

03 March 2022

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A view from Wall Street

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GDP and Inflation

GDP Growth (%)	2020	2021	2022E	2023E
Global	-3.1%	6.0%	4.3%	3.4%
US	-3.4%	5.7%	3.6%	2.0%
China	2.2%	8.1%	4.8%	4.8%
Emerging EMEA	-2.1%	5.3%	3.5%	3.3%
Latin America	-6.9%	6.7%	1.9%	2.3%
European Union	-6.0%	5.2%	3.6%	2.5%

CPI inflation (%)	2020	2021	2022E	2023E
Global	2.6%	4.0%	5.9%	3.6%
US	1.2%	4.7%	6.3%	3.1%
China	2.5%	0.9%	1.8%	1.7%
Emerging EMEA	5.5%	8.5%	15.8%	8.4%
Latin America	7.3%	10.8%	11.2%	8.3%
European Union	0.7%	2.9%	4.8%	1.9%

Short-term interest rates, %

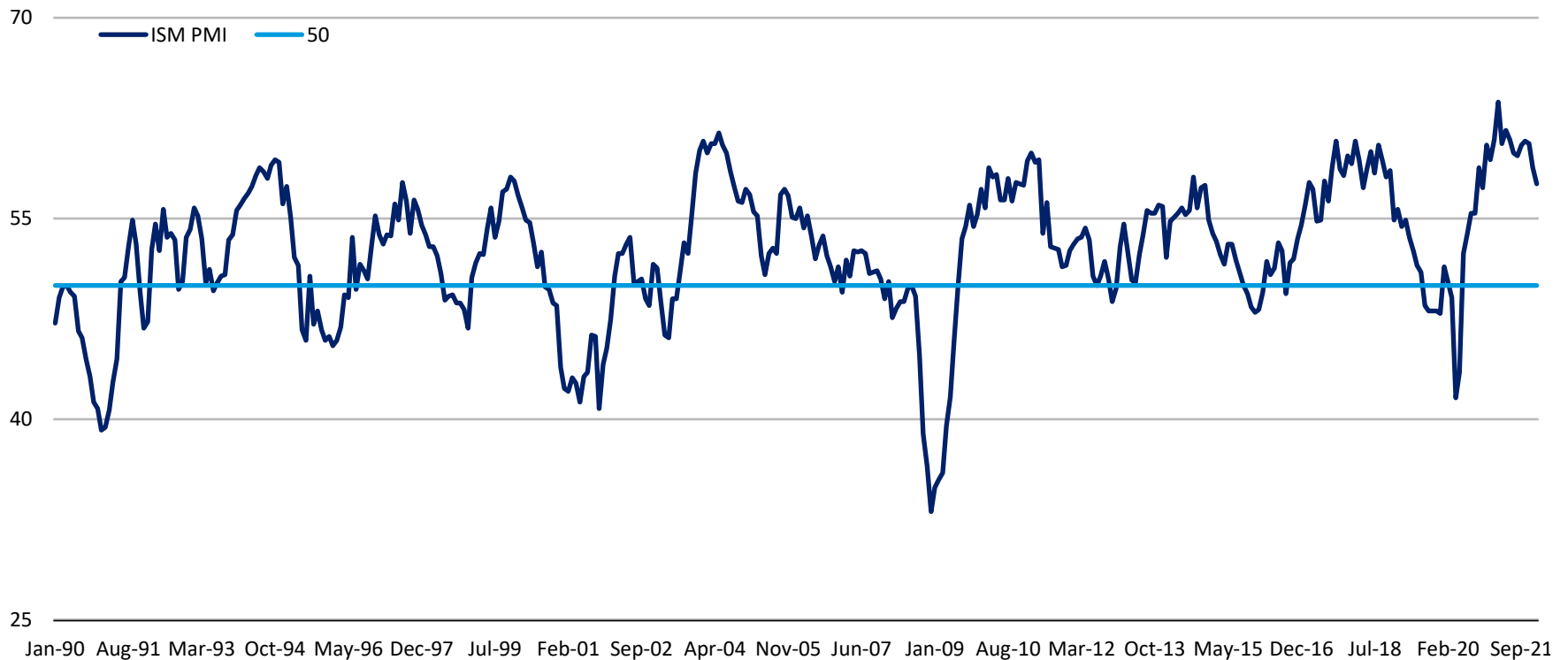
ST int rates (%)	Current	2020	2021	2022E	2023E
Global	2.85%	2.21%	2.62%	3.37%	3.60%
US	0.13%	0.13%	0.13%	1.88%	2.88%
China	4.35%	3.85%	3.80%	3.60%	3.60%
Emerging EMEA	7.51%	6.05%	7.13%	7.66%	7.34%
Latin America	7.56%	2.59%	6.51%	9.28%	8.32%
European Union	0.01%	-0.35%	-0.12%	0.65%	0.58%

ISM Purchasing Managers Index (PMI)



The Institute of Supply Management (ISM) surveys purchasing and supply executives nationwide to gauge sentiment regarding US manufacturing industries.

Greater than 50 indicates expansion, 50 indicates no change, and less than 50 indicates contraction.

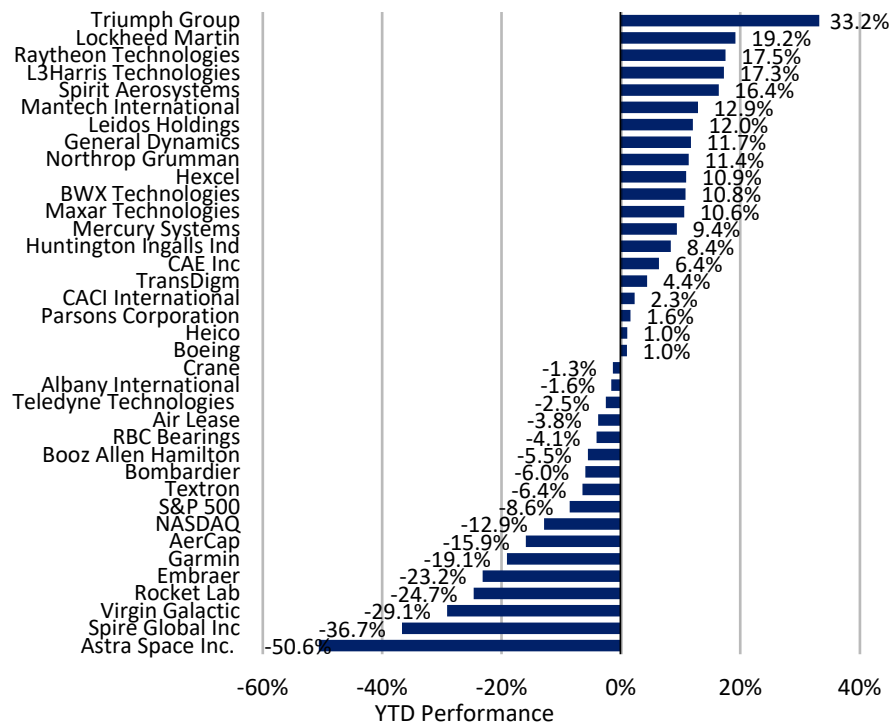


Best & worst performers 2022 YTD vs. 2021

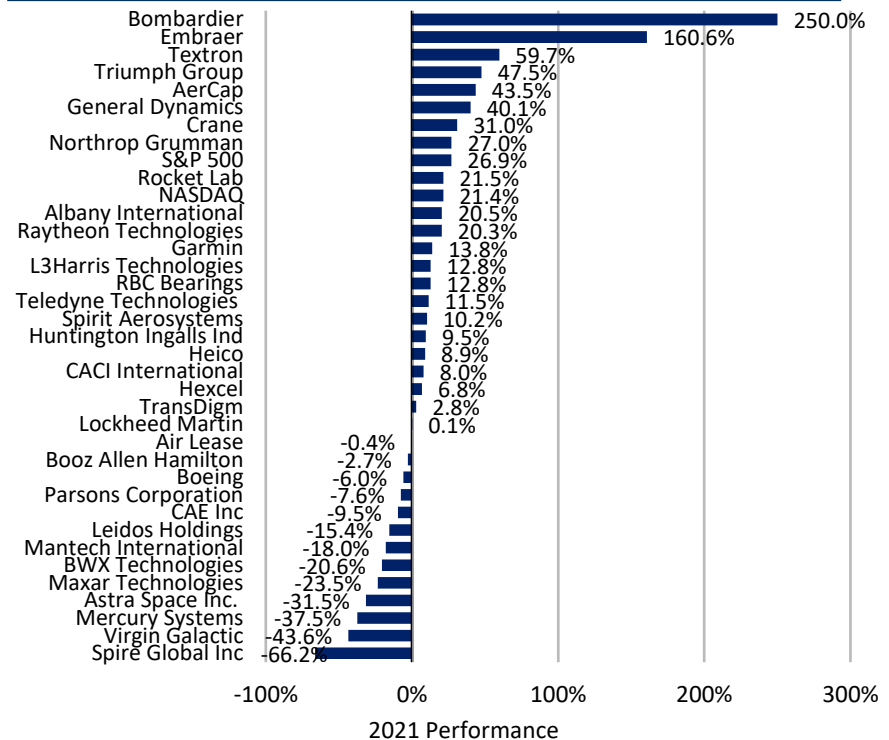


- Best performers YTD: TDG, LMT, RTX
 - 2021: BBD, ERJ, TXT
- Worst performers YTD: ASTR, SPIR, SPCE
 - 2021: SPIR, SPCE, MRCY

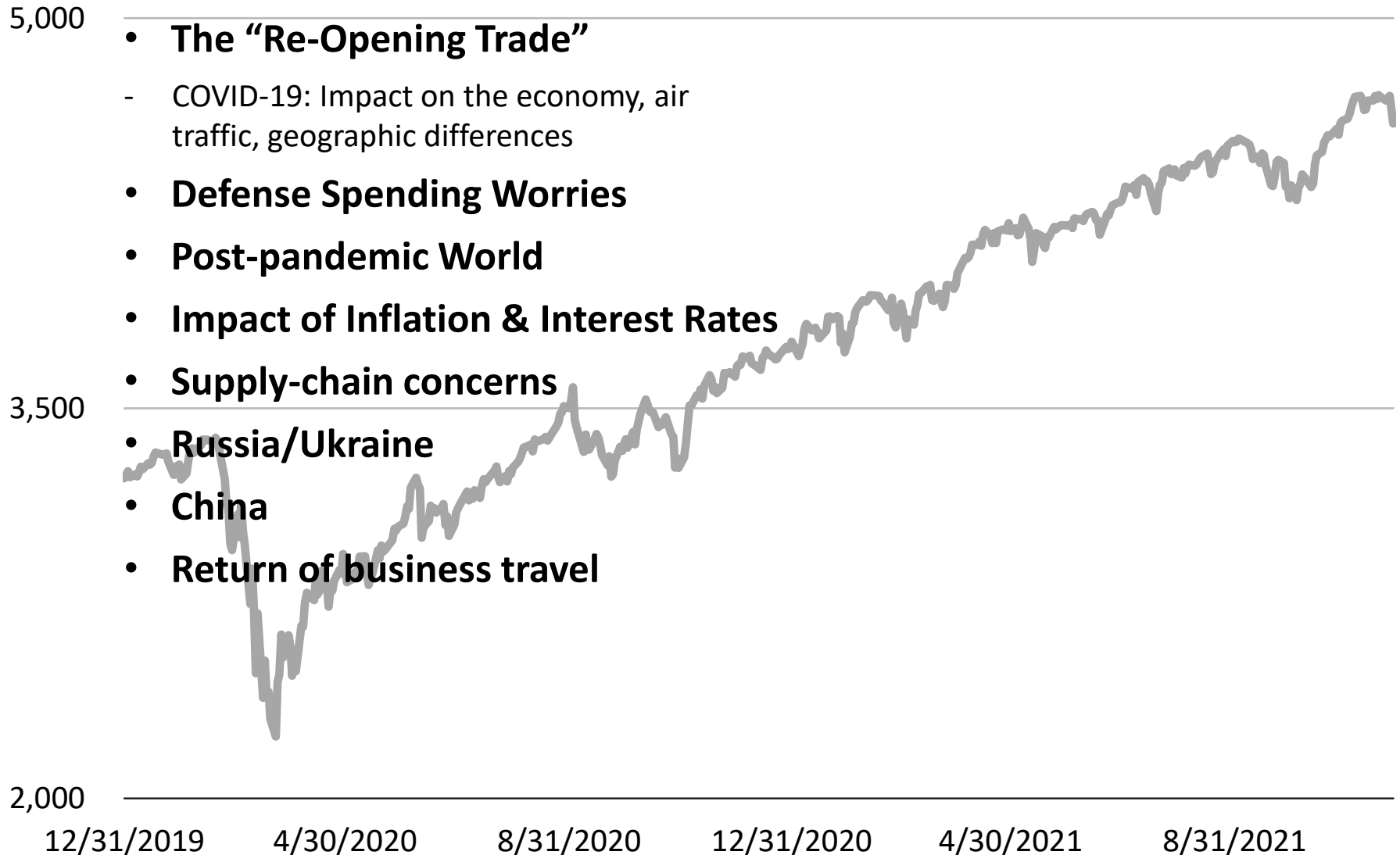
YTD (as of 28 February 2022)



