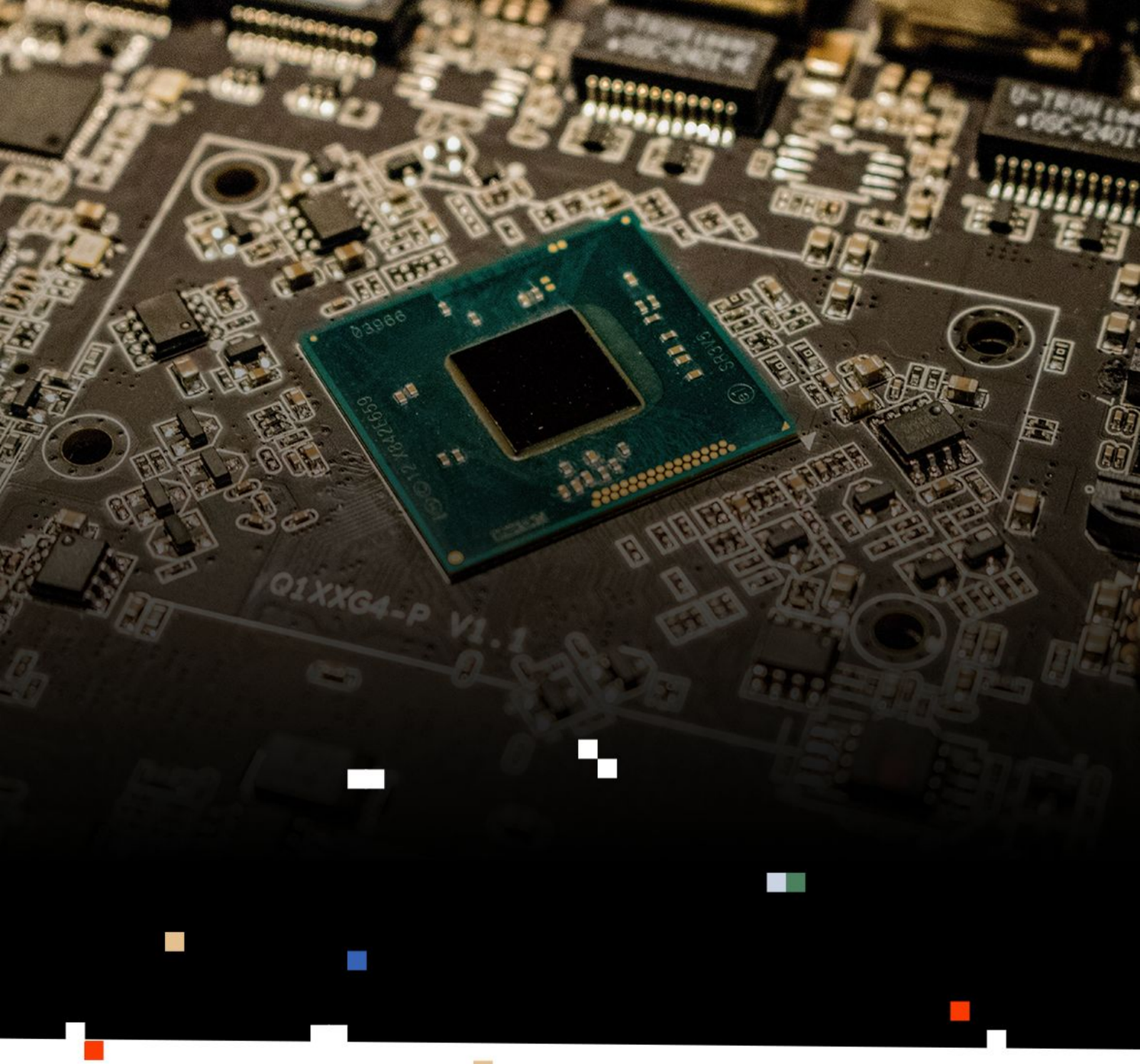


INFER April 2022 Update

Will the U.S. regain and retain a two-generation lead in microelectronic technology?

Published May 5, 2022

A monthly forecast update highlighting a strategic question from INFER

Will the U.S. regain and retain a two-generation lead in microelectronic technology?

Status quo assumption: If trends from the past 30+ years continue such as an increased level of investment from U.S. competitors, a lack of domestic manufacturing capacity, and a diminishing skilled workforce pool due to students choosing fields outside of "hard tech", the U.S. will remain behind in microelectronic innovation, manufacturing capacity, and investment.

See Appendix C for detailed methodology

HIGHLIGHTS THIS MONTH

INFER data from 15 forecasting questions (2 highlighted below) on microelectronics suggest that there is significant uncertainty about whether the U.S. will regain a leadership role in microelectronics.

By 31 December 2022, will the Taiwan Semiconductor Manufacturing Company announce plans to build a semiconductor fab in Europe?

52% chance
Up 12% from 2/24/22

RATIONALE SUMMARY SUPPORTING CURRENT FORECAST: The EU has made clear they are worried about semiconductor shortages, thus giving them an incentive to have more fabs in their territory.

See more details on Page 10

How many Chinese Universities will be listed in QS World University Rankings' top 100 universities for computer science in 2023?

Amount	Forecast	Change since 3/31/22
5 or Less	3%	-4% ↓
6 or 7	91%	+13% ↑
8 or More	6%	-9% ↓

RATIONALE SUMMARY: Computer Science has been one of the main areas of investment by the Chinese Government in the last few decades. As of now, there are 6 Chinese Government universities in the top 100 rankings, with another ranking in 101st. Combining that, along with the the current trends that have take place over the last 5 years, it is highly likely to either stay the same or increase to 7.

See more details on Page 24

INCLUDED IN THIS REPORT

2,560 FORECASTS
by
832 FORECASTERS
77% of Forecasters were INFER Pros

RECENCY
Good
80% forecasts made or updated in the last 35 days

Forecaster Location:	
USA	54%
Canada, UK, EU, AUS	25%
South East Asia	7%
Central & South America	13%
Other	1%

Overview

The invention of semiconductor technology by U.S. scientists led to the birth of Silicon Valley in the 1950s, which helped the U.S. become the dominant force in semiconductor research and manufacturing, but that dominance has been slipping for decades. Only 12% of semiconductor chips are produced in the U.S., down from 37% in 1990, according to the Semiconductor Industry Association.[1]

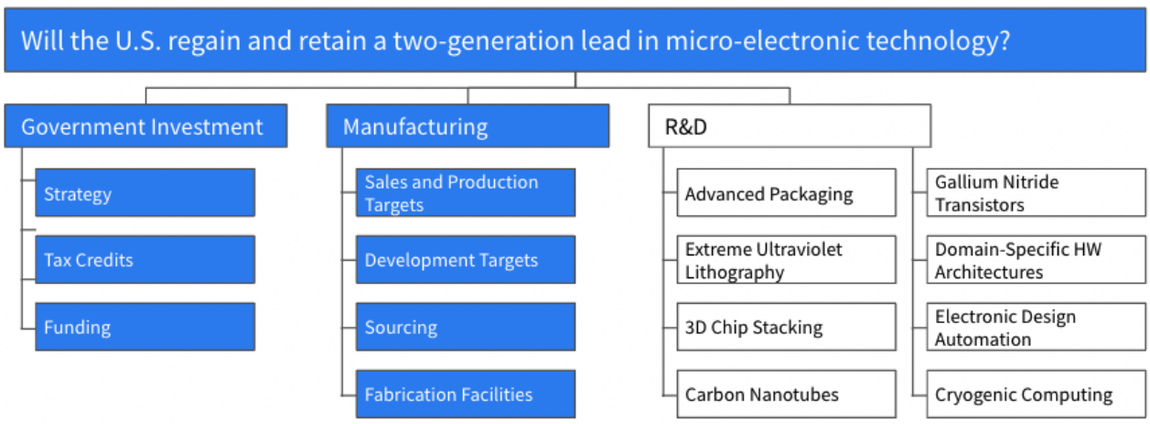
Today, the most advanced microchips in the world are made by Taiwan, showing how a lack of national prioritization and investment in microelectronics has caused the U.S. to lose its lead in microelectronic technology. Given such low integrated circuit production in the U.S., a vast majority is now sourced from East Asia, which has created supply chain vulnerabilities and geopolitical risks that could compromise multiple technologies and platforms.[2] Having the ability to manufacture advanced chips makes countries less vulnerable to supply chain disruptions and ensures they can continue utilizing the most advanced technological systems. U.S. reliance on East Asian, and especially Taiwanese chips, make the geopolitical jousting across the Taiwan straits and in the South China Sea especially problematic[3], and China's reliance on foreign sources has heightened the technological impact of U.S. export controls and sanctions.[4]

Tracking U.S. Progress With INFER

To begin understanding if the U.S. will regain and retain a two-generation lead in microelectronic technology, the National Security Commission on Artificial Intelligence (NSCAI) suggested three factors are pivotal: the amount and scope of U.S. Government investment, manufacturing capacity and capability, and new research and development[5].

Building on these factors, we identified forecast questions that inform our assessment of the United States' ability to regain a leadership role in the field. These questions are published for crowdsourced forecasting on inferpublic.com. (See Appendix-B to learn more about who is in our forecaster pool.)

The blue areas below represent topics where we are currently collecting forecasts and are discussed in this report, while the white areas are topics that are under consideration for future questions.



[1] https://news.mit.edu/2022/us-leadership-microelectronics-semiconductors-0119
[2] https://www.nytimes.com/2022/01/26/us/politics/computer-chip-shortage-taiwan.html
[3] https://www.reuters.com/investigates/special-report/taiwan-china-chips/
[4] https://www.scmp.com/tech/tech-war/article/3159828/us-china-tech-war-semiconductor-troubles-cloud-beijings-efforts-self
[5] "Chapter 13: Microelectronics," National Security Commission on Artificial Intelligence Final Report https://reports.nscai.gov/final-report/chapter-13/

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FORECAST QUESTIONS

APPENDICES

Will the U.S. Congress pass a tax credit for semiconductor manufacturing or design before 1 January 2023?

The Facilitating American-Built Semiconductors (FABS) Act, introduced in June 2021, would create a tax credit for investment in semiconductor manufacturing, and possibly semiconductor design.[6]

Based on 181 forecasts by 66 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Yes, tax credit for both manufacturing and design	38%	43% (+5%)
Yes, tax credit only for manufacturing	34%	31% (-3%)
Yes, tax credit only for design	4%	3% (-1%)
No tax credit	24%	23% (-1%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

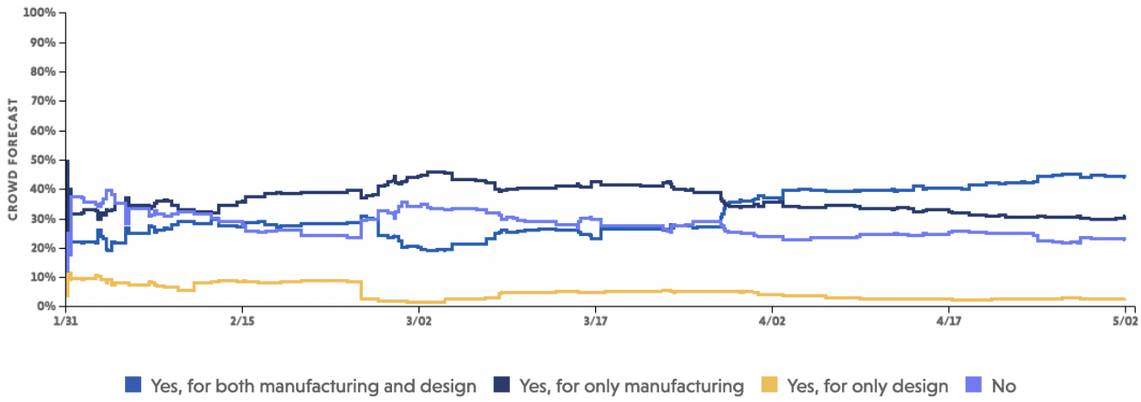
Bold = Summary of forecast rationales made in the last 30 days

A tax credit for both manufacturing and design will pass:	Only a tax credit for manufacturing will pass:	No tax credit will pass:
▪ Since it costs drastically more to build a new facility in the U.S. than in East Asia, federal incentives will help bring factories to the U.S. ▪ The economic risk of not passing credits for both manufacturing and design is too great. In the final version of the bill, lobbyists pushing for design credits will ultimately be successful. ▪ In an election year, politicians will make every effort to appeal to as many possible constituencies as they can, and providing tax credits is a great way to do so. ▪ The latest iteration of the FABS Act introduced in the House in late March included credits for both.	**▪ Last month, Secretary Raimondo gave a speech where she stressed the need to invest in manufacturing and semiconductors.** ▪ Manufacturing will have a large impact on voters, therefore incentivizing politicians to pass manufacturing credits as opposed to design, especially in an election year. ▪ Manufacturing is more tangible and politicians are better able to direct manufacturing to their individual states. ▪ The Biden Administration continues to show a strong desire to work with private industry in semiconductor manufacturing development.	▪ Lack of true bipartisan support in Congress, with other issues taking priority as the midterms approach. ▪ The Republicans will do everything within their power to block any such legislation, not wanting to give the Biden Administration any kind of win or momentum heading into the midterms. ▪ The crisis in Ukraine has slowed global supply, as well as stalled any bills that were potentially going to get passed in 2022.

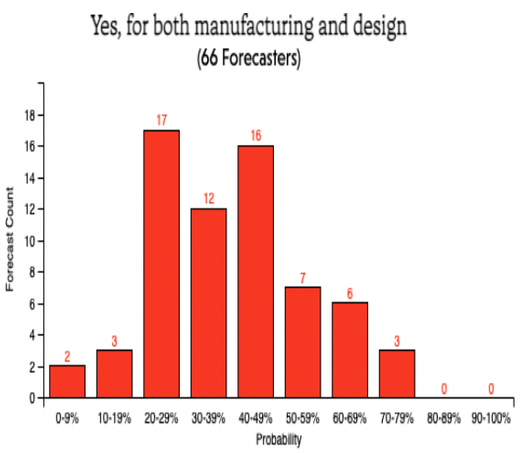
[6] https://www.congress.gov/bill/117th-congress/senate-bill/2107/text?r=68&s=1

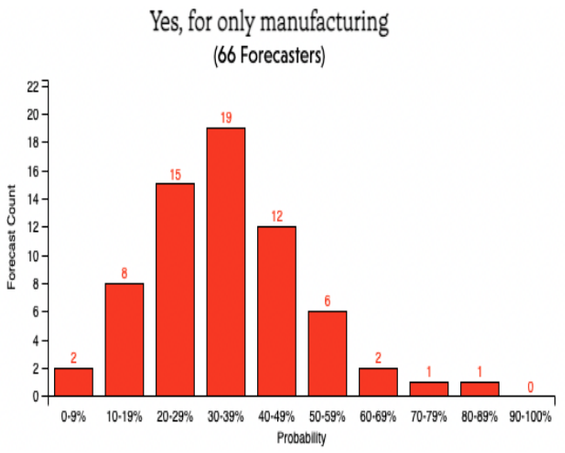
Will the U.S. Congress pass a tax credit for semiconductor manufacturing or design before 1 January 2023?

