US Economics Analyst

Super Profits and Superstar Firms

Jan Hatzius
(212) 902-0394 | jan.hatzius@gs.com
Goldman Sachs & Co. LLC

Alec Phillips
(202) 637-3746 | alec.phillips@gs.com
Goldman Sachs & Co. LLC

David Mericle
(212) 357-2619 | david.mericle@gs.com
Goldman Sachs & Co. LLC

Spencer Hill
(212) 357-7621 | spencer.hill@gs.com
Goldman Sachs & Co. LLC

Daan Struyven
(212) 357-4172 | daan.struyven@gs.com
Goldman Sachs & Co. LLC

Karen Reichgott
(212) 855-6006 | karen.reichgott@gs.com
Goldman Sachs & Co. LLC

Avisha Thakkar
(917) 343-4543 | avisha.thakkar@gs.com
Goldman Sachs & Co. LLC

- US corporate profit margins have risen over the last two decades to historic highs, especially for the most profitable firms. At the same time, three quarters of the US industries experienced an increase in concentration, with a few large firms earning a larger share of revenue.
- Analyzing industry-level data, we estimate that the rise in industry concentration since 1997 has boosted corporate operating profit margins by approximately 1.5 percentage points (pp), accounting for a third of the 4.2pp increase in operating profit margins between 1996Q4 and 2014Q4.
- The first hypothesis to explain the rising concentration is that new technologies have allowed a small number of "superstar" firms to widen their productivity advantage, tap into network effects, and gain disproportionately large market shares.
- The second hypothesis is that a small number of superstar firms have reaped most of the benefits from global access to new consumers, supply chains, and talent.
- The third hypothesis is that product market and antitrust policies have increasingly favored incumbent firms, rather than promoting competition.
- We single out the technology hypothesis as the likely candidate that best explains the rise in industry concentration, given the overlap in timing of the take-off of information and communication technologies in the mid-90s as well as the finding that industries with rising concentrations are also the ones with faster productivity growth and patenting activities.
- The rising productivity gap between salient superstar firms and non-superstar firms may also help explain why measured aggregate productivity growth has been weak despite a perceived fast disruption.
- While cyclical and other mean-reversion forces could exert downward pressure on corporate margins, the continued momentum of superstar firms could imply that high concentration levels and corporate profit margins may persist for longer.

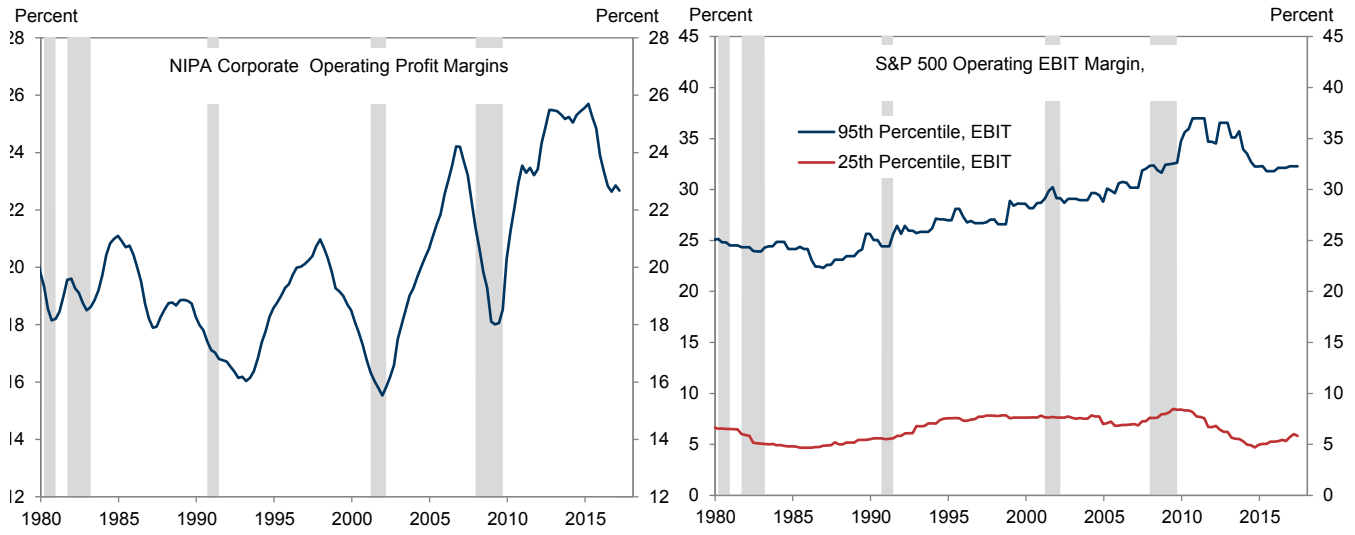
Super Profits and Superstar Firms

US corporate profit margins have risen over the last two decades to historic levels. At the same time, many industries have become more concentrated with a few large firms earning a larger share of revenue. In this week's Analyst, we explore the contribution of rising industry concentration to the rise in corporate profit margins, dig deeper into the causes of higher concentration, and discuss the longer-run outlook for profit margins.

