, collaboration, and commerce relative to the business of A&D
- Nine chapters – Los Angeles, San Fernando Valley, Santa Clarita Valley, South Bay, Orange County, San Diego, Arizona, Dallas-Ft. Worth, and Ventura County.
- Conduct monthly meetings with presentations, panels and tours with industry leaders focused on some aspect of the business of A&D



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The Aerospace & Defense Forum

Webinar Guidelines

• Turn off camera video	Alt+V	⌘+Shift+V
• Mute audio	Alt+A	⌘+Shift+A
• Active Speaker View	Alt+F1	⌘+Shift+W

• Questions in Chat addressed to Everyone.

3

The Aerospace & Defense Forum

Presenter

Richard L. Aboulafia
Vice President, Analysis
Teal Group

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World Aero Markets: Looking Up, From The Bottom of a Pit

To Aerospace & Defense Forum
Richard Aboulafia
Vice President, Analysis
Teal Group Corporation
www.tealgroup.com
www.richardaboulafia.com

June 2021

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Aircraft Markets, In Good And Bad Years

(last year was not good)

World New Deliveries In 2020 (2021 $)	CAGR '03-'08	CAGR '08-'14	CAGR '14-'19	Change '19-'20
Jetliners-SA ($27 b)	9.7%	6.9%	-2.0%	-54.8%
Jetliners-TA ($27.8 b)	5.0%	13.5%	2.1%	-49.1%
Regionals ($3.4 b)	3.9%	-3.1%	-6.3%	-47.8%
Business Aircraft ($18.2 b)	16.7%	-2.2%	-1.2%	-15.7%
Civil Rotorcraft ($3.1 b)	18.5%	-2.5%	-7.2%	-11.4%
Military Rotorcraft ($10.7 b)	10.6%	9.7%	-7.0%	-16.3%
Military Transports ($4.1 b)	3.2%	-0.9%	0.0%	-27.0%
Fighters ($18.3 b)	1.6%	0.8%	6.1%	-22.6%
All Civil ($79.9 b)	9.7%	5.6%	-0.5%	-40.0%
All Military ($36.9 b)	3.9%	4.1%	0.0%	-18.4%
Total ($116.7 b)	8.0%	5.2%	-0.4%	-34.5%

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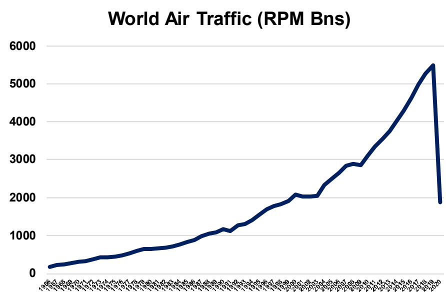
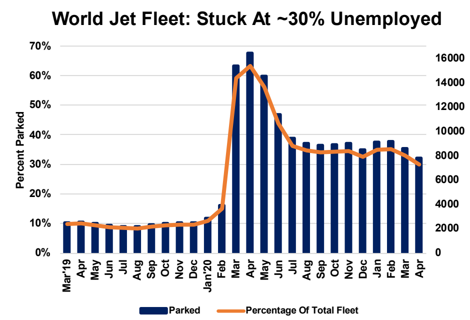
Unprecedented Numbers

- Traffic decline, parked fleet like no previous shock.
  - Per Paul Krugman, reflect a world economy recovering from a "medically-induced coma."
- Backlogs holding up (MAX a concern), but meaningless in a downturn.
- Many early retirements coming, particularly twin aisles.
  - Primarily twin aisles; A380 bloodbath.
- Aftermarket catastrophe – ASK decline, plus de-stocking, deferred maintenance, early retirements, USM, engine swapping, etc.





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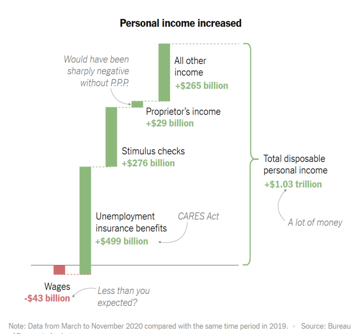
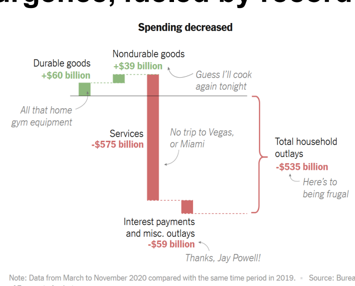
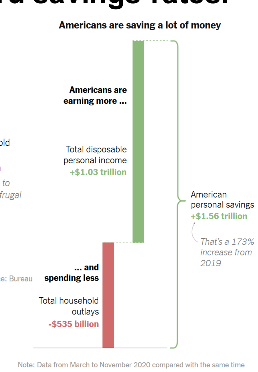
Traffic Peak Recovery By Late 2022. Why?

- Better-than-expected vaccine efficacy.
- Better-than-expected economic outlook.
- The China domestic comeback.
- Business travel resurgence.
- Vacation travel resurgence, fueled by record savings rates.