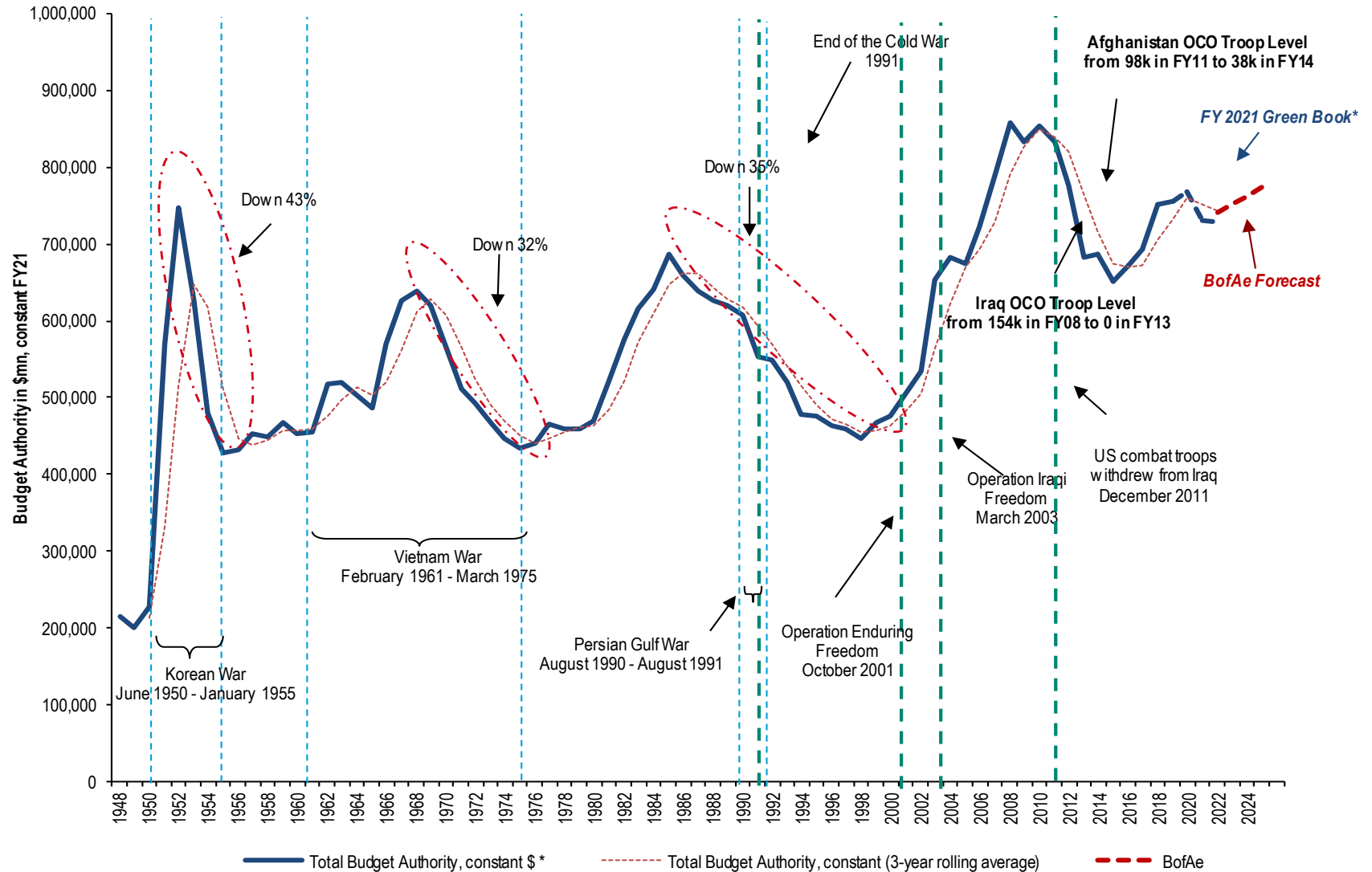
2021



What's on Investors' Minds?



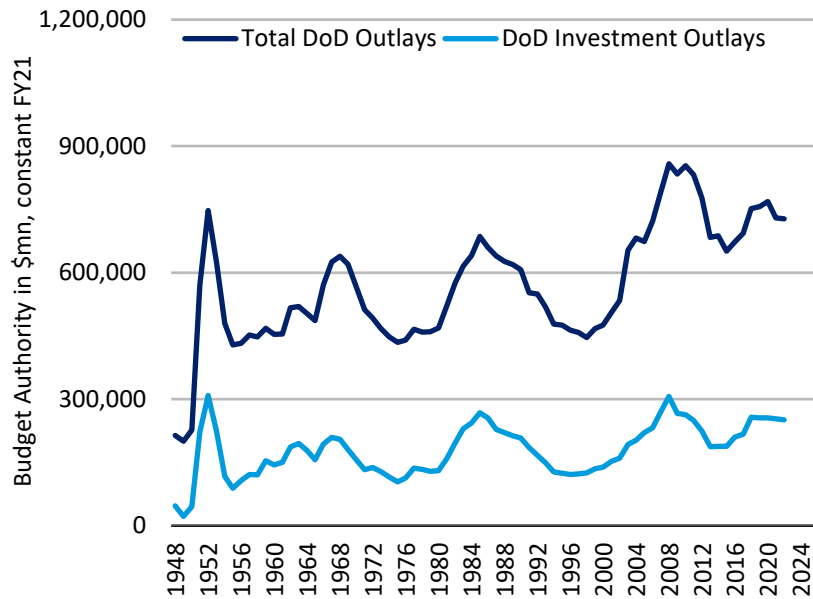
Defense budget



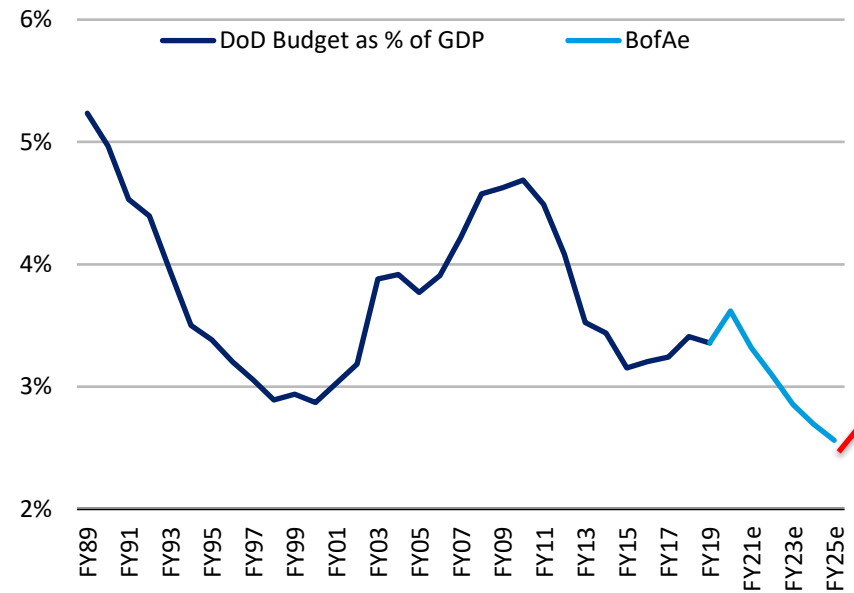
Defense budget



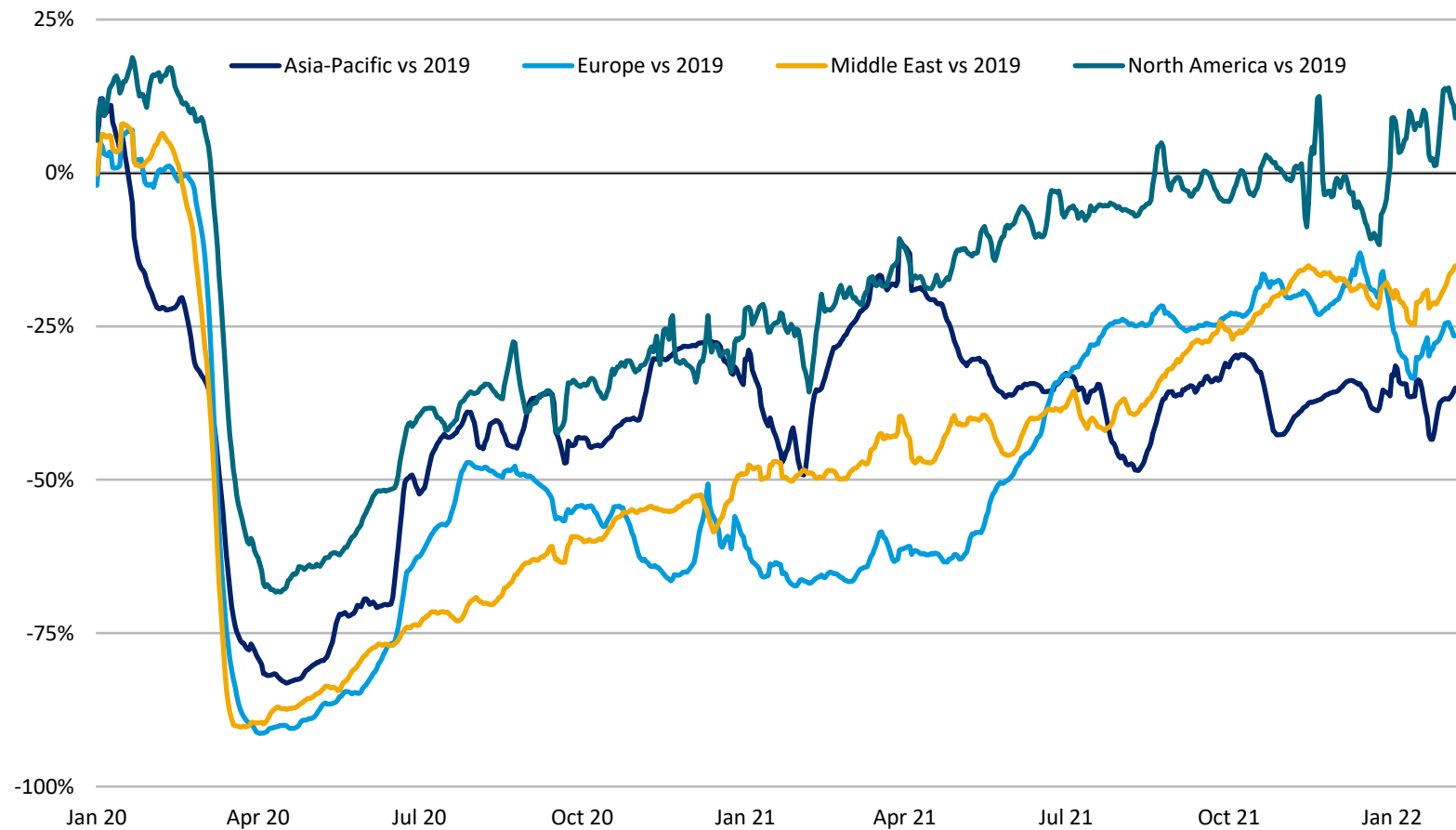
DoD Outlays vs. Investment Outlays



DoD Budget as % of GDP



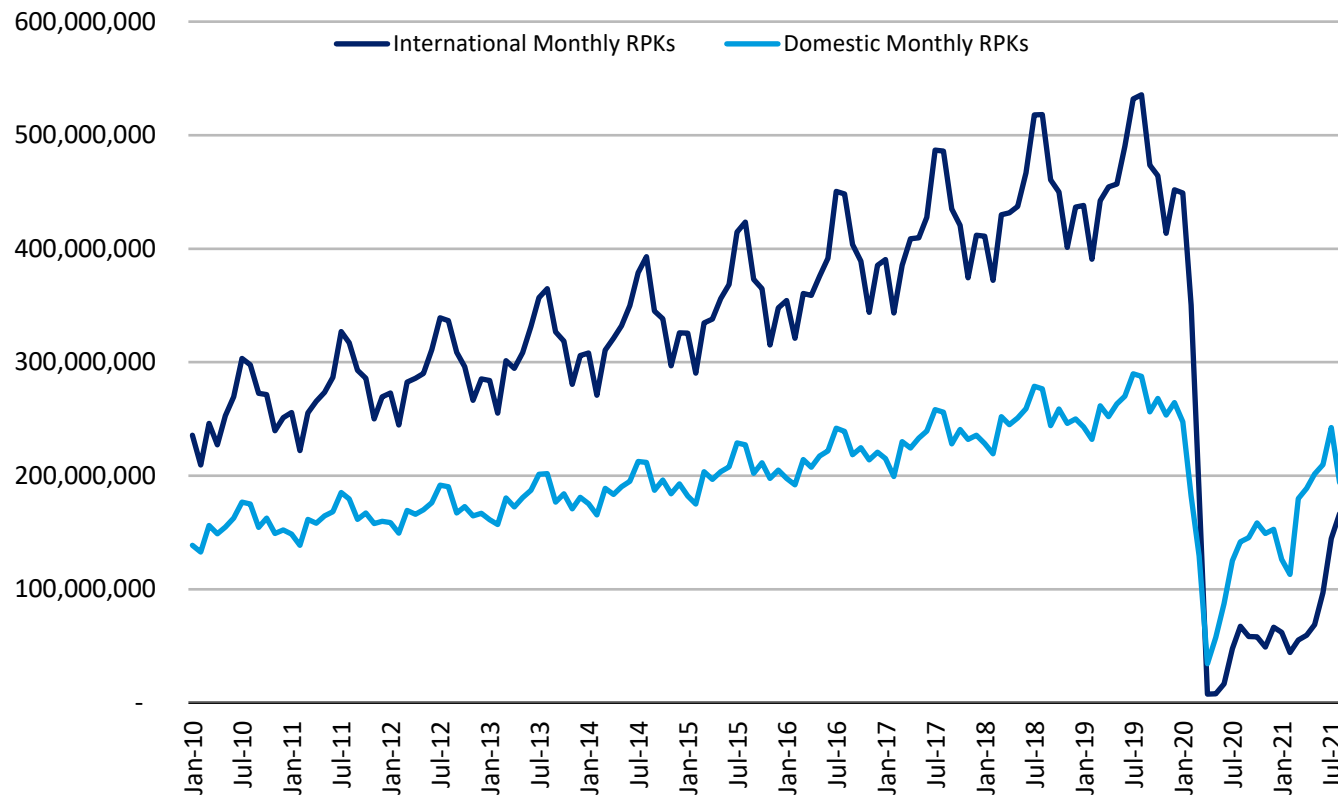
Global commercial flights daily tracked 7 day avg. vs. 2019



