

Americas Technology: Software Cloud Quarterly – 3Q19

In 3Q19, public cloud revenue growth continued to decline slightly, with LTM revenues growing +49% yoy, (vs. +51% in 2Q19 and +54% in 1Q19). However, we note that the absolute increase in dollars of public cloud spending continues to grow, with major platforms adding +\$21.1bn in incremental sales vs. the prior year, compared to +\$19.7bn in incremental revenue generated last quarter. We note that incremental revenues began to decelerate in 4Q18 after accelerating every quarter since 4Q17 (Exhibit 2). We continue to see support for our thesis that widespread public cloud adoption remains nascent, based on Gartner forecasts on spending which estimates ~10-11% penetration of enterprise IT spend and our June 2019 CIO survey which estimates that ~19% of workloads are now in the public cloud. We expect the largest three players (AWS, Azure, Google), to continue to dominate share of the market, accounting for 82% of incremental sales vs. 81% a year ago.

In this report, we update our estimates for key metrics (capex, margins, pricing) across each platform. We note that figures cited in this iteration of *Cloud Quarterly* may not match past iterations due to restatements, as well as historical and future estimate changes.

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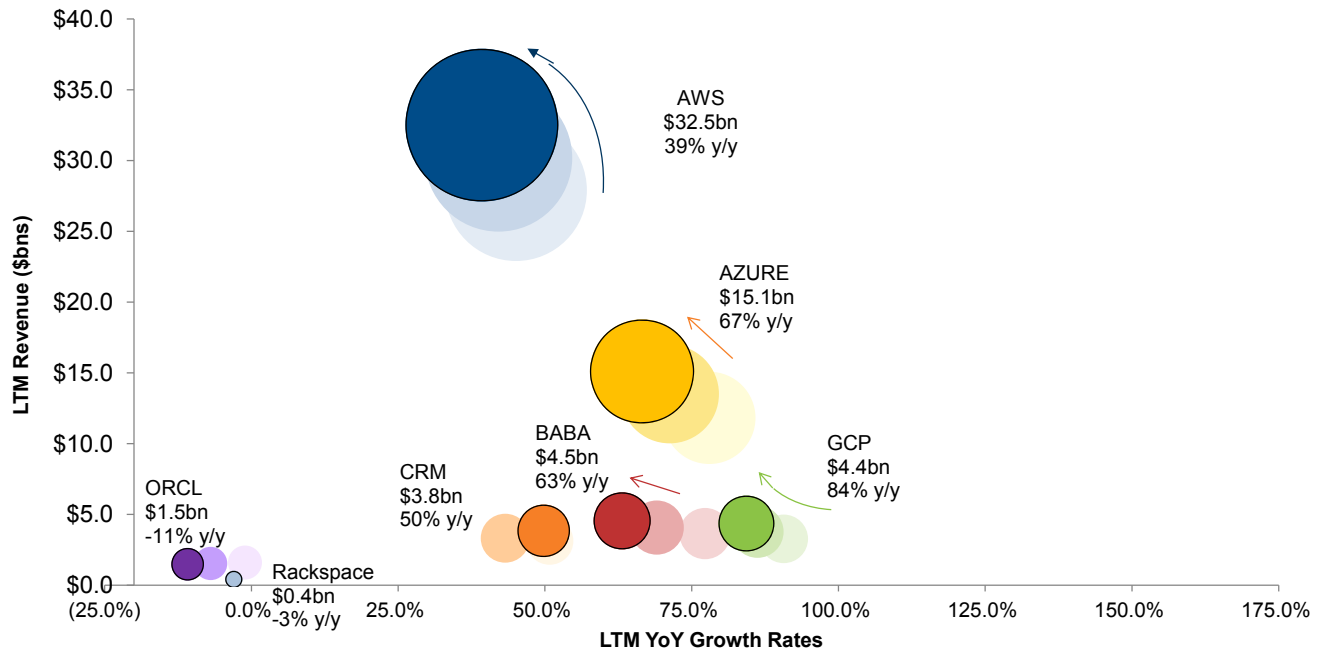
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Exhibit 1: LTM Public Cloud (IaaS and PaaS) Revenue and y/y Growth Rates

Based on GS estimates, figures in \$bns

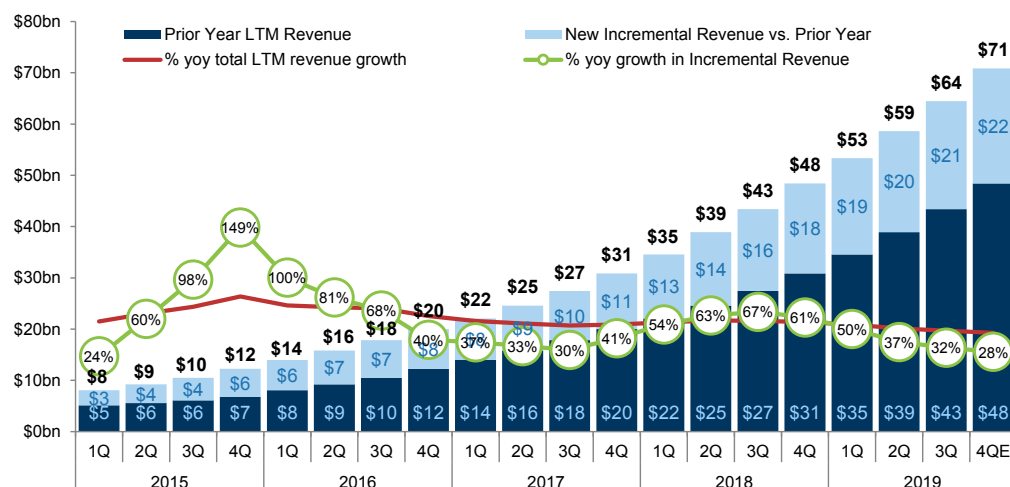


Source: Company data, Goldman Sachs Global Investment Research

In 3Q19, public cloud growth decelerated slightly, where annual growth in the major platforms we track was 46% yoy, in line with 2Q19, and compares to +55% yoy in 3Q18. As the largest player, Amazon drives a large contribution to the second derivative and decelerated this quarter (+35% yoy cc vs. 37% in 2Q), while Azure decelerated as well (+59% yoy cc vs. 64% in 2Q). However, the absolute increase in dollars of public cloud spending continues to grow at healthy clip, where in the last 12 months, major platforms added +\$21.1bn in incremental sales vs. the prior year, compared to +\$19.7bn in incremental revenue generated last quarter. As shown in Exhibit 2, we note that incremental revenues have been decelerating since 4Q18, after accelerating every quarter since 4Q17. Looking ahead, we expect CY19 aggregate revenue growth to grow +46% yoy (vs. 57% in CY18 and 54% in CY17).