Two Facts: Higher Profit Margins and Higher Concentration

Corporate profit margins began a steady rise in 2001Q4 (interrupted by the recession) and rose to a 65-year high in 2015Q1 (Exhibit 1, left panel). While profit margins dipped in 2015-2016 with lower energy prices, our US equity strategists point out that S&P 500 net profit margins excluding energy continued to move higher, and that S&P500 profits are once again in expansion mode. While margins of the most profitable firms have risen significantly in the last two decades, they have been roughly stable at less profitable firms (Exhibit 1, right panel). A deeper understanding of the increased right-skew of margins is key to explaining higher aggregate margins.

Exhibit 1: Rise in Margins Especially at Very Profitable Firms



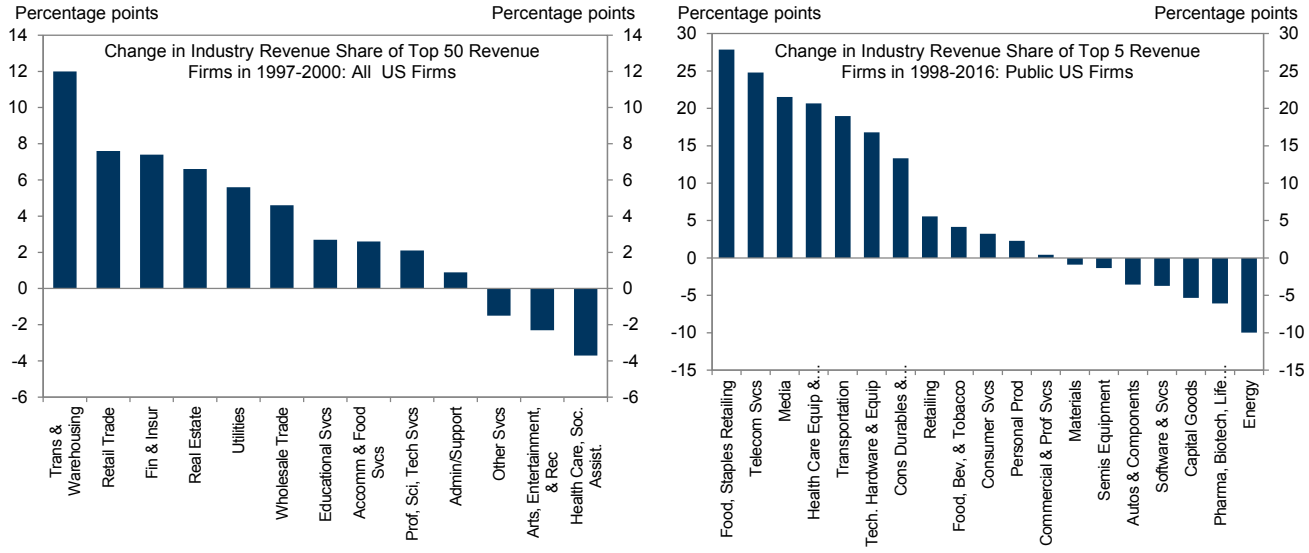
Source: Goldman Sachs Global Investment Research

The last two decades have been characterized by increases in both corporate profit margins and concentration of activity in the hands of a few firms. For instance, the share of total industry sales of the 4 largest firms has increased from 55.9% in 1997 to 82.7% in 2012 in the general merchandise stores industry and from 20.5% in 1997 to 57.0% in 2012 in air transportation.

The left panel in Exhibit 2 shows that the CR50—or the share of total industry sales attributed to the largest 50 firms—has increased in 10 of the 13 two-digit industries covered by the Economic Census. The increases were the most pronounced in transportation and warehousing, retail trade, and finance and insurance. Overall, about

75% of the NAICS three-digit industries experienced an increase in concentration levels over the last two decades. The right panel of Exhibit 2 shows that activity among public firms has also become increasingly concentrated, especially in food and staples retailing, telecom services, and media.[1]

Exhibit 2: Growing Industry Concentration in Economy and Stock Market



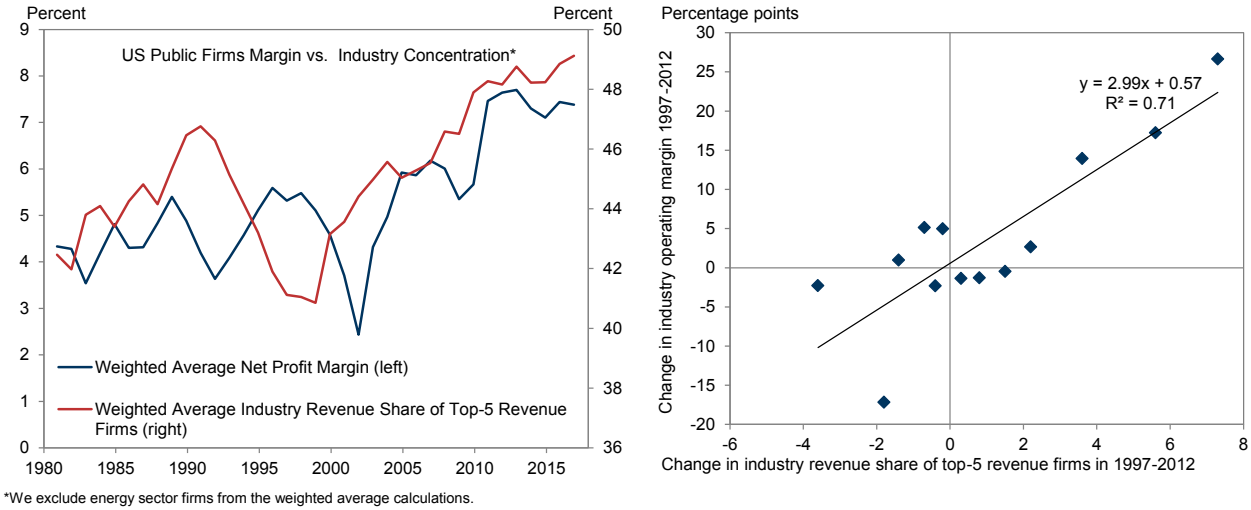
Source: Census Bureau, Goldman Sachs Global Investment Research