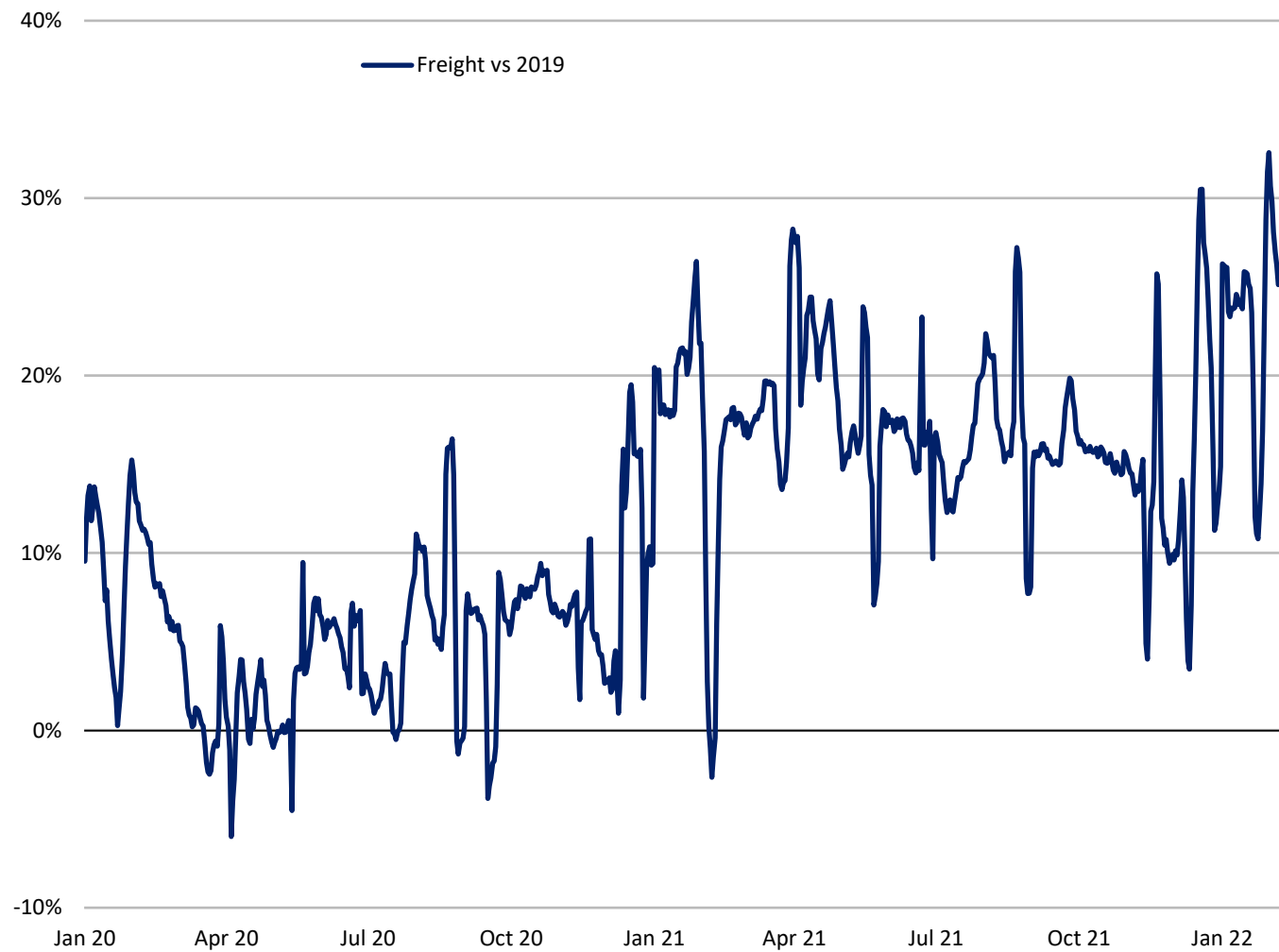
Domestic market has been recovering faster than international



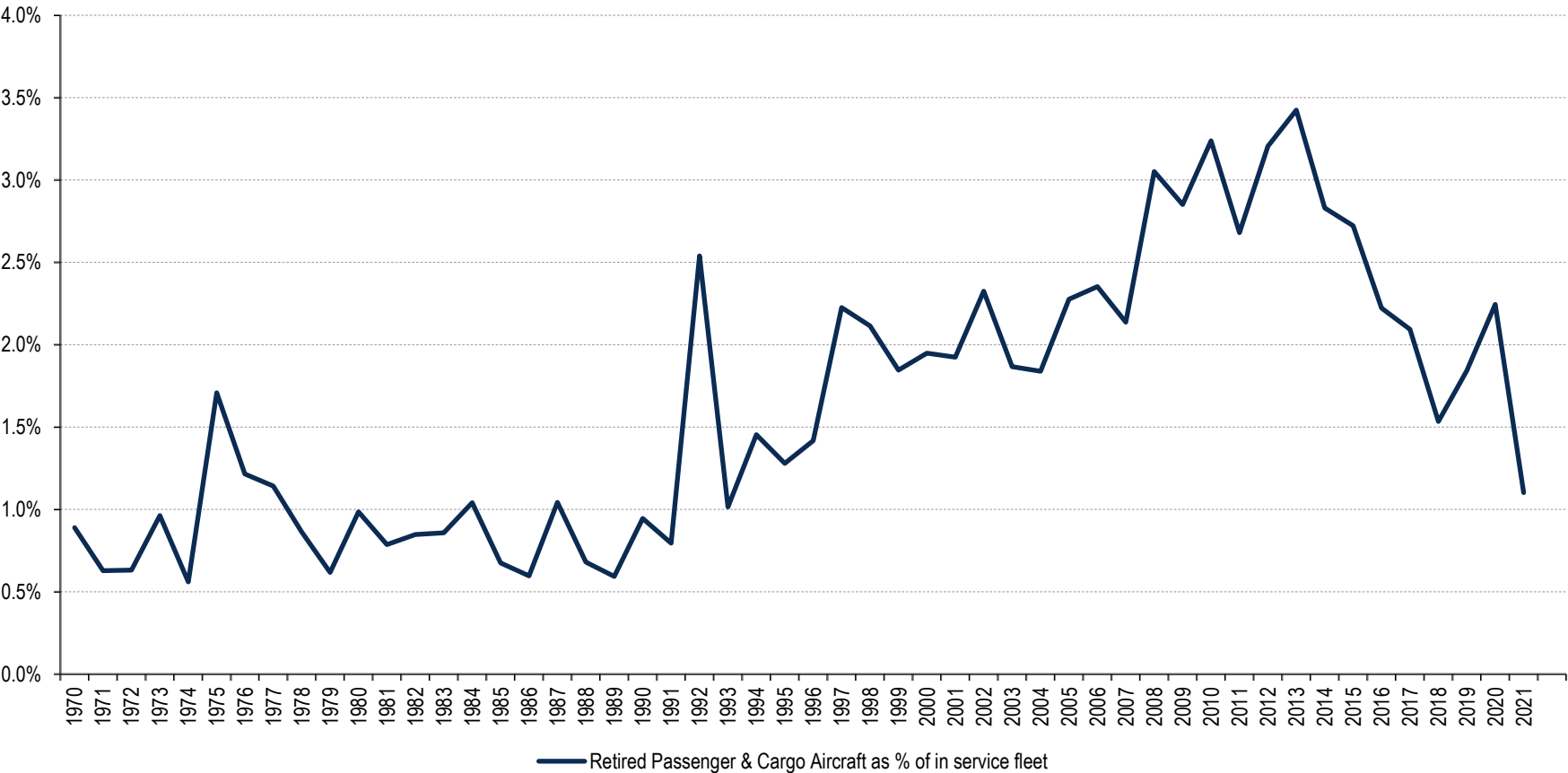
- January 2022 domestic RPKs were 26% below January 2019, while International RPKs were still 62% below 2019 levels
- US domestic market RPKs are still 18% below January 2019 levels, while Russia is up 33% vs. 2019



Global Dedicated Freighter Flights Tracked 7 day avg. y/y %



Retirements



Thoughts on the commercial aerospace aftermarket

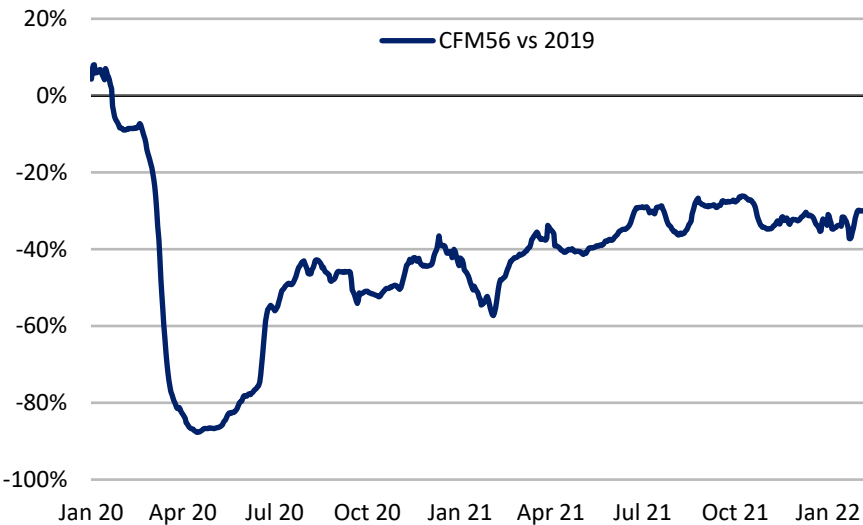


- IATA sees 2021e and 2022e RPKs 60% and 39% below 2019 levels, respectively
- Experts estimate that every 1% loss of aircraft utilization implies ~1.5-2% loss of aftermarket
- More significant impact to widebody vs. narrowbody
- Early retirements = excess of spare parts
- At the height of the pandemic (mid-April 2020), the parked competitive fleet was over 60% of the total fleet
- As of 14 October 2021, the parked competitive fleet was ~20% of the total fleet
- Engine maintenance costs are expensive (about \$4mn for a narrowbody engine overhaul)
- Some airlines are swapping out engines on unused aircraft (that have remaining "green time") with engines on flying aircraft that require maintenance

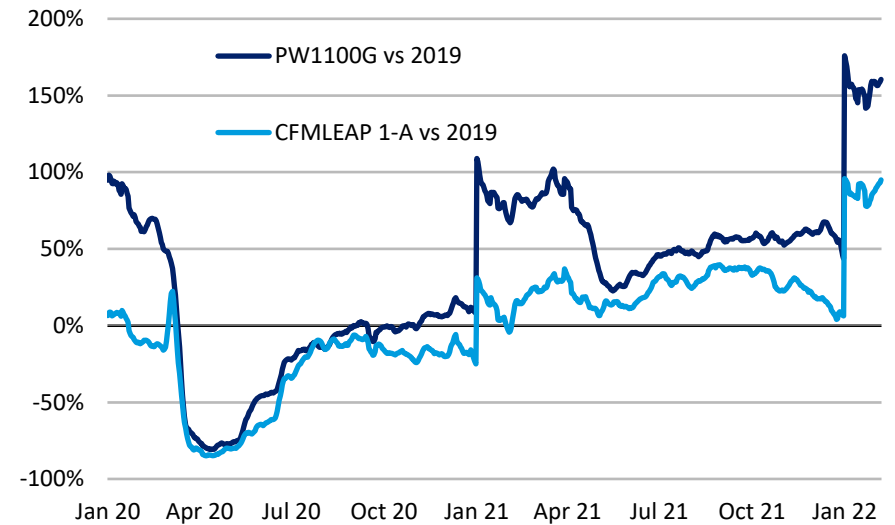
Engine Cycles



CFM56 family 7 day avg. daily flights tracked y/y %



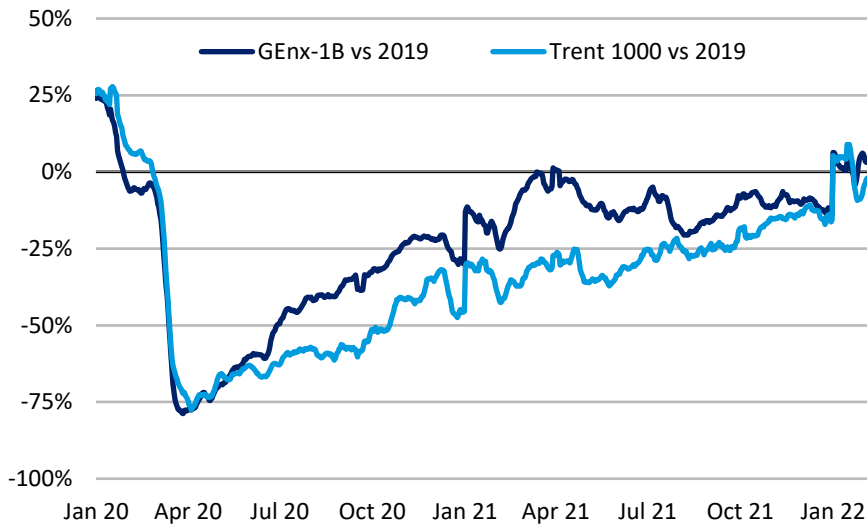
A320neo CFM LEAP vs. P&W GTF 7 day avg. daily flights tracked y/y %



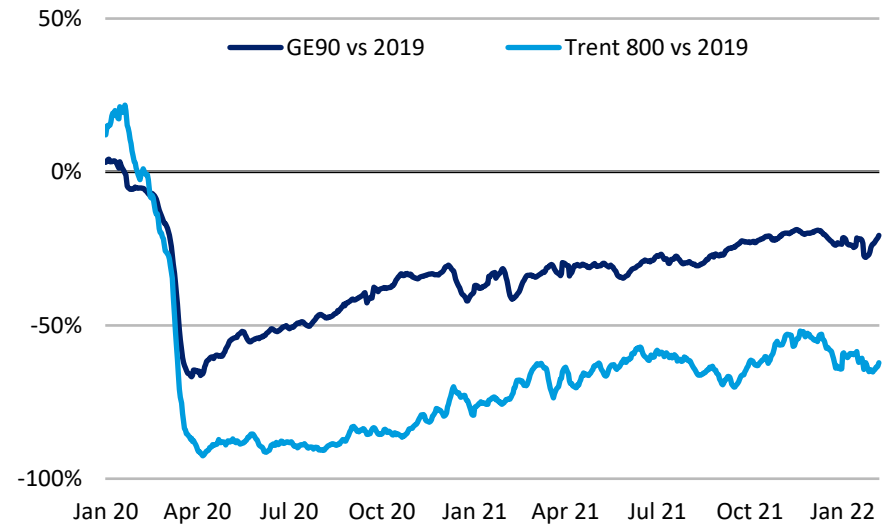
Engine Cycles - Widebodies



787: GENX vs. Trent 1000 7 day avg. daily flights tracked y/y %



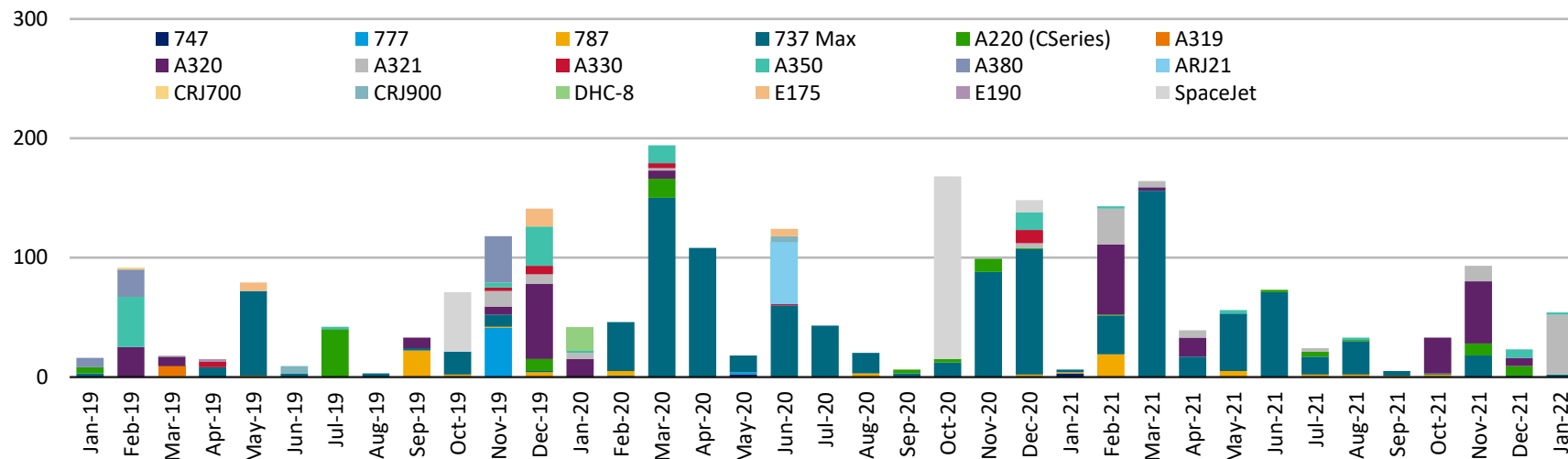
777: GE90 vs. Trent 800 7 day avg. daily flights tracked y/y %



