The Impact of the CHIPS for America Act on the Semiconductor Industry

Capstone Project

Department of Economics, Texas A&M University

Submitted by: Nameera Ali, Anjana Azhuvath, Kenny Evans

“SEMICONDUCTORS ARE THE BRAINS OF MODERN ELECTRONICS”[1]

Today, these chips are ubiquitous, ranging from hand-held devices to missile systems. The global semiconductor industry sales totaled at 149.9 billion dollars during the second quarter of 2024.According to the Semiconductor Industry Association, the sales are projected to increase by 15.8% by 2025. The US chips industry accounts for about 50% of the global market share, netting $264 billion in sales, (Ravi, S.,2023) . After pharmaceuticals, chip makers of the US plow a fifth of their profits back into the company as R&D, reaffirming America’s commitment towards remaining a world leader in chip design and manufacturing.

According to (Miller, C., 2022), Morris Chang’s leadership at Taiwanese Semiconductor Manufacturing Company (TSMC) attracted American firms, TSMC and Samsung of Taiwan, as they manufactured chips at their fabrication plants (fabs) while US-based companies specialized in fabless tech, also known as foundries. The COVID-19 pandemic, Geo-political tensions between US and China, the Ukraine and Russia War as well as super-specialization created bottlenecks in the market. In an effort to address this issue, the federal government introduced the CHIPS for America and Fabs act of 2022.

Creating Helpful Incentives to Produce Semiconductors (CHIPS) Act, offers financial assistance to accelerate development of microelectronics within the US. Sec (103) of the Bill outlines the guidelines for disbursement. It aims to support production, research and employment issues in the industry. Through $52 billion in manufacturing grants and 25% tax credit, the government hopes to strengthen national security and enhance supply chain resilience. (Ryan, Tim, 2022)

[1] https://www.semiconductors.org/wp-content/uploads/2024/04/SIA-Industry-Factsheet-2024.pdf

Through our research, we seek to understand the potential impact of the financial incentives on the semiconductor industry. So far very limited research is available on the effectiveness of this Act. Through an Event Study on the stock market ramifications of the CHIPS Act, our work will build a basis for understanding the effects of the act and contribute towards the broader discourse on strategic intervention effects.

PROBLEM STATEMENT AND OBJECTIVES

During the Covid-19 Pandemic, as workers were sent home to do their jobs remotely, demand for semiconductors skyrocketed to a level the industry was not prepared for, leading to a supply shortage that has created setbacks in several other industries (King et al., 2021). In prior decades, chip developers had already been moving out of the United States, as American production of semiconductors had decreased to 19% of the world's output, compared to 40% just 30 years earlier (Mazewski and Flores, 2022). This lack of American production of semiconductors has made it more costly to replenish the chip supply and created enough incentive for the Federal Government to act.

The CHIPS Act was passed by Congress in 2021 and enacted on August 9th, 2022 with the intention of creating financial incentives for semiconductor developers operating in the United States. The article published by Mazewski and Flores (2022) analyzed the mechanisms of the law that will allow for job development and economic growth. Two years following this publication, we plan to add to their analysis now that there is a sizable sum of financial data regarding the semiconductor industry since the passage of the CHIPS Act.

We have three questions in mind to assess the effectiveness of the CHIPS for America Act through its first two years in effect. First, what is the immediate stock price reaction of

semiconductor companies to the revelation of the company's CHIPS Act grant? This question aims to assess the direct, short-term impact of CHIPS Act grants on stock prices. By focusing on stock performance in the immediate period surrounding the grant date, this question helps determine if there is an immediate positive or negative reaction by investors. Second, do stock trends of semiconductor companies significantly differ before versus after the announcement of their CHIPS Act grant? This research question seeks to evaluate the effect of the CHIPS Act grant on stock performance by comparing stock trends pre- and post-grant. It will address whether the grants create sustained changes in stock price behavior or trends. Finally, does the CHIPS Act have a greater impact on smaller or larger semiconductor companies? By breaking companies into groups by market capitalization, we hope to find out if smaller companies, whose grants will often have a bigger ratio of grant size to company valuation, see greater increases in stock returns than companies that may be worth billions or trillions of dollars.

We have two primary objectives that we hope to achieve through our research in the Semiconductor Industry. Our objectives are to:

1. To assess the immediate impact of CHIPS Act grants on semiconductor companies' stock performance. The Efficient Market Hypothesis tells us that the stock price of a firm will factor in all publicly available information (Beechey et al., 2000; Malkiel, 2003), so a company's day-to-day stock changes will provide honest insight into what investors think and understand about the CHIPS Act grant when other factors are controlled for.

2. To evaluate the stock performance of semiconductor companies before and after the public discovers the company will receive a grant from the CHIPS Act, identifying any significant trends or shifts in stock behavior. This aims to compare stock trends across a defined pre- and post-grant period to determine if CHIPS Act grants have a sustained impact on stock

performance.

Through our study we seek to contribute to the body of literature on financial incentive schemes and stock performance. Additionally, our research will address the gap of limited analysis on the impact of the CHIPS ACT on the semiconductor companies. Our hypothesis is that after an immediate drop in stock returns after a company's grant announcement, the stock will rebound and show a return that is significantly greater than the returns from before the announcement and furthermore outpaces market forecasts. We also predict that smaller semiconductor companies will see more significant increases in daily stock returns than their larger counterparts.

