



Better, Quicker, Cheaper

AI and big data create new opportunities in the cloud.

May 2019

KEY INSIGHTS

- Our fundamental research helped us to see cloud software in action early in its development and led us to be early investors.
- We are seeing new opportunities as the cloud extends its reach into different parts of the enterprise.
- Valuations are elevated for many leading cloud providers, however, increasing the importance of careful stock selection.

“Software is eating the world,” internet pioneer Marc Andreessen observed in 2011—an appetite that shows no sign of abating. According to Gartner, spending on enterprise software has grown by roughly 10% annually over the past two years, and it is expected to continue to outpace business investment in all other technology categories through 2022.

Within enterprise software, the cloud segment is growing at the fastest pace of all. Software services delivered over the internet have grown exponentially in recent years, and we estimate that most new processing workloads are now being constructed and handled in the cloud. As legacy systems are rebuilt over time, we expect that the cloud will come to represent the majority of all existing workloads.

The cloud has been a key focus of the Global Technology Fund over the past decade, and we have invested in several

cloud software providers that have grown to dominate the industry. We have moderated some of our positions as valuations have become elevated, but we see promising areas for investment as the cloud begins to provide new services for companies.

User Advantages of Cloud Software

To understand the cloud’s continuing potential, it is helpful to review the advantages it provides users:

 *Reduced overhead:* Companies relying on the cloud do not have to plan for “lumpy” hardware expenditures, nor do they have to maintain a large IT administrative staff to maintain servers and deal with problems that may arise only sporadically. Cloud-based providers can much more efficiently spread these costs among a large user base.

 *Lower barriers to entry:* With lower overhead, companies of all sizes have easy access to cloud-based



Alan Tu

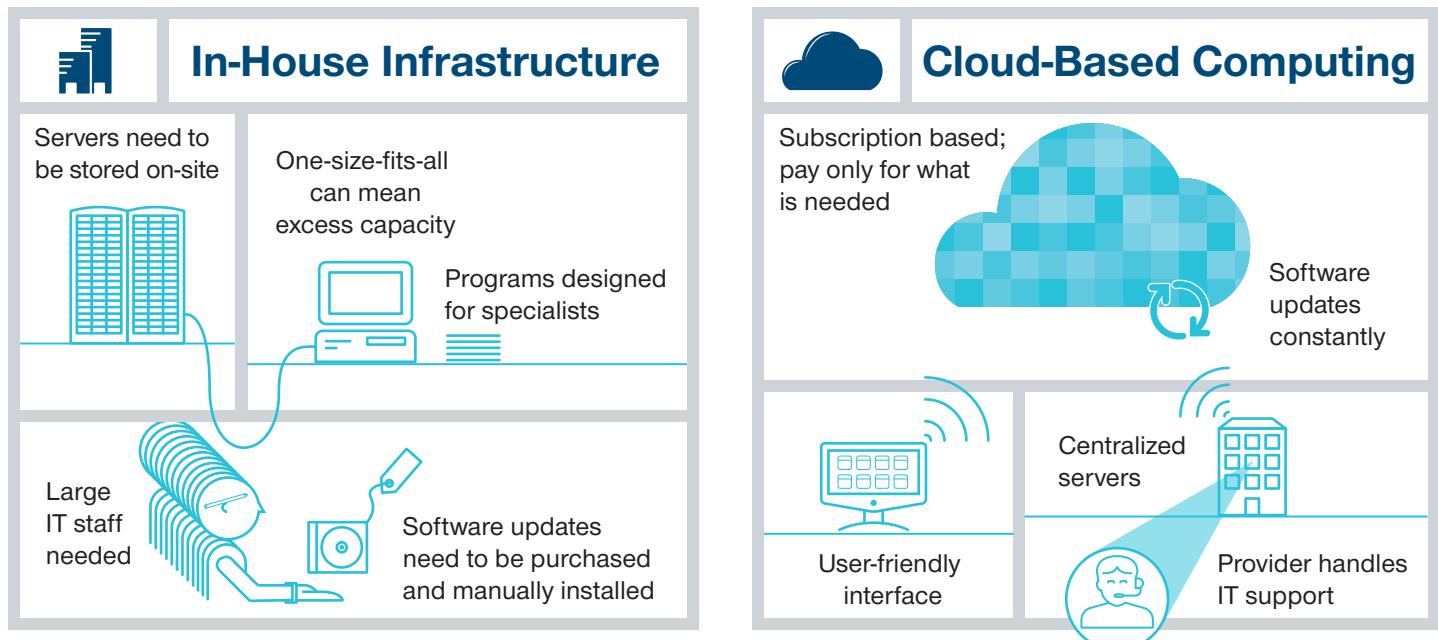
Portfolio Manager, Global Technology Fund

10%

Approximately how much spending on enterprise software has grown annually over the past two years.