Aircraft cancellations

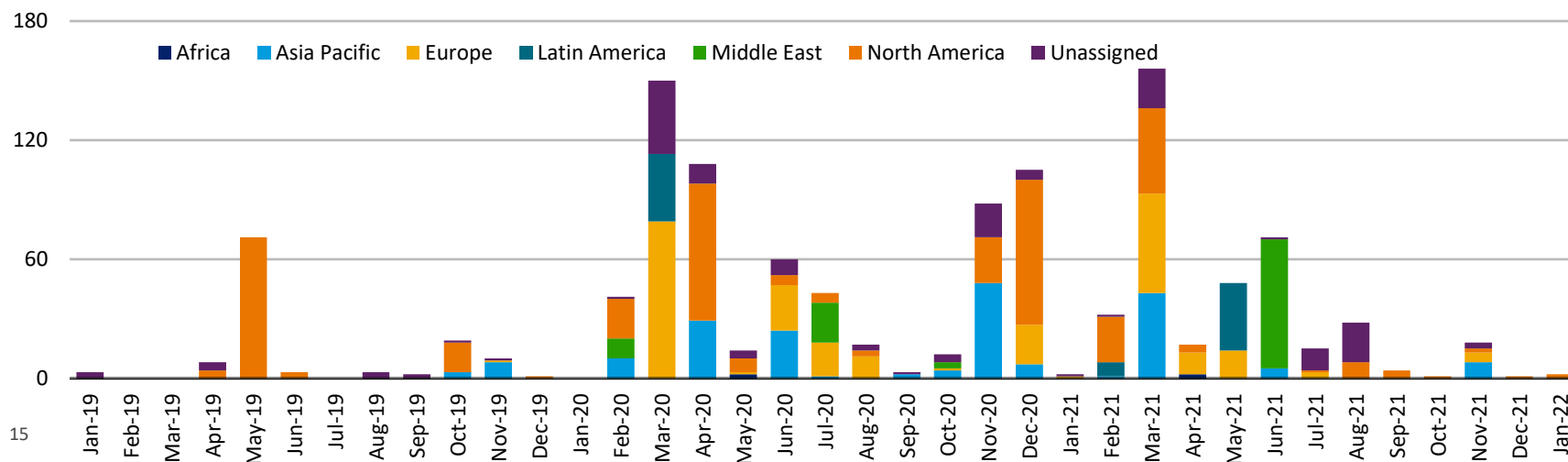


- According to Cirium, there were 692 aircraft cancellations in 2021 and 857 cancellations in 2020



- The 737 MAX was the aircraft with the most cancellations in 2020 (641)

- 395 additional 737 MAX orders were cancelled in 2021

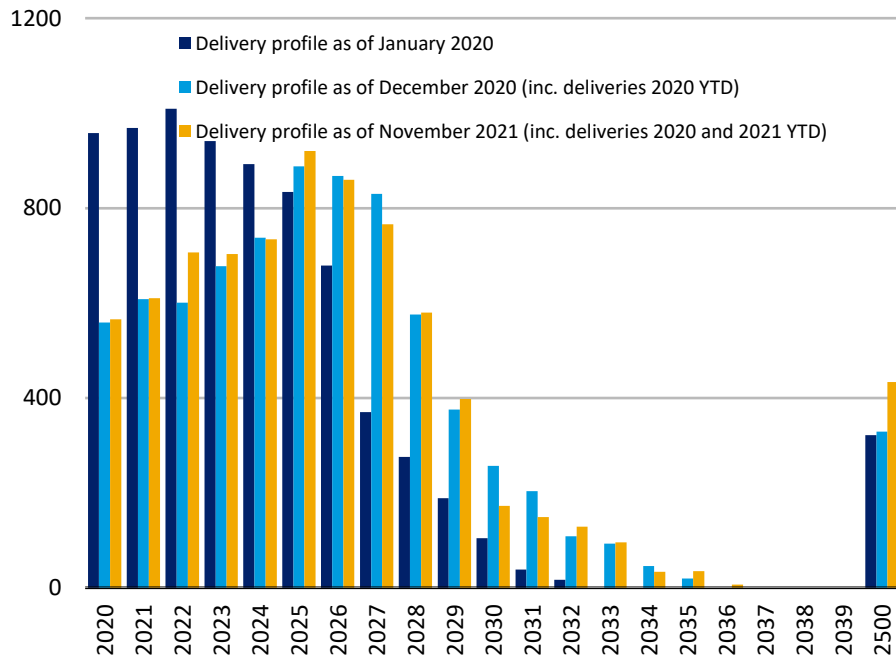


Change in Boeing and Airbus' deliveries due schedules

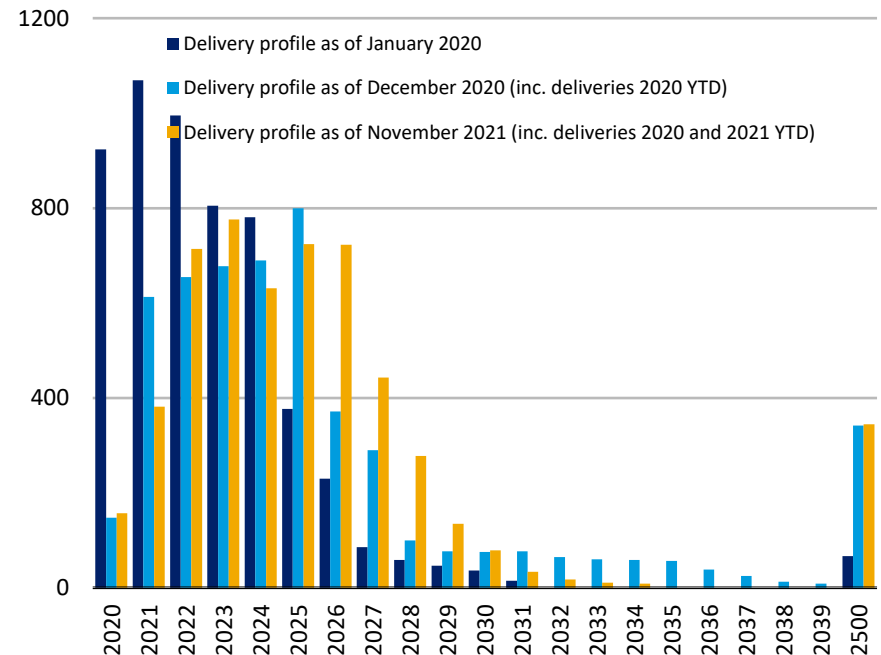


- Boeing and Airbus were negatively impacted by massive deferrals from '20-'24 to '25-'30 and beyond after the initial shock of the COVID crisis.
- However, we note that since December '20, AIR managed to strengthen its '22-'25 profile (expected deliveries up 5%).
- BA has significantly increased '26-'29 deliveries (expected deliveries up 88%), mostly on the back of recovering 737 activity

Change in Airbus deliveries due schedule



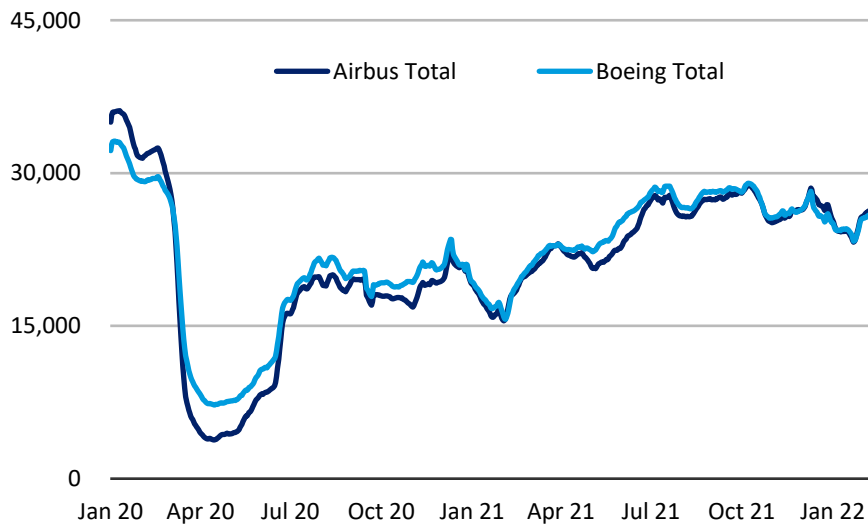
Change in Boeing deliveries due schedule



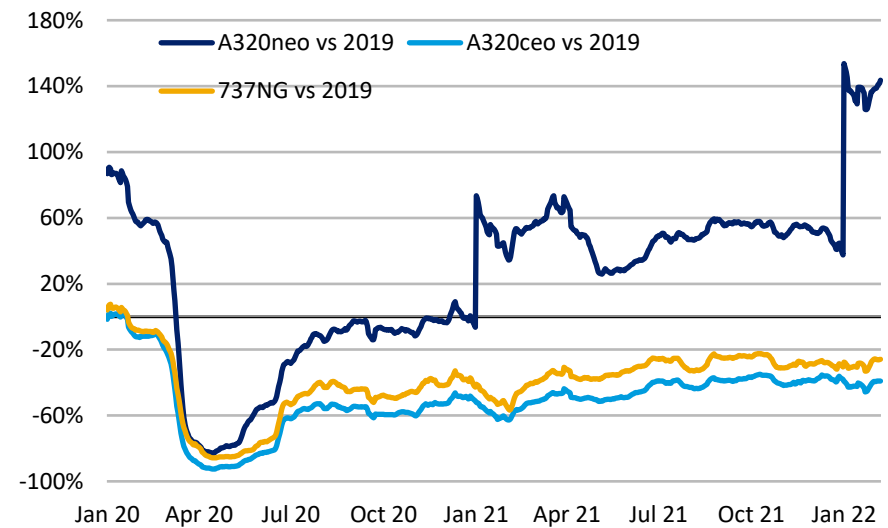
Airframe Flight Cycles



Airbus vs. Boeing total daily flights 7 day avg.



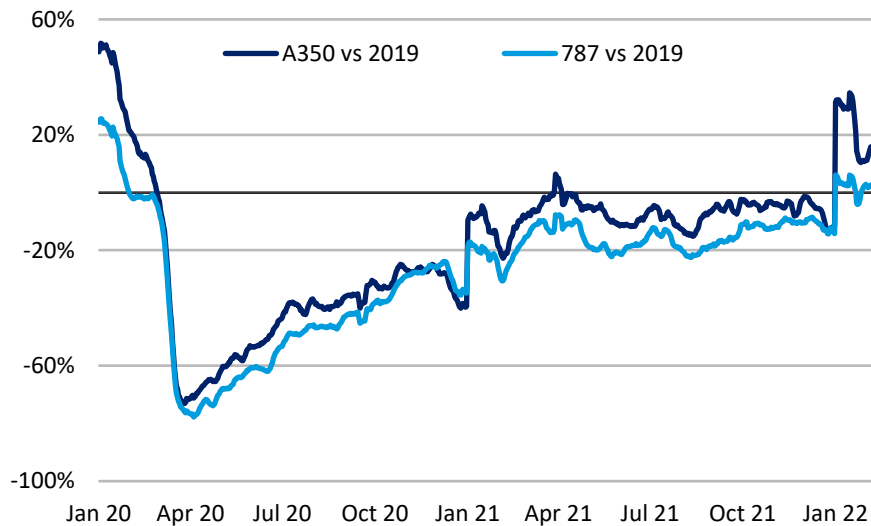
A320 vs. 737NG 7 day avg. daily flights y/y %



