Invesco

In Silico, Part IV

AI and its impact on labor, productivity, and tech-driven deflation

In Silico is a multi-part series discussing artificial intelligence, its economic and financial impact, and its role as a driver of change.

For an introduction to machine learning and deep learning we recommend reading In Silico, Part II: AI and the Quiet Revolution of Machine Learning. For an introduction to generative AI, we recommend In Silico, Part III: The Rise of Generative AI and How It Could Change Our Future.

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Introduction

The future macroeconomic impacts of AI are uncertain. Expectations range wildly from a non-event to a productivity bump to a world-changing displacement of labor. In this article we will focus on clarifying the nature of this uncertainty and make modest estimations of the future using assumptions from similar themes, trends, and events. We also explore AI's potential impact on labor automation and displacement, productivity, and technology's deflationary history.

Creative destruction

History is full of examples of creative destruction, where technological advancements create an ever-changing business landscape and, usually, economic growth. The inventions of steam power, electricity, the automobile, radio, the telephone, the personal computer, the Internet, and countless other examples have transformed the ways we live and work.

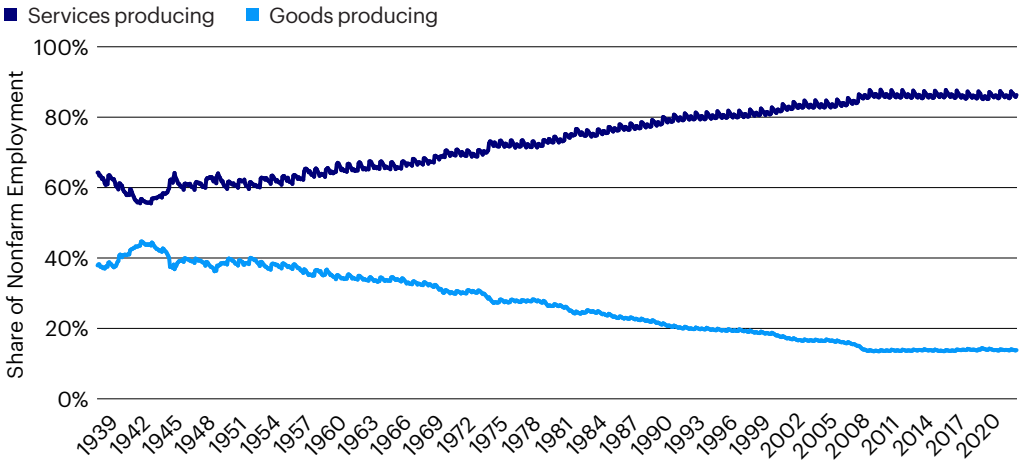
As technology changes, so does the role of labor. In just two centuries, many of today's major economies evolved from largely agricultural economies to manufacturing and then services-producing powerhouses. In 1870, 46% of US occupations were in agriculture, while about 14% of jobs were in services. By 1940, the share shifted to just 17.3% of occupations in agriculture, 41% in services, and the remainder in manufacturing. Today, the US is an information and services economy, where services make up a whopping 86% of jobs.[1] (See Figure 1.)

Generative AI may be the beginning of another cycle of creative destruction. As we explored in Part 3 "The rise of Generative AI and how it could change our future," generative AI capabilities are now able to meet (or sometimes even exceed) human performance in creative and information-focused outputs, evoking fears about its implications for information workers, including those in financial services, software engineering, and marketing. However, as we outlined in that piece, AI still has a variety of shortcomings. In the short-to-medium term, we believe that generative AI will primarily be a tool to complement and augment labor, not a replacement.

1 Source: 1870 and 1940: HSUS Series Ba1033-Ba1046 and The Rise and Fall of American Growth by Robert J. Gordon, 2016; current figures are from US Bureau of Labor Statistics, Macrobond, and Invesco, as of 30 June 2023.

Figure 1: US employment share has shifted over time towards services jobs

Share of nonfarm US employment in goods and services, 1939 to 2023



Sources: Invesco and Macrobond, as of 31 July 2023. Note: Just 1.3% of total US employment is on-farm employment as of 7 July 2023.

"Will AI replace me?"

Likely the most pressing, personal concern in the AI and labor discussion is "Will AI replace me?" The short answer is maybe. Maybe tomorrow, maybe never.

