Employment Impacts of the CHIPS Act

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  - Industrial policy was long “submerged,” operating especially through defense procurement.
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  - National security.
  - Resilience to shocks (e.g. covid).
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- Motivations:
  - National security.
  - Resilience to shocks (e.g. covid).
  - Creating good, high-paying jobs.
- We focus on employment.
  - Has the act created jobs? How many?
  - Politically salient, in past and probably future.

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  - Counties with semiconductor facility vs. counties with high-tech employment but no semiconductor facility.
  - Counties with semiconductor fabrication facility ("fab") vs. counties with semiconductor facility but no fab.

Main Findings

1. Anticipation effects (à la Ramey (2011)).
   - Began with introduction of pre-cursor bill (USICA) in Senate.
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- Back-of-the-envelope calculations of national effects:
  - Direct effect: 14,900-20,860 jobs.
  - Indirect effect: 28,310-32,780 jobs.
  - Not enormous relative to projected spending of $52.7 billion.
  - But larger than many expected, given industry capital-intensity.

Background

- Components of CHIPS Act:
  - \$39 billion: direct subsidies for production of semic¡+-¿onductors and related equipment and materials.
  - \$11 billion: R&D funding.
  - 25% investment tax credit.
    - Increased to 35% in July 2025.

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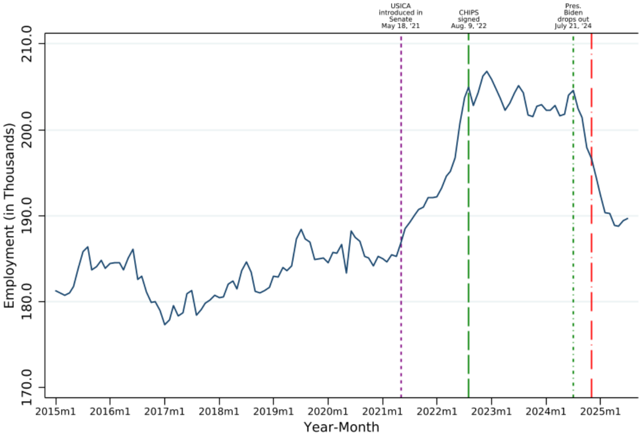
  - 25% investment tax credit.
    - Increased to 35% in July 2025.
- Timing:
  - May-June 2020: Endless Frontiers, CHIPS for Americas Acts introduced.
  - May 18, 2021: US Innovation and Competition Act (USICA) introduced.
  - June 8, 2021: USICA passed Senate 68-32 (with 19 Rep. votes).
  - Feb. 4, 2022: America COMPETES Act passed House.
  - July 27-28, 2022: CHIPS and Science Act passed Senate & House.
  - Aug. 9, 2022: CHIPS and Science Act signed by Biden.
  - Nov. 15, 2024: First major CHIPS Award finalized.

Employment in Semiconductors

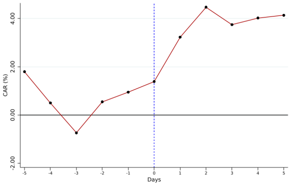


Notes: Figure plots national employmnet in the semiconductor industry (NAICS 334413) from the Current Employment Statistics (National Series).

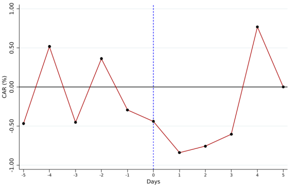
Using QCEW

Stock Market Reaction: Cumulative Abnormal Returns

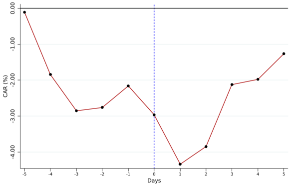
A. May 18, 2021



B. June 8, 2021



C. July 28, 2022



Notes: Cumulative Average Abnormal Returns (CAARs) for 21 seminconductor firms. Abnormal Returns (ARs) calculated by estimating the regression $R_{it} = \gamma_i R_{mt} + \alpha_i + \varepsilon_{it}$, where R_{it} is firm i's return and R_{mt} is the S&P 500's return, over the period 250 days to 30 days before the event, and then defining $AR_{it} = R_{it} - \widehat{\gamma}_i R_{mt} - \widehat{\alpha}_i$ for the indicated event window. The ARs are averaged across firms and summed across event window to get CAARs.

