September 13, 2017

Apple Suppliers' Dilemma, Part II

Next-gen iPhones to fuel core sales as suppliers branch out

Goldman Sachs

Equity Research

A year later, looking ahead: Highlighting 12 Buys, 4 Sells

Updating competitive landscape for Apple suppliers

With the announcement of the new iPhone, Apple suppliers are back in the spotlight. We refresh our 2016 analysis of the competitive landscape and find dependence on Apple's (Not Covered) product cycle remains high, which should drive supplier profits higher as the benefits of the latest launch flow through the ecosystem. Makers of advanced devices like OLEDs are likely to see the sharpest increase in margins, as demand for their product spikes with Apple's shift to a higher-end iPhone model. Over the long term, we continue to favor suppliers with exposure to both Apple and other growing profit pools, and we refresh our views across the ecosystem accordingly (see infographic on pg. 3-4).

Apple profit pool to accelerate from 2017: Five key changes

(1) Apple sales/op. profit exposure: The 53 companies' (51 in our previous report) average sales/op. profit exposure to Apple declined to 20%/20% in FY16 from 22%/24% in FY15. While we infer this means growth in business opportunities other than Apple, these suppliers remain heavily dependent on Apple. **(2) Supply structure**: The average Apple market share (at 45%) and % of devices/components with three or fewer suppliers (56%) are almost unchanged. The supply structure is unchanged but competition remains harsh. **(3) Profit pool:** We see total op. profits rising sharply yoy in FY17, and op. margins rising to 12% (FY17-19 average) from 9% (FY15-17) last time. This outlook reflects benefits from innovation in Apple technology/a shift toward the high end**. (4) New growth areas**: We see new growth areas accounting for a greater share of sales than last time. **(5) Stock performance**: The Strong Dependent group performed the best (on iPhone 7 boost and 8/X expectations), followed by Transformers and Leaders, with Laggards well behind and a widening performance gap.

Highlighting 12 Buys, 4 Sells

We highlight **12 Buys:** Leaders (strong positions with Apple and in new growth areas) are **Broadcom, Samsung Elec, Nidec and Murata Mfg**. Strong Dependents (strong with Apple, lagging in new growth areas) are **Catcher, Alps Electric, SK Hynix, Finisar, and Sony** (Sony is close to Leaders when non-hardware is included). Transformers (strong in new growth areas) are **TDK, Infineon, and Flex**. We highlight **4 Sells**: Laggards (struggling in both areas) are **TPK, LG Display, Ibiden and Wistron**.

Daiki Takayama
+81(3)6437-9870 daiki.takayama@gs.com
Goldman Sachs Japan Co., Ltd.

Wei Chen
+886(2)2730-4185 wei.chen@gs.com
Goldman Sachs (Asia) L.L.C., Taipei Branch

Nozomi Handa
+81(3)6437-9886 nozomi.handa@gs.com
Goldman Sachs Japan Co., Ltd.

UPDATED ECOSYSTEM INSIDE

A breakdown of top suppliers by segment & strength inside/outside the Apple profit pool

READ THE ORIGINAL

Apple Suppliers' Dilemma, Part I

June 30, 2016

We lay out the challenges facing component and assembly makers and introduce a framework to identify those best-positioned for success.

Read Report >

Goldman Sachs does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that the firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision. For Reg AC certification and other important disclosures, see the Disclosure Appendix, or go to www.gs.com/research/hedge.html. Analysts employed by non-US affiliates are not registered/qualified as research analysts with FINRA in the U.S.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Table of contents

Apple supply chain stock picks: 12 Buys, 4 Sells **5**

Apple profit pool to accelerate: Five key changes **12**

1. Changes in sales/profit exposure: Slightly lower than before, but dependence remains high 12
2. Supply structure: Largely unchanged, but product development competition remains tight 15
3. Profit pool: Key device margins set to rise sharply from FY17 15
4. New growth areas: No major changes, but sales weightings rising 16
5. Share price performance: A good year for Strong Dependents 18

Ratings, target prices, valuation methodology and risks **20**

Disclosure Appendix **21**

Prices in this report are as of the Sept. 11, 2017 market close unless indicated otherwise.

Further Reading on New Growth Fields

We see the Apple supplier ecosystem strengthening its ties to a range of emerging profit pools, including:

- OLEDs
- Virtual/Augmented Reality
- Connected Cars
- The Internet of Things
- Cloud Computing

Global technology hardware (Contributing analysts)

JAPAN

Daiki Takayama
daiki.takayama@gs.com, 81-3-6437-9870

Ikuo Matsuhashi
ikuo.matsuhashi@gs.com, 81-3-6437-9860

Masaru Sugiyama
masaru.sugiyama@gs.com, 81-3-6437-4691

Satoru Ogawa
satoru.ogawa@gs.com, 81-3-6437-4061

Nozomi Handa
nozomi.handa@gs.com, 81-3-6437-9886

Noguchi Yusuke
noguchi.yusuke@gs.com, 81-3-6437-9894

Tatsuya Natsuki
tatsuya.natsuki@gs.com, 65-6654-5564

US

Toshiya Hari
toshiya.hari@gs.com, 1-646-446-1759

Mark Delaney
mark.delaney@gs.com, 1-212-357-0535

Doug Clark
doug.clark@gs.com, 1-415-249-7453

Charles E Long
charles.long@gs.com, 1-212-902-7494

Balaji Krishnamurthy
balaji.krishnamurthy@gs.com, 1-415-249-7482

Timothy G Sweetnam
timothy.sweetnam@gs.com, 1-801-884-4492

Garrett Clark
garrett.clark@gs.com, 1-212-357-7956

Matthew Fahey
matthew.fahey@gs.com, 1-212-357-7520

GAO HUA SECURITIES (CHINA)

Donald Lu
donald.lu@ghsl.cn, 86-10-6627-3123

Lingling Hu
lingling.hu@ghsl.cn, 86-10-6627-3520

Tina Hou
tina.hou@ghsl.cn, 86-21-2401-8694

Scofield Chi
scofield.chi@ghsl.cn, 86-21-2401-8648

TAIWAN

Wei Chen
wei.chen@gs.com, 886-2-2730-4185

Jim Liu
jim.liu@gs.com, 886-2-2730-

KOREA

Giuni Lee
giuni.lee@gs.com, 82-2-3788-1177

Chris Jeon
chris.jeon@gs.com, 65-6654-5122

EUROPE

Alexander Duval
alexander.duval@gs.com, 44-20-7552-2995

Piyush Maheshwari
piyush.maheshwari@gs.com, 1-212-934-6921

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Apple Suppliers: A Cross-Section from Our Coverage

The following breakdown draws from 53 companies within our coverage that were included on Apple's latest list of top suppliers.

Assembly

108.4bn

- Hon Hai
- Pegatron
- Quanta
- Compal
- Wistron
- Flex

Components

NAND

$8.5bn

- Toshiba
- Samsung Elec
- SK Hynix
- Micron

DRAM

$3.8bn

- Samsung Elec
- Micron
- SK Hynix

Switches

$0.1bn

- Alps

Sensors

$0.1bn

- Alps

Baseband

$3.2bn

Accessories

$0.3bn

- GoerTek

Battery

$0.8bn

- Samsung SDI
- TDK

Packages

$0.03bn

- Ibiden

Strength in the Apple profit pool

Expanding non-Apple business in key growth areas

Defending the Apple profit pool

Slowly developing non-Apple business in key growth areas

$xxbn/mn 2016 combined GSe sales to Apple

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Display
$16.4bn
- JDI
- Samsung Elec.
- TPK
- Minebea
- Nitto Denko (polarising film)
- Nitto Denko (ITO film)
- Corning
- LG Display
- O-Film

Other Semis
$2.1bn
- Parade
- TI
- Analog
- STMicro
- Infineon
- Lumentum
- Finisar

Haptics
$0.7bn
- Nidec
- AAC
- Alps

PCB
$0.2bn
- Ibiden

Connectivity
$8.5bn
- Broadcom
- ASE
- Murata
- Skyworks
- Qorvo
- TDK
- NXP Semi
- Taiyo Yuden

Camera
$3.0bn
- Sony
- Largan
- Alps
- Mitsumi

Casing
$7.0bn
- Catcher
- Jabil Circuit
- Casetek

Passive
$2.9bn
- Murata
- Amphenol
- JAE
- Luxshare (lightning cable)
- Taiyo Yuden
- Luxshare (power cables)
- SEMCO
- TDK
- TE Conn
- Hirose Elec

HDDs
$0.1bn
- Western Digital
- Seagate

Acoustic
$1.3bn
- GoerTek
- AAC

Royalities
$2.5bn
- Qualcomm

Foundry
$4.6bn
- TSMC
- Samsung Elec

Ceramic Packages
$0.4bn
- Kyocera

Goldman Sachs

Strength in the Apple profit pool

Expanding non-Apple business in key growth areas

Defending the Apple profit pool

Slowly developing non-Apple business in key growth areas

$xxbn/mn 2016 combined GSe sales to Apple

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Apple supply chain stock picks: 12 Buys, 4 Sells

Three new iPhones announced (iPhone 8, 8 Plus and iPhone X)

The iPhone announcements came in roughly in line with our expectations. Pricing for the iPhone 8/X is slightly higher than our expectation by about US$40-50, which we believe will not meaningfully change the demand dynamics. Most of the expected new specifications were delivered (OLED screen, 3D sensing camera, new casing design, wireless charging and AR functions). The availability date for the iPhone 8/8 Plus is similar to previous cadence while iPhone X is six weeks behind. iPhone X availability reflects extended lead time in the supply chain, which we believe is due to debottlenecking as suggested by our Asia field trip in June. Hence, we believe the availability dates are better than feared, as some investors were concerned about the delay in the iPhone X announcement. In our view, the beneficiaries from the iPhone 8/X announcement are: **Samsung Elec**, **Micron** and **SK Hynix** (OLED and NAND), **Broadcom** (wireless charging) and **Catcher**, **Alps Electric** (OIS), **O- Film** (touch and front camera) and **Finisar** (3D sensing camera).