https://www.nytimes.com/2021/01/01/upshot/why-markets-boomed-2020.html

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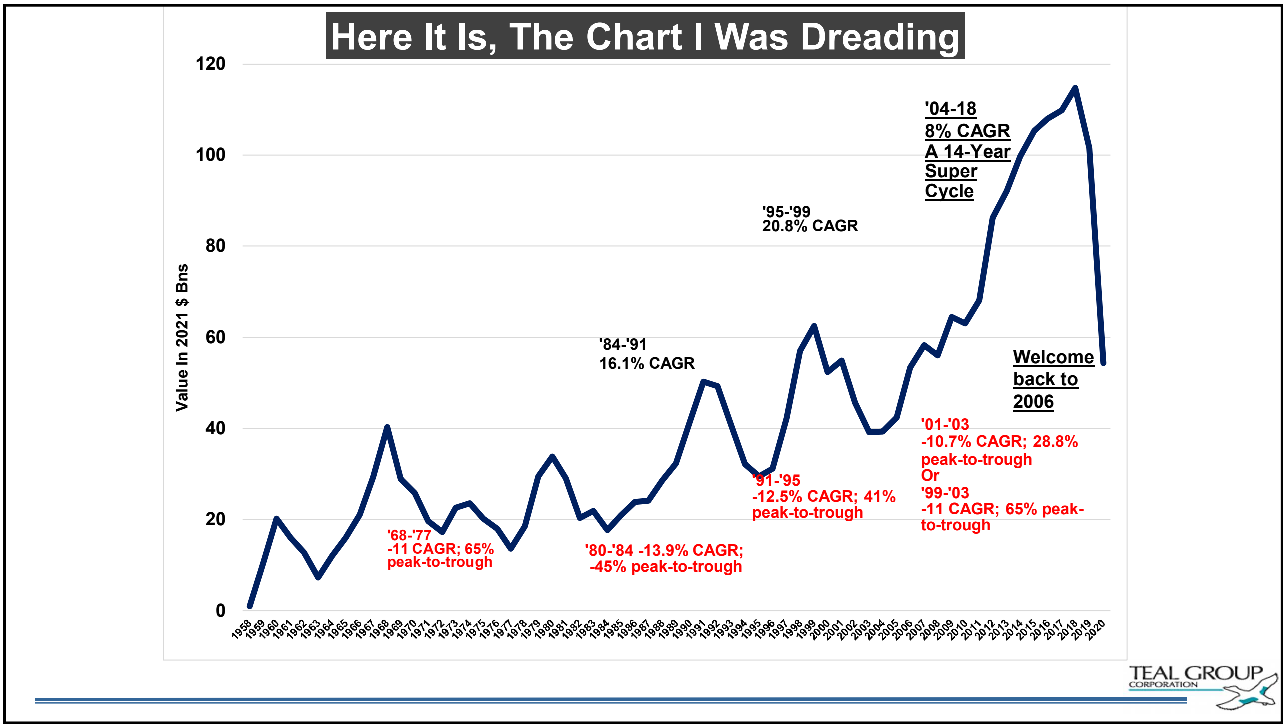
Here It Is, The Chart I Was Dreading
Value In 2021 $ Bns
'04-18
8% CAGR
A 14-Year
Super
Cycle
'95-'99
20.8% CAGR
'84-'91
16.1% CAGR
Welcome
back to
2006
'01-'03
-10.7% CAGR; 28.8%
peak-to-trough
Or
'99-'03
-11 CAGR; 65% peak-
to-trough
'91-'95
-12.5% CAGR; 41%
peak-to-trough
'68-'77
-11 CAGR; 65%
peak-to-trough
'80-'84 -13.9% CAGR;
-45% peak-to-trough
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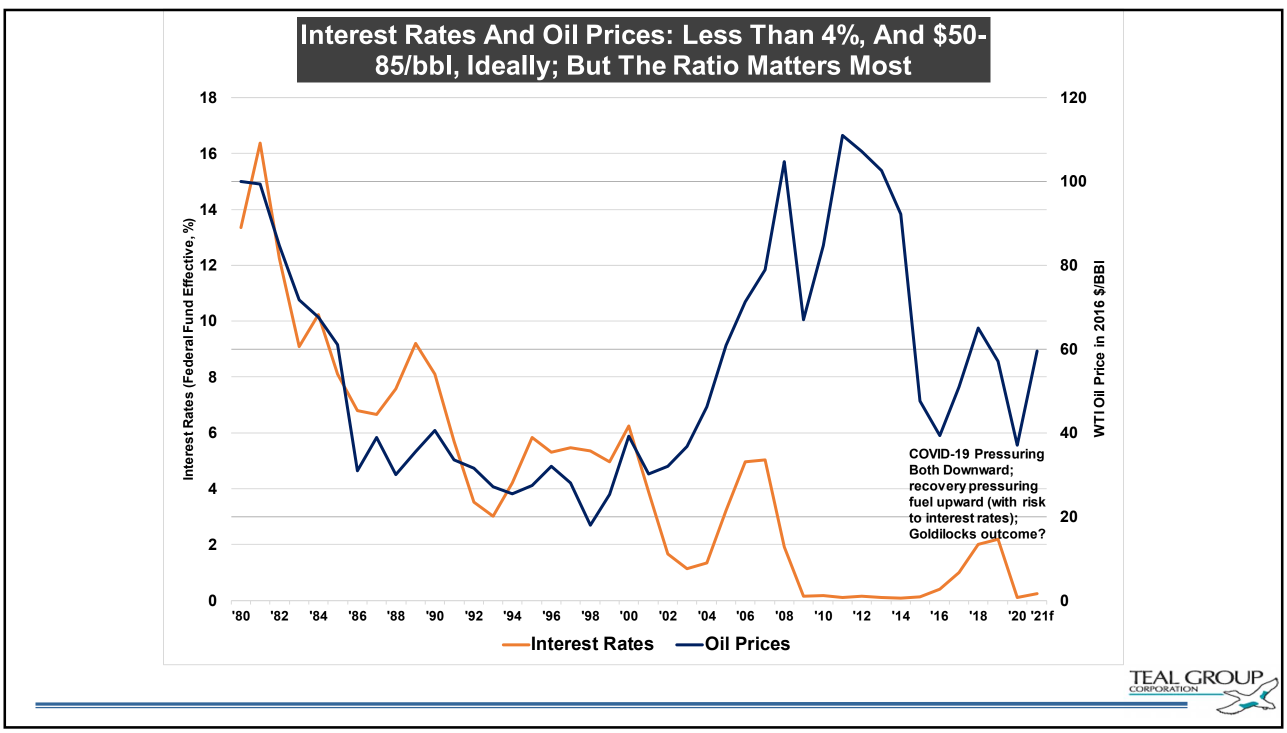
Interest Rates And Oil Prices: Less Than 4%, And $50-
85/bbl, Ideally; But The Ratio Matters Most
Interest Rates (Federal Fund Effective, %)
WTI Oil Price in 2016 $/BBl
COVID-19 Pressuring