CAARs Table

More Background

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  - CEO Caulfield later told CNBC: "We believe that for economies of scale and the ability to bring capacity online quicker it's better to expand existing facilities."
- Covid chips shortage evident by Jan. 2021 (King et al., 2021).

Data

- Main datasets:
  - Quarterly Census of Employment and Wages (QCEW)
    - Draws on administrative records from unemployment systems.
    - 6-digit industry (e.g. NAICS 334413), county, quarter level.
    - Extensive suppression/non-disclosure to preserve confidentiality.
    - Main estimates: impute zeros for missings. Robustness: drop missings.

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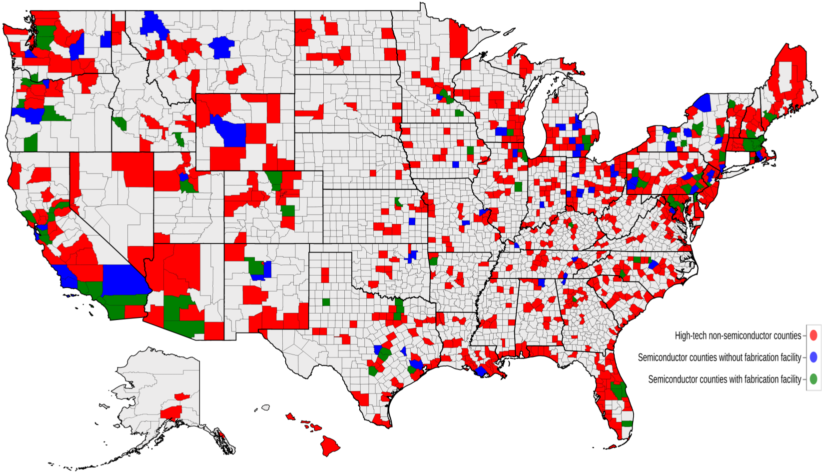
- Secondary datasets:
  - Quarterly Workforce Indicators (QWI).
  - Bureau of Economic Analysis (BEA) County GDP series.
  - Current Employment Survey.

Treatment & Control Groups



Source: Semiconductor Industry Association's (SIA) U.S. Semiconductor Ecosystem Map. Counties with a pre-existing fabrication facility are marked in green. Counties with pre-existing semiconductor facility but no fabrication facility are marked in blue. Counties with employment >100 in 11 high-tech sectors (defined by Census Bureau) but no pre-existing semiconductor production facility are marked in red.

Specifications

- Simple D-in-D:

$$Y_{it} = \mu + \alpha_i + \gamma_t + \beta \cdot \text{Treated}_i \cdot \text{Post}_t + \varepsilon_{it}$$

- D-in-D event study:

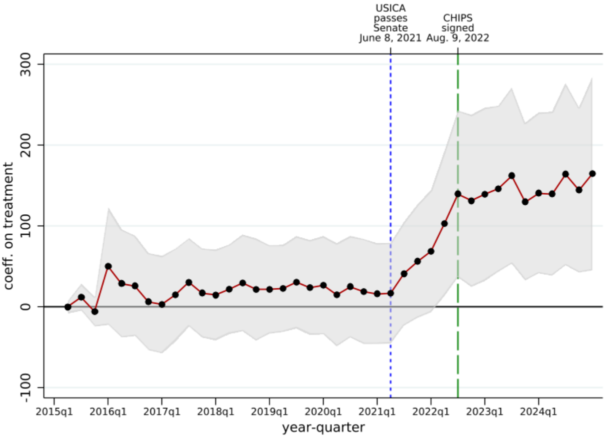
$$Y_{it} = \mu + \alpha_i + \gamma_t + \sum_{\tau=2015q2}^{2024q4} \beta_\tau \cdot D_{i,t}^{\tau} + \varepsilon_{it}$$

- Synthetic D-in-D (Arkhangelsky et al., 2021):

$$\left(\hat{\beta}, \hat{\mu}, \hat{\alpha}, \hat{\gamma}\right) = \underset{\beta,\mu,\alpha,\gamma}{\arg\min} \left\{ \sum_{i=1}^{n} \sum_{t=2015q1}^{2024q4} \left(Y_{it} - \mu - \alpha_i - \gamma_t - W_{it}\beta\right)^2 \hat{\omega}_i \hat{\lambda}_t \right\}$$

- Key assumption: Treatment & control groups (possibly with reweighting) would have been on parallel trends in absence of CHIPS.