The Impact of Concentration on Profit Margins

Has increased industry concentration boosted corporate profit margins? In principle, industries with a higher concentration could charge higher prices and earn higher profit margins. Empirically, the left panel of Exhibit 3 suggests that years in which the industry concentration rises tend to be followed by years in which margins rise. The Economic Census data show that the industries that became more concentrated in 1997-2012 were also the ones in which margins rose the most (Exhibit 3, right panel).

[1] Changes over time in the tendency for firms to be publicly listed can create some bias in concentration ratios. However, a growing academic literature shows that the trend of higher concentration in most industries over the last 20 years is robust across concentration metrics, datasets and industry granularity.

Exhibit 3: Margins and Industry Concentration Are Positively Correlated



*We exclude energy sector firms from the weighted average calculations.

Source: Goldman Sachs Global Investment Research

Several recent academic papers have shown that increased industry concentration is associated with higher profit margins, higher stock returns, and a lower labor share (Exhibit 4). For instance, Gustavo Grullon and co-authors find that an increase in industry concentration from the 25th to the 75th percentile leads to an increase in the ROA of 45% (relative to the median ROA).

Exhibit 4: Literature on Market Concentration and Margins

Study	US Firms: Sample	Higher Market Concentration is Associated with…	Magnitude of Effect
Grullon, Larkin, Michaely (2016)	Public: 1972-2014	Higher ROA, margins, stock returns.	Rise concentration from p25 to p50 increases ROA by 45% vs. median.
Bloningen, Pierce (2016)	Manufacturing: 1997-2012	Higher margins following M&As	Markups at acquired plants rises by ~30%.
Autor et al (2017)	Economy-wide: 1987-2012	Lower labor share	Rise concentration accounts for 1/3 fall in services labor share since 1982.
Barkai (2016)	Economy-wide: 1997-2012	Lower labor share	Rise concentration accounts for ~100% fall in labor share since 1997.

Source: Goldman Sachs Global Investment Research

We estimate the impact of industry concentration on margins in an industry panel dataset using concentration data from the Economic Census and gross operating margins from the BEA.[2] We find evidence that increases in industry concentration are associated with rising margins (Exhibit 5).

[2] We define gross operating margins as gross operating surplus over gross output.

Exhibit 5: Impact of Concentration on Profit Margins in Industry Panel

Dependent Variable: Operating Margin	1	2	3	4
Constant	19.112 [2.35]*	24.215 [5.49]**	19.273 [2.28]*	26.078 [5.80]**
Industry Revenue Share of Top-4 Revenue Firms	3.377 [4.28]**	2.786 [5.52]**	3.359 [4.08]**	2.57 [4.99]**
Observations:	54	54	54	54
R-squared:	0.26	0.99	0.26	0.99
Sector Fixed Effects:		X		X
Time Fixed Effects:			X	X

Note: Figures in brackets denote t-statistics.
*Significant at 5% level. **Significant at the 1% level.

Source: Goldman Sachs Global Investment Research

Next, we attempt to quantify the contribution of rising concentration to the increase in margins using our regression results. We focus on 1996Q4 and 2014Q4; two roughly comparable quarters in the business and energy price cycle. Operating profit margins of non-financial corporations as a share of net value added increased 4.2pp from 19.7% in 1996Q4 to 23.8% in 2014Q4.

Combining the average increase in the industry revenue-share of the top-4 firms in 1997-2012 and our coefficient estimates, we calculate that the rise in product market concentration accounts for a 1.5pp increase in operating profit margins in 1997-2014, or one third of the overall increase in margins. This estimate is roughly consistent with the finding by David Autor and co-authors that the rise in product market concentration accounts for one third of the fall in the labor share of the service sector over that period.

The estimate that rising product market concentration accounts for only one third of the increase in trend operating margins since 1996 suggests that other factors have also played an important role. Changes in the labor market—rising import competition and institutional changes—likely provide the most compelling complementary explanation for higher trend operating margins.[3] As our market economists have shown, the slow growth of real wages relative to average labor productivity over the last 20 years has boosted profit margins, whereas the catch-up of real wages with average labor productivity would lower margins. Focusing on product markets, we then dig deeper into three potential causes of rising concentration.