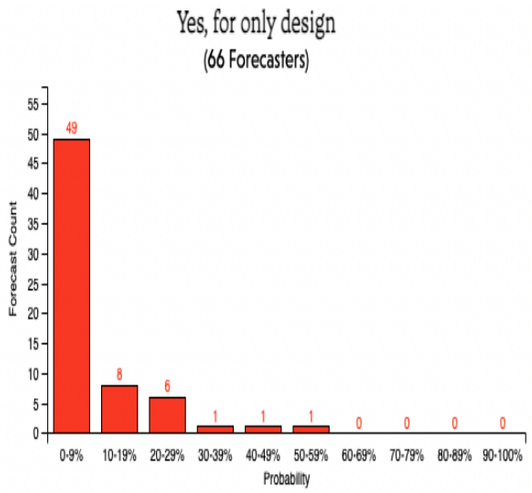
Consensus Trend

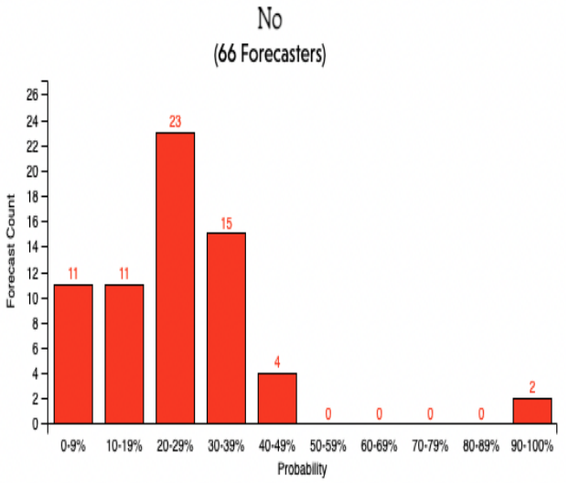


Forecast Distributions (See the most up-to-date distributions here.)









Will the U.S. President sign legislation which appropriates funds for the Advanced Packaging Manufacturing Program during FY'22?

The U.S. House of Representatives and Senate have each passed bills that allocate $2.5 billion in funding for the Advanced Packaging Manufacturing Program. Congressional leaders in both houses of Congress must now work to reconcile the two bills before sending them to the President to be signed.

Based on 126 forecasts by 54 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
No, $0 appropriated	7%	6% (-1%)
More than $0 but less than $1 billion	1%	2% (+1%)
More than or equal to $1 billion but less than $2 billion	4%	5% (+1%)
More than or equal to $2 billion but less than $2.5 billion	17%	18% (+1%)
More than or equal to $2.5 billion	71%	69% (-2%)

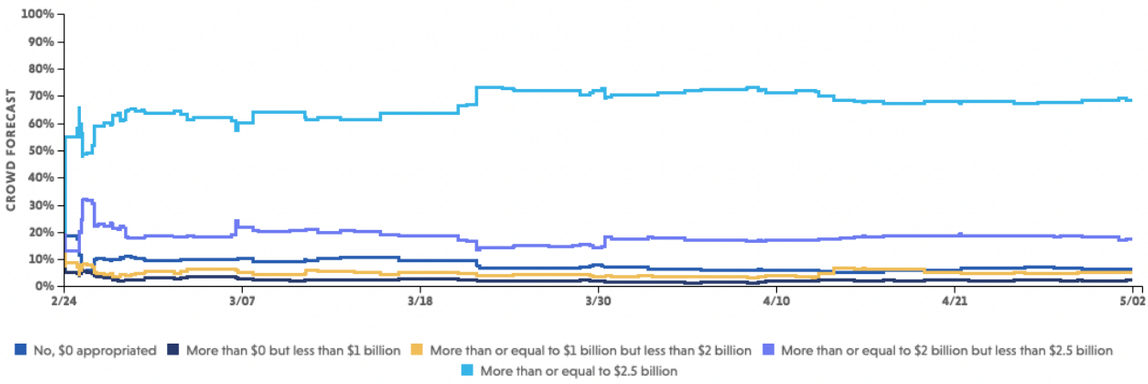
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

$2.5 billion or more appropriated:	Between $0 and $2.5 billion appropriated:	$0 appropriated:
▪ There is strong existing bipartisan support for the 2.5 billion, and some forecasters expect funding to increase from the levels currently in the bill. ▪ The semiconductor industry is becoming increasingly relevant strategically and geopolitically. ▪ Upcoming midterm elections could encourage the government to pass this bill quickly and potentially market it as reshoring high-tech manufacturing jobs, supporting national security, and lowering reliance on imports. ▪ $2.5 billion is small enough funding to avoid getting trimmed in reconciliation discussions.	▪ This bill is an “all or nothing” situation where either everything gets passed or nothing does. ▪ The nature of budgets is such that there are so many things to consider, that in the interest of fair negotiations something usually has to be given up.	▪ There is always a chance that reconciliation doesn’t happen and the bill doesn’t get passed. ▪ Trying to mandate oversight of spending could hold up the reconciliation process beyond the end of the fiscal year ending in 2022. ▪ Republican lawmakers might oppose any legislation that helps improve the image of Joe Biden or the Democratic party.

Will the U.S. President sign legislation which appropriates funds for the Advanced Packaging Manufacturing Program during FY'22?

Consensus Trend



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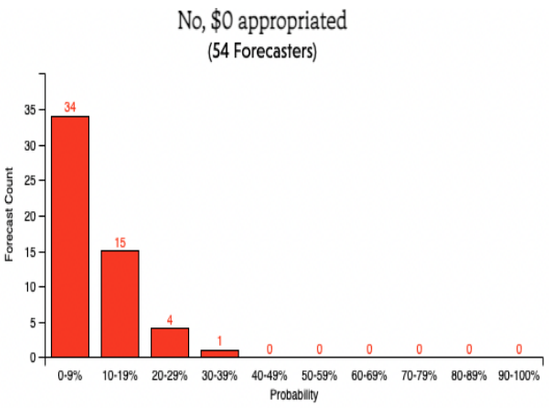
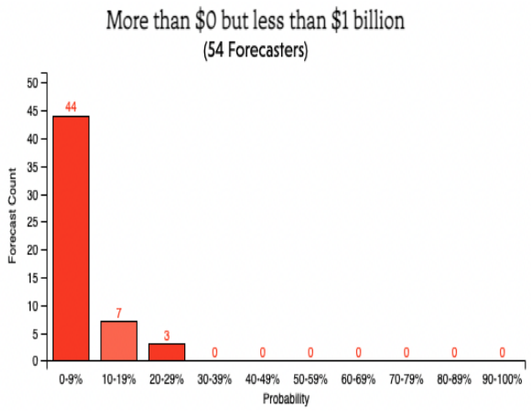
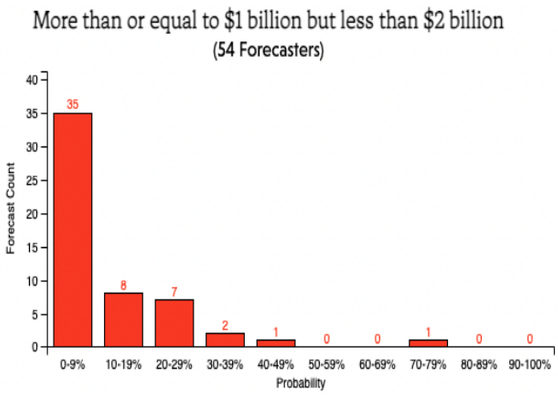
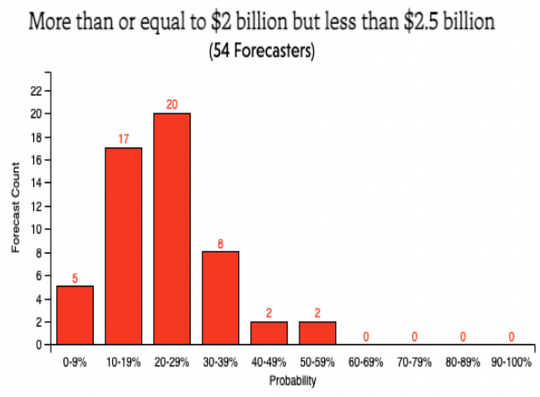
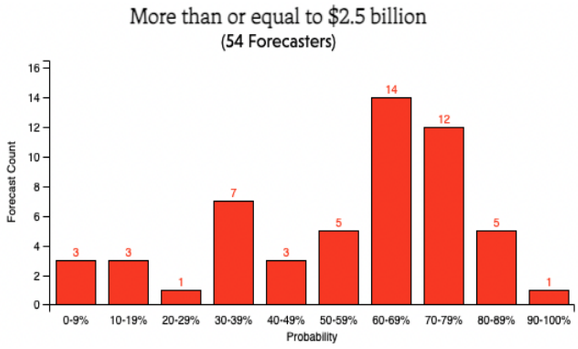










By 31 December 2022, will the Taiwan Semiconductor Manufacturing Company announce plans to build a semiconductor fab in Europe?

The Taiwan Semiconductor Manufacturing Company (TSMC) dominates semiconductor manufacturing.[7] The concentration of fabs, or fabrication facilities, also known as foundries, in Taiwan has led to concern about supply chain vulnerabilities that could disrupt multiple industries.[8] TSMC has announced plans to build fabs in the United States & Japan, and is considering whether to build one in Europe. [9]

Based on 148 forecasts by 66 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Yes	55%	52% (-3%)
No	45%	48% (+3%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

Above a 50% chance TSMC will announce plans to build a fab in Europe:	Below a 50% chance TSMC will announce plans to build a fab in Europe:
▪ **The Taiwan-Belgium Joint Business Council meeting, will be held in May of this year. It's highly likely that the Belgium side will make a strong pitch to TSMC to consider building a fab in Belgium.** ▪ There is high enough demand globally for semiconductors that an announcement will be made sometime in 2022. ▪ The EU has made clear they are worried about semiconductor shortages, thus giving them an incentive to have more fabs in their territory. ▪ An announcement could be made in 2022 to begin the process, but that does not necessarily mean the beginning of anything being built this calendar year.	▪ **All we have is rumors at this point. It is possible that TSMC might not want to overextend themselves with all of the new ongoing development and a volatile market.** ▪ Russia's invasion of Ukraine will likely delay any announcement, which will push any potential announced plans to build beyond 2022. ▪ TSMC is experiencing delays in its U.S. based chip plant in Arizona, including labor shortages and continued struggles with Covid-19. They will want to resolve these concerns first before announcing anything in Europe. ▪ It is in TSMC's best interest to wait and see if the EU Commission sponsored CHIPS Act gets passed, which would enhance Europe's semiconductor ecosystem, and perhaps alter TSMC's timeline in making an announcement.

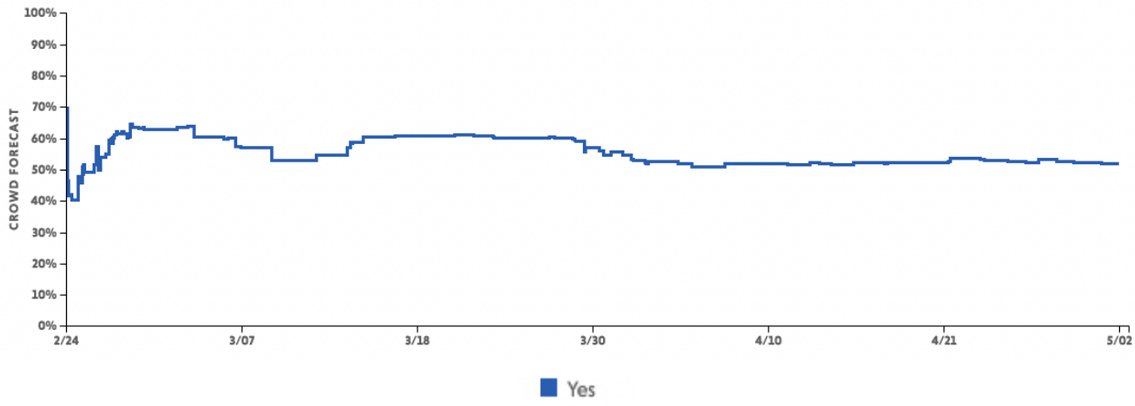
[7] https://www.cnbc.com/2021/03/16/2-charts-show-how-much-the-world-depends-on-taiwan-for-semiconductors.html

[8] https://www.nationaldefensemagazine.org/articles/2021/3/24/just-in-taiwan-viewed-as-achilles-heel-of-us-microelectronics-supply-chain
https://www.discoursemagazine.com/politics/2021/04/16/the-future-of-taiwan-semiconductors-alone-make-the-islands-continued-freedom-crucial-to-the-u-s/

[9] https://www.bloomberg.com/news/articles/2021-12-11/tsmc-in-early-stage-contact-with-germany-about-potential-plant
https://www.cnbc.com/2022/02/11/eu-chips-act-europe-will-need-help-from-us-asia-to-achieve-goals.html

By 31 December 2022, will the Taiwan Semiconductor Manufacturing Company announce plans to build a semiconductor fab in Europe?

Consensus Trend



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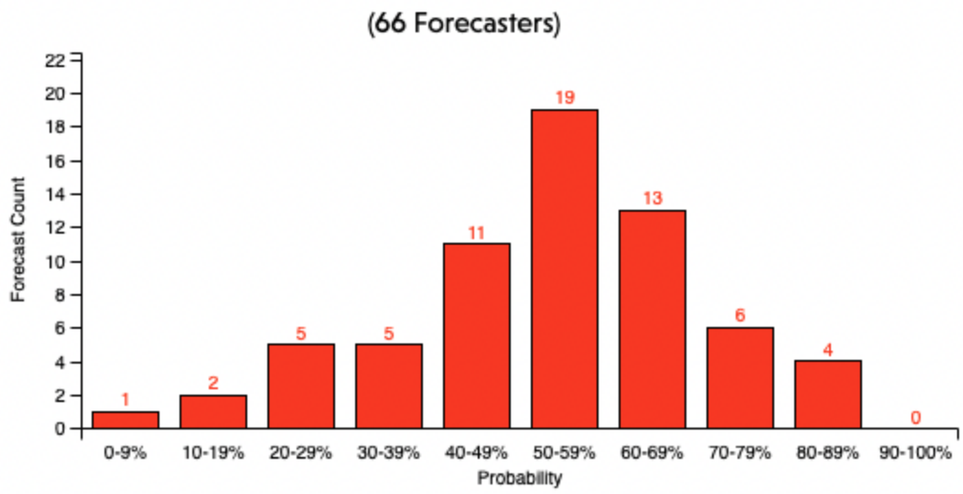


How many integrated circuit (IC) units will China produce in 2022?