As we wrote in Part 2 "The quiet revolution of machine learning," we think it is important to remember that AI has played an increasing part in our lives for at least the last 15 years. Over this time, machine learning and deep learning have become a standard set of tools for tackling problems across a wide variety of job tasks and roles. Commercial applications include a variety of optimization problems ('how does a set of variables predict X?') to customer behavior analysis to content recommendation. Deep learning technologies, which include computer vision capabilities, have been used in conjunction with robotics to manage real-world, dynamic problems, from automated transport and logistics to assembly line management.

Yet, throughout the last 15 years, developed market (DM) employment rates have not seen a permanent, dramatic change. Instead, in today's environment of content recommendation, ad targeting, and computer-assisted design, unemployment rates are at multi-decade lows. This suggests that while the workplace is evolving over time, human labor collectively is not being replaced even if individuals have changed positions or experienced friction in their attempts to match their skills to a changing environment.

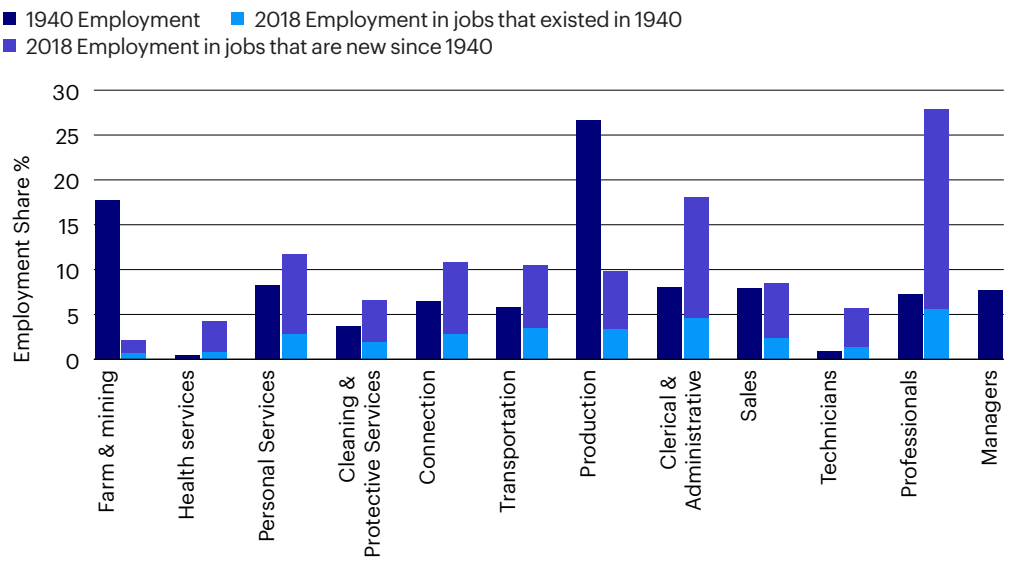
In the near term, we expect to see new dynamics emerge as workers adjust to new capabilities. This may include working with an AI "copilot" for coding and writing, which can meaningfully boost productivity by helping auto-fill rote coding tasks or overcome writer's block. For example, the code-sharing and collaboration website GitHub ran a study on its coding AI assistants and found programmers were able to complete a given software engineering assignment 56% faster than those working unassisted.[2] We may also see AI integrations into creative production pipelines for image editing and computer-generated imagery, audio or video production, and more as other modalities are explored.

Over the longer term, we believe that generative AI will free up human capital to move to where it can perform best, whether by simply freeing up time for 'deep work' or by enabling workers to conduct research and collaborate with AI tools. We also believe that there are still significant hurdles to AI use, like hallucinations, that require human presence for the foreseeable future. Nevertheless, some functions remain subject to automation. Indeed, history has shown on numerous occasions that new technologies have generally reduced or even eliminated entire categories of jobs but created higher skilled, higher value-added jobs in their place.

For example, a 2022 National Bureau of Economic Research (NBER) working paper examined the topic of labor displacement in greater detail and found that numerous jobs that exist today had not been invented in 1940 (See Figure 2). Indeed, the same paper examines how the development of human capital has grown in importance as labor has had to contend with an ever-changing technological landscape.

2 Source: Github: Research: quantifying GitHub Copilot's impact on developer productivity and happiness from 7 September 2022.

