



SYDNEY P. VAN SCOY, ASSOCIATE PORTFOLIO MANAGER, CLEARSTEAD

## THE FUTURE OF ARTIFICIAL INTELLIGENCE

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Many agree that Artificial Intelligence (AI) is the future; however, that future, has already arrived. To understand the full scope of AI, analyzing the breakdown of how it has evolved and how it affects the macroeconomic, microeconomic, and individual landscape is crucial.

AI is defined as a machine's ability to perform cognitive functions that we typically associate with humans, such as perceiving, learning, problem solving, and even exercising creativity.<sup>1</sup> This technology has been continuously evolving and adapting throughout time to promote ease and efficiency. More recently, ChatGPT has exploded in popularity and caused a lot of excitement surrounding AI. This system is a generative AI tool that relies on natural language processing to create human-like dialogue. This is done by using internet data and learned behavior patterns to answer both simple and complex questions that individuals may ask it online. While ChatGPT is a more recent development, AI has been around since the 1940s, which has helped it become as useful as it is today. Figure 1 shows a timeline of AI development over the past several decades.

## CLEARSTEAD CONTINUES TO BOLSTER TEAM WITH NEW TALENT

We are pleased to announce that we have added talent to the Reporting and Operations and Institutional Consulting teams with Administration team with Patrick Boehmer and Rachel Welch respectively.

Patrick Boehmer has joined Clearstead as a Performance Analyst. He is currently pursuing his degree in General Business at Cleveland State University. Prior to joining Clearstead, Patrick was employed at Progressive as a Data Analyst II.

Rachel Welch has joined Clearstead as an Institutional Coordinator. She is currently enrolled in a Bachelors of Business Administration program at Lorain County Community College. Prior to joining Clearstead, Rachel was employed at Celtic Enterprises as a Project Coordinator.

These changes underscore the firm's commitment to building its investment consulting practice, promoting the next generation of leadership, and maintaining a rigorous investment process.