Given ICs are integral to nearly all modern electronics, their production is critical for any national advanced technology strategy. In 2021, Chinese semiconductor manufacturing accelerated, with ~360 billion IC units being produced, increasing 33.3% year-on-year, compared to a 16.2% increase in 2020.[10]

Based on 113 forecasts by 52 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Less than 200 billion	1%	1% (Unchanged)
More than or equal to 200 billion but less than 300 billion	4%	4% (Unchanged)
More than or equal to 300 billion but less than 400 billion	23%	25% (+2%)
More than or equal to 400 billion but less than 500 billion	61%	62% (+1%)
More than or equal to 500 billion	11%	8% (-3%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

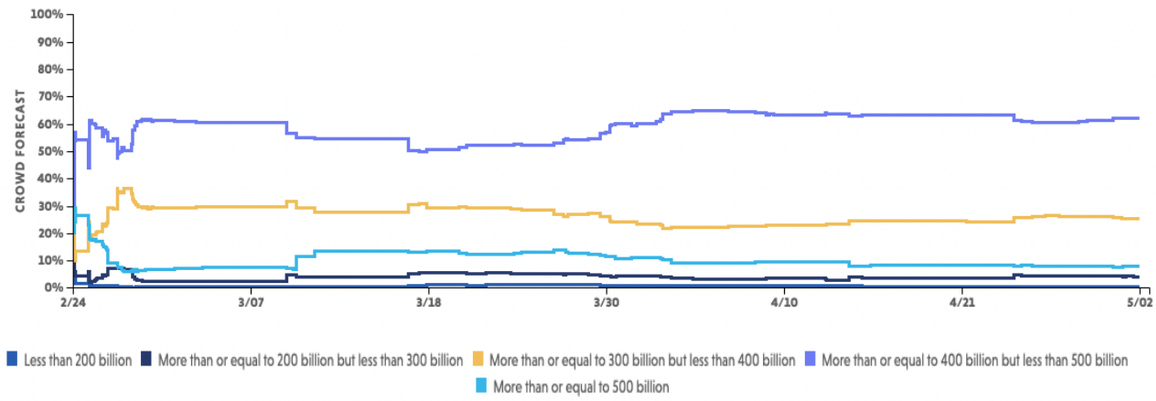
Bold = Forecast Rationales made in the last 30 days

Forecasters who assessed with highest probability that less than 400 billion will be produced:	Forecasters who assessed with highest probability that 400 billion or more will be produced:
▪ Lockdowns are devastating to industrial output and the supply chain. ▪ Due to increased trade tensions, and advancements in technology coming from other countries including Taiwan and South Korea, there could be a decrease from the 2021 amounts. ▪ The war in Ukraine could have a current and lasting negative impact on production well into 2022. ▪ Omicron has hit Hong Kong hard. I expect mainland China won't be hit as hard, but on the other hand the resulting lockdowns should be a detriment to China's manufacturing sector.	**▪ The upward trend in IC production will continue provided global demand, production capacity, and projected growing competition in Taiwan and Korea–as well as growing interest to reshore domestic production in the U.S. and Europe, China continue.** **▪ Despite Omicron and other potential challenges, this is still going to be a priority, and should not decline.** ▪ Starting with the base rate of 360 Billion produced in 2021, it is highly unlikely that figure decreases in 2022. If even a slight increase, then the 400 billion + figure will be achieved. ▪ As the global economy continues to rebound post-Covid, production will almost certainly increase from 2021. ▪ China is continuing to increase investment in domestic chip production despite lockdowns and conflict.

[10] https://www.yahoo.com/video/us-china-tech-war-chinese-093000108.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuaW5mZXItcHViLmNvbS8&guce_referrer_sig=AQAAAIDP98r-z7-e7LuhQPimjiU2MFp2RpzwUhyvHprmViBh2lAfYTNvVIObI1fe4INnxIcQsA_kOkCT2exEwL4i1fFdw97Qc6dvOvgdagU_uTIhcxrHMDwLQAHEBMDKBIniLxbH5dC14S3hIdyighyT8vZ4CNmeEu2Wc22DA0iESQIm

How many integrated circuit (IC) units will China produce in 2022?

Consensus Trend



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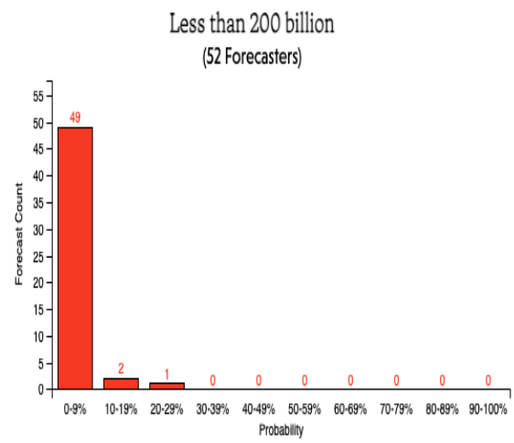
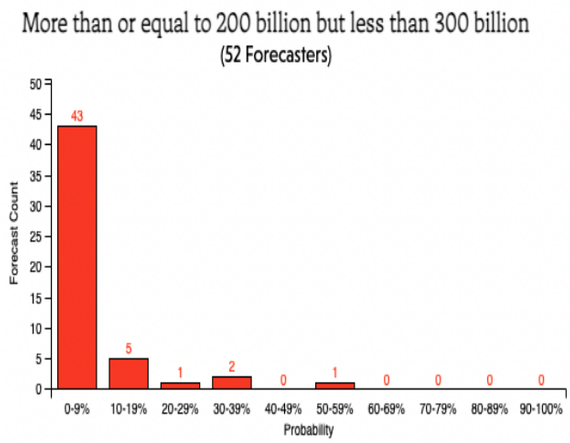
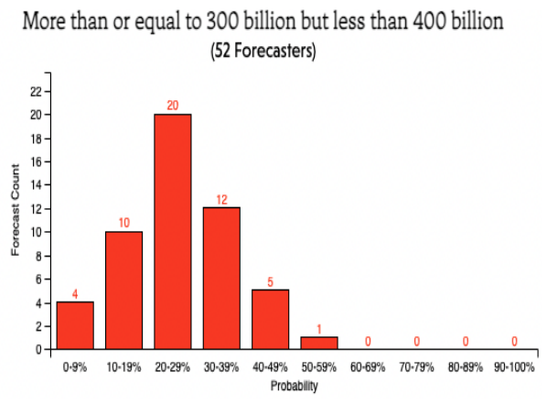
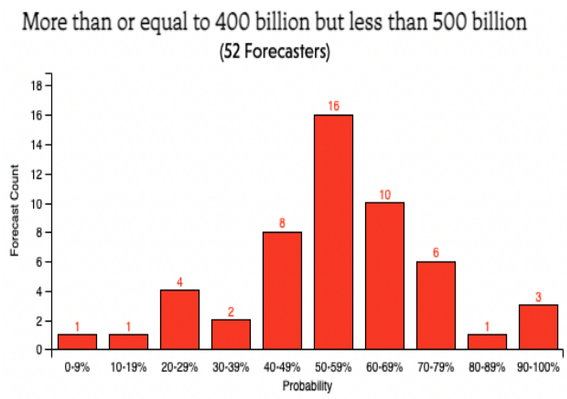
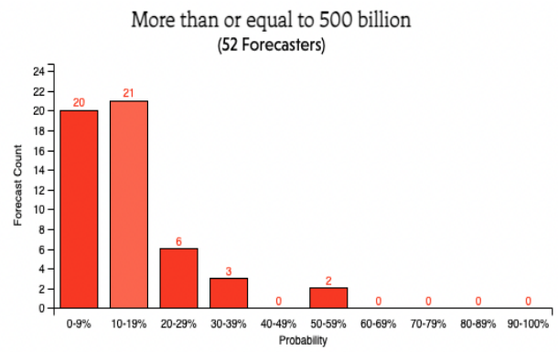










How will the percentage of SMIC revenue from 28 nm chips or smaller change over the next three years?

*This question closed 1 April 2022.

China depends on the U.S. and its allies for advanced semiconductor chips and the manufacturing equipment required to make them, which leaves it vulnerable to U.S. export controls. To reduce its dependence, China has prioritized developing its domestic semiconductor industry.

Based on 272 forecasts by 69 forecasters:

Time Period	INFER Forecasted Percentage of Revenue from 28nm chips or smaller
2022 H1	16% of revenue
2022 H2	18% of revenue
2023 H1	20% of revenue
2023 H2	22% of revenue
2024 H1	23% of revenue
2024 H2	24% of revenue
2025 H1	33% of revenue

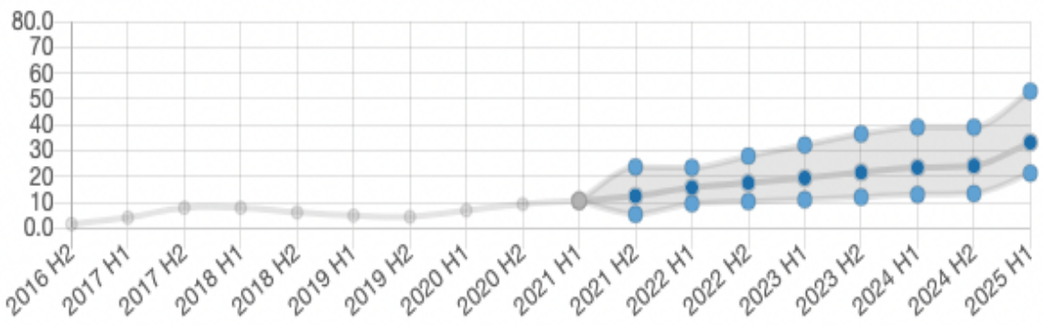
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

Forecasters who assessed SMIC's revenue share from 28nm chips or smaller increasing:	Forecasters who assessed SMIC's revenue share from 28nm chips or smaller stagnating or decreasing:
▪ SMIC's ability to overcome difficulties in producing 14 and 28 nm chips. ▪ SMIC may enter the 7 nm chip market in 2023 which would further increase revenue for chips under 28nm. ▪ SMIC's plans to increase investment, expand production capacity, and build three new plants in Beijing, Shanghai, and Shenzhen. ▪ Demand for smaller chips will increase more rapidly due to advances in AI, 5G, and other technologies placing higher demands on the underlying microelectronic hardware.	▪ Cyclical market trends may lead to stagnation in revenue share of <28nm chips in 2023. ▪ SMIC's potential inability to access highly-specialized Extreme Ultraviolet Lithography machines could impact their ability to produce <28nm chips at scale. ▪ SMIC's Tianjin fab is expanding, yet doesn't produce 28 nm chips. ▪ Similarly, SMIC's Beijing fab which primarily produces 40 nm chips is also expanding and currently makes up a large percentage of SMIC's revenue.

How will the percentage of SMIC revenue from 28 nm chips or smaller change over the next three years?

Consensus With 90% Forecast Intervals



Of the following companies, which will start volume production on a 3nm chip or smaller before 17 September 2023?

Although the industry is accustomed to TSMC releasing new products every two years.[11] TSMC's volume production of the 3nm chip is not expected to begin until the second half of 2022.[12] Samsung has plans to roll out their 2nm design in 2025, but volume production of the 3nm chip was delayed from 2021 to 2022.[13] Intel's roadmap calls for them to overtake their competition by releasing a 1.8nm chip by 2024.[14]

Based on 81 forecasts by 44 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Intel	27%	29% (+2%)
Samsung	49%	69% (+20%)
TSMC (Taiwan Semiconductor Manufacturing Company)	64%	86% (+22%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

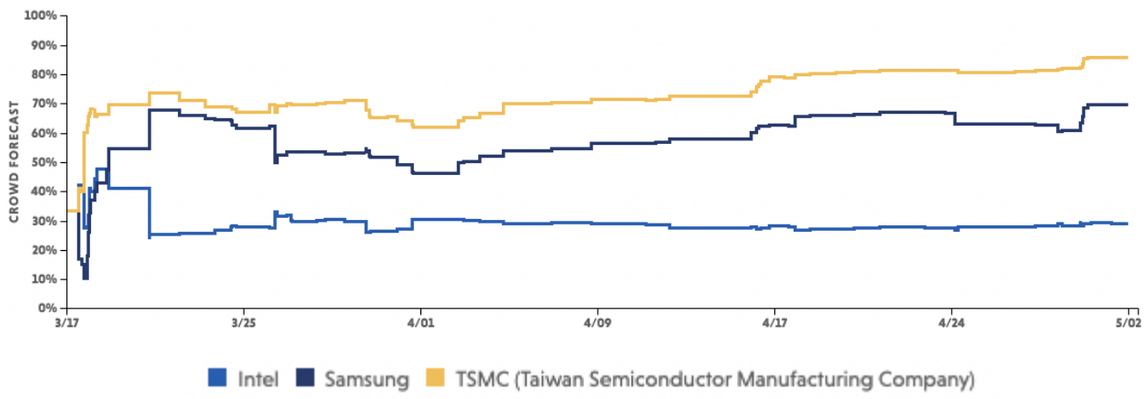
Bold = Forecast Rationales made in the last 30 days

Rationale for Intel:	Rationale for Samsung:	Rationale for TSMC:
▪ **Since their competitors seem to be moving their timelines up, Intel may feel pressure as well to speed up production.** ▪ Intel continues to invest in new conductor technologies and new fabric in Germany which will increase the chances of production. ▪ Intel may struggle to meet production by this date, specifically due to the complexities of designing the production process and how they have already seemingly fallen behind on technology. ▪ Intel has proven over time they they are capable of adapting quickly to emerging markets, more so than Samsung and TSMC.	▪ **Samsung recently announced they are on track to start high-volume production using their 3GAE (3nm-class gate all-around early) this quarter.** ▪ Samsung is scheduled to start producing its customers' first 3nm-based chip designs in the first half of 2022, while its second generation of 3nm is expected in 2023. ▪ It's not clear whether or not their first generation 3nm chip is "volume" or if they are waiting until the second generation of chip to do so.	▪ **TSMC has announced they will be ready to move its 3nm chip process to volume production in the second half of this year.** ▪ They are currently expecting (even after 8 months of delays) to begin volume production in Q4 2022, meaning they have an additional 9 months past the scheduled start of production to resolve positively here. ▪ TSMC has access to the most LUV technology and will take advantage of it. TSMC has already kicked off pilot production of chips built using N3 at its Fab 18 in southern Taiwan and will move the process to volume production by Q4 2022.