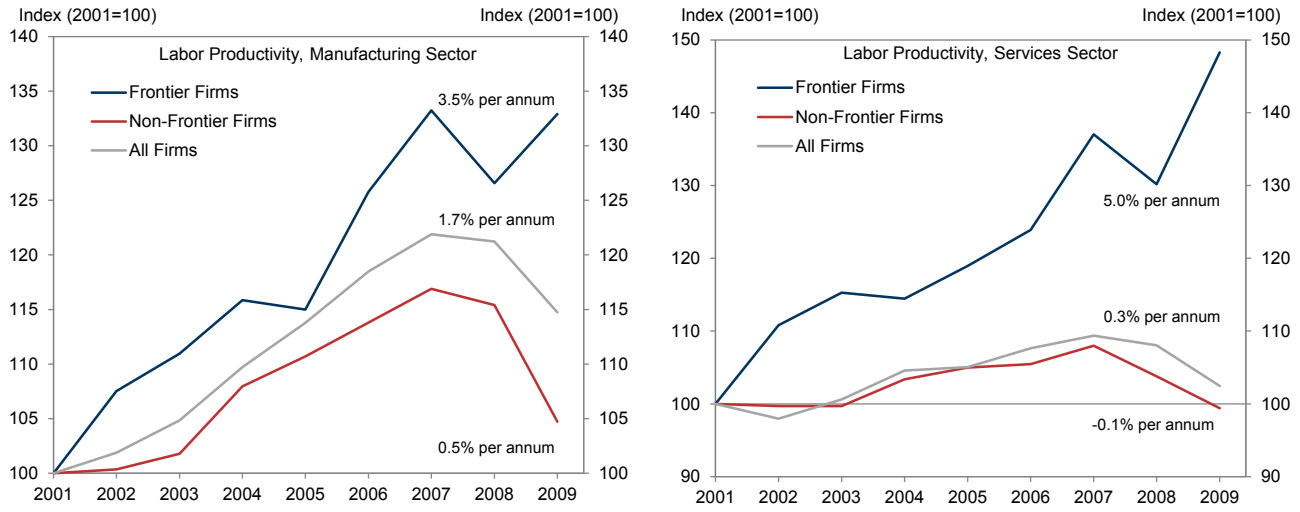
Concentration Story 1: Technology and Superstar Firms

The first hypothesis explaining rising concentration is that new technologies have allowed a small number of superstar firms to gain very large market shares. The starting

3. The declines in interest rates and effective corporate tax rates have also boosted net corporate profit margins. The decline in the effective tax rate has boosted net margins by approximately 0.6pp in 1997-2014.

point is that some firms are much more productive than others within a given industry.[4] OECD research estimates that the frontier firms—the global top-100 most productive firms in a given industry—are 5 times more productive than non-frontier firms. Moreover, the productivity advantage of frontier firms has widened over time, as shown in Exhibit 6.

Exhibit 6: Productivity Differences across Firms Have Risen over Time



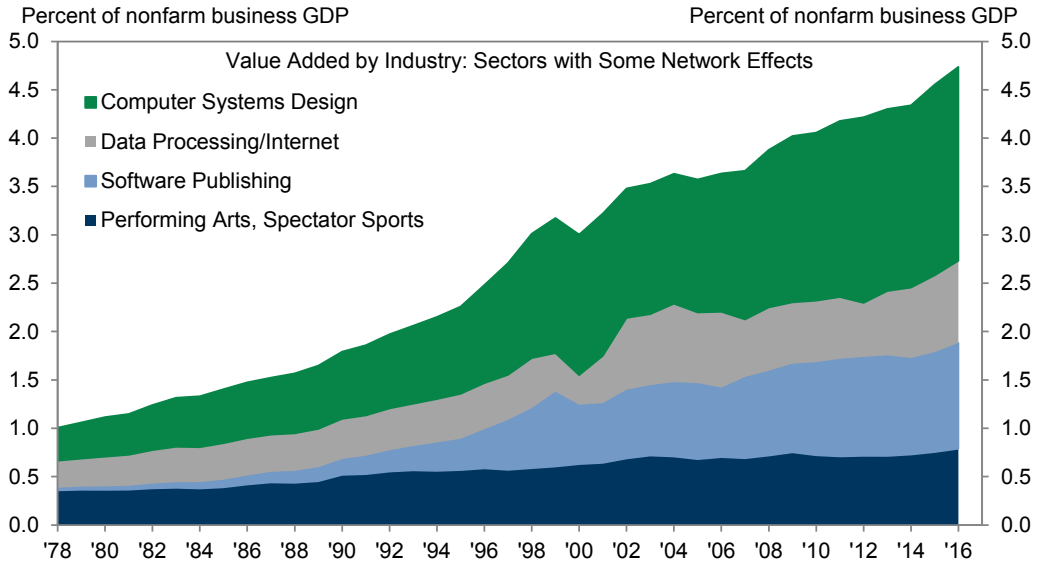
Note: "Frontier firms" are the top-100 global firms with the highest labor productivity in each 2-digit sector in ORBIS dataset.

Source: OECD, Goldman Sachs Global Investment Research

Recent technological changes have likely benefited the superstar firms the most. First, the proliferation of large social networks, online search engines, and software platforms illustrate the growing value of services as a function of the number of users. Sectors where such "network externalities" are an important factor account for a growing share of economic activity, as shown in Exhibit 7.

4. Chad Syverson estimates that plants at percentile 90 of the total factor productivity (TFP) distribution are twice as productive as plants at percentile 10 within narrow 4-digit SIC industries.

