

# **Group essay of subsidy on Semiconductor Industry**

**Group member: Andy, Clarence, Pedro, Stephanie**

**Class: Grade 10 Class 5**

# 1 Background

Subsidy is an amount of money paid by the government subsidy to firms for a variety of reasons: to prevent an industry from failing, to support producers' incomes, or as a form of protection against imports (due to the lower costs and lower prices that arise from the subsidy). Serving as a cutting-edge industry, the semiconductor production is crucial in advanced modern manufacturing processes and emerging technologies such as artificial intelligence and quantum computing. This field of production is facing a dramatic change, as the share in global production capacity of semiconductor manufacturers in US, the largest exporting country of chips worldwide, has declined from 36.5% in 2011 to 11.8% currently [1]. Consequently, the U.S. government counteracts this share reduction by granting subsidies to manufacturers to incentivize its own semiconductor industry, preventing the country's market share in semiconductor's industry being taken away by its international rivals.

The U.S. government supports the semiconductor and chip industry by signing the CHIPS Act of 2022, [2, 3]. On July 21, 2022, the senate agree on providing a \$52 billion subsidy on the semiconductor manufacturers locating in U.S.[4]. On February 28, 2023, the Department of Commerce is overseeing \$50 billion to revitalize the U.S. semiconductor industry, including another \$39 billion to provide incentives for the semiconductor producers [5].

## 2 Explanation

According to Fig.1, original equilibrium point is at  $P_e Q_e$ . After government imposed three subsidies on the semiconductor industry, the cost of production of semiconductors decreases. As a result, the supply curve  $S_1$  will shift downwards to  $S_2$ . The equilibrium quantity produced and consumed falls from  $Q_e$  to  $Q_s$ , and the price received by producers (semiconductor companies) increase from  $P_e$  to  $P_p$ . The consumer expenditure on the semiconductor products (silicon wafer used to produce chips) also changes from  $P_e Q_e$  to  $P_c Q_s$  and companies' revenue increases from  $P_e Q_e$  to  $P_p Q_s$ . The subsidy that government need to grant equals to  $(P_p P_c) \times Q_s = b + c + d + e + f = \$142$  billion. The consumer surplus increase from area  $a + b$  to  $a + b + e + f$ , and the producer surplus increases from  $e + g$  to  $g + h$ . The dead weight loss is area  $d$ , which is caused by a larger than optimum quantity produced ( $Q_s > Q_e$ ). The subsidy has caused overproduction relative to what is socially desirable, and an overallocation of resources, or allocative inefficiency.

## 3 Evaluation (5 stakeholders)

### 3.1 Producer

With the U.S. government's financial subsidies and great importance attached to the chip industry, there has been a significant increase in both the quantity demanded and the producer's price of semiconductors and chips. Consequently, producers have seen an increase in total revenue since the the CHIPS act 2022 was implemented.

For producers already engaged in the semiconductor industry before the policy was established, they possessed a reliable accumulation of core technology. Therefore, utilizing their past experience, they were able to quickly expand production to increase supply, earning the first wave of dividends. An example of this is Micron, a veteran producer in the industry, which announced a \$40 billion investment in memory chip manufacturing following the signing of the CHIPS Act.

As a result of the expansion in production, the subsidy leads to an immense increase in the consumption of raw materials required to manufacture semiconductors. More orders for raw material and higher revenue margins would occur at the same time. This had a positive economic impact on firms along the entire supply chain. However, with the increasing demand for raw materials, certain bottlenecks were encountered in the mining and supply of essential materials, necessitating effective measures to ensure the continued stability of the supply chain.

Simultaneously, under the guidance of positive signals from the U.S. government, many individual investors invested in leading semiconductor companies. This influx of investment supported technological innovation and product optimization within these firms. However, it also led to a more intense competition as more new entrants were attracted by the government subsidies, joining the industry. These new entrants are mainly companies transitioning from other sectors due to the rising demand for semiconductors or because of the corresponding decrease in demand for their original products.

With more competitors entering the market, oversupply became a major concern. To sell their stock- piles, producers decreased their selling prices, creating internal competition. This forced many companies to find ways to maintain their profit margin, sometimes leading to less sustainable practices. However, even with such strategies, some new entrants found it difficult to survive in the highly competitive market and eventually went bankrupt, [2, 3].

## 3.2 Consumer

These subsidies result in lower production costs for semiconductor manufacturers, which ultimately leads to increased affordability of semiconductor-based products. As a result, downstream consumers, including existing and new small-scale manufacturers, benefit in several ways.

Existing small-scale manufacturers benefit from government subsidies as the reduced production costs enable them to source semiconductors at lower prices. This affordability enhances their competitiveness and profitability in the market. Additionally, lower prices for semiconductor-dependent products incentivize existing consumers to replace their existing devices more frequently, upgrading to more advanced models, or purchasing additional semiconductor-dependent products. These actions result in increased demand and sales revenue for downstream manufacturers.