Exhibit 2: Leading Public Cloud vendors added ~\$21bn in LTM sales

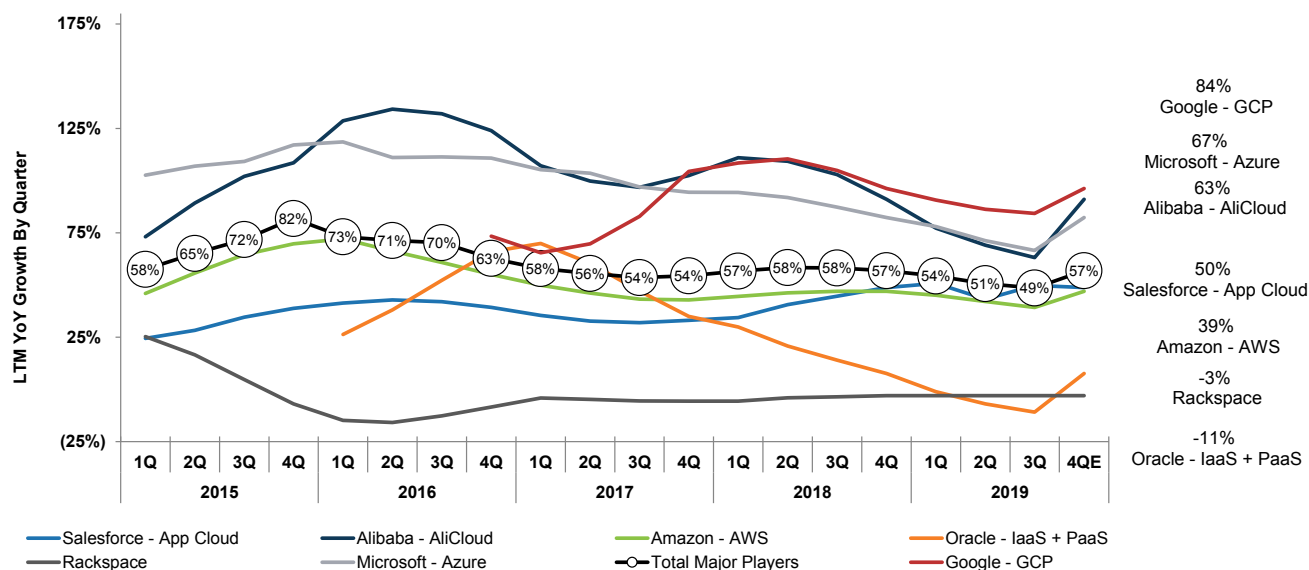
Figures in \$bn



Source: Company Data, Goldman Sachs Global Investment Research

Public cloud revenue growth and size by platform**Exhibit 3: LTM Public cloud vendor y/y growth (by quarter)**

Azure revenue reflects GS Estimates (Azure only, not commercial cloud)



Source: Company data, Goldman Sachs Global Investment Research

Amazon Web Services: AWS LTM revenue grew +39% yoy to \$32.5bn, vs. +42% in the prior period. Management has attributed the increase in customer usage to the increased pace of enterprise migrations and adoption of their services, especially their machine learning services. Management also noted on the 3Q earnings call that they had \$27bn in forward-looking usage commitments, with that backlog, consisting of revenues not recognized from contracts with terms that exceed a year, growing 54%

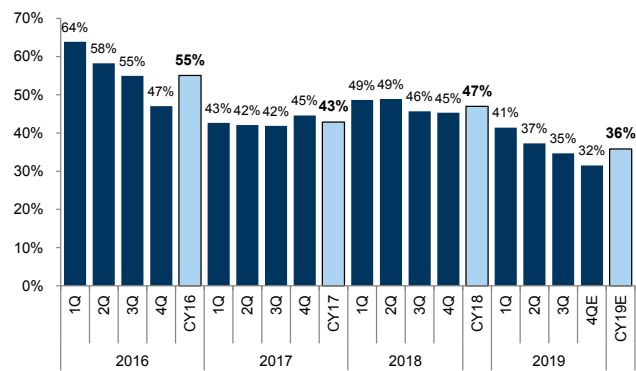
yoy, faster than revenue. As such the annualized run rate for AWS has grown to roughly \$36bn, compared to \$27bn in 3Q18.

Microsoft Azure: Azure LTM revenue grew +67% yoy to \$15.1bn, compared to +71% yoy growth last quarter. We continue to see Microsoft benefitting from Azure's differentiation through solutions such as Stack / Hybrid Benefit, which give customers an Azure-compatible environment on-premise while ensuring that they do not pay twice for software licenses, ultimately helping customers enable new application patterns unique to the hybrid cloud. Management noted that Azure continues to accelerate their innovation on both security as well as emerging workloads like IoT and edge AI. In 3Q, management noted that they saw material growth in the number of \$10mn+ contracts for Azure. We believe that this drives greater net expansion rates for its enterprise agreement renewals. Furthermore, the Department of Defense recently awarded Microsoft with a \$10bn, 10-year technology contract for the Joint Enterprise Defense Infrastructure (JEDI), to transform the military's cloud computing systems.

Google Cloud Platform: We estimate GCP grew LTM revenue +84% yoy to \$4.4bn, compared to +86% yoy last quarter. Management noted on the 3Q earnings call that continued strong customer momentum is being driven by their compute and data analytics solutions such as BigQuery. The company also continues to benefit from Anthos, which provides advanced security and support for multi and hybrid cloud environments, and their continued investments in data centers and new cloud regions.

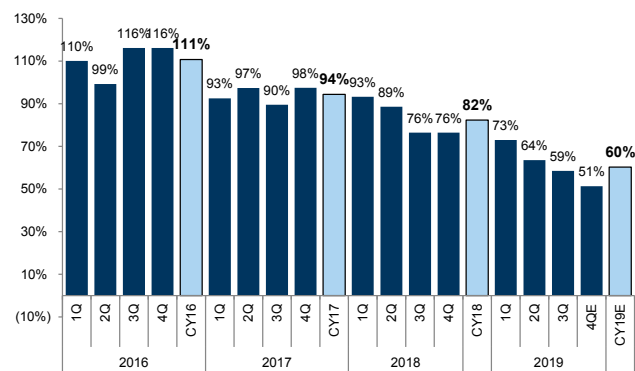
AliCloud: AliCloud LTM revenue grew +63% yoy to \$4.5bn, compared to +69% yoy last quarter. AliCloud continues to focus on growing the number of customers as well as upselling them with higher value-added services that will increase ARPU going forward. Management continues to recognize the increasing demand for cloud services and believes that the industry remains under-penetrated, as many traditional enterprises have sizable IT budgets yet to be spent on cloud services. The company noted that as of Sep 2019, 59% of listed companies in China were AliCloud customers.