Cloud-Based Computing Is Reframing the Way Businesses Work

Software delivered over the internet is reducing overhead and lowering barriers to entry.



Source: T. Rowe Price.

software. A start-up can now rent the needed computing infrastructure from Amazon Web Services, Microsoft's Azure, or another provider. Rather than pay for a product designed for giant firms, small companies can then essentially pay for as much sophisticated software as they need on a subscription-based model.

 *Constant updates:* One reason cloud software is user-friendly is because it is constantly being refined based on customer feedback and other inputs. Regulatory changes or developments can also be rapidly reflected in products. Software patches and security updates can be deployed immediately and without any effort on the part of the customer.

Cloud Is Also a Better Business Model for Providers

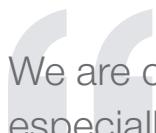
Aside from the value it offers customers, a cloud-based business model also offers significant advantages to software providers. Firms that get revenues through subscriptions instead of a

perpetual license enjoy a steadier revenue stream, freeing them from the feast-and-famine cycle that had characterized the industry.

Cloud software's consumer-friendly focus has also resulted in its viral adoption, with positive word of mouth substituting for expensive sales and marketing efforts—in a growing number of cases, users of the software are now also its buyers, bypassing the IT department. Distribution costs are much lower, especially in cases where technicians and other support specialists had to be dispatched to customers' offices to help with installation and maintenance. While IBM maintained a virtual army of field staff when it dominated the software industry a decade ago, its cloud-based competitors are much more streamlined.

Our History in Finding Cloud Opportunities

At T. Rowe Price, we have long recognized the potential of the cloud to upend the software industry, creating



We are currently especially interested in cloud-based companies that specialize in data analytics...

winners and leaving losers in its wake. Our fundamental research sent us early signals about the power of the cloud as our analysts saw it being deployed in a range of industries. Indeed, T. Rowe Price has now transitioned many parts of our technology operations to the cloud, reducing costs and adding efficiencies in our own business.

Salesforce.com, a provider of customer relationship management (CRM) software, was one of the earliest cloud-based providers. The Global Technology Fund was one of the initial investors in Salesforce when it began trading in June 2004, and we have remained active investors as the company has grown to be the largest cloud-focused provider by market capitalization—around USD 120 billion as of March 31, 2019.

Before Salesforce, CRM software was largely made up of opaque and customized databases of client contacts installed at considerable expense on a company's servers. Using the cloud and a subscription-based model has allowed Salesforce to construct a dynamic system that integrates customer information with many different parts of the organization, such as marketing and inventory management.

We also participated in the October 2012 initial public offering (IPO) of Workday, which offers support for human resources through the cloud. In many ways, Workday has brought the same innovations to HR that Salesforce did to CRM software, helping digitize, organize, and integrate processes that had been scattered throughout the organization. The software integrates HR processes (payroll, for example) with financial information, such as revenue management.

Where We Are Looking Next: Cloud-Based AI Helps Companies Manage Data Explosion

Salesforce, Workday, and other firms are taking advantage of another major development in technology: the growing

power of artificial intelligence (AI). For example, Workday's experience with millions of employee records means that its new People Analytics application can help executives identify both sources of attrition and especially high-performing areas. Salesforce has unveiled its "Einstein AI," which allows users to analyze which invoices are unlikely to be paid on time, for example.

We are currently especially interested in cloud-based companies that specialize in data analytics—a vital field as the amount of data collected by companies grows exponentially. We invested periodically in Splunk, a leading machine data analytics platform, since its initial public offering in April 2012. Splunk's platform allows businesses to quickly index, query, and analyze machine-generated log data, such as employee badge data and internet protocol (IP) log files. Not only can the information be vital for security purposes, but it can serve a valuable role in business analytics. Carnival Cruises, for example, is using Splunk to monitor data collected through wearable devices given to passengers with the aim of getting better insight into how customers use onboard facilities.

DATA, the ticker symbol of Tableau Software, reflects the company's key mission of allowing users to analyze vast and diverse amounts of data through sophisticated graphics and dashboards. Tableau's simple interface and innovative visualization technology has helped democratize business intelligence—formerly the purview of the IT department—by allowing nonexperts to conduct their own ad hoc data analysis. We have invested on and off in Tableau Software since its May 2013 IPO, and we have been pleased to see the company recently move to a subscription-based model rather than relying on perpetual licenses.