LITERATURE REVIEW

Due to the recent adoption of the CHIPS Act, our literature review is more centered around the general effects of subsidies on firms and industries. For example, Dixon and Nassios (2018) study various tax policies in Australia to compare the effectiveness of tax cuts and government subsidies in stimulating investment. Results pointing to greater benefits from subsidies would provide support for the actions of the U.S. Government regarding the CHIPS Act and would indicate to us that firms in our study should see increased investment following their grant. Alas, the authors indeed find that investment subsidies have a positive impact on both domestic and foreign investment on a company-by-company level as well as gross national income on a federal level. Both results lead us to believe that the CHIPS Act should see greater investment into the semiconductor industry and provide an overall boost to the American economy.

Criscuolo, Martin, Overman, and Reenen (2019), who were interested in the effectiveness

of industrial policy, studied the Regional Selective Assistance (RSA), a program in the United Kingdom that provided subsidies to industrial plants in certain disadvantaged regions. The goal for the authors was to see if industrial policy, specifically policies that grant subsidies to certain firms within an industry, can be used to stimulate economic growth and innovation, doing so by comparing firms who just made the cut for a subsidy to those who just missed out. The authors found that firms who received subsidies saw statistically significant increases in employment and spillover effects can benefit the region and beyond, although subsidy programs can also create extensive costs that cannot be ignored when evaluating the overall benefit (Criscuolo et al., 2019). Additionally, their study revealed that the positive effects of RSA subsidies were limited solely to smaller companies, guiding our hypothesis that the smaller semiconductor companies receiving grants will benefit more from their subsidy than the larger companies in our study.

One of the many aims of the CHIPS Act is to incentivize further research and development within the American semiconductor industry (Mazewski and Flores, 2022). Chen, Wang, Hu, and Zhou (2020) studied Chinese markets to determine how effective R&D subsidies are and if lacking equal access to investor information can weaken the usefulness of subsidies. The Shanghai-Hong Kong Stock Connect sees many foreign investors purchase shares in Chinese companies, a phenomenon that allowed the authors to run a quasi-natural experiment where foreign investors signal to the government which domestic companies should receive R&D subsidies. Among their findings, they determine that information asymmetry can significantly hamper the benefits of R&D subsidies and the market as a whole, an idea which will be further evident when discussing uncertainty in stock prices, as well as identifying greater economic gains from subsidies for smaller firms, further supporting that part of our hypothesis.

Veronesi and Pastor (2012) studied how governmental policy changes can create

uncertainty within the market and lead to changes in stock prices. The model used by the authors to test investor reactions to uncertainty, called a general equilibrium model, features a mean whose value is determined by government policies and is unknown to investors, although its effect on profitability can be observed over time. At any given point, a new policy can be introduced and although no evidence is introduced as to how that policy affects the mean, investors' beliefs about the mean may change and their reactions to those changes can be observed by the authors. Their model reveals several important findings, including that stock prices tend to see an immediate drop at the announcement of any relevant policy change, the drop in stock prices will be larger if the policy change introduces larger amounts of uncertainty, and policy changes make stock prices overall more volatile and more correlated across companies (Veronesi and Pastor, 2012). Although our study is not looking at stock prices on August 9th, 2022, the date that the CHIPS Act was passed into law, we suspect that the date that each individual company announced their grant from the CHIPS Act may still see drops in stock prices for that company in the short run. We can also use the idea by Veronesi and Pastor (2012) that larger price drops are associated with more uncertainty to determine which companies grant's came with more hesitance from investors.

DATA

We used the Semiconductors Industries Association website to create a list of companies that received grants from the CHIPS Act and when they announced those grants, eliminating companies that do not trade on United States stock markets. For the 11 companies we were left with, we accumulated data from the NASDAQ website of the stock's closing price each day starting with 245 trading days before the announcement of the grant to five days after, then calculated daily returns by subtracting the current closing price by the previous day's closing

price. Companies were split by market capitalization into micro-cap, midsize-cap, large-cap, and mega-cap groups so as to test which sized companies are most aided by the CHIPS Act.

We anticipated using the CRSP equally weighted returns as a proxy for market returns, however, due to a lack of access to CRSP data from 2024, we are substituting that data with market returns from the PHLX Semiconductor Sector Index.

Normal returns for stock and market data were calculated using the following formula:

$$R_t=(P_t - P_{(t-1)}) / P_{(t-1)}$$

Before running our event study, we wanted to look at the descriptive statistics for all the companies in our study to establish a basic-level analysis for American companies receiving CHIPS Act grants. It is important to remember that this data is from the entire 250-day window, not divided between estimation and event periods, so no definitive determinations can be made from this data.