Screen:

- iPhone X is the first iPhone to feature an OLED screen (with one million to one high contrast ratio)
- iPhone 8 features Retina HD display
- **Beneficiaries:**
  - **Samsung Elec** benefits from being the sole source supplier of OLED display
  - **Universal Display** benefits from supplying key input materials to OLED display

Brand new casing design:

- All three new models of iPhones are updated with new casing designs: Glass in the front and back with a metal band
- iPhone X uses a surgical-grade stainless band that is colored using the physical vapor deposition process
- iPhone 8/8 Plus use a stronger aerospace-grade aluminum band reinforced with a laser-welded steel substructure
- All three models are precision engineered at the microscopic level to protect against water, splashes and dust
- **Beneficiaries:**
  - **Catcher** benefits from the new industrial design, uplifting casing ASP to glass with a metal band structure
  - **Tongda** benefits from improved water, splash and dust protection, uplifting ASP of their waterproof o-rings

Face ID:

- Facial recognition function is featured in iPhone X only, with 3D sensing camera in the front
- Face ID replaces the touch ID enabling phone unlock and ApplePay authentication
- **Beneficiaries:**
  - **Finisar** and Lumentum benefit from supplying the VSCEL (Vertical Cavity Surface Emitting Laser) to the 3D sensing camera

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Camera:

- iPhone 8/8 Plus
  - Back camera: Added larger/faster 12mp sensor on both models and new OIS to the iPhone 8 model
  - Front camera: Similar hardware features as iPhone 7
- iPhone X
  - Back camera: Added larger/faster 12mp sensor and OIS on telephoto camera
  - Front camera: Added depth-sensing camera and OIS
- **Beneficiaries:**
  - **Alps** benefits from supplying additional OIS components
  - **Sony** benefits from supplying upgraded CMOS image sensors

Augmented Reality (AR):

- All three models are feature a new A11 bionic chip which is 70% faster than the previous A10 Fusion
- A11 also powers AR experiences in games and apps
- **Beneficiaries:**
  - TSMC benefits from being the foundry partner for the A11 chip

Wireless charging:

- All three models are featured with wireless charging capability over a pad (AirPower)
- The AirPower mat is sold separately
- **Beneficiary:**
  - **Broadcom** benefits from supplying the wireless charging chips
  - Luxshare benefits from supplying key components used in the AirPower mat

Preorder, availability and pricing:

- iPhone 8
  - Preorders begin Sept. 15 with availability on Sept. 22, in line with previous cadence.
  - Pricing of iPhone 8/8 Plus starts at US$699/US$799 respectively, which is about US$30-40 more from iPhone 7/7 Plus
  - No 128G option
- iPhone X preorder starts Oct. 27 with availability on Nov. 3, roughly 6 weeks behind iPhone 8.
  - Pricing starts with US$999 at 64G and US$1149 at 256G, which is US$200 more vs. the iPhone 8 Plus model.
  - No 128G option
- **Beneficiaries:**
  - **Samsung Elec**, **Hynix** and **Micron** benefit from a higher NAND density offering

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Re-evaluating Apple suppliers' industry position and growth strategy

We update our June 30, 2016 report *Apple Suppliers' Dilemma* (also referred as Part 1 in this report) and our preferences among global Apple-related companies.

In the previous report, we classified Apple suppliers into four groups—**Leaders, Strong Dependents, Transformers, and Laggards**—based on quantitative analysis of each firm's position in terms of two challenges facing Apple suppliers: (1) Keeping pace with technological innovation to secure their share of the Apple profit pool, and (2) actively expanding into new growth areas such as connected cars, IoT, virtual reality/augmented reality, and big data, artificial intelligence, and cloud computing.

Our investment ideas reflect our evaluation of each company's industry position and growth strategy rather than just based on the companies' level of dependence on Apple.

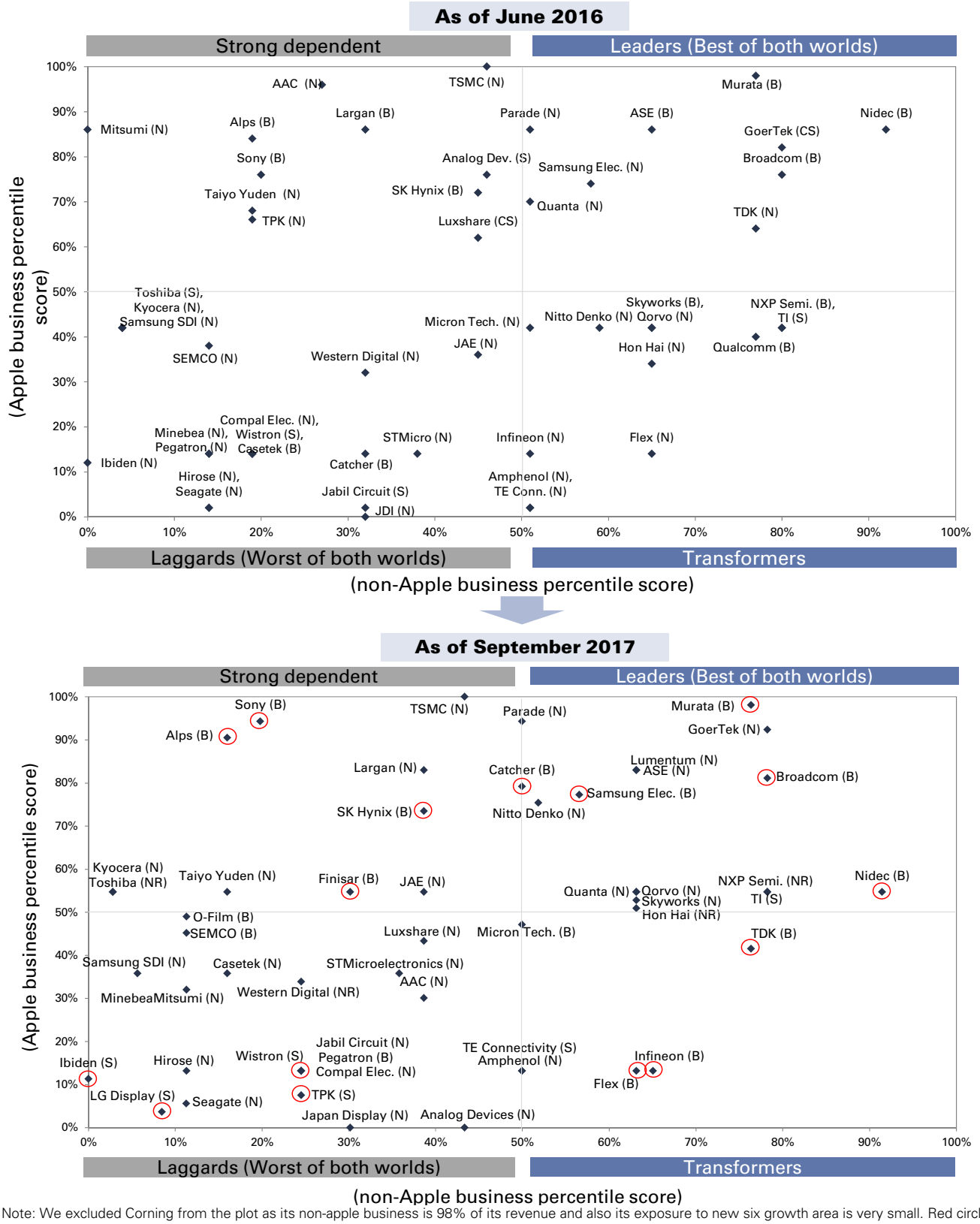
Highlighting 12 Buys among Leaders, Strong Dependents, and Transformers and 4 Sells among Laggards

We update our data on Apple suppliers in our global coverage universe (estimates for 53 firms vs. 51 last time, with Qualcomm removed due to suspension of coverage, Mitsumi removed due to its merger into MinebeaMitsumi, LG Display, O-Film, Finisar, Lumentum added after initiating coverage). We highlight 12 Buys and 4 Sells.

1. **Buys among Leaders (well positioned with Apple and in new growth areas): Broadcom, Samsung Electronics, Nidec, Murata Mfg.**
2. **Buys among Strong Dependents (strong with Apple, but lagging in new growth areas): Catcher, Alps Electric, SK Hynix, Finisar, Sony (Sony is close to Leaders group when non-hardware is included).**
3. **Buys among Transformers (leading in new growth areas): TDK, Infineon, Flex.**
4. **Sells among Laggards (weak with Apple and in new growth areas): TPK, LG Display, Ibiden, Wistron.**

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Exhibit 1: Highlighting 12 Buys among Leaders, Strong Dependents, and Transformers and 4 Sells among Laggards
Map of Apple suppliers' positions in the two profit pools (plot reflects changes between the plot in the June 2016 report and this update)



Note: We excluded Corning from the plot as its non-apple business is 98% of its revenue and also its exposure to new six growth area is very small. Red circle highlights the Buy stocks which are categorized as Leaders/Strong Dependent/Transformers, and Sell stocks which are categorized as Laggards. B=Buy, N=Neutral, S=Sell, Samsung Elec., Alps, Nidec, Catcher, Sony, Pegatron are on our Regional Conviction Lists.

