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A STUDY ON POLICYMAKERS PERCEPTION OF INVESTING IN DOMESTIC EDUCATION AND RESEARCH IN ORDER TO STRENGTHEN THE AMERICAN SEMICONDUCTOR WORKFORCE

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Abstract

Supply chains in the semiconductor sector as a whole are notoriously difficult to navigate. As a consequence of this, natural disasters have the ability to do a great deal of harm (pandemic lockdowns, or a factory fire). When it comes to the political pressure, it is not hard to see how this situation is comparable to a usual standoff in Mexico. Every single one of these departments and the businesses that operate inside them are dependent on one another as customers and suppliers. In theory, almost anyone may create a problem in the system for themselves. Companies that have employees or products that are extremely difficult to replace have a competitive edge and are worth more. As a result of the Huawei event, the United States is now in possession of the majority of the valuable assets that cannot be replaced. China does not now engage in any of the crucial high-value regions, and it does not have any major controls that are difficult to replicate in the semiconductor value chain segments that are considered to be essential to the industry. Their susceptibility is glaringly clear. Because of this, they might be hazardous. (Calhoun, 2021).

Keywords: Supply Chain, High Value Regions, Semiconductor

INTRODUCTION

When it comes to computers and other electronic equipment, nothing beats the reliability and efficiency of semiconductors. A semiconductor is a chemical element or compound that conducts electricity under certain but not all environmental circumstances; it is often a solid. This makes it a perfect material for manipulating electricity and common household gadgets. Insulators prevent electricity from flowing through them, whereas conductors carry it. To put it another way, semiconductors have characteristics that fall between those of conductors and insulators. Semiconductors are utilized in the production of diodes, integrated circuits, and transistors.

LITERATURE REVIEW

Approximately 120 years ago, scientists quietly began studying the electrical characteristics of silver sup hide, marking the humble beginning of the semiconductor industry. For the following 50 years, development slowed to a crawl, but with the advent of point contact rectifiers in 1885, a glimmer of hope emerged. In the early 20th century, before the invention of the vacuum tube, these gadgets were widely employed as detectors. Interest was rekindled in the early 1930s with the introduction of selenium and cuprous oxide rectifiers, and it gained more steam with the 1931 publication of a solid

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theory of semiconductors. After a brief dormancy, the cat whisker diode was given new life around World War II, when it was refined into a very effective radar detector. Thanks to the publicity surrounding the unveiling of the transistor in 1948, semiconductor electronics has risen to prominence as a serious area of study. "(Pearson, 1955)"

In the 21st century, cutting-edge computer chips have become a contentious geopolitical issue since they are essential to powering a wide range of potentially disruptive technologies. Semiconductors are an extremely important part of the economy, yet they are one of the few areas in which China is dependent on the rest of the world. China imports around $300 billion worth of semiconductors annually and at least 25% of annual revenues for the majority of the top American semiconductor companies come from China.

The advancement of technology in both countries is a direct result of their interdependence. If Tencent or Alibaba had relied on Chinese microprocessors in their early days, or if they had designed and built their own, they would not be the powerhouses they are now in the Chinese technology industry. And many American businesses have profited from Chinese consumers, markets, and developments. Production of systems and devices in China and Asia has allowed for economies of scale and price reductions that have contributed to the pervasiveness of IT. Hundreds, if not thousands, of product designs and cooperative technological development activities are now being worked on by American semiconductor businesses and their Chinese counterparts despite the harsh rhetoric on both sides of the Pacific. The semiconductor industry has become a flashpoint in the ongoing dispute between the United States and China, despite the efforts of those working together to try to avert this. As a result of COVID and Trump's election, many in Washington are considering tightening restrictions on Chinese exports of advanced semiconductors and the machinery needed to produce them in order to wean the American economy off its reliance on the country. Beijing, meantime, is working toward the vaguely defined objective of "technology independence," which was included in the country's 14th five-year plan presented in the previous year.

It is not clear how or even whether it is worthwhile to seek your own identity apart from your family.

Statement of the Problem

In order for China's semiconductor sector to achieve global leadership position, it must overcome significant obstacles.