Table 1 : Summary Statistics of Stock Returns for the Event Study Period

Recipient	Mean	Standard Dev	Range	Skewness	Kurtosis	Standard Err
WolfSpeed	-1.28E-03	0.05785994	0.376697	0.6699106052	1.596338071	0.0002314397
Polar Power	-2.18E-03	0.05613179	0.618085	-1.68724182	15.3373762	0.0035430073
Rocket Lab	4.52E-05	0.03974965	0.399125	0.70879791	5.6202655	0.0025089759
Amkor	1.58E-03	0.02621852	0.2565071	-0.65172363	5.9718308	0.0016548983
Entegris	1.36E-03	0.02229502	0.1487196	0.18479982	0.5244742	0.0014072492
Global Foundries	-5.34E-04	0.02292478	0.1633529	-0.06311945	0.9121389	0.0014469995
HP	7.97E-04	0.01833867	0.2180002	2.92436475	27.0418277	0.0011575265
Microchip Technologies	7.30E-04	0.0205876	0.128514	0.03130804	0.2617517	0.0012994776
Intel	1.60E-03	0.02415071	0.2119376	-0.2860327	2.6964779	0.0015243795
Texas	1.01E-03	0.01557522	0.1078657	0.19488422	0.7666207	0.000983099

Instruments						
TSMC	2.07E-03	0.02057847	0.1705048	1.39572884	6.1023428	0.000082313

Source: data retrieved from NASDAQ, computed on R

Polar Power has shown a decline in daily returns throughout this period as evidenced by a negative mean and skewness, while also having the widest range and highest kurtosis of all the companies in our study, suggesting there could have been a handful of poor days of returns acting as outliers to the dataset. Every other company, excluding GlobalFoundries, sees a positive average daily return, albeit most of them small insignificant returns.

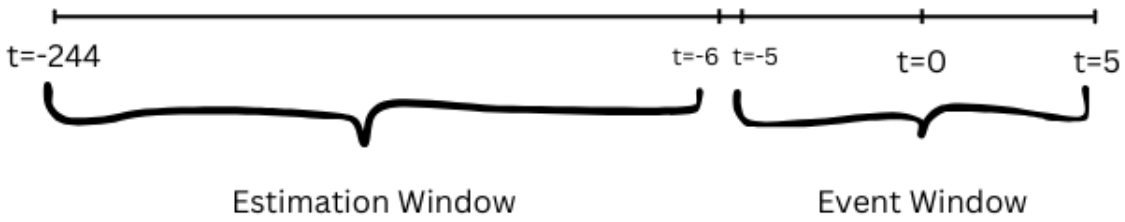
METHODOLOGY

An event study is an econometric tool used to estimate and visually present the dynamic effects of an event. The x-axis represents the event timeline, while the y-axis shows the impact of the event relative to a baseline, which serves as the comparison period (estimation window). In an event study, the timeline is divided into two key windows: the estimation window, which captures normal behavior before the event, and the event window, which reflects changes around the time that the event occurs. (Douglas, 2023).

Event Definition: An event study is being conducted on companies that received CHIPS Act grants to analyze its impact on stock prices. The analysis will assess stock performance before and after the grant announcement to gauge the market's response. To set up our event study, we will attempt to replicate the methodology used by Brown and Warner (1985). The data of the announcement is set as day 0 of our event study. For example, WolfSpeed announced their grant through the CHIPS Act, as well as an investment from a group called Apollo, early on October 15th, 2024, which would be set as day zero, and proceeded to see an increase of 25% in shares held that day (McColl, 2024). All companies made their announcement well in advance of

4:30 Eastern Time, the time that U.S. markets close, on their respective announcement day, so we can reasonably expect some immediate market reaction to occur that same day. A 239 day window was set up to model the expected returns based on the estimation period.

Figure 1: Event Study Timeline for the 250-day window



Source: Timeline estimation based Warner and Brown (1985)

Once we have defined our estimation and event windows, we will find each piece necessary for our OLS market model. This will begin by running a regression on the estimation window to determine average daily returns (α) and the level of systemic risk (β) for each stock (Brown and Warner, 1985).

Our ultimate OLS market model for this event study will take the following form as used by Brown and Warner (1985):

$$A_{i,,t} = R_{i,t} - (\widehat{\alpha}_i + \widehat{\beta}_i R_{m,t})$$

where $R_{i,t}$ is the observed value of stock i on day t, $A_{i,t}$ is the excess return for stock i on day t, or in other words the observed value of the stock minus the expected value of the stock, $R_{m,t}$ is the daily market returns for the NASDAQ, and $\hat{\alpha}_i$ and $\hat{\beta}_i$ are values taken from the

estimation window. Our null hypothesis in all regressions will be that there is no difference between the tested stock's actual daily returns and expected daily returns, based either on the observed returns of the market or the daily returns expected for that stock, and we will test all results against a 5% significance level.

Finally, we calculate the cumulative abnormal returns (CAR), which is the accumulation of all actual daily returns minus the expected daily returns, to evaluate if the announcement of Intel's grant from the CHIPS Act created an unexpected impact on investments during the event window (Schulman, 2024).

$$CAR = \sum_{t_1}^{t_n} AR_{i,t}$$

EMPIRICAL RESULTS

Company	**ADF Statistic**	**P-Value**
SolAero (Rocket Lab)	-12.2972	0.01
HP	-11.8437	0.01
Entegris	11.5146	0.01
Intel	-10.4025	0.01
Polar Power	-12.707	0.01
Microchip Technology	-11.7747	0.01
Amkor	-10.987	0.01
GlobalFoundries	-10.7816	0.01
Wolf Speed	-10.6045	0.01
Texas Instruments	-10.265	0.01
TSMC	-11.1843	0.01

Test for Stationarity

The Augmented Dickey-Fuller (ADF) test confirms that the daily returns data for all companies is stationary, as the p-value is below 0.05, and the ADF statistic is less than the critical value of -1.96 at the 0.05 significance level. This result confirms the stationarity of the daily returns, implying that both the mean (average daily returns) and variance of returns are consistent over time. This is important for analyzing abnormal returns during the event window, as it suggests that any observed abnormal returns will accurately reflect the event's impact (in this case, the grant announcement) on stock returns, rather than being influenced by any time-dependent trends.