New small-scale manufacturers also benefit from government subsidies. The lower production costs made possible by the subsidies allow them to enter the market with competitive pricing. As a result, they can attract new customers and gain a foothold in the industry. This market entry and competition foster innovation, as new manufacturers strive to differentiate themselves from the market and capture market share. The availability of subsidies provides an opportunity for new players to establish themselves and contribute to the overall growth of the semiconductor industry.

The positive impact of government subsidies on small-scale manufacturers is reflected in the data provided by the World Semiconductor Trade Statistics (WSTS). According to the WSTS, the sales of semiconductors in the United States increased from \$118,835 million to \$131,084 million in 2022, representing a significant growth of 10.3% from 2021 to 2022. The projected sales reaching \$143,278 million in 2023 further demonstrates the positive trajectory of the industry. These figures indicate that both new small-scale and existing manufacturers are benefiting from the affordability and accessibility enabled by government subsidies, [6].

Additionally, subsidies contribute to supply stability in the semiconductor industry. By supporting domestic manufacturers to upgrade their facilities and technologies, subsidies improve production efficiency and reliability. This reduces the risk of supply shortages caused by disruptions in global supply chains or sudden increases in demand. Since subsidies help mitigate price fluctuations, it ensures a consistent availability of products at more predictable prices for small-scale manufacturers as it stabilize the supply chain. This stability allows them to plan their production, manage costs, and serve their customers more effectively.

Furthermore, government subsidies foster technological advancements in the semiconductor industry. All scale of manufacturers, can invest in research and development to improve product quality, performance, and functionality. The resulting advancements in product benefit downstream consumers by providing them with higher-quality commodities that offer enhanced performance, improved user experiences, and increased functionality. These technological advancements help small-scale manufacturers stay competitive and meet the evolving demands of their customers.

### 3.3 Government

The first funding opportunity approved by the senators on July 21, 2022 seeks applications for projects to construct, expand, or modernize commercial facilities for the production of matured semiconductors, which includes both front-end chip wafer fabrication and back-end packaging, [1, 5].

The subsidy to the semiconductor industry aligns with the US government's efforts to enhance national security and supply chain resilience. As the dependency on foreign imports for critical semiconductor components has been long been a concern for the United States, the government aims to reduce reliance on foreign suppliers by providing incentives to domestic semiconductor manufacturers. Accordingly, a stable and secured supply of semiconductors for defense applications, infrastructure, and critical industries can be secured.

The subsidy to the semiconductor industry will foster technological advancement and innovation within the United States. With increased financial resources, semiconductor companies will be able to invest in cutting-edge technologies, such as advanced manufacturing processes, chip design capabilities, and emerging technologies like artificial intelligence and quantum computing. This will position the US as a global leader in semiconductor technology, attracting research and development activities, and promoting collaboration between the private sector and academic institutions. The resulting advancements will have far-reaching implications for multiple industries, including healthcare, telecommunications, automotive, and defense.

The subsidy to the semiconductor industry can positively impact the US trade balance and export competitiveness. By investing in the semiconductor sector, the government aims to increase domestic production and reduce imports of semiconductor components. This shift will help address the trade deficit and strengthen the country's export capabilities in semiconductors and related technologies. As the US semiconductor industry becomes more competitive globally, it is expected to attract foreign investments and increase opportunities for semiconductor exports, thus contributing to a favorable trade balance and supporting economic growth.

However, there is opportunity cost of this government expense, the government lost the chance to give subsidy to other industries. For example, U.S. government could have used these subsidies to support infrastructure and education.

Moreover, as the quantity of subsidy required to achieve the government's aim is hard to determine a number of human and financial resources would be needed to calculate the exact amount of subsidies needed to be approved.

### 3.4 Society

On July 21, 2022, the senate pass a bill in a 64-34 procedural vote signed by the Federal president, Joseph Biden, which is meant to provide a \$52 billion subsidy on the semiconductor manufacturers based in US. The national strategic objective is obvious in this case, as it is stated by observers. The US government hopes to create incentives for the producers of chips to increase the country's competitive edge on high-tech products against China. Preventing China growing into a superpower, limiting its semiconductors can certainly slow down China's advances in military industries, while the communist country rely highly on chip import for fabrication of high-tech enterprises. Keeping US ahead in the global technology competition is crucial to the country's national image and international relationships. This lead would benefits the US society and citizens at last, since the society enjoys the most recent technology advancement and citizens gain a stronger confidence in their country's development. The premium quality of US chips would be preferred by foreign customers and thus the country's export can be enlarged. Moreover, the guiding in cutting-edge industries also helps to establish a trust in government throughout the society, stabilizing the governing of the party in power. With the firmness in politics, the society is able to operate in a more efficient way.