T. ROWE PRICE BEYOND THE NUMBERS

Company Visit Pays Off in Surprising Ways

Seeing a product in use by a leading tech company led us to an IPO investment.

Not surprisingly, leading tech companies in Silicon Valley and elsewhere are often the first to learn about innovative enterprise software and deploy it in their own businesses. In one of our early visits to Airbnb, we saw the company making use of Zoom, a service that provides video and audio conferencing tools. We were impressed with the product—particularly how it can be used across platforms, such as mobile and desktop. We eventually participated in Zoom's IPO, which has been among the most successful to date in 2019 (as measured by the stock's advance from initial offering price to the day's close).

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Cloud-Based AI Also Key to Cybersecurity

Cloud-based AI is likely to play a growing role in cybersecurity. Many observers worry that criminals or hostile states could use AI to develop new ways to infiltrate systems, but the flip side is that cybersecurity firms are beginning to use AI to develop new defensive techniques. Using machine learning, cloud-based cybersecurity firms are able to identify anomalous patterns in attempts to gain access to a system. The technique is particularly powerful because it does not rely on a list of known previous attacks—known as “signatures”—but rather can identify novel assaults, such as time-delayed attacks or combining pieces of malware that have entered the system separately.

Notably, the bigger the data sets used in such systems and the more analysis they run, the better machine learning programs perform. This may provide a key advantage to cybersecurity firms tasked with protecting many varied computer networks.

Proofpoint is harnessing vast amounts of data to head off cyberattacks, with a focus on preventing sophisticated email “phishing” attacks—still the source of many security breaches. Using machine learning, the company identifies suspicious websites and email

patterns to head off attempts to install malware and other security breaches. We anticipate that cybersecurity will be one of the fastest-growing areas of cloud development in the coming years as data move beyond corporate firewalls.

The Rise of the Developer

The cloud era has also led to the rise of the developer as companies of all stripes are becoming software firms. The U.S. Department of Labor expects the number of application software developers to grow by nearly a third over the decade ending in 2026, with rapid growth spread out over industries as diverse as architectural services, machinery wholesaling, and motion picture production.

Recently, we have been particularly interested in cloud services designed to coordinate the workflow of software developers. We were an early private investor in Atlassian, whose Jira platform has become the standard workflow platform for programmers by easing project development. For example, instead of relying on constant meetings and emails, development teams can use Jira to allocate tasks, track progress, and handle approvals. The company has proven especially adept at viral, word-of-mouth marketing, allowing it to forgo the cost of traditional sales representatives.

The Value of an Active Approach

The rapid growth of cloud-based software has caught the market's attention in recent years, and the vast potential of leading firms has often appeared fully reflected in their stock prices. We have not been reluctant to trim or even eliminate positions where we still see long-term potential but where valuations have become unreasonable. Conversely, we have viewed broad pullbacks in technology stocks or the overall market as a chance to add back to our favored positions. Likewise, quarterly earnings misses and other temporary setbacks can create opportunities if the business remains fundamentally sound.

Finally, we are mindful that the cloud represents a fundamental and ongoing shift in the way companies operate—a shift that will create both winners and losers. We believe our fundamental research and our active approach will not only guide us to the companies making best use of the cloud but also help keep us to steer clear of slower-footed firms that are reliant on legacy systems. Finding the disruptors while avoiding the disrupted is likely to be crucial for successful technology investors in the years ahead.

WHAT WE'RE WATCHING NEXT

The cloud and delivery of online services aren't just revolutionizing Silicon Valley, of course, and we are keeping an eye out for emerging opportunities around the globe. MercadoLibre is the largest online trading platform in Latin America and the market leader in e-commerce in nine countries. We believe the company has considerable growth potential as increasingly prosperous consumers in the region obtain internet access.

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The fund's 10 largest holdings as of March 31, 2019 were Alibaba Group Holding (10.6% of total net assets), Facebook (9.2%), Microchip Technology (7.7%), Intuit (7.1%), Alphabet Class C (5.9%), Amazon.com (5.1%), Netflix (4.7%), Workday (4.3%), Tencent Holdings (4.1%), and ASML Holding (4.0%). In terms of other holdings discussed above, Proofpoint made up 3.6% of the portfolio; Salesforce.com, 3.2%; Splunk, 2.1%; MercadoLibre, 1.1%; Microsoft, 1.0%; and Tableau Software, 0.7%. Atlassian, Zoom, and IBM were not held in the portfolio.

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