Federal Legislation Opens Opportunities for Investments in U.S. based Semiconductor Foundry Companies

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Abstract

The article examines the bipartisan support for U.S. technology manufacturing under the U.S. CHIPS and Science Act and the earlier U.S. Innovation and Competition Act, which opens up a unique opportunity to invest in U.S. semiconductor and integrated device companies. Despite the high upfront costs and innovation risk factors inherent in the development of circuit manufacturing facilities, the recent federal prioritization of U.S. semiconductor manufacturing, combined with broader market demand for semiconductors and bipartisan support for over-reliance on Chinese manufacturing, provides a unique offsetting risk for investment in semiconductor manufacturing facilities. To assess this risk, this note will present an analysis of the competitiveness of global and domestic semiconductor foundry companies and outline the likely implications of U.S. policy for the industry over the next five years.

Global Demand for Semiconductors

Semiconductors have seen a significant growth in demand over the past few years and this trend is predicted to increase over a 5-year horizon. As more industrial machines are fitted with sensors, the consumer and business needs for silicon components and chips will likely drive this growth. From a consumer lens, semiconductors are essential components of smartphones, vehicles, gaming consoles, personal-computers, and cryptocurrency mining [https://www.economist.com]. Manufacturing demands include the need for semiconductor materials to develop emerging technologies such as autonomous driving development, artificial intelligence, the Internet of Things, and R&D more broadly [https://www.mordorintelligence.com]. According to the Semiconductor Industry Association, between February 2020 and February 2021, there was a 14.7% increase in semiconductor industry sales, highlighting a clear demand for chips across both consumer and manufacturing markets in the near term. Figure 1 provides a visual of global semiconductor revenues, and a clear picture of a steadily rising demands across a 25-year span, and the notably sharp increase in demand over the past 4 years [https://www.semiconductors.org].

The COVID-19 pandemic drove increased needs for personal-computers, vehicle sensors, and video games, among others, and existing foundries have not been able to keep up with demand [https://www.economist.com]. The innovations and advancements in semiconductors directly impact all downstream technologies, including the semiconductor fabrication plants (otherwise known as fabs), and manufacturing equipment. The gap in semiconductor supply is in part due to the high cost of semiconductor manufacturing plants. EE Times cost trend analyses places the value of a manufacturing plant between $15 – 30 billion for a leading-edge fab. This high entry cost prices out all but a few companies who can afford to build new plants [https://www.eetimes.com]. Atop the price risk, there is an additional risk factor of ensuring the fabrication plant is able to build the most up-to-date chips. The industry has seen a doubling of silicon transistors per unit area every two years, a remarkable technological feat but a challenge to align existing plant builds to have the capacity to develop the newest chip designs [https://www.iqsdirectory.com]. As modern technologies in the consumer and manufacturing spaces increasingly rely on semiconductors, the foundries that manufacture semiconductors are expected to benefit from the rapid growth, but that growth is tempered with threshold price and relevance risks inherent in building leading-edge fabs.

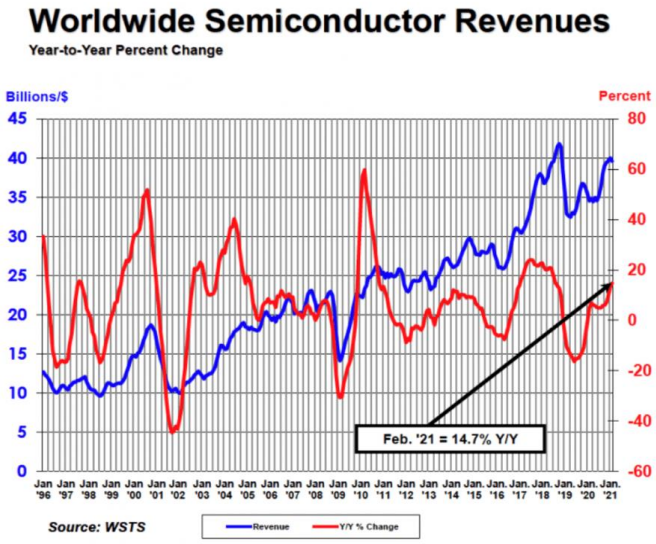

Figure 1: Worldwide Semiconducator Revenues
Source: WSTS: [https://www.semiconductors.org: update: December 2023].