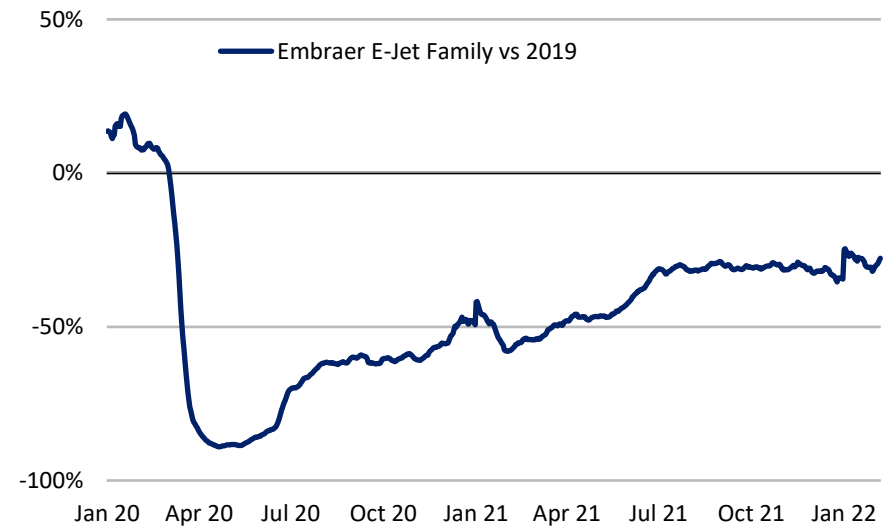
Airframe Flight Cycles



A350 vs. 787 – 7 day avg. daily flights y/y %



Embraer E-jet 7 daily avg. daily flights y/y %

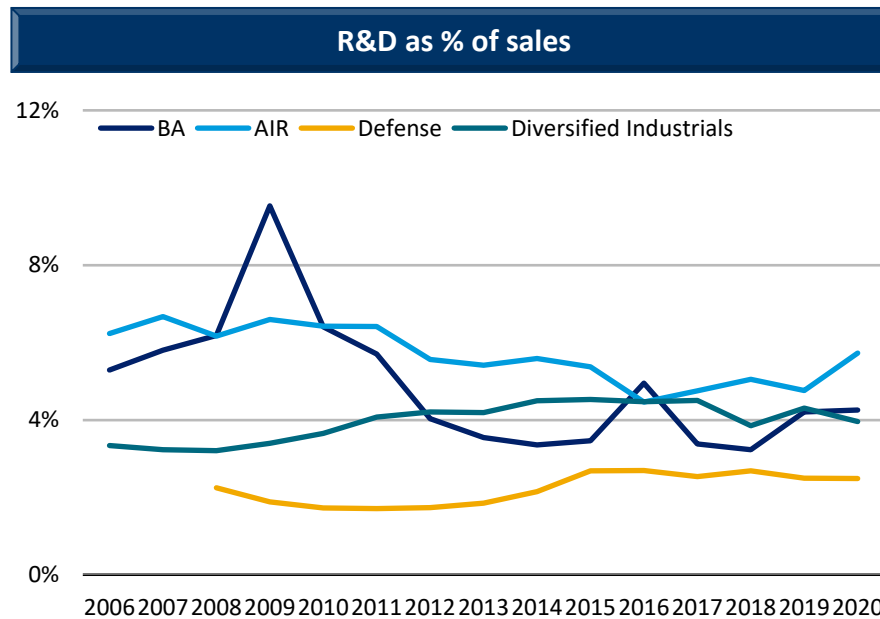


Focus on cash preservation and cost savings actions



OEMs and suppliers focused on cash preservation and cost savings actions

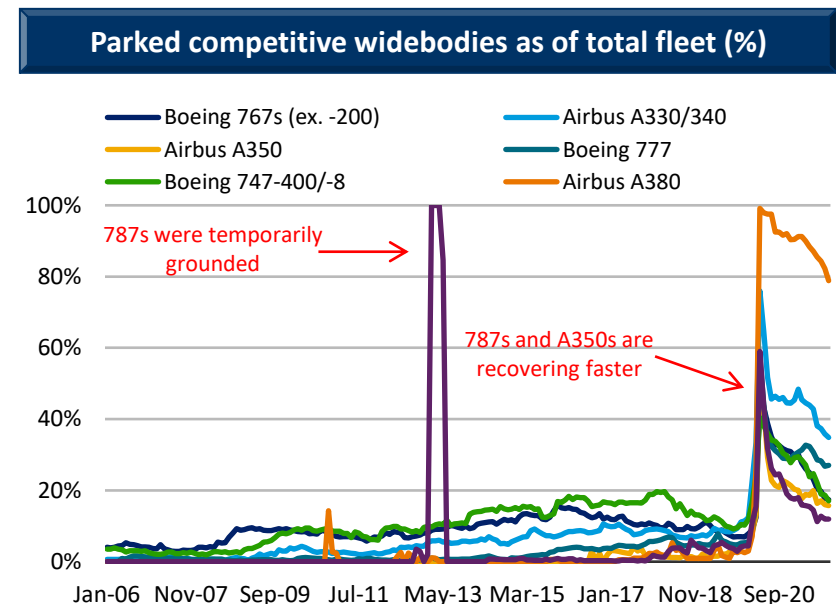
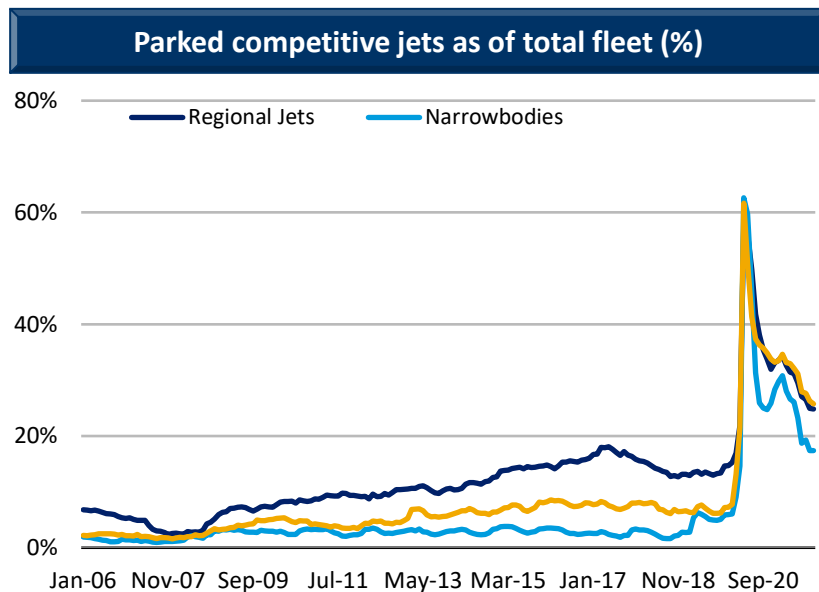
- Implemented furloughs and reduced workforce
- Deferred R&D and capital expenditures
- Reduced or temporarily suspended dividends and share repurchases
- Raised debt or tapped available credit lines in order to increase liquidity
- Closed or consolidated facilities
- Increased cost efficiencies and working capital optimizations



Narrowbodies are returning faster to service vs. widebodies



- Narrowbody aircraft are returning to service faster vs. widebodies
- Parked NBs were 17.4% of total fleet as of October 14, 2021, while parked WBs were 25.7% of total fleet
- NB strength will continue as long as domestic markets continue to drive demand growth
- Operators could use NBs to replace WBs on some international routes in the current lower demand environment. The A321LR/XLR enables airlines to operate routes previously reserved for larger WBs
- 737 MAX returning to service around the globe (...but still grounded in China)
- WBs are being used to support increased demand for global air freight
- New generation WBs are returning much faster than legacy widebodies



New aircraft programs are expected to EIS in the next years



- Boeing 777X (late 2023)
- Boeing 777XF (2027)
- Airbus A321XLR (2023)
- Airbus A350F (2025/2026)
- ~~Embraer E175-E2 (2024) ?~~
- Comac C919 (2022)
- Irkut MC-21 (2022)

OEMs will also have to decide whether to go ahead with new aircraft programs/variants

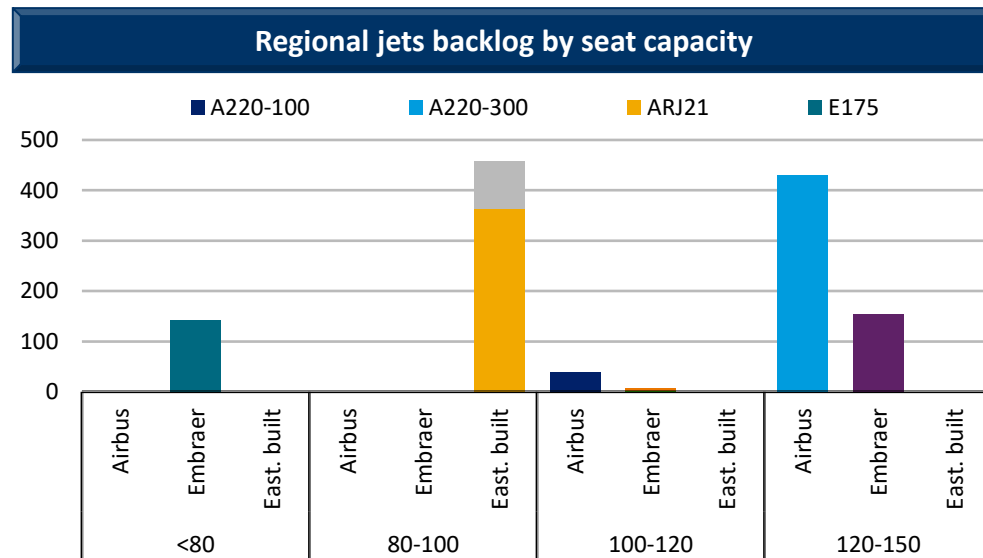
FAA will be more diligent in development plane process



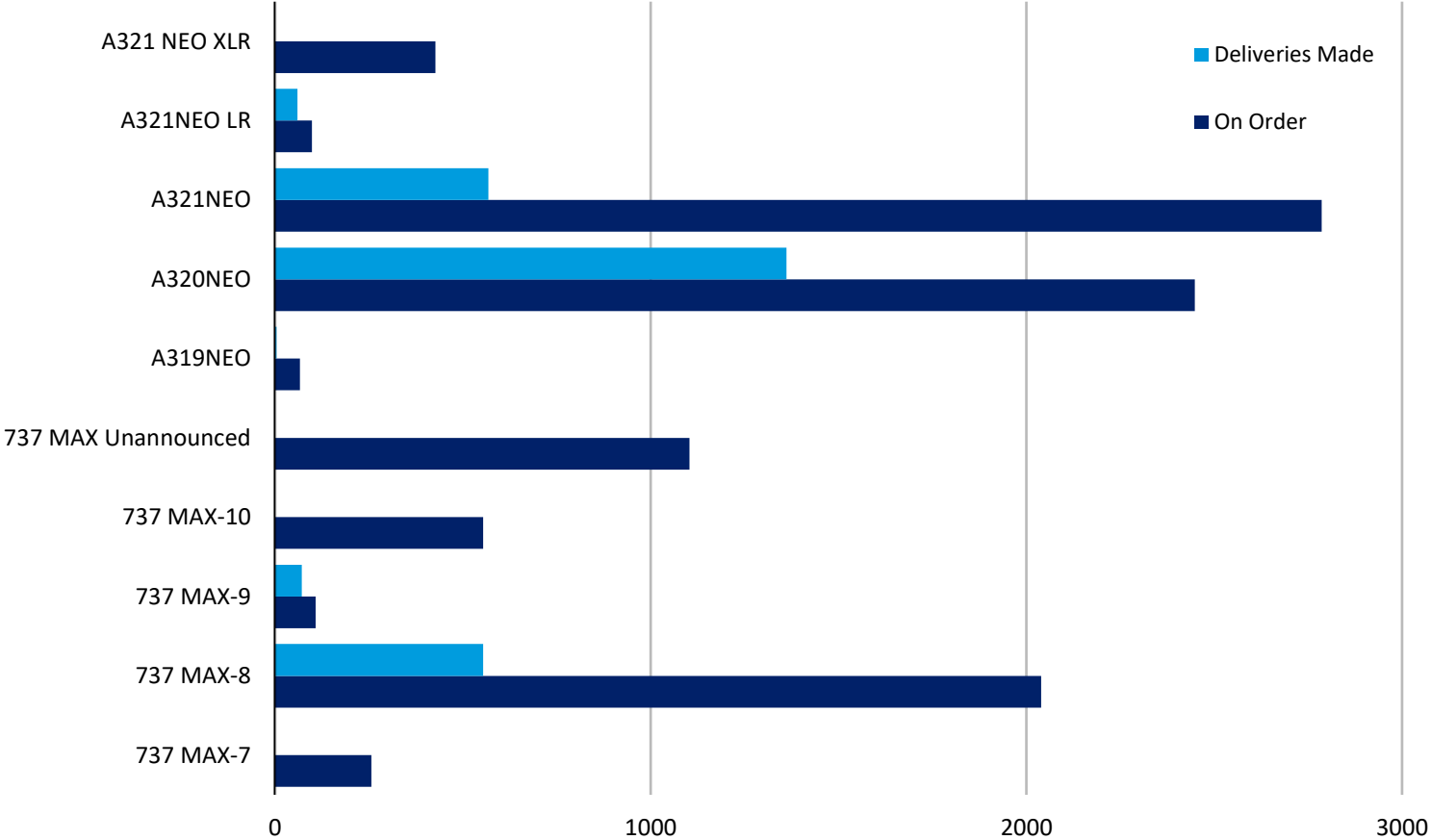
Regional jets: E-Jets vs. A220



- Regional jets could be a relative winner from a longer than expected lower demand environment
- A220 parked fleet levels as % of total fleet were at 5%, while E-Jets were at 15% as of October 14, 2021
- A220 was strengthened after Airbus acquired the program from Bombardier
- A220-300 remains as a popular option below the A320neo in the 120-150 seat capacity segment
- E175-E2 EIS was recently moved to 2027/28 after already being pushed back to 2024 from 2023
 - The continued delays are related to United States scope clause limitations