Exhibit 7: Sectors with Some Network Effects Are Growing Part of the Economy



Source: Department of Commerce, Goldman Sachs Global Investment Research

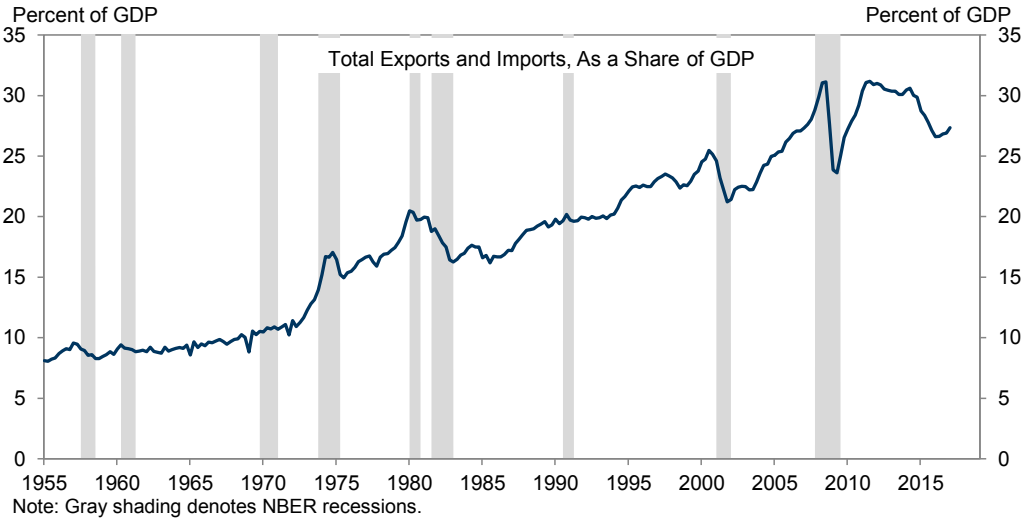
Second, easier online price/quality comparisons help the most efficient firms to win market share. Third, in general, firms with skills and scale advantages are better positioned to pay the fixed costs of inventing, adopting complex technologies or information technologies that facilitate collaboration.

Concentration Story 2: Globalization and Superstar Firms

The second hypothesis is that a small number of superstar firms have reaped most of the benefits from globalization. Globalization can give firms access to specialized global supply chains, and larger pools of consumers, and talented workers. However, in practice the vast majority of US firms do not export or recruit abroad, and the benefits of globalization have thus mostly accrued to a small share of firms.[5] One challenge for the second hypothesis is that trade volume had already started accelerating in the 1970s and 1980s when concentration ratios and profits fell (Exhibit 8).

[5] Mark Melitz has documented that only 21% of U.S. plants reported exporting anything in 1992 and that exporters have an average 33% advantage in labor productivity relative to non-exporters.

Exhibit 8: Trade Volume Already Started Accelerating in the 1970s and 1980s



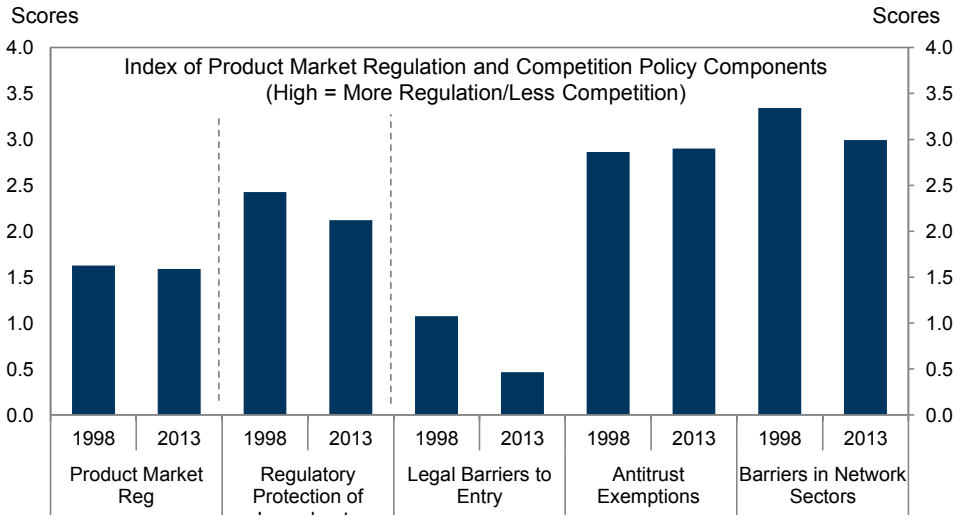
Source: Department of Commerce, Goldman Sachs Global Investment Research

Concentration Story 3: Competition Policy

The third hypothesis is that product market policies have increasingly favored incumbent firms, rather than promoting competition. Germán Gutiérrez and Thomas Philippon find that industries where regulation has risen the most also exhibited larger increases in industry concentration. Luigi Zingales and Mara Faccio suggest that lower antitrust activism in the US relative to Europe contributes to the higher average telecom services revenue per subscriber in the US than in Denmark and Germany.[6.]

[6.] Faccio and Zingales document average revenues per unique subscriber of $68 in the US, $31 in Denmark, and $23 in Germany, but also higher 4G coverage rates in the US.

