MORNING BRIEFING
September 28, 2023

Semis, Earnings & Musk's Robot

Check out the accompanying chart collection.

Executive Summary: A new trend among big tech companies: DIY AI. Amazon, Google, Tesla, Meta, and Microsoft are developing AI chips in house rather than paying up for Nvidia's products. … Also: Analysts expect much improved earnings growth for S&P 500 companies on the whole next year, but some industries with the strongest projected growth also have stock price indexes in the doghouse this year to date. Jackie points out which. … And: Inside the neural networks of Elon Musk.

Technology: Everyone's Making Semis. Large tech companies have been jumping into the semiconductor industry. Amazon, Google, Tesla, and others have developed semiconductors for use in their own operations instead of buying all of their semiconductors from Nvidia, Intel and the like. Custom-made chips tailored to their company's specific requirements can perform better and are cheaper to make than buying other companies' chips in the market.

In the case of AI server chips, companies undoubtedly are looking to save money by developing an alternative to Nvidia's chips, which in the case of its A100 GPUs can sell for $20,000 to $25,000 each on *eBay*. The costs can add up quickly. OpenAI, for example, will need more than 30,000 of Nvidia's A100 GPUs for the commercialization of ChatGPT, an April 18 *article* at TheVerge.com reported.

Here's a look at the progress some tech companies are making in designing their own chips:

(1) *Amazon chips in.* Earlier this week, Amazon said it will invest up to $4 billion in Anthropic, an artificial intelligence (AI) firm with an AI chatbot called "Claude 2." Anthropic will use Amazon Web Services (AWS) as its primary cloud provider, and it will use AWS-designed semiconductors when training the AI models on vast amounts of data.

Anthropic will use AWS Trainium and Inferentia chips to build, train, and deploy future foundation models. The two companies will also collaborate on the development of future Trinium and Inferentia technology. The two chips are considered a less expensive, more accessible alternative to Nvidia chips used for the same purposes.

Amazon jumpstarted its efforts in chip development in 2015 when it purchased Annapurna Labs, an Israeli startup. Since then, it has produced Graviton and Nitro, chips used in its servers. Now Amazon has an AI package to offer clients. In addition to Anthropic, Amazon can offer clients its Trainium and Inferentia chips; Titan, a large language model; and Bedrock, a service to help developers enhance software using generative AI. Some believe that having its own AI chips—which Microsoft does not have—will become a differentiator for Amazon, an excellent August 21 CNBC *article* on Amazon's efforts reported.

(2) *Google has AI chips too.* Google has custom developed Tensor Processing Units, chips designed to accelerate machine learning tasks like image recognition, natural language processing, and predictive analysis. Only customers of Google Cloud access the chips.

Google has also developed Tensor chips for its Pixel phones in conjunction with Samsung. Google reportedly is working to design its first fully custom chipset, the Tensor G5, by 2025 without the aid of Samsung, a July 7 Tom's Guide *article* reported. TSMC would handle the production of the chip.

(3) *Tesla has Dojo.* Tesla has built the Dojo chip to train AI networks in data centers. The chips are designed and built for "maximum performance, throughput and bandwidth at every granularity," the company's *website* states. The chips are used in the company's Dojo supercomputer, first revealed in 2021, and used to train Tesla's self-driving AI models. It can quickly analyze the company's extensive video from its fleet of vehicles, a September 25 *article* on DriveTeslaCanada.ca reported. The system could also be used in robotics and other autonomous systems. Tesla uses Taiwan Semiconductor Manufacturing Co. to manufacture the Dojo chips and reportedly has doubled its order this year, the article stated.

(4) *Meta & Microsoft in the mix.* Microsoft is working on developing the Althena AI chip, which could replace Nvidia chips. The project, which began in 2019, reportedly will result in chips that will be made available to Microsoft and Open AI employees as soon as next year.

Meta is also working on a chip for its AI services. The Meta Training and Inference Accelerator—or MTIA chip—in combination with GPUs purportedly delivers better performance, decreased latency, and greater efficiency, a May 18 *article* at TheVerge.com reported. It's not expected to come out until 2025.

(5) *Semi industry performance data.* The S&P 500 Semiconductors stock price index has risen 66.2% ytd through Tuesday's close, though it's down 11.5% from its record high on

August 1 (*Fig. 1*). Nvidia has had a huge impact on the industry this year. Its shares have risen 188.9% ytd through Tuesday's close. If the company were removed from the S&P 500 Semiconductors stock price index, the index would be up only 23.2% ytd.

