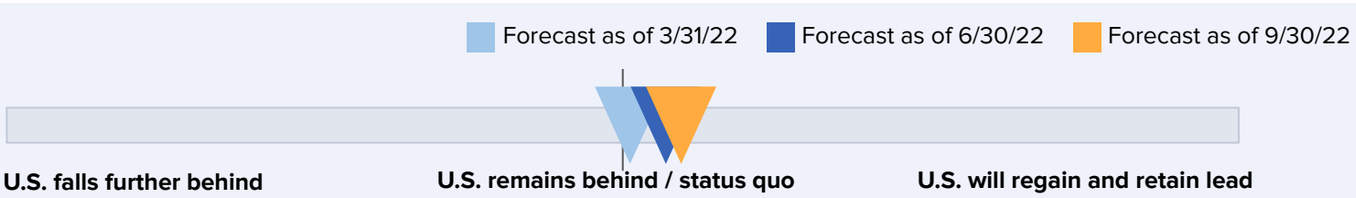
INFER July / August / September 2022 Update

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

Published 27 October 2022

July, August & September 2022 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

REPORT HIGHLIGHTS

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?

7% chance
Down 36% from 6/30/22

EXAMPLE RATIONALE SUPPORTING CURRENT FORECAST:
This would only happen once price stability returns to the markets, specifically European power prices. (@MCowley, 9/8/22)

See more details on Page 6

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

Company	Forecast (% chance)	Change since 6/30/22
Intel	25%	-8% ↓
Samsung	64%	+3% ↑
TSMC (Taiwan Semiconductor Manufacturing Company	11%	+5% ↓
Other	0%	0%

EXAMPLE RATIONALE SUPPORTING CURRENT FORECAST:
Samsung continues to post impressive profits; Intel's non-GAAP revenue was down 17%YoY this quarter as opposed to 1% in Q1. (@TrishBytes, 9/7/22)

See more details on Page 12

INCLUDED IN THIS REPORT

5,402
FORECASTS
by
1,130
FORECASTERS

75% of forecasters were INFER Pros

RECENCY
Good

65% forecasts made or updated in the last 90 days

Forecaster Location:	
USA	55%
Canada, UK, EU, AUS	23%
South East Asia	8%
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]

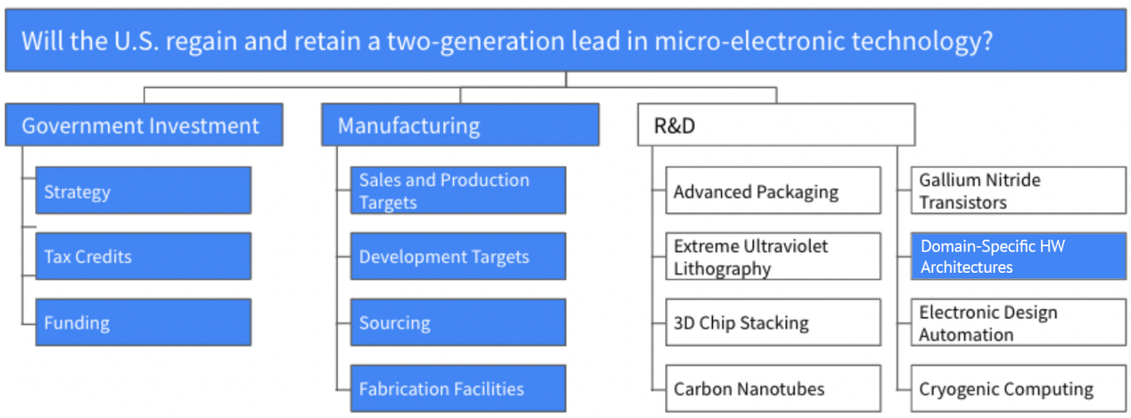
Today, the most advanced microchips in the world are made by Taiwan, showing how a lack of national prioritization and investment in microelectronics has caused the U.S. to lose its lead in microelectronic technology. Given such low integrated circuit production in the U.S., a vast majority is now sourced 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, starting in February 2022, 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 infer-pub.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

RESOLVED & CLOSED QUESTIONS

APPENDICES

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.[6] 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.[7] TSMC has announced plans to build fabs in the United States & Japan, and is considering whether to build one in Europe. [8]

Based on 405 forecasts by 84 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Yes	55%	52% (-3%)	43% (-9%)	7% (-36%)
No	45%	48% (+3%)	57% (+9%)	93% (36%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative 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:
▪ Intel made the announcement earlier this year, so it's certainly possible that Taiwan Semi could make it in the next few months. (@johnnycaffeine, 9/14/22) *	▪ There would be more buzz and rumors around if being considered. (@RyanBeck, 9/28/22) *
▪ Both Italy and Germany have been in talks with TSMC concerning the production of a new fab. (@michal_dubrawski, 8/21/22)	▪ Would only happen once price stability returns to markets - European power prices in particular - would a plan like this get looked at again. (@MCowley, 9/8/22) *
▪ Semiconductor availability is so constrained that they may announce a new fabrication facility to capitalize on high demand. (@mbbernstein, 7/31/22)	▪ The TMSC Chairman told annual shareholders that there are no concrete plans to build a fab in Europe. (@TrishBytes, 9/7/22) *

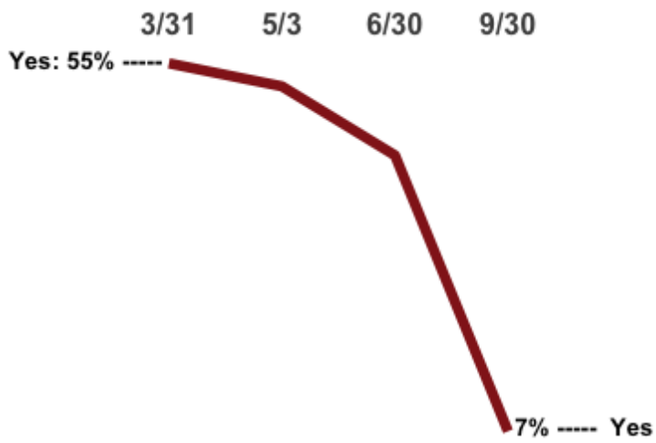
[6] https://www.cnbc.com/2021/03/16/2-charts-show-how-much-the-world-depends-on-taiwan-for-semiconductors.html

[7] 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/

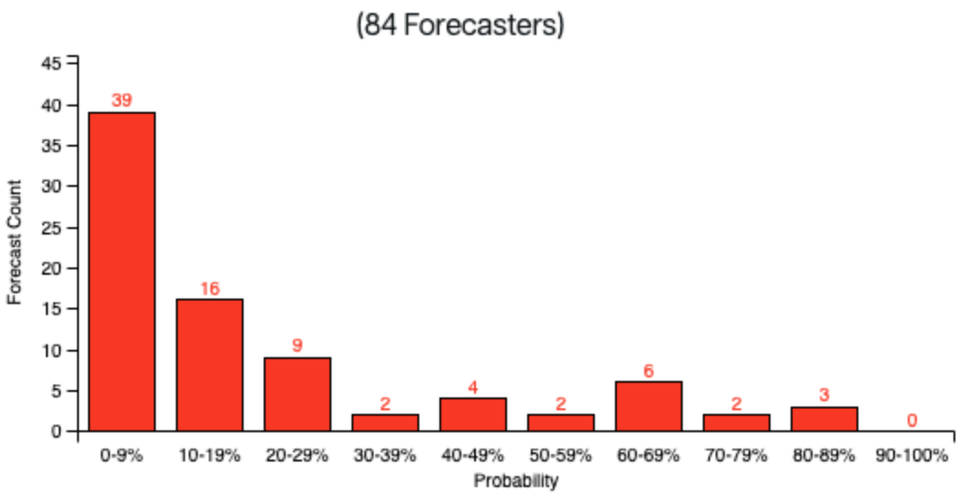
[8] https://www.bloomberg.com/news/articles/2021-12-11/tsmc-in-early-stage-contact-with-germany-about-potential-plant
https://www.cnbc.com/2022/02/11/eu-chips-act-europe-will-need-help-from-us-asia-to-achieve-goals.html

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

Consensus Trend (See the latest consensus trend here.)



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



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.[9]

Based on 302 forecasts by 60 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	NFER % Chance on 9/30
Less than 200 billion	1%	1% (0%)	1% (0%)	1% (0%)
More than or equal to 200 billion but less than 300 billion	4%	4% (0%)	6% (+2%)	2% (-4%)
More than or equal to 300 billion but less than 400 billion	23%	25% (+2%)	25% (+0%)	35% (+10%)
More than or equal to 400 billion but less than 500 billion	61%	62% (+1%)	61% (-1%)	56% (-5%)
More than or equal to 500 billion	11%	8% (-3%)	7% (-1%)	6% (-1%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative 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:
▪ Output this year has only gone as low as 25.9 billion/month and as high as 28.8billion/month, which gives a steady trend towards the 300-400 billion mark. (@qassiov, 9/18/22) *	▪ While current production is lower than expected, there is seasonal fluctuation in production and sales, as already shown by revenue increases in Q2. (@Samantha, 8/29/22)
▪ If production for the first seven months was only 198 billion due to Covid related factors, and those factors are still more-or-less still in effect, that should make us cautious about the probability the final total breaches the 400b mark. (@Hobbes, 9/7/22)	▪ China is actively seeking to become more self sufficient in this sphere. (@cmeinel, 7/25/22)
▪ Chip production decreased in July compared to the previous year. (@HS21, 8/19/22)	▪ Semiconductors production is a priority for national security and supply chain resilience in China. (@LPinheiro, 7/31/22)

[9] 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

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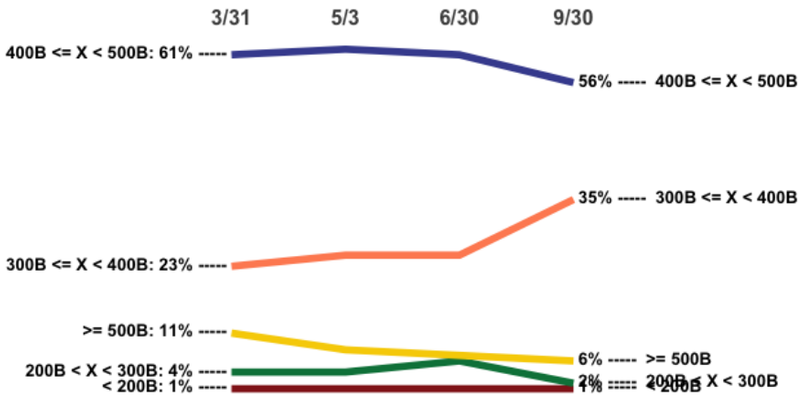

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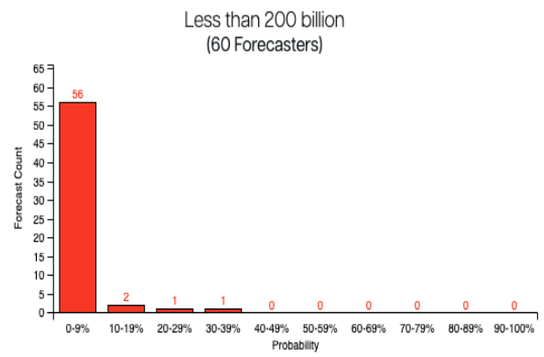
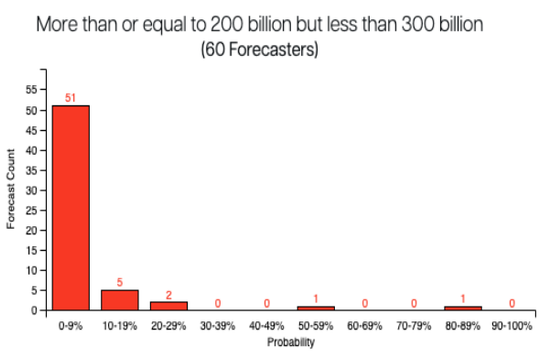
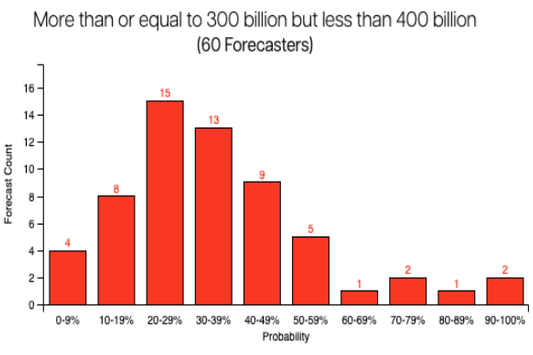
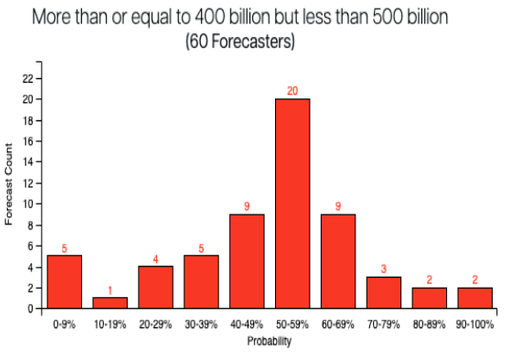
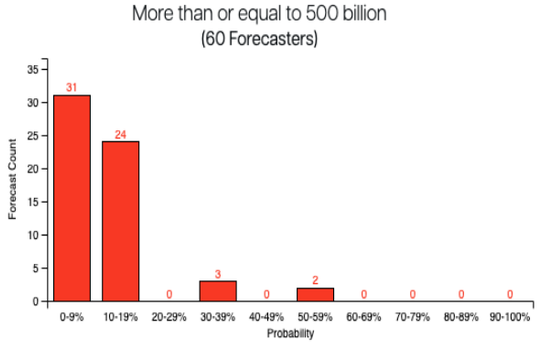










Of the following companies, which will start volume production on a 3nm chip or smaller before 17 September 2023?