Exhibit 4: AWS Quarterly Revenue Growth



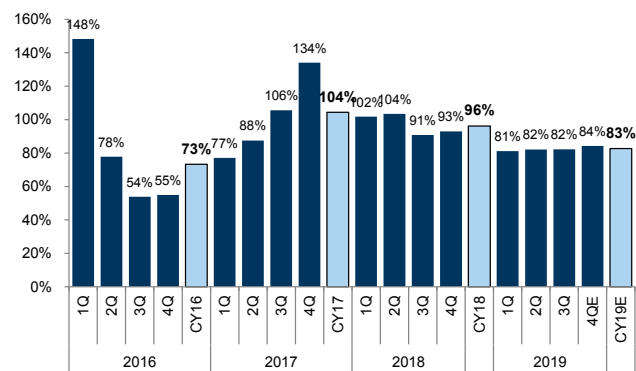
Source: Goldman Sachs Global Investment Research

Exhibit 5: Microsoft Azure Quarterly Revenue Growth



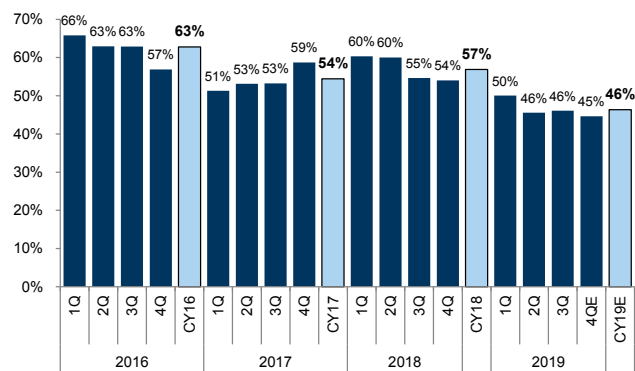
Source: Goldman Sachs Global Investment Research

Exhibit 6: Google Cloud Quarterly Revenue Growth



Source: Goldman Sachs Global Investment Research

Exhibit 7: Major Cloud Vendors - Quarterly Revenue Growth



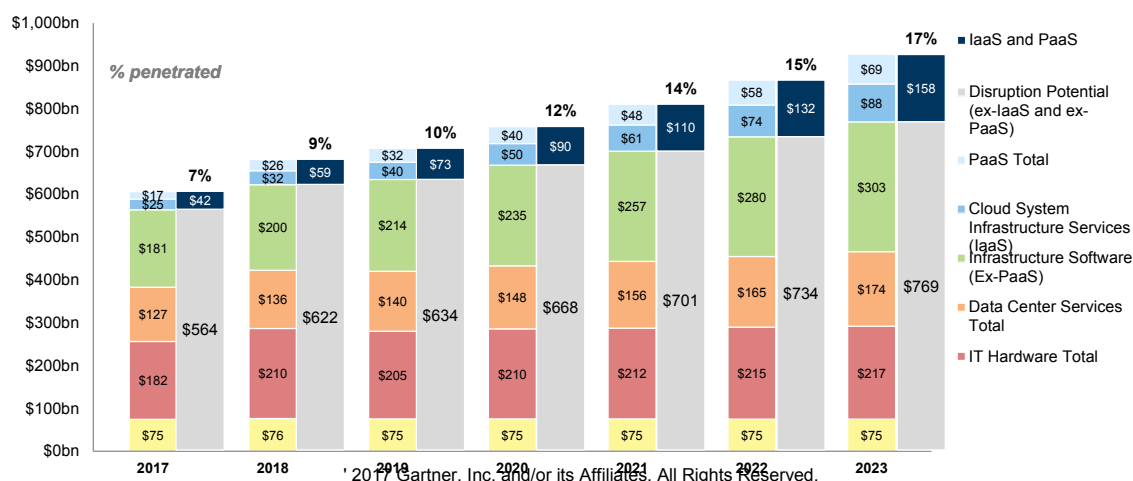
Source: Goldman Sachs Global Investment Research

Public cloud disruption potential of the enterprise IT market

Our checks continue to suggest that we remain in the early innings of public cloud. We estimate ~10% penetration of the ~\$707bn total potential enterprise IT market opportunity in 2019, which is set to increase to ~12% penetrated in 2020, of a ~\$758bn TAM. By 2023, we forecast a potential IT market opportunity of \$927bn across all levels of the IT stack ('18-'23 CAGR of 6%), of which ~17% or ~\$158bn (5Y CAGR of 22%) has been penetrated by IaaS and PaaS.

Exhibit 8: Public cloud has the potential to disrupt a ~\$710bn market in CY19E, growing to ~\$925bn in CY23E

Markets identified by GS, market sizes based on Gartner forecasts



Source: Gartner, Goldman Sachs Global Investment Research

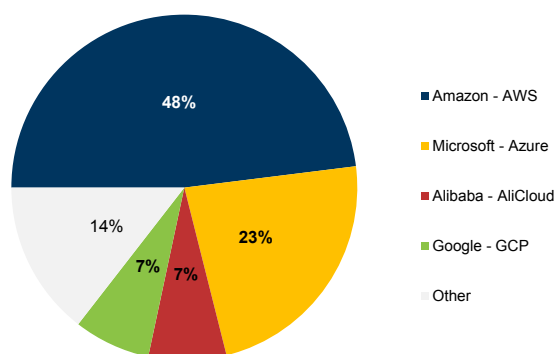
We estimate that Alibaba (AliCloud), Azure, Alphabet, and Tencent are all growing at rates above the major average peers, while AMZN, ORCL, and CRM grew at varying rates below the wider market. We continue to expect that the public cloud landscape will consolidate into an oligopolistic market structure, given the need to develop differentiated, value-add services to draw customers to these platforms (e.g. AI/ML, Containers, Database offerings), and the substantial capex requirements associated with infrastructure build-outs.

In 2017, we estimate that the top three platforms (AWS, Azure, GCP) comprised 59% of the market forecast (as defined by Gartner's PaaS and IaaS forecast), and in 2018 consolidated to roughly 66%. In 2019, based on Gartner's forecast, we expect the top three platforms to make up \$57bn, 78% of the total forecasted market of \$62bn.