Both Downward;
recovery pressuring
fuel upward (with risk
to interest rates);
Goldilocks outcome?
Interest Rates
Oil Prices
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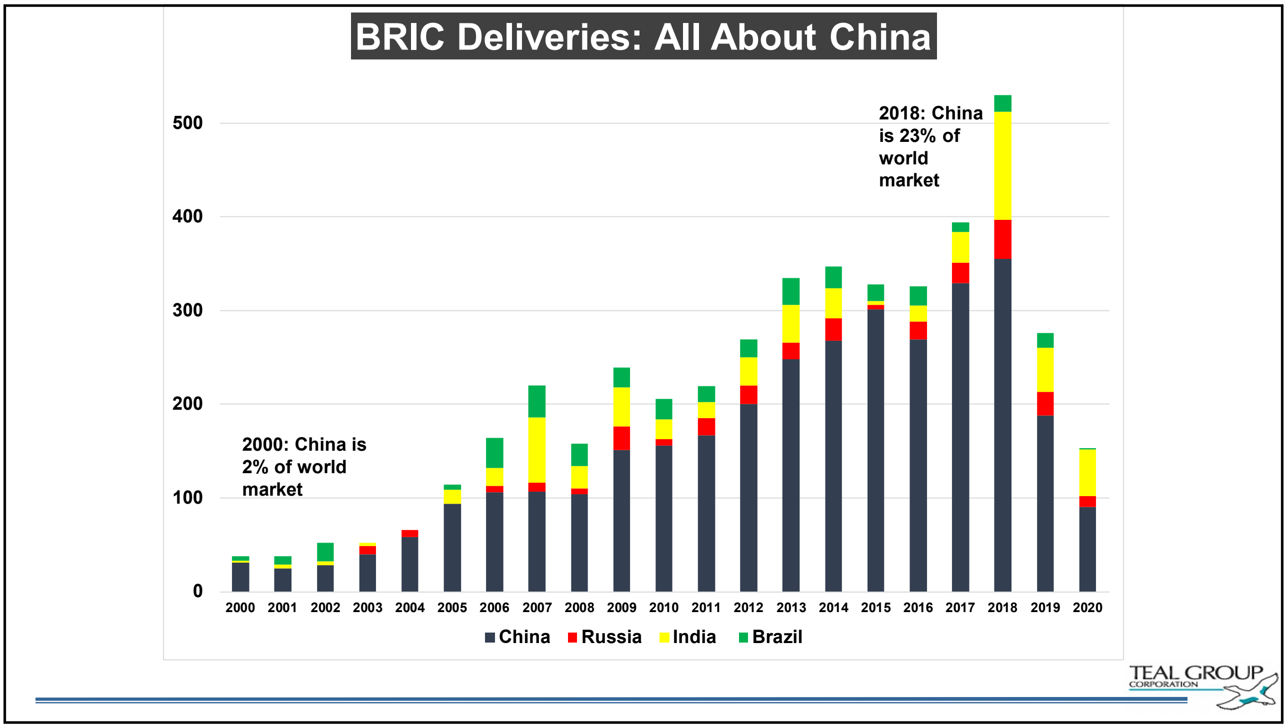
BRIC Deliveries: All About China
500
400
300
200
100
0
2018: China is 23% of world market
2000: China is 2% of world market
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
China Russia India Brazil
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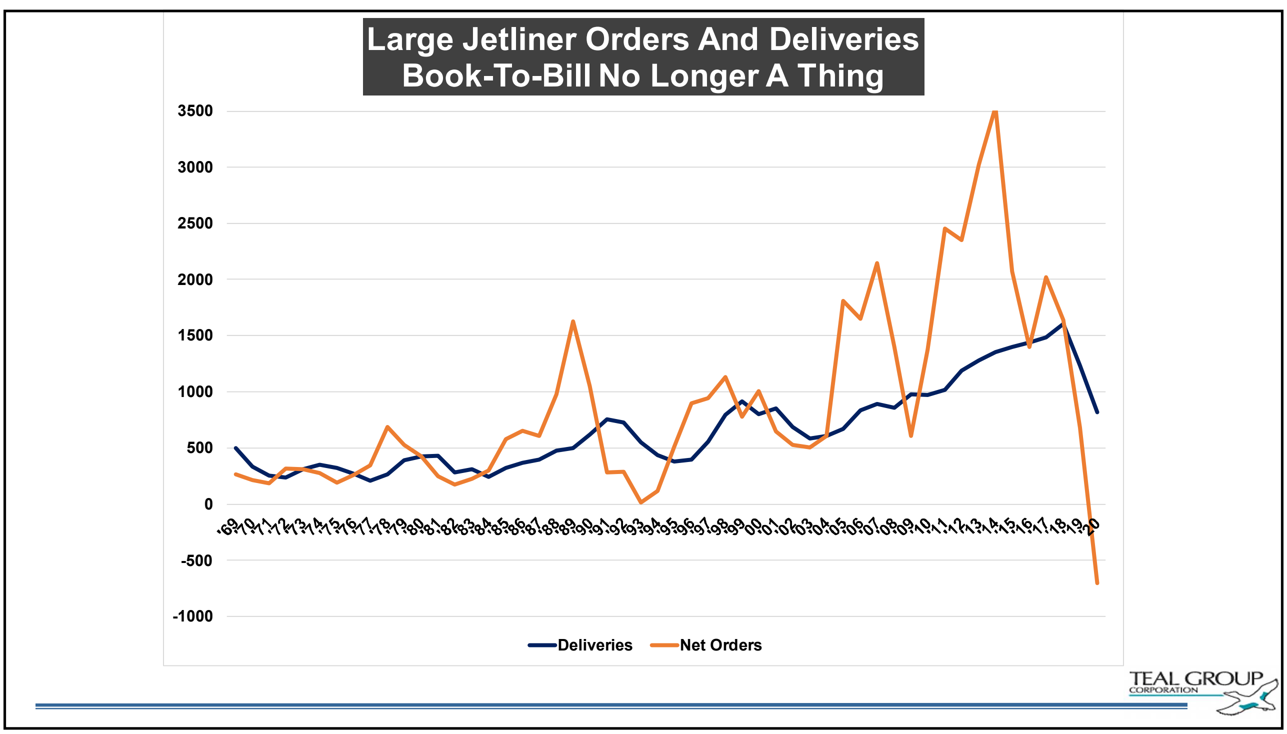
Large Jetliner Orders And Deliveries
Book-To-Bill No Longer A Thing
3500
3000
2500
2000
1500
1000
500
0
-500
-1000
Deliveries
Net Orders
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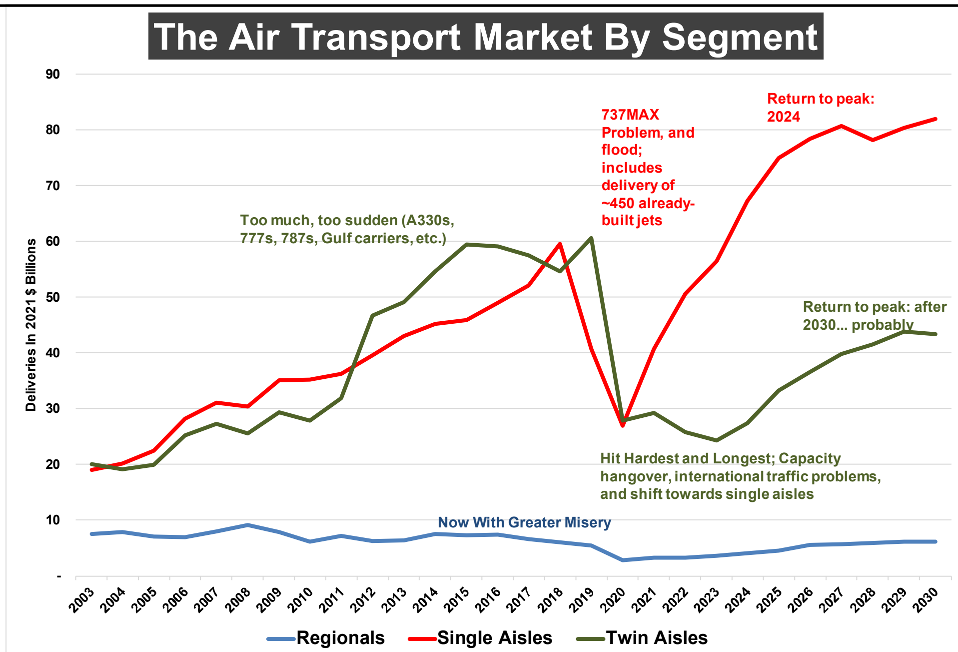
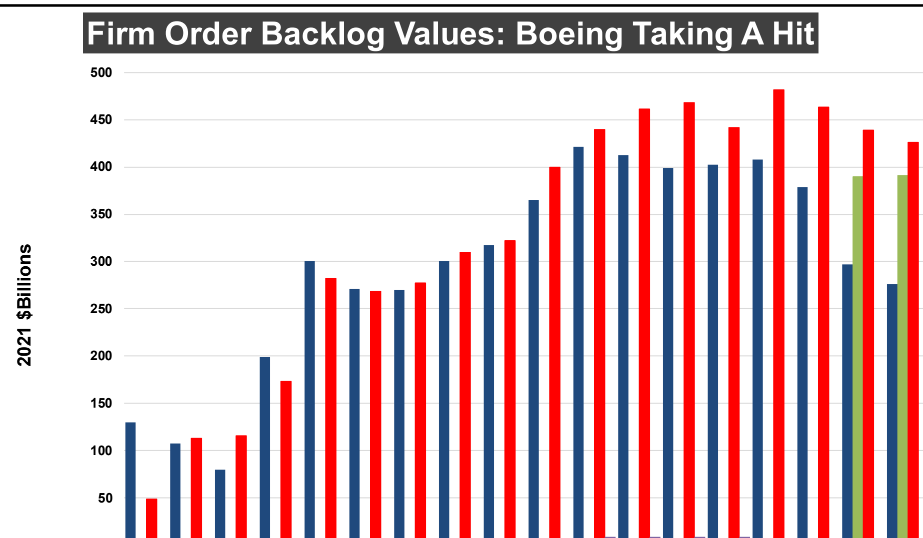
12