Figure 2: Employment share by period and industry, 1940 versus 2018



Sources: For illustrative purposes only, based on Autor, D. 'The Labor Market Impacts of Technological Change: From unbridled enthusiasm to qualified optimism to vast uncertainty' NBER Working Paper 30074, as of 2022..

We do not anticipate enormous net-reductions in labor attributable solely to generative AI. Results from a recent World Economic Forum (WEF) survey appears to support this view. The WEF surveyed organizations from November 2022 through February 2023 on how various innovations might affect the labor market. The survey results showed organizations across economies and sectors reported technological advancements generally as positive for job creation, including for AI; only drones, industrial automation, and humanoid robots were considered net job displacers.[3] Surveyed organizations believed that wider economic conditions were larger job displacers than automation.[4]

In general, predictions of automation typically rely on a sample of opinions from a range of subject matter experts to draw up guiding figures. For example, one can compile estimates about how long it will take for a given technology to reach human ability and to be integrated into workstreams. These estimates are compared against analyses of which jobs are most exposed to AI automation, with occupations classified based on the kinds of tasks involved in the job.

For example, McKinsey examined 2,100 "detailed work activities" that make up occupations, like "communicating with others about operational plans," and suggested that half of today's work activities could be automated between 2030 and 2060.[5] A Goldman Sachs study undertook a similar approach, examining 900 US occupations and 2,000 Euro area occupations.[6] They estimated some two-thirds of jobs are exposed to automation and that a quarter of work tasks could be automated, with white collar and knowledge workers, like administrators and lawyers, most impacted. In fact, it is physically intensive professions, like construction and maintenance, which seem most shielded. Indeed, physically intensive professions appear to occupy a niche between what is too costly to automate and what is so dangerous it must be automated. Across these estimates, we note that automation tends to affect particular work tasks rather than entire professions.

Going forward, we favor outlining three broad, medium-term scenarios for generative AI's impact on labor, with impacts likely varying across different fields:

Scenario #1 - Limited-Use Labor Augmentation: Generative AI shows incremental but limited impacts on labor in a narrow set of use cases due to computational bottlenecks and hardware access constraints, resource constraints, or core challenges unique to AI such as hallucinations and safety concerns.

Scenario #2 - Broad Labor Augmentation: Like previous automation and AI tools, generative AI augments human capital, with technically skilled or niche knowledge workers making use of new technologies. Generative AI may also bring quality-of-life improvements embedded into various apps or experiences, enabling a meaningful but smaller-than-expected productivity bump.

Scenario #3 - Labor Displacement: Generative AI replaces human labor across a range of functions after proving to be a highly effective, outperforming technology which is widely scalable, readily accessible, and affordable.

3 World Economic Forum: Future of Jobs Report 2023 p. 25
4 World Economic Forum: Future of Jobs Report 2023 p. 21
5 Source: The economic potential of generative AI: The next productivity frontier, McKinsey, 14 June 2023.
6 Goldman Sachs Research Newsletter

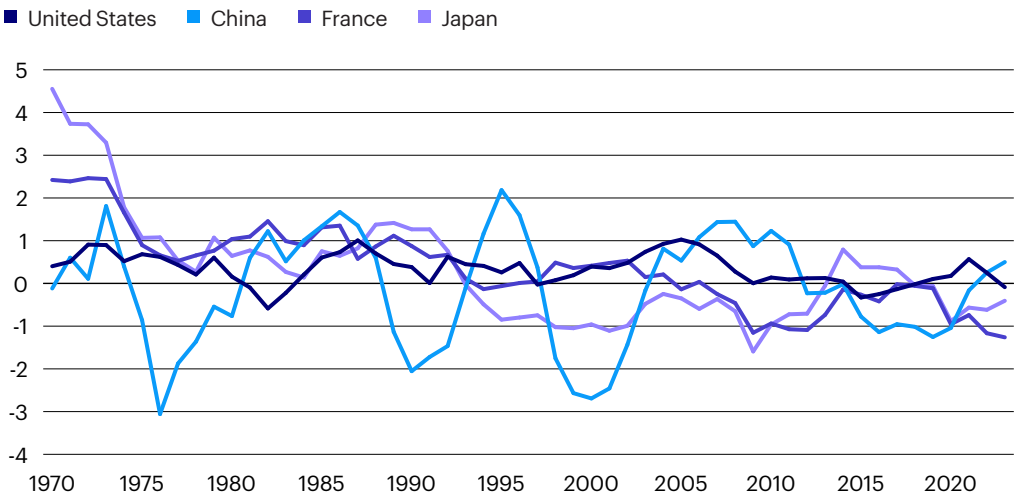
AI may help revive productivity growth

Basic economic models distill economic output into a "production function" composed of three factors of production: labor, capital, and a residual which we call total factor productivity (TFP). When combined, these three ingredients result in economic production. If the same number of labor hours produce more output with the same amount of capital, we call this TFP growth.