We expect public cloud growth to remain concentrated around the major cloud players

Exhibit 9: CY2019E Public Cloud Market Share

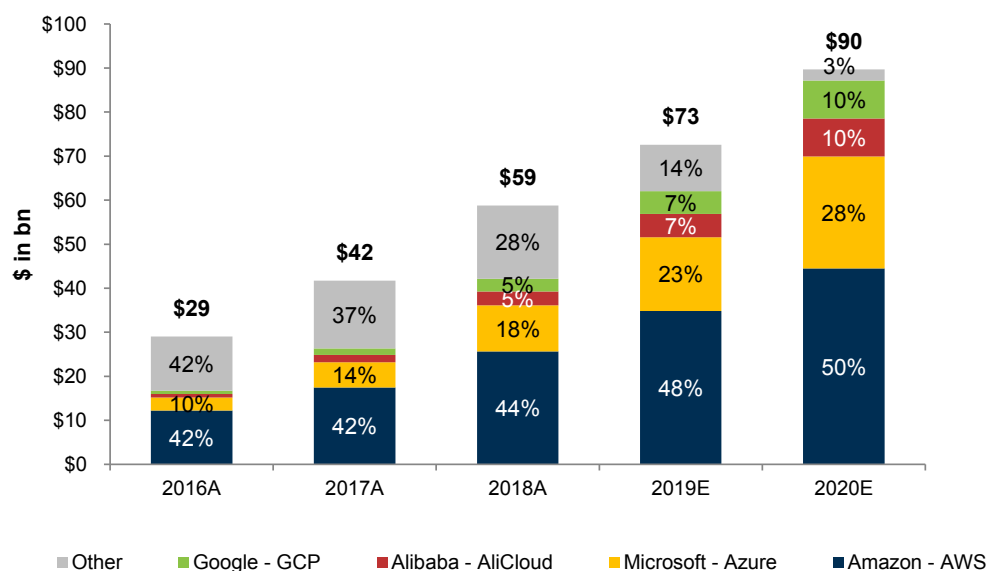
Market size based on Gartner Estimates; Company data based on GS Estimates



Source: Gartner, Goldman Sachs Global Investment Research

Exhibit 10: CY16-20E Public Cloud Market Share

Market size based on Gartner Estimates; Company data based on GS Estimates



Source: Gartner, Goldman Sachs Global Investment Research

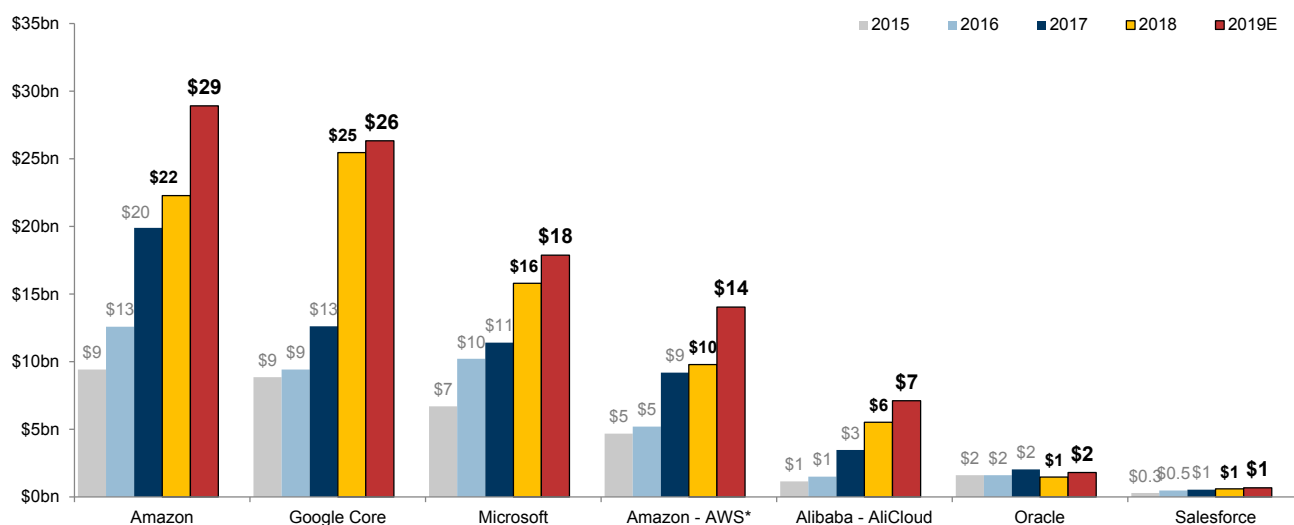
CapEx Trends

The top three US vendors, MSFT, AMZN, and GOOGL, grew LTM adjusted CapEx spending by +13.5% yoy this quarter (totaling \$70bn), representing a slight deceleration from +15% yoy last quarter, and compares to +45% in CY18, as continued improvements in efficiency drives higher utilization over time. As such, for CY19E, we

expect these players to increase capex by 15% yoy to \$73bn. We adjust capital expenditures to include additions to capital leases, as seen in exhibits 16-19. Capital lease impacts for ORCL, GOOGL and BABA are not material.

Exhibit 11: Capex spend by public cloud vendor

Figures include capital leases; AMZN CapEx Spend represents total consolidated capex across all businesses



Source: Company data, Goldman Sachs Global Investment Research

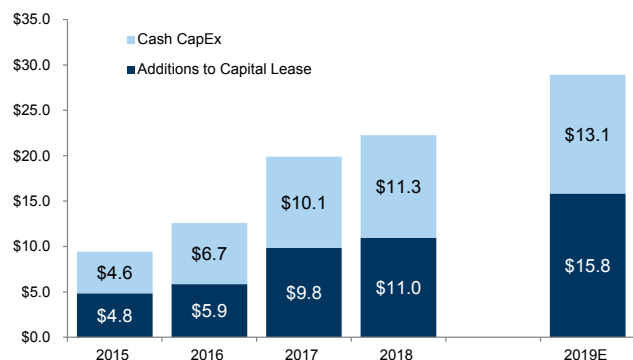
AWS: In the last 12 months, consolidated AMZN property & equipment additions grew 13% yoy to \$27.3bn (up from 7% last quarter). AWS capex is disclosed once per year in the company's 10K. We estimate that in the last twelve months as of 3Q19, the cloud platform spent roughly \$13bn, growing +35% yoy. Management noted on the 3Q earnings call an increase in infrastructure investment (TTM capital lease additions +30% yoy vs. +21% in 2Q). This compares to consolidated capex growth of +13% yoy in 2018, and the AWS figure of +6.5% yoy.

Azure: Microsoft does not disclose Azure capex, however we track the company's consolidated figure as a proxy. In the last 12 months, we witnessed a +15% yoy growth in total capex to \$16.9bn (incl. capital lease additions), while Azure revenue grew +67% yoy over the same time period. We continue to expect a significant impact on gross margins, as scale offers enormous benefits to the fixed depreciation costs of prior investments.

Google: Google discloses Core Capex (defined as capex excluding "Other Bets"), which we track as a proxy for cloud spend. In the last 12 months as of 3Q19, Google core capex grew +14% yoy to \$25.5bn, decelerating from +18% in the prior quarter and compared to +102% yoy in CY18. Management reiterated on the 3Q earnings call that capex spending continues to be heavily weighted towards data center construction and servers. In fact, the company disclosed on its most recent earnings call that typically 70% of its capex is related to technical infrastructure and 30% driven by office facilities although in 3Q19 the ratio was closer to 60%/40% due to the purchases of office facilities in the quarter. These technical infrastructure investments are for supporting

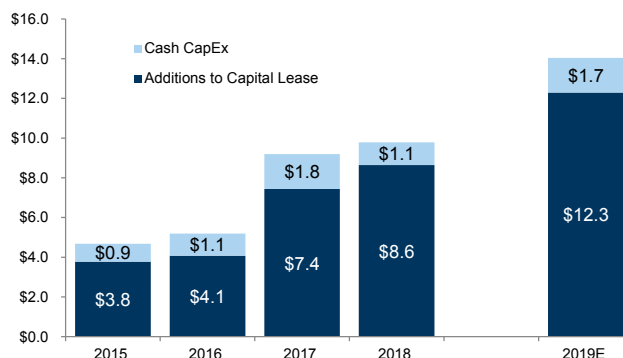
machine learning across their businesses as well as growth in Cloud.