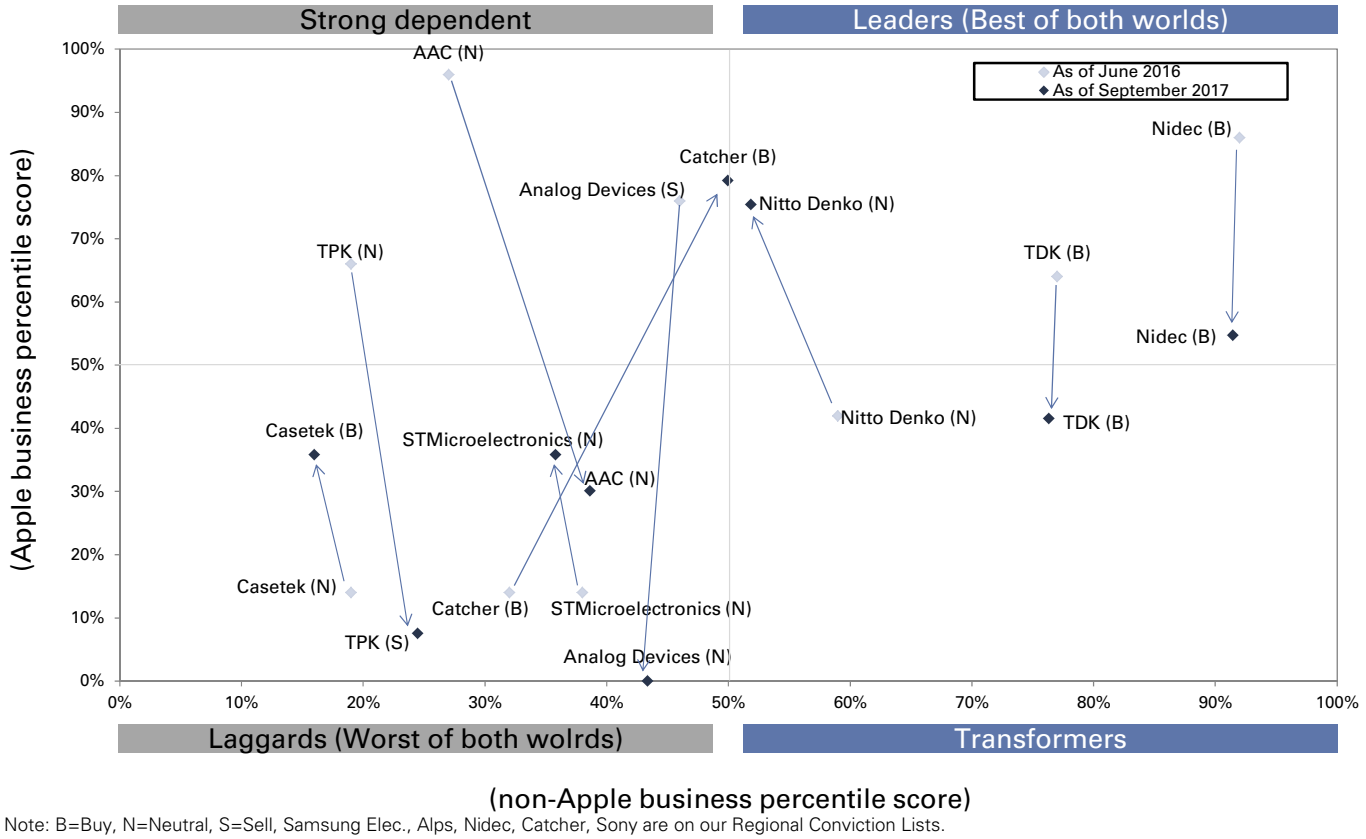
Source: Company data, Goldman Sachs Global Investment Research

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Names that made relatively large moves in the plot

We have extracted the companies whose positions in the plot have changed significantly since *Apple Suppliers' Dilemma* published in 2016 (see Exhibit 2). We note that positions can change even if actual absolute values remain the same because this is a percentile ranking relative to coverage. We list the reasons for changes in company positions in Exhibit 3.

Exhibit 2: Names that made large movements in the plot



Note: B=Buy, N=Neutral, S=Sell, Samsung Elec., Alps, Nidec, Catcher, Sony are on our Regional Conviction Lists.

Source: Company data, Goldman Sachs Global Investment Research

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Exhibit 3: Reasons for changes in company positions

Company name	Reason for changes
Nidec	Relative score down in view of TAM growth, share, and competitive environment for haptics supplied to Apple. However, given only a low weighting of sales to Apple, the decline in score has little relevance. Growth in automotive/FA robot motors/sensors/drive components is accelerating.
TDK	Relative score down in view of battery share/competitive environment, impact of de-consolidating high-frequency components. TDK is realigning its business portfolio with a sensor-driven focus on automotive/industrial/IoT applications.
Nitto Denko	We previously had concerns for TAM growth owing to the shift from LCD to OLED, but our relative score now rises as we switch focus to rising installed component value.
Catcher	Whereas previously we highlighted uncertainties over casing value-added creation, our relative score now rises on improved TAM growth of late (increase in installed component value) and a higher weighting of sales to Apple.
AAC	Relative score down in view of TAM growth potential, speed of technical innovation, and increased competition for acoustic components, and TAM growth, stiffer competition for haptics.
ST Microelectronics	Relative score up on a higher share of supply
Analog Devices	Relative score down on weaker TAM growth potential, harsher competition
Casetek	Relative score down on slower-than-expected growth in component supply for the iPhone
TPK	Relative score down on harsher competition, declining share

Source: Goldman Sachs Global Investment Research.

Overview of our analysis method

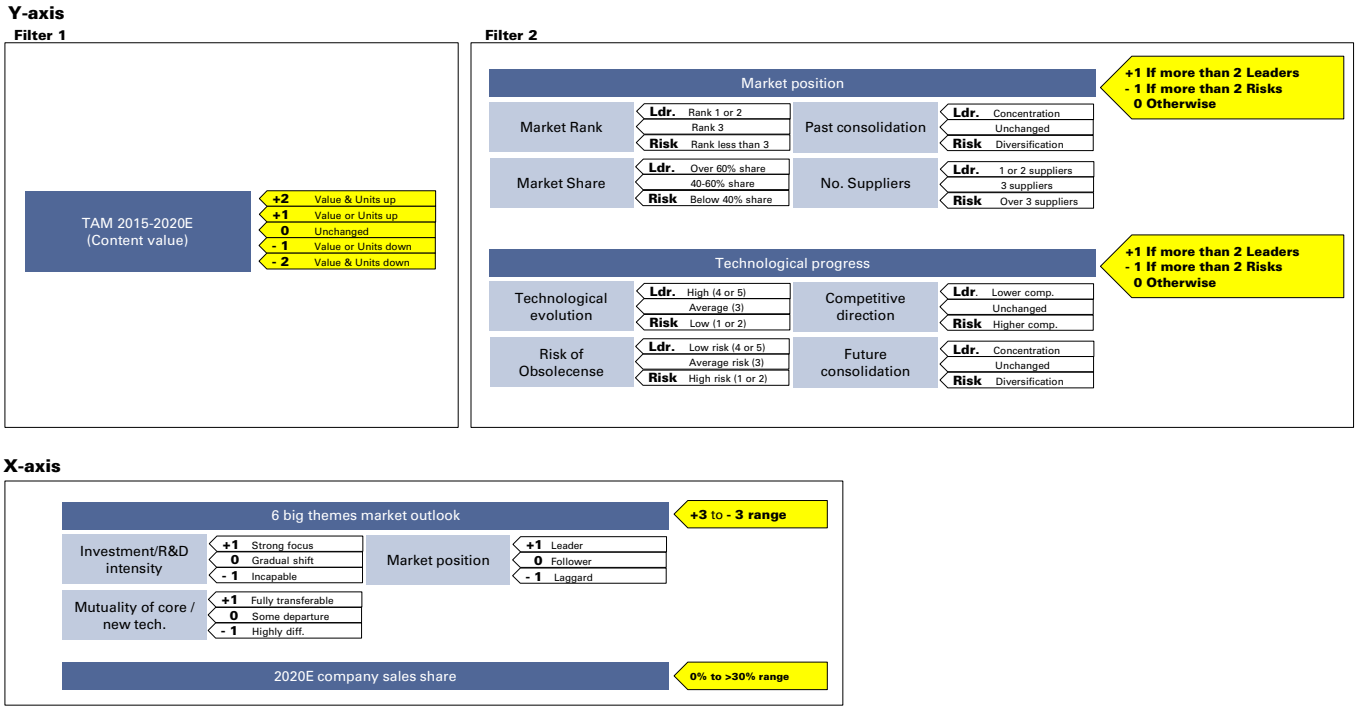
We summarize our four group classification (Strong Dependent, Leaders, Laggards and Transformers) based on plot created as below:

Y-axis percentile ranking: Apple-related business rankings in terms of (1) TAM (strength in content value and units of products for Apple and growth potential), (2) market position (market rank, market share, number of suppliers, and past consolidation), and (3) technological progress and future changes (rate of technological progress, risk of obsolescence, competitive climate changes, future consolidation).

X-axis percentile ranking: New growth area (connected cars, industrial IoT, big data, cloud computing, artificial intelligence, med tech, virtual reality/augmented reality, and smart devices/watches) business rankings in terms of (1) 2020E sales weightings, and (2) probability of attaining these weightings (based on current industry positions, intensity of investment/development, and compatibility/similarity of core technologies).

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Exhibit 4: Y-axis and X-axis percentile ranking calculation methods



Source: Company data, Goldman Sachs Global Investment Research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Apple profit pool to accelerate: Five key changes

