

Aircraft Market Risks White Paper

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A B747-400 just rumbled over here, taking off, well on her way to who knows where. It must be a city on the other side of the world, and those 347 people will be there safe and sound in a few hours. What a cool airplane, and I'm lucky to have about 10 hours in the flight simulator. These were not magenta-line-following hours, and the hot seat is a great teacher. The airplane is amazingly easy to fly and stable due to being such a big girl...800,000lbs or so. One time, I was the guinea pig on the night before the certification tests, and got to fly steep turns, high and low altitude/speed, a bunch of little red light stuff, and really bounced around on the edge of the envelope. She was similar to the glider too (except for a few zillion more pounds and horsepower) because flying is mostly about the wing, and keeping the air molecules moving right.

The stabilizer worked great, and it is bigger than some airliner wings. As you speed up, the jet's attitude gets more nose down, and the stabilizer needs to pivot so it goes straight through the air as you accelerate. Otherwise, if it stays at the take-off angle (leading edge down), it will raise the nose and could stall the wing if not correctly trimmed. Not good really because you are low/slow already and climbing nose-up. Control forces would increase too and you would need to turn into The Hulk eventually to fly the airplane.

MAXimum Mess

This is all the same when you put the flaps up, and that is when the new trimming software on the MAX was activated by the MBA-trained aircraft designers, especially if you are doing things (turning, putting g on the airplane) that reduce your margin to the stall speed. After they've also ignored generally accepted practice, and let all the marbles depend on just one angle-of-attack vane...the sensor that helps tell the computer what the deal currently is with the molecules, the wing, and the stall speed.

At first Boeing wanted to say that MCAS was not about avoiding a stall, but rather control feel and matching that with the previous B737NG airplanes (but not the trim cutout and switches...?). They had some company too, but that noise got much quieter after the excellent JTAR report:

<https://www.seattletimes.com/business/boeing-aerospace/international-regulator-report-slams-boeing-faa-over-737-max-design-and-approval/>

It's complicated: <https://www.satcom.guru/2019/10/flawed-assumptions-pave-path-to-disaster.html#more>

Subject matter experts like Dominic Gates and his team (Pulitzer Prize...!), Bjorn Fehrm (Leeham), and Peter Lemme (plus PPRuNe) provided some serious analysis. That thing acted like a stick-pusher, and nothing says anti-stall more than that. They might have added one if there was room, but this would also have attracted unwanted attention from The Regulators. Sadly, they've possibly left out adding ventral strakes underneath (as on F-16s), or one line of code:

IF (airspeed > 300kts) OR (altitude < 10000ft) OR (trim is nose down) THEN Stop

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Note that they've also made the trim cutout work in a different way from what pilots would have expected from the B737NG: Activate the yoke's trim button, or pull back hard enough, and the trimming would stop. So after your 8,000 hours of loving the Speed Trim System in the NGs/Classics, it would have been startling to find MCAS hiding in the undisclosed MAX details and insisting on putting your nose down, hard. The elevator feel computer will also have been increasing the control forces (hello control feel), with several confusing alarms and the scary stick shaker going off, and they've also changed how the pedestal cutout switches work...then aerodynamic forces jammed the stabilizer. Given the many alarms and the unexpected and unknown STAB trimming, any comfy armchair blame for these flight crews is wide of the mark by a country mile.

The Regulators (not Warren G/Nate Dogg)

My USAF father flew Boeing airplanes for 21 years, and I was rattled in the crib by all those KC-97s and B-47s at MacDill. Later on it was KC-135s/B-52s for him at McCoy, and then Vietnam, twice. Back then The Boeing Company (BA) did not have any trouble focusing on safety and getting the stabilizer/etc. put on right, otherwise I might not be sitting here. The fact that Boeing had not realized that the Angle of Attack Disagree light didn't get displayed without another option installed speaks for itself. The fact that they've somehow waited 13 months to tell the FAA speaks for changing this conflict of interest, and now. The unbalanced FAA/Boeing certification system obviously deserves a reassessment at the highest levels. This may even qualify as a national security risk, if we are going to have a risk management system that allows one of our biggest defense contractors and their overseers to happily screw up their most important revenue producer. Spirit AeroSystems (SPR) is on the ropes now as well, and without them there is no Boeing.