Since the mid 2000s, TFP growth has stagnated, with most increases in labor output per hour coming from capital deepening (See Figure 4). Indeed, the last time major developed economies saw a meaningful change in TFP was the information communication technology revolution, when the Internet and personal computers became widespread from the period 1995 to 2005 (See Figure 3).

Figure 3: Long-term productivity growth, selected economies

5-Year rolling annualized growth in total factor productivity, %



Sources: Macrobond, Conference Board, and Invesco. Annual data, latest available data as of 31 July 2023.

As outlined above, we believe AI should further help workers sift through, analyze, and prioritize the ever-growing volumes of information that is made available through information technology. Generative AI also promises the ability to assist with writing emails, summarizing content, preparing scripts, translating documents, assisting in editing and proofreading, and more. We believe generative AI should enable users to navigate their working lives more efficiently by reducing cognitive burdens, minimizing distractions, and increasing the speed at which they can produce content.

We believe artificial intelligence has significant potential to push productivity growth higher. Goldman Sachs anticipates a 0.3% to 3.0% increase in annual US labor productivity over a 10-year period, depending on a factors like adoption rates and innovation speeds, with a baseline scenario of an increase of productivity of 1.5% for 10 years.[7] Meanwhile, McKinsey anticipates that generative AI could have a 0.1% to 0.6% global annual increase in productivity growth until 2040, which could be more like 0.2% to 3.3% when factoring in other automation technologies.[8]

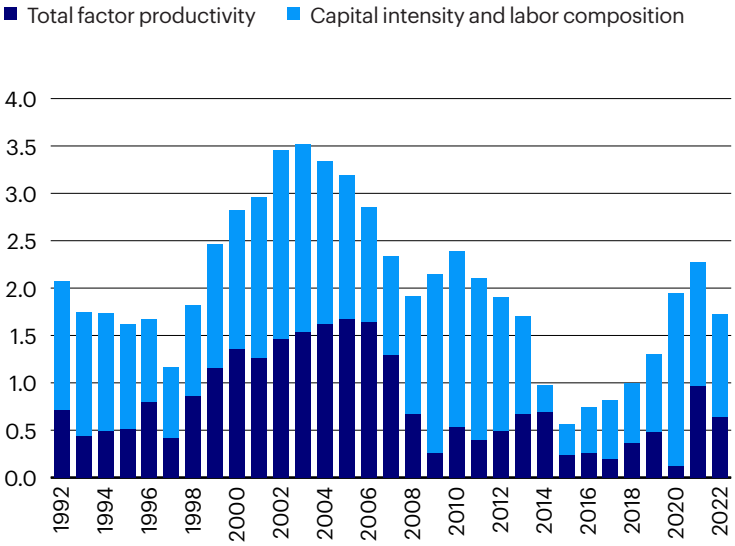
In our assessment, if we assume total factor productivity increases are similar to those of the initial information communication technology revolution of 1995-2005 over a similar period of time, we believe generative AI may add approximately 1.1% per year to total factor productivity growth over the next 10 years (See Figures 4 and 5). If other inputs are held constant, in 10 years generative AI would leave the economy 10.5% larger than without the effects of generative AI, in our view. Additional capital deepening related to AI spending may help grow this number further, especially in the near-term as AI-driven hardware investment ramp up.

The potential impact of generative AI on productivity is undoubtedly subject to large estimation error. Overall, though, we do anticipate a substantial positive boost from the technology to be realized over the course of the next decade.

7 Goldman Sachs Global Macro Research (Issue 120; 5 July 2023)
8 McKinsey 'The economic potential of generative AI' (June 2023).