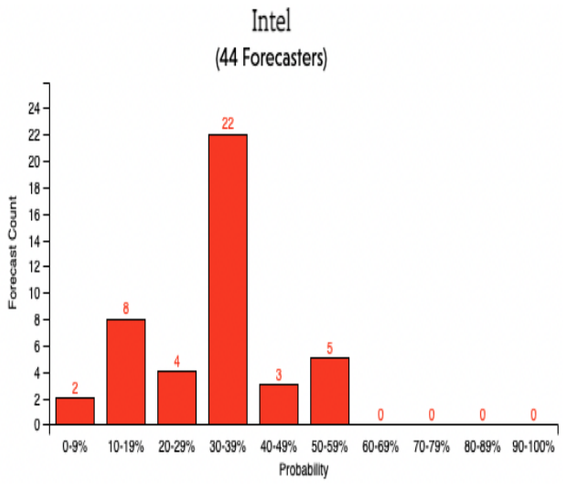
[11] https://www.anandtech.com/show/17013/tsmc-update-3nm-in-q1-2023-3nm-enhanced-in-2024-2nm-in-2025
[12] https://www.tsmc.com/english/dedicatedFoundry/technology/logic/l_3nm
[13] https://www.electronicdesign.com/technologies/embedded-revolution/article/21178098/electronic-design-samsung-foundry-delays-3nm-node-to-2022-2nm-due-by-2025
[14] https://analyticsindiamag.com/the-race-to-reduce-nanometers-in-chips/

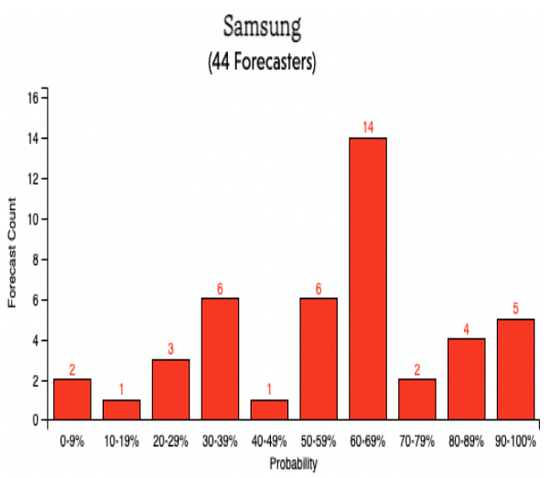
Of the following companies, which will start volume production on a 3nm chip or smaller before 17 September 2023?

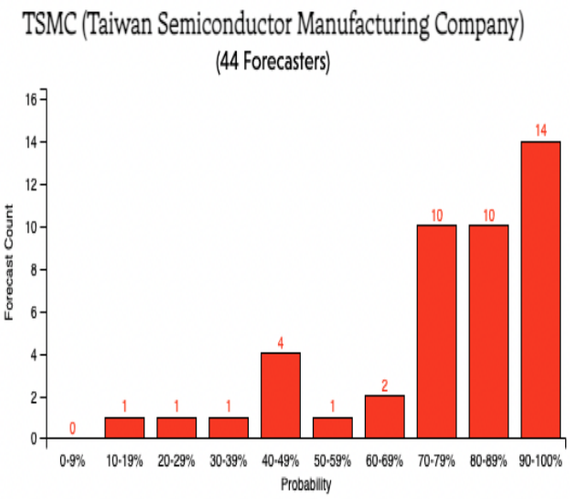
Consensus Trend



Forecast Distributions (See the most up-to-date distributions here.)







Which company will be the largest semiconductor company by sales revenue in 2022?

Despite an ongoing semiconductor shortage, worldwide semiconductor revenue rose to over $500 billion for the first time in 2021.[15] In this context, Intel, the U.S.'s largest semiconductor company, saw sales stall at $75.55 billion, while Samsung's sales surged to $83.085 billion, generating more semiconductor sales revenue than Intel for the first time since 2018.[16]

Based on 99 forecasts by 58 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Intel	29%	34% (+5%)
Samsung	62%	58% (-4%)
TSMC (Taiwan Semiconductor Manufacturing Company)	9%	8% (-1%)
Other	0%	0% (Unchanged)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

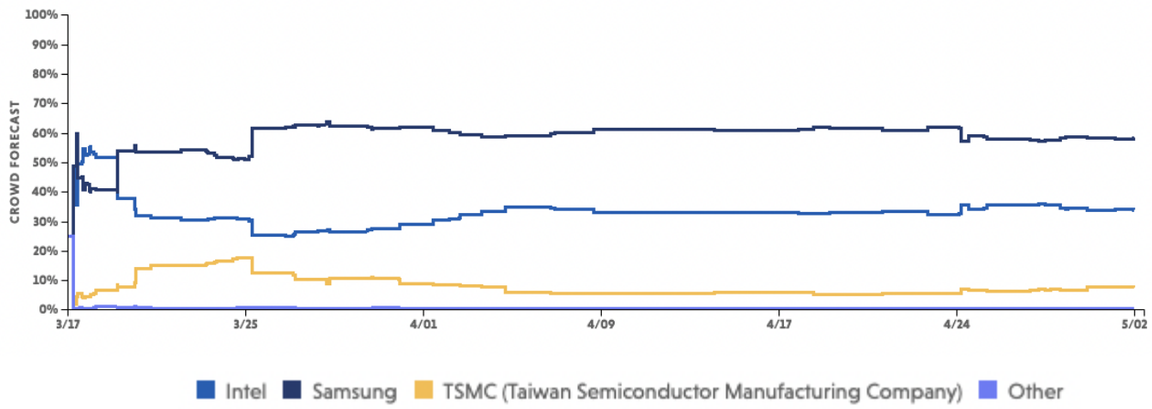
Intel:	Samsung:	TSMC:
▪While Intel will be a recipient of significant funding, Apple's switch to Apple silicon poses an issue for Intel's bottom line. ▪ Intel is a massive semiconductor company that captures a wider variety of applications and has a great upside. ▪ Intel will retake first place boosted by its planned $36 billion expansion of its European operations, including two fabs in Germany.	**▪ Samsung had the best Q1 out of this grouping.** ▪ Samsung's rise in revenue in 2021 was not an outlier, and the popularity of the NAND and DRAM markets, which Samsung has the lead in, led Samsung to have a better Q1 in 2022 than Intel. ▪ Intel made some missteps in its data center line of business that provides a clear line for Samsung to eat up even more market share chunks. ▪ The arguments for Samsung include rapid growth that is likely sustainable, a more diverse product base, and they appear to be the much more savvy company.	**▪ TSMC's Q1 revenue was up 36% year-over-year, thus closing the gap with Samsung and Intel.** ▪ They are tied for most advanced semiconductors (5nm, 3nm), and are also mostly focused on semiconductors, which could give them a strategic advantage. ▪ Opening a new plant in the US, which could benefit them greatly.

[15] https://www.windowscentral.com/samsung-intel-2021-semiconductor-revenue

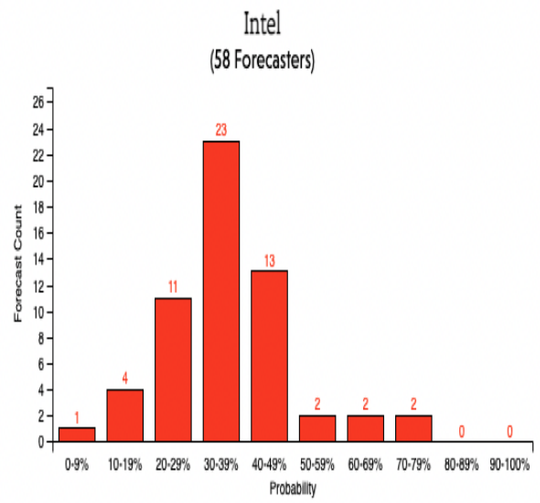
[16] https://www.icinsights.com/news/bulletins/17-Semiconductor-Companies-Forecast-To-Have-100-Billion-In-Sales-This-Year/

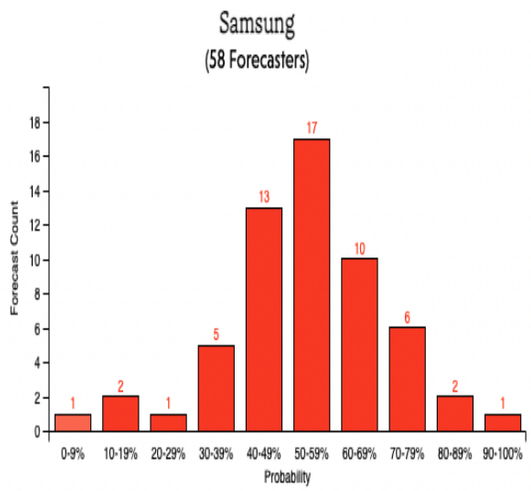
Which company will be the largest semiconductor company by sales revenue in 2022?

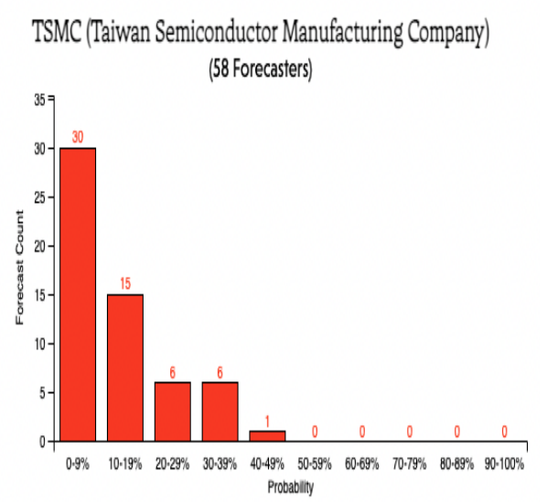
Consensus Trend

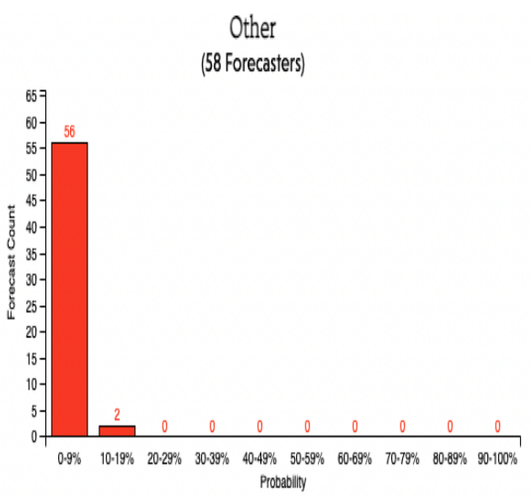


Forecast Distributions (See the most up-to-date distributions here.)









In 2022, will the Shanghai Micro Electronics Equipment Co. list a new lithography machine as an available product on its website?

*This question closed 17 April 2022.

Photolithography is a critical weakness of China's semiconductor industry.[17] Shanghai Micro Electronics Equipment Co (SMEE), the leading Chinese manufacturer, currently offers lithography equipment to support chips with 90nm nodes.[18] In September, SMEE announced that it had delivered a new product employing 3d chip packaging, but they did not announce its resolution and the new packaging product is not currently available on its website 2021.[19]

Based on 70 forecasts by 49 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 4/17
Yes	18%	15% (-3%)
No	82%	85% (+3%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

Forecasters who gave it a 25% + chance:	Forecasters who gave it below a 25% chance:
▪ There seems to be a political will to make China independent in the semiconductor business, and they will be making this a priority. ▪ China recently delivered its first advanced 2.5D/3D chip packaging stepper, meaning that the technology is nearing what is needed for a new lithography machine. ▪ With Beijing's display of technological might and scientific independence, SMEE should publish shortly, once it has recovered from the consequences of the U.S. Commerce Department's export watch list.	▪ **COVID surge and the neon scarcity have created additional barriers for any announcement or launch.** ▪ SMEE may face issues when it comes to importing parts after being listed as a "military end user" by the U.S government. ▪ There seems to be a roughly 5 year cycle for new models in this space, so taking that into account, it is unlikely to happen within this calendar year. ▪ Concerns about persistent inflation, supply chain disruptions from new COVID variants, and the Ukraine conflict are all factors that have weighed on the risk appetites for investors, which will likely decrease the possibility for SMEE releasing new product.

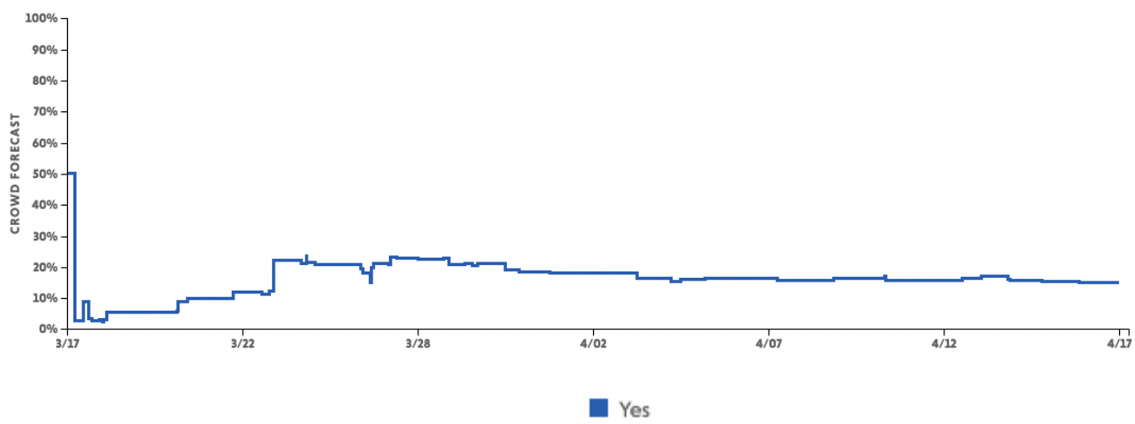
[17] https://www.ccsinsight.com/blog/chinese-chipmakers-look-inward-for-equipment-suppliers/

[18] http://www.smee.com.cn/eis.pub?service=homepageService&method=indexinfo&onclicknodeno=1_4_4_1

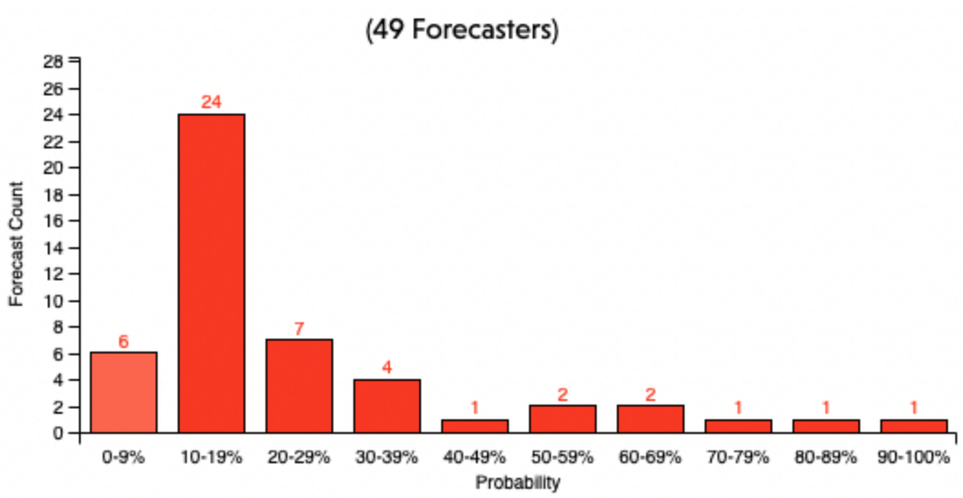
[19] https://news.cgtn.com/news/2022-02-07/China-delivers-its-1st-advanced-2-5D-3D-chip-packaging-stepper-17swMyw1NHq/index.html

In 2022, will the Shanghai Micro Electronics Equipment Co. list a new lithography machine as an available product on its website?