At this point, China is a very long way from achieving its goals of autonomy and global leadership in the semiconductor industry. China's manufacturing industry is at least two generations behind the vanguard, and as a result, it is dependent on overseas suppliers of manufacturing equipment. The industry's design sector is able to manufacture chips that are competitive on a global scale; yet, the industry's cutting edge is dependent on foreign suppliers for manufacturing. It is extremely doubtful that China will catch up to leading-edge capabilities in the near future, and the added drive from many national governments to tighten export controls on critical technologies is anticipated to

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dramatically slow down the rate at which China produces semiconductors. Despite the fact that technology roadblocks such as the ones outlined above do exist, the complexity of the industry also means that several bottlenecks may frequently be circumvented via the implementation of different cross-border changes. (Hodiak, 2020)

As potential policy responses to the strategic competition between the United States and China, decoupling and unwinding the integration of supply chains have become hot topics of discussion in recent years. However, another point of view contends that the most effective way to deal with interdependence and strategic competition is to rely on collective action and coordination between equal partners and allies in order to respond to shared economic and security concerns. This line of thinking suggests that this is the most effective way to deal with interdependence and strategic competition. With a player as determined, imaginative, and dynamic as the PRC, it would be a mistake for industry experts or national security technology officials to conclude that China's semiconductor efforts are currently being delayed or would continue to be delayed in the future. This will be done by leveraging a combination of indigenous development, foreign talent attraction programmes, joint undertakings, and other approaches. (Hodiak, 2020).

The country has been able to make considerable advances, particularly in low-end procedures of the multi-step chipmaking technique, but it is still decades away from more sophisticated operations. Companies such as Semiconductor Manufacturing International Corp., located in Shanghai, are a few generations behind world leaders such as Taiwan Semiconductor Manufacturing Co. and Samsung Electronics Co. The Chinese enterprise produced considerably older technology until 2015, and the nation as a whole has not been able to make significant inroads towards the cutting edge. And as chip design has progressed — along with the worldwide demand for higher quality semiconductors — China has found itself chasing changing objectives.

Take lithography, an essential procedure in the production of chips. In this stage, light is employed to transfer circuit layouts to a film, which is then utilised in the production of individual microprocessors. The so-called extreme ultraviolet tools for lithography can take more than ten years to create, and the price of the precise gear has been steadily rising. Due to the high level of investment required in terms of both money and knowledge, the industry has been concentrated around only three competitors. Beijing has made a concerted effort to achieve self-sufficiency in the semiconductor sector by providing various subsidies and incentives, such as tax exemptions that extend over many decades. The pursuit of independence is still an objective of national policy. However, significant ventures have failed miserably. Chinese companies that manufacture equipment for lower-end operations like chip cleaning are competing for customers in a market that is quite limited.

HSBC further observes that the chip-making equipment used in China are of a lower quality compared to those used by market leaders in other countries. Additionally, they are less exact and have a higher cost of maintenance. The cost of actually owning the pieces of equipment, in addition to the initial investment, rises steadily over time. Even if China were to achieve significant headway toward its chip designing and technological

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goals, the country would still be unable to produce chips for either internal consumption or export if it lacked the machinery necessary to manufacture them. Because it is unable to manufacture this equipment and that foreign players have a stronghold on the machines, the country will continue to be dependent on the global supply chain for some time.

OBJECTIVE OF THE STUDY

- "To Strengthen The U.S. Semiconductor Workforce, Policymakers Should Invest In Domestic Education And Research."

RESEARCH QUESTION

- How semiconductors can be used as a weapon in the trade war between the United States and china?

RESEARCH METHODOLOGY

In the future, we believe that there will be opportunities for semiconductors in the communication, consumer electronics, and automotive industries, in addition to the industrial sector. The desire for more advanced safety features in autos and the proliferation of internet-connected items are driving up the price of semiconductors, which are in short supply. This demand is also driving up the price of other products that are linked to the internet. Since the year 2000, the analyst's company, which specialises in market research and management consulting, has produced more than 600 reports on market intelligence and provided services to over a thousand customers located all over the world. In order to finish each research, the analytic team works practically nonstop for the better part of four months. The following sources were consulted by the investigators so that they could put together this significant document: extensive secondary research based on the financial statements of rivals and data that was public.

- Extensive searches of published works, market, and database information relevant to industry news.
- A compilation of the experiences, judgements, and insights of specialists who have analysed and watched the market for years.