Exhibit 9: OECD Index of Product Market Regulation Shows Stability for US

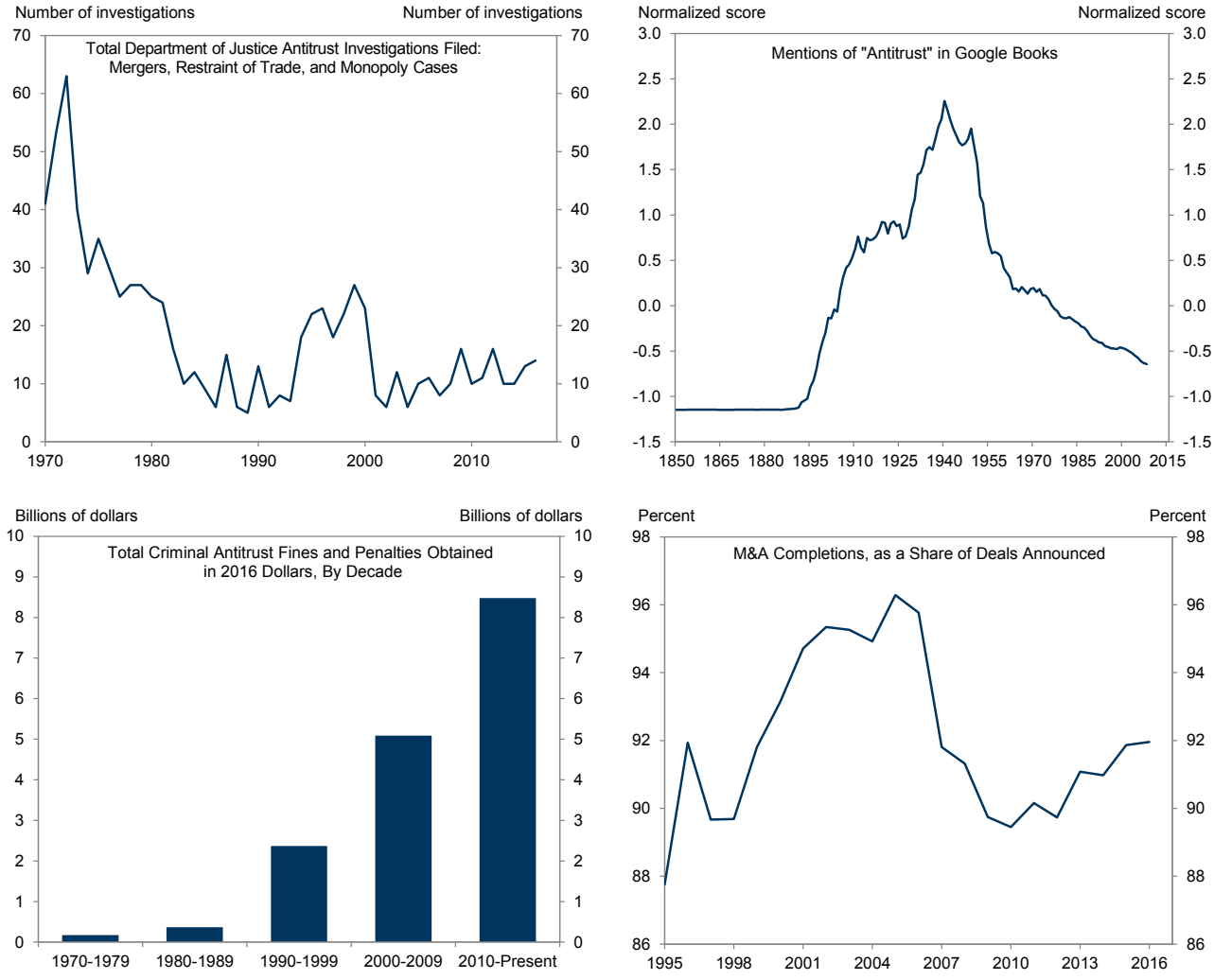


Source: OECD, Goldman Sachs Global Investment Research

Various OECD measures shown in Exhibit 9 suggest that US product market policy has not become more anti-competitive over the last 2 decades.[7] Exhibit 10 therefore provides some further proxies of the antitrust policy stance, sending conflicting signals. Declines in the number of Department of Justice antitrust investigations filed and the mentions of "antitrust" in books suggest a less restrictive policy. On the other hand, increases in antitrust fines/penalties and lower M&A completion rates suggest that policy may have become more restrictive. While each proxy is imperfect, the data do not lend support to a major trend in the stance of antitrust policies.

[7] Germán Gutiérrez and Thomas Philippon note that most European countries exhibited improvements in the OECD product market regulation index but did not see rises in concentration ratios.

Exhibit 10: Proxies of Antitrust Policies Do Not Suggest Major Trend in the Stance of Antitrust Policy



Source: Department of Justice, Goldman Sachs Global Investment Research

Taking Stock

Technological change, globalization, and product market policies all play a role in industry concentration, and more research is needed to quantify the contributions. Presently, we think that the impact of technological change on superstar firms is likely the most important driver of the rise in industry concentration for four reasons.

First, the take-off of information and communication technologies in the mid-90s coincides with the turning point in profit margins (while trade and product market policy data suggest no breaks in the mid-90s). Second, the technology channel is intuitive (e.g. network effects) and consistent with the large market shares of several big US tech firms and their major contributions to the rise in S&P500 profit margins. Third, David Autor and co-authors report that industries with rising concentrations are also the ones with faster productivity growth and patenting activities. Fourth, the rising productivity gap between salient frontier firms and non-frontier firms may help explain why

measured aggregate productivity growth has been weak despite a perceived fast disruption.