Although the industry is accustomed to TSMC releasing new products every two years, TSMC's volume production of the 3nm chip is not expected to begin until the second half of 2022..[10] [11] Samsung has plans to roll out their 2nm design in 2025, but volume production of the 3nm chip was delayed from 2021 to 2022.[12] Intel's roadmap calls for them to overtake their competition by releasing a 1.8nm chip by 2024.[13]

Based on 273 forecasts by 57 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Intel	27%	29% (+2%)	32% (+3%)	35% (+3%)
Samsung	49%	69% (+20%)	81% (+12%)	84% (+3%)
TSMC (Taiwan Semiconductor Manufacturing Company)	64%	86% (+22%)	85% (-1%)	82% (-3%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

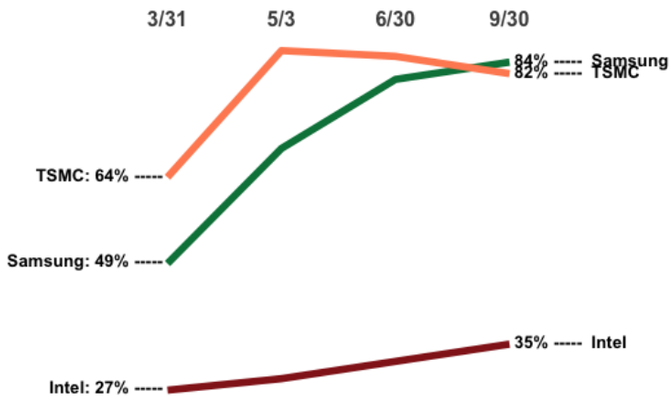
*** = Representative forecast rationales made in the last 30 days**

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. (@RyanBeck, 4/30/22) ▪ Intel has repeatedly proven themselves to adapt quickly to emerging markets, more so than the others. (@Carranza, 3/24/22) ▪ 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. (@MullenAustin, 3/18/22)	▪ TSMC and Samsung are set to become the only two entities producing 3nm chips globally. The chips will enable the development of integrated circuits that speed up the device performance without draining the battery. (@Pramila, 9/21/22) * ▪ While Samsung had to push back their target date to 2022, it shows that they are far along in the process of developing and producing this chip. (@Acordetti, 6/3/22) ▪ 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. (@o-maverick, 3/28/22)	▪ Samsung and TSMC have announced intentions to produce 3nm chip before the end of 2022. TSMC especially should be able to scale up for volume production by September 2023 to meet up with customer demand/expectation. (@mutallib, 8/25/22) ▪ Updating on TSMC based on recent news and upcoming M2 Pro chip which will be using TSMC 3nm process. (@heim, 8/25/22) ▪ TSMC has announced they will be ready to move its 3nm chip process to volume production in the second half of this year. (@Pramila, 5/21/22)

[10] https://www.anandtech.com/show/17013/tsmc-update-3nm-in-q1-2023-3nm-enhanced-in-2024-2nm-in-2025
[11] https://www.tsmc.com/english/dedicatedFoundry/technology/logic/l_3nm
[12] https://www.electronicdesign.com/technologies/embedded-revolution/article/21178098/electronic-design-samsung-foundry-delays-3nm-node-to-2022-2nm-due-by-2025
[13] 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 (See the latest consensus trend here.)



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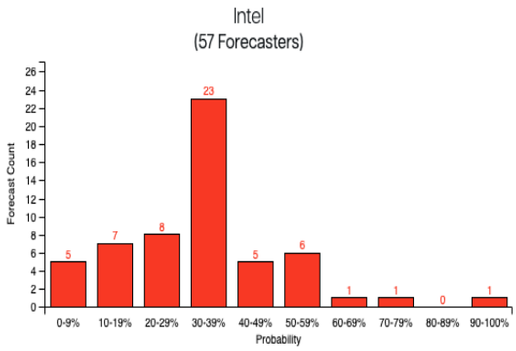
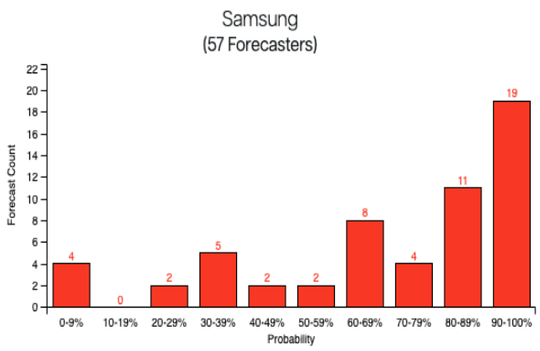
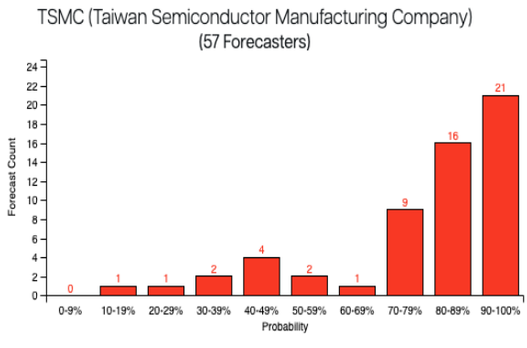






Which company will be the largest semiconductor company by sales revenue in 2022?

Despite an ongoing semiconductor shortage, worldwide semiconductor revenue rose to over $500 billion for the first time in 2021.[14] 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.[15]

Based on 341 forecasts by 80 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Intel	29%	34% (+5%)	33% (-1%)	25% (-8%)
Samsung	62%	58% (-4%)	61% (+3%)	64% (+3%)
TSMC (Taiwan Semiconductor Manufacturing Company)	9%	8% (-1%)	6% (-2%)	11% (+5%)
Other	0%	0% (0%)	0% (0%)	0%(0%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

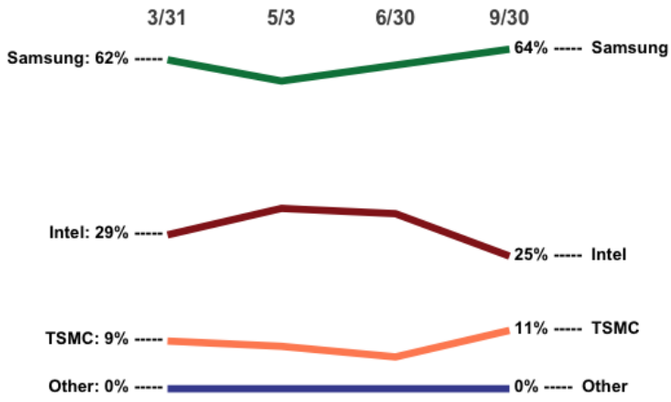
Intel:	Samsung:	TSMC:
▪ While Intel will be a recipient of significant funding, Apple's switch to Apple silicon poses an issue for Intel's bottom line. (@mbbernstein, 4/28/22) ▪ If Intel's foundries come online, it could bode extremely well for their production output. (@TrishBytes, 3/27/22) ▪ Intel will retake first place boosted by its planned $36 billion expansion of its European operations, including two fabs in Germany. (@geoffodlum, 3/23/22)	▪ Samsung looks most likely, but TSMC is getting very close. It could be a close call, and I might adjust my forecast for TSMC upwards later. They have a history of beating forecasts. (@belikewater, 10/5/22) * ▪ Samsung had the best YoY growth last year. (@thsavage, 6/28/22) ▪ Samsung's Q1 growth had the company's revenue rising 18% and the operating profit jumped 51% compared to Q1 2021. Semiconductors account for half of this profit. (@TrishBytes, 6/11/22) ▪ In 2021, Samsung was the leading semiconductor vendor with 75.95 billion U.S. dollars in revenue. (@Pramilla, 4/11/22)	▪ TSMC's Q1 revenue was up 36% year-over-year, thus closing the gap with Samsung and Intel. (@nonrival, 4/14/22) ▪ TSMC has been in talks with Apple about a bigger utilization of TSMC chips in new Apple products. (@olavo_sg, 3/31/22) ▪ Opening a new plant in the U.S., which could benefit them greatly. (@NickS, 3/26/22)

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

[15] 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 (See the latest consensus trend here.)



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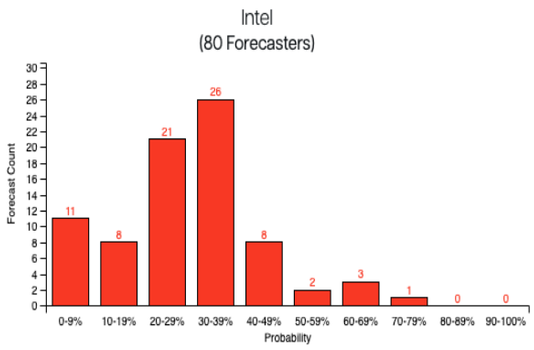

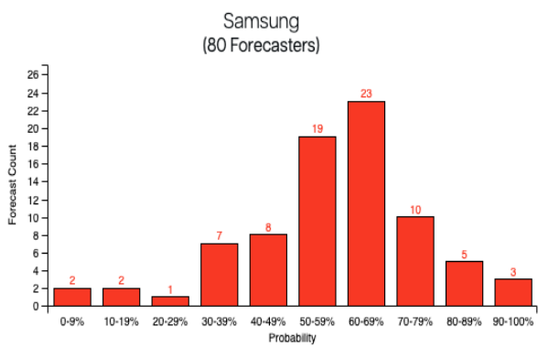

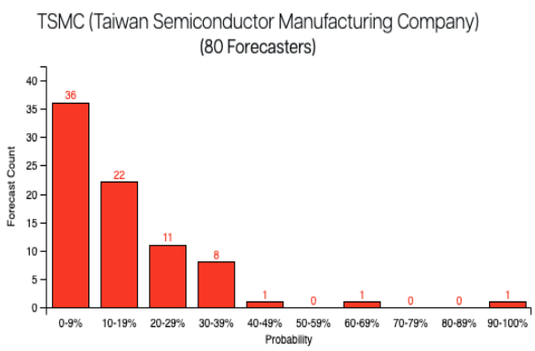

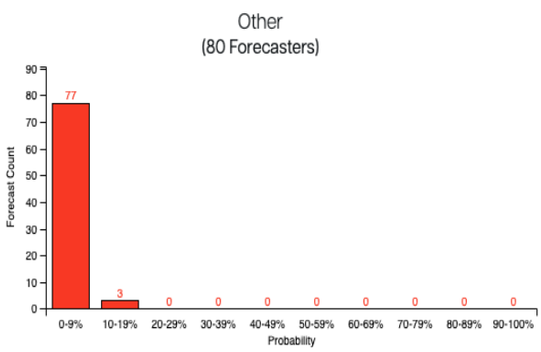

In 2022, will the Shanghai Micro Electronics Equipment Co. list a new lithography machine as an available product on its website?

Photolithography is a critical weakness of China's semiconductor industry.[16] Shanghai Micro Electronics Equipment Co (SMEE), the leading Chinese manufacturer, currently offers lithography equipment to support chips with 90nm nodes.[17] 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.[18]

Based on 244 forecasts by 58 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 4/17	INFER % Chance on 6/30	INFER % Chance on 9/30
Yes	18%	15% (-3%)	13% (-2%)	6% (-7%)
No	82%	85% (+3%)	87% (+2%)	94% (+7%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

Forecasters who gave it a 25% + chance:	Forecasters who gave it below a 25% chance:
▪ AMSL isn't completely out on doing business with China. It is plausible the AMSL may choose to support a machine domestically produced in China to avoid sanctions. (@TdHessLink, 9/24/22)*	▪ The industry has been seeing setbacks. I don't think they'll be ready soon although they're at 7nm. (@coastbylight, 9/30/22)*
▪ 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. (@Raan_Mend, 4/13/22)	▪ I think the current geopolitical and economic climate just isn't conducive to development and implementation. I think it will be unlikely in the short term to expect them to roll out a new lithography machine. (@gchalik, 8/27/22)
▪ SMEE has had new lithography machines planned to go into market by the end of 2021, so it's clear that this is a near-finished priority. (@JJMLP, 3/29/22)	▪ China's supply chain problems and overall economic health due to COVID would prevent innovation. (@cmeinel, 6/9/22)
▪ 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. (@Aadebamiwa77, 3/28/22)	▪ SMEE may face issues when it comes to importing parts after being listed as a "military end user" by the U.S government. (@MullenAustin, 3/18/22)
	▪ 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. (@mudikution, 3/21/22)

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

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

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

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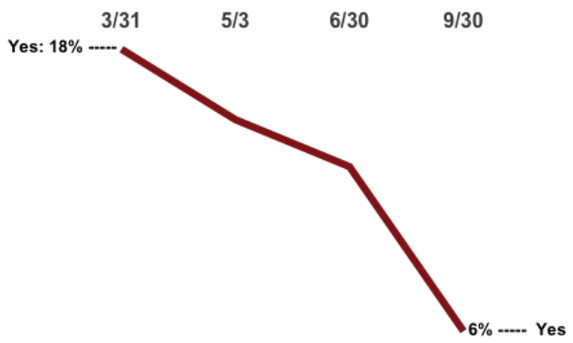
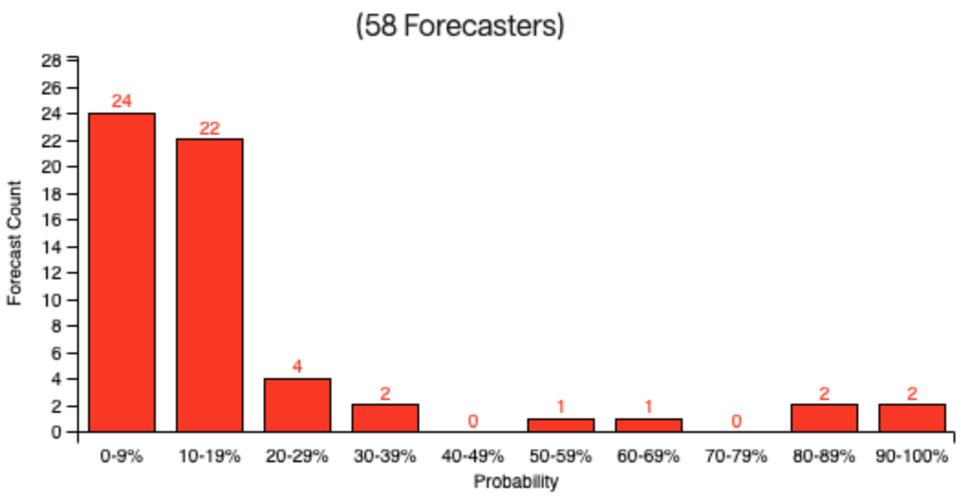
Consensus Trend (See the latest consensus trend here.)