The government's concern of US being lag behind in future hi-tech competition is not without a reason. Statistics show a gigantic slope in the US semiconductor manufactures' share in global capacity, dropping from 36.5% in 2011 to 11.8% now. This reduction can be explained partly because of the global lockdown in 2021 and the speedy development of China's high-tech companies. The consequence of a loss in availability of chips in ant time can

be disastrous to the society, as the production of heavy industry can be disrupted by this shortage in supply chain. Therefore, utilizing this subsidy, constructing a more resilient semiconductor ecosystem with the coordinating US allies worldwide is beneficial to the society. The social security in front of incidents such as cyberattack and COVID is guarded, while the knowledge are exchanged and the cross-border chip transportation is encouraged.

To ensure the CHIPS subsidy would be good stewards of taxpayers' dollars, the government set rigid regulations on the receivers of this fund so that the social benefits of this portion of tax can be maximized. The companies seeking this fund would have to submit a detailed plan on worker development to encourage the diversity and to enhance happiness of their workforce. Thus, job opportunities for the veteran, minority and women can be secured. For large firms, they must provide all faculty premium medical insurance and accessible child care if a fund over \$150 million is delivered from the government. Accordingly, the healthcare status can also be secured by the subsidy, [1, 4].

Last but not least, the subsidy enables the low-income people to afford high-tech products to enrich their lives, by translating the supply curve downwards and lowering the price of semiconductors.

### **3.5 Countries abroad**

The U.S. government's subsidies to its domestic semiconductor industry can have varying effects on different countries.

Germany is home to a number of leading semiconductor companies, such as Infineon Technologies and Robert Bosch GmbH. According to Statista, Germany's semiconductor industry generated revenues of approximately €13.4 billion in 2020, making it one of the largest semiconductor markets in Europe, [7].

One potential impact of the U.S. subsidies on Germany's semiconductor industry is increased competitive pressure. With the financial support from the U.S. government, American semiconductor firms may invest more in research and development, expand their production capacities, and adopt aggressive pricing strategies. In response, German semiconductor companies may need to increase their investments in innovation to maintain their competitiveness. For example, in 2020, Infineon Technologies spent €1.2 billion on research and development, accounting for 16.9% of its total revenue, [8]. It remains to be seen if German companies will increase their RD spending further to keep up with their U.S. counterparts.

Moreover, the U.S. subsidies may prompt the German government to introduce similar support measures for its domestic semiconductor industry. In December 2020, the German Federal Ministry for Economic Affairs and Energy announced a €400 million investment to support the country's semiconductor and electronics industries, in a bid to strengthen their global competitiveness, [9]. This investment could be seen as a response to the U.S. subsidies and may lead to further government support in the future.

## **4 Conclusion**

Since the government granted subsidy on semiconductor industry, the U.S. semiconductor manufacturers' market share in the whole world's semiconductor industry increase, making a great progress recently. The results are remarkable, as the proliferation of emerging technologies such as AI and 5G, the demand of semiconductor product increase and U.S. has significant development on these technologies, which is due to their support to semiconductor industry. When there are enough semiconductor manufacturers in U.S. and own large market share, at the appropriate time, the government could withdraw subsidies for the semiconductor industry and use them for other needs, such as infrastructure and education. The impact of the development of the semiconductor industry in the United States on the development of high-tech technologies in other countries is also enormous. The world is changing and the future is still uncertain. Any step we take is a cornerstone of future development. The only fact we know is that the semiconductor industry, which continues to grow massively, will have enormous contribution that is worth waiting for.