13



	1h 1997	1h 2001	End 2004	End 2006	End 2008	End 2009	End 2010	End 2011	End 2012	End 2013	End 2014	End 2015	End 2016	End 2017	End 2018	End 2019	End 2020	May 1 2021
Boeing	130.0	107.8	79.5	199.1	300.4	271.1	270.0	300.1	317.0	365.3	421.2	412.9	398.9	402.1	408.0	378.8	297.1	275.9
Without ASC 606																	390.0	391.0
Airbus	48.6	112.9	115.5	173.0	281.8	268.2	277.6	309.5	321.6	399.9	439.9	461.2	468.1	441.8	481.6	463.6	438.9	426.4
Bombardier	—	—	—	—	—	1.9	3.3	4.9	5.5	6.7	9.0	9.0	8.7	8.5	—	—	—	—

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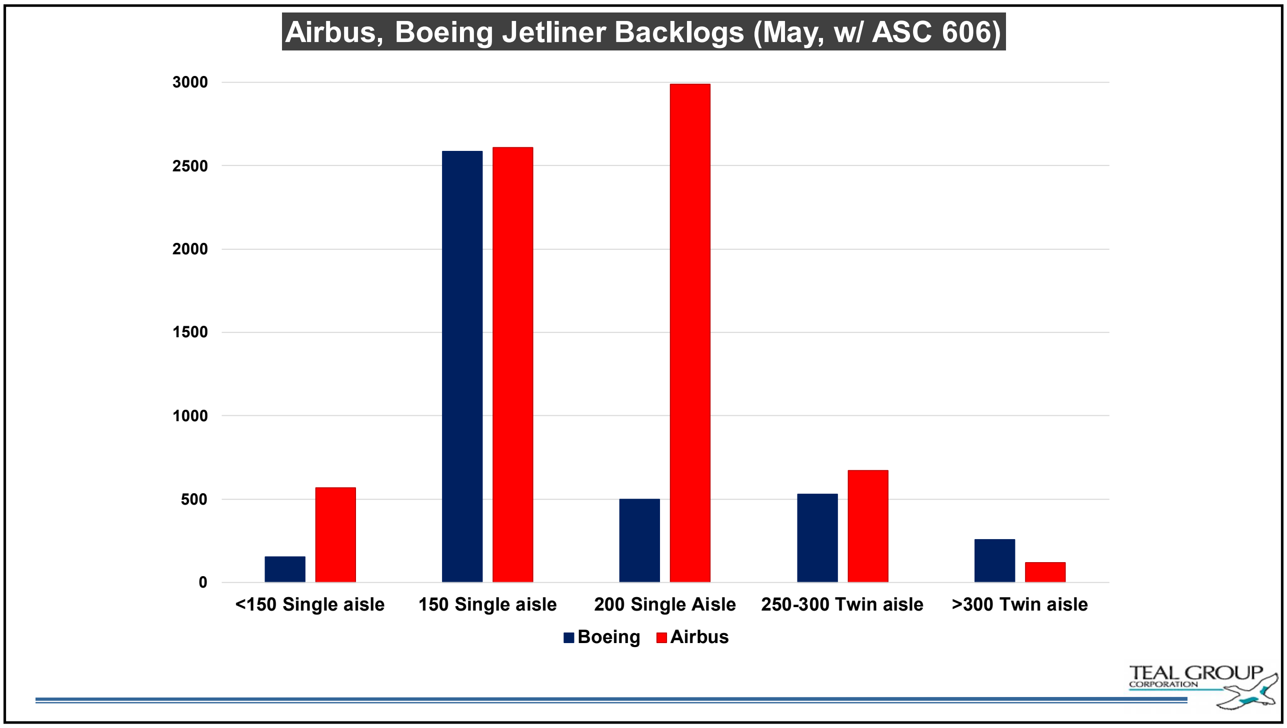
Airbus, Boeing Jetliner Backlogs (May, w/ ASC 606)
3000
2500
2000
1500
1000
500
0
<150 Single aisle
150 Single aisle
200 Single Aisle
250-300 Twin aisle
>300 Twin aisle
Boeing
Airbus
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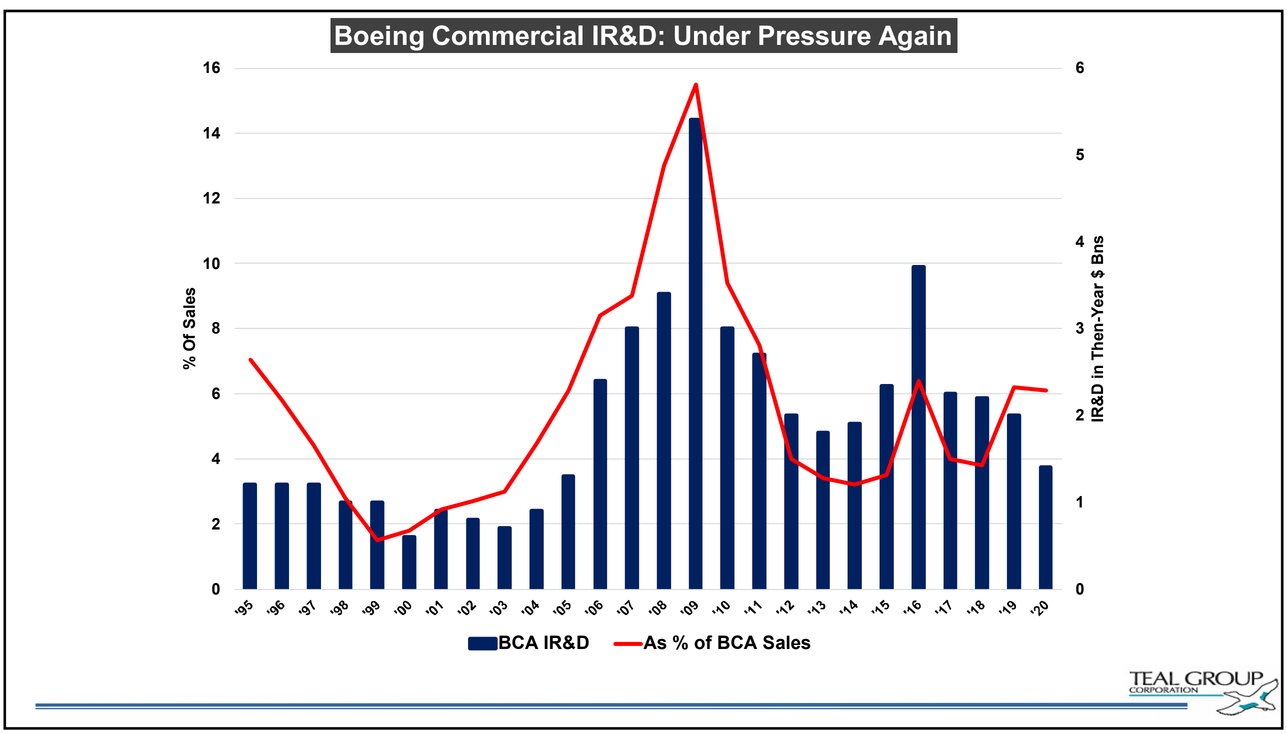
Boeing Commercial IR&D: Under Pressure Again
% Of Sales
IR&D in Then-Year $ Bns
16
14
12
10
8
6
4
2
0
'95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14 '15 '16 '17 '18 '19 '20
BCA IR&D
As % of BCA Sales
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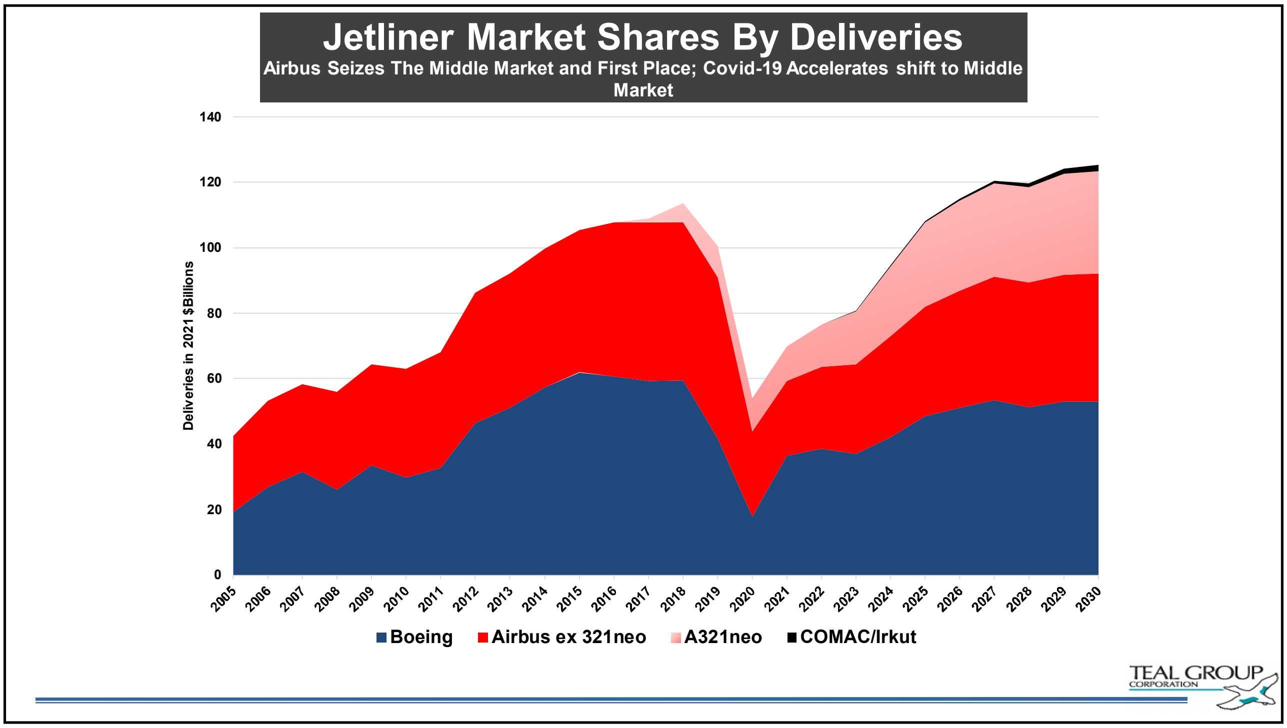
Jetliner Market Shares By Deliveries
Airbus Seizes The Middle Market and First Place; Covid-19 Accelerates shift to Middle Market
Deliveries in 2021 $Billions
140
120
100
80
60
40
20
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
Boeing
Airbus ex 321neo
A321neo
COMAC/Irkut
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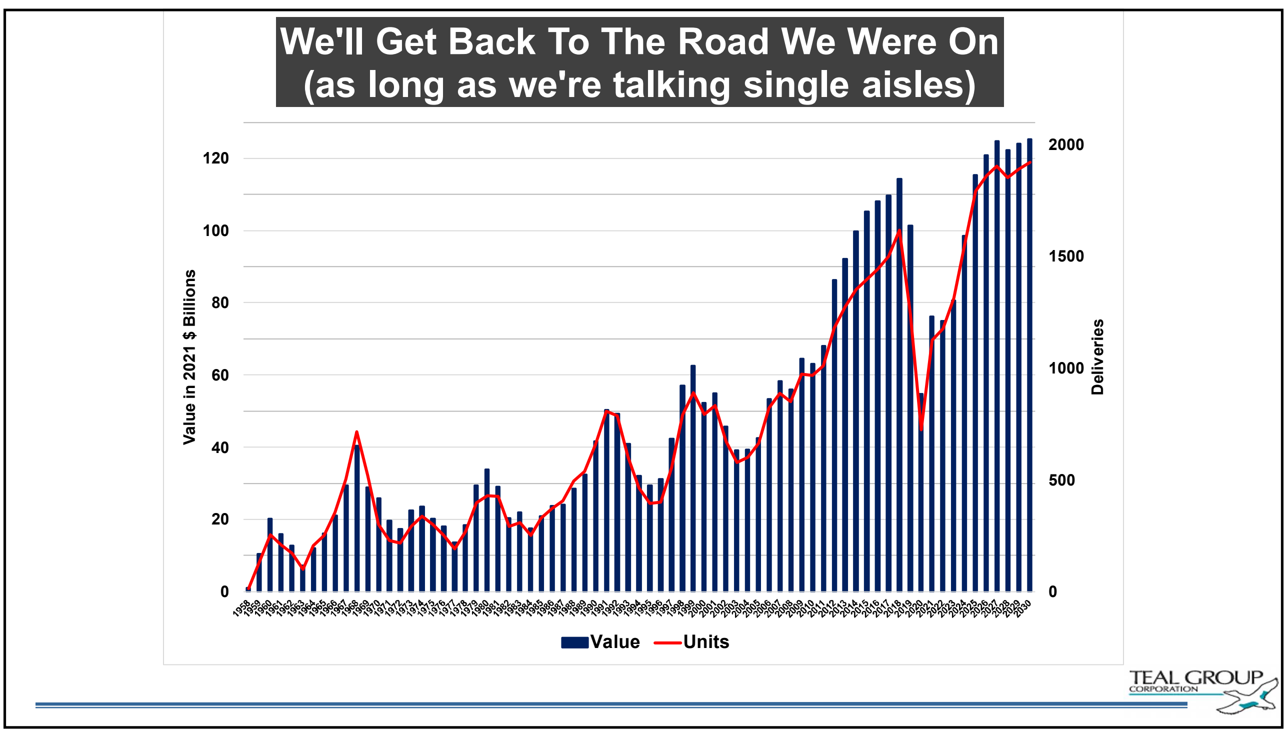
We'll Get Back To The Road We Were On
(as long as we're talking single aisles)
Value in 2021 $ Billions
120
100
80
60
40
20
0
Deliveries
2000
1500
1000
500
0
Value
Units
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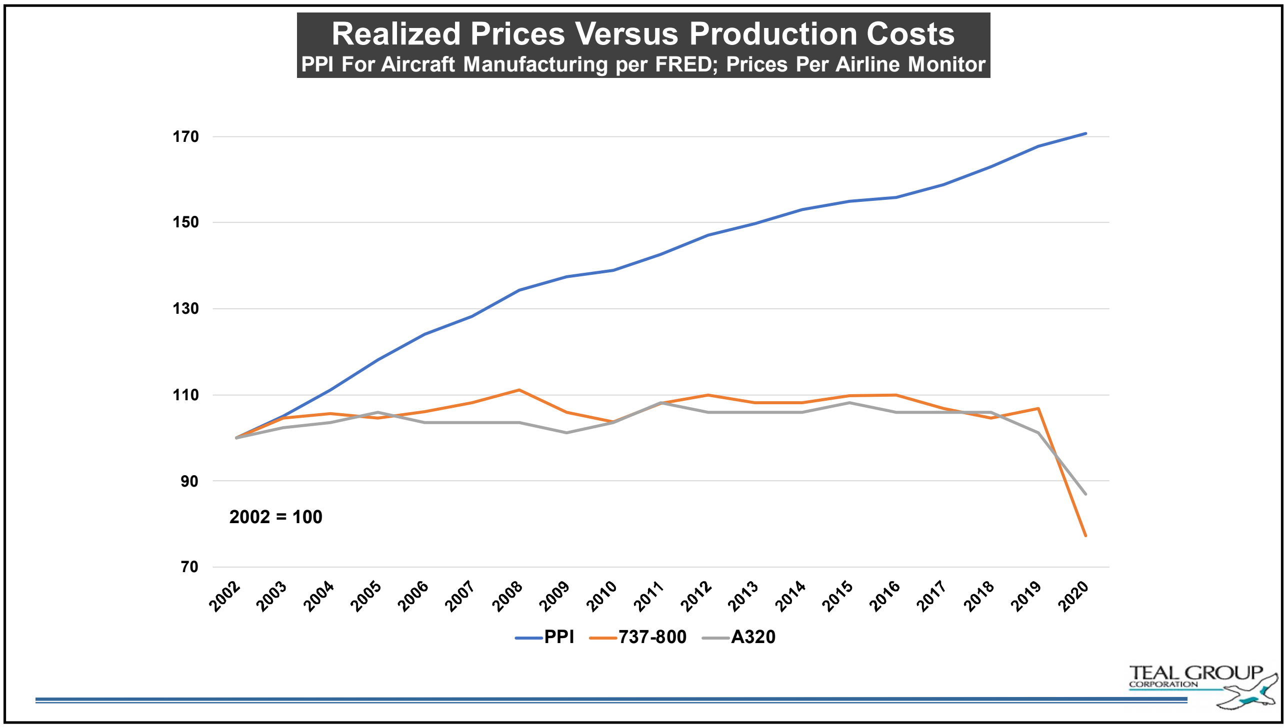
18


