MORNING BRIEFING
January 10, 2019

5G or Not 5G?

See the collection of the individual charts linked below.

(1) The next New, New Thing? (2) 4G is the Old, Old Thing for Apple and Samsung. (3) Will 5G stay in Vegas? (4) Bulls vs. bears on 5G. (5) The Internet of Things can use a faster wireless network with more capacity for more things. (6) IBM showing off its latest quantum computer at CES. (7) Neither 5G nor quantum computing is ready for prime time. (8) Could an amateur scientist featured on "60 Minutes" possibly have the next New, New Thing in energy?

Tech I: 5G at CES. Is 5G the next New, New Thing? Apple and Samsung reported horrendous handset sales in Q4, confirming that the 4G LTE handset market is officially saturated. Anyone who wants a spiffy phone has one, and in Q4 they didn't see a need to upgrade. But that may change over the next year or two as US phone carriers begin deploying fifth generation—or 5G—wireless networks. To tap into a 5G network, with its faster speeds and lower latency (i.e., delay), users will need new, upgraded phones.

All of the promise and hype surrounding 5G is on display at this week's Consumer Electronics Show (CES) in Las Vegas. Manufacturers are showing off devices that tap into a 5G network that doesn't exist in most areas of the US. In addition, the 5G technology has some serious quirks that could prevent mass adoption. But trade shows are not staffed by pessimists. So read on to hear about both the good and the bad that 5G purports to offer:

(1) *What the 5G bulls see*. The main benefits of a 5G network are faster speed and lower latency. "Qualcomm, the wireless chip maker, said it had demonstrated peak 5G download speeds of 4.5 gigabits a second, but predicts initial median speeds of about 1.4 gigabits. That translates to roughly 20 times faster than the current 4G experience," a 12/31 *NYT* article reported. So downloading a movie should take 17 seconds with 5G compared to six minutes for 4G.

A 5G network will facilitate more realistic virtual reality (VR) experiences because it will enable wireless headsets and thus more user mobility—i.e., no need for the VR headsets to be tethered to a personal computer. The lack of latency and faster connections will also make automated cars possible and empower the smart home of the future.

Verizon and AT&T have started upgrading their networks. Verizon has rolled out its Verizon Home 5G service in Houston, Indianapolis, Los Angeles, and Sacramento, while AT&T has upgraded its network in Atlanta, Charlotte, Dallas, Houston, Indianapolis, Jacksonville, Louisville, New Orleans, Oklahoma City, Raleigh, San Antonio, and Waco. This year, AT&T will add Las Vegas, Los Angeles, Nashville, Orlando, San Diego, San Francisco, and San Jose to that list.

(2) *What the 5G bears see.* Carriers may have started rolling out their 5G networks, but it will be many years before nationwide coverage is available. In the interim, 5G phones will also need to operate on 4G networks, making the phones bulkier and less energy-efficient.

Verizon will be first to offer a 5G phone by offering a device that will attach to the back of Motorola's Z3, a 4G phone. A 1/8 *FierceWireless* article anticipated the phone's arrival in the next month or so. Verizon and AT&T also have plans to offer 5G phones from Samsung later this year. Apple, however, plans to wait until 2020 before rolling out a 5G phone.

Until its phones are developed, AT&T is offering "a 5G mobile hotspot via Netgear's Nighthawk, and free data for up to 90 days. Data will cost $70 a month for 15GB thereafter," a 12/20 article in *Tom's Guide* explained. The Nighthawk works on both 4G LTE and 5G networks.

5G does have some drawbacks, including "worse penetration, smaller range, and more susceptibility to weather when compared to [4G] LTE. A [5G] signal can be blocked by your hand, a tree, a building and even rain or fog," concluded a 12/20 article in *Ars Technica*. As a result, 5G networks will need to have more towers and many more antennas. That could limit 5G rollouts to urban areas.

5G phones will have drawbacks as well. 5G phones will need to include more hardware, including a modem and extra antennas. The 5G phones will be more complex and require more power, but the extra hardware in the phones means there will be less space for a battery. The additional hardware needed may also make the phones more expensive, by $200-$300, according to an estimate by OnePlus. As the technology improves, these negatives will likely be reduced, if not overcome.