Company	**WStatistic**	**P-value**
SolAero (Rocket Lab)	0.9311	2.08E-09
HP	0.8219	3.10E-16
Entegris	0.9942	4.45E-01
Intel	0.96141	2.99E-06
Polar Power	0.8575	8.58E-01
Microchip Technology	0.99585	0.7454
Amkor	0.89238	2.37E-12
GlobalFoundries	0.99157	0.1615
Wolf Speed	0.97147	6.57E-05
Texas Instruments	0.9528	3.05E-07
TSMC	0.9145	8.94E-11

Test for Normality

As noted by Brown and Warner (1985), daily stock returns often exhibit heavier tails than a normal distribution, which is reasonable given that stock prices can experience sharp increases or declines on certain days. The QQ plots generated for each company's stock data confirmed the

presence of fat tails. Since the t-test assumes normality, adjustments may be necessary to avoid potential bias in the analysis. The non-normal distribution suggests that the data includes more extreme events than would be predicted by a normal distribution.

We also performed the Shapiro-Wilk normality test to assess the distribution of our data. The resulting p-values for the 250-day data window were almost all below 0.05, leading us to reject the null hypothesis and conclude that the data is not normally distributed for those companies. However, for Microchip Technology and Global Foundries, the p-values were greater than 0.05, indicating that we failed to reject the null hypothesis of normality. Furthermore, the W-statistic for these two companies was closer to the expected value, suggesting that their stock returns follow a normal distribution.

Company	Coefficients		P-Value	T Statistic	Standard Error
SolAero (Rocket Lab)	α	-0.001685	0.494	-0.684	0.002462
	β	0.680554	2.81E-06	4.8	0.141779
HP	α	0.000188638	0.867213989	0.167379749	0.001127003
	β	0.318949724	1.70E-08	5.84164306	0.054599317
Entegris	α	-0.0009891	0.222	-1.223	0.0008085
	β	1.0793575	<2e-16	23.338	0.0462492
Intel	α	0.0003073	0.817	0.232	0.0013238
	β	0.7956477	<2e-16	10.589	0.0751384
Polar Power	α	-0.003375	0.346	-0.945	0.003573
	β	0.120212	0.536	0.62	0.193775
Microchip Technology	α	-0.00075	3.43E-01	-0.95085	0.000787
	β	0.943346	6.40E-58	21.59966	0.043674
Amkor	α	-0.906357	2.00E-16	0.010333	0.001219
	β	0.096659	2.00E-16	15.45024	0.070184
GlobalFoundries	α	-0.00241	1.37E-02	-2.48346	0.000972

	β	1.035158	1.80E-47	18.37274	0.056342
Wolf Speed	α	-0.00635	0.03495	-2.12113	0.002994
	β	1.345928	1.21E-19	9.926852	0.135585
Texas Instruments	α	0.00012150	0.86	0.177	0.0006864
	β	0.5468219	<2e-16	16.153	0.0338517
TSMC	α	0.0001922	0.832	0.213	0.0009038
	β	0.8677216	<2e-16	17.038	0.0509273

Expected Returns

The OLS Regression performed to find out the expected returns using the equation,

$$X_{i,t} = \hat{\alpha}_i + \hat{\beta}_i R_{m,t} + \epsilon_{i,t}$$

,where the α represents the expected average daily returns, β represents the systematic market risk, and $R_{m,t}$ represents observed market returns. The expected average daily returns are statistically significant for Microchip Technologies, Amkor, Global Foundries, and Wolf Speed. The positive α HP, Intel, Texas Instrument, and TSMC indicate that these companies have a historical tendency to outperform the market based on the 239-days estimation window. This further implies that if the abnormal returns for these companies are positive and statistically significant, it underlines that the event [the grant announcement] has a positive strong impact. The remaining stock of companies that are recipients of grants under Chips Act have shown a negative average daily return for the 239-day event window. A significant positive abnormal return alongside the negative alpha could be notable because the stock typically underperforms. The α represents the baseline expectation for normal stock behavior, so any conclusion about the event's impact should take into consideration this preexisting trend.

A statistically significant β coefficient, which represents a measure of systematic risk, allows isolating the abnormal returns by adjusting how stocks would normally react to market

movement. β is a measure of market sensitivity, so if β>1, the stock is more volatile than the market, and if β < 1, it is less volatile than the market. Except for Polar Power, all the other companies have statistical significance β, which means that the stock's return is strongly related to market returns. β coefficients for Entegris, Wolf speed, and GlobalFoundries are greater than 1 which suggests that their stocks are more volatile than the market. For the remaining companies, the beta value is less than 1 suggesting those stocks are less volatile than the market.