Employment, Simple D-in-D, Semi vs High-Tech



Notes: Event-study specification. Outcome is the number of workers employed in the semiconductor sector (NAICS industry code 334413). Source is QCEW 6-digit data. Sample includes all counties with at least 100 workers in 11 high-tech sectors, as defined in Census Bureau (2024), as of 2021Q1. Shaded area is 95% confidence interval. Standard errors are clustered at the county level.

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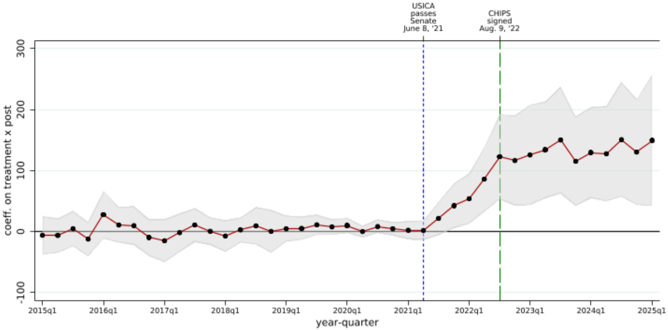

Notes: QCEW 6-digit data. Outcome is the number of workers employed in the semiconductor sector (NAICS industry code 334413). Estimated treatment effects produced by implementing the event-study estimator proposed by Clarke et al. (2024). Shaded area is confidence interval at the 95% level. Standard errors are clustered at the county level.

Employment, Simple D-in-D, Semi vs High-Tech

	Semiconductor production employment (1)	Semiconductor equipment & materials employment (2)	Semiconductor production, equipment & materials employment (3)
Panel A: Treatment effect post-USICA			
Treated x Post-USICA	106.087***	34.810**	140.898***
	(39.905)	(16.819)	(50.166)
Observations	36941	36941	36941
Pre-USICA outcome mean (treated counties)	868.8	164.5	1033.3
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated x Post-CHIPS	127.543***	36.088**	163.631***
	(46.912)	(18.252)	(57.996)
Observations	31535	31535	31535
Pre-USICA outcome mean (treated counties)	868.8	164.5	1033.3
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y

Notes: QCEW 6-digit data 2015Q1-2025Q1. In Panel A, the "Post" indicator identifies quarters after USICA passed in the U.S. Senate. In Panel B, the "Post" indicator identifies quarters after the CHIPS Act was signed into law. Panel B omits the time period from USICA until CHIPS Act for comparing outcomes after CHIPS Act to those prior to the precursor of CHIPS, the USICA. Outcome in Column 1 is the number of workers employed in the semiconductor sector (NAICS industry code 334413). Outcome in Column 2 is the number of workers employed in the manufacturing of equipment (NAICS 333242) or material inputs (NAICS 325120, 325180) for semiconductors. Outcome in Column 3 is the number of workers employed in either the semiconductor industry or the manufacturing of equipment (NAICS 333242) or material inputs (NAICS 325120, 325180) for semiconductors. Standard errors clustered at county level. *p $<$0.10; **p $<$0.05; ***p $<$0.01.

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	Semiconductor production employment (1)	Semiconductor equipment & materials employment (2)	Semiconductor production, equipment & materials employment (3)
Panel A: Treatment effect post-USICA			
Treated x Post-USICA	110.411***	15.755	124.082***
	(35.189)	(11.996)	(38.533)
Observations	36941	36941	36941
Pre-USICA outcome mean (treated counties)	868.8	164.5	1033.3
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated x Post-CHIPS	133.055***	13.836	142.392***
	(43.520)	(15.049)	(48.336)
Observations	31535	31535	31535
Pre-USICA outcome mean (treated counties)	868.8	164.5	1033.3

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Spillovers, Synthetic D-in-D, Semi vs High-Tech

	Semiconductor inputs employment (1)	Non-residential construction employment (2)	Total county employment (3)	County GDP (00,000s USD) (4)
Panel A: Treatment effect post-USICA				
Treated x Post-USICA	53.807**	135.779**	-2246.017	-4.590
	(25.688)	(56.641)	(2643.470)	(5.061)
Observations	36941	36941	36941	7920
Pre-USICA outcome mean (treated counties)	1069.256	1800.271	307456.376	590.851
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3				
Treated x Post-CHIPS	59.478*	159.816**	-3238.834	-5.378
	(34.654)	(78.206)	(3155.699)	(5.947)
Observations	31535	31535	31535	7040
Pre-USICA outcome mean (treated counties)	1069.256	1800.271	307456.376	590.851