1. Changes in sales/profit exposure: Slightly lower than before, but dependence remains high

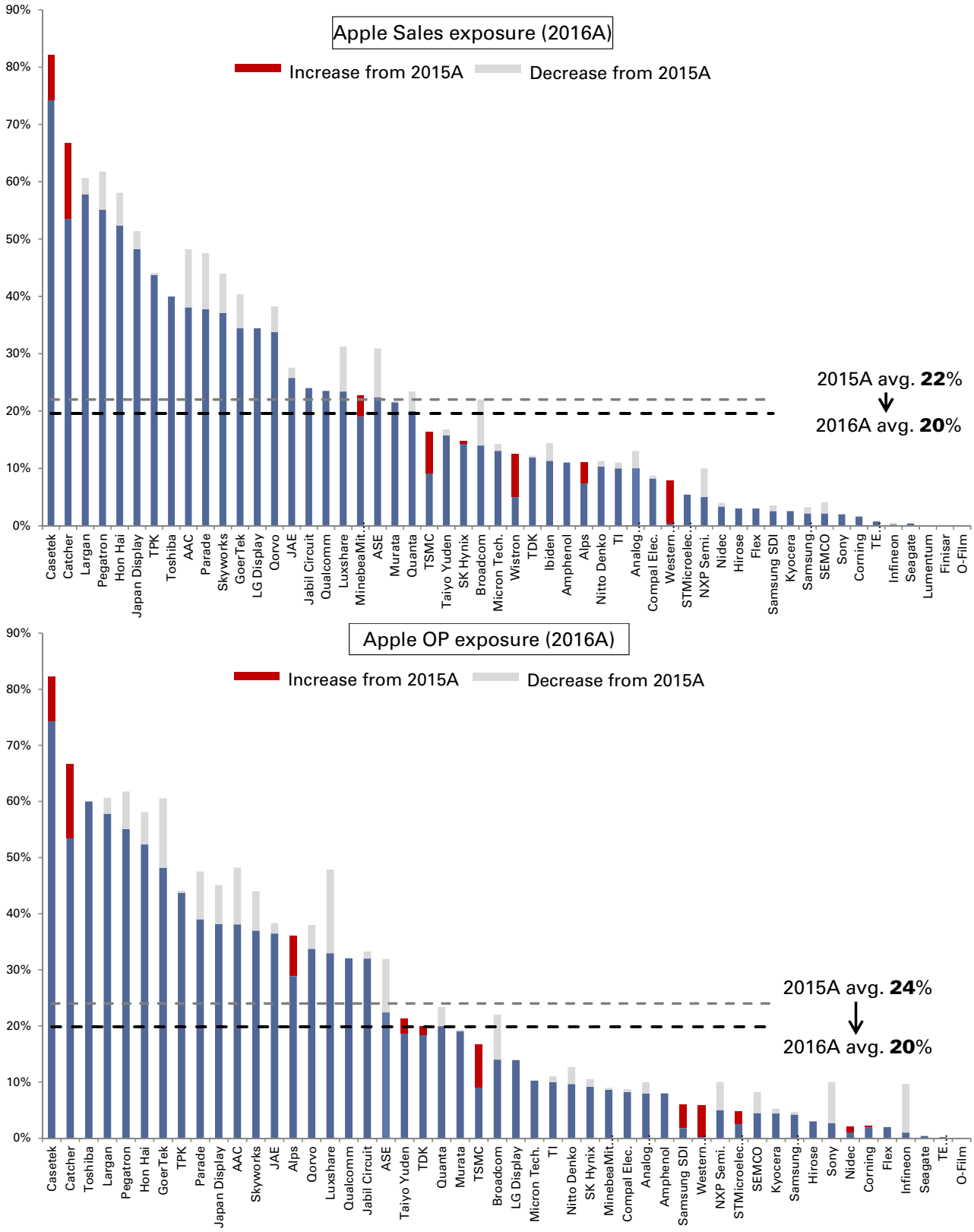
Apple still very important despite slightly declining avg. dependence

Exhibit 5 shows changes in Apple-related business' share of estimated sales and operating profits for Apple suppliers in our coverage in FY15-16. Increasing the number of companies to 53 after initiating coverage on LG Display, O-Film, Finisar and Lumentum and drop coverage of Mitsumi (merged to MinebeaMitsumi) had a minor impact. Also, for we include Qualcomm in the list while using our historical data based on FY15-16 results (no estimates for FY17 onward) as we have suspended coverage of the company.

From FY15 to FY16, the average Apple related sales exposure decreased to 20% from 22% and operating profit exposure fell to 20% from 24%. A closer look shows that exposure increased at Casetek and Catcher, which originally had high exposures to Apple, while it declined slightly at most other companies. A comparison with FY16-FY19E reveals our outlook for overall exposure to remain largely unchanged. We thus think that companies' dependence on a single customer (Apple) will remain high.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

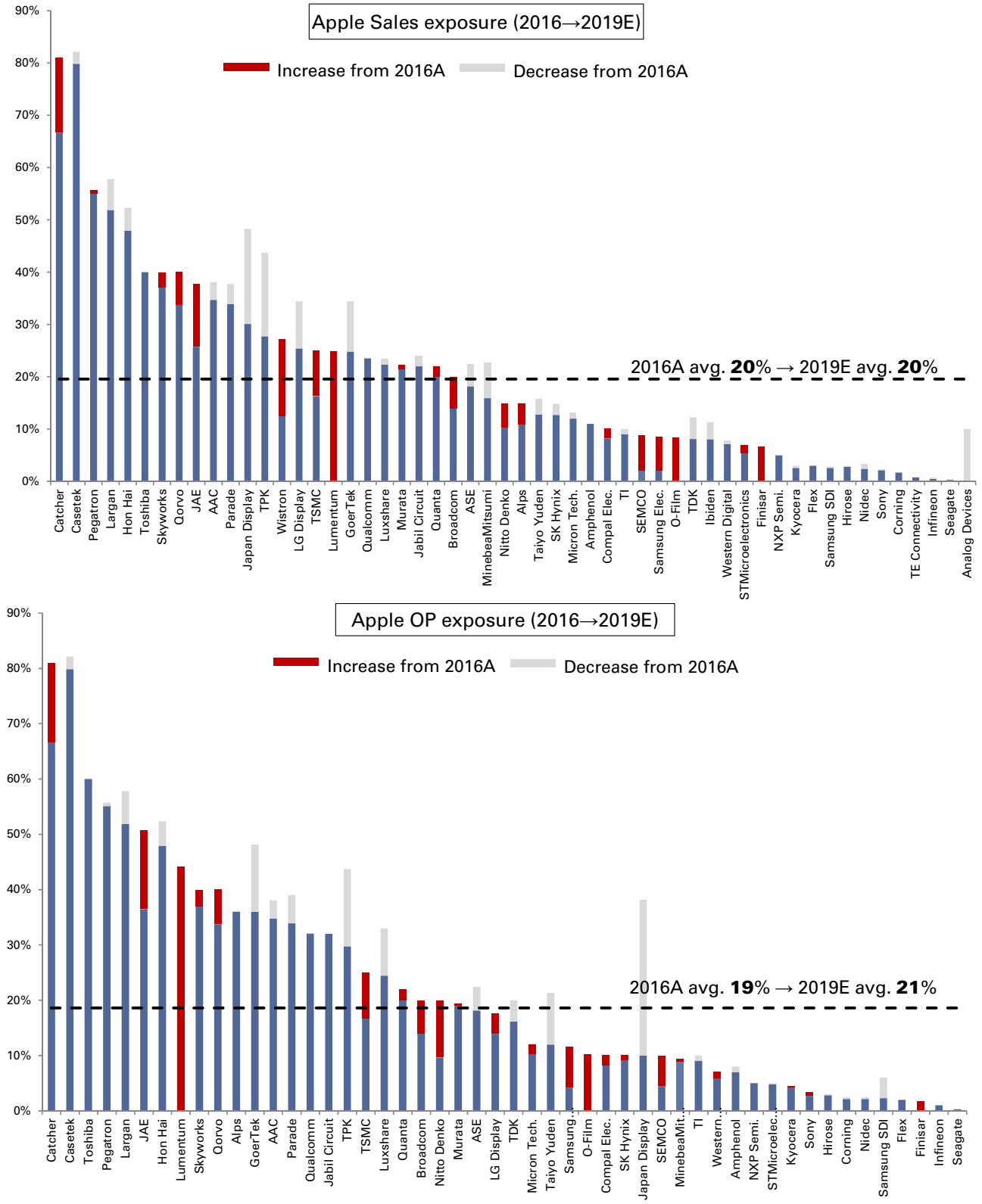
Exhibit 5: : Apple-related sales/operating profit weightings in FY15-16 and changes (based on GSe)



Source: Company data, Goldman Sachs Global Investment Research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Exhibit 6: Apple-related sales/operating profit exposure in FY16-19 and changes (based on GSe)



Note: Adding LG Display, O-Film, Finisar and Lumentum to coverage since we published Part 1 had a minor impact. For Qualcomm we use only estimates based on FY15-16 results (no estimates for FY17 onward) as we have suspended coverage of the stock.

Source: Company data, Goldman Sachs Global Investment Research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

2. Supply structure: Largely unchanged, but product development competition remains tight

Although we have seen changes in individual Apple suppliers' market position (market rank, market share, number of suppliers, and past consolidation), and technological progress and future changes (rate of technological progress, risk of obsolescence, competitive climate changes, future consolidation), we do not see any major changes overall.

For example, this update of the June 2016 report shows that Apple's average share of procurement is basically unchanged at around 45%, and 56% of supplier categories still have three or fewer companies. Nevertheless, this time we found no components/devices where competition is easing (competition was easing for acoustic components in Part 1). Although the supply structure is unchanged, we believe that product and technological competition remains tight.

3. Profit pool: Key device margins set to rise sharply from FY17

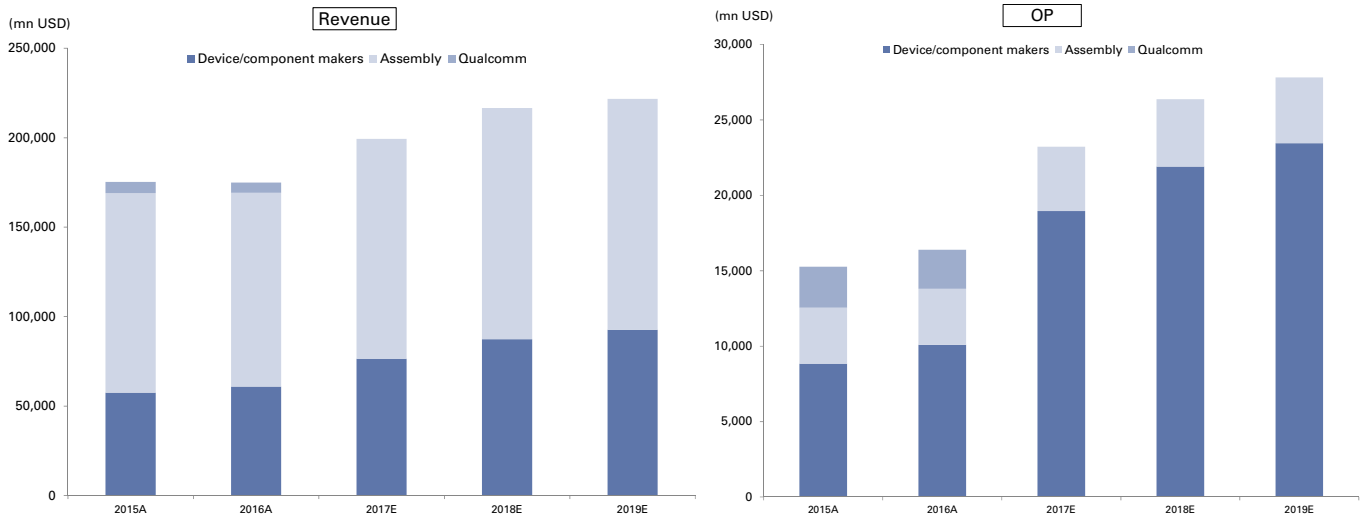
Supplier profits to reaccelerate from FY17

We estimate that Apple accounted for US$175 bn/US$15.3 bn of sales/operating profits at 53 suppliers (including newly coverage: LG Display, O-Film, Finisar, Lumentum, drop: Mitsumi) in FY15 and for US$175 bn/US$16.4 bn in FY16.