Some welcome good news recently from Canada and EASA: They will more or less go along with what the FAA recommends after the flight tests and training updates are all done. After the re-certification, they will continue work on adding a synthetic airspeed to the system, as has been used on the B787 for many years. The idea is to prevent bad information from being displayed to the pilots, and this calculation (plus having both FCCs active, so both AoA vanes are used) will allow the code to have another way to check how things are going. The regulatory process may still include putting on a third angle-of-attack vane (later), which would be a huge deal, best avoided. What we really need to fix now is the FAA's oversight capabilities.

So it seems like 1 January would be doing great, but then there is the lack of simulator seat-miles. This will be a limiting factor to getting the MAX pilots back flying again since it's the same for everyone...3 take-offs and landings in the last 90 days, or you ain't going. Crews will also need to complete the training program finalised as part of the re-certification, which could mean 4 to 6 simulator hours each. All B737 pilots (over 20,000) who might fly a MAX must be trained, but some airlines will ring-fence a MAX sub-fleet in their (smaller) schedules, and train the rest over time.

Given the stem-to-stern re-examination, the MAX will be the safest thing going, which makes it clear that this level could have been achieved in March 2017.

One other spectre lurking about is the B777X program. Were some of the same ideas and processes brought to bear on this airplane and its software...? Some have warned that this project has also not been covered in much glory. It seems that given the lower production rates and worsening slowdown in the widebody market, there will be more room to move the certification into the future

if necessary, and avoid filling up any parking lots. There are about 220 A330s/B777-300ERs coming off lease over the next 6 - 7 years, so they can cheaply fill in gaps that may develop, and will be significant competition for the B777X and A350-1000. Especially since point-to-point flights will increase as travelers avoid hubs and connections.

Obviously, until there is a firm recovery underway, airlines like Emirates and Lufthansa (DLAKY) will keep deferring their B777X orders into the future and Emirates has already switched some to the B787-9, a hybrid hub/point-to-point airplane. The B777-300ER has a large belly hold cargo (marginal profit) capacity so this will be a factor in fleet planning decisions.

Interesting Times

The current global mess is overwhelming, and no forecast model could have predicted this upheaval, or that such an obviously smart company could be so shortsighted. It is beyond a shock that Boeing has behaved so badly, let the C Series end up in Toulouse and Alabama (for one Canadian dollar), saved money on the MAX but focused \$43bn on buying their own shares (supporting EPS and option prices) plus \$30bn and counting to fix the MAX, did not ground the airplanes after the first accident or right after the second, and even bizarrely considered a taxpayer-funded bail-out. As if their defense business doesn't get that sort of thing every year, and the DoD couldn't make huge advance payments. The USAF did pay \$882mn for the KC-46 tanker that they had been withholding.

The B737 MAX seems to be the one that should think about a bailout. The whole thing has lurched from one crisis to the next, drifting quietly to the right, dragging Boeing Commercial down. We have not heard from China, and they are clearly not in any hurry or likely to rely much on the FAA this time around. This is a huge risk and if MAX remains grounded in China, the usefulness and values of the aircraft obviously will be hit for the longer term. Will they make an example of this situation, or just hurt the U.S...? Will they discount even their own lessors who have become so important for the aircraft finance industry, the cornerstone of the whole aviation system. They will have airplanes to certify in the future so the precedent would be counterproductive. The damage they might do, and during this industry crisis too, has helped the EASA/Canadian regulators to ease up some and let the airplanes get flying again.

Airbus (EADSY) has had the second mover advantage since they took the risk and built the impressive A320, which excelled vs. the B737-400. This meant that Boeing needed to develop the B737NGs, and Airbus later countered with the A320neo/A321neo...which led then to the MAX. At the time, Boeing couldn't have gone for a new clean-sheet airplane because it is really an engine thing, and the technology was not all there yet. Imagine competing in a hugely expensive global chess game over a 40 year time horizon, with such cutting edge pieces, and the main ones are not quite done yet, including the rules of the (business model) game. The A321-200neo is range limited at max. payload (2,500nm), but the A321-200LR (3,100nm) and MAX 8 (3,200nm) were already affecting the trans-Atlantic widebody market and the A321-200XLR (3,650nm) will be doing more of that from 2023. Per Bjorn Fehrm, the A220-300 with a limited passenger load may reach 4,000nm.