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?

In the face of the semiconductor shortage, the U.S. is seeking to increase its chip manufacturing capabilities by developing domestic fabs.[19] Photolithography is a critical component of these fabrication facilities, and ASML is the world leader in that field.[20]

Based on 205 forecasts by 51 forecasters:

Possible Answer	INFER % Chance on 4/3	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Less than 5%	21%	15% (-6%)	17% (+2%)	9% (-8%)
More than or equal to 5% but less than 10%	49%	52% (+3%)	58% (+6%)	70% (+12%)
Between 10% and 15%, inclusive	22%	29% (+7%)	22% (-7%)	19% (-3%)
More than 15%	8%	4% (-4%)	3% (-1%)	2% (-1%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

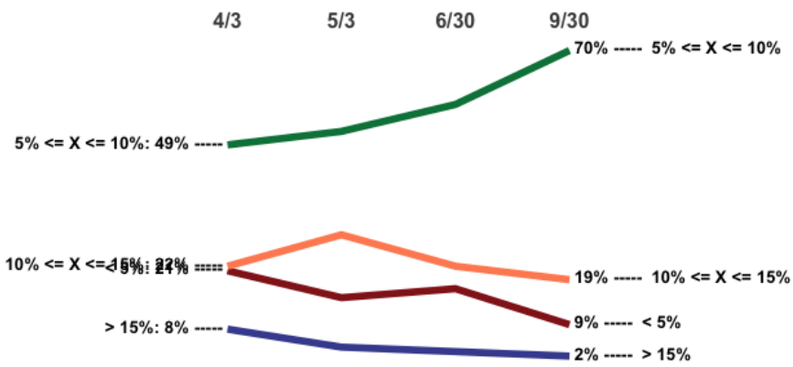
Forecasters who gave it less than 10% chance:	Forecasters who gave it 10% chance or higher:
▪ News of the ban on ASML sales to China came out in early July. Q2 numbers show Q1 Chinese sales shifted primarily to Taiwan and Japan. (@Samantha, 9/25/22)*	▪ The enactment of the CHIPS and Science Act gave the impetus for reshoring semiconductor production in U.S. over the medium and long term. (@zfishman, 10/3/22)*
▪ Leaning a bit into the 5-10% bucket, since that seems to be historically the most likely bucket & nothing seems to have happened this year to cause significant shift. (@ben, 9/25/22) *	▪ ASML Q4 2021 financial results shows that 2021 sales to U.S. were ~10%. (@sepeskoe, 5/29/22)
▪ In Q4 2021 sales were 5% & in Q1 2022 Sales were at 6%. Historically, percentage sales to the U.S. have been less than 10%. (@missag, 8/31/22)	▪ 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. (@agallant121, 4/22/22)
▪ Q1 2022 had 6% of total sales to the U.S., there would have to be a drastic increase from Q2-Q4 to boost the yearly average above 10%. (@ACordetti, 6/7/22)	▪ Politicians have been making these decisions and, in the U.S., this has been made a priority. (@btv, 4/1/22)
▪ Russia's export curbs due to the war could worsen the spply in the global chips market, due to Ukraine being one of the world's largest suppliers of noble gasses. (@cmeinel, 6/3/22)	

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

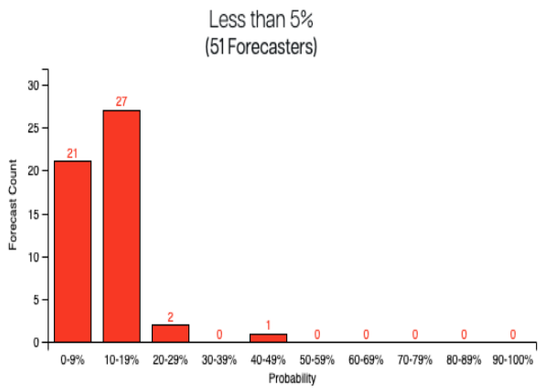
[20] https://fortune.com/2021/10/19/asml-chips-euv-silicon-valley-biden/

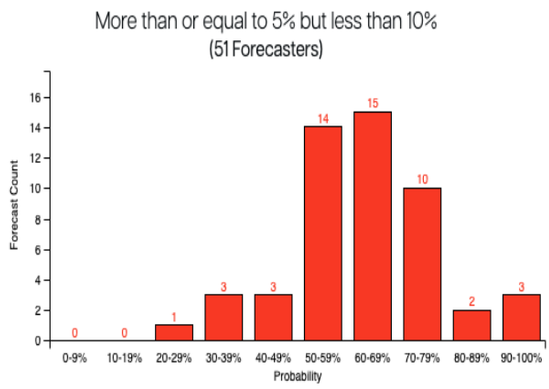
What percentage of ASML's lithography sales will be to the United States in 2022?

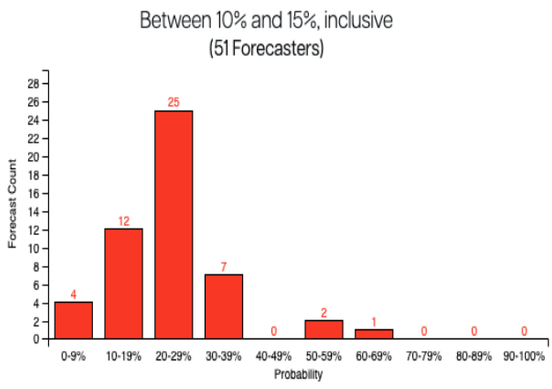
Consensus Trend (See the latest consensus trend here.)

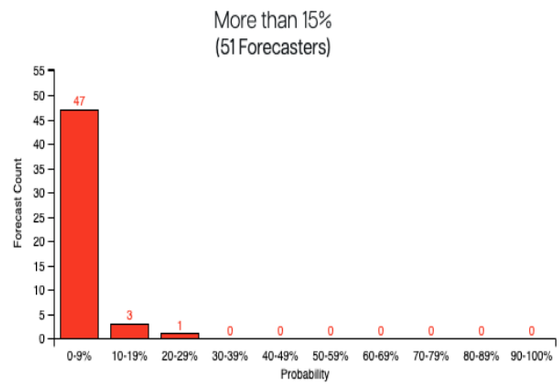


Forecast Distributions (See the most up-to-date distributions here.)









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

Rankings have been proven to significantly help maintain and build institutional position and reputation. Having an institution rank as highly as possible only improves the chances of falling into a prospective students shortlisting process. Also, rankings can be deemed as a reliable source to help encourage the collection and publication of reliable national data in higher education.[21]

Based on 246 forecasts by 71 forecasters:

Possible Answer	INFER % Chance on 4/3	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Less than or equal to 5	4%	3% (-1%)	4% (+1%)	4% (0%)
Between 6 and 7 inclusive	85%	91% (+6%)	91% (0%)	91% (0%)
More than or equal to 8	11%	6% (-5%)	5% (-1%)	5% (0%)

Summary of Forecaster Rationales (See Live Forecasts and Rationales)

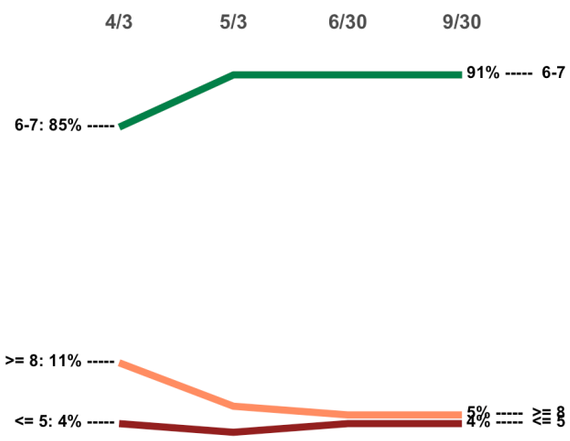
*** = Representative forecast rationales made in the last 30 days**

Less than or equal to 5:	Between 6 and 7 inclusive:	More than or equal to 8:
▪ The current number could decrease given the global uncertainty of the pandemic and the war in Ukraine. (@Yifan, 4/29/22) ▪ 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. (@BlancaElenaGG, 4/17/22)	▪ 6-7 is most plausible scenario as movements on the list usually are not rapid. (@Michalbod, 9/9/22) * ▪ It has been 6 in 2021 and 2022 will likely stay around same. (@sbk29, 8/31/22) ▪ Currently China (mainland) has 6 universities in the top 100 for computer science. The Chinese presence in the top 100 of universities has increased over the last years in all rankings. The universities that are currently in the top 100 of the mentioned ranking range between #15 and #86. I believe it is not very likely they will fall. (@LPinherio, 7/31/22) ▪ As of now, there are 6 Chinese Government universities in the top 100 rankings, with no. 6 being at #86 on the rankings. (@ACordetti, 6/8/22)	▪ Much of the rankings are based on academic reputation. As China is perceived as a greater industrial/academic power, its reputation will also increase. (@rithwik, 5/25/22) ▪ There was a large increase from 2020-2021 in comparison to 2019-2020. This could demonstrate a tendency that might be replicated by 2023. (@mariaaberaldo, 4/30/22) ▪ 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. (@geoffodlum, 3/31/22)

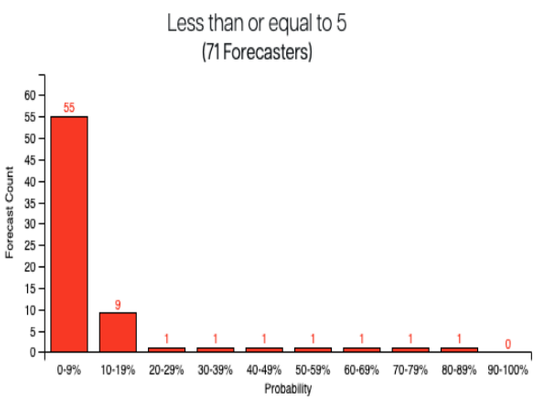
[21] https://www.qs.com/4-reasons-why-rankings-matter-in-higher-education/

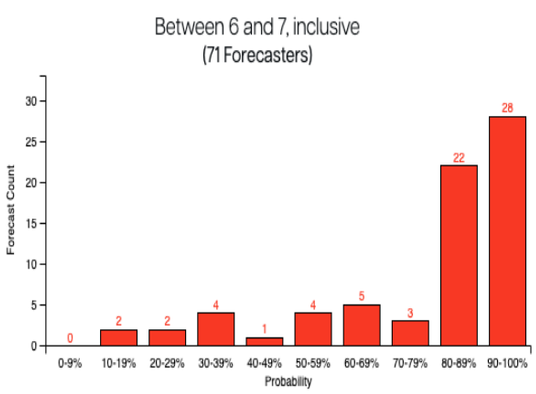
How many Chinese Universities will be listed in QS World University Rankings' top 100 universities for computer science in 2023?

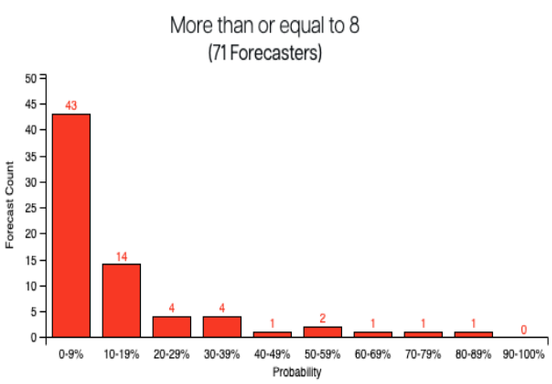
Consensus Trend (See the latest consensus trend here.)



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







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. Therefore, export controls on chips could reduce China's access to them. If China cannot import SME, it will remain dependent on imports for chips.