Notes: Outcome in Column 1 is the aggregate number of workers employed in the input sectors for semiconductors (NAICS codes 331410, 334418, 334412, 334416, 334417, 334419, 326112, 326113, 334118, 334515 and 811310). Outcome in Column 2 is the number of workers employed in non-residential construction building construction (NAICS 541713 and 541715). Outcome in Column 3 is the total county employment (All 6-digit NAICS industries aggregated). The pre-USICA outcome mean is the outcome mean for treated counties for the 2015Q1-2021Q1 period. The employment numbers are obtained from the BLS Quarterly Census of Employment and Wages. Outcome in Column 4 is the yearly county GDP in hundred thousands of chained US dollars. County level GDP numbers are only available on the year level until 2023 and are obtained from Bureau of Economic Analysis. *p $<$0.10; **p $<$0.05; ***p $<$0.01.

Additional Results

- Robustness:
  - Not imputing zeros for missings. No imputation
  - Doing analysis at 4-digit level, using QWI to supplement QCEW. 4-digit 4-digit no imp.
- Wages:
  - Generally find positive effects, but less robust than employment effects. Wages Wages no imp.

Employment, Simple D-in-D, Fab vs Fabless

	Semiconductor production employment (1)	Semiconductor equipment & materials employment (2)	Semiconductor production, equipment & materials employment (3)
Panel A: Treatment effect post-USICA			
Treated x Post-USICA	191.345***	78.533**	269.878***
	(70.800)	(31.212)	(88.806)
Observations	6109	6109	6109
Pre-USICA outcome mean (treated counties)	1523.5	238.1	1761.6
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated x Post-CHIPS	229.122***	82.931**	312.053***
	(83.147)	(34.247)	(102.710)
Observations	5215	5215	5215
Pre-USICA outcome mean (treated counties)	1523.5	238.1	1761.6
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y

Notes: Treated counties are ones that have a semiconductor production facility; control counties are ones that have a semiconductor facility but not a production facility (e.g. are fabless). Under this definition, treatment group is 125 counties, control group is 24 counties.

Employment, Synthetic D-in-D, Fab vs Fabless

	Semiconductor production employment (1)	Semiconductor equipment & materials employment (2)	Semiconductor production, equipment & materials employment (3)
Panel A: Treatment effect post-USICA			
Treated x Post-USICA	180.131***	27.269	210.942***
	(52.476)	(18.312)	(64.336)
Observations	6109	6109	6109
Pre-USICA outcome mean (treated counties)	1523.5	238.1	1761.6
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated x Post-CHIPS	217.933***	28.452	252.678***
	(62.164)	(20.637)	(76.549)
Observations	5215	5215	5215
Pre-USICA outcome mean (treated counties)	1523.5	238.1	1761.6

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  - Labor mobility between treated and control counties within semiconductors is likely small.
  - CHIPS funding is modest relative to macro-economy.

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  - Labor mobility between treated and control counties within semiconductors is likely small.
  - CHIPS funding is modest relative to macro-economy.
- Scaling up D-in-D estimate gives roughly the increase observable in raw time-series data.
  - Estimate from raw time series: 18,000.
  - Estimate from scaling up D-in¡+-¿-D estimate (semi vs. high-tech): 14,900-20,860.

Conclusion

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- CHIPS Act raises important issues about design of industrial policy:
  - Targeted subsidies vs. tax credits?
  - How can government claim part of upside?
  - Should social policy be embedded in industrial policy?