The market's share and size have been assessed by conducting in-depth research and conducting interviews with key participants from across the supply chain. As a consequence of this, the analyst compiles a substantial quantity of information derived from a wide range of sources, verifies the accuracy of the data, and then performs an exhaustive analysis. Following the compilation of the data, results, and insights, the analyst will then present the findings in a concise report in order to contribute to the process of making strategic decisions. (Andrea, 2021).

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RESEARCH DESIGN

The semiconductor industry is experiencing a period of rapid change due to the increasing interest in AI and autonomous vehicles. Well-known semiconductor manufacturers include Broadcom and Micron in addition to Samsung Electronics and NXP Semiconductors. The principal end use of wireless technology is expected to be communication due to its high demand. Most of the anticipated expansion will occur in the automotive sector, thanks to the rebounding market after COVID-19 and the rising electronic content of vehicles. During the time period covered by this prediction, the greatest market for IoT (internet of things) and electronic content in automobiles will continue to be China, Taiwan, and India, along with other nations located in the APAC region. It is anticipated that the markets for automotive electronics and industrial electronics would have the greatest growth in North America throughout the period covered by the projection.

Analysis

Three qualitative approaches to literature reviews are presented: locating, categorizing, and assessing the scientific progress of the Fourth Industrial Revolution from the OR&DS perspective for semiconductor manufacture. The researchers employed a double-screening process to locate applicable studies: Initially, the research team zeroed in on articles with terms like "wafer," "integrated circuit," and "chip" in the title or abstract.

The findings of the categorization are used to generate a decision-support matrix that illustrates the connections between the keywords. The Mutually Exclusive Collectively Exhaustive (MECE) methodology was employed for feature extraction (select parent methods, and the most compatible technique with them). Tabular data representing the classifier's verdict in different domains, researchers may draw from a wider or narrower selection of literature, depending on the nature of their work. Journal papers published in the recent few months were given preference over older studies, and those that were too similar to earlier studies were eliminated from further consideration. Sort out the study procedures used by Wier inga et al (including: validation, evaluation, solution, philosophical, opinion, experience) Production industries have been categorised by Messiaen et al (including quality management, design, process and planning, control, environment, health and safety, maintenance and diagnosis, scheduling, and virtual manufacturing) Using the keyword strategy, classify the submissions according to their category (including: architecture, framework, theory, methodology, model, platform, process, tool) The logical categorization scheme developed by Delen and Demirkan (including: descriptive, predictive, and prescriptive) Intelligence for semiconductor product development and manufacture in the commercial sector. There is a dearth of analytical discussion of the new responsibilities for the next stage of smart manufacturing.

CONCLUSION

In this study, we covered the most recent studies that have been conducted on SMOxs as well as their potential use as gas sensors. The chemical, physical, optical, and electrical properties of these materials have already sparked the interest of researchers

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in the use of these substances as gas sensors with a detection range of ppb levels and below. The SMOxs that were synthesised in a variety of morphologies, sizes, crystal and microstructures have shown that they are more capable of detecting a variety of gases, such as H2, NO2, CO, NH3, O2, VOCs, NO, SO2, and H2S, with good sensitivity, selectivity, and stability across a wide temperature range. Additionally, there is an increase in the total number of active reaction sites. This makes gas detection possible with a short response and recovery time. These nanostructured SMOxs are essentially capable of speeding up electron transport, which in turn leads in an improved gas sensitivity. Other methods, such as loading with NMs, bulk doping with elements, creating heterojunctions, and compounding with other functional materials, have all been shown to significantly increase gas-sensing characteristics in the laboratories of researchers. As a consequence of this, future research should concentrate on evaluating the characteristics of various materials to identify which ones have the highest selectivity in a variety of environmental conditions while also having the quickest reaction and recovery times. Manufacturing of gas sensors has to be enhanced in terms of both their long-term stability and their ability to be processed using nanotechnology. (Saruhan B. &., 2021).