Based on 516 forecasts by 80 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Less than $5 billion	3%	2% (-1%)	2% (0%)	2% (0%)
More than $5 billion but less than or equal to $6 billion	13%	12% (-1%)	14% (+2%)	14% (0%)
Between $6 billion and $7 billion inclusive	38%	35% (-3%)	41% (+6%)	44%(+3%)
Between $7 billion and $8 billion inclusive	30%	33% (+3%)	30% (-3%)	29% (-1%)
More than $8 billion	16%	18% (+2%)	13% (-5%)	11%(-2%)

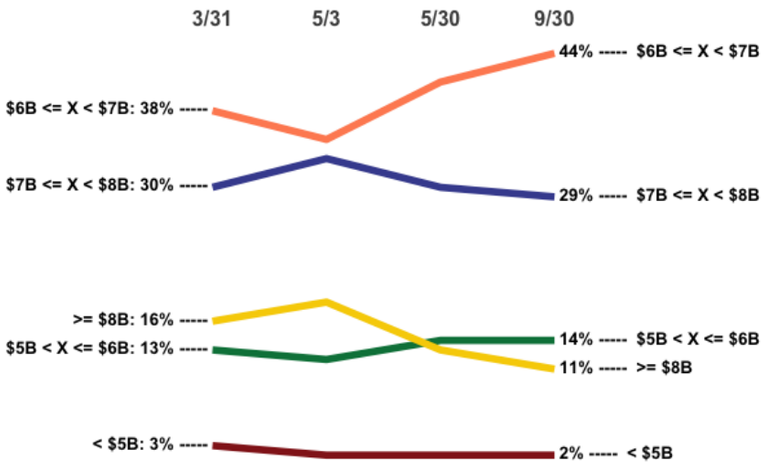
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

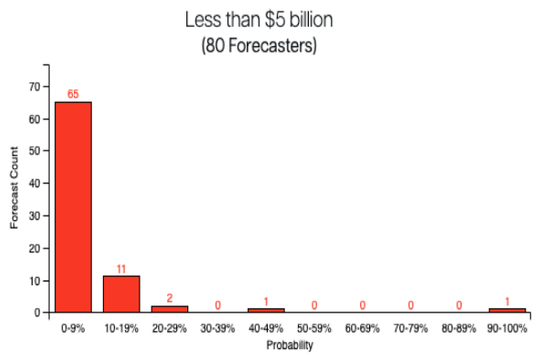
Forecasters who predicted less than $ 6 billion	Forecasters who predicted between $6 billion and $8 billion, inclusive	Forecasters who predicted more than $8 billion:
▪ By 2022, the technological blockade by the U.S. will become more evident to prevent China from advancing in Artificial Intelligence. (@NashellV1dales, 9/29/22)*	▪ Looks like in H1 it was $3.2 which gives 0,54 billion per month and I did not hear anything that would suggest that it plummeted in July, August or September so most probably we are already close. (@Michalbod, 9/9/22)*	▪ Inflation will drive this value higher than 2021, but how much higher will depend on shutdowns, supply chains, and so forth. I do not think that will be enough to drive this lower. (@cafebedouin, 4/24/22)
▪ The U.S. will seek to reverse the race for artificial intelligence that China intends to lead, trying to reduce exports of semiconductors. (@JorgeVillan, 9/27/22)*	▪ The numbers seem to be holding steady instead of plummeting from year-to-year like we've seen for chips exports. (@RyanBeck, 6/27/22)	▪ This is going higher in 2021; unless nationalistic fighting begins, why would it decrease in 2022. (@btv, 2/10/22)
▪ Continuing supply chain problems and economic weakness within China pose a big restriction on trade. (@cmeinel, 6/9/22)	▪ Underlying conditions, worsened by Covid lockdowns in Shanghai and elsewhere, are starting to feel more akin to a recession–something China hasn't experienced in decades. This would wipe out upward trends. (@mollygh, 5/30/22)	
▪ The U.S. is trying to limit the export of semiconductors, so it is no reasonable for it to increase by over 2 billion in the next year. (@aine, 5/21/21)		

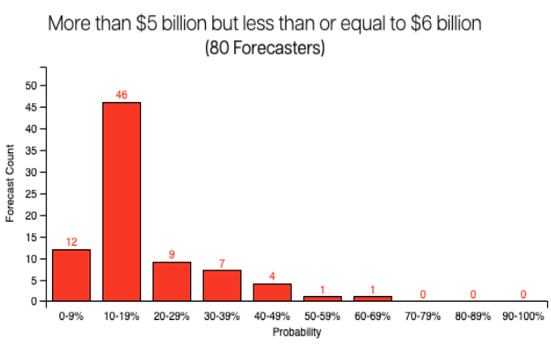
What will be the value, in dollars, of U.S. exports of semiconductor manufacturing equipment to China in 2022?

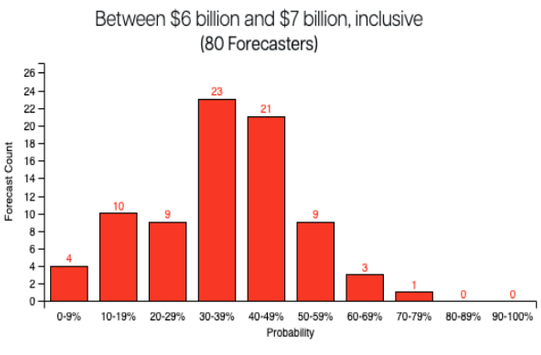
Consensus Trend (See the latest consensus trend here.)

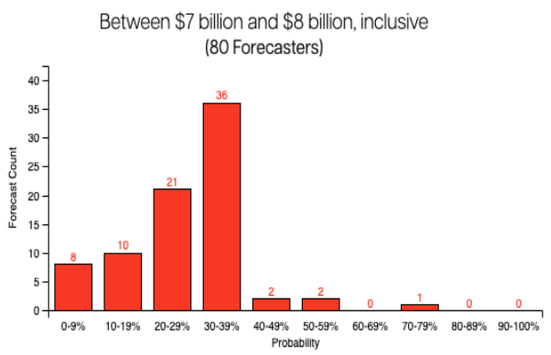


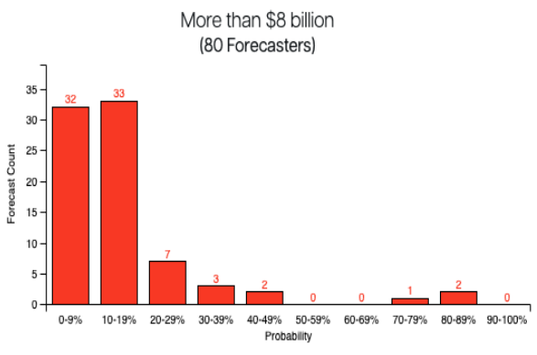
Forecast Distributions (See the most up-to-date distributions here.)











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 for imports of the most advanced semiconductor chips. Therefore, export controls on chips could reduce China's access to them. If China cannot import SME, it will remain dependent on imports for chips. This question focuses on semiconductor chips.

Based on 480 forecasts by 66 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Less than $8.5 billion	3%	3% (0%)	5% (+2%)	6% (+1%)
More than $8.5 billion but less than or equal to $10 billion	8%	10% (+2%)	16% (+6%)	28% (+12%)
Between $10 billion and $11.5 billion inclusive	20%	24% (+4%)	26% (+2%)	36% (+10%)
Between $11.5 billion and $13 billion inclusive	38%	36% (-2%)	31% (-5%)	20% (-11%)
More than $13 billion	31%	27% (-4%)	22% (-5%)	10% (-12%)

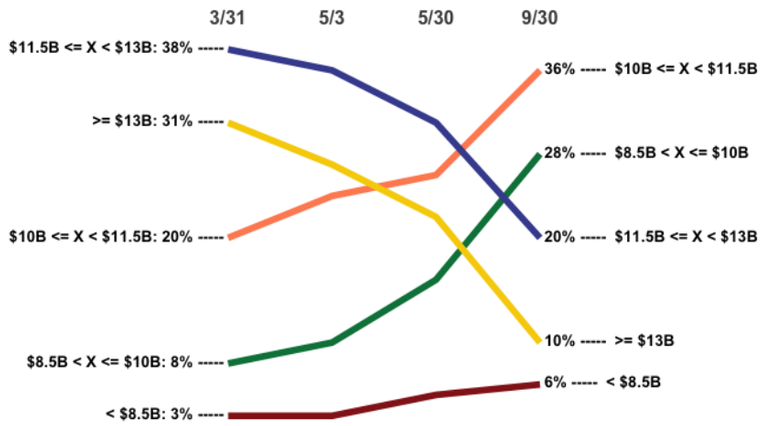
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

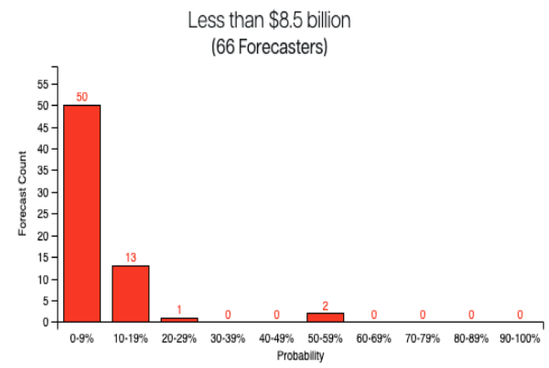
Forecasters who predicted less than $ 10 billion	Forecasters who predicted between $10 billion and $ 13 billion, inclusive	Forecasters who predicted more than $13 billion:
▪ We were exporting a lot of chips to them in recent years, so this could stand to fall quite a bit, but right now, the year is almost over, and the numbers from through june doubled yield 9.8ish. (@btv, 10/2/22)* ▪ Supply chain issues due to lockdowns should cause this figure to come in lower than expected. (@cmeinel, 6/9/22) ▪ Demand from downstream sectors such as smartphones, consumer products and personal computers has, to quote the CEO of SMIC, "dropped like a rock." (@DKC, 5/16/22)	▪ With the National Party Congress coming up, my feel is there will be a period of easing back of the "tough guy" position Xi has adopted on Covid and trade (not in a huge way) but enough to see the average $800M exceeded for the last few months of the year. (@McCowley, 9/22/22)* ▪ It was 4.92 Billion in first 6 months which if kept would point towards B/C anything else would require significant acceleration or decline. (@Michalbod, 9/9/22)* ▪ The 6 month rolling average is now 838 million, which would put it just over 10 billion if it stayed at that level for the year. (@RyanBeck, 6/27/22)	▪ 2021 Data is $12.2B – when accounting for YoY increases, the result is more than $13B. (@Jim, 5/3/22) ▪ China is still extremely dependent on U.S./Taiwanese semiconductors, and there is little indication that this would change within the year. (@coastbylight, 4/21/22) ▪ The lack of chips in several different industries will greatly encourage the trade of semiconductor chips. (@000, 4/3/22)

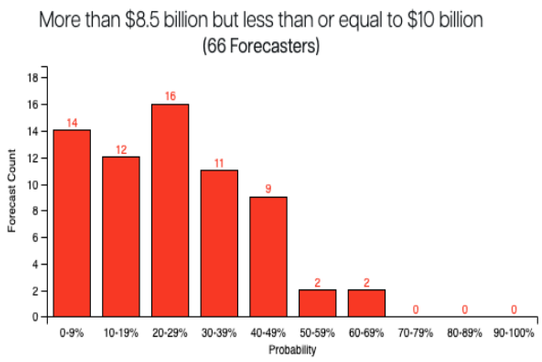
What will be the value, in dollars, of U.S. exports of semiconductor chips to China in 2022?

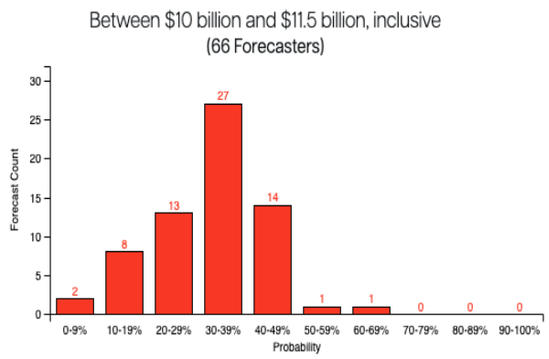
Consensus Trend (See the latest consensus trend here.)

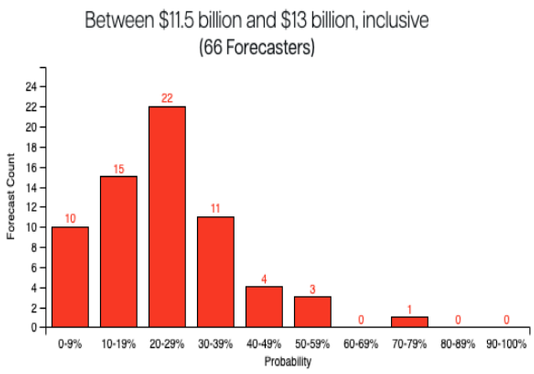


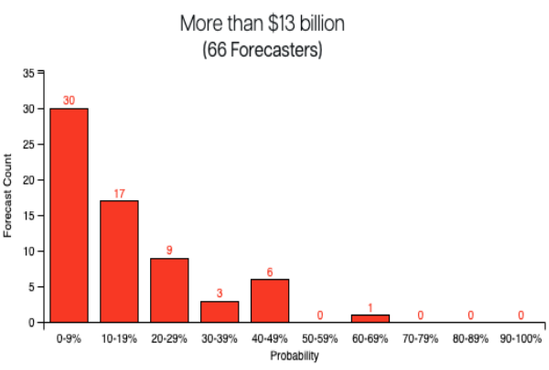
Forecast Distributions (See the most up-to-date distributions here.)











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. Therefore, export controls on chips could reduce China's access to them. If China cannot import SME, it will remain dependent on imports for chips. This question focuses on semiconductor chips.