Exhibit 12: Amazon – Cash Capex vs. Capital lease additions



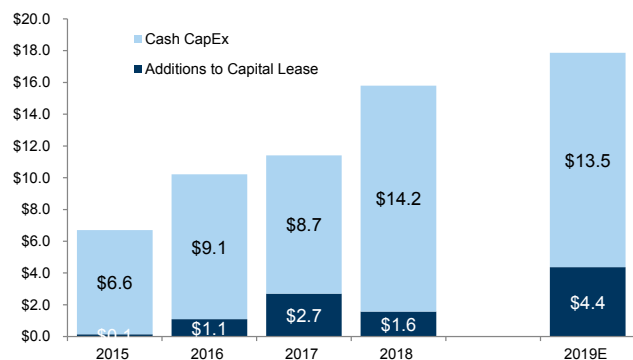
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 13: AWS – Cash Capex vs. Capital lease additions



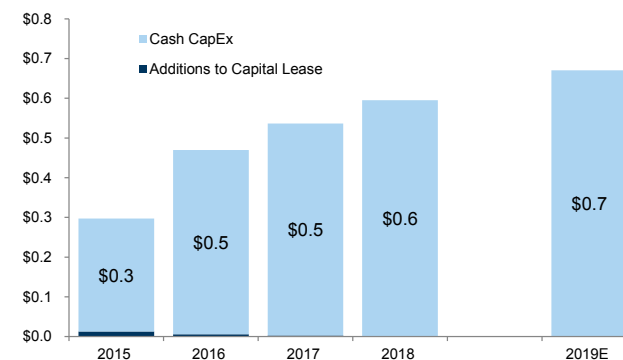
Source: Company data, Goldman Sachs Global Investment Research

Exhibit 14: Microsoft – Cash Capex vs. Capital lease additions



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 15: Salesforce – Cash Capex vs. Capital lease additions
Figures in \$mns



Source: Company data, Goldman Sachs Global Investment Research

We track the additions of new regions and availability zones to each of the major cloud platforms. In line with trends we have seen earlier this year, AWS announced plans for a new region in Zaragoza, Spain while Microsoft launched new regions in Switzerland and Germany, and Google announced plans for a new region in Warsaw and Las Vegas. We continue to see considerable investment in new capabilities, across all platforms.

Exhibit 16: New region additions to major platforms

	AWS	Google Cloud	Microsoft Azure
Availability Zones	69 (+12 in progress)	61 (+15 in progress)	52 (+2 in progress)
LTM CapEx	\$27.3 bn	\$25.5 bn	\$17.4 bn
LTM Cloud Sales	\$32.5 bn	\$4.4 bn	\$15.1 bn
New Zones (coming online soon)	Cape Town Jakarta Milan Zaragoza	Salt Lake City Seoul Jakarta Las Vegas Warsaw	Norway West / East
New Developments			
Apr-17	Announces Swedish Region		
May-17		Launches Northern Virginia Region	Announces two new regions in S. Africa
Jun-17	Third AZ in EU (Frankfurt) Region	Launches Singapore and Sydney Region	
Jul-17	Sixth AZ in US East (N. Virginia) Region	Launches London Region	Arizona and Texas availability for US Government Cloud
Aug-17			Announces two new regions in Australia
Sep-17	Announces Bahrain Region	Launches Sao Paulo Region, the first in South America, and Germany Region, the second in continental EU	Completion of the MAREA transatlantic subsea cable
Oct-17		Launches Mumbai Region	
Nov-17	AWS Secret Region	Announces Hong Kong Region	
Dec-17	New AWS China (Ningxia) Region and addition to EU (Paris) Region		Launches new AZ in France
Jan-18	Additional AZ to EU (London)	Launches Netherlands Region	
Feb-18		Launches Montreal Region and Announces Osaka Region	
Mar-18	AZ added to Gov Cloud	Launches third AZ in Netherlands	Announces Azure Government Secret regions and new AZ in France
Apr-18			Two new regions in Australia and New Zealand available
May-18		Announces Zurich Region	
Jun-18		Launches Finland Region	
Jul-18		Launches Los Angeles Region	
Aug-18			
Sep-18			Launches new AZ in North Europe and US West
Oct-18	Announces Cape Town Region	Announces Jakarta Region	
Nov-18	Launches AWS GovCloud (US-East) Region and Announces Milan Region		Launches new AZ in Southeast Asia
Dec-18	Launches in Stockholm		
Jan-19			Launches new AZ in East US 2
Feb-19			
Mar-19		Launches Zurich Region	Launches Azure South Africa regions; New AZ in East US
Apr-19	Launches AWS Asia Pacific (Hong Kong) Region; Announces Jakarta Region	Announces Salt Lake City and Seoul Regions	Announces retirement of US Gov Iowa region in April 2020; Launches new AZ in UK South and Japan East
May-19	Launches AZ in Asia Pacific (Seoul & Mumbai) regions	Launches Osaka Region	
Jun-19			Launches new regions in UAE
Jul-19	Launches AWS Middle East (Bahrain) Region	Announces Las Vegas Region	
Aug-19			Launches new regions in Switzerland
Sep-19		Announces Warsaw Region	Launches new regions in Germany
Oct-19	Announces Zaragoza Region		
Nov-19			
Dec-19			

Source: Company data, Goldman Sachs Global Investment Research

Margin Trends

Margins for both Azure and AWS continue to improve steadily, driven by continued leverage on fixed costs in the model as workload volumes increase, there are new higher-margin product offerings and features, and as greater efficiency is achieved in the data center footprint.

AWS: AMZN does not disclose AWS gross margins outright, however we assume based on disclosures in the company's 10K that ~50% of the company's D&A expenses allocated to AWS is allocated to AWS expenses and where non D&A-related expenses (i.e. power, cooling, customer support, and data center staff) made up 35% of AWS revenues. We modify our methodology to reflect a more gradual improvement of AWS gross margins and that they have remained relatively steady in the last few years. As such, we arrive at an implied gross margin of 52% in CY19E, vs. 53% in CY18, and 52% in CY17. We expect AWS GAAP operating margins to be 26.5% in CY19E vs. 28.4% in CY18 and 24.8% in CY17.

Exhibit 17: AWS Gross / Operating Margin Breakdown

Figures in \$mn; Depreciation expense includes amortization of capitalized internal-use software and website development costs and other corporate property and equipment depreciation expense are allocated to all segments based on usage.