## A Appendix

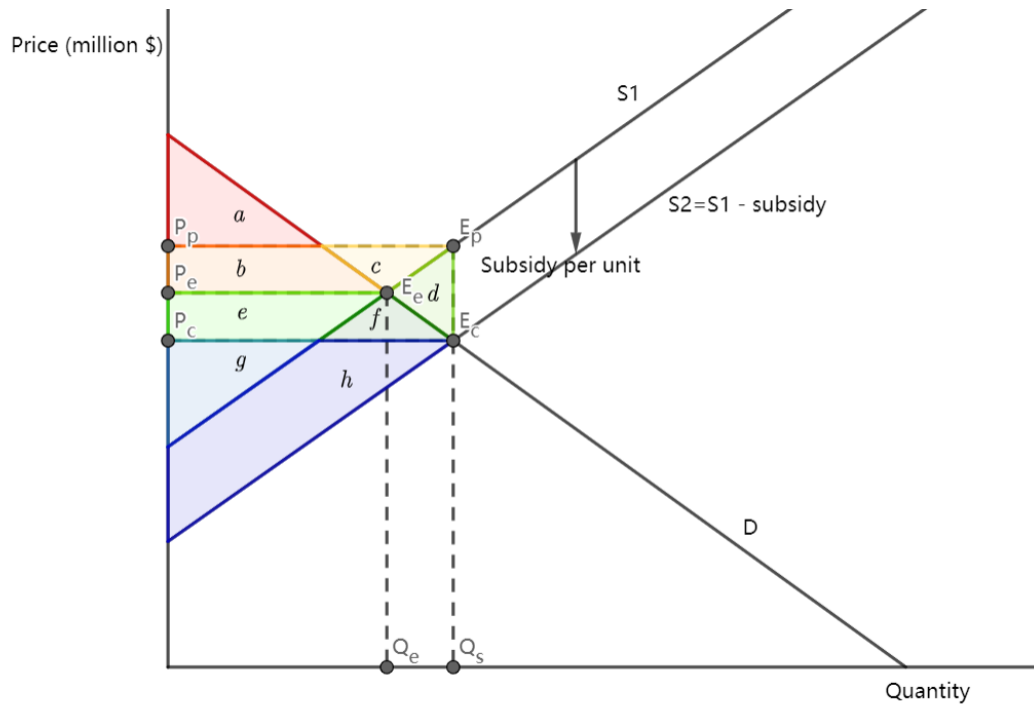


Figure 1: This is the theoretical graph in 2 Explanation part.

	Before grant subsidy	After grant subsidy
Price (consumer)	$P_e$	$P_c$
Price(producer)	$P_e$	$P_p$
Quantity	$Q_e$	$Q_s$
Consumer expenditure	$P_e \times Q_e$	$P_c \times Q_s$
Producer revenue	$P_e \times Q_e$	$P_p \times Q_s$
Government expenditure	0	$(P_p - P_c) \times Q_s$ $b + c + d + e + f$
Consumer surplus	$a + b$	$a + b + e + f$
Producer surplus	$e + g$	$g + h$
Welfare loss	0	$d$

## References

- [1] “Biden-Harris Administration Launches First CHIPS for America Funding Opportunity — commerce.gov.” <https://www.commerce.gov/news/press-releases/2023/02/biden-harris-administration-launches-first-chips-america-funding#:~:text=As%20part%20of%20the%20bipartisan,%2439%20billion%20in%20semiconductor%20incentives.>

- [2] “Biden signs bill providing \$52B in subsidies to US semiconductor industry — jurist.org.” <https://www.jurist.org/news/2022/08/biden-signs-bill-providing-52b-in-subsidies-to-us-semiconductor-industry/>.
- [3] “‘War of the states’: EV, chip makers lavished with subsidies — apnews.com.” <https://apnews.com/article/microchip-electric-vehicles-battery-semiconductor-states-subsidies-3ac>
- [4] “US Congress Moves Toward \$52 Billion in Subsidies for Semiconductor Firms — voanews.com.” <https://www.voanews.com/a/us-congress-moves-toward-52-billion-in-subsidies-for-semicon6667675.html>.
- [5] “Biden’s Semiconductor Plan Flexes the Power of the Federal Government — nytimes.com.” <https://www.nytimes.com/2023/02/27/us/politics/chips-act-biden-commerce-department.html>.
- [6] “WSTS Home — wsts.org.” <https://www.wsts.org/esraCMS/extension/esrasearch/search?query=summary+forecast>.
- [7] “Actions motivated by environmental reasons by gender EU 2014 — Statista — statista.com.” <https://www.statista.com/statistics/410974/actions-taken-for-environmental-reasons-in-the-past-month-eu-gender/>. [Accessed 20-May-2023].
- [8] I. T. AG, “Semiconductor System Solutions - Infineon Technologies — infineon.com.” <https://www.infineon.com/dgdl/Infineon+Annual+Report+2020.pdf?fileId=5546d46175b876680175e6dd0540001e>. [Accessed 20-May-2023].
- [9] B. F. M. for Economics Affairs and C. Action, “2020 Federal Government Report on Energy Research — bmwk.de.” [https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/federal-government-report-on-energy-research-2020.pdf?\\_\\_blob=publicationFile&v=5](https://www.bmwk.de/Redaktion/EN/Publikationen/Energie/federal-government-report-on-energy-research-2020.pdf?__blob=publicationFile&v=5). [Accessed 20-May-2023].

## B Contribution

1 Background: Stephanie  
 2 Explanation: Pedro and Clarence  
 3.1 Producer: Pedro  
 3.2 Consumer: Clarence  
 3.3 Government: Stephanie  
 3.4 Society: Andy  
 3.5 Countries abroad: Clarence  
 4 Conclusion: Stephanie  
 Resource research: Andy, Clarence, Pedro, Stephanie  
 A Appendix (graph Fig.1 and table): Stephanie  
 Intergrating: Pedro  
 Rewrite Paragraphs & Revision: Andy