Based on 502 forecasts by 64 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Less than $320 billion	4%	3% (-1%)	2% (-1%)	1% (-2%)
More than $320 billion but less than or equal to $350 billion	7%	8% (+1%)	6% (-2%)	4% (-2%)
Between $350 billion and $380 billion, inclusive	20%	24% (+4%)	23% (-1%)	24% (1%)
Between $380 billion and $410 billion, inclusive	32%	32% (0%)	34% (+2%)	37% (+3%)
More than $410 billion	37%	33% (-4%)	35% (+2%)	34% (-1%)

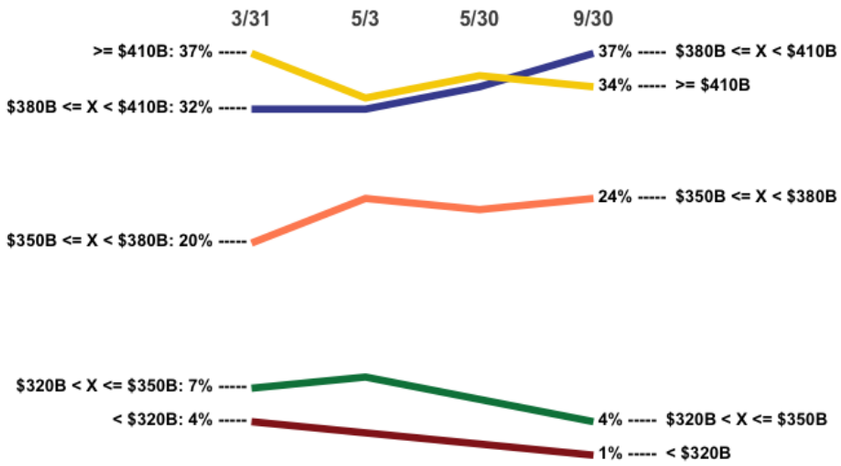
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

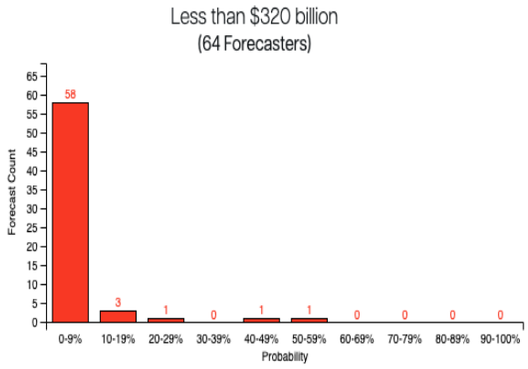
Forecasters who predict less than or equal to $350 billion:	Forecasters who predict between $350 billion and $410 billion, inclusive:	Foresters who predict more than $410 billion:
▪ Geopolitical tensions and trade wars pose a significant risk to the total amount that China would be able to import this year. (@mudiku, 4/17/22) ▪ COVID lockdowns and riots in Shanghai will substantially limit the imports of China, including SMEs. (@cmeinel, 4/9/22)	▪ Based on numbers - Q1 was ~$107B. Comtrade data to date. Assuming this will be the highest quarter of the year, it would seem unlikely the number will be above $410B. (@McCowley, 9/30/22) * ▪ The value of China's chip imports from January to August this year rose 2.6 % to U.S. $277 billion, up from U.S. $270 billion in the same period last year, signifying that the country is buying more expensive IC products. (@DKC, 9/11/22) * ▪ While the combination of COVID lockdowns and the war in Ukraine limit supply chains, the demand for SME will drive up imports significantly. (@DKC, 5/16/22)	▪ 2021 data shows $433.7 billion for the year, putting the the most recent year into the top bucket. Unlikely to see change. (@RyanBeck, 6/2/22) ▪ Monthly imports so far in 2022 show a trend of imports higher than previous years, even when factoring in COVID and geopolitical issues. (@MullenAustin, 3/10/22)

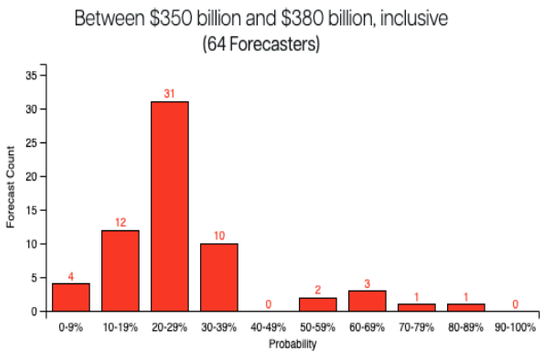
What will be the value, in dollars, of all Chinese imports of semiconductor chips in 2022?

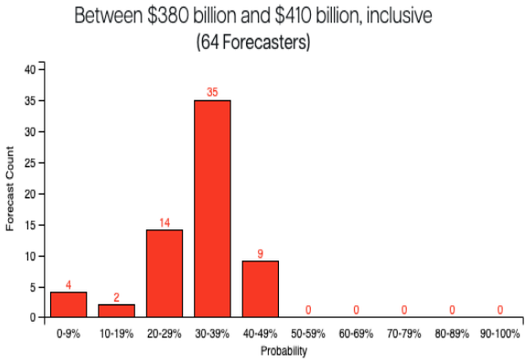
Consensus Trend (See the latest consensus trend here.)

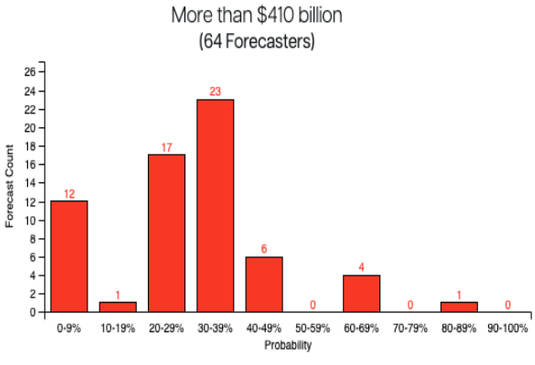


Forecast Distributions (See the most up-to-date distributions here.)









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 SME -- i.e., the tools used by chip factories to make chips. 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. Therefore, export controls on chips could reduce China's access to them. If China cannot import SME, it will remain dependent on imports for chips. This question focuses on SME. The United States is considering a number of actions that would reduce the export of SME to China as well.

Based on 458 forecasts by 59 forecasters:

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 9/30
Less than $25 billion	1%	1% (0%)	1% (0%)	1% (0%)
More than $25 billion but less than or equal to $35 billion	14%	14% (0%)	17% (+3%)	19% (+2%)
Between $35 billion and $45 billion, inclusive	39%	41% (+2%)	41% (0%)	45% (+4%)
Between $45 billion and $55 billion, inclusive	33%	33% (0%)	32% (-1%)	28% (-4%)
More than $55 billion	13%	11% (-2%)	9% (-2%)	7% (-2%)

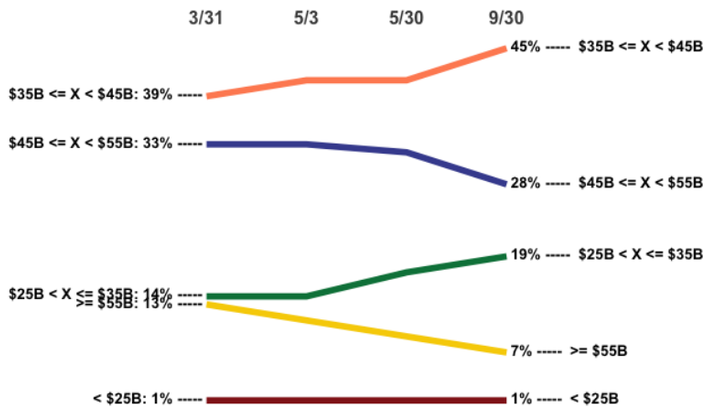
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

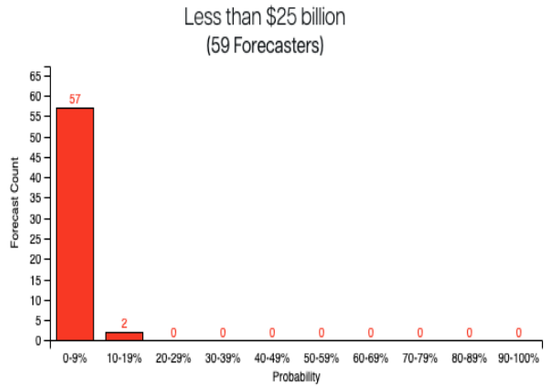
Forecasters who predict less than or equal to $35 billion:	Forecasters who predict between $35 billion and $55 billion, inclusive:	Foresters who predict more than $55 billion:
▪ COVID, riots in Shanghai, and the poor performance of the Sinovac will lead to additional zero-COVID measures being placed on the population and thus stifle all business. (@cmeinel, 6/9/22) ▪ With companies shutting down due to the chip shortage, there is less of a need to import SME. (@000, 4/3/22)	▪ Moving slightly more to the mid and low buckets based on restrictions of U.S. exports to China and general decline in economic outlook. (@fionack, 10/10/22) * ▪ By my reading of the current comtrade data is there was $11.6B worth of imports in Q1 of 2022. There's likely to be a slowdown in the numbers for Q2, but this still appears on track to clear $35B. (@Mcowley, 9/19/22) * ▪ China's chip industry is growing after U.S. sanctions on local champions from Huawei Technologies Co. to Hikvision spurred appetite for home-grown components. (@DKC, 6/23/22)	▪ Factoring in an upward trend and inflation, China is going to need to import significant numbers of SME to meet total demand. (@cafebedouin, 4/24/22) ▪ Demand is not going down, and inflation will continue to push these values up. (@fh, 7/5/21)

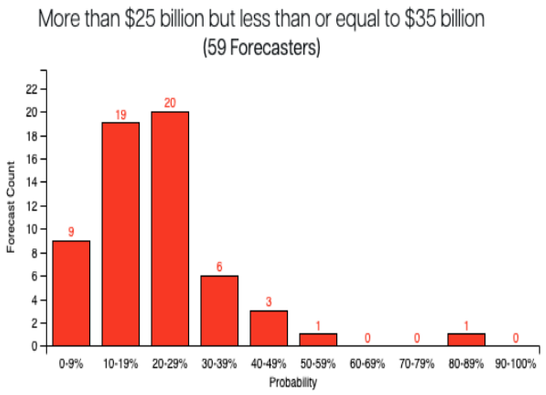
What will be the value, in dollars, of all Chinese imports of semiconductor manufacturing equipment in 2022?

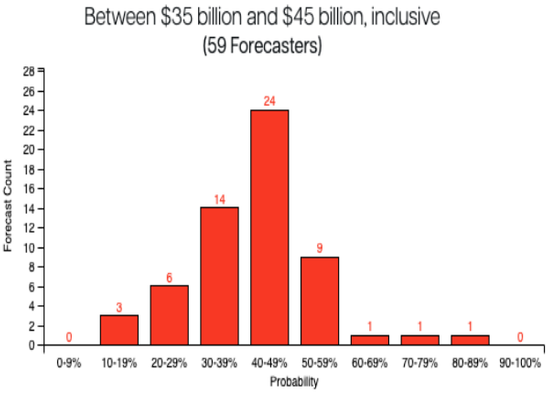
Consensus Trend (See the latest consensus trend here.)

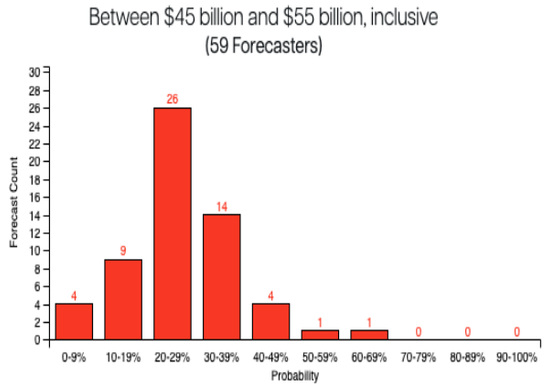


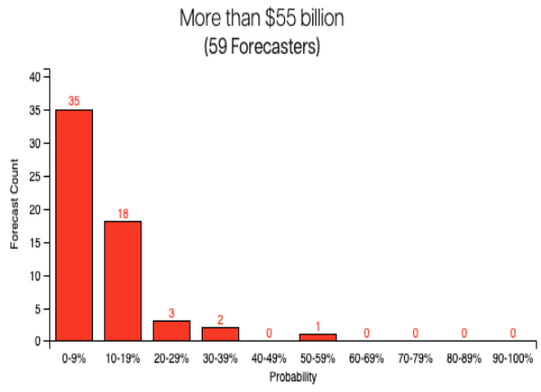
Forecast Distributions (See the most up-to-date distributions here.)











Will Google score more wins than any other submitter in the next round of the MLPerf training benchmarking suite?

MLCommons hosts MLPerf, a set of biannual benchmarking competitions to assess how fast different machine learning programs are at various tasks including image classification, object detection, speech recognition, and natural language processing (MLCommons, EnterpriseAI). Google has been using MLPerf to test the speed of its Tensor Processing Unit, an application-specific integrated circuit (ASIC) designed to accelerate AI applications (Google Cloud). In the June 2022 (v2.0) round, Google scored 5 wins. NVIDIA scored the second most wins with 3.

Based on 42 forecasts by 21 forecasters:

Possible Answer	INFER % Chance on 9/30
Yes	23%
No	77%

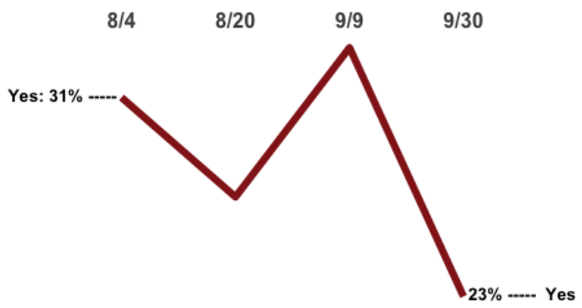
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

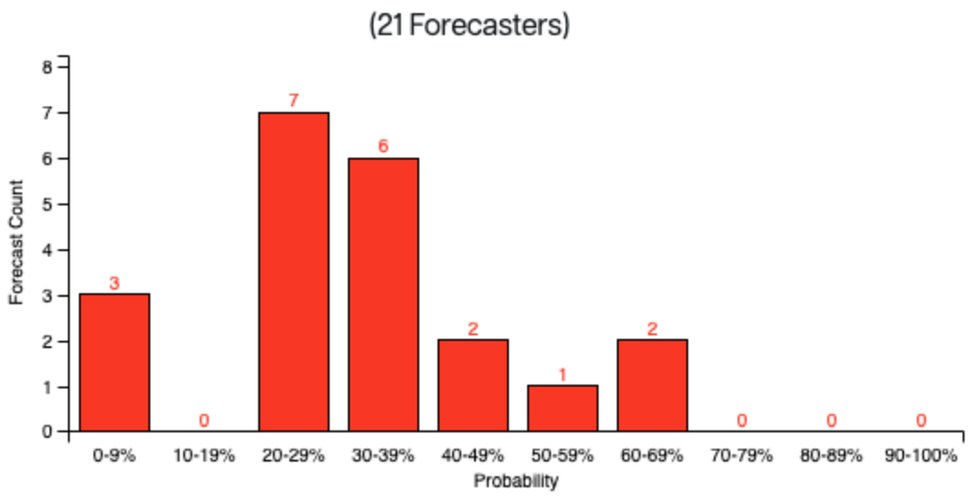
Yes:	No:
▪ In June 2022, Google scored 5 points, and NVIDIA, who got second place, just scored 3. The difference between them is vast, so for the next round, it can be said that Google will try to do it even better. (@Mauricio_B, 9/24/22)* ▪ Given that google is a leader in machine learning, and according to the data it appears that google has had significantly faster times than a lot of the submitters, I think it is likely that they will have the most victories again. Additionally, since they have two more victories than the next highest winner, they have a more comfortable margin of victory. (@ACordetti, 8/20/22)	▪ Boils down to Google vs NVIDIA probably. I'd guess that it hinges on Google releasing new hardware, such as the TPUv5. I don't expect that to be the case. (@heim, 9/28/22)* ▪ I do not think that Google will take part in 2.1 also Nvidia results for their new set are impressive and were released just before competition. (@Michalbod, 9/9/22)* ▪ Google has generally focused on quality over quantity, whereas Nvidia has flooded the competition with lots of entries every time. In the round before the most recent one, Google didn't submit any entries, but in all other rounds, it submitted 0.19x to 0.35x as many entries as Nvidia. (@belikewater, 8/25/22)

Will Google score more wins than any other submitter in the next round of the MLPerf training benchmarking suite?