Abnormal Returns

$$A_{i,,t} = R_{i,t} - X_{i,t}$$

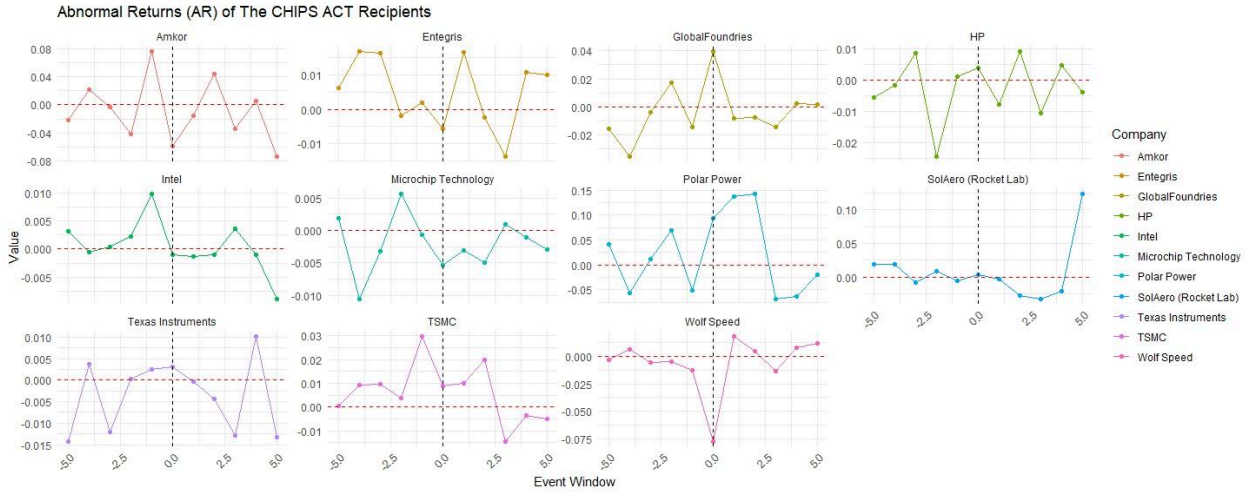
Since the Abnormal Return $A_{i,t}$ is the difference between actual returns $R_{i,t}$ and expected returns $X_{i,t}$, it directs us to determine the effect of the event on the stock returns by isolating the excess returns $A_{i,t}$. Except for Intel, all the companies have experienced either a positive or negative abnormal return on the event day. It could be possibly due to the surge in speculative trading and momentum buying and selling of stocks as investors react to the new information.

Polar Power, Entegris, Wolfspeed, and TSMC have exhibited a consistent increase in positive abnormal returns following the event day at t=1, suggesting that investors are highly confident in the companies' performance after receiving the grant. While Polar Power is a micro-cap company, TSMC, Entegris, and Wolfspeed are large-cap companies, indicating that investor confidence is strong across both small and large firms in response to the grant. Investors may interpret these grants as a sign of lower financial risk for these companies, leading to a positive adjustment in stock prices. The CHIPs Act grants may be viewed as catalysts for accelerated growth. Investors expect these companies to leverage the funding to increase

production capacity, enhance R&D, and fast-track technological advancements, improving long-term revenue and profitability prospects.

The post-event day abnormal returns are negative for companies such as Amkor, Intel, Texas Instruments, Microchip Technologies, GlobalFoundries, and HP. As Veronesi & Pastor (2012) suggested, there is typically an immediate drop in stock prices following an announcement. Our results confirm this, as the abnormal returns for more than half of the companies on day (t = 1) are negative. This indicates that the actual returns for these stocks were lower than the expected returns, suggesting that investors perceive uncertainty regarding the recipients of the CHIPs Act grants. One of the possible reasons for negative abnormal returns could be that receiving government funding may increase scrutiny from regulators and stakeholders, potentially adding pressure to meet heightened expectations (Xinle et al., 2021). If investors feel that meeting these expectations is challenging, they may perceive added risk, impacting stock prices negatively.

Chart1: Graphical Representation Abnormal Returns of CHIPS ACT Recipients



Source: Data retrieved from NASDAQ, visualized on R

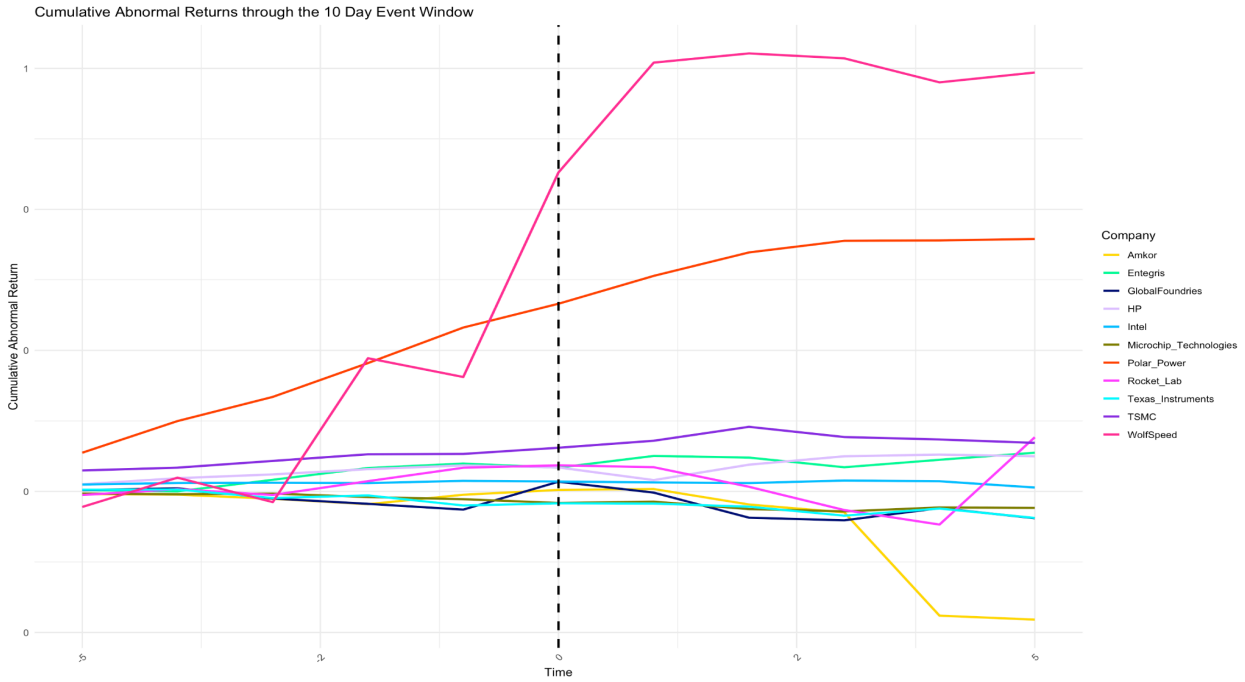
Does the incentive-size ratio have an impact on the average CAR of companies?