	CY14	CY15	CY16	CY17	CY18	CY19E
AWS Revenue	\$ 4,644	\$ 7,880	\$ 12,219	\$ 17,458	\$ 25,656	\$ 34,842
% Growth y/y	49%	70%	55%	43%	47%	36%
D&A in COGS (~50% of AWS D&A)	\$ 949	\$ 1,288	\$ 1,731	\$ 2,262	\$ 3,048	\$ 4,511
Other COGS (~35% of AWS Revenue)	\$ 1,625	\$ 2,758	\$ 4,277	\$ 6,110	\$ 8,980	\$ 12,195
Total COGS	\$ 2,574	\$ 4,046	\$ 6,007	\$ 8,372	\$ 12,027	\$ 16,706
Gross Profit (GSe)	\$ 2,070	\$ 3,834	\$ 6,212	\$ 9,086	\$ 13,629	\$ 18,136
Gross Margin (GSe)	45%	49%	51%	52%	53%	52%
Implied Operating Expenses	\$ 1,612	\$ 2,326	\$ 3,103	\$ 4,755	\$ 6,333	\$ 8,893
yoy growth in opex	37%	44%	33%	53%	33%	40%
GAAP Operating Income	\$ 458	\$ 1,508	\$ 3,109	\$ 4,331	\$ 7,296	\$ 9,243
% margin	9.9%	19.1%	25.4%	24.8%	28.4%	26.5%
% Growth y/y		229%	106%	39%	68%	27%

Source: Goldman Sachs Global Investment Research

Azure: As customers expand their usage beyond lower-margin core compute, and PaaS increases as a percentage of total revenue, we expect continued improvement in gross margins. Management has stated in the past that depreciation currently reflects roughly 50% of COGS, and expects this to increase over time as the company achieves leverage from other costs. Long-term, management believes that Azure will have the same steady-state gross margins as does AWS (assuming the same mix of IaaS/PaaS). Based on our estimates, CY18 MSFT Azure gross margins were 42%, increasing from 24% in 2017. We expect gross margins for Azure to increase to ~50% in CY19E.

Exhibit 18: Azure Gross Margins

Figures in \$mns; based on estimates

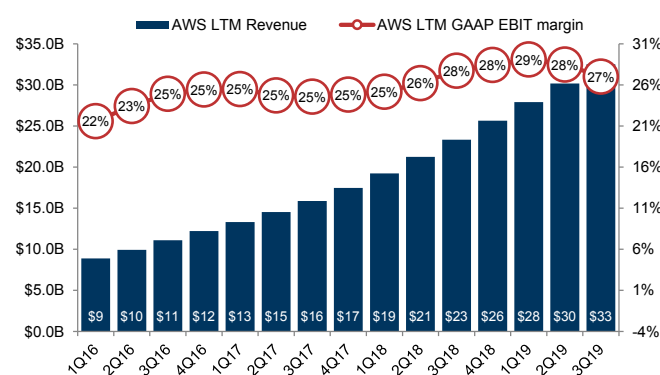
	CY14	CY15	CY16	CY17	CY18	CY19E
Azure Revenue	\$ 644	\$ 1,397	\$ 2,944	\$ 5,723	\$ 10,433	\$ 16,720
% Growth y/y	112%	117%	111%	94%	82%	60%
GAAP Gross Profit	\$ (175)	\$ (265)	\$ (28)	\$ 1,351	\$ 4,379	\$ 9,007
% margin	-27%	-19%	-1%	24%	42%	54%

Source: Goldman Sachs Global Investment Research

AliCloud: Since reporting its operating margins for the first time in C2Q16, we have tracked the performance of Alibaba's cloud business alongside AWS. In 2018, Alibaba's cloud computing business reported GAAP operating margins of (26%), compared to (32%) in CY16, and (23%) in CY17. On an adjusted basis, LTM non-GAAP operating margins were (4%) this quarter, compared to (6%) in CY18 and (5.5%) in CY17.

Exhibit 19: AWS GAAP EBIT Margins

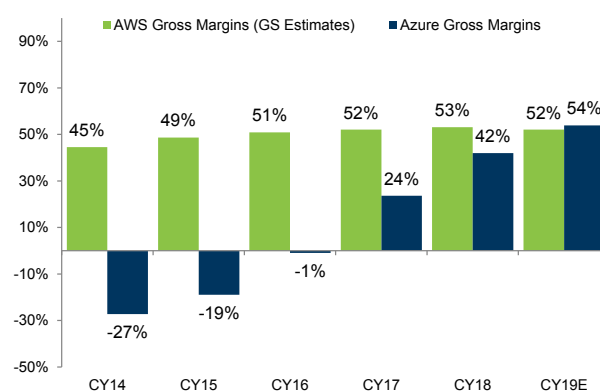
Figures in \$bn



Source: Goldman Sachs Global Investment Research

Exhibit 20: AWS vs. Azure estimated gross margins

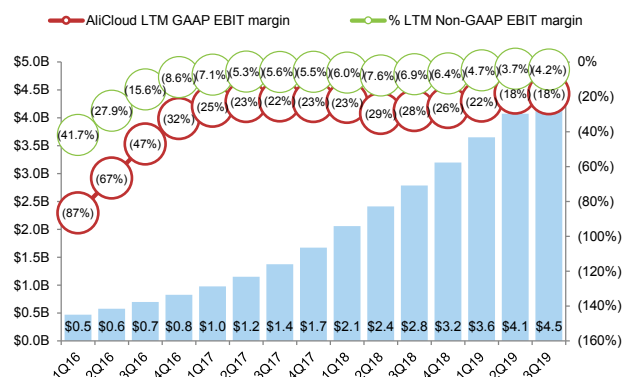
Based on company data



Source: Company data, Goldman Sachs Global Investment Research

Exhibit 21: AliCloud GAAP Operating Margins vs. Revenues

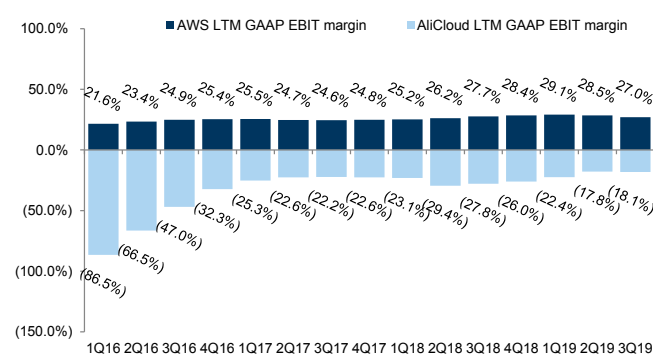
Based on company data



Source: Company data, compiled by Goldman Sachs Global Investment Research

Exhibit 22: AWS vs. AliCloud GAAP Operating Margins

Based on company data



Source: Company data, compiled by Goldman Sachs Global Investment Research

Pricing Trends

Exhibit 23: Pricing Structures

	AWS	Google	Azure
	Pricing Structure		
Type of discount	Reserved Instances (RIs)	Sustained Use Discount (SUD) Committed Use Discount (CUD)	Reserved Instances (RIs)
Length of commitment	1 or 3 years	SUD: No commitment CUD: 1 or 3 years	1 or 3 years
Range of discount levels	Up to 75%	SUD: Up to 30% CUD: 37% (1Y) 55% (3Y)	Up to 72%
Other documented programs	RI Volume discounts Spot instances	Preemptible VMs	Hybrid Use Discount Enterprise Agreement