Consensus Trend (See the latest consensus trend here.)



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



How many total unique AI systems will Baidu and Alibaba submit for the next round of the MLPerf benchmarking suite?

The MLPerf Benchmarking suite measures how fast systems can train models to a target quality metric. MLPerf has emerged as an industry standard for companies to publicly show how fast their hardware has become for solving machine learning problems. Here is a short summary of the current benchmarks and metrics with a detailed description of the motivation and guiding principles behind the benchmark suite.

Based on 43 forecasts by 20 forecasters:

Possible Answer	INFER % Chance on 9/30
Less than or equal to 4	34%
Between 5 and 9, inclusive	55%
More than or equal to 10	11%

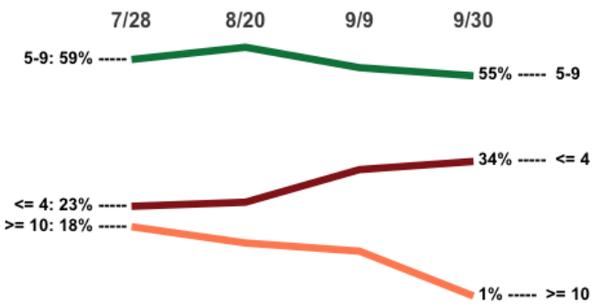
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

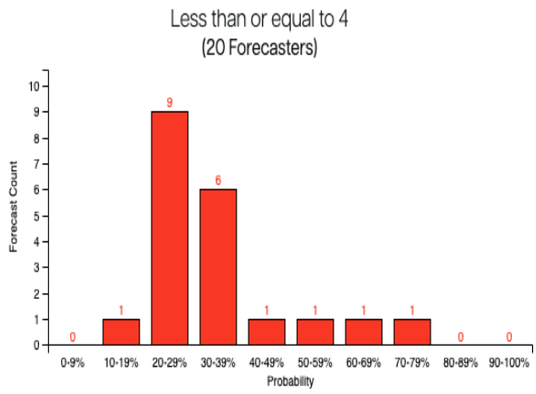
Less than or equal to 4:	Between 5 and 9, inclusive
▪ I do not think that Alibaba nor Baidu will submit many systems in situation where are unlikely to win. And I believe it is not time for them yet to win. (@Michalbod, 9/9/22)*	▪ With the increasing number of benchmark suites, companies will likely make more submission. (@JJMLP, 9/4/22)* ▪ Baseline of 4 from the previous year, and a growth rate from Baidu. I find it likely that in the competitive environment of today Baidu/Alibaba will submit more than in previous years. (@NickS, 8/31/22) ▪ I'm expecting Baidu and Alibaba to submit more system than the last time, given the recent influx and interested in AI systems. (@heim, 7/31/22)

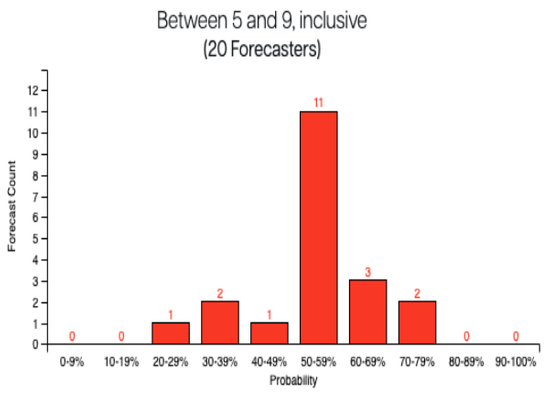
How many total unique AI systems will Baidu and Alibaba submit for the next round of the MLPerf benchmarking suite?

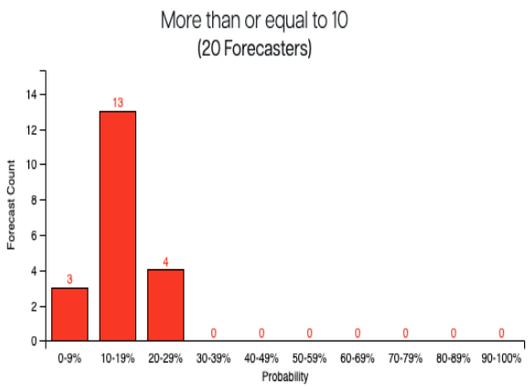
Consensus Trend (See the latest consensus trend here.)



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







Will the price per chip-hour of Google's cloud-based Tensor Processing Unit (TPU v4) be greater than $3.22 on January 1, 2023?

Google's tensor processing units (TPUs) are AI hardware accelerators that have led to dramatic improvements in training large machine learning models based on neural networks. Google began using TPUs internally in 2015, and in 2018 made them available for third party use, both as part of its cloud infrastructure and by offering a smaller version of the chip for sale (Wikipedia). While per-unit costs of cloud computing services tend to fall over time, analysts are concerned that the current geopolitical and economic environment could mean that this is due for a correction in the near future (S&P Global).

Based on 53 forecasts by 29 forecasters:

Possible Answer	INFER % Chance on 9/30
Yes	4%
No	96%

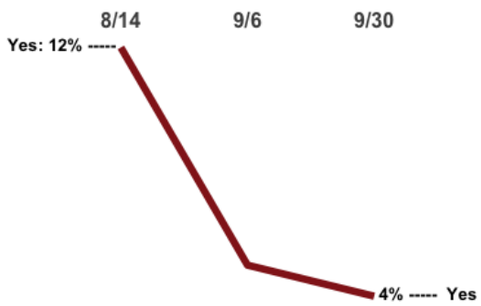
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

Bold = Representative forecast rationales made in the last 30 days

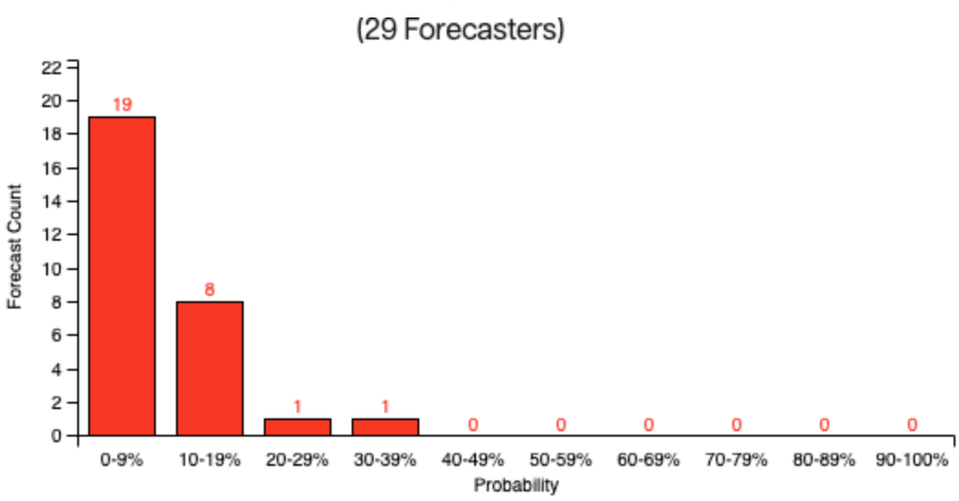
Yes:	No:
▪ Inflation increasing overall costs. (@mbbernstein, 9/28/22) *	▪ I see low possibility of rising price as Google did not have policy of rising it in the past; Also, timeframe is quite short now. It would be an unprecedented move in a competitive market. (@michalbod, 9/9/22) * ▪ The main factor being possible demand spikes, but the likelihood of a large enough demand spike to cause a price change is perhaps still quite low. (@efosong, 9/5/22) * ▪ The importance of price stability and competitiveness. Also energy does not seem to be a concern for Google's infrastructure. (@paul_rowan, 9/1/22) *

Will the price per chip-hour of Google's cloud-based Tensor Processing Unit (TPU v4) be greater than $3.22 on January 1, 2023?

Consensus Trend (See the latest consensus trend here.)



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



Which of the following companies will announce a new neuromorphic chip or system by 30 June 2023?

A neuromorphic chip is a single piece of integrated circuiting (IC) hardware capable of native neuromorphic computing. A neuromorphic system is a system that is composed of one or more neuromorphic chips. Typically, they comprise many chips to handle much bigger loads than a single chip is designed to handle. Because neuromorphic chips are not commercially available (unlike ordinary computing chips), such systems must be built and made accessible (through the cloud) by the manufacturers themselves, and assigned names, such as Pohoiki Springs.

In September of 2021, Intel announced its second generation neuromorphic chip (Intel). Neuromorphic computing promises increased computational power and decreased energy consumption, both of which are needed to fully realize the potential of Artificial Intelligence (Forbes, Quanta).

Based on 82 forecasts by 35 forecasters:

Possible Answer	INFER % Chance on 9/30
Intel	20%
IBM	24%
BrainChip Holdings Ltd.	22%
Qualcomm Technologies, Inc.	9%

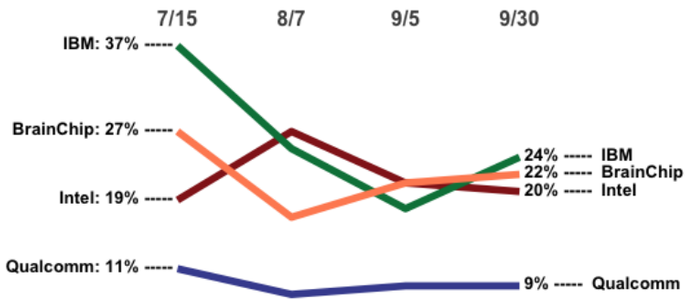
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

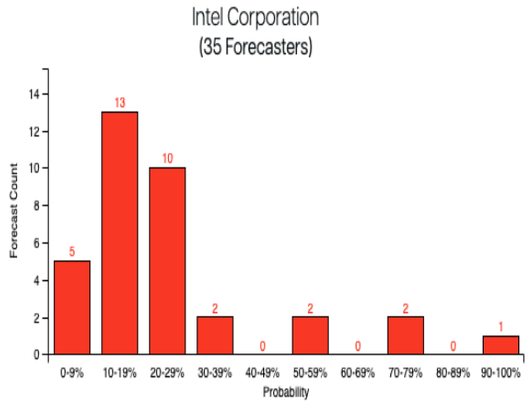
Intel:	IBM:	BrainChip:
▪ Intel released one recently they have the highest chance of doing another. (@farrahanne, 7/31/22)	▪ I'm giving IBM the highest spot out of the 4 based on the fact that it appears to have the most active ongoing research and has not just released a new neuromorphic product. (@mullenaustin, 8/29/22)	▪ BrainChip Holdings, in large part because it arguably is the worldwide leader in edge AI on-chip processing and learning, and having demonstrated this with the first-to-market neuromorphic processor, AkidaTM. (@cmeinel, 9/7/22)*

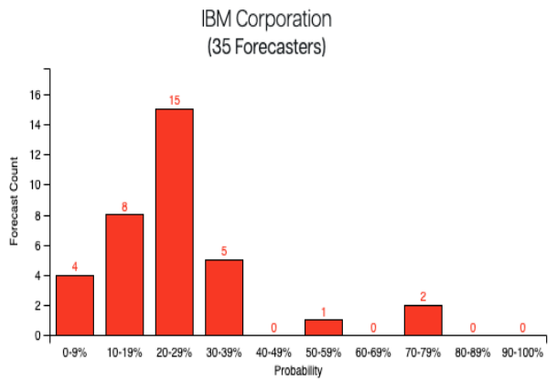
Which of the following companies will announce a new neuromorphic chip or system by 30 June 2023?

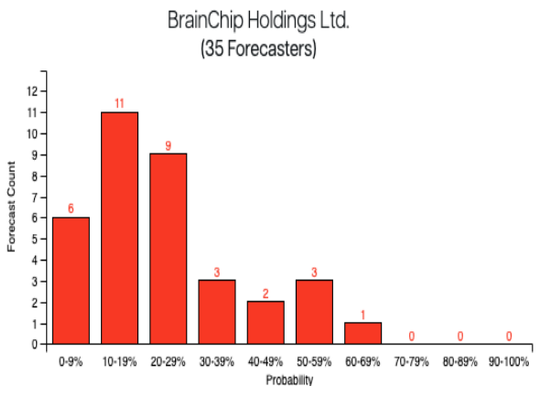
Consensus Trend (See the latest consensus trend here.)