Realized Prices Versus Production Costs
PPI For Aircraft Manufacturing per FRED; Prices Per Airline Monitor
170
150
130
110
90
70
2002 = 100
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
PPI
737-800
A320
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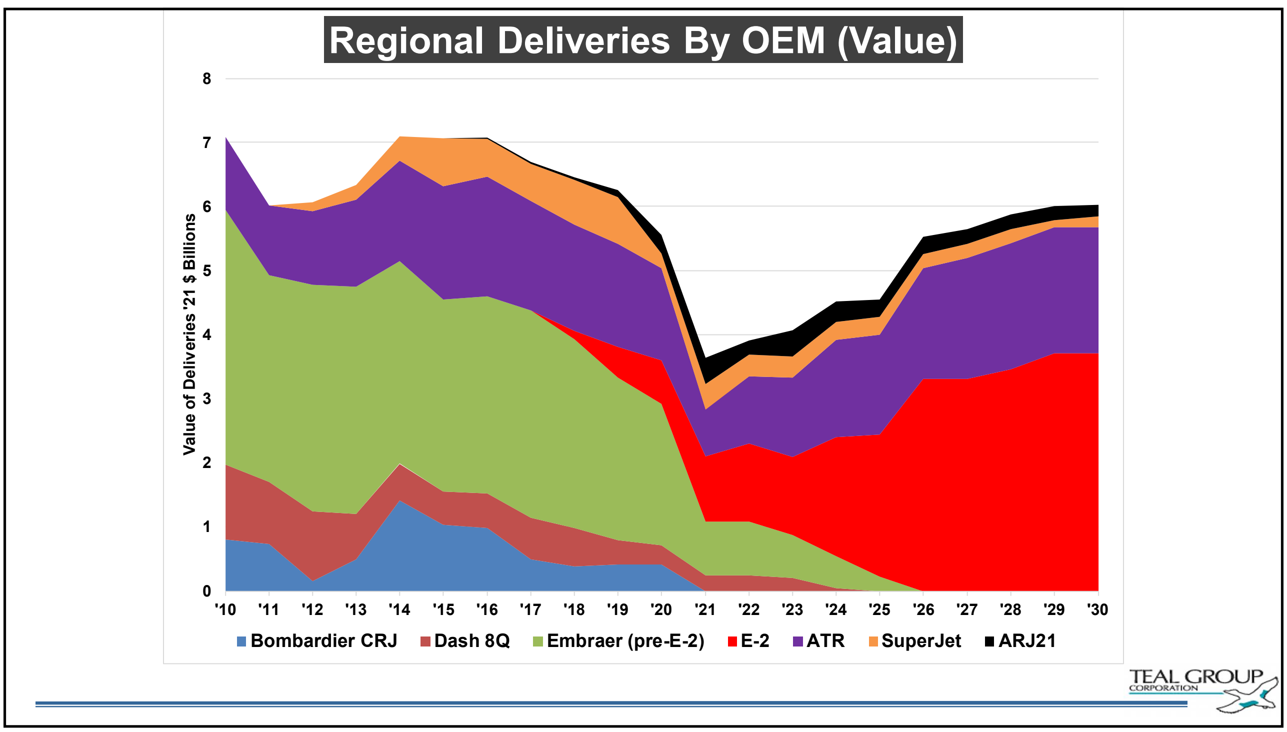
Regional Deliveries By OEM (Value)
Value of Deliveries '21 $ Billions
8
7
6
5
4
3
2
1
0
'10
'11
'12
'13
'14
'15
'16
'17
'18
'19
'20
'21
'22
'23
'24
'25
'26
'27
'28
'29
'30
Bombardier CRJ
Dash 8Q
Embraer (pre-E-2)
E-2
ATR
SuperJet
ARJ21
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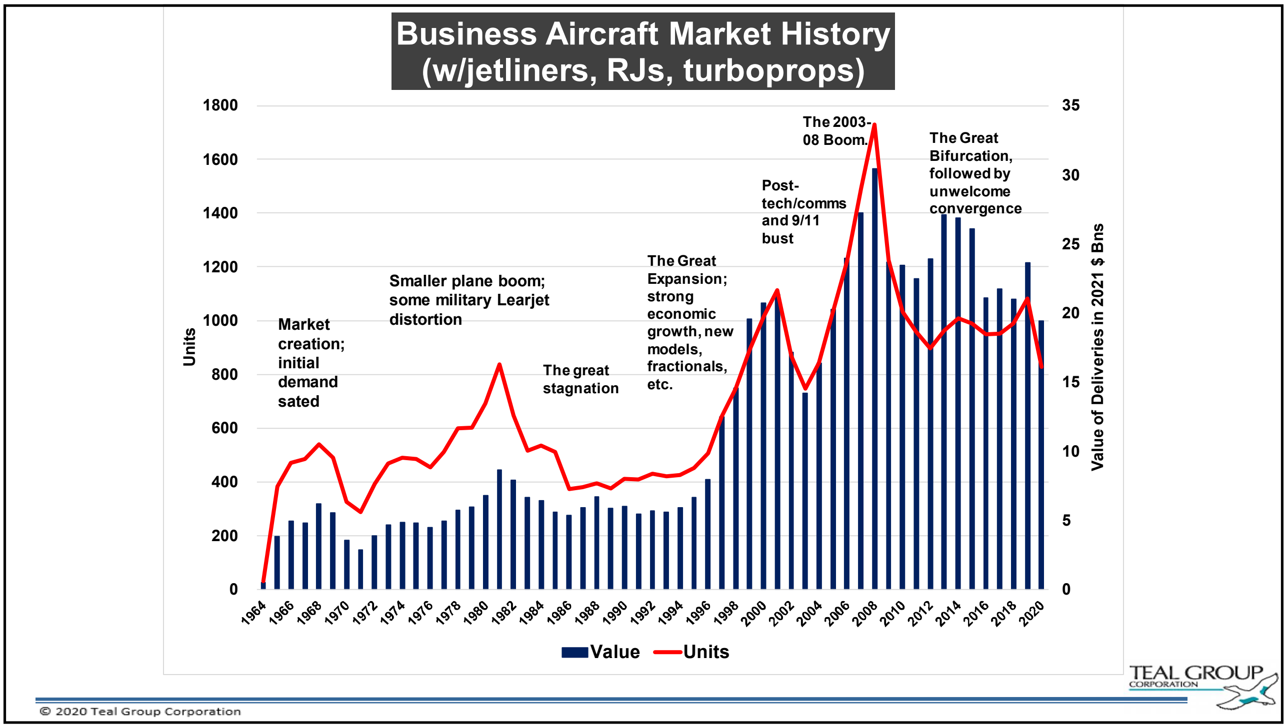
20


Business Aircraft Market History (w/jetliners, RJs, turboprops)
Units
Value of Deliveries in 2021 $ Bns
Market creation; initial demand sated
Smaller plane boom; some military Learjet distortion
The great stagnation
The Great Expansion; strong economic growth, new models, fractionals, etc.
Post-tech/comms and 9/11 bust
The 2003-08 Boom.
The Great Bifurcation, followed by unwelcome convergence
Value
Units
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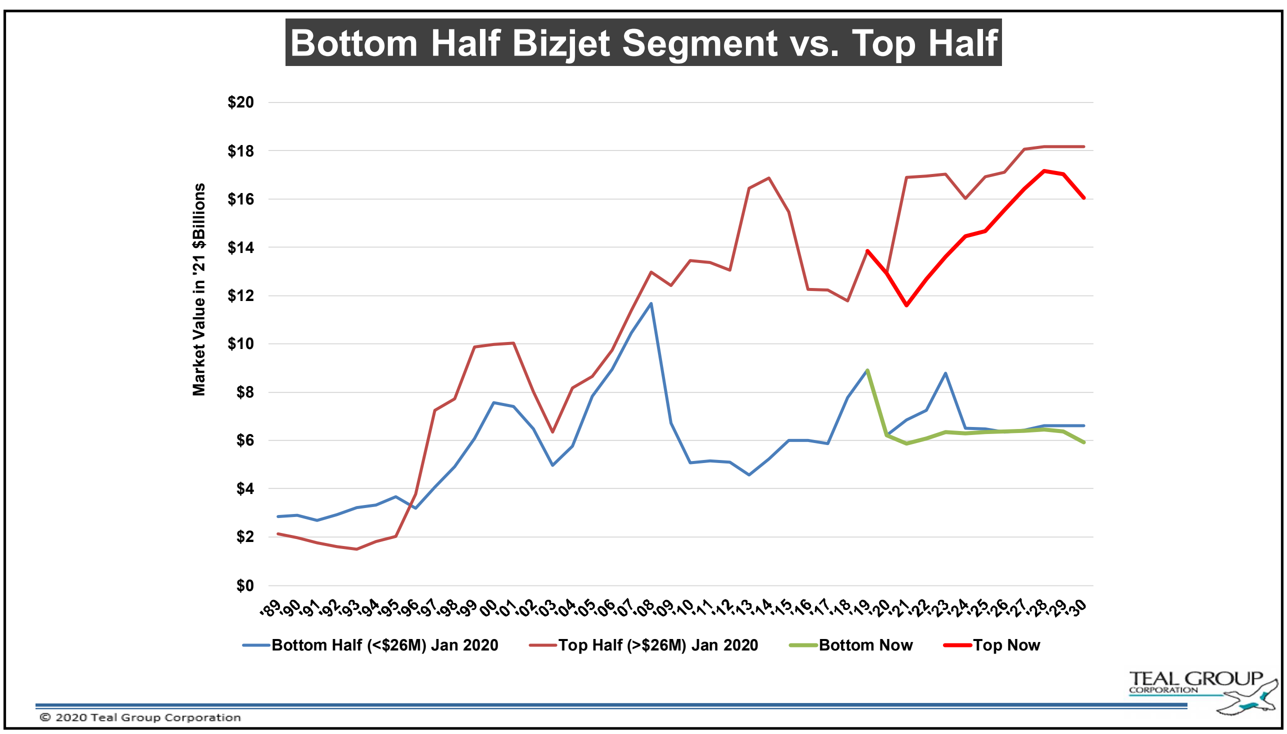
Bottom Half Bizjet Segment vs. Top Half
Market Value in '21 $Billions
Bottom Half (<$26M) Jan 2020
Top Half (>$26M) Jan 2020
Bottom Now
Top Now
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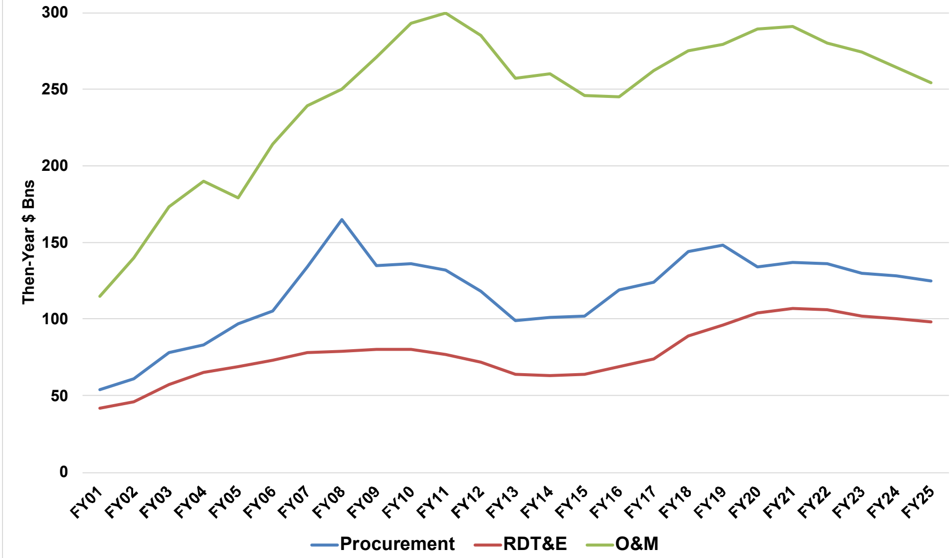
DoD Investment: Much Better Than In The Last Jetliner Downturn