Consensus Trend



Forecast Distributions (See the most up-to-date distributions here.)



What percentage of ASML's lithography sales will be to the United States in 2022?

*This question opened 31 March 2022.

In the face of the semiconductor shortage, the U.S. is seeking to increase its chip manufacturing capabilities by developing domestic fabs.[20] Photolithography is a critical component of these fabrication facilities, and ASML is the world leader in that field.[21] The question will be resolved based on ASML's 2022 full year results.

Based on 40 forecasts by 31 forecasters:

Possible Answer	INFER % Chance 4/3	INFER % Chance 5/3
Less than 5%	21%	15% (-6%)
More than or equal to 5% but less than 10%	49%	52% (+3%)
Between 10% and 15%, inclusive	22%	29% (+7%)
More than 15%	8%	4% (-4%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

Forecasters who gave it less than 10% chance:	Forecasters who gave it 10% chance or higher:
▪ Sales to the U.S. were ~1.5 billion Euros in 2021, which lies in between the 5-10% range. It is highly unlikely this will dramatically change in 2022. **▪ While there are certainly many semiconductor facilities currently under construction, they likely will not be finished in 2022. Therefore, don't expect a major change until 2023 or 2024.** **▪ It takes a good amount of time to build both the machines and the fabs, so any increased investment will take time to turn into actual sales & revenue.** **▪ Leaning more into the <5% category due to the trend in the annual figures. It takes up to 2 years to get from order to delivery for new machines.**	**▪ Per ASML's 2021 annual report, slightly less than half of their sales were to the U.S. Recognizing this total included more than just lithography (systems, services, etc), but lithography did account for a significant portion of this total. That said, this should exceed 15% by a wide margin.** **▪ ASML's growing monopoly will increase sales to the U.S. (as well as everywhere else), since this technology is not easy to replicate and many of their customers invest in ASML (like Intel) which incentivizes them to purchase from them.** **▪ This could happen only because COVID could have played a larger role than expected in the recent decline, along with the U.S. government's likely upcoming large investments that Biden supports.**

[20] https://www.forbes.com/sites/randybrown/2021/07/14/can-the-us-compete-for-chip-dominance/?sh=1739dcccfcc

[21] https://fortune.com/2021/10/19/asml-chips-euv-silicon-valley-biden/

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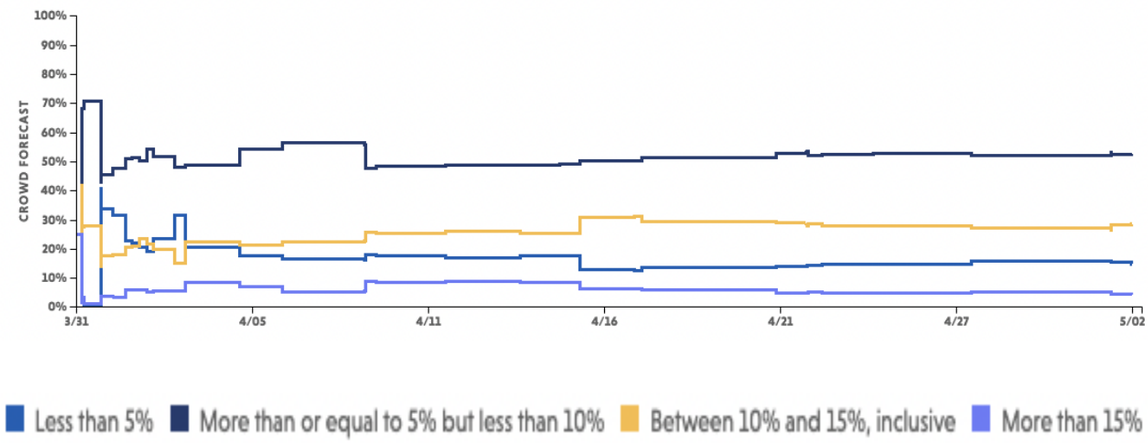
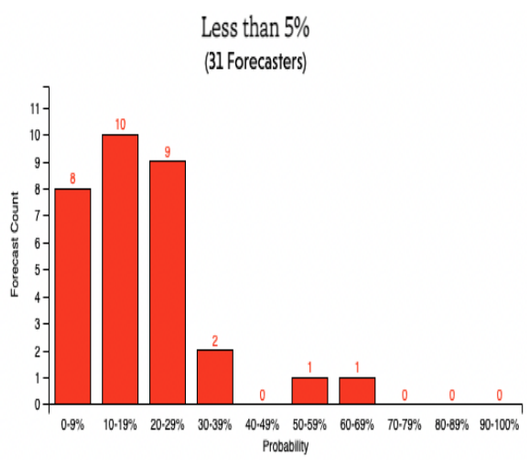
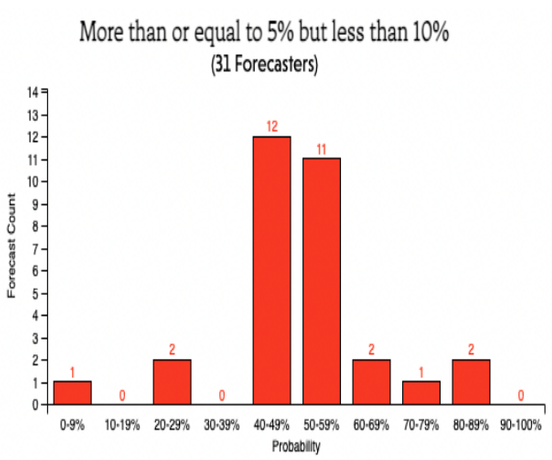
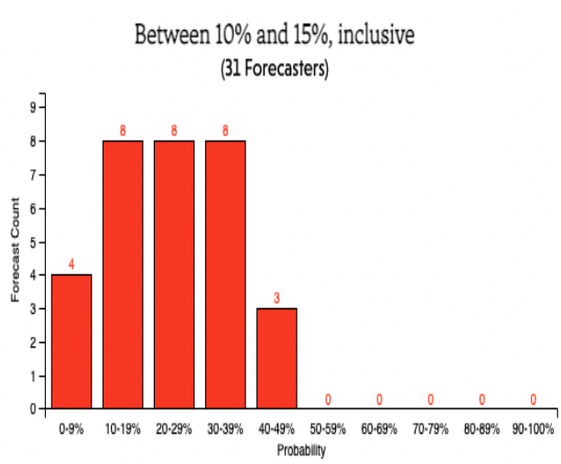
Consensus Trend

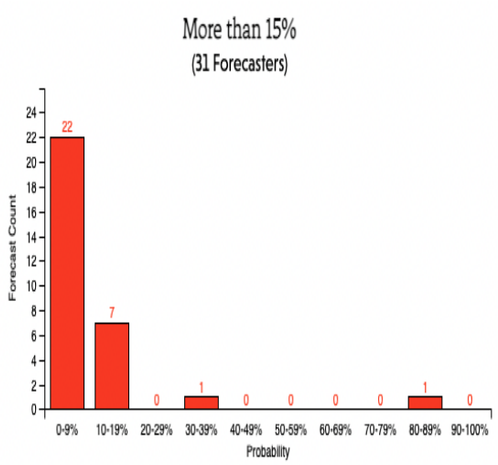


Forecast Distributions (See the most up-to-date distributions here.)









How many Chinese Universities will be listed in QS World University Rankings' top 100 universities for computer science in 2023?

*This question opened 31 March 2022.

This question will be resolved using QS World University Rankings by Subject 2023: Computer Science and Information Systems, expected to be released in April 2023. The current rankings can be accessed by filtering "Location" to "China (Mainland)".[22]

Based on 58 forecasts by 45 forecasters:

Possible Answer	INFER % Chance 4/3	INFER % Chance 5/3
Less than or equal to 5	4%	3% (-1%)
Between 6 and 7 inclusive	85%	91% (+6%)
More than or equal to 8	11%	6% (-5%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

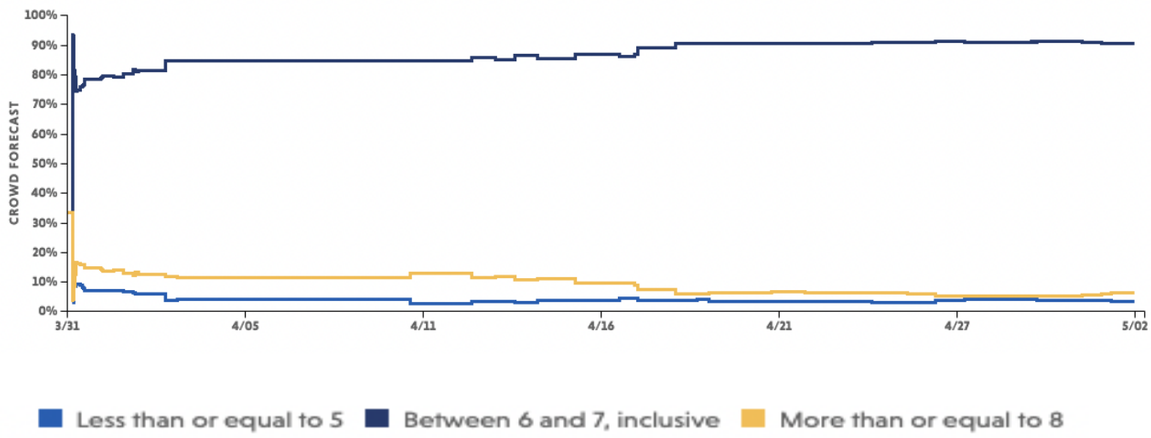
Bold = Forecast Rationales made in the last 30 days

Less than or equal to 5:	Between 6 and 7 inclusive:	More than or equal to 8:
▪ China has placed a heavy emphasis on shielding its economy by betting on self-sufficiency, especially on technology. Also, self-sufficiency is a key topic in their 5-year plan, which could result in the current number decreasing. **▪ The current number could decrease given the global uncertainty of the pandemic and the war in Ukraine.**	**▪ Computer Science has been one of the main areas of investment by the Chinese Government in the last few decades. As of now, there are 6 Chinese Government universities in the top 100 rankings, with another ranking in 101st, which is why it will either stay or increase.** **▪ Seems highly unlikely that another university will either leave or enter the top 100 within the next year based on current trends.**	**▪ There was a large increase from 2020-2021 in comparison to 2019-2020. This could demonstrate a tendency that might be replicated by 2023.** **▪ The Chinese Government may decide that having additional universities in the top 100 is reputationally important and therefore may put a large amount of additional resources and pressure on individual universities to meet certain metrics necessary to make this list.**

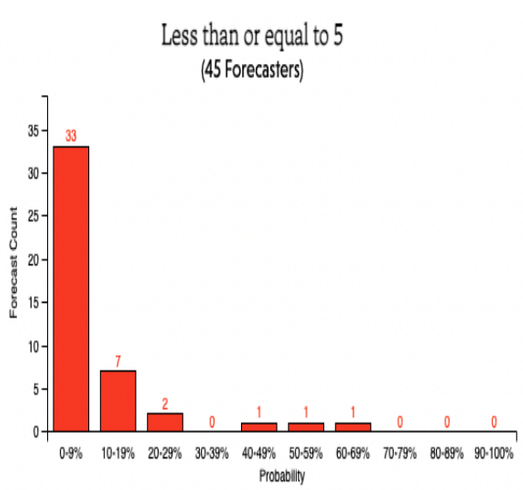
[22] https://www.topuniversities.com/university-rankings/university-subject-rankings/2021/computer-science-information-systems

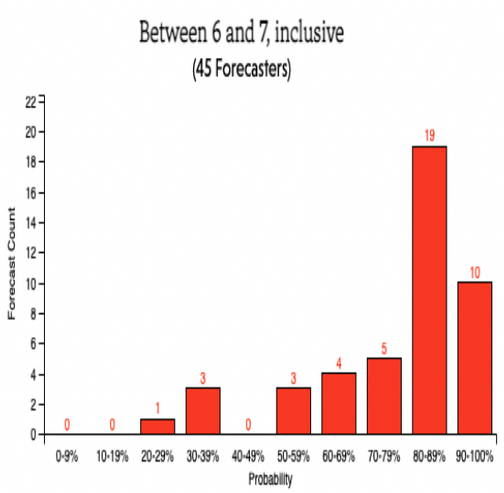
How many Chinese Universities will be listed in QS World University Rankings' top 100 universities for computer science in 2023?

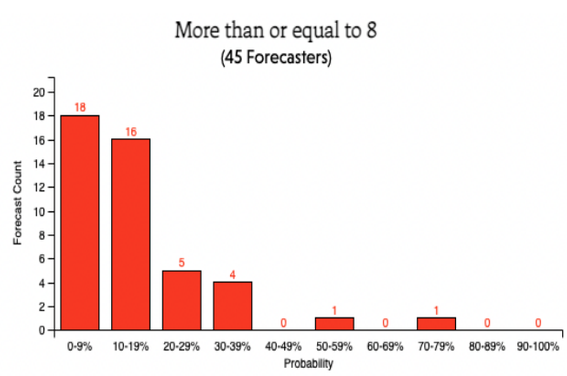
Consensus Trend



Forecast Distributions (See the most up-to-date distributions here.)







What will be the price per ton of aluminum on 1 June 2022?

*This question opened 31 March 2022.

An aluminum shortage has seen the price of aluminum rise to historically high levels in recent months.[23] Sanctions on Russia, the 3rd largest supplier of aluminum, may worsen the shortage and cause prices to rise even higher. This question will be resolved using the "close" price of aluminum on 1 June 2022 as reported by Markets Insider.[24]

Based on 104 forecasts by 62 forecasters:

Possible Answer	INFER % Chance 4/3	INFER % Chance 5/3
Less than $3,000	7%	27% (+20%)
More than or equal to $3,000 but less than $3,500	44%	53% (+9%)
More than or equal to $3500 but less than $4,000	41%	18% (-23%)
More than or equal to $4,000	8%	2% (-6%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

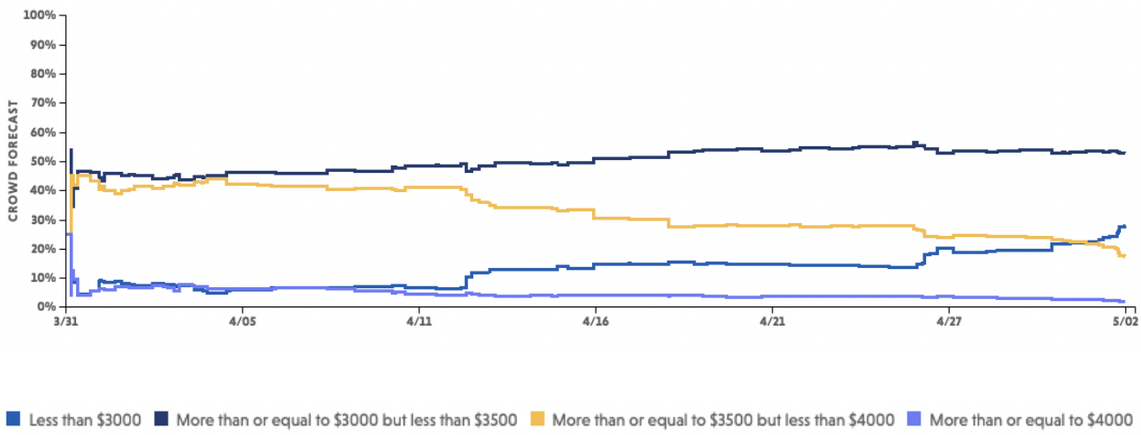
Forecasters who predict $3,499 or less	Forecasters who predict $3,500 or greater
▪ Aluminum does not face the same constraints as other metal commodities. Russia will discount the price for much needed cash. **▪ Based on data form the past year, it seems most likely to stay between $3,000-$3,500. However, there is a chance it could climb as higher demand for lighter, more fuel efficient vehicles continues to grow.**	**▪ The price and inflationary pressures will increase as a result of the war in Ukraine.** **▪ The International Monetary Fund (IMF) forecasts that aluminum prices will rise to $2,083/t in 2021 — a jump of 22% over the previous year, the largest predicted increase among the three forecasts — and to $2,126/t in 2022. The long-term IMF projection is that the price of aluminum will reach $2,276/t in 2026.**

[23] https://asia.nikkei.com/Business/Markets/Commodities/Aluminum-prices-hit-13-year-high-amid-power-shortage-in-China

[24] https://markets.businessinsider.com/commodities/aluminum-price

What will be the price per ton of aluminum on 1 June 2022?