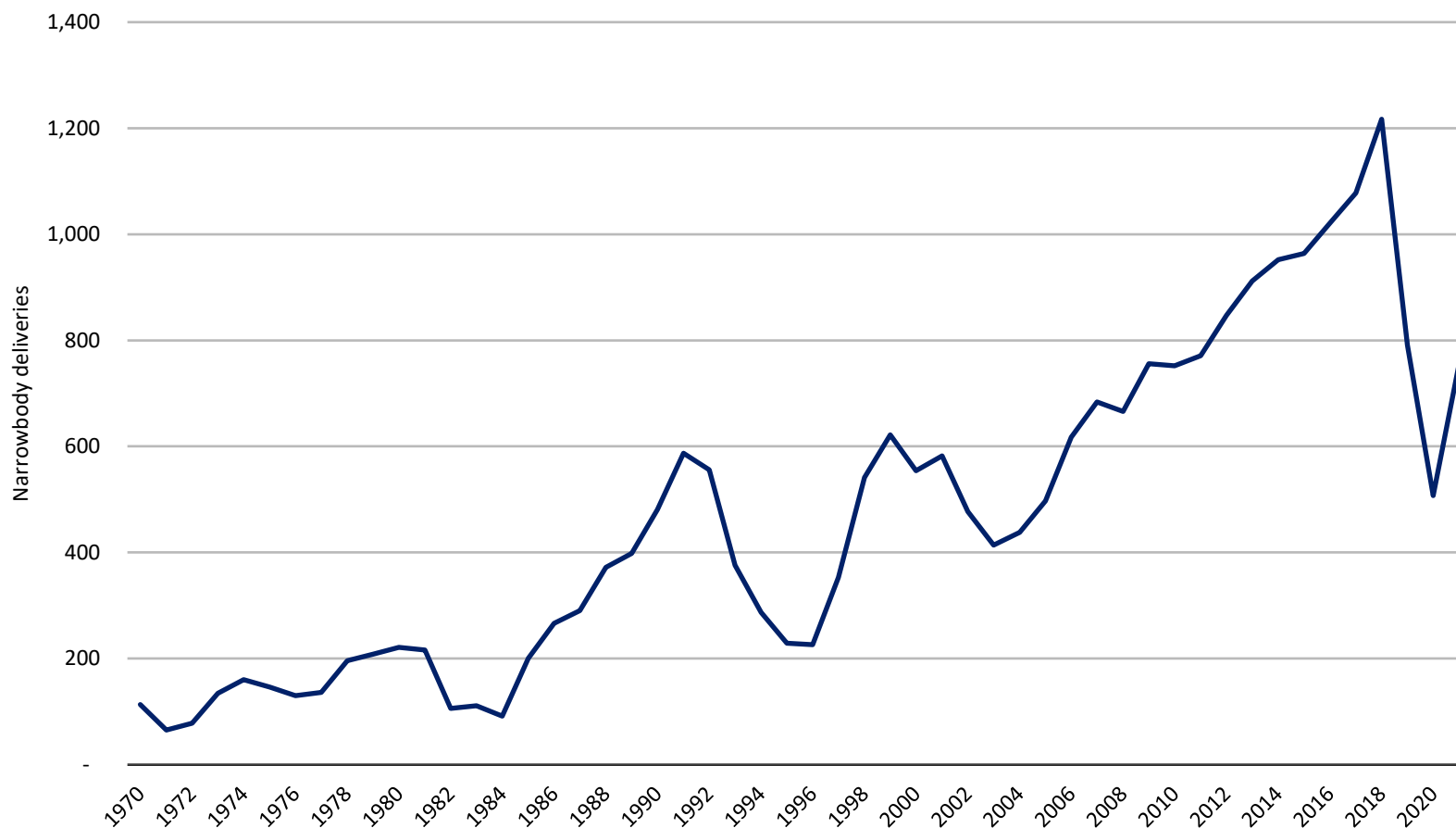
Narrowbody competition



OEM Recovery – Narrowbody deliveries



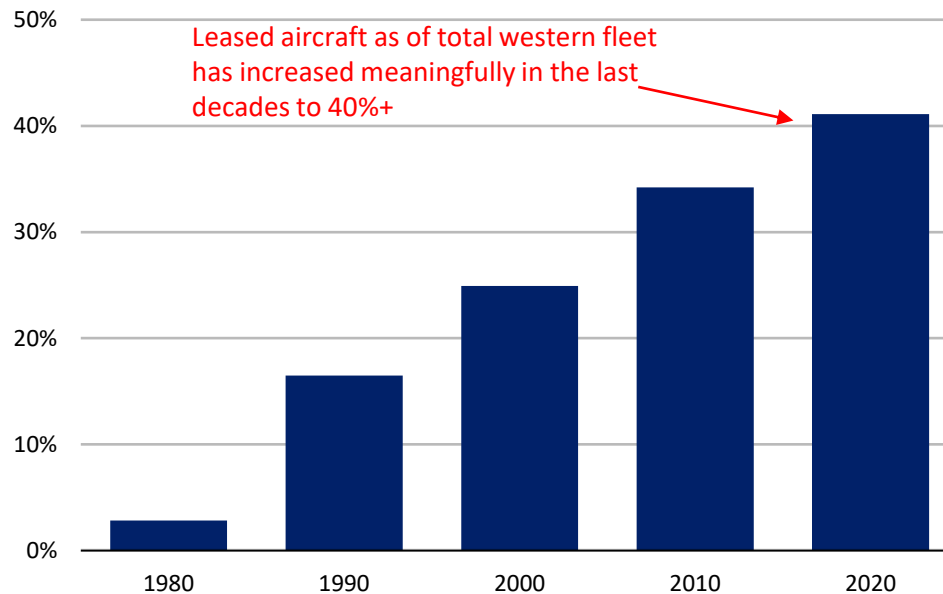
- If Airbus delivers 75 A320/month or 900/year and next peak is ~1,500 aircraft, then Boeing would have 40% market share



Lessors to benefit from air traffic recovery



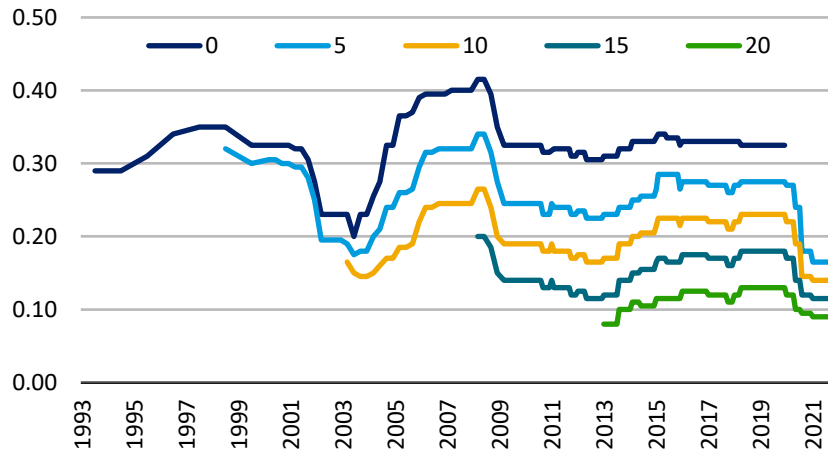
- Aircraft leasing has been growing in the last decades → In 1980 3% of the total aircraft fleet was leased vs. 40%+ today
- The industry is very fragmented, but the top 20 lessors account for 60%+ of the total lessor fleet
- Lessors are expected to benefit from pressure on airlines finances. As airlines focus on deleveraging and increasing fleet flexibility, they are expected to rely on the lessors to access new aircraft and to execute sale and leasebacks (SLB) of their existing aircraft
- 60%+ of Boeing and Airbus' deliveries in 2021 were taken by lessors or financed by a SLB transaction
- Investment grade lessors will benefit in a higher rates environment. Rising interest rates boost lessors net interest spreads
- Lease rates remain under pressure since the pandemic erupted, but have now started to recover



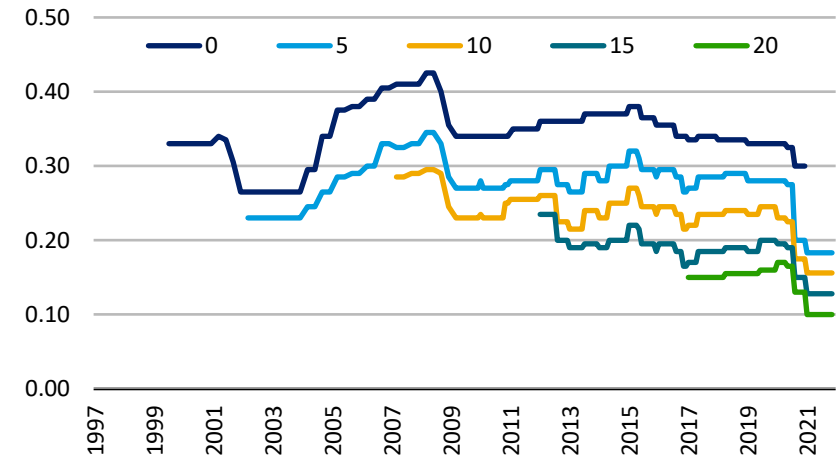
Monthly market lease rates for narrowbodies



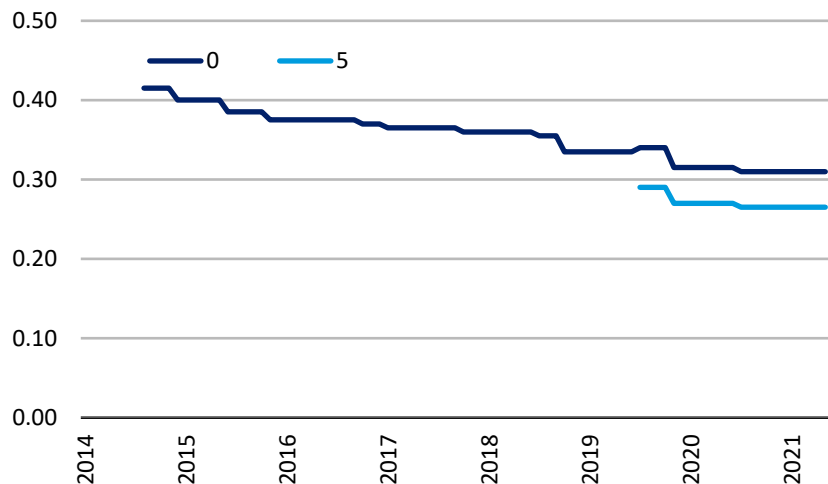
A320neo rates dipped in January 2021



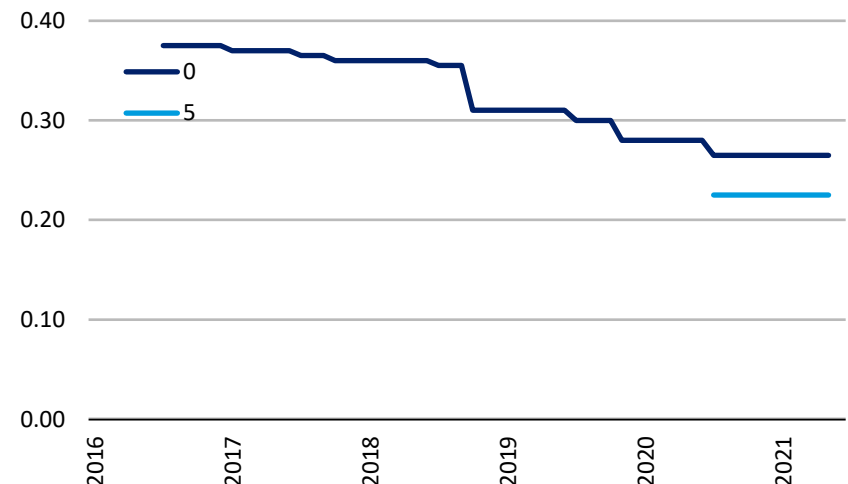
737 NG rates also stepped down in January 2021



A320neo lease rates are slightly down in 2021 YTD



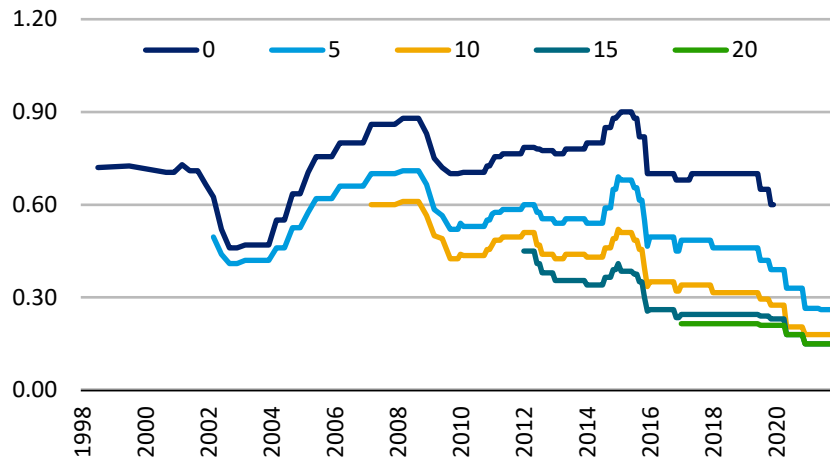
737 MAX lease rates are lower than A320neo



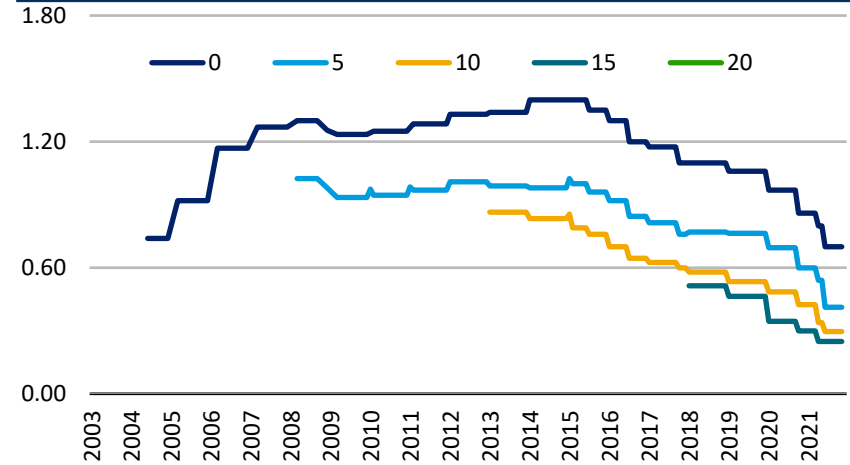
Market lease rates for widebodies



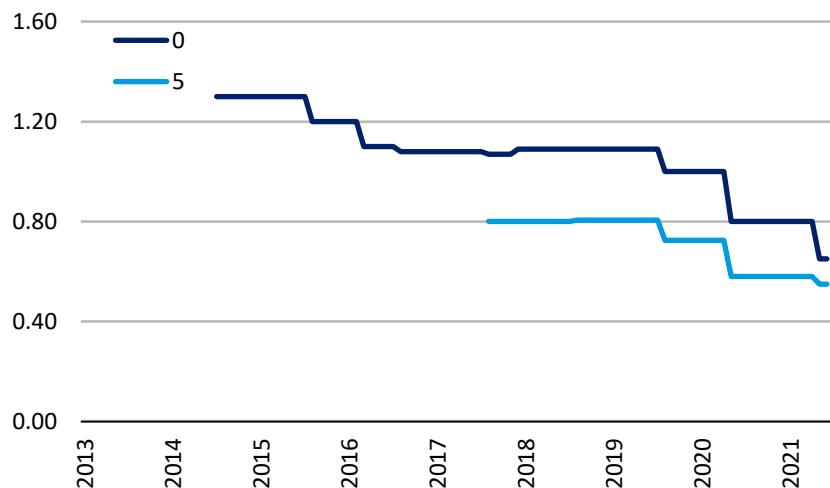
A330-200 rates are slightly down in 2021 YTD



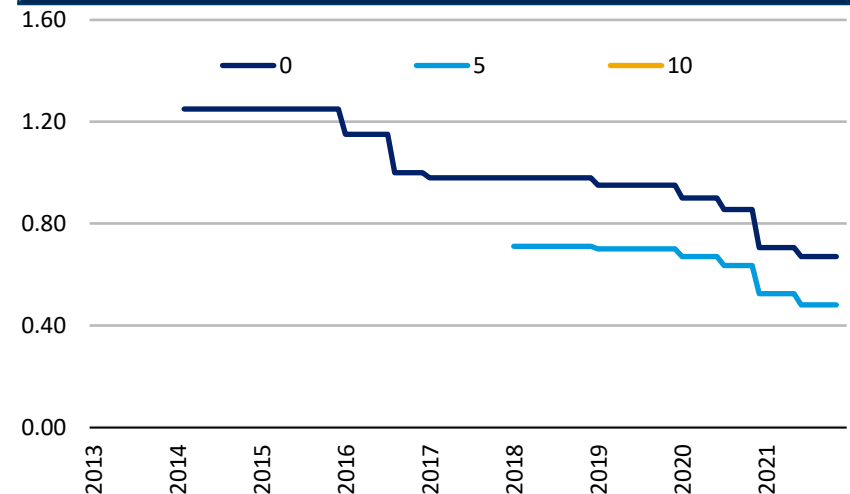
777-300 rates continue to be pressured



A350-900 rates stepped down in October 2021



787-9 rates stepped down in June 2021



Future of commercial aviation



- Aircraft electrification could start to emerge in the next years
- Electrification could begin with smaller aircraft using batteries in regional shorter-range routes
- Lower short range cost of flying would increase the number of viable new routes. Using batteries will allow more point-to-point travel at a lower price point. Electric flight costs are 40-80% lower than traditional power
- Incremental infrastructure needs would not be significant
- Hydrogen fuel cells could emerge as an option in the longer term. Fuel cell weight and power, and available room for housing the hydrogen are still hurdles on development