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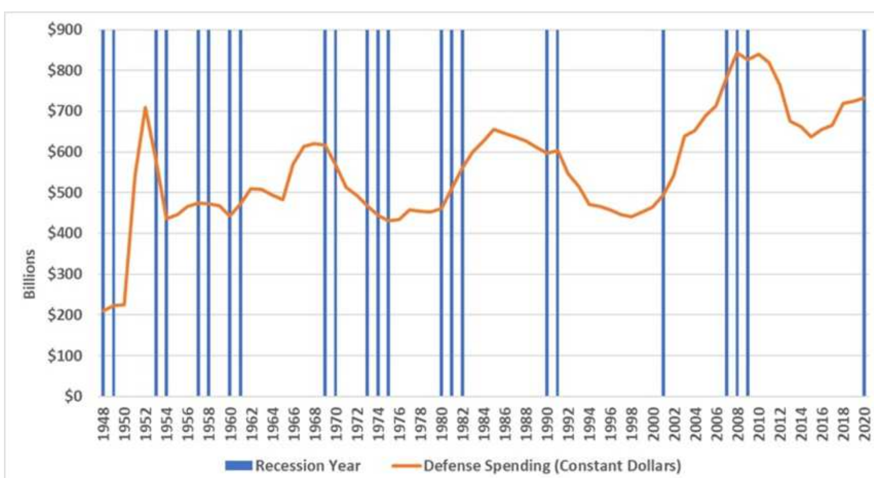
No Clear Relationship Between US Defense Spending, Economy



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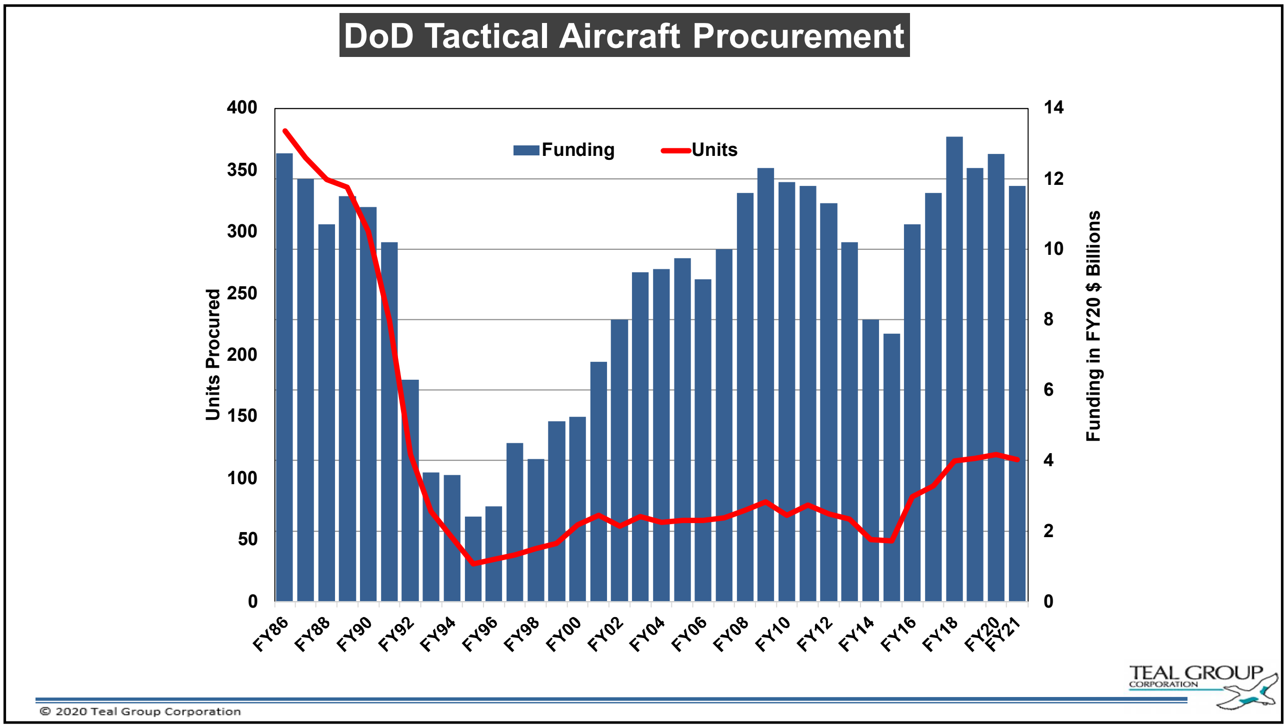
DoD Tactical Aircraft Procurement
Funding
Units
Units Procured
Funding in FY20 $ Billions
400
350
300
250
200
150
100
50
0
14
12
10
8
6
4
2
0
FY86 FY88 FY90 FY92 FY94 FY96 FY98 FY00 FY02 FY04 FY06 FY08 FY10 FY12 FY14 FY16 FY18 FY20 FY21
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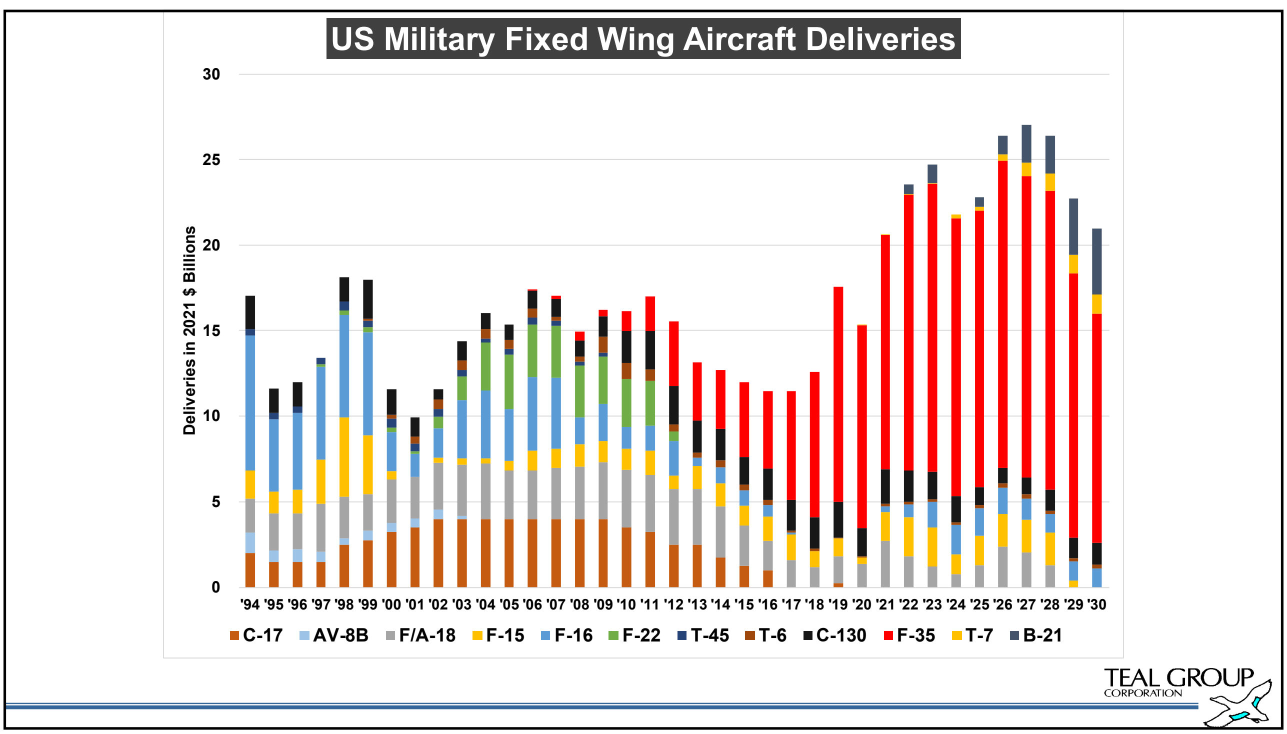
US Military Fixed Wing Aircraft Deliveries
Deliveries in 2021 $ Billions
30
25
20
15
10
5
0
'94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14 '15 '16 '17 '18 '19 '20 '21 '22 '23 '24 '25 '26 '27 '28 '29 '30
C-17 AV-8B F/A-18 F-15 F-16 F-22 T-45 T-6 C-130 F-35 T-7 B-21
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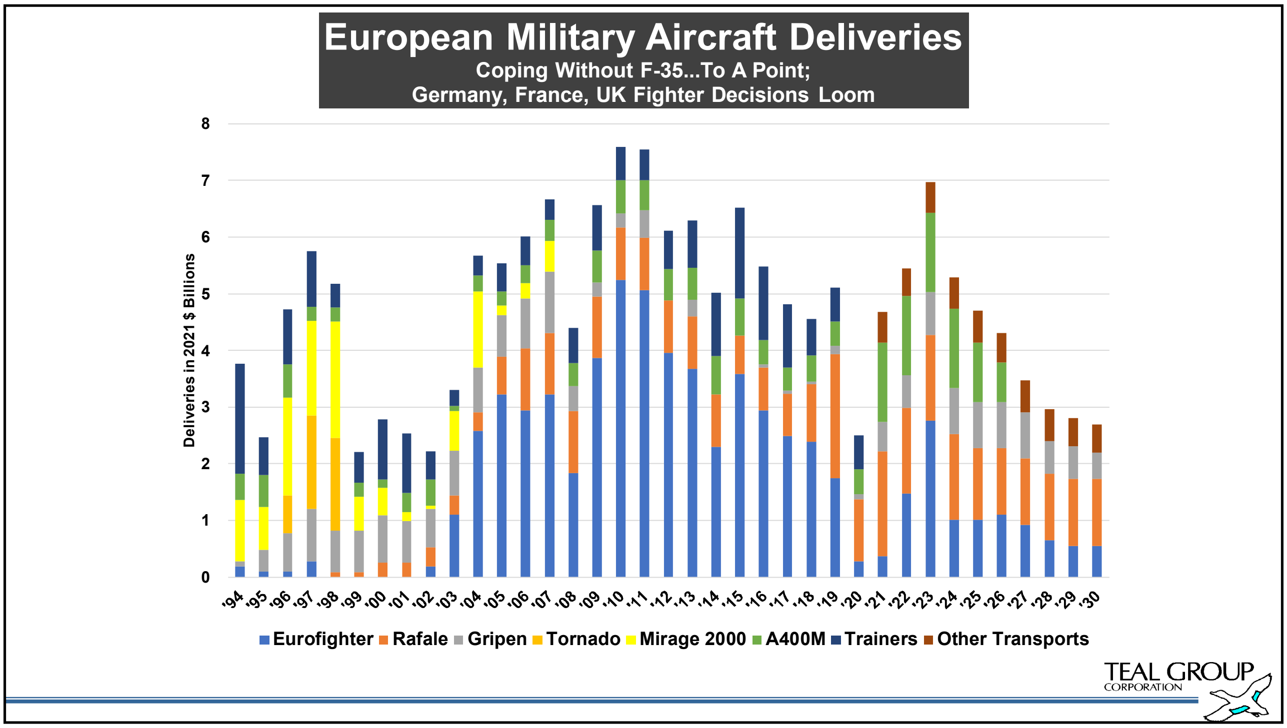
European Military Aircraft Deliveries
Coping Without F-35...To A Point;
Germany, France, UK Fighter Decisions Loom
Deliveries in 2021 $ Billions
0
1
2
3
4
5
6
7
8
'94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14 '15 '16 '17 '18 '19 '20 '21 '22 '23 '24 '25 '26 '27 '28 '29 '30
Eurofighter
Rafale
Gripen
Tornado
Mirage 2000
A400M
Trainers
Other Transports
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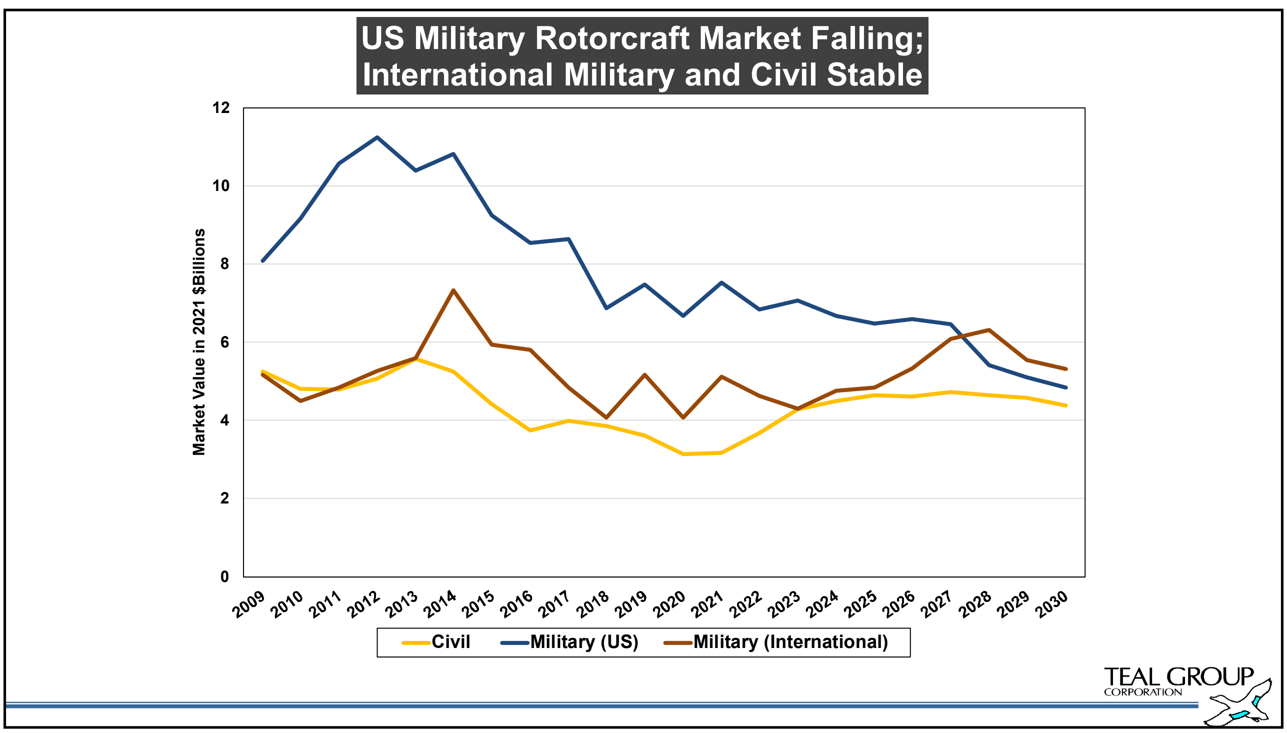
US Military Rotorcraft Market Falling;
International Military and Civil Stable
Market Value in 2021 $Billions
0
2
4
6
8
10
12
2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030
Civil
Military (US)
Military (International)
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Global Aircraft Market Outlook In One Page

