

MONONGAHELA CAPITAL MANAGEMENT

PERCEPTIONS

2 nd Quarter, June 30, 2023	06/30/2023	% Change 2 nd Quarter	% Change Year to date
Dow Jones Industrials	34,407.60	3.97 %*	4.94 %*
S & P 500	4,450.38	8.74 %*	16.89 %*
Russell 2000	1,888.73	5.21 %*	8.09 %*
BC Aggregate BD Index		-0.84 %	2.09 %
10 YR. Treasury Yield	3.84 %		
30 YR. Treasury Yield	3.86 %		

* Includes reinvested dividend

The Chain Reaction of Discovery

Christopher Nolan's latest film, *Oppenheimer*, is slated to be released in late July. The movie portrays the complex life of J. Robert Oppenheimer, a theoretical physicist who, as director of the top-secret Los Alamos Laboratory, played a central role in the Manhattan Project and the development of nuclear weapons during World War II. Ahead of the release, we revisited the Pulitzer Prize and National Book Award winner, *The Making of the Atomic Bomb* by Richard Rhodes published in 1987. The book exhaustively chronicles the events leading up to the detonation of two atomic bombs over Hiroshima and Nagasaki in August 1945. While Oppenheimer and Los Alamos are featured prominently in the book, the first half provides a fascinating story of scientists and breakthroughs as a new era of physics was ushered in at the turn of the century.

The idea of an atom had been around since the Ancient Greek philosophers and was revived in the 1700s. It was not until 1911 however that Ernest Rutherford discovered an essential part of the atom, the nucleus. The leading theory at that time – the “plum pudding” model – postulated that an atom was mostly an empty void like a mushy ball of pudding where electrons, only recently discovered, floated sparsely around like plums. A beam of particles directed towards atoms should therefore largely pass through uninhibited. Rutherford noticed that some particles deflected at an angle of a few degrees however and, always with a knack for experiment, wanted to measure it.

In a somewhat simple experiment, Rutherford, alongside his assistant Hans Geiger and student Ernest Marsden, sent particles towards a plate of gold foil. Most particles passed through as expected, but some deflected more than anticipated. Rutherford asked that the experiment be redesigned. On a hunch, he wanted to look for particles being reflected directly back instead of measuring for only a small angle of deflection. The experiment confirmed Rutherford's intuition, and the results would have profound implications. He described the results as “quite the most incredible event that has ever happened to me in my life” stating “it was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you.” From the results, Rutherford correctly deduced that the atom was not

just an empty void but must contain an extremely small and dense center – the center which the particles in the experiment were occasionally bouncing into. Rutherford had found the nucleus of the atom, and thus the era of “nuclear” physics was born.

Rhodes details how exciting this period was for theoretical and experimental physicists. While the century started with only one thousand physicists around the world, the field quickly grew and, inspired by Rutherford and others like Niels Bohr, a dizzying array of breakthroughs occurred as scientists rushed to test, collaborate, publish, and lecture in a budding new field. In 1932 James Chadwick identified an important component of the nucleus – the neutron. By 1938 Lise Meitner and Otto Frisch had proved that bombarding the element uranium with neutrons could cause the uranium atom to split, thereby releasing energy (following Einstein’s famous equation) and importantly more neutrons. If these neutrons interacted with the nuclei of more uranium atoms, the reaction could continue and perhaps grow. Then on December 2, 1942 Enrico Fermi stood in front of a pile of seemingly inert 45,000 graphite bricks under the bleachers of Stagg Field at the University of Chicago ready for the next great experiment.

This was no ordinary stack of bricks however. They had been refined and laboriously machined before being strategically stacked in 57 layers with uranium latticed throughout. The uranium spewed neutrons and the graphite, acting as moderator, slowed them down giving time to interact with other uranium nuclei. Only rods of cadmium, which absorbs neutrons, slotted throughout the pile acted as a control mechanism. On this cold December day ready to proceed, Fermi directed all but one rod to be removed. With a slide rule in hand, Fermi instructed the final rod’s removal six inches at a time as the neutron intensity increased. At 3:53pm, inside the pile, more neutrons were being created than absorbed. A critical mass had been achieved and shortly after Fermi ordered the control rods reinserted. While the Chicago Pile-1, as it became known, had produced only a half watt of energy – enough power for one small lightbulb – the intensity was doubling every two minutes (in an hour and a half, it would have either produced a million kilowatts or melted down by then). Incredibly, the gap between discovering the atomic nucleus and controlling subatomic particles in a self-sustained nuclear reaction was a mere 31 years.

As we revisited Rhode’s book and reflected on the first half of the year in the markets, it is hard not to think about artificial intelligence (AI). We will leave the analysis of similarities (or dissimilarities) between nuclear physics and artificial intelligence to the experts, but the resemblance in the aurora of excitement towards scientific breakthrough is hard to miss. Apt or not, this excitement has bled into the markets.

On May 24th this year, Nvidia Corp released its first quarter results. Expectations for the manufacturer of specialized computer components like GPUs and related software were already high after the year started with promising AI announcements like the launch of OpenAI’s ChatGPT 4.0 in March and subsequent integration across many Microsoft services. In fact, before the earnings release, Nvidia was already up 109% for the year. As the headlines came out, the market was pleased with first quarter revenue which came in slightly better than expected but shocked when Nvidia said that it was “significantly increasing our supply to meet surging demand” and that for the second quarter “revenue is expected to be \$11.00 billion, plus or minus 2%.” The consensus for expected second quarter revenue by security analysts who publicly follow the stock had been near \$7 billion. It is rare for a company to

surprise with this much upside, especially for a very large company. Nvidia closed the next day up 24%, and by the end of the quarter was up over 189% for the year, no small feat for a company that joined the rarefied air of companies with market valuations over a trillion dollars.

Scientific and technological progress is often evolutionary, like the years of theory and experiment leading up to Enrico Fermi's moment under the bleachers at Stagg Field. Once that moment does occur, theory becomes reality and the advanced search for practical applications begins. Nvidia's dramatic announcement was a very tangible confirmation that we have entered the investment phase of discovering AI's potential. Cap Ex spending benefits the toolmakers, like Nvidia, and they are the first to recognize revenue and profitability from the transformation. While AI is already presenting productivity gains in applications like task automation and programming, we are very early in the discovery process. Platform changes like desktop to mobile computing took years to develop; the potential for AI and the related applications to be fully realized will be measured in years and decades.

The efficiencies and productivity gains AI offers will eventually translate into increased revenue and profitability. From our investment research perspective, this is what ultimately will drive value and outsized returns in the market. While the initial focus has been on the technology sector, the efficiencies presented will benefit all sectors, from Healthcare to Finance. Of course, as with all new technologies, there will be winners and losers, visionaries and charlatans promising the moon. As we manage your portfolio, we will work to diligently separate the hype from reality and properly construct your individual portfolio with an appropriate balance of opportunity and risk.