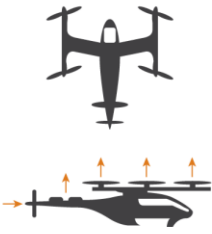

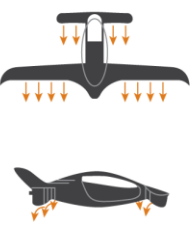
Airbus released three concepts of **ZEROe** hybrid-hydrogen aircraft in early 2021. The turbofan concept is designed to transport 120-200 passengers with a +2,000nm range

The Future is Now





Most companies developing prototypes are utilizing Lift + Cruise or Tiltrotor/wing designs

Multicopter	Lift + Cruise	Tilt Rotor/Wing	Ducted Vector Thrust
			
Airbus (CityAirbus) Ehang (116, 184, 216) Volocopter (VoloCity)	BETA Technologies (ALIA-250) Boeing (PAV) Juant Air Mobility (Journey) Opener (BlackFly) Volocopter (VoloConnect) Wisk (Cora)	Archer (Maker) Airbus (Vahana) Joby (S4) Kitty Hawk (Heaviside) Vertical Aerospace (VA-X4)	Bell (Nexus 4EX/6HX) Lilium (Lilium Jet) Urban Aeronautics (CityHawk)

Source: BofA Global Research, Lilium

Airlines could be interested in emerging technologies

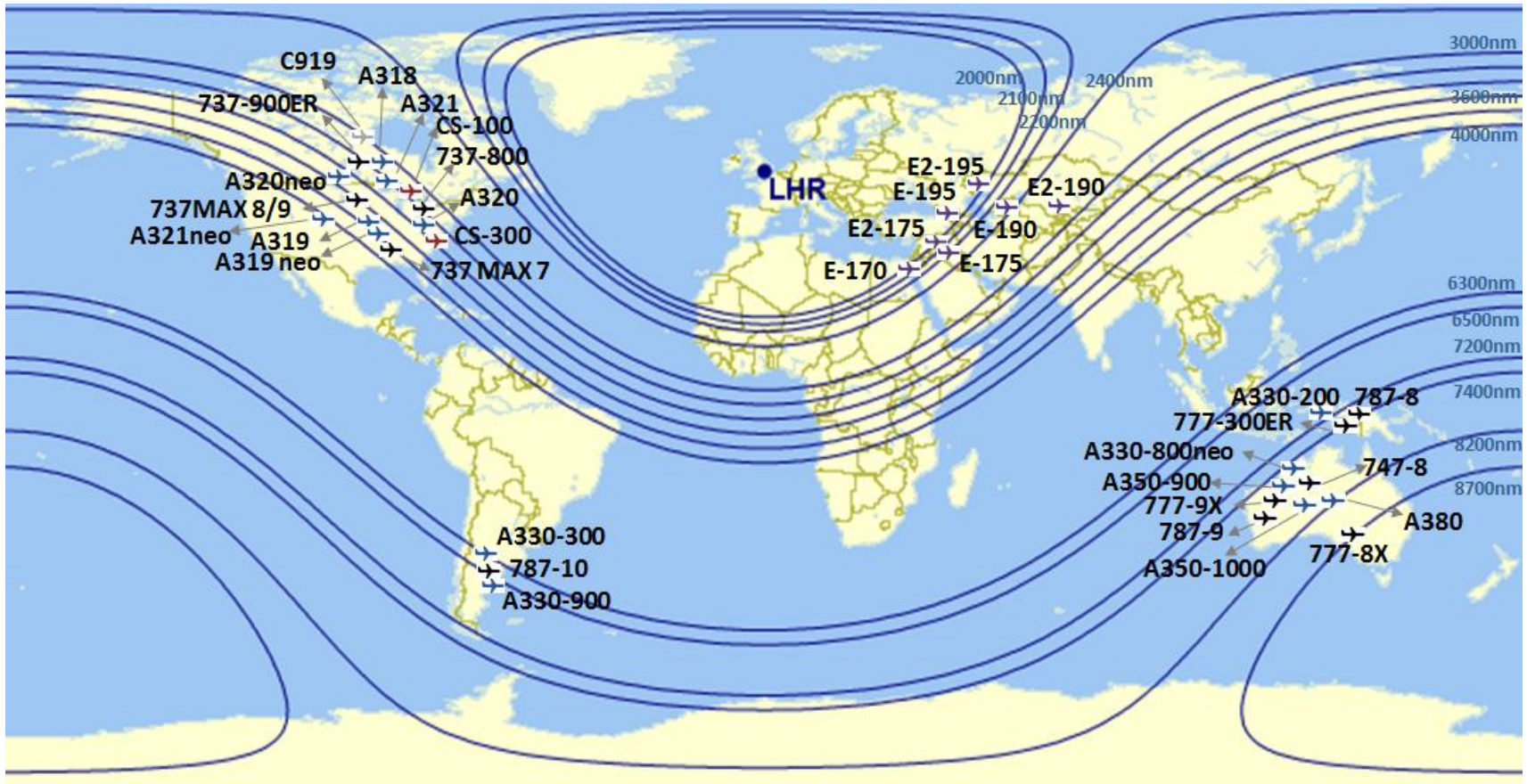


- United Airlines announced an agreement with Archer Aviation in early 2021. Archer is focused on urban air mobility (UAM) and is developing its own eVTOL
- United will contribute its expertise in airspace management to assist Archer with the development of battery-powered, short-haul aircraft
- United has placed a \$1 billion order for 200 Archer eVTOL aircraft, with an option to purchase 100 more for \$500 million
- United and Mesa Airlines would offer customers a quick, economical and low-carbon way to get to United's hub airports and commute in dense urban environments
- Archer unveiled its full scale eVTOL aircraft in 2021 and plans to begin aircraft production in 2023, launching consumer flights in 2024
- UPS also announced a deal with Beta Technologies. The first 10 aircraft are expected to be delivered in 2024, with an option to purchase up to 150 units. UPS will use the aircraft to provide air service in small and medium markets
- United Airlines ordered 15 of Boom's Overture supersonic aircraft with an option for 35 more; expected to carry passengers by 2029

Boeing: To be or not to be?



- A321neo range is unmatched by the 737 MAX family

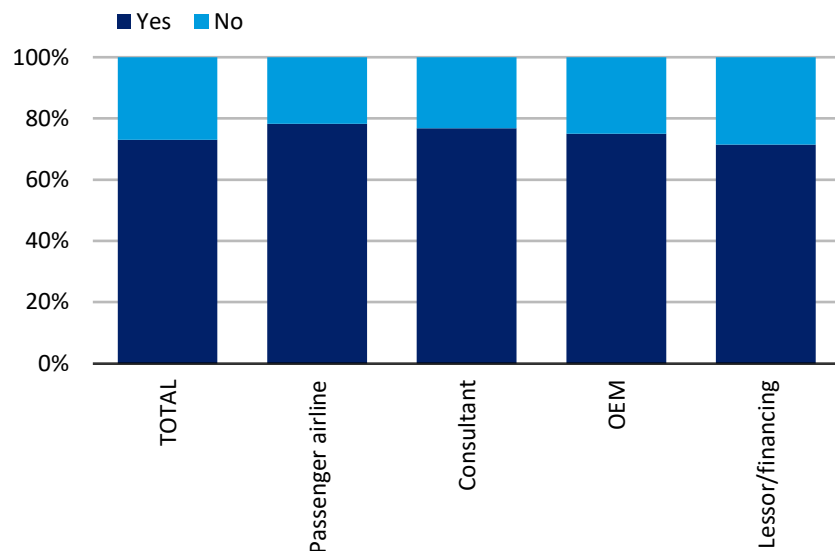


~80% think Boeing needs to offer a more capable NB

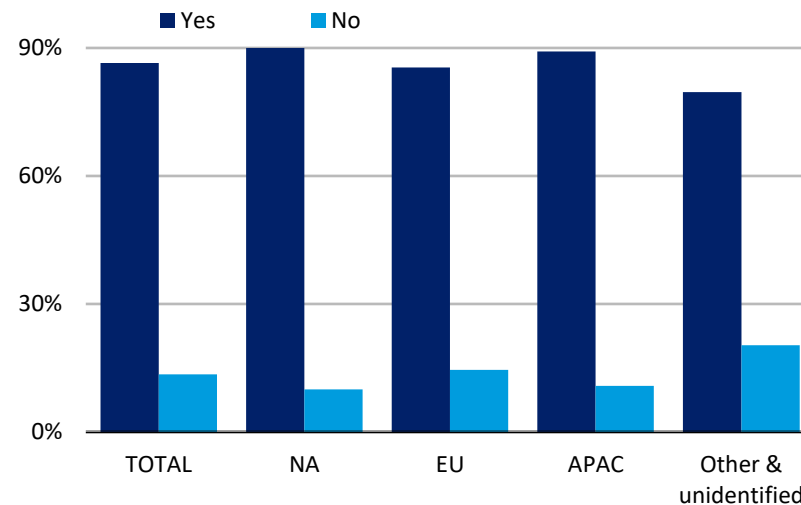


- Proprietary survey with Aviation Week Network shows robust demand for a more capable Boeing NB.
- 78% think Boeing needs to offer the new aircraft & 86% of those would be interested in buying it.

Almost 80% think BA need to develop a more capable NB



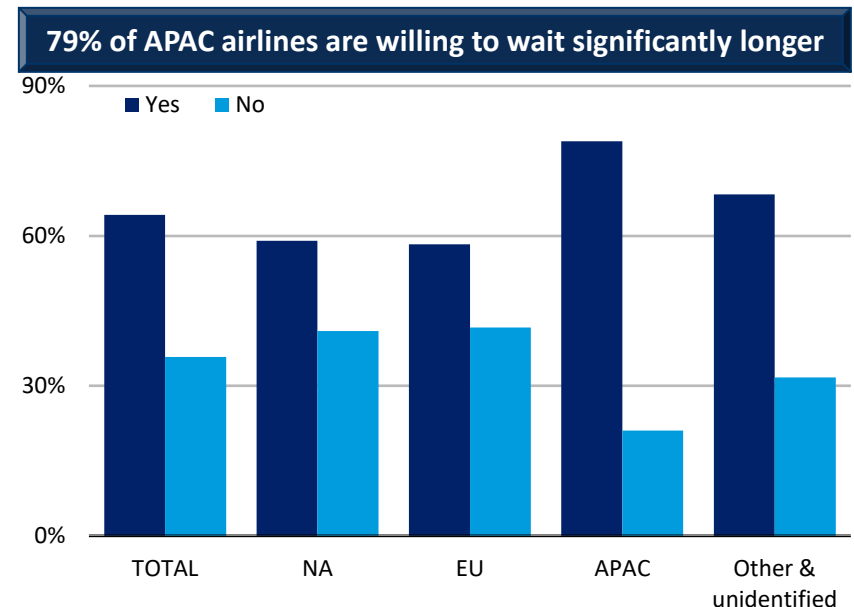
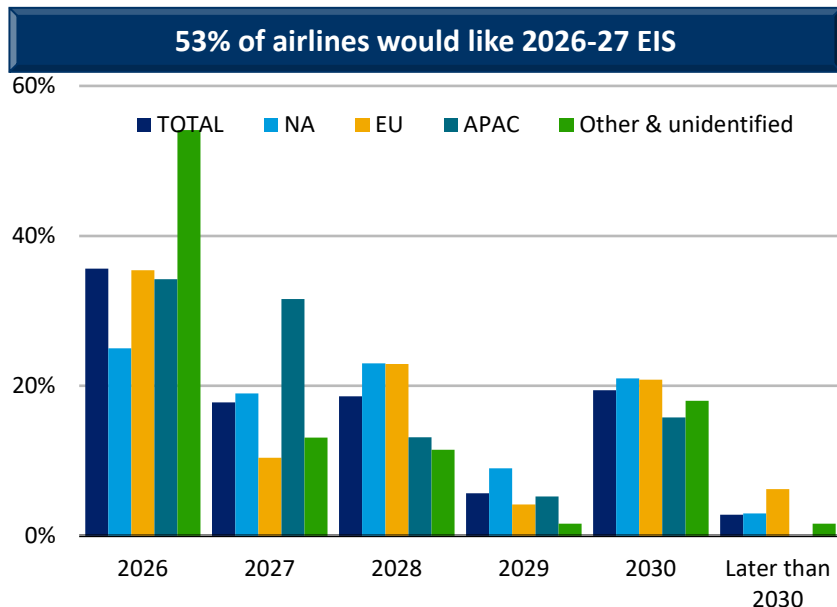
86% airlines are interested in new aircraft



Boeing's dilemma: window of opportunity vs. balance sheet



- 53% of airlines want the aircraft before 2027, 64% willing to wait longer if that meant integration of new propulsion concepts
- But Boeing BS is currently stretched out: raise capital through equity or wait until the BS is stronger?
- We estimate the program development could take 7-8 years and a \$15-20bn investment.
- Boeing will eventually have to develop the aircraft if they want to remain competitive in the NB market in the long term.
- Waiting until next propulsion technology is available could pose significant to risk Boeing's position in the market.