(Deliveries, *not* Production)

Segment	2021	'21-'22	Risk	Elevator Comment
Jetliners-SA	51.2%	24.4%		Includes some already-built MAXs. Watch China, fuel, traffic.
Jetliners-TA	5.2%	-11.9%		Overcapacity, slow international recovery, secular shift to SAs; 787 inventory issue
Regionals	14.0%	-0.9%		No Boeing supply chain effect on E-2; Scope clause de-risked, but little growth.
Business Aircraft	-7.5%	7.6%		Another hit after many false starts over a disappointing decade.
Civil Rotorcraft	-0.9%	14.2%		Large civil hit again. Too many new models aimed at a weak segment (oil/gas).
Military Rotorcraft	0.5%	3.7%		Programs end/slow; no risk of accelerated downturn; FVL beyond forecast, exc FARA.
Military Transports	-2.8%	-1.8%		A seriously underperforming market.
Fighters	28.5%	19.4%		I like this market. F-35 (after COVID disruption), plus strong Gen 4.5
All Civil	17.3%	8.8%		SAJetliner snapback due to MAX, weakness in other segments; more overcapacity risk.
All Military	14.4%	12.3%		Global insecurity, Tension, Malice. Special mission (ISR, B-21) also boosts topline.
Total Industry	16.4%	9.9%		Back to peak in 2024

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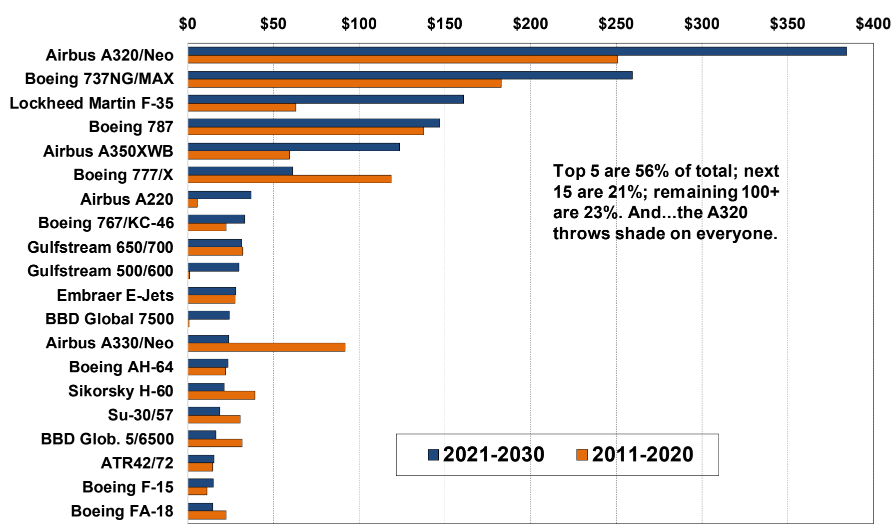
Top 20 Aviation Programs; Volume Matters

Cumulative Deliveries Value in '21 $ Bns



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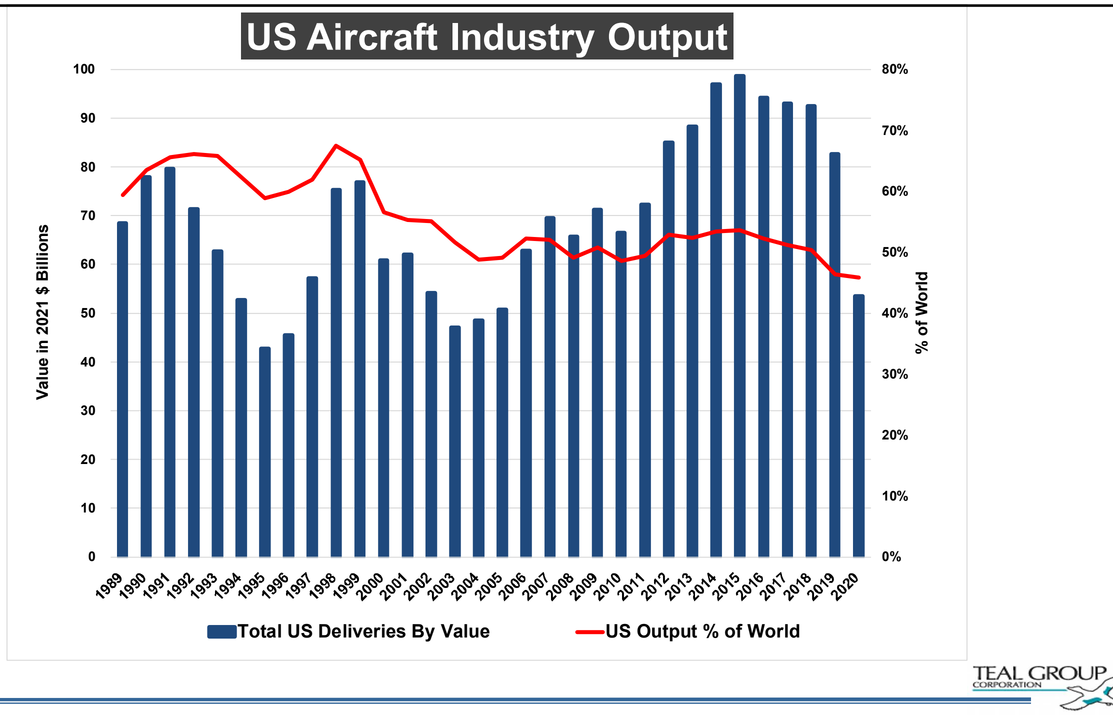