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Figure 1

1946	1950	1956	1956-1974	1958	1966
<p><b>McCulloch-Pitts Neuron</b></p> <p>Warren McCulloch and Walter Pitts propose a computational model for an artificial neuron, laying the foundation for neural networks.</p> <p><i>(Source: "Elements of Artificial Neural Networks" Tambe, Kulkarni, and Deshpande)</i></p>	<p><b>Turing Test</b></p> <p>Alan Turing introduces the concept of the Turing Test, a measure of a machine's ability to exhibit intelligent behavior indistinguishable from that of a human.</p> <p><i>(Source: Dartmouth Artificial Intelligence Conference)</i></p>	<p><b>Dartmouth Workshop</b></p> <p>John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon organize the Dartmouth Workshop, widely considered the birthplace of AI, where the term "artificial intelligence" is coined.</p> <p><i>(Source: Dartmouth Artificial Intelligence Conference)</i></p>	<p><b>Early AI Research</b></p> <p>Researchers develop early AI programs and techniques, including the Logic Theorist, General Problem Solver, and the development of rule-based expert systems.</p> <p><i>(Source: AI: A Modern Approach, Stuart Russell and Peter Norvig)</i></p>	<p><b>Perceptron</b></p> <p>Frank Rosenblatt introduces the perceptron, a simple neural network model capable of learning, marking a significant advancement in AI research.</p> <p><i>(Source: "The Perceptron: A Probabilistic Model for Information Storage and Organization in the Brain," Frank Rosenblatt)</i></p>	<p><b>ELIZA</b></p> <p>Joseph Weizenbaum creates ELIZA, a natural language processing program that simulates conversation, pioneering the field of chatbots.</p> <p><i>(Source: "ELIZA—A Computer Program for the Study of Natural Language Communication Between Man and Machine," Joseph Weizenbaum)</i></p>
1973	1980s	1986	1997	2011	2012
<p><b>LISP and Knowledge-Based Systems</b></p> <p>The programming language LISP, designed for AI research, becomes widely used. Researchers also begin developing knowledge-based systems, which use rules and inference to solve complex problems.</p> <p><i>(Source: "The Evolution of AI" John Sunda Hsia)</i></p>	<p><b>Expert Systems</b></p> <p>Expert systems, which utilize knowledge bases and rule-based reasoning, gain popularity. They are used in various domains, such as medicine and finance.</p> <p><i>(Source: "Elements of Artificial Neural Networks" Tambe, Kulkarni, and Deshpande)</i></p>	<p><b>Backpropagation</b></p> <p>The backpropagation algorithm for training multi-layer neural networks is rediscovered and becomes a fundamental technique in deep learning.</p> <p><i>(Source: "A Very Short History of Artificial Intelligence (AI)" Gil Press)</i></p>	<p><b>Deep Blue Defeats Kasparov</b></p> <p>IBM's Deep Blue defeats chess champion Garry Kasparov, demonstrating the power of AI in complex strategic games.</p> <p><i>(Source: "Deep Blue Defeats Kasparov," IBM Research)</i></p>	<p><b>Watson Wins Jeopardy!</b></p> <p>IBM's Watson AI system wins the Jeopardy! game show against human champions, showcasing advancements in natural language processing and knowledge retrieval.</p> <p><i>(Source: "Building Watson: An Overview of the DeepQA Project," IBM Journal of Research and Development)</i></p>	<p><b>ImageNet Breakthrough</b></p> <p>Deep learning models, specifically convolutional neural networks (CNNs), achieve significant improvements in image classification accuracy, with models like AlexNet winning the ImageNet competition.</p> <p><i>(Source: "ImageNet Classification with Deep Convolutional Neural Networks," Alex Krizhevsky et al.)</i></p>
2014	2016	2017	2018	2020	
<p><b>Generative Adversarial Networks (GANs)</b></p> <p>Ian Goodfellow introduces GANs, a framework for training generative models by pitting two neural networks against each other, leading to advancements in image generation and other creative applications.</p> <p><i>(Source: "Generative Adversarial Nets," Ian Goodfellow et al.)</i></p>	<p><b>AlphaGo Defeats Lee Sedol</b></p> <p>Google's AlphaGo defeats world champion Go player Lee Sedol, demonstrating AI's ability to excel in complex, strategic board games.</p> <p><i>(Source: "Mastering the game of Go with deep neural networks and tree search," Nature)</i></p>	<p><b>DeepMind's AlphaZero</b></p> <p>DeepMind develops AlphaZero, an AI system capable of mastering Go, chess, and shogi without prior knowledge or human guidance, solely through self-play and reinforcement learning.</p> <p><i>(Source: "Mastering Chess and Shogi by Self-Play with a General Reinforcement Learning Algorithm," Science)</i></p>	<p><b>Transformer Architecture</b></p> <p>The Transformer architecture, introduced by Vaswani et al., revolutionizes natural language processing with models like BERT and GPT, achieving state-of-the-art performance on various language tasks.</p> <p><i>(Source: "Attention Is All You Need," Vaswani et al.)</i></p>	<p><b>GPT-3</b></p> <p>OpenAI unveils GPT-3, a language model with 175 billion parameters, demonstrating impressive language generation capabilities and the potential for large-scale AI systems.</p> <p><i>(Source: "Language Models are Few-Shot Learners," Tom B. Brown et al.)</i></p>	

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## MACROECONOMIC LEVEL

According to the Bureau of Labor Statistics, the US productivity growth rate is well below its long-term average at 1.3% per year for the last 3.5 years.<sup>2</sup> AI may be a solution to reversing this recent lag for many reasons, particularly because of its ability to complete tedious tasks more quickly. Research has concluded that the continued adoption of AI has the potential to increase the annual productivity growth by ~1.5% to ~2.5% in the coming decade.<sup>3</sup> This is especially meaningful since productivity has been contributing more to GDP growth than employment growth has for several decades.