The incentive-size ratio analyzes the scale of the incentive relative to the size of the firm. The ratio would aid in understanding how the market interprets the incentive.We hypothesize that if the size of incentive is too small relative to the firm's size it may not have a substantial impact on the stock performance of the company.

Table 1 in the Appendix summarizes the incentive-size ratio of each company. The largest ratio was observed for Polar Power, a micro-cap stock. A ratio of 1.45 suggested the incentive size was larger than the firm's market capitalization. The ratio was lower than 5% of the market capitalization for eight of our stocks and under 1% for five of the stocks. HP had the smallest incentive-size ratio at 0.00148.

Cumulative Abnormal Returns

Chart 2: Representation of Cumulative Abnormal Returns of CHIPS ACT Recipients



Source: Data retrieved from NASDAQ, visualized on R

The slope coefficients, or beta, offered insights into the risk tied to each stock relative to

the market, in the estimation window. The beta coefficients of over 1 for Entegris, WolfSpeed and GlobalFoundries suggested that the stock was riskier. These findings are similar to MacKinlay, A. C. (1997).In the event period however, the cumulative abnormal returns appear to be stable for most stocks. Polar Power and WolfSpeed appear to be relatively volatile with sizable CAR's during the event period. Polar Power appears to have responded positively to the CHIPS ACT announcement. Pronounced differences were observed for WolfSpeed pre and post announcement.

Marginal decline was seen in the case of GlobalFoundries and Rocket Lab through most of the event window. Companies such as Entegris, Intel and TSMC achieved stable cumulative abnormal returns despite extremely small incentive to market cap ratios. The post-event stability could either indicate that the investors anticipated the news or that the news was perceived to have no real impact on the company performance as seen in Brown and Warber (1985). Companies with relatively larger incentive to market cap ratios such as GlobalFoundries, Amkor and Microchip Technologies were characterized by smaller cumulative returns. This inverse relationshipIn particular, Amkor saw the largest decrease in returns relative to expectations during their event window of all the companies in our study. All companies outside of Amkor saw positive or neutral reactions to the announcement of their CHIPS Act grant.

Table: T Test Results of Cumulative Abnormal Returns

Company Name	Mean CAR	t_statistic	p_value	Incentive-size Ratio
HP	0.03287	7.57553	0.00002	0.00368
Microchip Technologies	-0.01446	-5.10673	0.00046	0.00314
GlobalFoundries	-0.01590	-2.78552	0.01927	0.05377
Amkor	-0.04018	-1.92235	0.08348	0.04053
WolfSpeed	0.34579	4.11971	0.00208	0.02018

Entegris	0.03250	5.75801	0.00018	0.00368
Polar Power	0.24395	7.26903	0.00003	1.45915
TSMC	0.05979	10.31719	0.00000	0.00848
Intel	0.01228	14.63392	0.00000	0.06364
Rocket Lab	0.01116	1.09425	0.29950	0.01003
Texas Instruments	-0.01652	-4.12891	0.00205	0.00902

Source: Data retrieved from Nasdaq, Computed on R

H_0: The CHIPS Act had no significant impact on the company stock for the event period.

H_A: The CHIPS Act had a statistically significant impact on the stock performance of companies during the event period.

