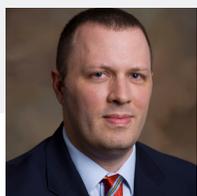




PRICE POINT

November 2017

Timely intelligence and analysis for our clients.



Paul Greene
Portfolio Manager, Media & Telecommunications Fund

Global Technology **CLOUD COMPUTING: STILL IN ITS EARLY STAGES AND SPREADING GLOBALLY**

KEY POINTS

- In our view, the growth of cloud computing is only in its early stages.
- Cloud computing results in a significant reduction in a company's investment in hardware and software as well as subsequent cost savings on IT staff needed to maintain those resources.
- Innovations such as machine learning and other forms of artificial intelligence could increase demand for cloud infrastructure and services.
- Our global research platform has helped us to identify the key characteristics that may lead to successful outcomes among cloud computing companies, and we seek enterprises that we believe are successfully innovating and expanding market share.

WHY COMPANIES HAVE THEIR HEADS IN THE CLOUD

For years, companies needed to install servers and software on site to meet their various computing needs. This technology required expensive maintenance and routine upgrades. Now, cloud computing offers a more customer-friendly solution—one that is disrupting the technology landscape.

Providers of cloud computing services host hardware and applications in their own data centers, which customers access through the Internet. These companies offer on-demand computing power or software to customers via the cloud. These avenues result in both a significant reduction in a company's investment in hardware and software as well as subsequent cost savings on IT staff needed to maintain those resources.

COST SAVINGS AND INCREASED EFFICIENCIES

To better illustrate the benefits of and growing appeal for on-demand computing power, it helps to look at the dominant player in the industry—Amazon.com's Amazon Web Services (AWS). Launched in 2006, AWS has experienced rapid growth, with revenues of less than USD \$1 billion in 2011 jumping to over USD \$12 billion in 2016. AWS's scalability allows companies to adjust to meet the amount of server capacity they require, effectively ending the days of idle capacity. AWS and similar cloud-based infrastructures and platforms, like Microsoft's Azure and Alibaba Group Holding's AliCloud, help facilitate e-business, big data analytics, enterprise applications, and many other functions.

On-demand computing power allows firms to focus on their core competencies rather than diverting resources to maintain in-house technology. In fact, an increasing number of businesses run their operations entirely through the cloud. Netflix is a prominent example. Netflix began its migration to the cloud in 2008 following a database corruption that prevented it from shipping DVDs for three days. The cloud has helped avoid another interruption, while also supporting Netflix's rapid growth and expansion—allowing management to focus on key issues rather than diverting time and resources to keeping pace with the company's ever-increasing capacity needs.