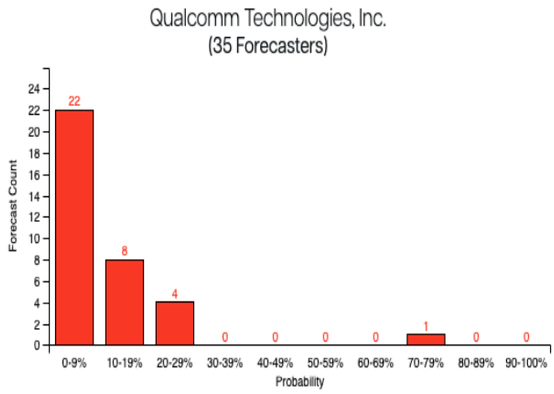


Forecast Distributions (See the most up-to-date distributions here.)









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

*This question closed 28 July 2022.

Both the U.S. Senate and House of Representatives passed H.R. 4346, The Chips & Science Act of 2022, which contains provisions for a tax credit for investments in semiconductor manufacturing.

Based on 343 forecasts by 75 forecasters:

Highlighted = Forecaster highest % chance

* = Correct Answer

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 7/28
Yes, tax credit for both manufacturing and design	38%	43% (+5%)	36% (-7%)	24% (-12%)
Yes, tax credit only for manufacturing *	34%	31% (-3%)	36% (+5%)	55% (+19%)
Yes, tax credit only for design	4%	3% (-1%)	3% (0%)	2% (-1%)
No tax credit	24%	23% (-1%)	25% (+2%)	19% (-6%)

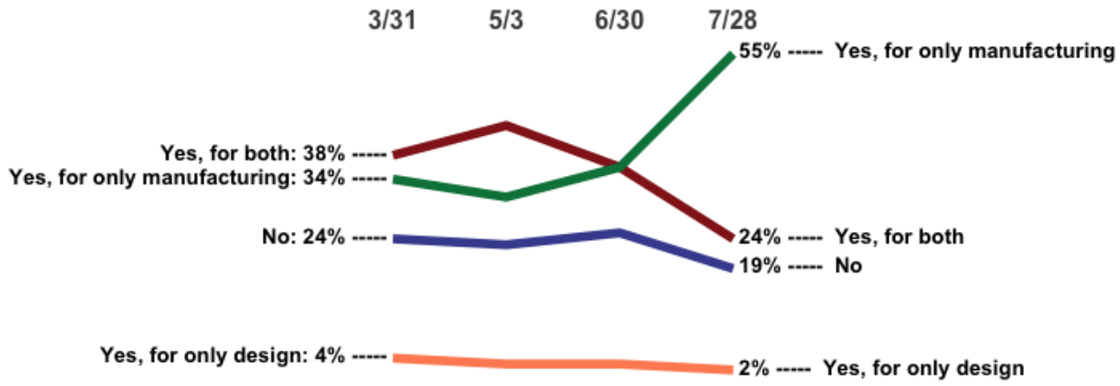
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

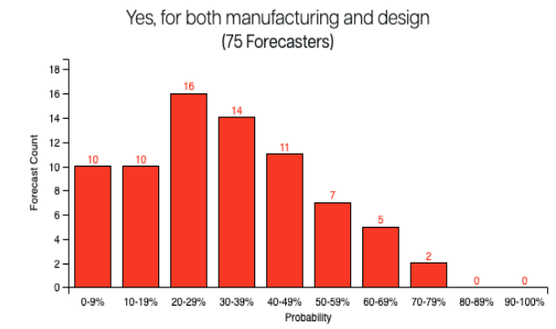
A tax credit for both manufacturing and design will pass:	Only a tax credit for manufacturing will pass:	No tax credit will pass:
▪ There's serious consideration of including FABS within Republican circles, with little Democratic opposition. (@kmcochran, 5/17/22) ▪ Chipmakers in Taiwan, South Korea and Japan already have significant subsidies for their operations. (@Mariana_DiazG, 4/15/22) ▪ FABS Act has bipartisan and bicameral support from key legislatures. (@Hinterhunter, 3/29/22)	▪ Revising upwards as the Senate has approved of the CHIPS Act for manufacturing but not design. (@MullenAustin, 7/27/22) ▪ Might not be necessary tif general R&D tax credits are fixed. (@RyanBeck, 5/5/22) ▪ The Biden administration appears more interested to work with private industry in manufacturing than semiconductor design. (@Carranza, 3/23/22) ▪ Manufacturing is more tangible and politically more desirable than semiconductor design. (@Shaun-ee, 2/28/22)	▪ Calibrating as it looks like the GOP is forcing Schumer to get this through reconciliation rather than as a standalone bill. (@bte, 7/14/22) ▪ There is a military focus on shifting political focus away from semiconductor chips and towards international conflict in Eastern Europe. (@Paul_Rowan, 6/16/22) ▪ Lack of true bipartisan support in Congress, with other issues taking priority as the midterms approach. (@Israakhan, 5/28/22)

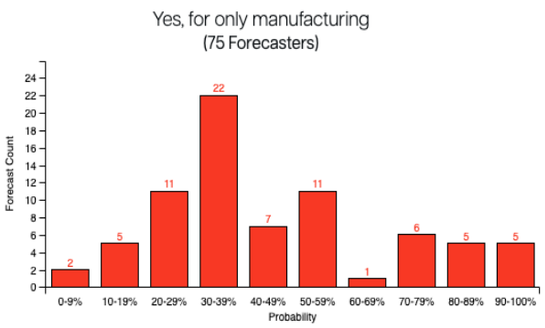
Will the U.S. Congress pass a tax credit for semiconductor manufacturing or design before 1 January 2023?

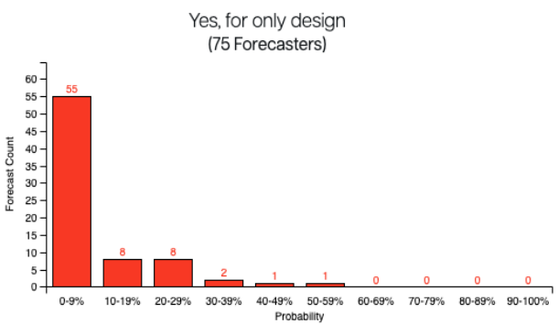
Consensus Trend (See the latest consensus trend here.)

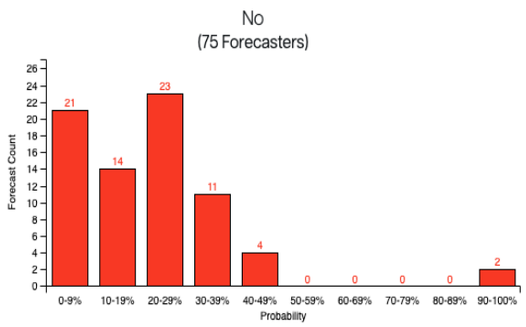


Forecast Distributions (See the most up-to-date distributions here.)









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

*This question closed 9 August 2022.

President Biden signed the CHIPS and Science Act into law, which allocates $2.5 billion in funding for the Advanced Packaging Manufacturing Program.

Based on 285 forecasts by 67 forecasters:

Highlighted = Forecaster highest % chance

* = Correct Answer

Possible Answer	INFER % Chance on 3/31	INFER % Chance on 5/3	INFER % Chance on 6/30	INFER % Chance on 8/9
No, $0 appropriated	7%	6% (-1%)	5% (-1%)	3% (-2%)
More than $0 but less than $1 billion	1%	2% (+1%)	1% (-1%)	1% (0%)
More than or equal to $1 billion but less than $2 billion	4%	5% (+1%)	4% (-1%)	2%(-2%)
More than or equal to $2 billion but less than $2.5 billion	17%	18% (+1%)	14% (-4%)	9%(-5%)
More than or equal to $2.5 billion *	71%	69% (-2%)	76% (+7%)	85%(+9%)

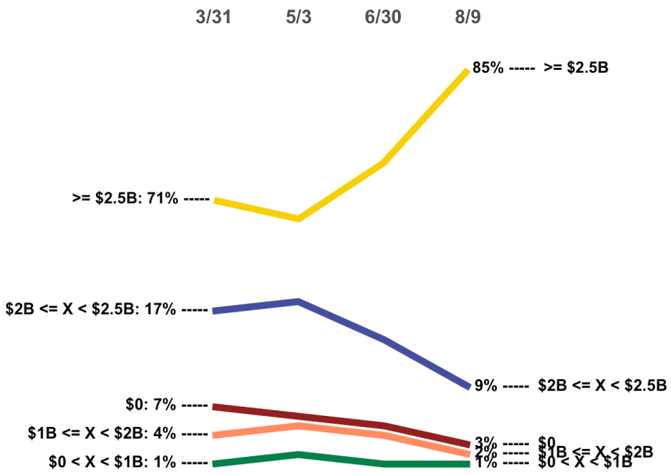
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

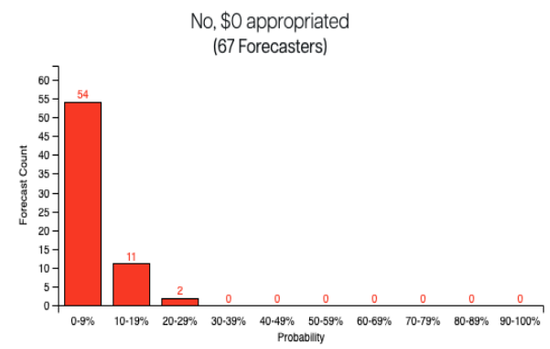
$2.5 billion or more appropriated:	Between $0 and $2.5 billion appropriated:	$0 appropriated:
▪ The CHIPS Act 2022 was approved by the House after passing the Senate. After passing the House, it is a matter of time for Biden to sign it, since it is a political victory for his Administration. (@LPinheiro, 7/30/22) ▪ Basing my estimates on the perspective that if the legislation is passed, there's no major motivation to decrease the funding, as the topic concerns jobs and competitiveness. (Paul_Rowan, 6/18/22) ▪ The government is trying to become independent on the semiconductor business, this is a continuation of that strategy. (@Himanshu, 6/12/22)	▪ House Republicans have signaled some opposition to the Green Climate Fund, which would allow for more disagreement and discussion. (@shaun-ee, 3/26/22) ▪ Getting the bill approved by the President may involve some shuffling around of funds that could impact the APMP. (@mbbernstein, 2/28/22)	▪ There is a chance that the bill is scrapped or delayed beyond 2022. (@galaga, 5/8/22) ▪ It could be slowed down and decreased as a priority due to more politically pressing issues. (@thsavage, 3/10/22)

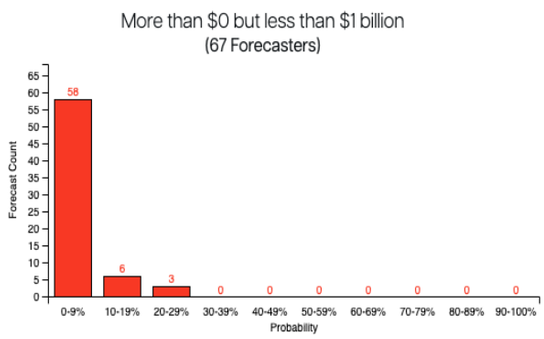
Will the U.S. President sign legislation which appropriates funds for the Advanced Packaging Manufacturing Program during FY'22?

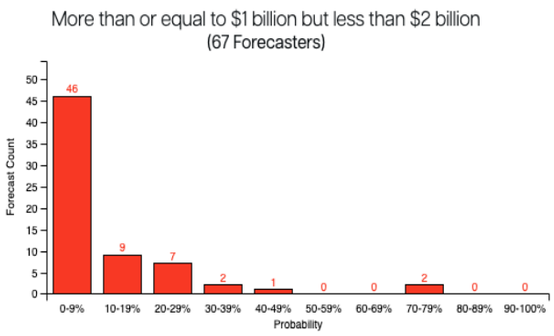
Consensus Trend (See the latest consensus trend here.)

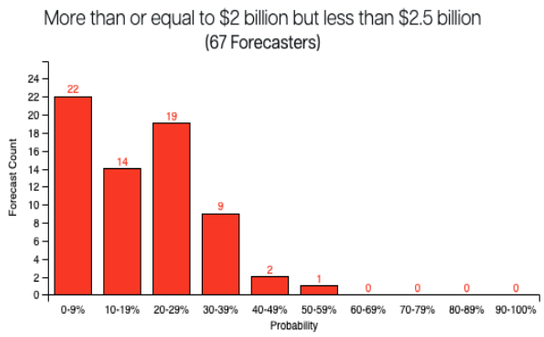


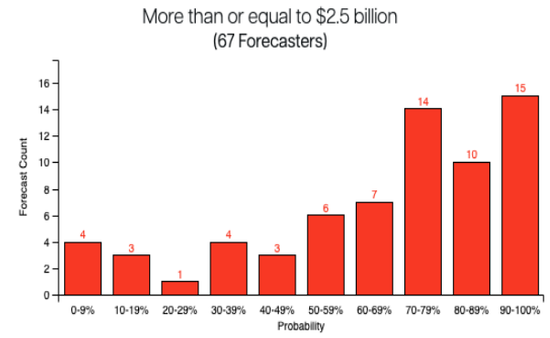
Forecast Distributions (See the most up-to-date distributions here.)