Semiconductor stocks have rallied in advance of the rebound anticipated in revenues and earnings growth next year. The industry is expected to see its revenue growth flip from a decline of 2.1% this year to an increase of 17.4% in 2024 (*Fig. 2*). Likewise, earnings are expected to decline 7.5% this year but surge 37.0% in 2024 (*Fig. 3*). If Nvidia's earnings were eliminated from the Semiconductors industry, the industry's forward revenues growth rate would drop to 7.9% from 15.6% and its forward earnings growth drops to 20.6% from 35.5%.

The Semiconductors industry's forward P/E peaked at 29.5 in mid-July, and it currently stands at 22.7 (*Fig. 4*). But as earnings rebound next year, the cyclical industry's forward P/E should fall. If Nvidia's forward P/E of 28.3 were eliminated from the calculation, the industry's forward P/E would be only 19.0.

Strategy: Looking at 2024. You'd never know it by this week's stock market performance, but analysts actually are quite optimistic about the S&P 500 companies' earnings prospects in 2024. They're collectively forecasting an 11.7% earnings increase next year, following flattish growth this year of a projected 1.1% and last year's actual 7.1% increase.

Notably, earnings growth is expected for all 11 of the S&P 500's sectors next year. Here's the performance derby for Wall Street analysts' consensus 2024 earnings forecasts for the S&P 500 and its 11 sectors: Communication Services (18.2%), Technology (15.3), Consumer Discretionary (15.1), Health Care (13.1), Industrials (13.1), S&P 500 (11.7), Utilities (8.6), Financials (8.5), Consumer Staples (7.4), Materials (6.1), Real Estate (3.6), and Energy (2.1) (*Table 1*).

Several of the industries expected to enjoy the strongest earnings growth in 2024 nonetheless have stock price indexes that have fallen ytd through Tuesday's close. Here those industries are, ranked by their 2024 earnings growth forecasts: Property & Casualty Insurance (46.6% 2024 earnings growth forecast, -2% ytd return), Gold (38.3, -16.5), Investment Banking & Brokerage (30.8, -14.9), Aerospace & Defense (29.6, -12.2), Housewares & Specialties (26.8, -27.5), Copper (26.4, -3.8), Broadcasting (25.6, -9.9), Pharmaceuticals (23.6, -2.5), Home Furnishings (22.7, -17.0), and Reinsurance (22.5, -0.7).

Three industries from the Financials sector are expected to have an impressive earnings

turnaround in 2024: Property & Casualty Insurance, Investment Banking & Brokerage, and Reinsurance. Some observers have been optimistic that recent IPOs from ARM and Instacart would signal the beginning of a new IPO cycle. The market selloff might squash this nascent optimism. Insurance industry analysts may be hopeful that the companies will be able to raise the premiums they charge in the wake of recent disasters. Stock investors don't seem quite so sure.

The strong earnings expected for both the Copper and Gold industries stands in sharp contrast to the poor performance of their stock price indexes. As for the underlying commodities, the price of copper is down 4.7% ytd through Tuesday's close, and the price of gold is up 4.6% ytd. The Gold industry contains the shares of Newmont Mining, which have been under pressure since the company offered to purchase Australian gold and copper miner Newcrest Mining for $17.5 billion.

Disruptive Technologies: Musk's Neural Networks. While Elon Musk is best known for manufacturing electric cars and space rockets, he's also juggling some smaller projects that are equally as interesting. They include developing human-like robots and mind-reading devices, both of which involve neural networks and both of which have made progress recently. Let's take a look:

(1) *Optimus grows up.* Last weekend, Tesla released an impressive *video* on X (a.k.a. Twitter) of Optimus, its human-like robot. It showed Optimus using "vision" to pick up and sort small blocks. The robot has human-like fingers and moves smoothly, more like a human than a herky-jerky robot. When a human moved around the blocks, Optimus was able to react to the changes and continue sorting. When one of the blocks fell on its side, Optimus knew to set the block upright.

Optimus has a neural network, which is also used in AI and in Tesla's autonomous cars. "A neural network is a method in artificial intelligence that teaches computers to process data in a way that is inspired by the human brain. It is a type of machine learning process, called deep learning, that uses interconnected nodes or neurons in a layered structure that resembles the human brain. It creates an adaptive system that computers use to learn from their mistakes and improve continuously. Thus, artificial neural networks attempt to solve complicated problems, like summarizing documents or recognizing faces, with greater accuracy," explains the AWS *website*.

Tesla switched to using neural networks over the last year. Previously, Tesla's Autopilot system was trained using a rules-based approach. The car's camera would identify a red

light, and its software program would create rules instructing it to stop at red lights.