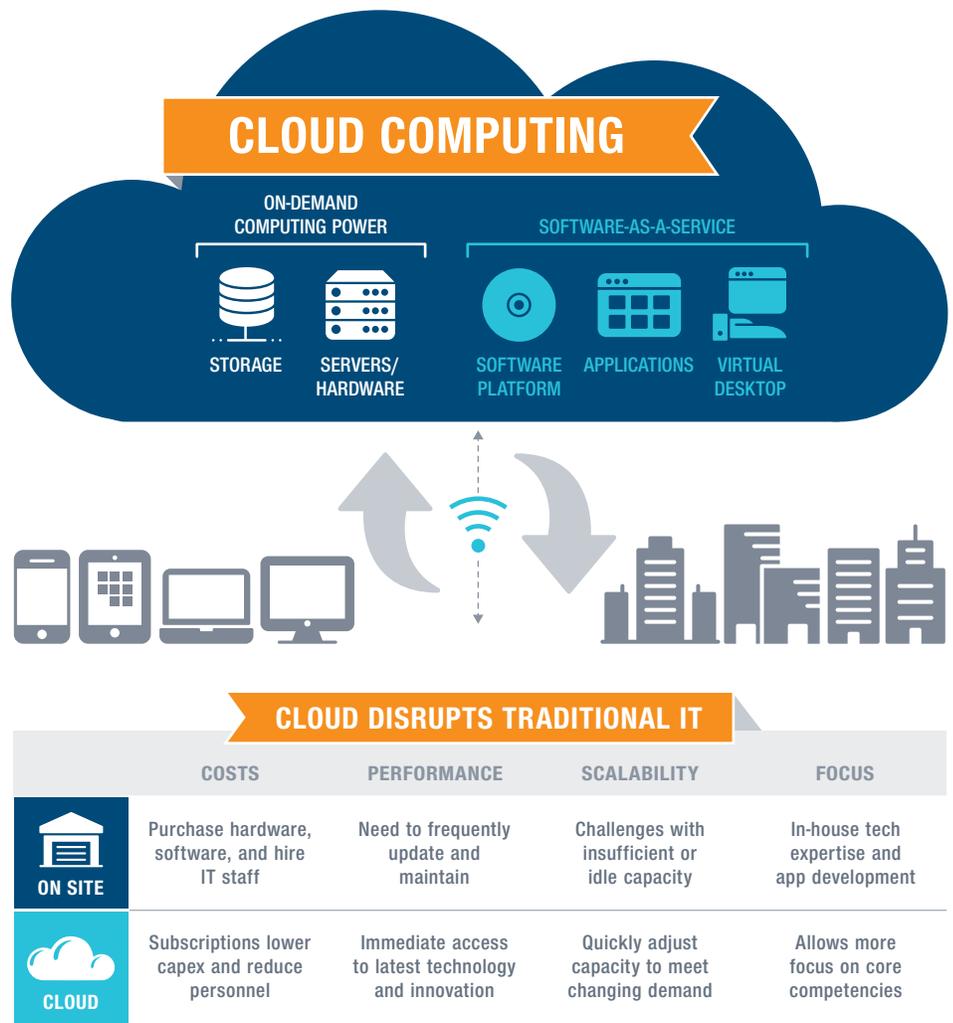
In our meetings with management teams across the technology sector and in other sectors, we've consistently heard that cloud computing models can lead to significant cost and operational efficiencies. Over the past five years, we've noted that companies have increasingly adopted a "cloud first" strategy, as more businesses demonstrate an interest in opting for cloud services versus on-site options. A recent survey of more than 2,000 IT professionals conducted by the antivirus software company McAfee found that over 80% of businesses are now adhering to a cloud first strategy.

FROM LICENSES TO SUBSCRIPTIONS

Businesses are making use of the cloud in a variety of ways. For example, a retailer might decide that it wants to use social media as a means to resolve customer issues and complaints. Several leading providers of enterprise software-as-a-service (SaaS) are helping companies more strategically track and respond to customer posts.

Salesforce is a leading SaaS provider, with the majority of its revenue derived from customer relationship management applications. Salesforce's strong front-office product portfolio and highly recurring subscription business model

FIGURE 1: The Benefits of Cloud Computing Can't Be Ignored—And Businesses Know It



Source: T. Rowe Price.

could help it remain a major beneficiary of the trend toward SaaS. We are mindful, however, that the company's operating margins are lower than some of its peers and that the potential for future acquisitions could be a headwind for the stock.

Workday helps enterprises manage labor resources and firms' financial information. Most of Workday's revenue comes from human resource applications. We believe that its platform is highly versatile and differentiated, making it a very durable software company. However, we continue to be mindful of valuation and changes to the stock's risk/reward profile. Our

expertise in investing in these software companies helps us to effectively assess their valuations and the valuations of similar companies based on our understanding of what the steady state of operating margins should be for a software company when it is fully scaled. Additionally, our insights into how much value each new customer will add assist in our evaluation of a company's decision to expand.

ARTIFICIAL INTELLIGENCE WILL FURTHER DRIVE CLOUD ADOPTION

Cloud computing is also likely to play a key role in the rapidly growing field of