Source: Rightscale

We continue to witness a deceleration in the number of price cuts, after the introduction of pricing mechanisms such as reserved instances (AWS/MSFT), and sustained/committed use discounts (GCP). As utilization of these discounts becomes more commonplace among enterprise customers with more defined usage levels, it is possible that we may see stability in long term pricing dynamics that could limit further aggressive and direct pricing cuts, and grow adoption of mission-critical workloads. Looking ahead, we continue to expect pricing to remain deflationary, given the general orientation of large players like AWS to pass on cost savings to the customer as offerings such as serverless computing gains traction. Since its launch, AWS has reduced prices at least 67 times, where its philosophy is to pass on a portion of the cost savings from scale and efficiency, to customers.

LTM Price Cut Summary:

3Q17: Google reduced prices on its local solid-state disk (SSDs) by up to 63% on GCE VMs, and up to 71% on pre-emptible VMs.

4Q17: In November, MSFT notably announced the availability of reserved instances for VMs, offering up to a 72% price reduction vs. pay-as-you-go. Additionally, they released Azure Hybrid Benefits, which allow Windows Server customers to move on-premise licensed workloads in the cloud, leading to ~80% in potential savings for certain deployments. Google announced in November that it would be lowering the prices for NVIDIA Tesla GPUs by up to 36%, likely targeted at developers leveraging GCP for machine learning workloads. AWS restructures IoT pricing model, cutting prices by ~20-40%.

1Q18: Microsoft lowered the price for its support plans from \$300 per month, to \$100 per month, while response time for critical support cases was improved, while Google pressed further into its push for share of GPU workloads by offering pre-emptive GPU instances at a 50% discount to recently lowered on-demand instances.

2Q18: AWS reduced the on-demand and reserved instance prices for EC2 storage-optimized H1 instances by ~15%.

3Q18: AWS reduced pricing for existing Lightsail instances by up to 50% and discounted data transfers from EC2, S3, and Cloudfront by up to 34% in Japan and 28% in Australia. Microsoft introduced a 30% discount to the Basic App Service Plan for Linux and a 20% discount to the Premium version.

4Q18: AWS reduced pricing for existing P3 instances, both on-demand and RI, by up to 20% and Standard RIs with a 3-year term by up to 15%.

1Q19: AWS reduced prices for AWS Fargate by up to 50%.

2Q19: GCP extended committed use discounts to include GPUs, Cloud TPU Pods, and local SSDs, applying up to a 55% discount. AWS reduced prices for certain P3 and reserved instances in the AWS China by up to 40%. Azure also offered up to a 66% discount to Basic app service plans for Linux.

3Q19: AWS reduced IoT Core and Device Management prices by 15-20% in APAC regions and reduced storage prices for Elastic File System Infrequent Access storage class by up to 44%. Azure offered up to a 35% discount for Linux App Services and up to a 65% discount for reserved capacity for Azure SQL Data Warehouse.

Exhibit 24: Pricing for specific instances/offerings

Based on official company blogs

	Google Cloud Platform	Amazon AWS	Microsoft Azure
Feb 2017	-	-	A1 Basic VMs (Linux) cut by 42% F1 to F16 VMs (Linux) cut by 23% Hot / Cold Block Storage by 26% / 38%
Mar 2017	Compute Engine reduced by up to 5% Committed Use discount of up to 57%	-	-
April 2017	-	-	L VMs reduced 60% - 69%
May 2017	-	AWS Reserved Instances Standard: up to 75% reduced Convertible: up to 45% reduced EC2: M4 reduced 7%	General Purpose VMs reduced by up to 7%
July 2017	-	Microsoft SQL Server instances on AWS reduced by up to 52%	-
Aug 2017	Local SSD Storage reduced up to 63% price cut for GCE VMs up to 71% for Preemptive VMs; per second billing introduced	AWS Introduces per second billing	-
Nov 2017	Lowering the cost of Intel Skylake VMs by 6-10%; New lower prices for GPUs and Local SSDs; Simplified Kubernetes Engine Pricing	New IOT Pricing Model reduced by ~20-40%;	Introduced Reserved Instances discounts of up to 72%, and 82% for Hybrid Use Benefit
Dec 2017	-	up to 15% EC2 reduction in Asia	52% price reduction in Azure HDInsight
Jan 2018	Pre-emptible GPUs offered at reduced 50% discount	-	Azure standard support pricing by 66%
May 2018	-	~15% EC2 reduction for H1 Storage optimized instances	-
Jun 2018	Lowered preemptible GPU prices to 70% off on-demand VMs; Pre-emptible Cloud TPU offers a 70% discount	New reduced AWS Config pricing model	30% savings through new purchasing model for certain Azure SQL Database deployments
July 2018	Resource-based pricing for GCE; SUDs based on all machine type usage instead of individual	-	vCore-based purchasing model for SQL databases & elastic pools
Aug 2018	-	Lightsail instances prices reduced by up to 50%	-
Sep 2018	-	up to 34% reduction in data transfer prices from EC2, S3, and Cloudfront in Asia	30% savings for Basic & 20% savings for Premium App Service Plan for Linux; extended preview price for Linux on ASE
Oct 2018	-	-	-
Nov 2018	-	-	-
Dec 2018	-	Up to 20% reduction on P3 instances (on-demand and RI) and 15% reduction for Standard RIs with a 3-year term for all instance sizes	-
Jan 2019	-	up to 50% reduction on AWS Fargate vCPU and memory across all regions	-
Feb 2019	-	25% reduction in EC2 X1 instances on Mumbai region	-
Mar 2019	up to 42% reduction on Coldline storage	-	-
Apr 2019	-	-	Reserved capacity pricing available with up to 65% savings on compute costs; Azure Container instances pricing reduced between 35-50%
May 2019	-	-	VM series discounts: 56% savings for NCv1-series & 40% savings on Hv1 and NVv1-series; reserved instances discount available for VMs
Jun-19	extended committed use discounts to GPUs, Cloud TPU Pods, and local SSDs with up to 55% off on-demand prices	up to 40% price reduction on P3 1-year reserved instances and 10% on 3-year RIs in AWS China region	up to 66% discount to Basic app service plan for Linux
Jul-19	-	-	-
Aug-19	-	15%-20% price reduction in prices for IoT Core and Device Management in APAC regions	up to 50% discount on Azure Archive Storage up to 35% discount for Linux App Service on the Premium v2 plan
Sep-19	-	44% reduction in storage prices for Elastic File System Infrequent Access storage class	reserved capacity for Azure SQL Data Warehouse - 37% or 65% discount for 1 or 3-year option
Oct-19	-	CloudFront reduces prices in S. America by 56%	new capacity reservation pricing model for Azure Monitor Log Analytics along with discount of up to 25% discount compared to Pay-As-You-Go