Figure 4: Recent productivity growth has primarily been from capital deepening

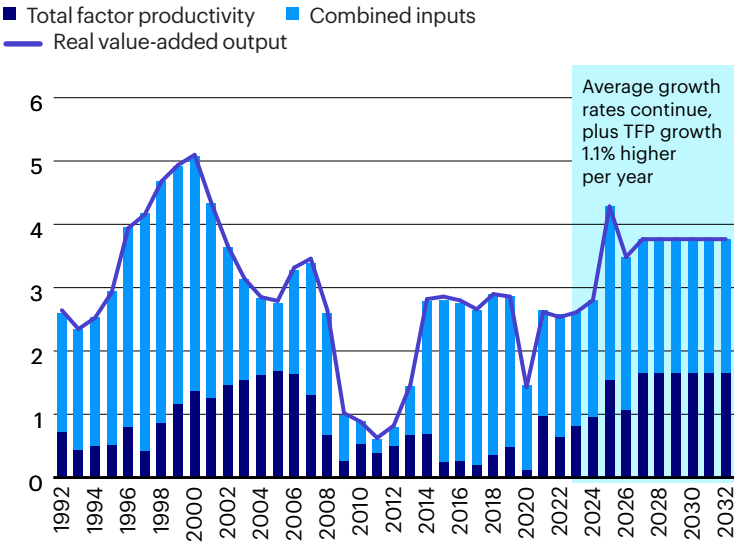
US 5-year annualized productivity growth (%), 1992 to 2022



Sources: Macrobond, US Bureau of Labor Statistics Productivity Database, and Invesco, as of 31 July 2023.

Figure 5: Generative AI may revive TFP growth—and boost growth

US 5-year annualized growth of real value-added by contribution (%), 1992 to 2032



Sources: Macrobond, US Bureau of Labor Statistics Productivity Database, and Invesco, as of 31 July 2023. Values from 2023 to 2032 are projections, where Combined Inputs grow at the average growth rate observed from 2010 to 2022, and Total Factor Productivity grows at an annualized growth rate of 1.6% out to 2032.

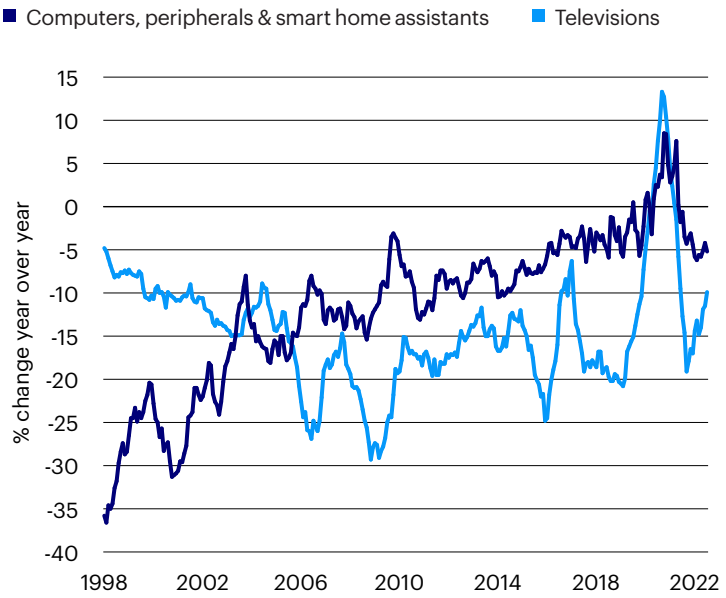
Technology's deflationary role

Technology has a long history of deflationary effects on the economy. As mentioned earlier, major inventions such as steam power, electricity, and mechanization have freed up valuable labor hours to be allocated to a myriad of other tasks, increasing aggregate supply in the process. As supply expands and workers become more productive, they tend to also become richer in the process. Indeed, reflecting this, many economists suggest long-term real wage growth should approximately track long-term productivity growth. In other words, if we hold wages constant, then increases in supply are deflationary.

Viewed in this context, technological innovation is deflationary because it expands potential output. Moreover, hardware involved in information technology, especially semiconductors, are increasingly being produced more cheaply and at greater scale. Recent technological developments that make use of computers, data storage, and connectivity have accelerated deflationary forces as prices have fallen (See Figures 6 and 7). In essence, today's technology has the potential to exert deflationary forces via both increased aggregate supply and falling costs of the required hardware.

