

Winning Through Technology: The Returns to Digital Differentiation

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The recent sell-off in tech shares is not a sign of deteriorating fundamentals. Instead, it's best interpreted as part of a pattern typically observed during periods of rapid technological change.

Capital markets initially tend to focus on companies operating at the frontiers of new technology, such as electrification in the 1920s, networked computing in the 1990s, and the digital transformation today.

Over time, attention shifts to the much larger set of investment opportunities among businesses that *adopt* those technologies to introduce new products and services, accelerate growth, boost productivity, and widen margins.

During these periods of diffusion, returns tend to accrue to businesses that make efficient use of "technology" as an input rather than the businesses that happen to be classified as part of the "technology" sector.

WINNING THROUGH TECHNOLOGY: THE RETURNS TO DIGITAL DIFFERENTIATION

Recent market volatility has led some investors to reconsider portfolio exposures to technology. Between mid-November and the last week in March, the NASDAQ shed roughly II% of its value. Losses have been 3x larger, on average, among recent IPOs and the nascent, loss-making businesses often thought to comprise the index's most technologically savvy constituents (Figure I).

While some may regard this sell-off as evidence that the "digital revolution" has run out of steam, this interpretation is at odds with the underlying fundamentals. Business investment in software, data, digital and related R&D continues to *accelerate*. By the end of QI 2022, real business spending on digital transformation was 23% higher than in 2019, even as all other business outlays rose by only 3% over the same period (Figure 2). Instead of backing off from data and digital in anticipation of a "return to normal," businesses have leaned in more heavily.

The disjunction between prices and fundamentals suggests capital markets may have reached an inflection point. The economy continues to evolve towards a more efficient, digitized future, but, if the past is any guide, the returns associated with this transformation may no longer be found exclusively – or even primarily – in the tech sector.



Figure 1. Tech Returns Since November 2021 Peaks

Figure I. Source: Carlyle Analysis of Bloomberg, Cap IQ March 31, 2022. There is no guarantee any trends will continue.



Figure 2. Business Investment Concentrated in Software & Digital Technology

CAPITAL FLOWS & TECHNOLOGICAL REVOLUTIONS

Financial markets tend to be very good at spotting technological revolutions, but have rarely proven able to anticipate their second-and-third-order effects. Capital often flows directly to the businesses operating at the frontiers of the transformational technology without sufficient consideration for the downstream opportunities that technology creates. The result has been meteoric increases in the valuations of the businesses that *introduce* the era-shaping technology (Figure 3) even as more of the eventual returns accrue to the companies that *adopt* it.

Figure 2. Source: Carlyle, BEA, March 3I, 2022. There is no guarantee any trends will continue.

Figure 3.

Five-Year Change in Valuation Ratios



RETURNS TO ELECTRIFICATION IN THE 1920s

This pattern first emerged in the I92Os. American society was transformed by mass electrification made possible by high-pressure steam power plants and centralized generation, distribution, and system management.¹ In just a few years, electric utilities' revenues grew by more than 3.4x² and their market values roughly doubled relative to fundamentals (Figure 3), as investors sought ways to deploy capital alongside these broad societal trends.

But as investors focused myopically on the growth in electric utilities' revenues, far more economic value was being created by the factories that were buying that power. Electrification allowed manufacturers to use a large number of complex machines simultaneously, which made mass production processes possible and sharply reduced the cost of producing consumer durables like refrigerators, washing machines, and radios (Figure 4). And since these products had to be plugged in to operate, mass electrification not only drove down manufacturers' production costs, but also stimulated demand for their products.

In the IO years from the start of the sustained boom in electricity generation,³ durable goods manufacturers generated a 3.02x MOIC, on average, good for an II.7% IRR in the depths of the Great Depression (!) and 2.26x greater than the average MOIC of electric utilities over the same period (Figure 5). The technological revolution unlocked by mass electrification was real, but the ultimate beneficiaries of it were the companies that *used* that electricity rather than those who sold it.

White, E. (1990), "The Stock Market Boom and Crash of 1929 Revisited," Journal of Economic Perspectives.

² Ronald C. Tobey, 1997, "Technology as Freedom: The New Deal and the Electrical Modernization of the American Home."

³ Measured based on five-year annualized growth in the Industrial Production Index, Federal Reserve Board of Governors, January 2022.

Figure 3. Source: Carlyle Analysis; CRSP Database, December 2021. There is no guarantee any trends will continue.



Figure 4. Two-Year Decline in Production Costs by Item





Figure 4. Source: Ronald C. Tobey, 1997, "Technology as Freedom: The New Deal and the Electrical Modernization of the American Home." There is no guarantee any trends will continue. Figure 5. Source: Carlyle Analysis; CRSP Database, December 2021. There is no guarantee any trends will continue.

RETURNS TO NETWORKED COMPUTING IN THE 1990s

This same pattern repeated itself in the 1990s. Personal computer sales grew exponentially thanks to standardization in production processes and software licensing. By the end of the decade, nearly 500 million computers were installed globally, about 75% of which were at the workplace.⁴ This facilitated even faster growth in software development, related hardware (modems, mobile scanners, etc.), and networking protocols and infrastructure.⁵ Spending on these products and services rose by 50% as a share of all business spending in the second half of the decade.