Federal Support and Funding

The recent Creating Helpful Incentives to Produce Semiconductors and Science (CHIPS) Act (HR 4346) became public law in August 2022, indicating significant U.S focus on semiconductors and advanced technology

[https://www.congress.gov]. The act allocates $280 billion in funding and incentives over the next ten years to encourage the production of semiconductors in the United States, ostensibly for national security purposes [https://www.whitehouse.gov]. $52.7 billion is designated for American semiconductor research, development, manufacturing and workforce development. $39 billion is directed towards manufacturing incentives, including $2 billion for legacy chips used in autos and defense systems, $13.2 billion designated for research and development and workforce development and $500 million directed towards information communications technology security and supply chain activities [https://www.mckinsey.com]. By encouraging both workforce development and investment in the necessary facilities and equipment in the US to for the fabrication, assembly, testing, and packaging of semiconductors, the Act is a landmark legislation signaling America First industrial policies. The high value of investment is significant and intended to unlock additional private sector investment.

Guardrails in the Act limit semiconductor investments in countries of concern, including China, Iran, Russia, and North Korea. Concerns about the negative effects on global semiconductor supply chains persist, as firms will have to bear the cost and burden of shifting production from China. There are also concerns about market inefficiencies: by encouraging duplicative semiconductor efforts in the US (that may already be ongoing in Taiwan, China, etc) global competitiveness may be limited for the sake of national security. However, the incentives and funding designated through the Act is likely to significantly benefit the U.S. manufacturing sector and help ease global supply chain bottlenecks in the long run.

The earlier U.S. Innovation and Competition Act of 2021 passed the Senate on May 28, 2021, and was a precursor to this more recent legislation encouraging advanced technology. The Innovation and Competition Act was considered a successful bipartisan effort, securing an affirmative vote of 68-32 [https://www.congress.gov]. The bill would inject $250 billion over 5 years into the private sector towards high technology efforts in 5G, autonomous vehicles, robotics, artificial intelligence, synthetic biology, quantum computing, and most significantly semiconductors. The bill includes $49.5 billion over 5 years for a CHIPS for America fund to implement a Department of Commerce semiconductor incentive and R&D program, $39 billion to focus on legacy chip production to advance national security interests, and $10.5 billion allocated to the National Semiconductor Technology Center and other authorized semiconductor focused programs [https://www.schumer.senate.gov]. The Act would also fund a grant program managed by the Commerce Department that would match financial incentives offered by state governments to chipmakers who improve upon or build new factories, so there are likely parallel incentives and support at the state and local level [https://www.cnbc.com].

The bill also has broader political support from a national security standpoint, and the White House and Department of Defense lend a national security urgency to the pro-U.S. manufactured semiconductor narrative. In the White House's June 3rd Executive order, President Biden expands the scope of E.O. 13959 to prohibit U.S. investments in 59 Chinese companies that "undermine the security or democratic values of the U.S. and our allies" [https://www.whitehouse.gov]. Of the 59 companies prohibited, one of the top global semiconductor manufacturers Semiconductor Manufacturing International Corporation is on that list, indicating that a shift away from reliance on Chinese semiconductor manufacturing is a top policy priority of the White House [https://www.whitehouse.gov]. Echoing the sentiments of the White House, in his press releases on the U.S. Innovation and Competition Act, Sen. Chuck Schumer explicitly indicated that one of the primary goals of the Innovation and Competition Act is to open new state-of-the-art foundries in the U.S. and decrease reliance on market dominant foundries based in South Korea, Taiwan, and China . Political momentum and funding to create a favorable environment for Uc is likely to have a significant effect on companies owning semiconductor fabrication plants and allow for these firms to experience net growth and increased revenues across the next 5-10 years.

Competitive Analysis

Presently, a small number of global semiconductor firms compete and collaborate to supply against the growing demand for semiconductors. Industry forecasts predict that the total value of the global semiconductor market will surpass $1 trillion by 2030 [https://www.usitc.gov]. Around 80% of the world's chip-making capacity is in Asia, and Figure 2 below reveals the significant market share held by Taiwan-based TSMC. The graph also visually contextualizes the smaller market share divvied up among competitors, including South Korea-based Samsung Electronics, U.S.-based GlobalFoundries, and China-based UMC.