Neural networks learn by watching "millions of examples of what humans have done … It's like the way humans learn to speak and drive … [W]e might be given a set of rules to follow, but mainly we pick up the skills by observing how others do them," explained Dhaval Shroff, a member of Tesla's autopilot team in an *excerpt* from Water Isaacson's *Elon Musk* biography. The Autopilot system is shown millions of videos of humans reacting properly to driving situations, which have been recorded by Tesla vehicles. By learning this way, the system reacts to unusual situations and breaks the rules when necessary, just as humans do when driving. The driving system based on neural networks is awaiting approval from regulators.

While no time has been given for Optimus' release, it's easy to imagine the robot working in Tesla factories; if the company slashed its labor costs as a result and passed the savings onto customers by lowering the price of a Tesla, it could gain a competitive advantage. Never one for humility, Musk said earlier this year that the "Optimus stuff is extremely underrated," and demand could be as high as 10-20 billion units, a September 24 Electrek *article* reported. "He went as far as 'confidently predicting' that Optimus will account for 'a majority of Tesla's long-term value.'"

(2) *Harnessing brain waves.* Neural networks are something Musk is familiar with from another of his companies, Neuralink. It has developed a device that's implanted in a monkey's head and can transmit the monkey's thoughts to a lever, allowing the monkey to play the "Pong" video game without ever touching a controller.

The brain's neurons send information to different parts of the body. Neurons connect to each other in a neural network and communicate using chemical signals called neurotransmitters. "The reaction between different neurons will create an electric field, and these reactions can be recorded by placing neurotransmitters nearby. The electrodes will then translate these signals into an algorithm a computer can interpret," explained November 2020 *article* published in *Medium*.

Neuralink received FDA approval in May to test its device on humans in a six-year trial that will evaluate whether the system can help those with paralysis control devices by using their thoughts. The PRIME (Precise Robotically Implanted Brain-Computer Interface) study is looking for people with quadriplegia due to vertical spinal cord injury or ALS who are over the age of 22 and have a consistent caregiver, a September 19 *article* at TheVerge.com reported. The brain device, a surgical robot that implants the device, and the user app each

will be evaluated. Neuralink and Musk have come under criticism for Neuralink's treatment of monkeys during the development of the product.

Some have speculated that the system could be used to treat conditions such as obesity, autism, depression, hearing loss, and schizophrenia. There are also reports that the device could be used to download a new language or stream music into your head. The company does face competition. Precision Neuroscience, formed by a Neuralink co-founder, has developed a thin piece of tape that sits on the brain's surface, and Blackrock Neurotech implanted its first brain-computer interface back in 2004, noted a September 21 BBC *article*.

Calendars

US: **Thurs:** Real GDP & GDP Price Index 2.2%/2.0%; Headline & Core PCED 2.5%/3.7%; Corporate Profits 1.6%; Kansas City Manufacturing Index; Initial & Continuous Jobless Claims 217k/1.675m; Pending Home Sales; Natural Gas Storage; Powell; Cook; Goolsbee. **Fri:** Headline & Core PCED 0.5%m/m/3.5%y/y & 0.2%m/m/3.9%y/y; Personal Income & Spending 0.4%/0.5%; University of Michigan Consumer Sentiment Total, Current Conditions, and Expectations 67.7/69.8/66.3; One-Year & Five-Year Expected Inflation Rates 3.1%/2.7%; Chicago PMI 47.4; Wholesale Inventories 0.1%; Baker-Hughes Rig Count; Williams. (FXStreet estimates)

Global: **Thurs:** Eurozone Business & Consumer Confidence 92.5; Eurozone PPI; Germany CPI 0.4%m/m/4.6%y/y; Italy Business Confidence 98; Italy Business Confidence 106.0; Spain Retail Sales 3.4%y/y; Spain CPI 3.5%y/y; Japan Unemployment Rate 2.6%; Japan Industrial Production -0.8%; Japan Retail Sales 6.6%y/y; ECB Economic Bulletin; Enria; McCaul. **Fri:** Eurozone Headline & Core CPI 4.5% & 4.8%y/y; Germany Import Price Index 0.5%; Germany Retail Sales 0.1%; Germany Unemployment Change & Unemployment Rate 14k/5.7%; France CPI -0.2%m/m/5.9%y/y; Italy CPI 1.2%m/m/5.2%y/y; UK GDP 0.2%q/q/0.4%y/y; Lagarde. (FXStreet estimates)