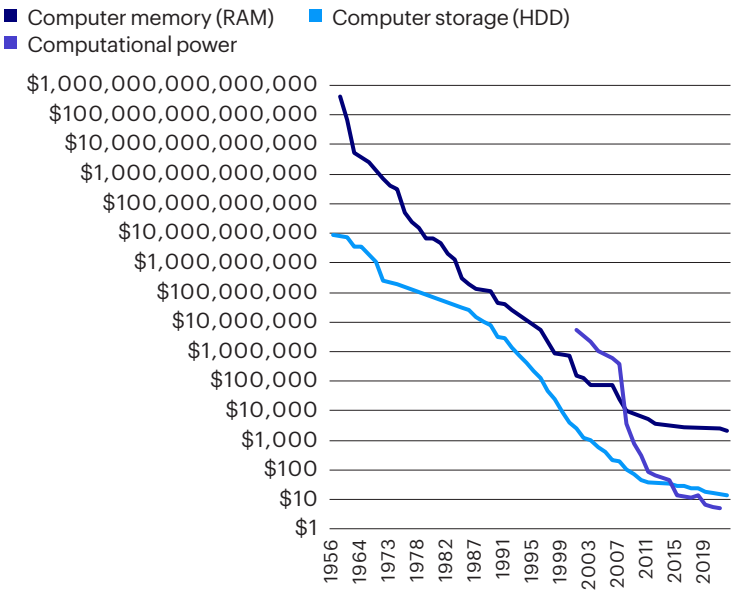
Figure 6: Ex-pandemic, technology goods have been falling in price for decades.

US CPI Sub-indices for Televisions and Computers



Sources: Macrobond and Invesco, as of 31 July 2023.

Figure 7: The cost of computation has fallen exponentially over recent decades



Source: OurWorldInData, as of 31 July 2023. Note: Scale is logarithmic. Some unreported or missing values have been interpolated for illustrative purposes. 'Computer Memory (RAM)' and 'Computer Storage (HDD)' are in USD per Terabyte. RAM = Random Access Memory, HDD = Hard Disk Drive. 'Computational Power' is a measure of the cost of sequencing one billion base pairs of DNA in USD per Gigabase.

In the last decade, the digital world has also become a largely interoperable and scalable way to process and send information further, faster, and with comparatively less degradation than physical world solutions. Following Moore's Law, advances in Information and Communication Technology saw computational technology improve at an exponential rate while also becoming significantly cheaper over time. Rapidly improving and ever more accessible technology has enabled a virtuous cycle in which more people can process and send more kinds and greater volumes of information. We believe these common systems have enabled greater technological advances and greater accessibility to that technology.

As technology has become embedded in our economy, AI has already found numerous uses over recent decades (as we described in Part 2). From search engines, to navigation, to product recommendation, to signal generation, AI is already used across a wide range of functions. As we described in the previous section, this already appears to have had a positive impact on the economy, with potentially more to come with the advent of generative AI.

If generative AI can grow productivity and do so with increasing economies of scale, it may well be a new deflationary force. This would be a welcome development against the backdrop of today's tight labor markets, above-target inflation, and aging demographics.

Conclusion

New technologies typically foretell disruption, and generative AI may be the next chapter in a long history of such advancements. We expect generative AI to enable greater productivity growth and to exert deflationary pressures on the prices of goods and, to a greater extent, services. In the process, AI is more likely to augment labor than displace labor in the near term. As the technology continues to evolve, history suggests labor displacement is increasingly likely, but such displacement will likely be supplemented by the creation of new kinds of jobs. As Yogi Berra once said: "It is difficult to make predictions, especially about the future."[9] We believe this is especially true about the future capabilities of generative AI and its impacts on automation.

9 This quote is often attributed originally to Danish physicist Niels Bohr.

Investment risks

The value of investments and any income will fluctuate (this may partly be the result of exchange rate fluctuations) and investors may not get back the full amount invested.

Artificial Intelligence (AI) - Companies engaged in AI typically face intense competition and potentially rapid product obsolescence. These companies are also heavily dependent on intellectual property rights and may be adversely affected by loss or impairment of those rights. Additionally, AI companies typically invest significant amounts of spending on research and development, and there is no guarantee that the products or services produced by these companies will be successful. Companies that are capitalizing on Innovation and developing technologies to displace older technologies or create new markets may not be successful.

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