As with electric utilities 70 years earlier, it was natural for investors to flock to the companies at the forefront of this technological revolution. The average market value of software, personal computer, and network technology businesses rose 256% relative to book values (Figure 3). But, as then, investors' focus on revenues proved just as myopic; most of the incremental economic value accrued to the *users* of the new technology.

The U.S. "productivity miracle" of the late-1990s was mainly concentrated in manufacturing and retail.⁶ By ramping up spending on computers, wireless barcode scanners, and inventory software systems, many businesses in these sectors were able to match production to sales, automate the flow of goods, unbundle production processes, and streamline logistics networks and supply chains.⁷ In the IO-years following this IT spending boom, durable goods inventories declined by 20% relative to sales and related labor productivity rose by 57% (Figure 6).



Figure 6. IT Investment in Retail & Manufacturing Sector

4 Kanellos, Michael (June 30, 2002). "personal computers: More than I billion served". CNET.

5 A Brief History of the Internet Computer Communication Review Volume 39, Number 5, October 2009.

- 6 Nicholas Bloom, Raffaella Sadun and John Van Reenen Americans Do IT Better: US Multinationals and the Productivity Miracle The American Economic Review, 2012, Vol. 102, No. I.
- 7 "US Productivity Growth, 1995-2000: Understanding the contribution of Information Technology relative to other factors," McKinsey Global Institute, 2001.

Figure 6. Source: McKinsey Global Institute; Carlyle Analysis; Bureau of Labor Statistics; Bureau of Economic Analysis. There is no guarantee any trends will continue.

These massive efficiency gains translated directly into increased earnings and enterprise values. Over the IO years following the start of the boom, the typical business in the retail and manufacturing sector outperformed average tech returns by I6% and I9%, respectively (Figure 7), with far greater outperformance observed among the most aggressive adopters of new technology in these sectors.⁸ This isn't horizon shopping; if one were to measure returns from the point when valuations reached their zenith, the cumulative outperformance relative to tech would be 70.2% for retail (infected by the results of some dot-com sellers) and more than IO0% for manufacturing.

IMPLICATIONS FOR TODAY

The increase in tech sector valuations over the past five years (Figure 3) provides a clear and conspicuous signal that contemporary digital

technologies⁹ have the potential to change society every bit as much as electrification and networked computing did in prior decades. For investors, the key will be understanding how these various technologies can be best applied to the specific circumstances facing businesses across the economy.

One of the messages that emerges from prior episodes is that technological revolutions are not spurred by the advent of new technology so much as by its adoption. Electricity generation was a 19th century invention. The first networked computer system was introduced in 1969.¹⁰ Barcode scanners were first deployed in 1974. In business-to-business context, adoption only occurs when downstream businesses perceive how the associated tech spending will add to their bottom line.

In other words, rapid growth in tech revenues and valuations tend to be an important signal about an increase in expected returns *elsewhere in the economy*.

Figure 7.

Returns to Networked Computing by Sector, 1995-05



8 Walmart, for example, accounted for 1/6th of the total productivity gains over that period, per McKinsey (2001), and earned a 4.62x net MOIC over that period.

9 This should be interpreted to include all forms of digital communication in addition to data capture, storage, analytics, artificial intelligence (AI), automation and robotics, cloud computing, and the Internet of Things (IoT).

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Figure 7. Source: Carlyle Analysis; CRSP Database, December 2021. There is no guarantee any trends will continue.

The evidence that this is occurring today can be found in the productivity data. The U.S. economy is now 3.5% larger than it was at the end of 2019 even as payroll employment has declined by 3.7 million jobs since then." Proprietary data indicate that economy-wide revenueper-employee has increased by 15% since the end of 2019 (Figure 8), with especially large gains in implied productivity in IT services, professional and business services (consulting, law, etc.) and manufacturing (Figure 9). In each case, the gains seem tied directly to digital technologies that (I) allow for greater remote work, (2) streamline engagement with customers and clients, and (3) automate pricing decisions, workflows, and production processes.

Figure 8. Digitization & Reinvention: Portfolio-Wide Revenues Per Worker Up 15% Since Onset of Pandemic







II Carlyle Analysis. Bureau of Labor Statistics and Bureau of Eocnomic Analysis Data. January 2022.

Figure 8. Source: Carlyle Analysis; Bureau of Economic Analysis of Portfolio Data; Bureau of Labor Statistics. January 2022. There can be no assurance these market conditions will continue to be achieved.

Figure 9. Source: Carlyle Analysis; FRED; January 2022. There is no guarantee these trends will continue.

THE DIGITAL TRANSFORMATION'S DOWNSTREAM BENEFITS

By providing a sudden glimpse of a digitized, virtual future, the pandemic was the rare event that allowed investors and management teams to conceive of the transformational potential of new technologies. Its real-word business continuity test made it clear that businesses today were competing on the basis of technology, irrespective of the industry in which they operate. These competitive pressures will only intensify in 2022 as acute worker shortages force more businesses to consider investments in labor-saving software and technology (Figure IO). While no one should doubt the tailwind digital transformation provides for the tech sector, one company's revenues are another's investment. When accounting for differences in valuations and market conditions, the returns to the adoption of new technology can often be far greater than the returns to its sale. Judging from past data, the market rotation from tech providers to tech users isn't a sign of the end of the digital transformation, but just its next stage.





Figure IO. Source: Carlyle Analysis, CBO Data, August 2021. There is no guarantee these trends will continue.

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