Source: Company Data

Exhibit 25: Pricing for specific compute instances

Pricing is based on a select few instances – not indicative of the entire portfolio

Type	vCPU	Mem.	AWS	Azure	GCP
General Purpose	2	8GB	\$0.09	\$0.08	\$0.11
	4	16GB	\$0.19	\$0.17	\$0.21
	8	32GB	\$0.37	\$0.33	\$0.43
Compute Optimized	2	4GB	\$0.09	\$0.08	\$0.08
	4	8GB	\$0.17	\$0.17	\$0.16
	8	16GB	\$0.34	\$0.34	\$0.33
Memory Optimized	2	16GB	\$0.13	\$0.13	\$0.13
	4	32GB	\$0.25	\$0.25	\$0.27
	8	64GB	\$0.50	\$0.31	\$0.54

Notes: Prices are for Linux VMs/Instances located in N Virginia (US East) for AWS, US East for MSFT, and N. Virginia (us-east-4) for GCP and are correct as of November 4, 2019. Memory sizes may vary. Google's VMs generally have less memory than AWS or Azure VMs.

Source: Company Data

Other noteworthy items

VMW public cloud partnerships:

- **VMware Cloud on AWS:** During VMworld 2019 Europe, VMC on AWS was launched in the AWS Stockholm region, bringing the total number of available regions to 17. Management noted that in the past year, the total number of VMs have increased 9x and the number of partners with a VMware Cloud on AWS competency have increased 3x. VMC on AWS customers can now leverage VMware PKS to run containers and Kubernetes and in the future, will also be able to leverage Project Pacific. Project Pacific is an initiative to embed Kubernetes into the control plan of vSphere so that customers can manage containers and VMs on the same platform.
- **Azure VMware Solutions:** VMW noted at VMworld 2019 Europe that they continue to see customer traction, especially across retail, healthcare, and public sector verticals, for Azure VMware Solutions. This service is expected to expand into more regions globally, especially in APAC, through the first half of 2020. Customers are also now able to leverage VMware HCX to move large volumes of applications over to Azure with little to no downtime. Both MSFT and VMW also announced a collaboration to allow customers to leverage SQL Server 2019 for all of their applications deployed across hybrid environments on VMware vSphere infrastructure.
- **Oracle partnership:** At OpenWorld 2019, ORCL announced a partnership with VMware, which allows customers to manage their own VMW-certified stack, extending on-premise VMW environments to OCI, which will be available in 4Q19.

Public Cloud Scorecard

Exhibit 26: Public Cloud Scorecard 3Q19

* denotes stock is on the respective Conviction List, figures in \$mns

Ticker	Company	Rating as of 11/5/19	Market Cap as of 11/5/19	LTM Public Cloud Platform Revenue			Total LTM Capex			
				LTM Revenue	YoY growth	% of Total LTM Revenue	% of LTM IaaS and PaaS TAM	Total LTM Capex	% of Revenue	YoY growth
AMZN	Amazon - AWS	Buy*	\$893bn	\$32,502mn	39%	14%	47%	\$12,974mn	6%	35%
MSFT	Microsoft - Azure	Buy	\$1100bn	\$15,100mn	67%	13%	22%	\$17,400mn	15%	14%
CRM	Salesforce - App Cloud	Buy	\$137bn	\$3,843mn	50%	31%	6%	\$654mn	5%	16%
GOOGL	Google - GCP	Buy*	\$833bn	\$4,357mn	84%	3%	6%	\$25,507mn	19%	14%
BABA	Alibaba - AliCloud	Buy*	\$475bn	\$4,547mn	63%	9%	7%	\$4,440mn	9%	-19%
ORCL	Oracle - IaaS + PaaS	Buy*	\$183bn	\$1,482mn	-11%	4%	2%	\$1,663mn	4%	1%
Total			\$3,621bn	\$61,831mn	49%			\$62,637mn		

Source: Company data, Goldman Sachs Global Investment Research

Exhibit 27: Public Cloud Scorecard 2019

* denotes stock is on the respective Conviction List, figures in \$mns

Ticker	Company	Rating as of 9/3/19	Market Cap as of 9/3/19	LTM Public Cloud Platform Revenue			Total LTM Capex			
				LTM Revenue	YoY growth	% of Total LTM Revenue	% of LTM IaaS and PaaS TAM	Total LTM Capex	% of Revenue	YoY growth
AMZN	Amazon - AWS	Buy*	\$885bn	\$30,186mn	42%	12%	46%	\$11,910mn	5%	26%
MSFT	Microsoft - Azure	Buy	\$1039bn	\$13,505mn	71%	11%	21%	\$16,900mn	13%	24%
CRM	Salesforce - App Cloud	Buy	\$134bn	\$3,321mn	43%	23%	5%	\$640mn	4%	18%
GOOGL	Google - GCP	Buy*	\$757bn	\$3,776mn	86%	3%	6%	\$23,922mn	16%	18%
BABA	Alibaba - AliCloud	Buy*	\$449bn	\$4,072mn	69%	7%	6%	\$4,850mn	8%	-2%
ORCL	Oracle - IaaS + PaaS	Buy*	\$173bn	\$1,536mn	-7%	4%	2%	\$1,660mn	4%	-4%
Total			\$3,437bn	\$56,397mn	51%			\$59,882mn		

Source: Company data, Goldman Sachs Global Investment Research

Valuation & risks

Alibaba (BABA): Maintain Buy rating (on CL) and \$255 12-month PT, based on our SOTP. Key risks include slower GMV growth, lower monetization, and more intense competition.

Alphabet (GOOGL): Maintain Buy rating (on CL) and \$1,500 12-month PT, based on an equal-weighted blend of DCF, P/E, and EV/EBITDA. Key risks include revenue impact from potential product changes mandated by regulators, weaker-than-expected cost discipline, competition, and dilutive M&A.

Amazon (AMZN): Maintain Buy rating (on CL) and \$2,200 12-month PT, based on our SOTP. Key risks include competition,

margin pressures from investment, and valuation

Microsoft (MSFT): Maintain Buy rating and \$161 12-month PT, based on equally weighted DCF, EV/FCF, and P/E. Key risks include adoption of hybrid cloud, Windows and Office performance, IT spending, and macro trends.

Oracle (ORCL): Maintain Buy rating (on CL) and \$62 12-month PT, based on an equal-weighted blend of DCF, P/E, and EV/sales. Key risks include pressure on IT spending due to macro weakness and cloud adoption.

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