Cyclical factors and secular mean-reversion forces could exert downward pressure on corporate margins. Our US portfolio strategists expect S&P500 profit margins to peak in 2018 and expect that a tight labor market and rising wages will result in S&P500 margin contraction in 2019 and 2020. Over a longer horizon, our analysis suggests that the continued momentum of superstar firms could imply that relatively high concentration levels and trend corporate profit margins may persist.

Daan Struyven

We would like to thank Arjun Menon for his contributions.

The US Economic and Financial Outlook

(% change on previous period, annualized, except where noted)

	2014	2015	2016 (f)	2017 (f)	2018 (f)	2019 (f)	2020 (f)	2017 Q1	2017 Q2	2017 Q3	2017 Q4	2018 Q1	2018 Q2	2018 Q3	2018 Q4
OUTPUT AND SPENDING															
Real GDP	**2.4**	**2.6**	**1.6**	*2.1*	*2.2*	*1.7*	*1.5*	**1.4**	*1.9*	*2.5*	*2.3*	*2.3*	*2.0*	*2.0*	*2.0*
Consumer Expenditure	**2.9**	**3.2**	**2.7**	*2.6*	*2.1*	*1.6*	*1.5*	**1.1**	*3.0*	*2.4*	*2.3*	*2.0*	*1.9*	*1.8*	*1.8*
Residential Fixed Investment	**3.5**	**11.7**	**4.9**	*3.3*	*1.5*	*1.7*	*1.9*	**12.9**	*-4.0*	*1.0*	*2.0*	*2.0*	*2.0*	*2.0*	*2.0*
Business Fixed Investment	**6.0**	**2.1**	**-0.5**	*4.0*	*2.8*	*2.6*	*2.3*	**10.4**	*3.3*	*2.3*	*2.3*	*2.9*	*2.9*	*2.9*	*2.9*
Structures	**10.3**	**-4.4**	**-2.9**	*7.3*	*1.9*	*2.0*	*1.7*	**22.5**	*4.7*	*0.5*	*1.5*	*2.0*	*2.0*	*2.0*	*2.0*
Equipment	**5.4**	**3.5**	**-2.9**	*2.6*	*3.0*	*2.4*	*2.0*	**7.8**	*2.5*	*3.5*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*
Intellectual Property Products	**3.9**	**4.8**	**4.7**	*3.8*	*3.0*	*3.2*	*3.0*	**6.4**	*3.5*	*2.0*	*2.0*	*3.5*	*3.5*	*3.5*	*3.5*
Federal Government	**-2.5**	**0.0**	**0.6**	*-0.1*	*1.1*	*1.1*	*1.0*	**-2.0**	*1.5*	*0.3*	*0.5*	*1.5*	*1.5*	*1.5*	*1.0*
State & Local Government	**0.2**	**2.9**	**0.9**	*0.3*	*1.9*	*2.2*	*2.0*	**-0.2**	*0.1*	*1.5*	*2.0*	*2.0*	*2.0*	*2.5*	*2.5*
Net Exports ($bn, '09)	**-426**	**-540**	**-563**	*-599*	*-609*	*-640*	*-680*	**-596**	*-602*	*-602*	*-602*	*-602*	*-607*	*-611*	*-616*
Inventory Investment ($bn, '09)	**58**	**84**	**22**	*0*	*16*	*23*	*25*	**3**	*-16*	*5*	*10*	*13*	*15*	*18*	*20*
Industrial Production, Mfg.	**1.2**	**0.1**	**0.0**	*1.4*	*1.7*	*1.2*	*1.0*	**2.1**	**1.4**	*2.0*	*2.0*	*1.5*	*1.5*	*1.5*	*1.5*
HOUSING MARKET															
Housing Starts (units, thous)	**1,001**	**1,107**	**1,177**	*1,272*	*1,397*	*1,458*	*1,480*	**1,238**	**1,164**	*1,337*	*1,350*	*1,371*	*1,390*	*1,406*	*1,420*
New Home Sales (units, thous)	**440**	**503**	**561**	*642*	*715*	*769*	*795*	**619**	*621*	*652*	*676*	*693*	*708*	*722*	*736*
Existing Home Sales (units, thous)	**4,923**	**5,234**	**5,440**	*5,493*	*5,483*	*5,539*	*5,598*	**5,620**	*5,467*	*5,437*	*5,449*	*5,462*	*5,476*	*5,489*	*5,503*
Case-Shiller Home Prices (%yoy)*	**6.1**	**4.8**	**4.9**	*4.9*	*3.7*	*3.2*	*2.3*	**5.2**	*5.5*	*5.2*	*3.9*	*3.8*	*3.7*	*3.6*	*3.6*
INFLATION (% ch, yr/yr)															
Consumer Price Index (CPI)	**1.6**	**0.1**	**1.3**	*1.9*	*1.9*	*2.2*	*2.3*	**2.6**	**1.9**	*1.7*	*1.5*	*1.3*	*1.9*	*2.2*	*2.1*
Core CPI	**1.7**	**1.8**	**2.2**	*1.8*	*2.0*	*2.3*	*2.4*	**2.2**	**1.8**	*1.7*	*1.7*	*1.6*	*2.0*	*2.2*	*2.2*
Core PCE**	**1.6**	**1.4**	**1.7**	*1.5*	*1.8*	*2.1*	*2.2*	**1.7**	*1.4*	*1.4*	*1.6*	*1.6*	*1.9*	*1.9*	*1.9*
LABOR MARKET															
Unemployment Rate (%)	**6.2**	**5.3**	**4.9**	*4.4*	*4.2*	*4.2*	*4.4*	**4.7**	**4.4**	*4.3*	*4.2*	*4.2*	*4.2*	*4.2*	*4.1*
U6 Underemployment Rate (%)	**12.0**	**10.4**	**9.6**	*8.6*	*8.2*	*8.2*	*8.4*	**9.2**	**8.6**	*8.5*	*8.3*	*8.2*	*8.2*	*8.2*	*8.1*
Payrolls (thous, monthly rate)	**237**	**228**	**194**	*168*	*119*	*60*	*60*	**182**	**164**	*175*	*150*	*125*	*125*	*125*	*100*
GOVERNMENT FINANCE															
Federal Budget (FY, $bn)	**-483**	**-439**	**-587**	*-675*	*-700*	*900*	*1,050*	**--**	*--*	*--*	*--*	*--*	*--*	*--*	*--*
FINANCIAL INDICATORS															
FF Target Range (Bottom-Top, %)^	**0-0.25**	**0.25-0.5**	**0.5-0.75**	*1.25-1.5*	*2.25-2.5*	*3.25-3.5*	*3.25-3.5*	**0.75-1.0**	**1.0-1.25**	*1.0-1.25*	*1.25-1.5*	*1.5-1.75*	*1.75-2*	*2.0-2.25*	*2.25-2.5*
10-Year Treasury Note^	**2.17**	**2.27**	**2.45**	*2.75*	*3.25*	*3.60*	*3.70*	**2.40**	**2.31**	*2.65*	*2.75*	*2.90*	*3.00*	*3.10*	*3.25*
Euro (€/$)^	**1.21**	**1.09**	**1.06**	*1.07*	*1.10*	*1.15*	*1.20*	**1.07**	**1.14**	*1.08*	*1.07*	*1.06*	*1.05*	*1.08*	*1.10*
Yen ($/¥)^	**120**	**120**	**117**	*116*	*120*	*125*	*125*	**111**	**112**	*114*	*116*	*117*	*118*	*119*	*120*