Excluding Qualcomm (i.e., based on the 53 assembly and devices firms with the four firms newly added to coverage), we estimate FY17-FY19 Apple-related sales of US$199 bn/US$217bn/US$222 bn and operating profits of U$23.2 bn/U$26.4bn/U$27.8 bn.

1HFY16 was hobbled by weak iPhone 6S sales, but we expect Apple-related sales to rise considerably in FY17 on prolonged iPhone 7 benefits in 1H and iPhone 8/iPhoneX production in 2H.

Exhibit 7: GSe for Apple suppliers' total Apple-related sales/operating profits



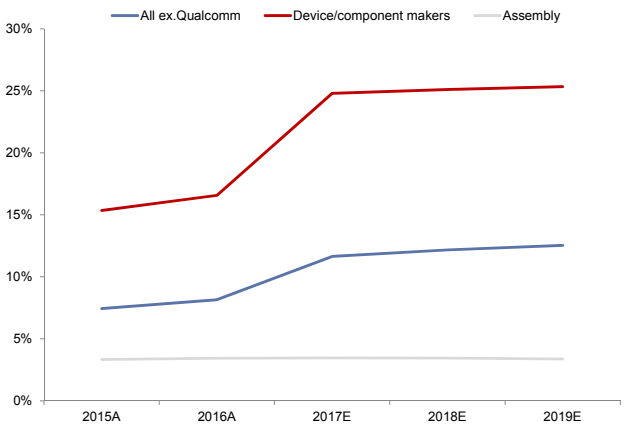
Source: Company data, Goldman Sachs Global Investment Research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Profit margins rising, mainly for key devices

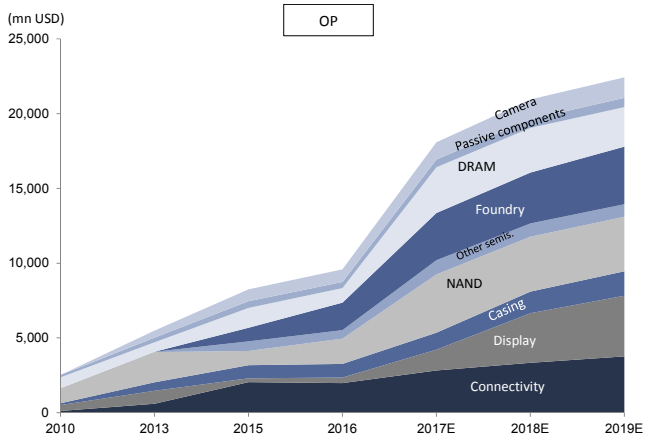
We estimate that operating margin (53 company basis) will rise to 12% in FY17, 12% in FY18, and 13% in FY19, which is higher than the average of 9% for FY15-FY17. We estimate that the operating margins excluding assemblers will rise to 25% in FY17-FY19 average, versus an FY15-FY17 average of 19%. Most of this rise in profit margin can be attributed to profit rises in the key devices of NAND, DRAM, OLED, and LSI. We believe key devices manufacturers are benefitting significantly from the iPhone becoming more high-end and from technological innovation.

Exhibit 8: Apple supplier aggregate operating margin



Source: Company data, Goldman Sachs Global Investment Research.

Exhibit 9: Key device profits from Apple



Source: Company data, Goldman Sachs Global Investment Research

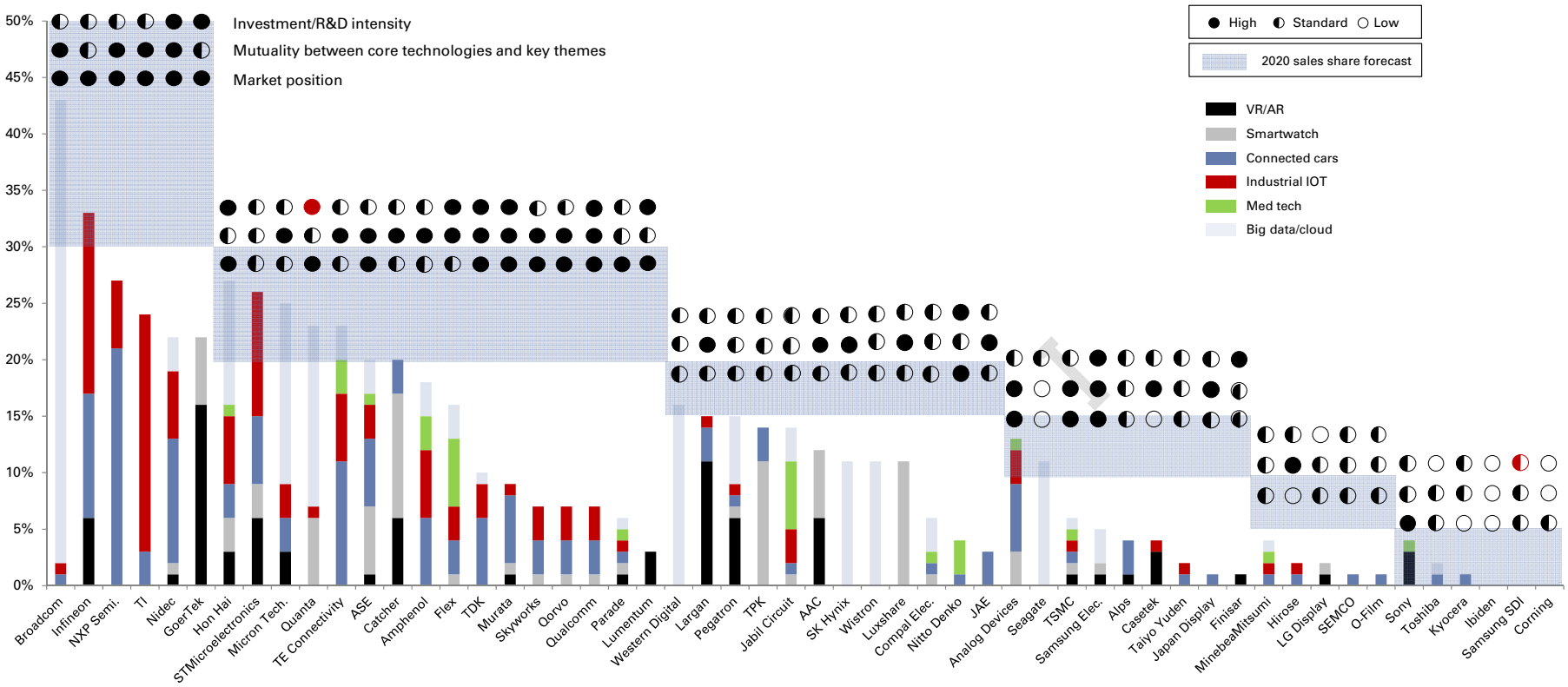
4. New growth areas: No major changes, but sales weightings rising

We have updated each firm's developments in new growth areas in Exhibit 10. While there is nothing new for many firms, overall sales weightings (current weightings and 2020E weightings) are slightly rising in five areas excluding med tech.

Also, our probability score (based on current industry positions, intensity of investment/development, and compatibility/similarity of core technologies) is almost unchanged from previous data input.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Exhibit 10: Update on current exposures to six new growth areas, 2020 weightings, and probability of attainment



Note: Changes from the Vol.1 (published in June 2017) are showed as red circles. Quanta: Standard → High, Samsung SDI: Low → Standard.

Source: Goldman Sachs Global Investment Research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

5. Share price performance: A good year for Strong Dependents

Strong Dependents outperformed others on iPhone 7 strength

Exhibit 11 shows historical share price performance for each of the four groups. Overall, share prices tend to fall once a year around iPhone launch announcements, but the sales of that year's iPhone ultimately determine the share price afterwards.

Over roughly the past year, strong sales of the iPhone 7 resulted in Strong Dependent group share prices significantly outperforming the other categories, and the difference with Laggards also widened. Transformers ranked second and Leaders third.

Companies that made especially large contributions to the Strong Dependent group's performance include SK Hynix, TPK, AAC Technologies, Largan, Luxshare, and Taiyo Yuden. Meanwhile, the Laggards were held back by Toshiba, Casetek, Japan Aviation Electronics, and Japan Display.