(3) *Implementation*. Verizon's CEO Hans Vestberg gave a number of examples of how 5G will change our world in his keynote address at CES on Tuesday. At last year's Indianapolis 500, Verizon put a driver in a car that had blacked-out windows and told him to drive the track fast, according to Vestberg's prepared remarks. The driver wore a 5G head cam that allowed him to "see" the track and with much less latency versus a 4G product.

Vestberg said the Verizon 5G network "will support one million connected devices per square kilometer. By comparison, 4G enables connection of maybe 100,000 devices per square kilometer. That increase has all kinds of amazing implications including the emergence of meaningful device-to-device connectivity, a true Internet of Things."

Verizon plans to connect 1 million drones to its 5G network through a company it owns, Skyward. The company's clients use drones for safety inspections when lines of sight from land are obstructed. Low-latency 5G is also expected to be used by the medical profession. Low-latency wireless AR glasses could enable a doctor to look at both a patient's CT scan and the patient at the same time, allowing a procedure to be done more carefully and precisely.

(4) *Carriers vs equipment companies*. Verizon and AT&T are the sole members of the S&P 500 Integrated Telecommunication Services industry, which has risen 6.6% ytd and has lost only 4.9% y/y as of Tuesday's close (*Fig. 1*). That's a far sight better than the performance of the S&P 500 Technology Hardware, Storage & Peripherals industry, which has fallen 3.6% ytd and 13.9% y/y (*Fig. 2*).

The Integrated Telecommunication Services industry is forecast to have revenue growth of 5.1% this year and earnings growth of only 1.4% (*Fig. 3* and *Fig. 4*). The industry's forward P/E has fallen to 9.8, down from 13.0 a year ago (*Fig. 5*).

Meanwhile, analysts expect the Technology Hardware, Storage & Peripherals industry will see revenue decline by 1.0% this year and earnings rise only 0.7% (*Fig. 6* and *Fig. 7*). The industry's forward P/E stands at 11.6, down from 14.0 a year ago (*Fig. 8*).

Tech II: Quantum Computing at CES. There weren't any quantum leaps in quantum computing announced at CES, but IBM used the trade show to showcase some incremental advancements highlighting the technology's progress.

IBM introduced the Q System One, the first quantum computer to "fully integrate high-precision electronics and cryogenic cooling into a stand-alone system," reports a 1/8 Digital Trends article. The new computer "allows quantum computing to be run outside of the confines of a lab environment—a first for quantum computers, which typically require particular environmental conditions to operate." The computer is sealed in an airtight container because the slightest vibration from noise or change in temperature prevents it from operating properly.

This still isn't a computer that a typical corporation would buy. It stands nine feet tall and nine feet wide. But IBM continues to give companies and researchers access to the company's quantum computers via the Cloud. To that end, the company announced plans to open Q Quantum Computation Center later this year in Poughkeepsie, New York.

In addition, ExxonMobil and CERN, the European Laboratory for Particle Physics, have joined the IBM Q Network, a research effort to advance quantum computing. "Quantum computing can potentially provide us with capabilities to simulate nature and chemistry that we've never had before," said Vijay Swarup, vice president of research and development for ExxonMobil Research and Engineering in a 1/8 press release. It should help the company to develop new "energy technologies."

CERN will explore how quantum computing will advance scientific knowledge of the universe. The organization plans to "apply quantum machine learning techniques to classify collisions produced at the Large Hadron Collider, the world's largest and most powerful particle accelerator."

IBM laid out how other labs are using IBM's quantum computers:

(1) The Argonne National Laboratory is developing quantum algorithms to "tackle challenges in chemistry and physics."

(2) Fermilab is using quantum computers to better understand the results of hadron collisions and to study neutrino-nucleon cross-sections.

(3) Lawrence Berkeley National Laboratory is using them to study "strong correlation, environmental coupling, and excited state dynamics in molecular complexes and materials; novel error mitigation and circuit optimization techniques, and theories resembling the standard model in high-energy physics."