References I

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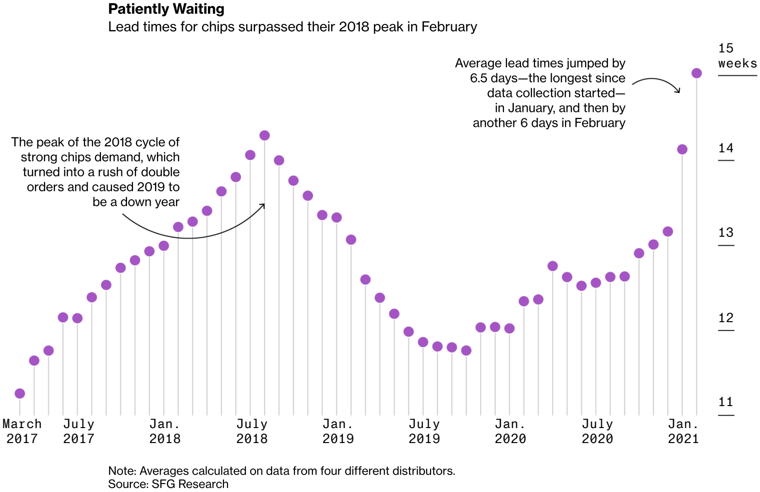
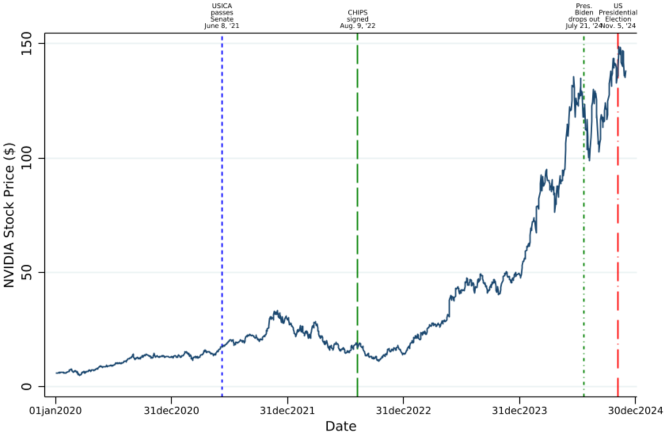
Chips Shortage Evident in Jan. 2021



Source: King et al., Bloomberg News, March 29, 2021.

Return

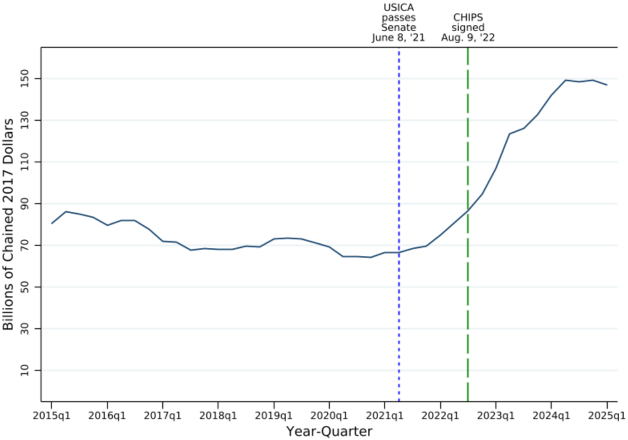
Nvidia


USICA passes Senate June 8, '21
CHIPS signed Aug. 9, '22
Pres. Biden drops out July 21, '24
US Presidential Election Nov. 5, '24
NVIDIA Stock Price ($)
0
50
100
150
01jan2020
31dec2020
31dec2021
31dec2022
31dec2023
30dec2024
Date

Design Issues

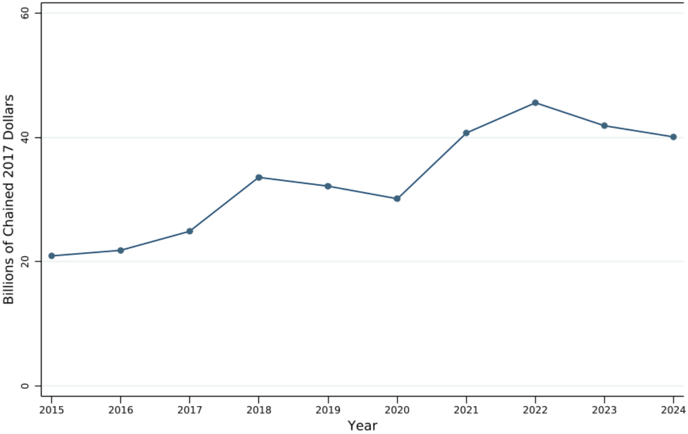
- Targeted subsidies vs. tax credits
  - Pros for targeted subsidies:
    - Less fiscal uncertainty.
    - Greater transparency about which firms benefit.
    - More flexible when there are multiple market failures, and/or redistribution is a social goal.
  - Cons for targeted subsidies:
    - Gov't may bear a larger share of cost of mistakes.
    - Discretion → possibility of political capture.
- How can government claim upside potential?
  - Ownership stakes can generate benefits to taxpayers and restrain rent-seeking.
  - But again, discretion → possibility of political capture.
  - Loans combined with warrants (purchase options) may be preferable.
- Should social policy be embedded in industrial policy?
  - Admittedly poses problems for intellectual consistency.
    - If childcare is desirable, why not require it of all sectors?
  - Political compromise is pragmatic and necessary.