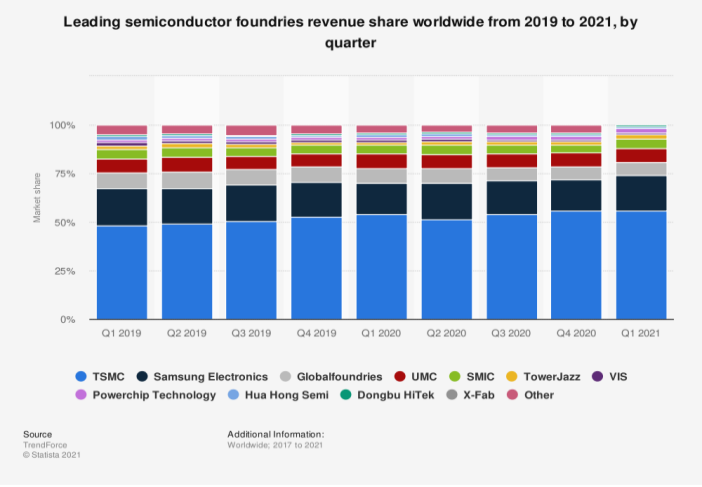

Figure 2: Leading semiconductor foundries revenue share worldwide 2019 to 2021, by quarter
Source: [https://www.statista.com: update: December 2023].

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the total value of the global semiconductor market will surpass $1 trillion by 2030 [https://www.usitc.gov]. Around 80% of the world's chip-making capacity is in Asia, and exhibit B below reveals the significant market share held by Taiwan-based TSMC. The graph also visually contextualizes the smaller market share divvied up among competitors, including South Korea-based Samsung Electronics, U.S.-based GlobalFoundries, and China-based UMC.

Due to the increased demand in semiconductors and the dominance of a handful of global semiconductor foundries, competition among firms to capture more of the semiconductor manufacturing market is heated. A competitive analysis from a sampling of five firms (including pure-play, integrated device manufacturers, and companies that both manufacture and design chips) that have sufficient assets and revenues in the past year to position for an investment in additional manufacturing to meet demand shows that these firms are already developing U.S. Chip manufacturing expansion plans (see: Table 1 and 2). Domestic and international firms are unveiling plans to commit significant assets to expand their U.S. footprint through the development of additional U.S. plants. Across 2020 – 2021 Intel, Global Foundries, Texas Instruments, and TSMC revealed intent to develop between 2–4 factories across the U.S. Political support and funding of these private sector initiatives shores up the financial and redundancy risk of these plans and increases the likelihood that the U.S. chip manufacturing expansion plans will come to bear over the next 5 years, thus making an investment in semiconductor manufacturing foundries a sound investment.

Table 1: U.S. Chip Manufacturers

Company	Country of Origin	U.S. Chip Manufacturing Expansion plans?	2020 Revenue (USD)	Total Assets (USD)
Intel*	US	Plans to spend $20bn to build 2 factories in Arizona	$77.87 billion	$153.09 billion USD
Global Foundries	US	3 US plants. Partnership with Global Wafers to expand a production facility in Missouri	$5.7 billion	Not a public company
Texas Instruments*	US	4 US manufacturing plants	$14.46 billion	$18.018 billion USD

*Companies are not exclusively pure-play and integrated device manufacturer semiconductor foundry companies.

Source: [https://www.reuters.com; https://governor.mo.gov; https://www.anandtech.com; https://www.sec.gov; ttps://www.ti.com: update: December 2023].

Table 2: International – Chip Manufacturers

Company	Country of Origin	U.S. Chip Manufacturing Expansion plans?	Revenue (USD)	Total Assets (USD)
TSMC (Taiwan Semiconductor Manufacturing Company Limited)	Taiwan	In May 2020 Announced plans to build a chip manufacturing factory in Arizona. Owns U.S. Subsidiary WaferTech	$47.95 billion	$81.26 billion
UMC (United Microelectronics Corporation)	Taiwan	n/a	$5 billion	$11.9 billion

Source: [https://www.reuters.com: update: December 2023].

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