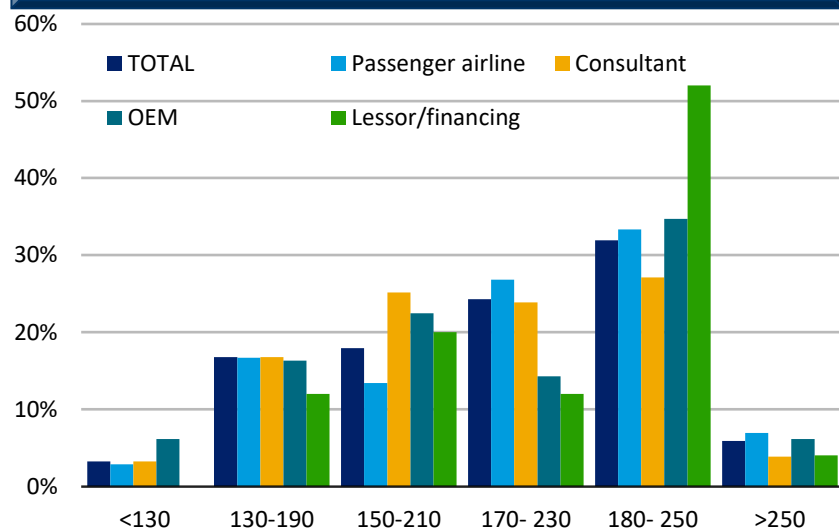


>4,000nm & 170-250 seats in the preferred configuration

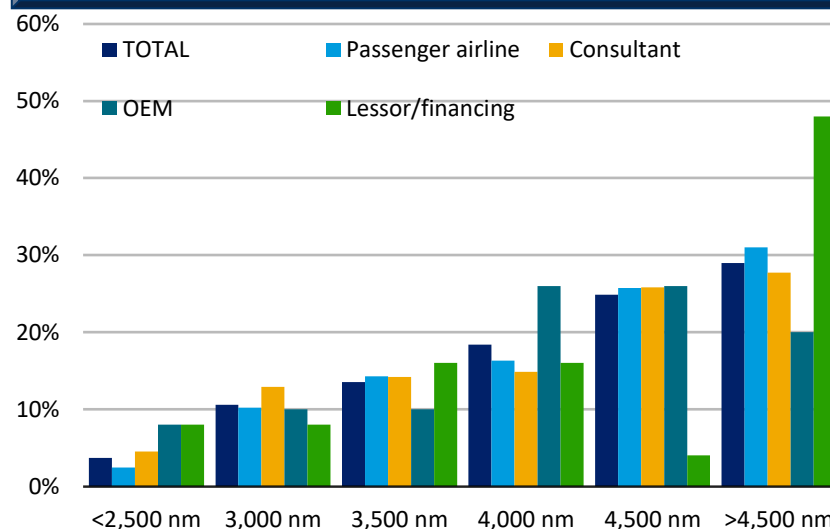


- 73% see the new narrowbody aircraft as having a max range of 4,000nm or more
- 60% see it having 170-250 seats
- We est. the aircraft to offer a ~4,500nm range and 200-250 seat options (with first variant at the higher end).
- 78% of the airlines would expect a 10-20% reduction in direct operating costs
- 60% see customer acceptance issues with an open rotor
- 74% of airlines see environmental sustainability as very or extremely important, mainly driven by European and APAC airlines.
- 72% would consider small widebody aircraft, with some resistance in Europe

Lessors/financing prefer 180-250 seats (52% of responses)



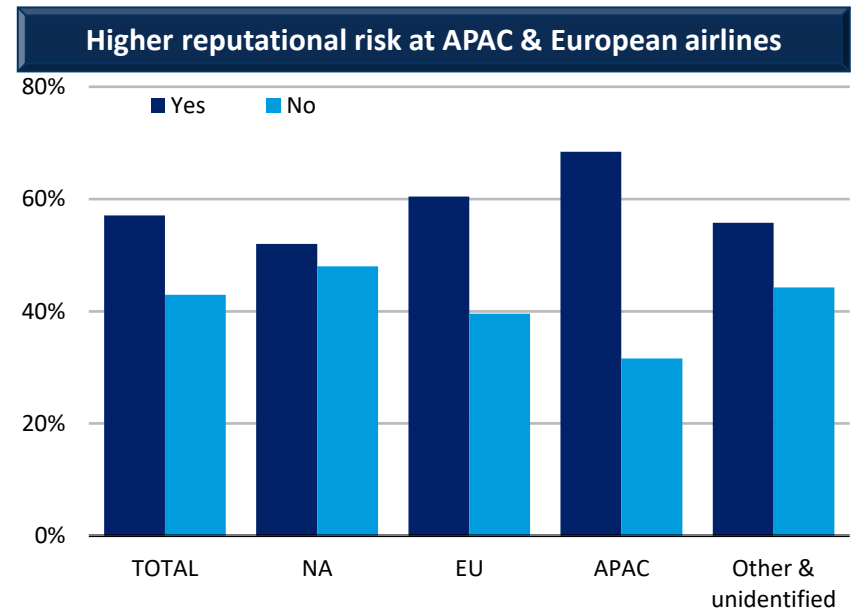
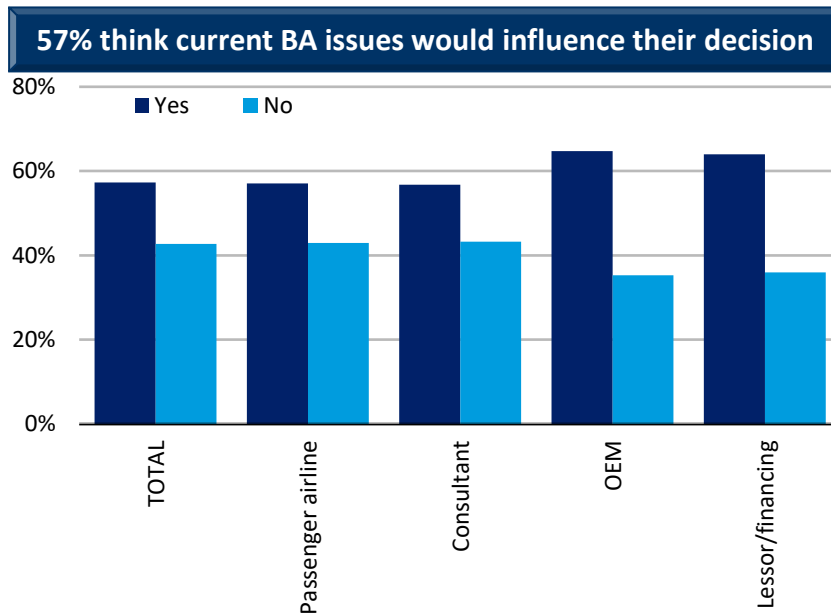
Most of the responders prefer a >4,000nm range (72% of resp)



57% see reputational risk from current Boeing issues

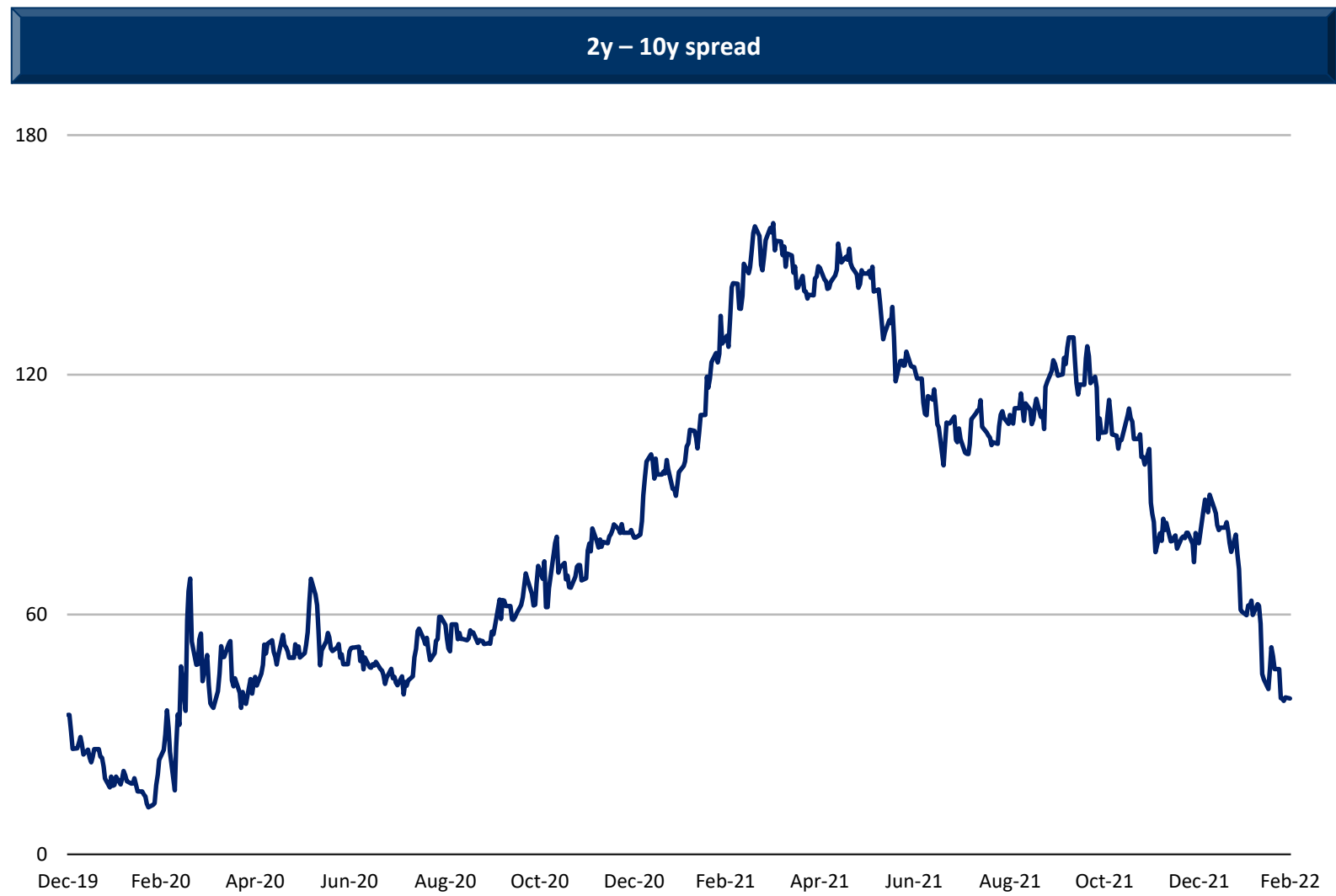


- 57% see reputational risk: led by OEM (65%) & Lessors (64%)
- Higher reputational risk perceived in APAC and European airlines interviewed – 68% and 60% think Boeing problems would influence their order decision



Is the global aerospace ecosystem decoupling?

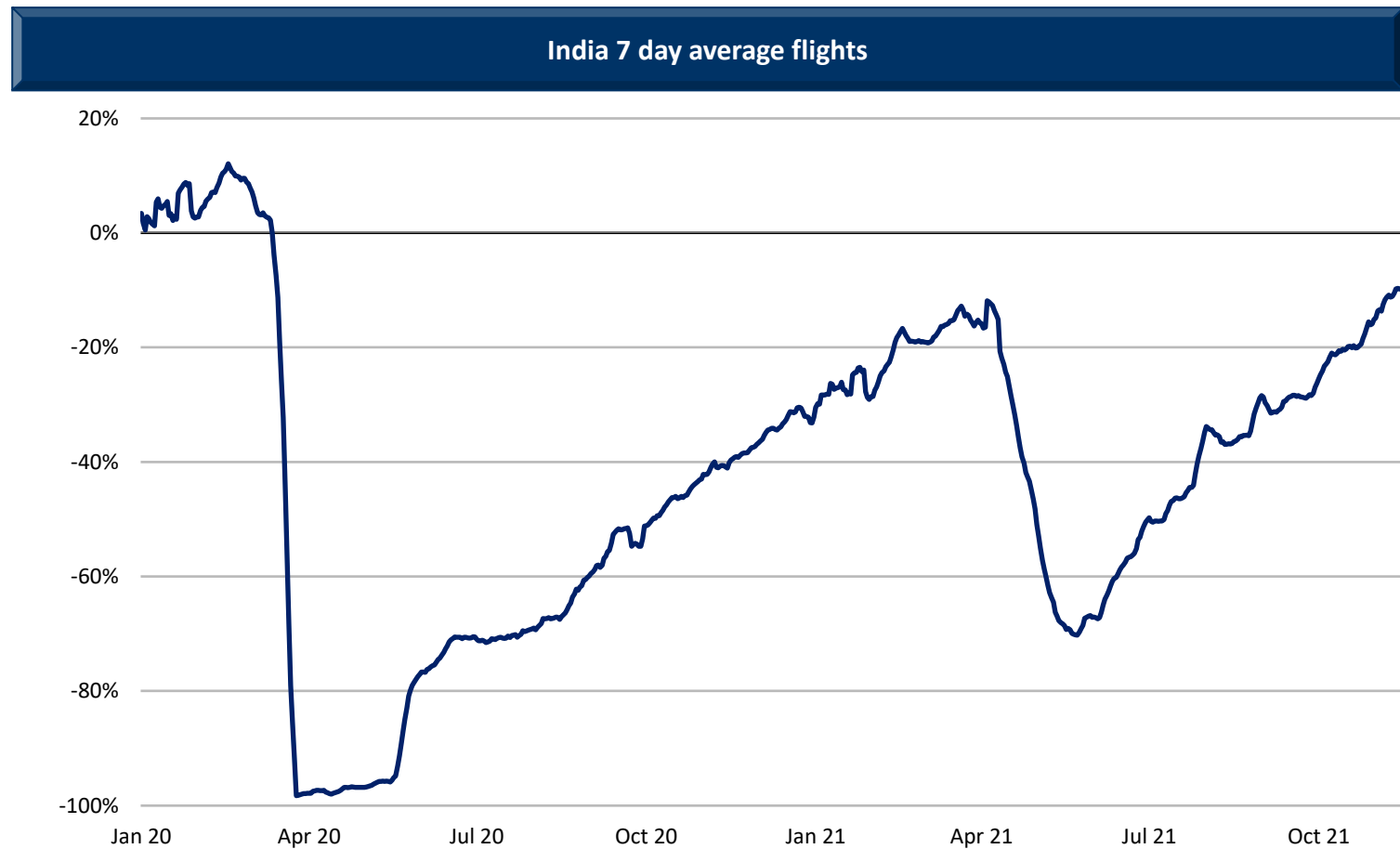




Risks still linger



- The surge in COVID cases in India led to a sharp decline in flights in May 2021, which has now mostly recovered.



Stock mentioned list



Stocks mentioned

Prices and ratings for stocks mentioned in this report

BofA Ticker	Bloomberg ticker	Company name	Price	Rating
ASTR	ASTR US	Astra	US\$ 3.39	C-3-9
YBBD B	BBD/B CN	Bombardier Inc.	C\$ 1.49	C-3-9
ERJ	ERJ US	Embraer	US\$ 14	C-1-9
LMT	LMT US	Lockheed Martin	US\$ 450	B-2-7
MRCY	MRCY US	Mercury Systems	US\$ 65.84	B-3-9
RTX	RTX US	Raytheon Tech	US\$ 100.74	B-1-7
SPIR	SPIR US	Spire Global inc	US\$ 2.14	C-3-9
TXT	TXT US	Textron	US\$ 73.42	B-2-7
TDG	TDG US	TransDigm Group	US\$ 675.51	B-1-9
SPCE	SPCE US	Virgin Galactic	US\$ 9.42	C-3-9

Source: BofA Global Research

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Investment rating	Total return expectation (within 12-month period of date of initial rating)	Ratings dispersion guidelines for coverage cluster ^{R1}
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Neutral	≥ 0%	≤ 30%
Underperform	N/A	≥ 20%

^{R1} Ratings dispersions may vary from time to time where BofA Global Research believes it better reflects the investment prospects of stocks in a Coverage Cluster.

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