Consensus Trend



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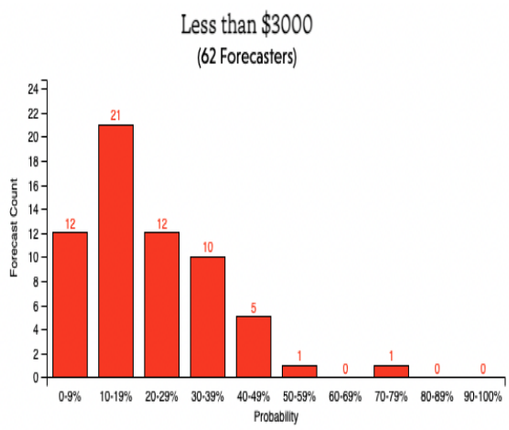
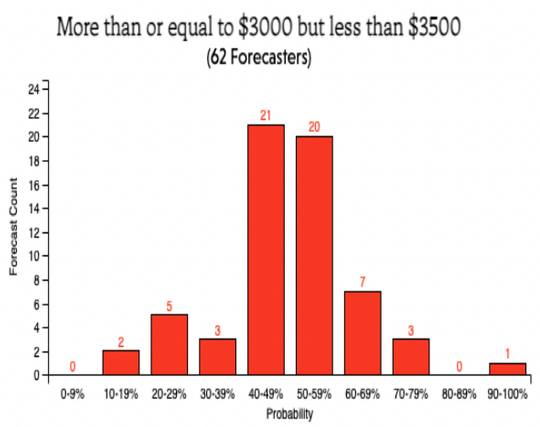
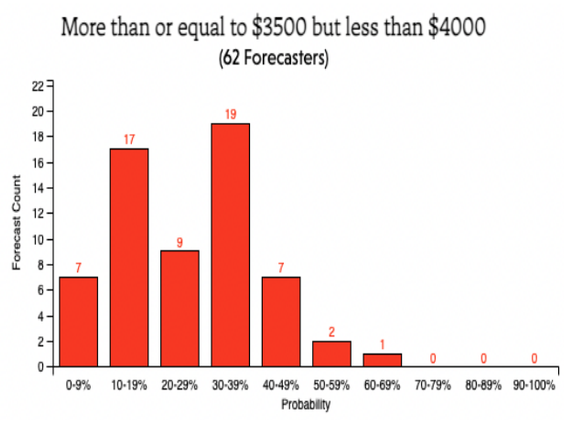
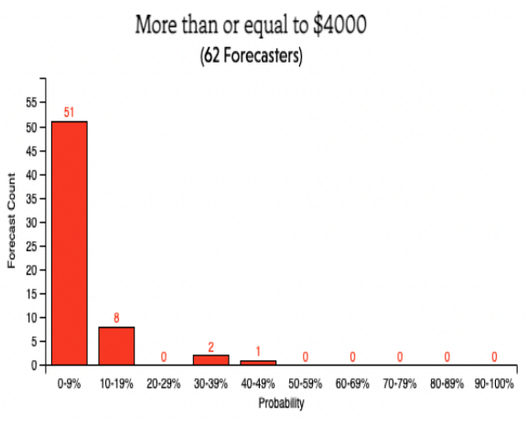








What will be the value, in dollars, of U.S. exports of semiconductor manufacturing equipment to China in 2022?

The semiconductor manufacturing process has many components manufactured through complicated, highly globalized supply chains. China's ability to produce advanced semiconductor chips is particularly dependent on U.S., Japanese, and Dutch imports of advanced semiconductor manufacturing equipment (SME) making it vulnerable to export controls.

Based on 347 forecasts by 70 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Less than $5 billion	3%	2% (-1%)
More than $5 billion but less than or equal to $6 billion	13%	12% (-1%)
Between $6 billion and $7 billion inclusive	38%	35% (-3%)
Between $7 billion and $8 billion inclusive	30%	33% (+3%)
More than $8 billion	16%	18% (+2%)

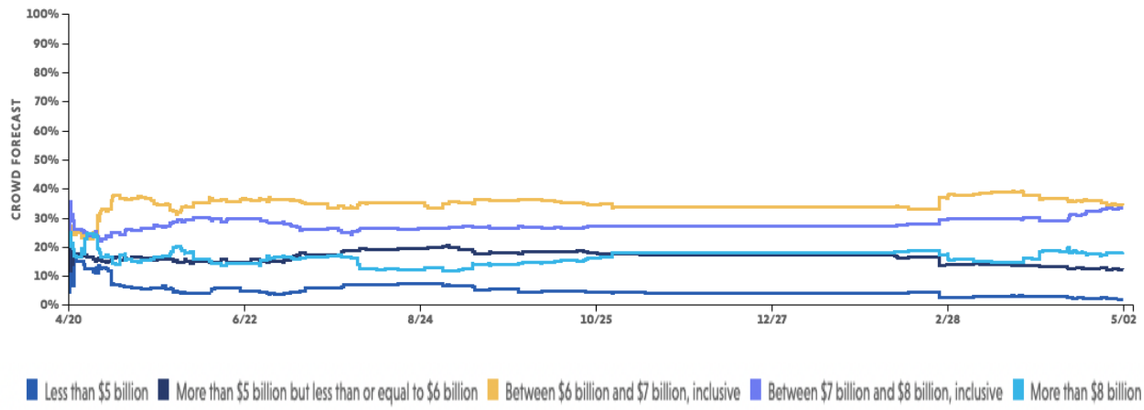
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

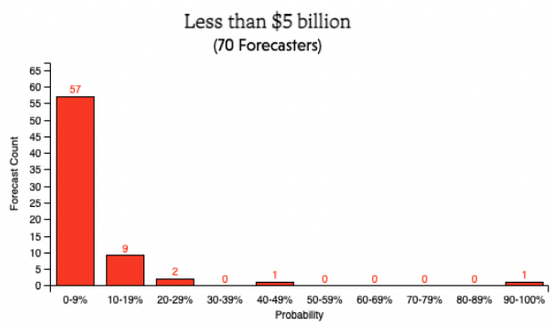
Forecasters who predicted less than $ 6 billion	Forecasters who predicted between $6 billion and $ 8 billion, inclusive	Forecasters who predicted more than $8 billion:
▪ The supply chain problems due to lockdowns will not be easily solved anytime before June at the earliest. **▪ The relationship between China and the US, as well as the situation in Ukraine, will negatively affect the amount of US export to China.** ▪ Supply chain issues due to COVID lockdowns pose limits on chip imports. ▪ Due to the unstable U.S.-China relationship and the recent/upcoming events regarding conflicts and sanctions in Eurasia, these exports can be negatively affected.	**▪ Using 2021 Jan+Feb % of year total and 2022 Jan+Feb reports to predict 2022 total, while allowing for the possibility of new trade restrictions will keep us in the $6-7b range.** **▪ Omicron moves fast. A cluster of infections in Shanghai, for example, has forced the government to impose a hurried lockdown, for which it seems woefully unprepared.** ▪ With 2021 imports totaling in this range, it is difficult to impact a change of billions of dollars in exports this year than last year. ▪ Actions will be taken to reduce exports to China to dampen growth, but current trends dictate around this range.	**▪ Inflation will drive this value higher than 2021.** ▪ With a $2B increase in net trade from 2020 to 2021 from $5.7B to $7.8B, this trend will continue into 2022. ▪ This is going higher in 2021; unless nationalistic fighting begins, why would it decrease in 2022.

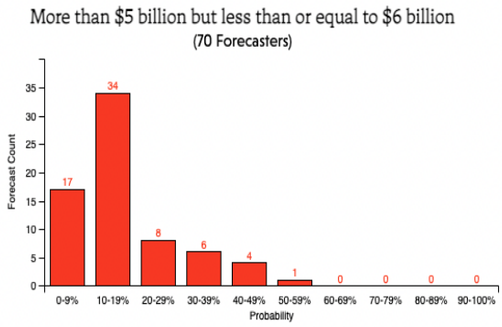
What will be the value, in dollars, of U.S. exports of semiconductor manufacturing equipment to China in 2022?

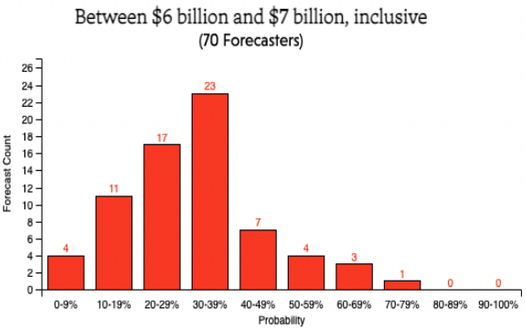
Consensus Trend

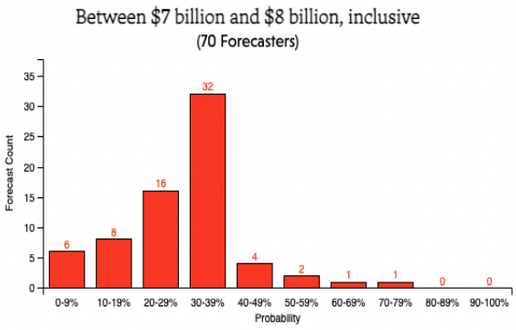


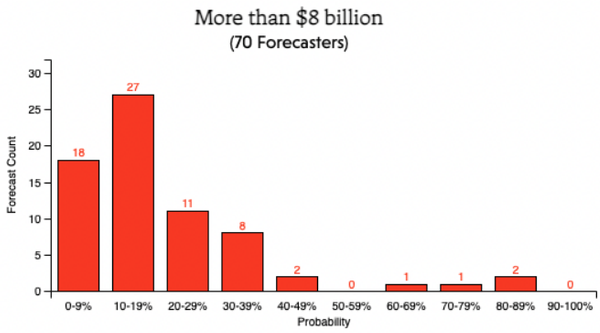
Forecast Distributions (See the most up-to-date distributions here.)











What will be the value, in dollars, of U.S. exports of semiconductor chips to China in 2022?

The semiconductor manufacturing process has many components manufactured through complicated, highly globalized supply chains. Although China is building up its chip manufacturing capacity , it is still reliant on imports for most of the semiconductor chips it consumes, especially chips from the United States, Taiwan, and South Korea.

Based on 302 forecasts by 56 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Less than $8.5 billion	3%	3% (Unchanged)
More than $8.5 billion but less than or equal to $10 billion	8%	10% (+2%)
Between $10 billion and $11.5 billion inclusive	20%	24% (+4%)
Between $11.5 billion and $13 billion inclusive	38%	36% (-2%)
More than $13 billion	31%	27% (-4%)

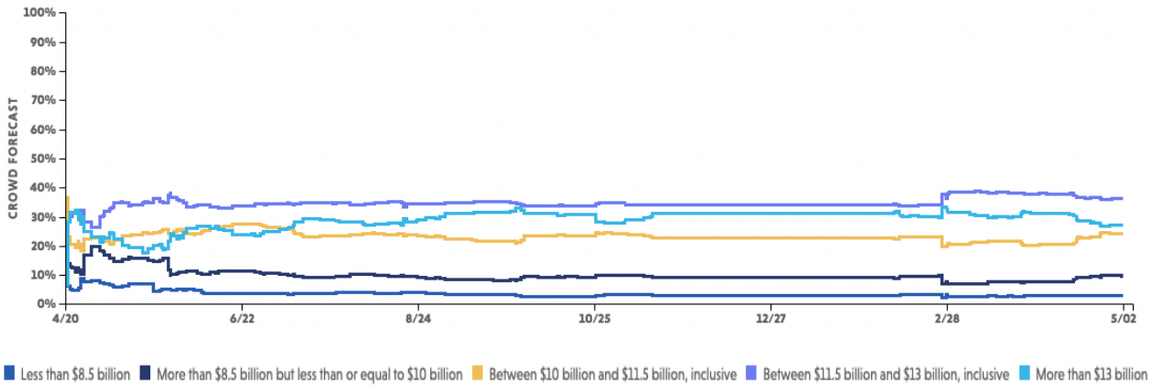
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

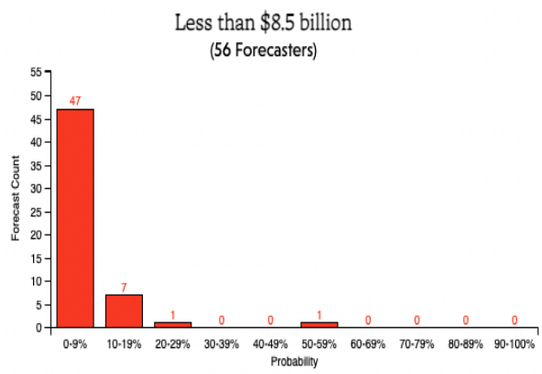
Forecasters who predicted less than $ 10 billion	Forecasters who predicted between $10 billion and $ 13 billion, inclusive	Forecasters who predicted more than $13 billion:
▪ Supply chain issues due to lockdowns should cause this figure to come in lower than expected. ▪ 2022 has seen less imports than last year in publicly-available data; given this trend, likely less than $10b.	**▪ 2021 was up to $12.2b, though the monthly data seems to be showing a decline.** ▪ Following past trends, the January and February data suggests these boundaries, given no change in export controls. ▪ Industries are in dire need of chips and will lobby for increased trade flow with China to meet demand.	**▪ Over the past month, we've seen an uptick in the strength of the Renminbi against the USD.** ▪ China is still extremely dependent on U.S./Taiwanese semiconductors, and there is little indication that this would change within the year. ▪ Although the Jan/Feb numbers might mark a change in trend, it's not compelling enough to see a 6% drop from 2021 levels.