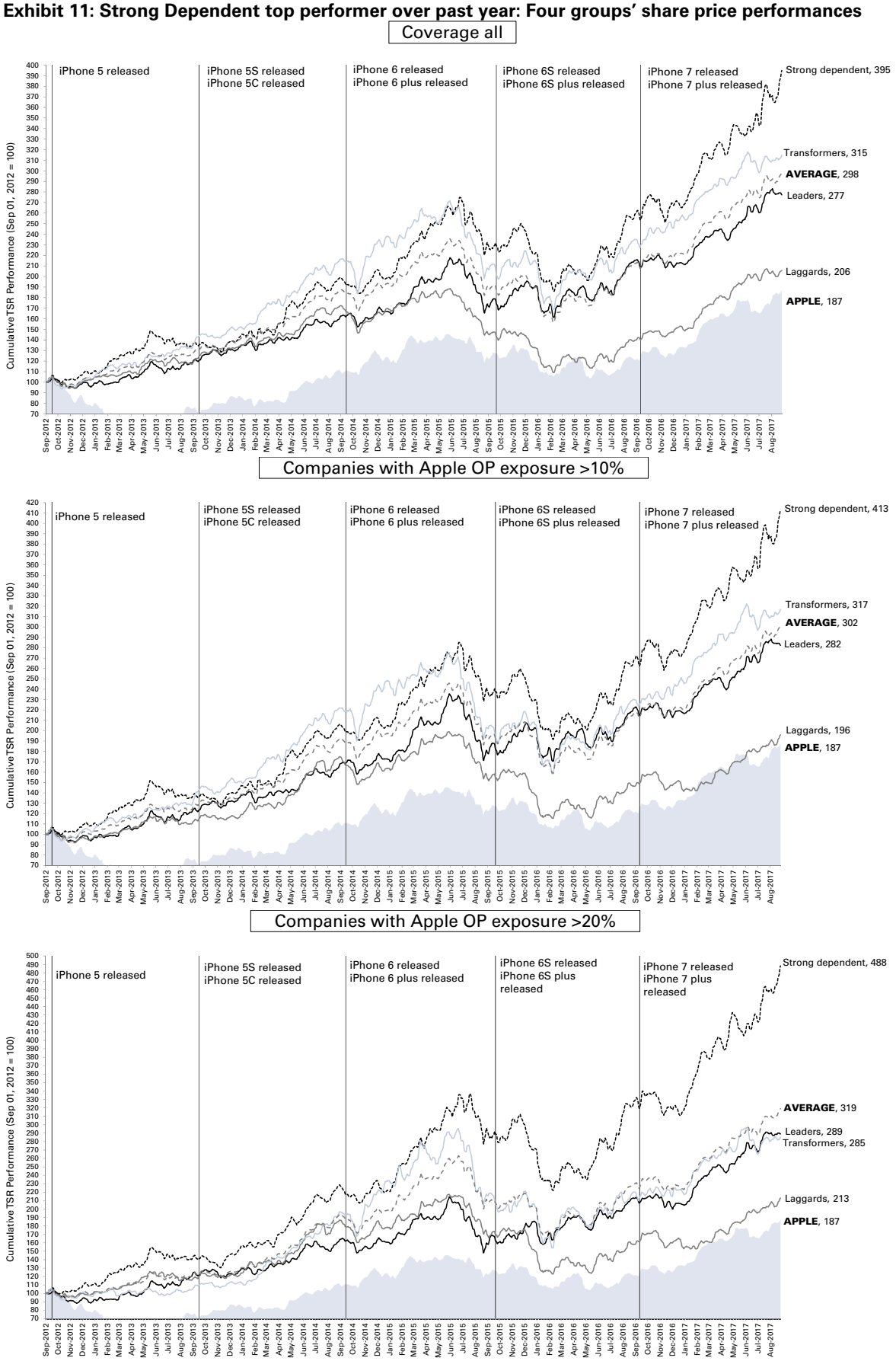
We emphasize Buys among Leaders, but Strong Dependent group may continue to enjoy limelight depending on iPhone 8/iPhone X sales

While iPhone 8 sales will likely be the overwhelming focus, we will be monitoring (1) Sep-Oct contracts and sales, and (2) component orders outlook revisions around December (affects Jan-Mar seasonal adjustments). In the past, if the outlook for sales through the year-end tended to the strong side, then Jan-Mar seasonal adjustments were minor. This could heighten expectations for year-on-year growth in 1H2018 for many companies.

We focus on the Buy-rated Leader names due to their growth sustainability and the balance they have achieved between Apple-related businesses and new growth areas. However, we believe that the Strong Dependent group may remain in the spotlight depending on iPhone 8/iPhone X sales.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Exhibit 11: Strong Dependent top performer over past year: Four groups' share price performances



Source: Datastream, Goldman Sachs Global Investment Research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Ratings, target prices, valuation methodology and risks

Exhibit 12: Rating, target prices, valuation methodology and risks

Company	Rating	Closing Price	Target Price	Valuation	Risk
Broadcom	Buy	US$ 247.74	US$ 295	17x normalized EPS of $17.35	Weak smartphone demand, changes in the competitive landscape, M&A
Samsung Elec.	Buy*	KRW 2490000	KRW 3350000	SOTP (2018E EV/EBITDA)	Major deterioration in memory supply/demand, sharp contraction in smartphone margins
Nidec	Buy*	¥ 12835	¥ 13200	FY3/19 EV/GCI vs. CROCI/WACC	Stronger yen, weaker than expected HDD production
Murata	Buy*	¥ 16590	¥ 17600	FY3/18-19 avg. EV/GCI vs. CROCI/WACC	Stronger yen, swings in MLCC supply-demand
Catcher	Buy*	NT$ 359.5	NT$ 454	2018E sector average P/B-ROE of 11X, discounted by 8% COE	Weaker iPhone/iPad orders; lower metal adoption or metal content in future smartphone designs
Alps	Buy*	¥ 2919	¥ 4100	FY3/18-19 avg. EV/GCI vs. CROCI/WACC	Stronger yen, smartphone production swings
SK Hynix	Buy	KRW 73800	KRW 88000	FY12/18 P/B vs. ROE	Sharp deterioration in DRAM/NAND supply/demand, unexpected increase in supply capacity
Sony	Buy*	¥ 4470	¥ 5600	SOTP	Failure for major in-house games, delays in reorganizing the movie business
Finisar	Buy	US$ 21.37	US$ 32	CY18 non-GAAP P/E	Capex volatility, China softness, pricing/competition, sub-100G exposure
TDK	Buy	¥ 7170	¥ 8500	FY3/18-19 avg. EV/GCI vs. CROCI/WACC	Stronger yen, weaker than expected HDD production
Infineon	Buy	EUR 20.35	EUR 21.3	8.5x 2018E EV/EBITDA (70% weighting) and a 30% M&A weighting at 16x 2018E EV/EBITDA	Weaker end markets, worsening semi cycle and negative macro dynamics.
Flex	Buy	US$ 16.66	US$ 18	15X CY18 P/E	Revenue, margins, capital allocation
TPK	Sell	NT$ 117.5	NT$ 68	2017E sector average P/B-ROE of 11X	Higher iPhone sales; ASP/GM increase on new iPhone touch; entry into the sensor business.
LG Display	Sell	KRW 31900	KRW 29000	FY12/18 P/B vs. ROE	Slower-than-expected LCD supply growth, stronger-than-expected demand for OLED TVs and mobile OLEDs
Ibiden	Sell	¥ 1777	¥ 1390	FY3/18-19 avg. EV/GCI vs. CROCI/WACC	Weaker yen, greater PCB contribution than expected
Wistron	Sell	NT$ 26.9	NT$ 13.3	0.5X 2017E trough P/B	Higher-than-expected NB shipments and faster GM recovery

Note: *On Regional Conviction List; pricing as of September 11, 2017; Nidec target price has 18-m time frame. All other target prices have 12-m time frames.

Source: Datastream, Goldman Sachs Global Investment Research.

Exhibit 13: Target price histories for Korean companies

Samsung Electronics (005930.KS)	
Date of report	Target price (W)
14-Jul-17	3,350,000
24-Jan-17	1,950,000
6-Jan-17	1,880,000
16-Dec-16	1,850,000
27-Oct-16	1,750,000
11-Oct-16	1,700,000
7-Oct-16	1,750,000
19-Sep-16	1,650,000
28-Jul-16	1,550,000
7-Jul-16	1,500,000
15-Jun-16	1,400,000
29-Apr-16	1,350,000
7-Apr-16	1,300,000
28-Jan-16	1,250,000
20-Jan-16	1,300,000
30-Oct-15	1,400,000
7-Oct-15	1,350,000
20-Sep-15	1,300,000

Samsung Electronics pref (005935.KS)	
Date of report	Target price (W)
14-Jul-17	2,500,000

SK Hynix (000660.KS)	
Date of report	Target price (W)
13-Sep-17	88,000
25-Jul-17	83,000
14-Jul-17	82,000
30-Jan-17	65,000
16-Dec-16	54,000
20-Oct-16	50,000
18-Sep-16	43,000
28-Jun-16	35,000
26-Apr-16	32,000
30-Mar-16	33,000
26-Jan-16	34,000
20-Jan-16	36,000
22-Oct-15	50,000
11-Oct-15	53,000

LG Display (034220.KS)	
Date of report	Target price (W)
26-Jul-17	29,000
14-Jul-17	30,000
24-Jan-17	23,000
21-Nov-16	22,000

Source: Goldman Sachs Global Investment Research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Disclosure Appendix

Reg AC

We, Daiki Takayama, Wei Chen, Nozomi Handa, Donald Lu, Ph.D., Toshiya Hari, Mark Delaney, CFA and Alexander Duval, hereby certify that all of the views expressed in this report accurately reflect our personal views about the subject company or companies and its or their securities. We also certify that no part of our compensation was, is or will be, directly or indirectly, related to the specific recommendations or views expressed in this report.

Unless otherwise stated, the individuals listed on the cover page of this report are analysts in Goldman Sachs' Global Investment Research division.

GS Factor Profile

The Goldman Sachs Factor Profile provides investment context for a stock by comparing key attributes to the market (i.e. our coverage universe) and its sector peers. The four key attributes depicted are: Growth, Financial Returns, Multiple (e.g. valuation) and Integrated (a composite of Growth, Financial Returns and Multiple). Growth, Financial Returns and Multiple are calculated by using normalized ranks for specific metrics for each stock. The normalized ranks for the metrics are then averaged and converted into percentiles for the relevant attribute. The precise calculation of each metric may vary depending on the fiscal year, industry and region, but the standard approach is as follows:

Growth is based on a stock's forward-looking sales growth, EBITDA growth and EPS growth (for financial stocks, only EPS and sales growth), with a higher percentile indicating a higher growth company. **Financial Returns** is based on a stock's forward-looking ROE, ROCE and CROCI (for financial stocks, only ROE), with a higher percentile indicating a company with higher financial returns. **Multiple** is based on a stock's forward-looking P/E, P/B, price/dividend (P/D), EV/EBITDA, EV/FCF and EV/Debt Adjusted Cash Flow (DACF) (for financial stocks, only P/E, P/B and P/D), with a higher percentile indicating a stock trading at a higher multiple. The **Integrated** percentile is calculated as the average of the Growth percentile, Financial Returns percentile and (100% - Multiple percentile).