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

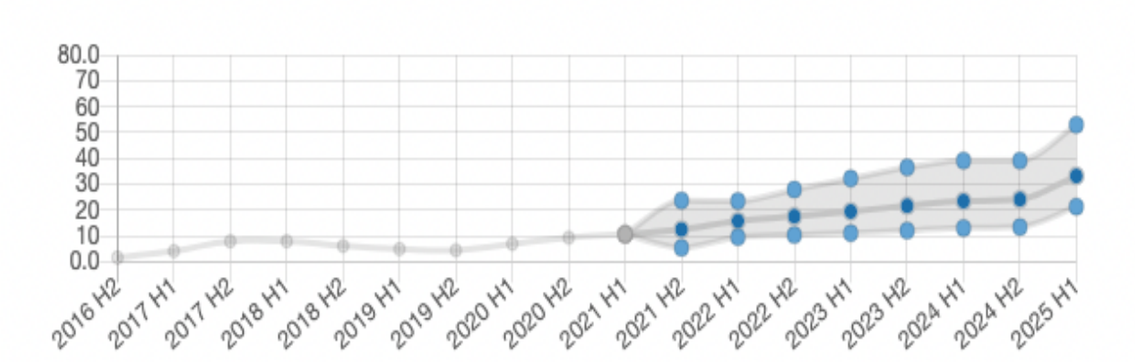
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative 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:
▪ The company's growth continues to increase, largely due to increased investments in smaller chips. (@Pramila, 3/19/22) ▪ SMIC's plans to increase investment, expand production capacity, and build three new plants in Beijing, Shanghai, and Shenzhen. (@DKC, 2/18/22) ▪ 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. (@heim, 2/13/22)	▪ SMIC's potential inability to access highly-specialized Extreme Ultraviolet Lithography machines could impact their ability to produce <28nm chips at scale. (@000, 3/31/22) ▪ Increasing signs of a worldwide recession may cause a decrease in innovation and a return to larger, more financially reliable chips. (@cmeinel, 3/18/22) ▪ SMIC's Tianjin fab is expanding, yet doesn't produce 28 nm chips. (@Gandt, 9/15/21)

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

Consensus With 90% Forecast Intervals



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

*This question closed 1 June 2022.

On 1 June 2022, the closing price of aluminum was $2,726.15. (Markets Insider)

Based on 310 forecasts by 88 forecasters:

Highlighted = Forecaster highest % chance

* = Correct Answer

Possible Answer	INFER % Chance on 4/3	INFER % Chance on 5/3	INFER % Chance on 5/30
Less than $3,000 *	7%	27% (+20%)	86% (+59%)
More than or equal to $3,000 but less than $3,500	44%	53% (+9%)	13% (-40%)
More than or equal to $3,500 but less than $4,000	41%	18% (-23%)	1% (-17%)
More than or equal to $4,000	8%	2% (-6%)	0% (-2%)

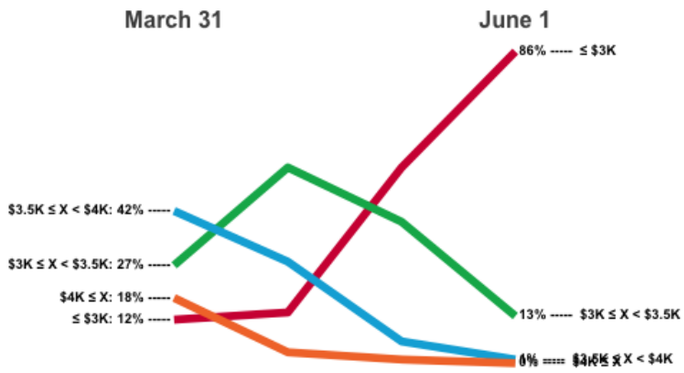
Summary of Forecaster Rationales (See Live Forecasts and Rationales)

*** = Representative forecast rationales made in the last 30 days**

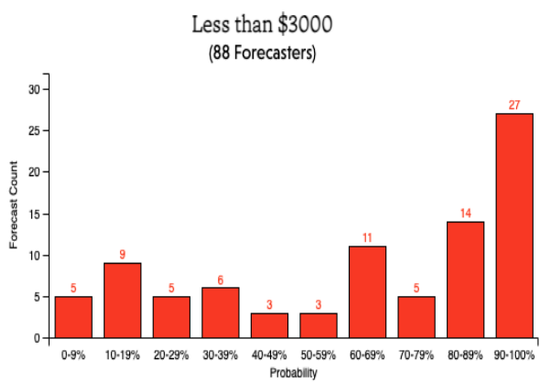
Forecasters who predict $3,499 or less	Forecasters who predict $3,500 or greater
▪ The range has been between $2,750 - $3,300 from April to May. (@salmon, 5/13/22) ▪ Aluminum does not face the same constraints as other metal commodities. Russia will discount the price for much needed cash. (@HinterHunter, 4/1/22) ▪ 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. (@HS21, 4/15/22)	▪ Unless substantial new sanctions on Russia are announced, aluminum prices seem likely to remain near their current levels or fall as supply chains continue to adapt to the invasion of Ukraine (@bcs53, 4/29/22). ▪ The price and inflationary pressures will increase as a result of the war in Ukraine. (@Lia, 4/1/22) ▪ 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. (@Pramilla, 4/10/22)

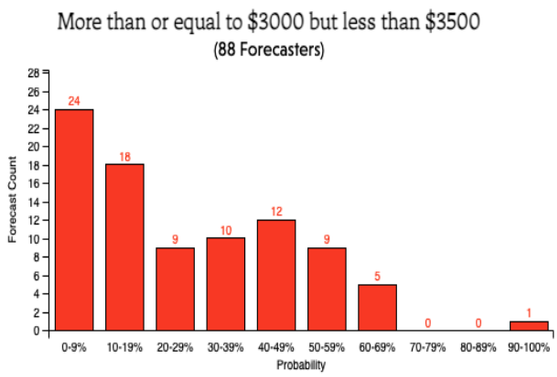
What will be the price per ton of aluminum on 1 June 2022?

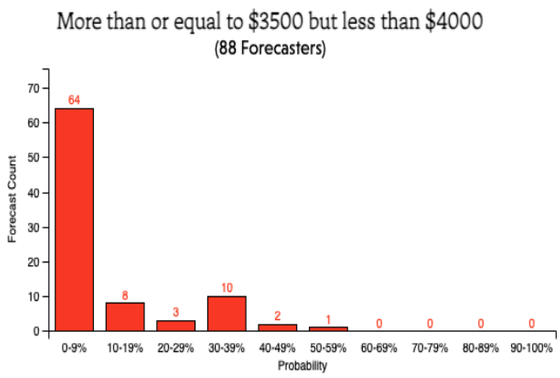
Consensus Trend (See the latest consensus trend here.)

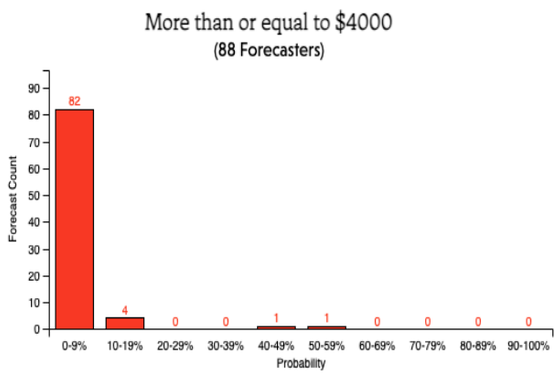


Forecast Distributions (See the most up-to-date distributions here.)









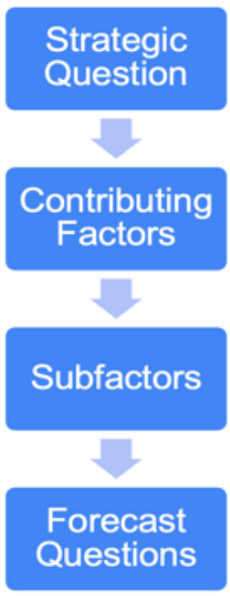
Appendix A - Methodology for Identifying Forecast Questions

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? [22]
	Funding	Will the U.S. President sign legislation which appropriates funds for the Advanced Packaging Manufacturing Program in Fiscal Year 2022? [23]
Manufacturing	Sales Targets	How will the percentage of SMIC revenue from 28 nm chips or smaller change over the next three years? [24] 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? [25]

[22] As a result of this question closing, it was not used as part of the slider methodology discussed in Appendix C.
[23] *Same note as above.*
[24] *Same note as above.*
[25] *Same note as above.*

	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?
R&D	Domain-Specific HW Architectures	Will Google score more wins than any other submitter in the next round of the MLPerf training benchmarking suite? How many total unique AI systems will Baidu and Alibaba submit for the next round of the MLPerf benchmarking suite? Will the price per chip-hour of Google's cloud-based Tensor Processing Unit (TPU v4) be greater than $3.22 on January 1, 2023? Which of the following companies will announce a new neuromorphic chip or system by 30 June 2023?

Appendix B - Current Forecaster Pool Profile

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

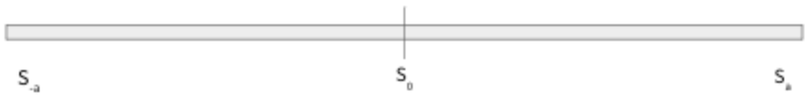
Gender	
Male	58%
Female	29%
Nonbinary, or prefer not to say	13%
Age	
18-24	35%
25-36	32%
37-48	13%
49-60	7%
61+	13%
Country	
United States	55%
Canada, UK, European Union, AUS	23%
South East Asia	8%
Central and South America	13%
Other	1%
Education	
Graduate education (completed or have some)	67%
Undergraduate education (completed or have some)	33%
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_o: Scenario 0 represents perpetuation of the status quo.

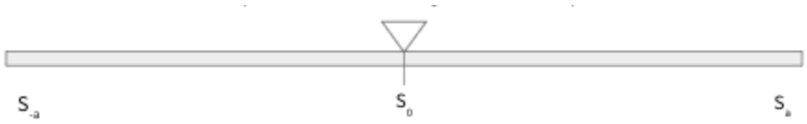
These three scenarios are represented on a horizontal axis, called the slider. This axis runs from -1 to 1, with 0 at the midpoint. The midpoint is labeled S_o, the endpoint at -1 is labeled S_{-a}, and the endpoint at 1 is labeled S_a.



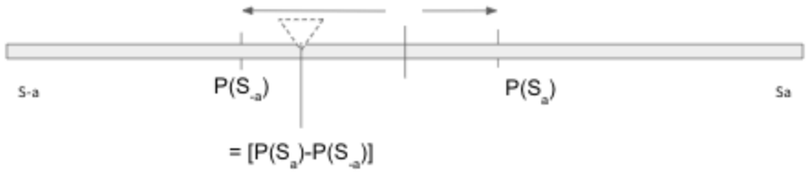
A set of forecasting questions is identified, and their answers are each associated with one of the scenarios S_a, S_{-a}, or S_o. We define the probability of a scenario S_x as the average of the probabilities of the set of outcomes associated with S_x. More formally, for a set of outcomes, O_{xi},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

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

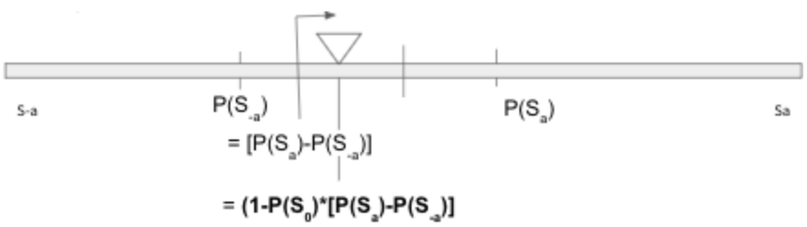
The ticker's position on the slider begins at the status quo, S_o.



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_o, 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-$P(S_o)$).



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
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[26]	U.S. Regains Leadership
	More than 300 billion, but less than 400 billion	Status Quo
	400 billion or more[27]	U.S. 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[28]	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[29]	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	Less than or equal to 5	U.S. regains leadership
	6-7, inclusive	Status Quo

[26] Combined answers of "Less than $200 billion" and "$200 to $300 billion"
[27] Combined answers of "Between $400 billion and $500 billion" and "More than $500 billion"
[28] 100%-P[Intel]
[29] Combined answers of, "TSMC (Taiwan Semiconductor Manufacturing Company)" and "Other"

computer science in 2023?	8 or more	U.S. falls behind
What percentage of ASML's lithography sales will be to the United States in 2022?	Less than 5%	U.S. falls behind
	5%-10% inclusive	Status Quo
	More than 10%[30]	U.S. 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	U.S. falls behind
	Between 7 billion and 8 billion, inclusive	Status Quo
	Less than 7 billion	U.S. regains leadership
What will be the value, in dollars, of U.S. exports of semiconductor chips to China in 2022?	More than 13 billion	U.S. falls behind
	Between 11.5 billion and 13 billion, inclusive	Status Quo
	Less than 8.5 billion	U.S. regains leadership
What will be the value, in dollars, of all Chinese imports of semiconductor chips in 2022?	Less than 350 billion	U.S. falls behind
	Between 350 and 380 billion, inclusive	Status Quo
	More than 380 billion	U.S. regains leadership
What will be the value, in dollars, of all Chinese imports of semiconductor manufacturing equipment in 2022?	More than 45 billion	U.S. falls behind
	Between 35 billion and 45 billion, inclusive	Status Quo
	Less than 35 billion	U.S. regains leadership
Will Google score more wins than any other submitter in the next round of the MLPerf training benchmarking suite?	Yes	U.S. regains leadership
	No	Status Quo
How many total unique AI systems will Baidu and Alibaba submit for the next round of the MLPerf benchmarking suite?	Less than or equal to 4	U.S. regains leadership
	Between 5 and 9, inclusive	Status Quo
	More than or equal to 10	U.S. falls behind
Will the price per chip-hour of Google's cloud-based Tensor Processing Unit (TPU v4) be greater than $3.22 on January 1, 2023?	Yes	Status Quo
	No	U.S. regains leadership
Which of the following companies will announce a new	At least one of Intel, IBM, BrainChip Holdings, or	U.S. regains leadership

[30] Combined answers for "Between 10-15%, inclusive" and "More than 15%"

neuromorphic chip or system by 30 June 2023?	Qualcomm Technologies	
	None of the above[31]	Status Quo

31 P[None of the above] = (1-P[Intel])*(1-P[IBM])*(1-P[BrainChip])*(1-P[Qualcomm])