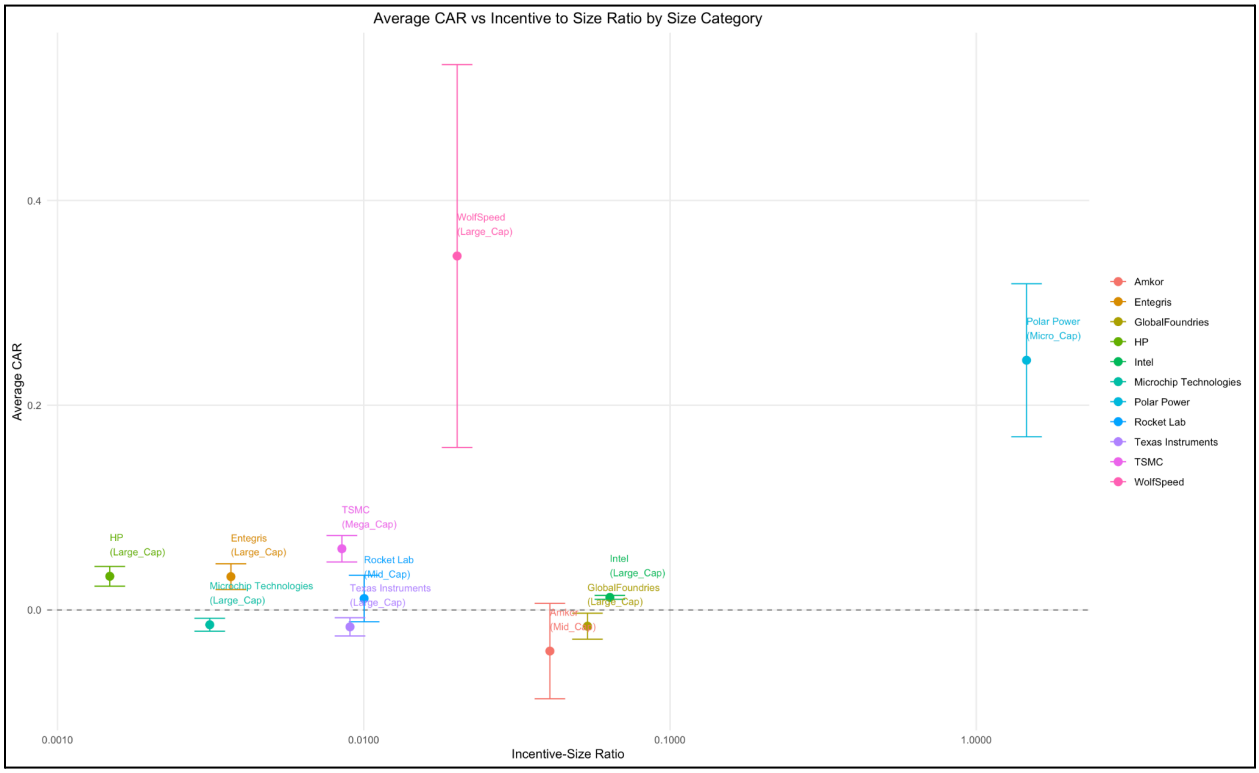
Statistical Significance: The p-values of Rocket Lab and Amkor were found to be over the 5% significance threshold. There is no sufficient evidence to state that the CHIPS ACT had a significant impact on the stock performance of those companies. The remaining company's cumulative abnormal returns were found to have p-values under our 5% mark. Therefore the CHIPS Act had a statistically significant effect on the CAR of our remaining companies.

Mixed Average Cumulative Abnormal Returns: Microchip Technologies, Texas Instrument and GlobalFoundries had negative cumulative abnormal returns on average for the 10-day event window. Large and Mega Cap companies were characterized by marginally positive cumulative abnormal daily returns around the announcement, on average. The large average return was observed for Polar Power.

Chart 2 shows the relationship between average cumulative abnormal returns and company's incentive-size ratio, used to help answer the company size part of our hypothesis. While an initial look at the chart may suggest a reasonably positive correlation between average CAR and incentive-size ratio, WolfSpeed and Polar Power are drastically pulling the average up while most others have an average lingering around zero. Despite this, only Amkor and Rocket

Lab show insignificant average CAR's, though other companies vary between results above zero versus below zero. Overall, no correlation between average cumulative abnormal returns and incentive-size ratio appears to exist, though most companies have registered significant changes to their daily returns from grant announcements.

Chart 3 : Graphical Representation of Average CAR against Incentive to Size Ratio of Companies



Source: Data retrieved from Nasdaq, visualized on R

CONCLUSION

When the CHIPS Act was passed in 2022, it presented an opportunity to get an industry in decline over the previous 30 years back on track. At least 11 companies with stocks traded in the United States have received grants through the CHIPS Act over the past two years, and these companies saw mixed immediate reactions from the market as evidenced by our analysis of the

cumulative abnormal returns for each company during their event window. Although some companies saw statistically significant returns around the time of their grant announcement, several other companies in our study saw no real change in returns from what was expected by market forecasters while others saw significant declines from their expected daily returns. These results seem to indicate that the market does not necessarily view the CHIPS Act as an absolute win for any company receiving a grant, but rather evaluates each company awarded a grant on a case-by-case basis.

Part of our hypothesis was that smaller companies receiving CHIPS Act grants would see greater stock improvement than the larger companies in our study. These results were hindered in part because only one of our 11 studied companies was a micro-cap sized company, while only two were midsize. We did not find direct evidence in either direction as to which size of companies reap the greatest benefits from receiving a grant. Despite this, we did find that of our three companies with a micro-cap or midsize-cap market capitalization, two of them went from negative returns before their grant announcement to positive returns following the announcement, so even as we remain unsure if they saw greater benefits than their larger counterparts, we are confident that the CHIPS Act is beneficial to smaller semiconductor companies.