* Weighted average of metro-level HPIs for 381 metro cities where the weights are dollar values of housing stock reported in the American Community Survey.
** PCE = Personal consumption expenditures. ^ Denotes end of period.
Note: Published figures in bold.

Source: Goldman Sachs Global Investment Research

Economic Releases and Other Events

Date		Time (EDT)	Indicator	Estimate GS	Consensus	Last Report
Mon	**Jul 24**	**10:00**	**Existing Home Sales (Jun)**	**-1.5%**	**-0.8%**	**+1.1%**
Tue	**Jul 25**	9:00	FHFA House Price Index (May)	n.a.	+0.6%	+0.7%
		9:00	**S&P/Case Shiller Home Price Index (May)**	**+0.2%**	**+0.3%**	**+0.3%**
		10:00	**Consumer Confidence (Jul)**	**115.0**	**116.0**	**118.9**
		10:00	Richmond Fed Survey (Jul)	n.a.	7	7
Wed	**Jul 26**	**10:00**	**New Home Sales (Jun)**	**+1.5%**	**+0.8%**	**+2.9%**
		14:00	FOMC Meeting Results			
Thu	**Jul 27**	**8:30**	**Durable Goods Orders (Jun)**	**+5.3%**	**+3.1%**	**-0.8%**
		8:30	**Durable Goods Orders Ex-Transport (Jun)**	**+0.5%**	**+0.4%**	**+0.3%**
		8:30	**Core Capital Goods Orders (Jun)**	**+0.5%**	**+0.3%**	**+0.2%**
		8:30	**Core Capital Goods Shipments (Jun)**	**+0.3%**	**+0.3%**	**+0.1%**
		8:30	**Advanced Goods Trade Balance (Jun)**	**-$65.5bn**	**-$65.0bn**	**-$66.3bn**
		8:30	Wholesale Inventories—Prel (Jun)	n.a.	+0.2%	+0.4%
		8:30	**Initial Jobless Claims**	**250,000**	**240,000**	**233,000**
		8:30	Continuing Claims	n.a.	1,959,000	1,977,000
		11:00	Kansas City Fed Survey (Jul)	n.a.	+12	+11
		17:00	GS Analyst Survey (Jul)	n.a.	n.a.	52.9
Fri	**Jul 28**	**8:30**	**Real GDP— Q2 Annualized (Advance)**	**+1.9%**	**+2.5%**	**+1.4%**
		8:30	**Personal Consumption (Q2)**	**+3.0%**	**+2.8%**	**+1.1%**
		8:30	**Employment Cost Index (Q2)**	**+0.6%**	**+0.6%**	**+0.8%**
		10:00	**UMich Consumer Sentiment—Final (Jul)**	**93.2**	**93.1**	**93.1**

Source: Goldman Sachs Global Investment Research, Bloomberg

Disclosure Appendix

Reg AC

We, Jan Hatzius, Alec Phillips, David Mericle, Spencer Hill, Daan Struyven, Karen Reichgott and Avisha Thakkar, hereby certify that all of the views expressed in this report accurately reflect our personal views, which have not been influenced by considerations of the firm's business or client relationships.

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

Disclosures

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.

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.