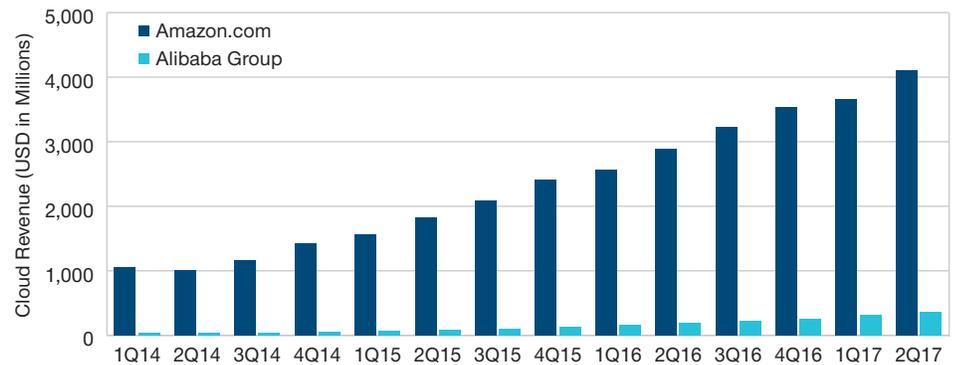
artificial intelligence (AI). Businesses in areas ranging from financial services to biotechnology to retail are seeking to use artificial intelligence to improve efficiencies, develop new products, and better target markets. In particular, companies are hoping to task computers with mining massive amounts of data and draw conclusions from it without the use of human programmers, a process known as “machine learning.”

Developing in-house machine learning platforms is a herculean task, however. First, the data that are fed into machine learning programs need to be properly organized and labeled. Second, massive amounts of computing power are required to train the models, calling for a significant investment in hardware that may sit idle for much of the time. Third, the true AI expertise needed to set up and to maintain the models is both scarce and expensive. As *The New York Times* recently reported, even junior AI specialists often command up to \$500,000 a year in compensation.

Outsourcing to the cloud solves many of these problems. Cloud services can aid companies in the collection and preparation of their data while enabling it to exist closer to the compute necessary to train AI models, thus saving on bandwidth costs. In the cloud, companies are also able to readily access AI frameworks, tools, or off-the-shelf AI models already developed by the cloud providers themselves or the developer community. For example, a company wishing to make use of voice recognition to improve customer service or other facets of its business can leverage Amazon Lex, an offering that utilizes the same deep learning technologies Amazon built to power Alexa in its popular Echo devices. Given the rapid growth and complexity of AI, companies have every incentive to leverage cloud platforms in their effort to remain competitive.

FIGURE 2: Early Days for AliCloud Revenue—But Accelerating

As of June 30, 2017



Sources: Amazon and Alibaba.

GLOBAL MIND-SET FOR A GLOBAL TREND

A key advantage of investing across the globe is that we can apply what we learned in one market to others. For example, our extensive experience investing in Amazon helped guide our early interest in China’s Alibaba Group Holding, which has grown to become one of the largest e-commerce companies in the world.

We believe that Alibaba, like Amazon, is cementing its place as a global leader in the collection and utilization of data. In some areas, Alibaba may even stand alone. Given the variety of its business lines and the many areas of the Chinese economy in which it operates, we believe no other company can rival Alibaba in the comprehensiveness of the data it has on its users, which it can then feed into massively scaled applications. Remarkably, Alibaba is responsible for roughly three-quarters of online sales in the country.

Likewise, AliCloud, the company’s cloud business, has scale and network benefits that are reminiscent of a younger AWS. To be sure, cloud computing adoption is still in its early

stages within the region, and we acknowledge that AliCloud is likely to encounter unforeseen challenges in its push for widespread adoption. Additionally, local competitors such as Tencent Holdings and Huawei pose a challenge. On the other hand, AliCloud boasts advantages relative to its predecessor. Unlike Amazon.com in 2006, AliCloud does not need to pitch the benefits of cloud computing to potential customers since these are now well known. Furthermore, AliCloud faces fewer competitive headwinds given the absence of many legacy software providers in China.

CONCLUSION

In our view, the growth of cloud computing is only in its early stages. Nevertheless, investing in cloud computing requires a deep understanding of the industry and how emerging trends and innovations will leverage—and even change—this technology. We believe our bottom-up approach to stock selection coupled with our firm’s global capabilities uniquely position us to identify cloud computing companies that are best positioned to potentially achieve meaningful growth.

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As of October 31, 2017, the securities listed represented the following percentage of the Media & Telecommunications Fund's portfolio: Amazon.com 10.61%, Alibaba Group Holding 6.85%, Tencent Holdings 3.62%, Netflix 2.01%, Microsoft 0.56%, Salesforce.com 0.41%, and Workday 0.35%. The following security was not held by the fund as of October 31, 2017: Huawei. The manager's views and portfolio holdings are historical and subject to change. This material should not be deemed a recommendation to buy or sell any of the securities mentioned.

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