Financial Returns and Multiple use the Goldman Sachs analyst forecasts at the fiscal year-end at least three quarters in the future. Growth uses inputs for the fiscal year at least seven quarters in the future compared with the year at least three quarters in the future (on a per-share basis for all metrics).

For a more detailed description of how we calculate the GS Factor Profile, please contact your GS representative.

Quantum

Quantum is Goldman Sachs' proprietary database providing access to detailed financial statement histories, forecasts and ratios. It can be used for in-depth analysis of a single company, or to make comparisons between companies in different sectors and markets.

GS SUSTAIN

GS SUSTAIN is a global investment strategy aimed at long-term, long-only performance with a low turnover of ideas. The GS SUSTAIN focus list includes leaders our analysis shows to be well positioned to deliver long term outperformance through sustained competitive advantage and superior returns on capital relative to their global industry peers. Leaders are identified based on quantifiable analysis of three aspects of corporate performance: cash return on cash invested, industry positioning and management quality (the effectiveness of companies' management of the environmental, social and governance issues facing their industry).

Disclosures

Coverage group(s) of stocks by primary analyst(s)

Daiki Takayama: Japan-Electronic Components, Korea Technology. Wei Chen: Taiwan Hardware Component and Assembly. Donald Lu, Ph.D.: A-share Telecoms and Technology, Greater China Telecoms and Technology. Toshiya Hari: America-Semiconductor Capital Equipment, America-Semiconductors. Mark Delaney, CFA: America-IT Supply Chain: Components, America-IT Supply Chain: Distributors, America-IT Supply Chain: Drives, America-IT Supply Chain: EMS, America-Semi Devices. Alexander Duval: Europe-Communications Technology, Europe-Semiconductor & Tech Hardware.

A-share Telecoms and Technology: Accelink Technologies, China United Network Comm, Dahua Technology, Fiberhome Telecom Tech, GoerTek Inc., Hikvision Digital Technology, Shenzhen Luxshare Precision Ind, Shenzhen O-Film Tech Co., Wangsu Science & Technology Co., ZTE Corp. (A).

America-IT Supply Chain: Components: Amphenol Corp., Belden Inc., CommScope Holding, Sensata Technologies Holding, TE Connectivity Ltd..

America-IT Supply Chain: Distributors: Arrow Electronics Inc., Avnet Inc..

America-IT Supply Chain: Drives: Seagate Technology, Western Digital Corp..

America-IT Supply Chain: EMS: Flex, Jabil Circuit Inc..

America-Semi Devices: M/A-COM Technology Solutions Holding, Marvell Technology Group, Microchip Technology Inc., Micron Technology Inc., Microsemi Corp., ON Semiconductor Corp..

America-Semiconductor Capital Equipment: Applied Materials Inc., Entegris Inc., Keysight Technologies Inc., KLA-Tencor Corp., Lam Research Corp., Teradyne Inc., Versum Materials Inc..

America-Semiconductors: Advanced Micro Devices Inc., Analog Devices Inc., Broadcom Ltd., Integrated Device Technology Inc., Intel Corp., Maxim Integrated Products, Nvidia Corp., NXP Semiconductors NV, Qorvo Inc., Skyworks Solutions Inc., Texas Instruments Inc., Xilinx Corp..

Europe-Communications Technology: Ericsson, Ericsson, Gemalto, Nokia, Nokia, Spirent Communications Plc, Technicolor.

Europe-Semiconductor & Tech Hardware: ASML Holding, Infineon, Ingenico SA, Mobileye NV, STMicroelectronics, STMicroelectronics.

Greater China Telecoms and Technology: China Communication Services, China Mobile (HK), China Mobile (HK) (ADR), China Telecom, China Telecom (ADR), China Unicom, China Unicom (ADS), Hua Hong Semiconductor Ltd., Mediatek, Parade Technologies Ltd., Silergy Corp., SMIC, SMIC (ADR), Sunny Optical Technology Group, TSMC, TSMC (ADR), United Microelectronics Corp., United Microelectronics Corp. (ADR), ZTE Corp. (H).

Japan-Electronic Components: Alps Electric, Hirose Electric, Ibiden, IRISO Electronics, Japan Aviation Electronics Industry, Japan Display Inc., Kyocera, Mabuchi Motor, MinebeaMitsumi Inc., Murata Mfg., NGK Insulators, NGK Spark Plug, Nichicon, Nidec, Nippon Ceramic, Nitto Denko, Pacific Industrial, Shinko Electric Industries, Taiyo Yuden, TDK.

Korea Technology: LG Display, LG Electronics, Samsung Electro-Mechanics, Samsung Electronics, Samsung Electronics (Pref), Samsung SDI Co., Samsung SDS Co., SK Hynix Inc..

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

Taiwan Hardware Component and Assembly: AAC Technologies, Acer, Advanced Semiconductor Engineering, ASUSTeK Computer, Casetek Holdings, Catcher Technology, Compal Electronics, Hon Hai Precision, HTC Corp., Largan Precision, Lenovo Group, Pegatron, Quanta Computer, Siliconware Precision Industries, Tongda Group, TPK Holding, Wistron.

Company-specific regulatory disclosures

Compendium report: please see disclosures at http://www.gs.com/research/hedge.html. Disclosures applicable to the companies included in this compendium can be found in the latest relevant published research

Distribution of ratings/investment banking relationships

Goldman Sachs Investment Research global Equity coverage universe

	Rating Distribution			Investment Banking Relationships		
	Buy	Hold	Sell	Buy	Hold	Sell
Global	32%	54%	14%	65%	56%	49%

As of July 1, 2017, Goldman Sachs Global Investment Research had investment ratings on 2,753 equity securities. Goldman Sachs assigns stocks as Buys and Sells on various regional Investment Lists; stocks not so assigned are deemed Neutral. Such assignments equate to Buy, Hold and Sell for the purposes of the above disclosure required by the FINRA Rules. See 'Ratings, Coverage groups and views and related definitions' below. The Investment Banking Relationships chart reflects the percentage of subject companies within each rating category for whom Goldman Sachs has provided investment banking services within the previous twelve months.

Price target and rating history chart(s)

Compendium report: please see disclosures at http://www.gs.com/research/hedge.html. Disclosures applicable to the companies included in this compendium can be found in the latest relevant published research

Regulatory disclosures

Disclosures required by United States laws and regulations

See company-specific regulatory disclosures above for any of the following disclosures required as to companies referred to in this report: manager or co-manager in a pending transaction; 1% or other ownership; compensation for certain services; types of client relationships; managed/co-managed public offerings in prior periods; directorships; for equity securities, market making and/or specialist role. Goldman Sachs trades or may trade as a principal in debt securities (or in related derivatives) of issuers discussed in this report.

The following are additional required disclosures: **Ownership and material conflicts of interest:** Goldman Sachs policy prohibits its analysts, professionals reporting to analysts and members of their households from owning securities of any company in the analyst's area of coverage. **Analyst compensation:** Analysts are paid in part based on the profitability of Goldman Sachs, which includes investment banking revenues. **Analyst as officer or director:** Goldman Sachs policy generally prohibits its analysts, persons reporting to analysts or members of their households from serving as an officer, director or advisor of any company in the analyst's area of coverage. **Non-U.S. Analysts:** Non-U.S. analysts may not be associated persons of Goldman, Sachs & Co. and therefore may not be subject to FINRA Rule 2241 or FINRA Rule 2242 restrictions on communications with subject company, public appearances and trading securities held by the analysts.

Distribution of ratings: See the distribution of ratings disclosure above. **Price chart:** See the price chart, with changes of ratings and price targets in prior periods, above, or, if electronic format or if with respect to multiple companies which are the subject of this report, on the Goldman Sachs website at http://www.gs.com/research/hedge.html.

Additional disclosures required under the laws and regulations of jurisdictions other than the United States

The following disclosures are those required by the jurisdiction indicated, except to the extent already made above pursuant to United States laws and regulations. **Australia:** Goldman Sachs Australia Pty Ltd and its affiliates are not authorised deposit-taking institutions (as that term is defined in the Banking Act 1959 (Cth)) in Australia and do not provide banking services, nor carry on a banking business, in Australia. This research, and any access to it, is intended only for "wholesale clients" within the meaning of the Australian Corporations Act, unless otherwise agreed by Goldman Sachs. In producing research reports, members of the Global Investment Research Division of Goldman Sachs Australia may attend site visits and other meetings hosted by the issuers the subject of its research reports. In some instances the costs of such site visits or meetings may be met in part or in whole by the issuers concerned if Goldman Sachs Australia considers it is appropriate and reasonable in the specific circumstances relating to the site visit or meeting. **Brazil:** Disclosure information in relation to CVM Instruction 483 is available at http://www.gs.com/worldwide/brazil/area/gir/index.html. Where applicable, the Brazil-registered analyst primarily responsible for the content of this research report, as defined in Article 16 of CVM Instruction 483, is the first author named at the beginning of this report, unless indicated otherwise at the end of the text. **Canada:** Goldman Sachs Canada Inc. is an affiliate of The Goldman Sachs Group Inc. and therefore is included in the company specific disclosures relating to Goldman Sachs (as defined above). Goldman Sachs Canada Inc. has approved of, and agreed to take responsibility for, this research report in Canada if and to the extent that Goldman Sachs Canada Inc. disseminates this research report to its clients. **Hong Kong:** Further information on the securities of covered companies referred to in this research may be obtained on request from Goldman Sachs (Asia) L.L.C. **India:** Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (India) Securities Private Limited, Research Analyst - SEBI Registration Number INH000001493, 951-A, Rational House, Appasaheb Marathe Marg, Prabhadevi, Mumbai 400 025, India, Corporate Identity Number U74140MH2006FTC160634, Phone +91 22 6616 9000, Fax +91 22 6616 9001. Goldman Sachs may beneficially own 1% or more of the securities (as such term is defined in clause 2 (h) the Indian Securities Contracts (Regulation) Act, 1956) of the subject company or companies referred to in this research report. **Japan:** See below. **Korea:** Further information on the subject company or companies referred to in this research may be obtained from Goldman Sachs (Asia) L.L.C., Seoul Branch. **New Zealand:** Goldman Sachs New Zealand Limited and its affiliates are neither "registered banks" nor "deposit takers" (as defined in the Reserve Bank of New Zealand Act 1989) in New Zealand. This research, and any access to it, is intended for "wholesale clients" (as defined in the Financial Advisers Act 2008) unless otherwise agreed by Goldman Sachs. **Russia:** Research reports distributed in the Russian Federation are not advertising as defined in the Russian legislation, but are information and analysis not having product promotion as their main purpose and do not provide appraisal within the meaning of the Russian legislation on appraisal activity. **Singapore:** Further information on the covered companies referred to in this research may be obtained from Goldman Sachs (Singapore) Pte. (Company Number: 198602165W). **Taiwan:** This material is for reference only and must not be reprinted without permission. Investors should carefully consider their own investment risk. Investment results are the responsibility of the individual investor. **United Kingdom:** Persons who would be categorized as retail clients in the United Kingdom, as such term is defined in the rules of the Financial Conduct Authority, should read this research in conjunction with prior Goldman Sachs research on the covered companies referred to

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

herein and should refer to the risk warnings that have been sent to them by Goldman Sachs International. A copy of these risks warnings, and a glossary of certain financial terms used in this report, are available from Goldman Sachs International on request.