Figure 2<sup>4</sup> shows the percentage that employment and productivity growth have contributed to the US's Real GDP growth per decade. Notably, between 1972 and 1982, employment growth made up 79% of the Real GDP growth, while between 2012 and 2022 only 28% of Real GDP growth came from employment. The consistent lag in employment growth is likely to continue the same trajectory, making it important for productivity growth to increase going forward. Figure 3<sup>4</sup> shows the US's annualized Real GDP growth rate per decade and from the sources of its growth. Again, employment growth has lagged, while productivity growth continued to surge—partially driven by technology throughout the tech bubble. If the economy continues to adopt AI and it hits its expected growth projections, it may bring the US productivity growth rate back to, or exceed, its long-term average of 2.2%.<sup>2</sup> If this occurs, \$10 trillion could be added to the US's cumulative GDP in the next 10 years.<sup>5</sup> This massive increase in GDP and productivity growth explains some of the excitement that has surrounded AI over the past year.

Figure 2

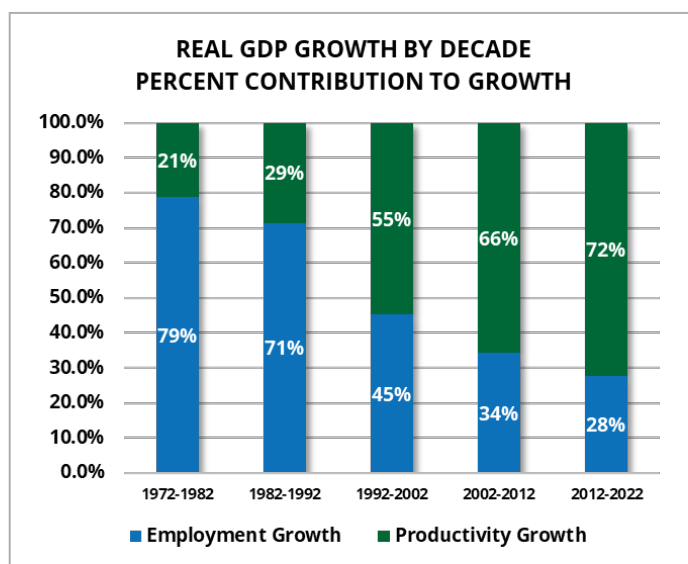
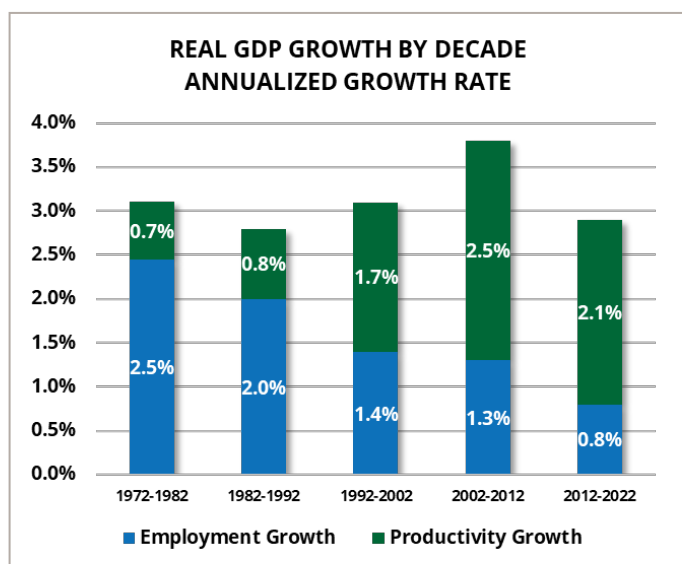


Figure 3



Economists now estimate that approximately two-thirds of US occupations will be exposed to some degree of AI automation in the future.<sup>3</sup> While many are worried that AI will take jobs from humans, most research shows that it will more likely complement a wide variety of occupations rather than replacing actual workers. It is noted that about 60% of today's jobs did not exist in the 1940s,<sup>3</sup> which is likely due to the surge in technology. Can we expect similar job creation growth from AI? At this point it is unclear, but the likelihood of new jobs being created due to this innovation is highly likely.