Family Orders as of 30 June: B737 MAX 4,266 A320/321neo 7,445

The Market

Notional aircraft market values and lease rates have been reduced by 20-30% (of \$10mn to \$20mn each) for 15+ year-old airplanes that are being grounded. Newer airplanes are reduced by 10-15%

(of \$55mn, if not \$150mn each) so lessors and airlines will be looking at ugly asset impairments, not to mention all the millions that airlines owe to passengers for canceled flights, and writing down the value of airline investments. (Shoulda bought Amazon.) Actual aircraft transaction data will be difficult to come by, and updating forecasts every week or two is unreasonable. It would actually help single-aisle market values and lease rates if the B737 MAX were to take several months longer to get back into service. Many canceled aircraft are likely to be ordered again later at lower prices, assuming there are no more gremlins afoot.

Since ticket fees are normally a source of working capital, much of that money has been burned up by now, and all sorts of lender's debt covenants (cash levels) are being stepped on. Airplanes are being returned to lessors, and if there are more high profile bankruptcies, then those fleets will also go on the market with obvious repercussions for asset values across the board. And let's not even think about Brexit, Hong Kong, or China v. India with the U.S. 6th Fleet and the Russians in the middle of it.

The size and cost of widebodies multiplies the business risk compared to smaller aircraft. If you can't keep the load factor and yield high enough, the cost of flying all that metal and fuel around will eat you up. That has put the A380s out so soon, but Emirates is already bringing some back. Then we have higher crew/maintenance costs, big city airport fees, the price of fuel, and the (sometimes ugly) cost of hedging for its volatility. This, and upcoming maintenance, is causing airlines to quit on some older airplanes big and small, and keep the newer ones. Some leased airplanes may have a tidy sum in their maintenance reserve account, and the owners will prefer keeping it that way since it can support their return. Modern airplanes are a "free" fuel hedge, so you won't lose a couple of hundred million every few years and end up with nothing. If oil prices do collapse, at least you still have some shiny new airplanes, and maintenance is way less since some system's warranties go on for several years.

Lease rate payments are being deferred by the lessors, and the last thing they want is to repossess airplanes with no secondary demand. Such an impairment cycle might collapse the whole thing really, just as in the real estate market. Airlines would normally love the low fuel costs/interest rates and cheap airplanes, except travel has become an attack vector and revenue is down 60-80%.

Interesting times...? Well, it's been pretty interesting the whole time and this is about as interesting as it gets, since the Fed is still balancing some spinning basketballs from 2008. They've been in the Twilight Zone buying corporate bonds and even junk bonds/syndicated loans so debt investors are getting a bigger bailout than the airlines, and a recovery back to more normal conditions cannot come soon enough.

The financial system was in better shape this time around, but the Asset-Backed Securities (ABS) market and others may not recover for 4 to 6 years. The EETC structure includes a liquidity facility of 18 months, and then the riskier debt levels start paying the higher levels, which have historically fared well in re-organizations. Section 1110 supports the investment thesis, and this is a good summary:

<https://www.aviationfinance.aero/articles/14995/EETC-performance>

So the big lessors will expand their share of the market again, and more banks may decide financing airplanes makes sense if they can still find an airline, since aircraft are usually reliable and mobile collateral. Brave aircraft leasing investors will be looking for deals since the investment return

(IRR) is mainly a function of the equipment cost (hammered now), the monthly lease rate/loan payment, and the future sale value, as shown here by our detailed lease IRR model (for a 2010 A320-200ceo, 20% equity):

	<u>E.C.</u>	<u>Lease Rate</u>	<u>Sale (2028)</u>	<u>IRR</u>
January:	\$20mn	\$180,000	\$12mn	2%
July:	\$17mn	\$180,000	\$12mn	18%
	\$16mn	\$180,000	\$12mn	25%

Note that this means an 18% or 25% return each year for 8 years. Aircraft with leases attached obviously sell for more, and the trading/cycle aspect can make a big difference, plus this aircraft can have a second life as a freighter conversion. Lease parameter expectations from before the shutdown will suffer from downtime, a likely reduction in future sale values, and re-leases at much lower monthly payments. None of this is good and even the large lessors are having their first Force 5 sort of weather, but this is short term hopefully. They will be buyers of other people's bad deals and come out of this even better off. Some banks with loans to smaller, less well-positioned lessors, and to a bunch of weak airlines as well, may be in for the real fun. Asset values are likely to decline further and this is being slowed strangely by lease payment deferrals. At some point, buying some of these modern half-price aircraft is really a no-brainer.

We can help if you need strategic advice, lease restructurings, and net cash flow-based IRR answers like these. Sector investors should have a look at the balance sheet, fleet and strategy of AerCap (AER), since the market may eventually figure this business out. And if you want to buy Boeing shares, then why not buy Airbus as well...and have your own "free" hedge.

More updates to follow...and we wish you all the best,

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