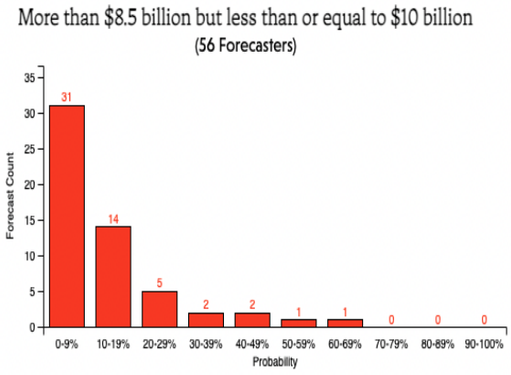
What will be the value, in dollars, of U.S. exports of semiconductor chips to China in 2022?

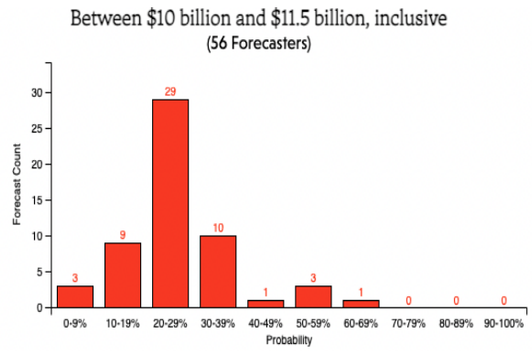
Consensus Trend

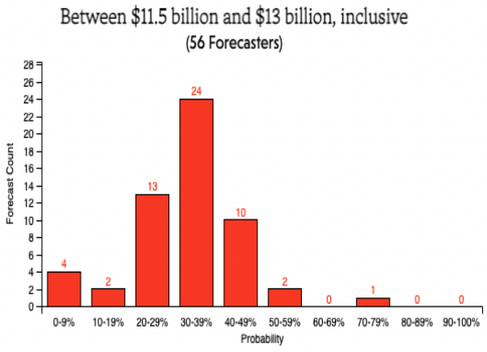


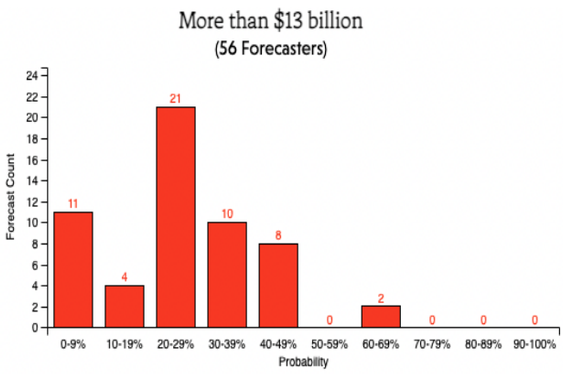
Forecast Distributions (See the most up-to-date distributions here.)











What will be the value, in dollars, of all Chinese imports of semiconductor chips in 2022?

The semiconductor manufacturing process has many components manufactured through complicated, highly globalized supply chains. Although China is building up its chip manufacturing capacity using imported SME, it is still reliant on imports for most of the semiconductor chips it consumes. China is especially reliant on the United States, Taiwan, and South Korea for imports of the most advanced semiconductor chips.

Based on 329 forecasts by 58 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Less than $320 billion	4%	3% (-1%)
More than $320 billion but less than or equal to $350 billion	7%	8% (+1%)
Between $350 billion and $380 billion, inclusive	20%	24% (+4%)
Between $380 billion and $410 billion, inclusive	32%	32% (Unchanged)
More than $410 billion	37%	33% (-4%)

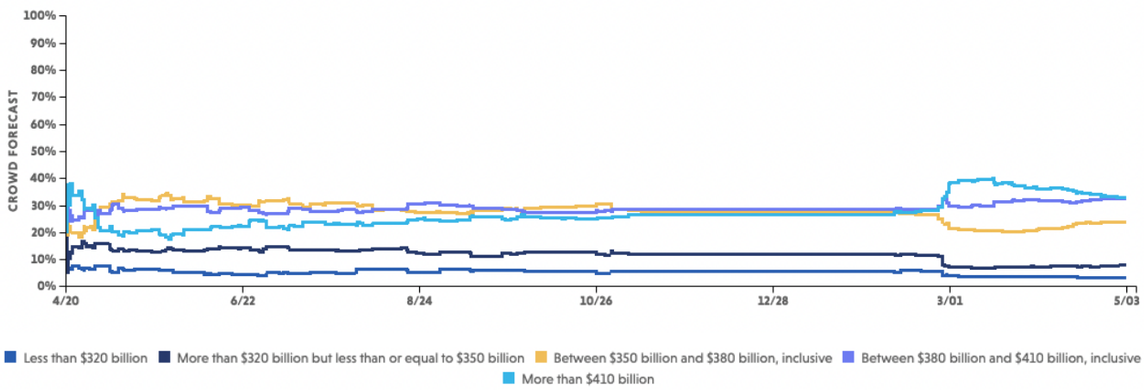
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

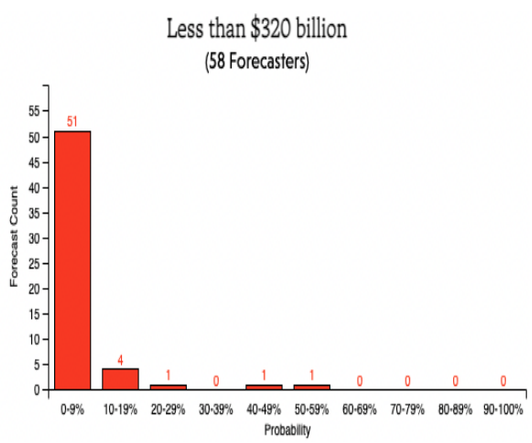
Forecasters who predict less than or equal to $350 billion:	Forecasters who predict between $350 billion and $410 billion, inclusive:	Foresters who predict more than $410 billion:
▪ **Geopolitical tensions and trade wars pose a significant risk to the total amount that China would be able to import this year.** ▪ COVID lockdowns in Shanghai will substantially limit the imports of China, including SMEs.	▪ **While the combination of COVID lockdowns and the war in Ukraine limit supply chains, the demand for SME will drive up imports significantly.** ▪ **China's economy may slow give the collision between Omicron and its zero Covid policy.** ▪ While the volume of trade is down, the value of integrated circuits in particular have risen dramatically and more than make up for the loss in quantity.	▪ **Volume is down, but costs are up. The 2020 data should be the floor. There is some chance inflation stunts growth, but unlikely.** ▪ **2020 figures are the floor.** ▪ Monthly imports so far in 2022 show a trend of imports higher than previous years, even when factoring in COVID and geopolitical issues.

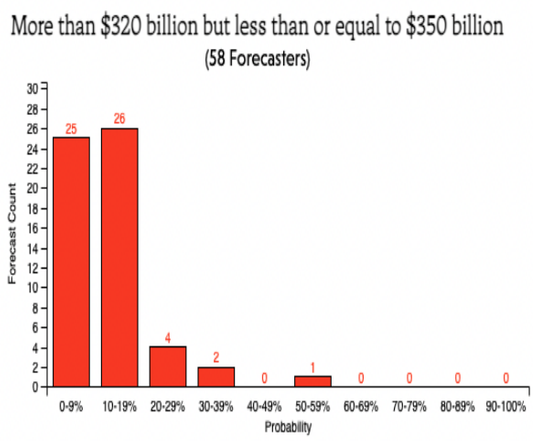
What will be the value, in dollars, of all Chinese imports of semiconductor chips in 2022?

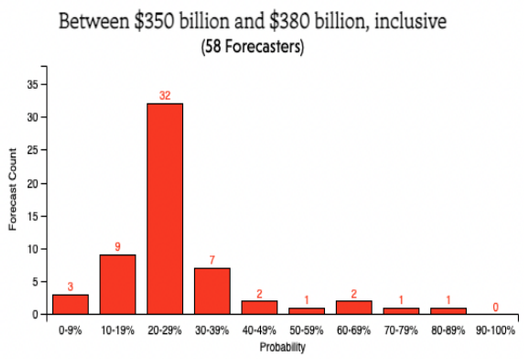
Consensus Trend

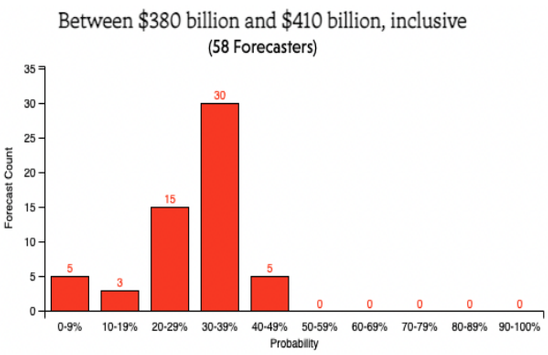


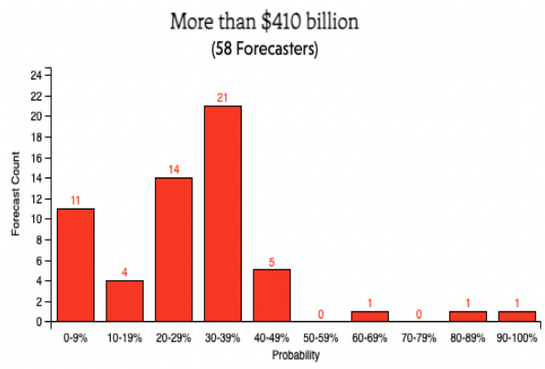
Forecast Distributions (See the most up-to-date distributions here.)











What will be the value, in dollars, of all Chinese imports of semiconductor manufacturing equipment in 2022?

The semiconductor manufacturing process has many components manufactured through complicated, highly globalized supply chains. China's ability to produce advanced semiconductor chips is particularly dependent on U.S., Japanese, and Dutch imports of advanced semiconductor manufacturing equipment (SME) -- the tools used by chip factories to make chips.

Based on 290 forecasts by 52 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3
Less than $25 billion	1%	1% (Unchanged)
More than $25 billion but less than or equal to $35 billion	14%	14% (Unchanged)
Between $35 billion and $45 billion, inclusive	39%	41% (+2%)
Between $45 billion and $55 billion, inclusive	33%	33% (Unchanged%)
More than $55 billion	13%	11% (-2%)

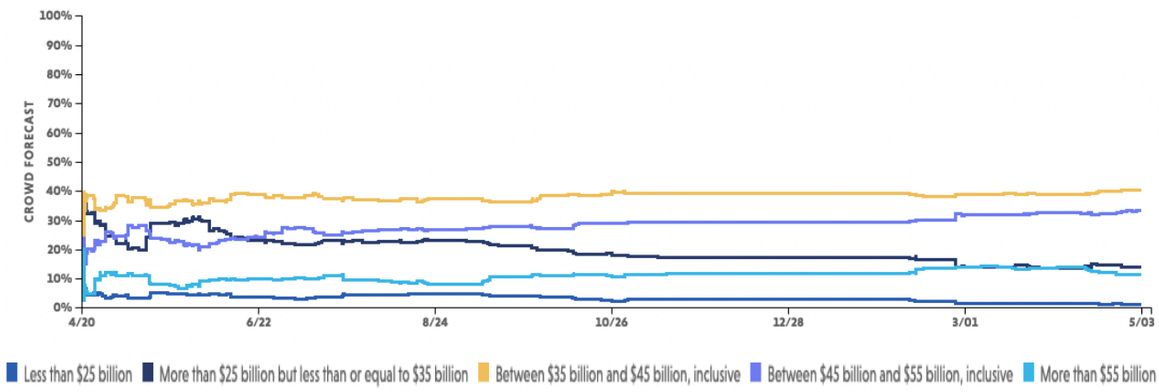
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Forecast Rationales made in the last 30 days

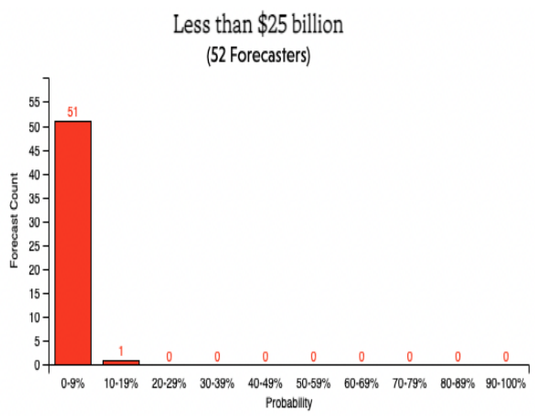
Forecasters who predict less than or equal to $35 billion:	Forecasters who predict between $35 billion and $55 billion, inclusive:	Foresters who predict more than $55 billion:
▪ **With companies shutting down due to the chip shortage, there is less of a need to import SME.** ▪ COVID, riots in Shanghai, and the poor performance of the Sinovac will lead to additional zero-COVID measures being placed on the population and thus stifle all business.	▪ **Problems with agriculture, general hardships due to the Omicron BA.2 variant, the poor performance of Sinovac, and its zero covid measures are all issues China has to currently deal with.** ▪ American policymakers could impose restrictions on valuable technology exports to China to prevent competition, but this does not prevent the rest of the world from exporting to China. ▪ China's plan to increase domestic chip production will decrease the need to import SME. ▪ Supply chains are being disrupted but at the same time, prices are increasing which would increase the value per purchase.	▪ Factoring in an upward trend and inflation, China is going to need to import significant numbers of SME to meet total demand. ▪ Demand is not going down, and inflation will continue to push these values up.

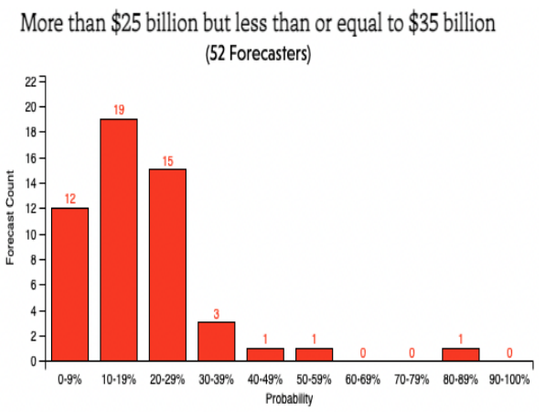
What will be the value, in dollars, of all Chinese imports of semiconductor manufacturing equipment in 2022?