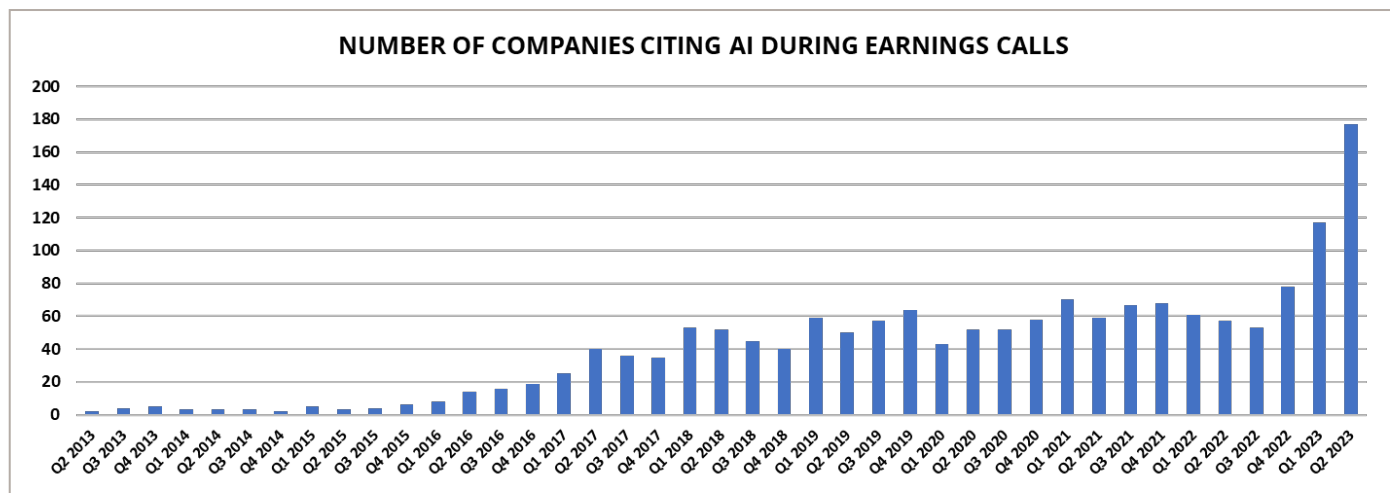
## MICROECONOMIC LEVEL

As AI is an increasingly hot topic, many companies are looking to adopt some form of AI into their company structure. As seen in Figure 4,<sup>6</sup> more than one-third (177) of S&P 500 companies mentioned AI during the second quarter of 2023's earnings season, with every sector being represented. This is the highest number of S&P 500 companies citing AI in quarterly earnings reports in 10+ years.

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Figure 4



Of these 177 companies, the Information Technology sector led the way with 88% of companies mentioning AI, followed by Communication Services (42%), Real Estate (39%), and Financials (38%).<sup>6</sup> Tech giants such as Google and Microsoft mentioned AI numerous times with Google mentioning AI 62 times during their earnings report, up from 52 times in the first quarter, while Microsoft mentioned it 58 times, which was up from 35 times.<sup>7</sup> The increase of AI mentions, along with the continued frequency has caused a lot of chatter—making it a more prominent topic of discussion.

Whether it is being used to detect earlier stages of cancer based on a series of patterns, to being used for driverless cars or analyzing earning calls, AI can benefit a wide variety of sectors. Not only will the integration of AI affect a company's consumers, but it will also boost company productivity, increasing the overall economic productivity. It is estimated that AI and analytics can increase company productivity between 15%-40%, depending on the industry, generating between \$2.6 trillion to \$4.4 trillion in global corporate profits annually.<sup>11</sup> A large portion of this productivity and profit growth is expected to hit banking, technology, life sciences, and transportation industries. As the excitement of AI has surged, we can continue to expect new developments, further benefiting a wide variety of industries, while increasing productivity and corporate earnings.

A Forbes Advisor survey concluded that more than 50% of businesses that use AI use it for cybersecurity and fraud management purposes.<sup>8</sup> Since AI can analyze and interpret data, it can easily detect patterns and anomalies which may indicate potential cyber threats or fraudulent activity. On the other hand, 56% of business owners use AI for customer service support, while 64% believe that AI will help improve customer relations.<sup>8</sup> This includes the use of AI powered chatbots, product recommendations, and touch point optimization through emails, text messages, and instant messaging—strategies that many consumers have used before. AI has given these companies the opportunity to become nimbler and more productive, with the goal of driving sales growth and minimizing overall costs.