The results from this Event Study capture a snapshot of the moment the world discovered each company was getting aid from the CHIPS Act, showing us the first impression the market had of these CHIPS Act grants. First impressions are memorable and can often affect how people and things are perceived going forward, but they are not the end of the story. The work necessary to fully carry out the CHIPS Act will continue through 2026, and more studies will need to be conducted to learn the full impact this law will have on the semiconductor industry and all other

technology sectors that depend on chips. Once a few more years of data accumulates, future studies can be conducted on the CHIPS Act's effect on U.S. economic growth, employment, and further technological innovation due to a supply of semiconductors ready to match our country's growing demand for technology.

APPENDIX

Table A: Grouping of Companies based on Incentive and Company Size

Market Capitalization(Million)	**Company**	**Incentive Amount Grant Only (In Millions USD)**	**Incentive to Size Ratio**
133,573.61	Intel	100	0.000748650875
33,749.40	HP	50	0.001481507937
51,560.71	Microchip Technology	162	0.003141926977
20,359.62	Entegris	75	0.003683762729
777,982.00	TSMC	6600	0.008483486794
2,383.20	SolAero (Rocket Lab)	23.9	0.01002851592
177,453.50	Texas Instruments	3200	0.01803289334
37,169.37	Wolf Speed	1500	0.0403558144
9,870.18	Amkor	400	0.0405261304
27,897.87	GlobalFoundries	1500	0.05376754824
84.3	Polar Power	123	1.459148511

WORKS CITED

Beechey, M.J., Gruen, D.W., & Vickery, J.I. (2000).The Efficient Market Hypothesis: A Survey.

Brown, S. J., & Warner, J. B. (1985). Using daily stock returns: The case of event studies.Journal of Financial Economics, 14(1), 3-31. https://doi.org/10.1016/0304-405X(85)90042-X.

Chen, Y., Wang, Y., Hu, D., & Zhou, Z. (2020). Government R&D subsidies, information asymmetry, and the role of foreign investors: Evidence from a quasi-natural experiment on the shanghai-hong kong stock connect. Technological Forecasting and Social Change, 158, 120162.

Criscuolo, C., Martin, R., Overman, H.G., & Reenen, J.V. (2019). Some Causal Effects of an Industrial Policy.American Economic Review.

Dixon, J.M., & Nassios, J. (2018). The Effectiveness of Investment Stimulus Policies in Australia.

H.R.4346 - 117th Congress (2021-2022): Supreme Court Security Funding Act of 2022 | congress.govlibrary of Congress. https://www.congress.gov/bill/117th-congress/house-bill/4346.

Intelligence, fDi.The world's top semiconductor investors. fDi Intelligence – Your source for foreign direct investment information - https://www.fdiintelligence.com/content/data-trends/the-worlds-top-semiconductor-investors-82433.

King, I., Wu, D., & Pogkas, D. (2021, March 29). *Why is there a chip shortage? covid-19, surging demand cause semiconductor shortfall*. Bloomberg.com. https://www.bloomberg.com/graphics/2021-semiconductors-chips-shortage/

Miller, C. (2022, October 13). *"chip war" traces the evolution of the semiconductor industry*. The Economist. https://www.economist.com/culture/2022/10/13/chip-war-traces-the-evolution-of-the-semiconductor-industry

Miller, Douglas L. 2023. "An Introductory Guide to Event Study Models." Journal of Economic Perspectives, 37 (2): 203–30. DOI: 10.1257/jep.37.2.203

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of economic literature*, *35*(1), 13-39.

Malkiel, B.G. (2003). The Efficient Market Hypothesis and Its Critics. Journal of Economic Perspectives, 17(1), 59-82.

Mazewski, M., & Flores, C. (2022, May). Economic impacts of the Chips for America Act. Data for Progress. https://www.filesforprogress.org/memos/USICA_Semiconductors.pdf.

McColl, B. (2024, October 15). *Wolfspeed stock soars as semiconductor maker gets Chips Act,*

Apollo financing. Investopedia. https://www.investopedia.com/wolfspeed-stock-soars-as-semiconductor-maker-gets-chips-act-apollo-financing-8728232

Ravi, S. (2023, July 27). The state of the industry report highlights challenges and opportunities facing U.S. chip industry. Semiconductor Industry Association. https://www.semiconductors.org/the-state-of-the-industry-report-highlights-challenges-and-opportunities-facing-u-s-chip-industry/.

Rep. Ryan, Tim [D-OH-13]. (2022, November 8). *H.R.4346 - 117th Congress (2021-2022): Chips and science act | congress.gov | library of Congress*. Congress.gov. https://www.congress.gov/bill/117th-congress/house-bill/4346

Schulman, C. (2024, September 26). Learning about Event Studies with Dr. Craig Schulman. personal.

Stephen J. Brown, Jerold B. Warner, Using daily stock returns: The case of event studies, Journal of Financial Economics, Volume 14, Issue 1, 1985, Pages 3-31, ISSN 0304-405X, https://doi.org/10.1016/0304-405X(85)90042-X.

VERONESI, P., & PÁSTOR, L. (2012). Uncertainty about Government Policy and Stock Prices. The Journal of American Finance Association, 67(4).

Xinle, T., Zhen, W., & Xinting, L. (2021). The influence of government subsidy on enterprise innovation: based on Chinese high-tech enterprises. Economic Research-Ekonomska Istraživanja, 35(1), 1481–1499. https://doi.org/10.1080/1331677X.2021.1972818.