Tech III: Can Plants Save the World? This past weekend's "60 Minutes" episode on CBS profiled an amateur scientist, 81-year-old Marshall Medoff, who invented a way to unlock the energy inside plants and use it to create clean fuel for cars, a plastic equivalent that disintegrates, and a sweetener that isn't fattening.

It's an amazing story that seems too good to be true. According to "60 Minutes," 25 years ago Medoff became obsessed with the environment and global warming. He ended his business career and became a scientist, working out of a garage in a storage facility for 15 years in an effort to transform plants into clean and cost-effective transportation fuel.

Medoff knew there was a lot of energy in sugar molecules locked inside cellulose, part of a plant's cellular walls. He used an electron accelerator and its beams of electricity to break apart the plants and

unlock the sugars and trapped energy. Medoff formed a company, Xyleco, and investors gave it "hundreds of millions of dollars" to build a factory. The factory takes agricultural residue, like corn cobs from farms, puts it through the electron accelerator, and combines it with enzymes to release the plant sugars.

One of the plant sugars, xylose, is sweet but not caloric. Medoff is also using the plants to make plastics that can disintegrate as fast as 11 weeks. And perhaps most importantly, he is taking the sugars and converting them into ethanol, gasoline, and jet fuel. The gasoline can be used in cars currently on the road and distributed through existing gas stations. But Medoff's gasoline emits 77% less greenhouse gas than traditional gasoline.

Xyleco has a Who's Who board of directors, including Bob Armstrong, the former head of MIT's chemical engineering department; former Shell Oil executive Sir John Jennings; Steve Chu, former head of the US Department of Energy; George Shultz, former Secretary of State; and William Perry, former Secretary of Defense.

A quick Google search turned up patents held by Medoff, who has no scientific background, but little else about him. The same is true of a Xyleco search. But for Earth's sake, we hope the story is accurate.

CALENDARS

US. Thurs: Jobless Claims 222k, EIA Natural Gas Report, Powell, Barkin, Clarida, Bullard, Evans. **Fri:** Headline & Core CPI 1.9%/2.2% y/y, Treasury Budget, Baker-Hughes Rig Count. (Econoday estimates)

Global. Thurs: China New Yuan Loans (CNY) 825.0B, China CPI & PPI 2.1%/1.6% y/y, China Aggregate Financing (CNY) 124.5B, Japan Trade Balance -¥612.6b, Japan Leading & Coincident Indexes 99.5/103.0, ECB Publishes Account of December 12-13 Governors Council Meeting. **Fri:** UK GDP (monthly) 0.1%, UK Headline & Manufacturing Industrial Production -0.7%/-0.7% y/y, UK Trade Balance -£2.8b, Australia Retail Sales 0.3%m/m, China Direct Investment. (DailyFX estimates)

STRATEGY INDICATORS

Stock Market Sentiment Indicators (*link*): The Bull/Bear Ratio (BBR) bounced back above 1.00 this week after falling below last week for the first time since late February 2016. The BBR rebounded to 1.18 after sinking the prior three weeks from 2.23 to 0.86—which was the lowest reading since mid-February 2016. Bullish sentiment jumped to 34.8% this week after sliding the previous three weeks from 46.7% to 29.9%—which was the fewest bulls since February 2016; bullish sentiment was as high as 61.8% in early October. Meanwhile, bearish sentiment sank to 29.4% following a 14.2ppts surge the prior two weeks to 34.6%—which was the most bears since March 2016; it had fluctuated in a narrow band (below 20.0%) for most of H2-2018. The correction count (to 35.8% from 35.5%) was little changed this week, though below the 41.1% reading at the end of November—which was the highest percentage since late September 2015. The AAII Ratio climbed for the third week this week, from 30.0% to 43.6%, as bullish sentiment rose from 20.9% to 33.0% over the period and bearish sentiment fell from 48.9% to 42.8%.