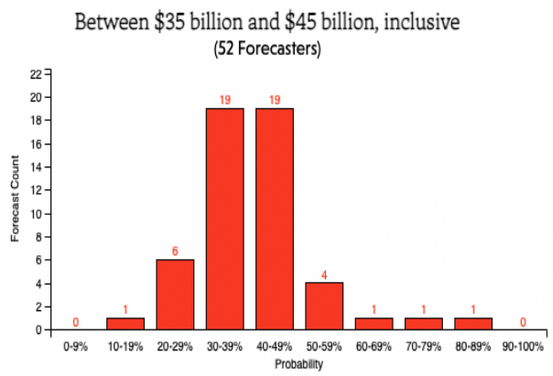
Consensus Trend

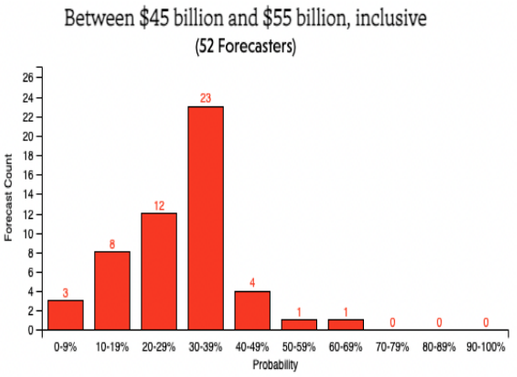


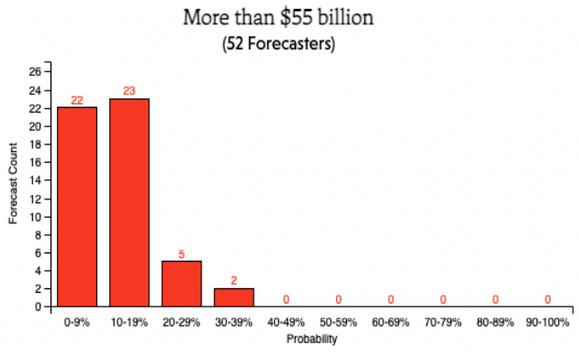
Forecast Distributions (See the most up-to-date distributions here.)











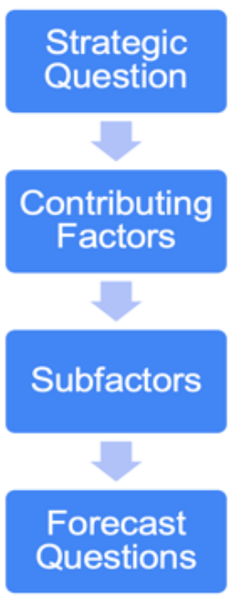
Appendix A - Methodology for Identifying Forecast Questions

INFER operates as a continuous, 4-step life-cycle between U.S. Government policymakers and a global community of forecasters who bring a diverse, informed perspective to their assessment of the future.

1. As initial input, policymakers work with INFER to identify *priority areas* (e.g. “AI competitiveness”) and *strategic questions* within those priority areas (e.g. “Will the U.S. regain its lead in microelectronics?”) where guidance, regulation, or clarification is needed to inform policy and strategy.
2. INFER draws on open source resources and subject matter experts to define what *contributing factors* will need to be understood to best inform the answer to the strategic question (e.g. “What will the future of domestic microelectronics manufacturing capabilities be?”). We call the process of identifying these pivotal factors “strategic question decomposition.”
3. Using those factors identified in the decomposition, we define signals or sign-posts that we can use to assess the outcome of that factor. From those signals, we author *forecast questions* that appear on our public crowdsourced forecasting platform at inferpublic.com (e.g. “Will the U.S. Congress pass tax credits to incentivize semiconductor manufacturing and design in 2022?”).
4. Based on the forecasts the crowd generates, INFER creates curated reports and automated dashboards to share with policymakers. Unlike a one-time survey, individuals are encouraged to update their forecasts over time so INFER can always create near real-time assessments of what will happen in the future.

Here’s a model of that strategic question decomposition process and terms we use to describe it:

- **Strategic questions** represent the broad categories we want to learn more about. Breaking down a strategic question is the main focus of a decomposition.
- **Contributing factors** are the primary drivers of the strategic question. They directly influence the outcome in one direction or another.
- **Sub-factors** are the individual elements that make up and influence a contributing factor. Depending on the size and scope of the strategic question, it may be possible to identify signals directly from the contributing factors without the need for sub-factors.
- **Signals** are specific metrics or events that tell us how a factor or sub-factor is trending, and that ultimately used to create **Forecast questions** we publish on INFER.



Once forecasts have been made, the decomposition model is used to synthesize and analyze data from individual forecasts and glean information about how a strategic question might trend. We call this **recomposition**—the process and product of combining forecasts together to provide insight into the strategic question. This final recomposition can take many forms, e.g., a dashboard, a summary report, or an index.

Decomposing our strategic question about microelectronics

Forecast questions are selected to provide coverage over the contributing factors and subfactors listed on page 3 , with an emphasis on questions that allow us to assess multiple factors or subfactors at once. In addition, U.S. strength in this arena cannot be assessed without an assessment of Taiwan, China, and other industry players. Taiwan is the current industry leader and China is a geopolitical competitor who is aggressively pursuing dominance in this area. Catching Taiwan and remaining ahead of China is key to achieving the U.S.'s strategic goal of reclaiming and retaining a two generation lead in microelectronics. As such, the set of forecast questions are designed to cover advances and setbacks in all three countries, across all three contributing factors.

The table below lists the forecast questions INFER has launched to assess our broader strategic question about regaining and retaining a two-generation lead in microelectronic technology.

Contributing Factor	Subfactor	Forecast Question
Government Investment	Strategy	How many Chinese Universities will be listed in QS World University Rankings' top 100 universities for computer science in 2023? What will be the value, in dollars, of U.S. exports of semiconductor manufacturing equipment to China in 2022? What will be the value, in dollars, of U.S. exports of semiconductor chips to China in 2022?
	Tax Credits	Will the U.S. Congress pass a tax credit for semiconductor manufacturing or design before 1 January 2023?
	Funding	Will the U.S. President sign legislation which appropriates funds for the Advanced Packaging Manufacturing Program in Fiscal Year 2022?
Manufacturing	Sales Targets	How will the percentage of SMIC revenue from 28 nm chips or smaller change over the next three years? Which company will be the largest semiconductor company by sales revenue in 2022?
	Production Targets	How many integrated circuit (IC) units will China produce in 2022? What will be the value, in dollars, of all Chinese imports of semiconductor chips in 2022?
	Development Targets	Of the following companies, which will start volume production on a 3nm chip or smaller before 17 September 2023? In 2022, will the Shanghai Micro Electronics Equipment Co. list a new lithography machine as an available product on its website?
	Sourcing	What will the price per ton of aluminum be on 1 June 2022?

	Fabrication Facilities	By 31 December 2022, will the Taiwan Semiconductor Manufacturing Company announce plans to build a semiconductor fab in Europe? What percentage of ASML's lithography sales will be to the United States in 2022? What will be the value, in dollars, of all Chinese imports of semiconductor manufacturing equipment in 2022?

Appendix B - Current Forecaster Pool Profile

Attributes of the forecasters who have responded to the forecast questions included in this report.

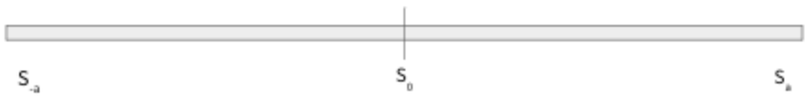
Gender	
Male	64%
Female	31%
Nonbinary, or prefer not to say	5%
Age	
18-24	24%
25-36	45%
37-60	27%
60 and older	3%
Country	
United States	54%
Canada, UK, European Union, AUS	25%
South East Asia	7%
Central and South America	13%
Other	1%
Education	
Graduate education (completed or have some)	65%
Undergraduate education (completed or have some)	35%
Degree Fields - choose all that apply	
Science, Engineering, or Technology	34%
Political Science, International Relations, International Business	34%
Foreign Service, Security, or Government	20%
Public Policy	19%
Public Administration, Business Administration	8%
Other	21%
Experience in Relevant Topics **1-Not at all familiar to 5-Very Familiar**	**Rated 4-5**
AI or machine learning	43%
U.S. policy on AI	22%
China policy on AI	16%
Advanced computing (supercomputers, quantum)	18%
Biotechnology	19%
Climate science	27%
Energy	27%
Forecasting and critical judgment	59%
Reasoning, decision making, and rationality	74%
Cognitive psychology	42%

Appendix C - Methodology for Slider Position

For each strategic question, three scenarios are defined:

- S_a: Scenario A
- S_{-a}: Scenario -A represents the opposite of Scenario A
- S_0: Scenario 0 represents perpetuation of the status quo.

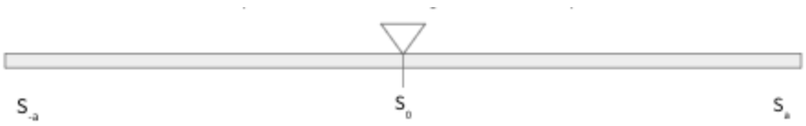
These three scenarios are represented on a horizontal axis, called the slider. This axis runs from -1 to 1, with 0 at the midpoint. The midpoint is labeled S_0, the endpoint at -1 is labeled S_{-a}, and the endpoint at 1 is labeled S_a.



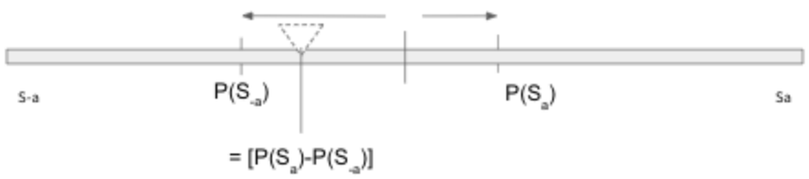
A set of forecasting questions is identified, and their answers are each associated with one of the scenarios S_a, S_{-a}, or S_0. We define the probability of a scenario S_x as the average of the probabilities of the set of outcomes associated with S_x. More formally, for a set of outcomes, O_{xi}, i=1, ...n

$$P(S_x) = \frac{\sum_{i=1}^{n} P(O_{xi})}{n}$$

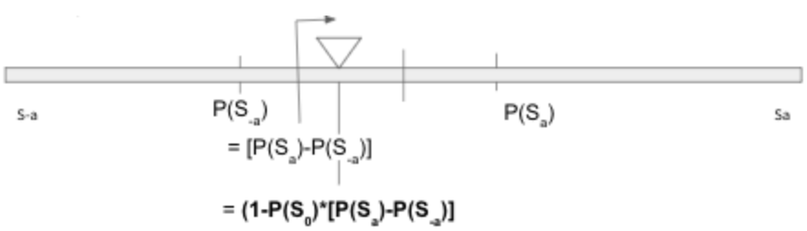
The ticker's position on the slider begins at the status quo, S_0.



The probabilities of S_a and S_{-a} move the ticker toward their respective end points, resulting in a net movement probability of $P(S_a)$-$P(S_{-a})$.



The probability of the status quo scenario, S_0, then moves the ticker back toward the status quo by multiplying the net movement probability by the probability that we depart from the status quo, $(1-P(S_0))$.



The final position of the ticker is thus represented by the following equation:

$$= (1 - P(S_0)) \times [P(S_a) - P(S_{-a})]$$

For the purposes of this report the scenarios are defined as follows:

- S_a: The U.S. regains a two generation lead in microchip technologies.
- S_{-a}: The U.S. falls further behind in microchip technologies.
- S_0: Status quo

The answers of the forecast questions included in this metric are assigned to the following scenarios.

Question	Answers	Associated Scenario
Will the U.S. Congress pass a tax credit for semiconductor manufacturing or design before 1 January 2023?*	Yes[25]	U.S. Regains Leadership
	No	Status quo
Will the U.S. President sign legislation which appropriates funds for the Advanced Packaging Manufacturing Program during FY'22?	Yes[26]	U.S. Regains Leadership
	No	Status Quo
By 31 December 2022, will the Taiwan Semiconductor Manufacturing Company announce plans to build a semiconductor fab in Europe?	Yes	U.S. Regains Leadership
	No	Status Quo
How many integrated circuit (IC) units will China produce in 2022?	300 billion or less than 300 billion[27]	U.S. Regains Leadership
	More than 300 billion, but less than 400 billion	Status Quo
	400 billion or more[28]	U.S. Falls Behind
How will the percentage of SMIC revenue from 28 nm chips or smaller	Less than 15% in H2 2022	Status Quo

[25] Combined answers of "Yes, for both manufacturing and design," "Yes, for only manufacturing," and "Yes, for only design."
[26] Combined answers of "More than $0 but less than $1 billion", "More than or equal to $1 billion but less than $2 billion", "More than or equal to $2 billion but less than $2.5 billion", and "More than or equal to $2.5 billion"
[27] Combined answers of "Less than $200 billion" and "$200 to $300 billion"
[28] Combined answers of "Between $400 billion and $500 billion" and "More than $500 billion"

change over the next three years?[29]	15% or more in H2 2022	US falls behind
Of the following companies, which will start volume production on a 3nm chip or smaller before 17 September 2023?	Intel	U.S. Regains Leadership
	Not Intel[30]	U.S. Falls Behind
Which company will be the largest semiconductor company by sales revenue in 2022?	Intel	U.S. Regains Leadership
	Samsung	Status Quo
	TSMC or Other[31]	U.S. Falls Behind
In 2022, will the Shanghai Micro Electronics Equipment Co. list a new lithography machine as an available product on its website?	Yes	U.S. Falls Behind
	No	Status Quo
How many Chinese Universities will be listed in QS World University Rankings' top 100 universities for computer science in 2023?[32]	Less than or equal to 5	US regains leadership
	6-7, inclusive	Status Quo
	8 or more	US falls behind
What percentage of ASML's lithography sales will be to the United States in 2022?[33]	Less than 5%	US falls behind
	5%-10% inclusive	Status Quo
	More than 10%[34]	US regains leadership
What will be the value, in dollars, of U.S. exports of semiconductor manufacturing equipment to China in 2022?	Less than 8 billion	US falls behind
	Between 7 billion and 8 billion, inclusive	Status Quo
	Less than 7 billion	US regains leadership
What will be the value, in dollars, of U.S. exports of semiconductor chips to China in 2022?	More than 13 billion	US falls behind
	Between 11.5 billion and 13 billion, inclusive	Status Quo

[29] This is a multi-time period question and includes predictions about SMIC revenue for 2022-2025. Slider calculations are based on predictions for H2 of 2022. Revenue in H1 of 2021 was 10.6%, up 3.7% from H1 of 2020. Based on this trend, we defined the status quo as SMIC generating less than 15% of its revenue from 28nm or smaller chips in 2022.
[30] 100%-P[Intel]
[31] Combined answers of, "TSMC (Taiwan Semiconductor Manufacturing Company)" and "Other"
[32] This question was released on 3/31/2022 so does not yet have sufficient data to be included in the slider calculations. It will be included in future reports.
[33] This question was released on 3/31/2022 so does not yet have sufficient data to be included in the slider calculations. It will be included in future reports.
[34] Combined answers for "Between 10-15%, inclusive" and "More than 15%"

	Less than 8.5 billion	US regains leadership
What will be the value, in dollars, of all Chinese imports of semiconductor chips in 2022?	Less than 350 billion	US falls behind
	Between 350 and 380 billion, inclusive	Status Quo
	More than 380 billion	US regains leadership
What will be the value, in dollars, of all Chinese imports of semiconductor manufacturing equipment in 2022?	More than 45 billion	US falls behind
	Between 35 billion and 45 billion, inclusive	Status Quo
	Less than 35 billion	US regains leadership