European Union: Disclosure information in relation to Article 4 (1) (d) and Article 6 (2) of the European Commission Directive 2003/125/EC is available at http://www.gs.com/disclosures/europeanpolicy.html which states the European Policy for Managing Conflicts of Interest in Connection with Investment Research.

Japan: Goldman Sachs Japan Co., Ltd. is a Financial Instrument Dealer registered with the Kanto Financial Bureau under registration number Kinsho 69, and a member of Japan Securities Dealers Association, Financial Futures Association of Japan and Type II Financial Instruments Firms Association. Sales and purchase of equities are subject to commission pre-determined with clients plus consumption tax. See company-specific disclosures as to any applicable disclosures required by Japanese stock exchanges, the Japanese Securities Dealers Association or the Japanese Securities Finance Company.

Ratings, coverage groups and views and related definitions

Buy (B), Neutral (N), Sell (S) -Analysts recommend stocks as Buys or Sells for inclusion on various regional Investment Lists. Being assigned a Buy or Sell on an Investment List is determined by a stock's total return potential relative to its coverage. Any stock not assigned as a Buy or a Sell on an Investment List with an active rating (i.e., a stock that is not Rating Suspended, Not Rated, Coverage Suspended or Not Covered), is deemed Neutral. Each regional Investment Review Committee manages various regional Investment Lists to a global guideline of 25%-35% of stocks as Buy and 10%-15% of stocks as Sell; however, the distribution of Buys and Sells in any particular analyst's coverage group may vary as determined by the regional Investment Review Committee. Additionally, each Investment Review Committee manages Regional Conviction lists, which represent investment recommendations focused on the size of the total return potential and/or the likelihood of the realization of the return across their respective areas of coverage. The addition or removal of stocks from such Conviction lists do not represent a change in the analysts' investment rating for such stocks.

Total return potential represents the upside or downside differential between the current share price and the price target, including all paid or anticipated dividends, expected during the time horizon associated with the price target. Price targets are required for all covered stocks. The total return potential, price target and associated time horizon are stated in each report adding or reiterating an Investment List membership.

Coverage groups and views: A list of all stocks in each coverage group is available by primary analyst, stock and coverage group at http://www.gs.com/research/hedge.html. The analyst assigns one of the following coverage views which represents the analyst's investment outlook on the coverage group relative to the group's historical fundamentals and/or valuation. **Attractive (A).** The investment outlook over the following 12 months is favorable relative to the coverage group's historical fundamentals and/or valuation. **Neutral (N).** The investment outlook over the following 12 months is neutral relative to the coverage group's historical fundamentals and/or valuation. **Cautious (C).** The investment outlook over the following 12 months is unfavorable relative to the coverage group's historical fundamentals and/or valuation.

Not Rated (NR). The investment rating and target price have been removed pursuant to Goldman Sachs policy when Goldman Sachs is acting in an advisory capacity in a merger or strategic transaction involving this company and in certain other circumstances. **Rating Suspended (RS).** Goldman Sachs Research has suspended the investment rating and price target for this stock, because there is not a sufficient fundamental basis for determining, or there are legal, regulatory or policy constraints around publishing, an investment rating or target. The previous investment rating and price target, if any, are no longer in effect for this stock and should not be relied upon. **Coverage Suspended (CS).** Goldman Sachs has suspended coverage of this company. **Not Covered (NC).** Goldman Sachs does not cover this company. **Not Available or Not Applicable (NA).** The information is not available for display or is not applicable. **Not Meaningful (NM).** The information is not meaningful and is therefore excluded.

Global product; distributing entities

The Global Investment Research Division of Goldman Sachs produces and distributes research products for clients of Goldman Sachs on a global basis. Analysts based in Goldman Sachs offices around the world produce equity research on industries and companies, and research on macroeconomics, currencies, commodities and portfolio strategy. This research is disseminated in Australia by Goldman Sachs Australia Pty Ltd (ABN 21 006 797 897); in Brazil by Goldman Sachs do Brasil Corretora de Títulos e Valores Mobiliários S.A.; in Canada by either Goldman Sachs Canada Inc. or Goldman, Sachs & Co.; in Hong Kong by Goldman Sachs (Asia) L.L.C.; in India by Goldman Sachs (India) Securities Private Ltd.; in Japan by Goldman Sachs Japan Co., Ltd.; in the Republic of Korea by Goldman Sachs (Asia) L.L.C., Seoul Branch; in New Zealand by Goldman Sachs New Zealand Limited; in Russia by OOO Goldman Sachs; in Singapore by Goldman Sachs (Singapore) Pte. (Company Number: 198602165W); and in the United States of America by Goldman, Sachs & Co. Goldman Sachs International has approved this research in connection with its distribution in the United Kingdom and European Union.

European Union: Goldman Sachs International authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority, has approved this research in connection with its distribution in the European Union and United Kingdom; Goldman Sachs AG and Goldman Sachs International Zweigniederlassung Frankfurt, regulated by the Bundesanstalt für Finanzdienstleistungsaufsicht, may also distribute research in Germany.

General disclosures

This research is for our clients only. Other than disclosures relating to Goldman Sachs, this research is based on current public information that we consider reliable, but we do not represent it is accurate or complete, and it should not be relied on as such. The information, opinions, estimates and forecasts contained herein are as of the date hereof and are subject to change without prior notification. We seek to update our research as appropriate, but various regulations may prevent us from doing so. Other than certain industry reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst's judgment.

Goldman Sachs conducts a global full-service, integrated investment banking, investment management, and brokerage business. We have investment banking and other business relationships with a substantial percentage of the companies covered by our Global Investment Research Division. Goldman, Sachs & Co., the United States broker dealer, is a member of SIPC (http://www.sipc.org).

Our salespeople, traders, and other professionals may provide oral or written market commentary or trading strategies to our clients and principal trading desks that reflect opinions that are contrary to the opinions expressed in this research. Our asset management area, principal trading desks and investing businesses may make investment decisions that are inconsistent with the recommendations or views expressed in this research.

The analysts named in this report may have from time to time discussed with our clients, including Goldman Sachs salespersons and traders, or may discuss in this report, trading strategies that reference catalysts or events that may have a near-term impact on the market price of the equity securities discussed in this report, which impact may be directionally counter to the analyst's published price target expectations for such stocks. Any such trading strategies are distinct from and do not affect the analyst's fundamental equity rating for such stocks, which rating reflects a stock's return potential relative to its coverage group as described herein.

We and our affiliates, officers, directors, and employees, excluding equity and credit analysts, will from time to time have long or short positions in, act as principal in, and buy or sell, the securities or derivatives, if any, referred to in this research.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC

The views attributed to third party presenters at Goldman Sachs arranged conferences, including individuals from other parts of Goldman Sachs, do not necessarily reflect those of Global Investment Research and are not an official view of Goldman Sachs.

Any third party referenced herein, including any salespeople, traders and other professionals or members of their household, may have positions in the products mentioned that are inconsistent with the views expressed by analysts named in this report.

This research is not an offer to sell or the solicitation of an offer to buy any security in any jurisdiction where such an offer or solicitation would be illegal. It does not constitute a personal recommendation or take into account the particular investment objectives, financial situations, or needs of individual clients. Clients should consider whether any advice or recommendation in this research is suitable for their particular circumstances and, if appropriate, seek professional advice, including tax advice. The price and value of investments referred to in this research and the income from them may fluctuate. Past performance is not a guide to future performance, future returns are not guaranteed, and a loss of original capital may occur. Fluctuations in exchange rates could have adverse effects on the value or price of, or income derived from, certain investments.

Certain transactions, including those involving futures, options, and other derivatives, give rise to substantial risk and are not suitable for all investors. Investors should review current options disclosure documents which are available from Goldman Sachs sales representatives or at http://www.theocc.com/about/publications/character-risks.jsp. Transaction costs may be significant in option strategies calling for multiple purchase and sales of options such as spreads. Supporting documentation will be supplied upon request.

All research reports are disseminated and available to all clients simultaneously through electronic publication to our internal client websites. Not all research content is redistributed to our clients or available to third-party aggregators, nor is Goldman Sachs responsible for the redistribution of our research by third party aggregators. For research, models or other data available on a particular security, please contact your sales representative or go to http://360.gs.com.

Disclosure information is also available at http://www.gs.com/research/hedge.html or from Research Compliance, 200 West Street, New York, NY 10282.

© 2017 Goldman Sachs.

No part of this material may be (i) copied, photocopied or duplicated in any form by any means or (ii) redistributed without the prior written consent of The Goldman Sachs Group, Inc.

This document is being provided for the exclusive use of SHIBIN XIE at ALLIANZ GLOBAL INVESTORS US LLC