S&P 500 Earnings, Revenues, Valuation & Margins (*link*): Consensus S&P 500 forward revenues and earnings forecasts both rose last week. Forward revenues is at a record high for the first time since the end of November, but forward earnings remains 0.5% below its record high in early December. Analysts expect forward revenues growth of 6.3% and forward earnings growth of 8.0%. Forward revenues growth remains near a seven-year high, but forward earnings growth is down from a six-year

high of 16.9% in February to the lowest level since June 2016. Prior to the passage of the Tax Cuts and Jobs Act (TCJA), forward revenues growth was 5.5% and forward earnings growth was 11.1%. Turning to the annual growth expectations, analysts expect revenue growth to slow to 6.4% in 2019 from 8.8% in 2018, and think earnings growth will drop to 7.3% from a TCJA-boosted 23.7% in 2018. The forward profit margin was steady w/w at 12.2%, but that's down 0.2ppt from a record high of 12.4% in mid-September. Still, that's up from 11.1% prior to the passage of the TCJA in December and compares to a 24-month low of 10.4% in March 2016. The S&P 500's forward P/E rose w/w to 14.5 from 14.3, which was the lowest reading since October 2013 and down 23% from a 16-year high of 18.6 at the market's valuation peak in late January. The S&P 500 price-to-sales ratio of 1.77 is up from 1.75 a week earlier, which was the lowest since November 2016 and down 19% from a record high of 2.16 in late January.

S&P 500 Sectors Earnings, Revenues, Valuation & Margins (*link*): Consensus forward revenues rose w/w for eight of the 11 sectors, and forward earnings rose for 10/11 sectors. Information Technology was the only sector to have both measures fall w/w. Forward revenues and earnings are at or around record highs for 4/11 sectors: Consumer Discretionary, Health Care, Industrials, and Tech. The forward profit margin appears to be rolling over from recent highs for all but Financials and Utilities. They were at record highs during 2018 for 8/11 sectors, all but Energy, Health Care, and Real Estate. Energy's forward earnings had about tripled from the 18-year low in April 2016 through early November, but has tumbled 11.4% since then. Forward P/S and P/E ratios are now well below their 2018 highs for all sectors, and are at multi-year lows for five sectors: Energy, Financials, Industrials, Materials, and Tech. Energy's forward P/E of 13.3 is elevated relative to historical levels, but continues to slowly return to normal after soaring in 2016 when revenues and earnings collapsed. Due to the TCJA, higher margins are expected y/y in 2018 for all sectors but Real Estate, but that sector's forward earnings includes gains from property sales and typically improves as the year progresses. The outlook for 2019 shows lower margins are expected y/y for 3/11 sectors: Communication Services, Health Care, and Real Estate. During the latest week, the forward profit margin rose for Real Estate, but fell for five sectors. Nine of the 11 sectors are down from record highs just a few months ago. Here's how the sectors rank based on their current forward profit margin forecasts versus their highs during 2018: Information Technology (22.4%, down from 23.0%), Financials (19.0, down from 19.2), Real Estate (15.5, down from 17.0), Communication Services (14.8, down from 15.4), Utilities (at a record high of 12.9%), S&P 500 (12.2, down from 12.4), Materials (11.1, down from 11.6), Health Care (10.5, down from 11.2), Industrials (10.2, down from 10.3), Energy (7.2, down from 8.0), Consumer Staples (7.5, down from 7.7), and Consumer Discretionary (7.5, down from 8.3).

Contact us by email or call 480-664-1333.

Ed Yardeni, President & Chief Investment Strategist, 516-972-7683
Debbie Johnson, Chief Economist, 480-664-1333
Joe Abbott, Chief Quantitative Strategist, 732-497-5306
Melissa Tagg, Director of Research Projects & Operations, 516-782-9967
Mali Quintana, Senior Economist, 480-664-1333
Jackie Doherty, Contributing Editor, 917-328-6848
Valerie de la Rue, Director of Institutional Sales, 516-277-2432
Mary Fanslau, Manager of Client Services, 480-664-1333
Sandy Cohan, Senior Editor, 570-775-6823