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Covid-19 Impact: Nothing New; Just An Acceleration of Pre-existing Trends

- Societal: growing inequality, growth of e-commerce over stores, movie theaters decline, normalization of formerly fringe beliefs, rising ill-liberal "democracies."
- Macroeconomic: lower interest rates, excess savings, few investment opportunities, cheaper fuel, China de-coupling.
- Industry:
  - More point-to-point international routes (fragmentation); related demand for smaller, mid-range jets.
  - End of quadjets, marginalization of all larger jets.
  - Growing reliance on third party jetliner finance.
  - Jetliner price deflation.
  - Supplier rationalization, particularly 3/4th tier.
  - New product funding drought.
  - China indigenous substitute product development
  - Boeing single aisle breadth concerns; Airbus mid-market dominance.
  - Rolls-Royce under pressure.
  - OEMs and airlines: strong get stronger, weak get weaker.
  - Uncertain search for various alternative propulsion/fuel concepts.
- K-patterns everywhere: Domestic/int'l traffic, single aisles/twins, developed/emerging, bizav/scheduled, etc.

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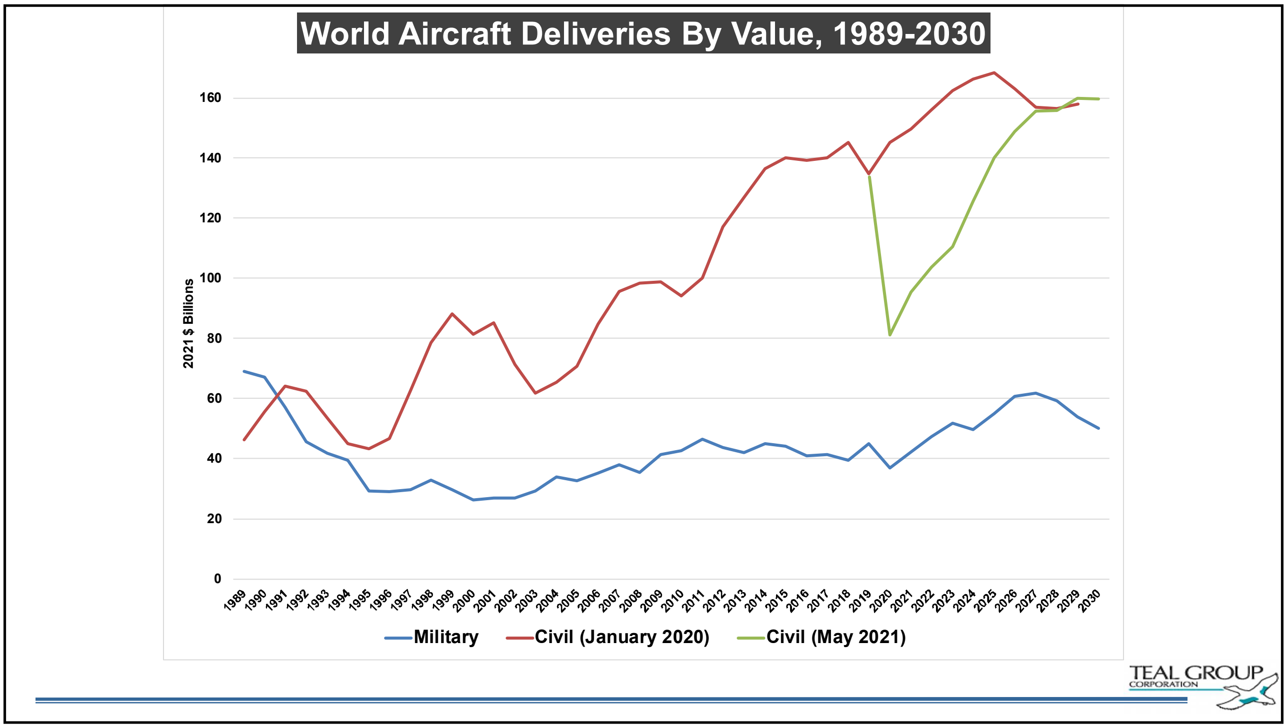
World Aircraft Deliveries By Value, 1989-2030
2021 $ Billions
160
140
120
100
80
60
40
20
0
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030
Military
Civil (January 2020)
Civil (May 2021)
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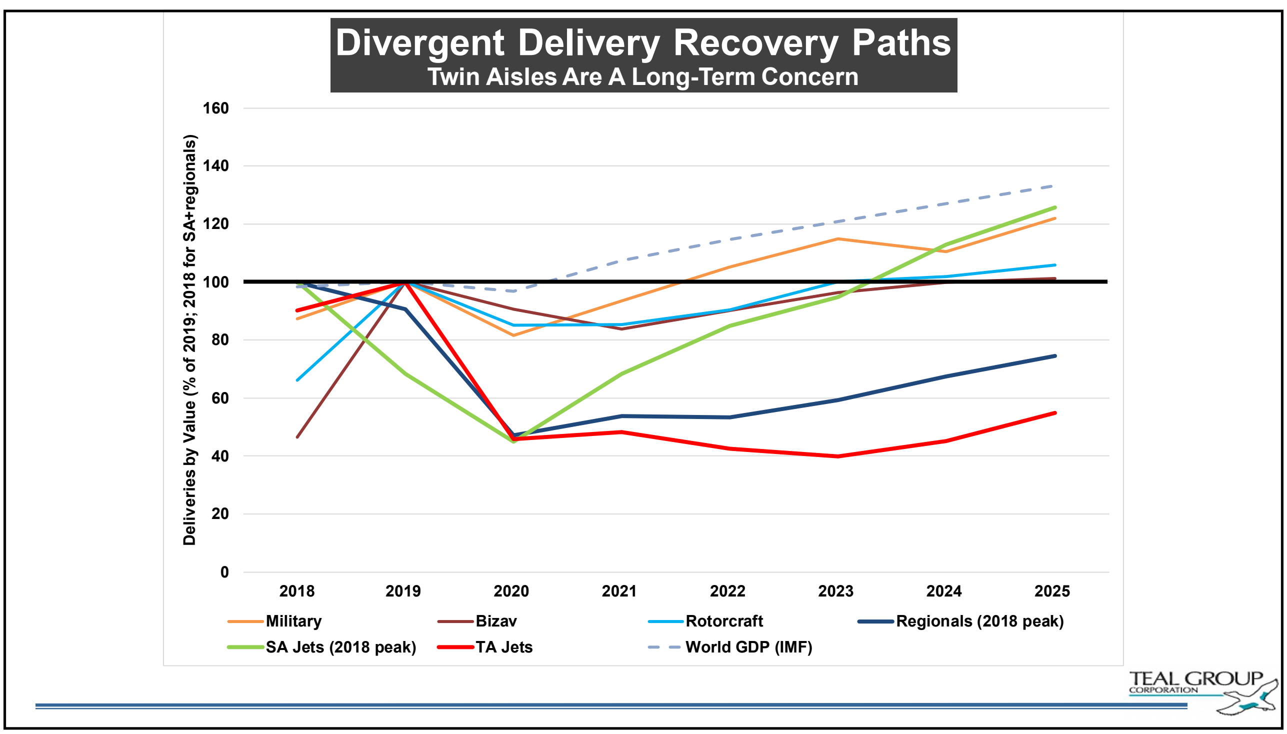
Divergent Delivery Recovery Paths
Twin Aisles Are A Long-Term Concern
Deliveries by Value (% of 2019; 2018 for SA+regionals)
160
140
120
100
80
60
40
20
0
2018 2019 2020 2021 2022 2023 2024 2025
Military
Bizav
Rotorcraft
Regionals (2018 peak)
SA Jets (2018 peak)
TA Jets
World GDP (IMF)
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Q&A

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Upcoming Chapter Webinars/Meetings

Webinars start at 8:00am Pacific Time unless otherwise stated.

- July 15: **"The Future of the Wide-Body";** Jens Flottau, Executive Editor, Commercial Aviation, Aviation Week | Santa Clarita Valley & San Fernando Valley Chapters
- August 26: Leon Alkalai, Co-Founder, Verrix, Founder/CEO, AstroLabs, Former JPL Tech Fellow | Ventura County Chapter
- September 23: **"A Business Health Assessment – Whether Exiting or Not"**; Larry O'Toole, Founder, Yosemite Associates | Los Angeles Chapter

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The Aerospace & Defense Forum

- Individual Membership is $350/year and provides free attendance at all A&D Forum meetings and webinars. Membership is free for those not located near one of the eight operating chapters.
- Recordings of over 250 chapter and webinar presentations are available for download by A&D Forum members.
- You can join the mailing list of any chapter for free, which will also provide you the monthly A&D Forum Newsletter.
- Opportunities to sponsor chapters or webinars are available.

For more info:
https://aerospacedefenseforum.org/

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Thank You

“Defense and Aviation Markets: Navigating the Covid Aftermath”

June 11, 2021

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