Strategy Indicators

Stock Market Sentiment Indicators (*link*): The *Bull-Bear Ratio* dropped below 2.00 for the first time since late May, falling for the second week from 2.25 to 1.83 this week; it was at 3.07 eight weeks ago. *Bullish* sentiment fell for the second week by 7.0ppts to 43.7% this

week, after climbing the prior two weeks by 7.6ppts (to 50.7% from 43.1%). It was at 57.1% during the August 1 week—which was the most bulls since November 2021, when the reading reached a danger level of 57.2%. Meanwhile, _bearish_ sentiment climbed for the fifth week, by 5.3ppts, to an 18-week high of 23.9% this week, after falling five weeks ago from 20.0% to 18.6%—it had fluctuated in a volatile flat trend before the recent move up. The _correction count_ climbed for the second week to 32.4% this week, after falling the prior three weeks by 10.3ppts (to 26.8% from 37.1%); it was 24.3% eight weeks ago, which was the lowest since the start of the year. Turning to the _AAII Sentiment Survey_ (as of September 21), bullish sentiment sank to a 16-week low, while bearish sentiment rebounded back above its historical average. The _percentage expecting stock prices to rise over the next six months_ fell for the second week by 10.9ppts to 31.3% (lowest since June 1), after climbing the prior two weeks by 9.9ppts (to 42.2% from 32.3%)—putting optimism below its historical average of 37.5% for the fifth time in six weeks. The _percentage expecting stocks to fall over the next six months_ rose 5.4ppts to 34.6%, after falling the prior three weeks by 6.7ppts (to 29.2% from 35.9%). Pessimism is above its historical average of 31.0% for the third time in five weeks. The _percentage expecting stock prices will stay essentially unchanged over the next six months_ pulled back by 2.3ppts to 34.1% during the September 21 week, after increasing 8.2ppts to 36.4% the prior week, which was the highest since May 18 (37.4%). It was above its historical average of 31.5% for the fifth time in six weeks.

S&P 500 Sectors & Industries Forward Profit Margin Since March 30 Bottom (_link_): The S&P 500's forward profit margin rose 0.1pt w/w to an 11-month high of 12.8% as of the September 21, 2023 week. It's now up 0.5ppt from a two-year low of 12.3% during the March 30 week. Seven of the 11 sectors' margins have improved since then, with the S&P 500's gain paced by four sectors. It's still down 4.4%, or 0.6ppt, from its record-high 13.4% during the June 9, 2022 week, as eight of the 11 sectors' margins are down since then, with the S&P 500's drop paced by four of the 11 sectors. Here's the sector performance since the S&P 500's forward profit margin bottom on March 30: Consumer Discretionary (up 14.7% to 8.4%), Communication Services (up 14.7% to 16.6%), Information Technology (up 9.8% to 25.7%), Industrials (up 5.2% to 10.8%), S&P 500 (up 4.4% to 12.8%), Real Estate (up 2.9% to 17.1%), Materials (up 1.9% to 11.2%), Consumer Staples (up 1.7% to 6.8%), Financials (down 1.4% to 18.2%), Utilities (down 1.4% to 13.0%), Energy (down 2.5% to 11.4%), and Health Care (down 3.7% to 9.3%). These are the best performing industries since the March 30, 2023 bottom: Casinos & Gaming (up 92.8% to 7.4%), Publishing (up 22.4% to 3.0%), Homebuilding (up 19.5% to 12.8%), Wireless Telecommunication Services (up 19.4% to 13.7%), Interactive Media & Services (up 16.6% to 23.3%), Semiconductors (up 16.4% to 31.1%), Brewers (up 15.0% to 9.1%), and Hotels, Resorts, & Cruise Lines (up 13.3%).

US Economic Indicators

Durable Goods Orders & Shipments (*link*): Durable goods orders remain at record levels. *Durable goods orders* edged up 0.2% in August, following a 5.6% drop in July, led by a 14.9% plunge in transportation orders, primarily aircraft. Headline orders had increased the prior four months, by 11.2%, to a new record high. *Excluding transportation*, durable goods orders expanded for the eighth time in nine months, by 0.4% in August and 1.7% over the period, to a new record high. Meanwhile, *nondefense capital goods orders excluding aircraft* (a proxy for future business investment) climbed 0.9% last month to a new record high, while *nondefense capital goods shipments excluding aircraft* (used in calculating GDP) climbed 0.7%, also to a new record high. In August, orders for motor vehicle & parts, electrical equipment, appliances & components, and machinery all climbed to new record highs. Meanwhile, orders for both primary metal and fabricated metals remained in record-high territory.

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, 570-228-9102