According to Cornyn, companies based in the United States hold nearly half of the global market share for these types of microchips. It is possible that the widespread use of industrial policy by governments throughout the world, which has traditionally been unpopular in the United States, is to blame for China's meteoric rise in this market. China's meteoric rise in this market has been attributed to the widespread use of industrial policy by governments throughout the world. Cornyn suggested the investment policies of South Korea, Taiwan, Singapore, and Germany as potential strategies for maintaining competitiveness in this industry. There is a consensus among the senators that the United States is already playing catch-up with regard to 5G technology because of their readiness to invest in domestic technologies. Despite this, China's contribution to this value chain has been confined to the purchase of semiconductors for incorporation into the country's own machinery. However, due to a scarcity of processors, Huawei has been forced to scale back its mobile manufacturing goals, which has put the company's 5G business in jeopardy. China has made several attempts to produce its own semiconductors, but all of them have been unsuccessful. It has committed to making large investments in this industry, but building capabilities in the manufacture of semiconductors is not an easy task. This information was gleaned from the local press. According to the South China Morning Post, which cited information provided by Caixin Media, employees at the facility received a WeChat message requesting that they resign and making it clear that there are no plans to resume operations. The impassable barrier that has been erected between Huawei and Chinese Electronics Company as a result of Donald Trump's trade restrictions and Joe Biden's continuous enforcement of those limitations (TSMC). In 2019, Huawei was responsible for generating a total of $5.4 billion, which is equivalent to approximately one-seventh of TSMC's income. Any chipmaker that is dependent on American technology is prohibited from conducting business with Huawei in order to avoid incurring the wrath of the government of the United States. Because it is a significant customer of United States businesses like Applied Materials, who are in the business of producing chipmaking equipment, TSMC is vulnerable to the embargo. The

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fact that TSMC will lose such a significant customer is indeed regrettable, but the fact that Huawei will no longer be able to do business with them poses an existential threat to the company. As a consequence of this, Huawei is less dependent on technology developed in the United States than its Western competitors, such as Nokia, which is more dependent on technology developed in the United States. HI Silicon, on the other hand, does not manufacture chips. Alternatives are as difficult to find for TSMC as a libertarian member of the Chinese Communist Party (CCP). As a consequence of this, industry experts say that Huawei is rapidly running low on chips.

Intel has developed a strategy that is fairly comparable to this one in order to compete effectively with Nvidia's offerings. Because of its location smack dab in the midst of the most recent dispute between the United States and China, Taiwan plays an extremely important role in the global trade of technologies and in international politics. There is no electronic device or kind of artificial intelligence that can work properly without the use of microchips. It will take India a very long time to gain the specialised expertise that just a select few researchers throughout the world now possess.

Processor chips are used in a wide variety of products, including mobile phones and vehicles, as well as medical equipment and domestic goods. Because of the widespread spread of the coronavirus, manufacturing on a worldwide scale has ground to a standstill, which has raised concerns regarding supplies. The development of Chinese-made chips is at the centre of the Communist Party's long-term effort to wean China off of its dependence on technology from the United States, Japan, and other suppliers that Beijing views as potential economic and geopolitical adversaries. This is a strategy that no other nation is pursuing. It is possible that manufacturers of smartphones with a single global operating system and two network protocols may need to sell numerous versions of their products in order to satisfy demand in different areas. That puts a damper on the company's plans to become the dominant player in the market for smartphones of the next generation. Huawei has been accused by officials in the United States of creating a security concern and perhaps facilitating Chinese espionage. Huawei has categorically denied all of these allegations. According to industry experts, Huawei and certain other Chinese competitors are getting close to matching the capabilities of industry leaders such as Intel Corporation, Qualcomm Inc., Samsung Electronics KR:005930 of South Korea, and Arm Ltd. of the United Kingdom in terms of "bleeding edge" logic processors for smartphones. Foundries like as Shanghai's state-owned SMI are lagging behind in terms of output and are at least a decade behind industry heavyweights such as Chinese Electronics Corp. TW: 2330, which manufactures semiconductors for Apple Inc. AAPL and other international brands.

Officials refute the notion that China is attempting to cut itself off from the rest of the world economy by encouraging smartphone and other manufacturers to use Chinese suppliers, regardless of the fact that these suppliers are more expensive. During the Asia-Pacific meeting that took place in Malaysia in November, Chinese President Xi Jinping delivered a speech via video link in which he stated, "We would never go back in history by seeking to disconnect." Even while China's SMIC is just one-third as accurate as the technology used in the United States, the precision of 14 nanometers is a major increase. TSMC, a

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semiconductor manufacturer based in Taiwan, intends to improve its precision to 2 nanometers in the near future. In order to stay current, SMIC intends to purchase the most recent equipment offered by ASML; however, the Dutch government has not yet granted its authorisation. (Press, 2021).

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