While AI provides a wide variety of benefits to businesses, it does pose potential concerns for business owners as well. Over 50% of business owners expressed concern about AI integration since their businesses may become too dependent on technology.<sup>8</sup> This thought likely comes from the significant increase in technology usage over the past two decades and the continuous developments we have experienced. There is also concern that AI integration will affect the work force—approximately 33% of businesses have expressed this concern, while 77% of the public has the same worry.<sup>8</sup> While this is true, as mentioned before, AI will more likely complement a wide variety of industries, completing tedious work so employee efforts can be focused elsewhere. The last significant fear that business owners have about AI is that it may spread misinformation or provide bias errors, negatively impacting a company's customer relations.<sup>8</sup> This thought may have some validity, but AI has the goal to make jobs easier and help business run more efficiently based on "learned" information. As we continue to see more developments in this space, the increased use of these products should benefit companies in the long run.

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## INDIVIDUAL LEVEL

It is likely that you have had some form of interaction with AI whether it was through the chatbot feature on a website, unlocking your phone with facial recognition, talking to Alexa or Siri, or by playing an online game against a computer. These features have affected many individuals and continued developments in this space can, and likely will, present greater value, especially to the investment industry.

The investment management industry has adapted and integrated new strategies that can provide additional opportunities for growth due to the adoption of AI. Some investment managers are using Natural Language Processing and Machine Learning to make their processes more efficient. Natural Language Processing gives a machine the ability to comprehend and interpret the human language while reducing human biases.<sup>9</sup> This can help research by processing vast amounts of data quickly to provide data-driven investment recommendations and insights. Many AI-related strategies can deliver more efficient ways to monitor markets, company performance, evaluate risk factors, analyze market data, and review news sentiment.

One form of AI trading is through Algorithmic Trading, where AI can make split-second trades based on a predefined set of rules and models. These algorithms can exploit market inefficiencies, capitalize on short-term price discrepancies, and manage company-related risks more efficiently.<sup>10</sup> While this is true, the use of AI may cause a portfolio to become overly reliant on backward-looking data. This may cause the system to overlook or incorrectly capture market dynamics, therefore providing an inadequate or incorrect point of view—markets, after all, are social systems subject to investor (irrational or rational) behavior. AI may also underestimate the importance of human judgement, so it is important that there is human expertise integrated with AI strategies. By leveraging a combination of AI and human involvement, investment strategies can be enhanced, and optimal outcomes could be achieved.

AI has drastically changed over time and will continue to do so. It is likely that AI will boost productivity, aiding in company earnings growth and a significant increase in GDP. The addition of AI could increase efficiency and create new job opportunities. This has already started to affect the investment industry and will continue to do so while working with investment professionals. As new developments are made, we will continue to explore and make changes that benefit our clients and our company. Overall, AI has provided a multitude of opportunities thus far, and we expect it to continue to do so.

### Sources:

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*Performance data shown represents past performance. Past performance is not an indicator of future results. Current performance data may be lower or higher than the performance data presented.*

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## MARKET BENCHMARK RETURNS

September 30, 2023		1M	3M	12M	YTD
US Large Cap	S&P 500	-4.8%	-3.3%	21.6%	13.1%
US Small Cap	Russell 2000	-5.9%	-5.1%	8.9%	2.5%
Developed Intl	MSCI EAFE	-3.4%	-4.1%	25.6%	7.1%
Emerging Intl	MSCI Em Mkt	-2.6%	-2.9%	11.7%	1.8%
Real Estate	NAREIT	-6.9%	-8.0%	-0.9%	-5.2%
Core Fixed	BarCap Agg	-2.5%	-3.2%	0.6%	-1.2%
Short Fixed	BarCap 1-3Yr	0.0%	0.7%	2.8%	1.9%
Long Fixed	BarCap LT G/C	-6.2%	-9.4%	-2.9%	-5.4%
Corp Debt	BarCap Corp	-2.6%	-3.0%	3.5%	0.0%

Source: Bloomberg

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