Investment in Structures in Manufacturing



Source: U.S. Bureau of Economic Analysis, Gross Private Domestic Investment and Capital Transfers: Private Fixed Investment in Structures by Type, Chained dollars: Manufacturing. Data are seasonally adjusted and annualized (by BEA). Dotted blue line indicates Q2 of 2022, when the USICA was passed and the dotted green line indicates Q3 of 2022 when the CHIPS Act and Inflation Reduction Act (IRA) were passed. Y-axis is investment per quarter.

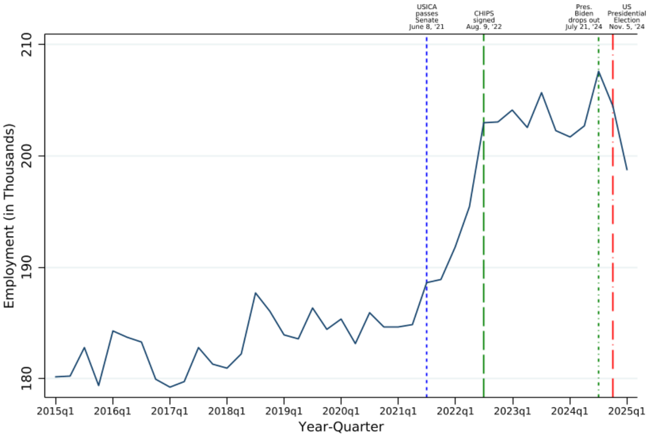
Plant/Property/Equipment Spending, Semi. Firms



Source: Security and Exchange Commission Form 10-K filings by semiconductor firms. Following the Semiconductor Industry Association, the following firms are included: Akoustis, AMD, Analog Devices, Broadcom, Cirrus Logic, Global Foundaries, Intel, Lattice Semiconductor, Littelfuse, Luminar, Marvell, Microchip, Micron, Nvidia, ONSEMI, Qorvo, Qualcomm, Silicon Labs, Skywater, SkyWorks, Texas Instruments, Western Digital, and Wolfspeed. The y-axis variable is total purchases of property, plant and equipment for the above firms in billions of 2017 dollars. The 10-K forms report purchases for entire calendar year; 2021 thus includes more than six months following the Senate passage of USICA on June 8, 2021.

CAR figure

Semiconductor Employment, using QCEW



Notes: Y-axis is the total number of workers in the semiconductor industry (NAICS 334413) across the United States, as reported in the BLS Quarterly Census of Employment and Wages.

Return

Employment, Simple D-in-D, No Imputation

	Semiconductor production employment (1)	Semiconductor equipment & materials employment (2)	Semiconductor production, equipment & materials employment (3)
Panel A: Treatment effect post-USICA			
Treated x Post-USICA	176.681**	68.035**	244.716**
	(75.985)	(33.372)	(97.154)
Observations	27157	27157	27157
Pre-USICA outcome mean (treated counties)	1593.5	285.9	1879.3
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated x Post-CHIPS	219.107**	72.493*	291.600**
	(92.304)	(37.127)	(115.628)
Observations	23218	23218	23218
Pre-USICA outcome mean (treated counties)	1593.5	285.9	1879.3
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y

Return

Employment: Simple D-in-D, 4-digit

	Semiconductor production employment (1)	Semiconductor equipment & materials employment (2)	Semiconductor production, equipment & materials employment (3)
Panel A: Treatment effect post-USICA			
Treated x Post-USICA	76.195*	83.415***	159.609***
	(44.515)	(25.525)	(61.753)
Observations	43747	43747	43747
Pre-USICA outcome mean (treated counties)	1716.142	552.479	2268.621
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated x Post-CHIPS	92.916*	94.609***	187.525**
	(52.904)	(29.166)	(72.915)
Observations	37345	37345	37345
Pre-USICA outcome mean (treated counties)	1716.142	552.479	2268.621
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y

Return

Employment, Simple D-in-D, No Imputation, 4-digit

	Semiconductor production employment (1)	Semiconductor equipment & materials employment (2)	Semiconductor production, equipment & materials employment (3)
Panel A: Treatment effect post-USICA			
Treated x Post-USICA	83.703*	94.465***	178.168**
	(50.370)	(28.642)	(69.657)
Observations	33273	33273	33273
Pre-USICA outcome mean (treated counties)	1929.851	606.507	2536.358
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated x Post-CHIPS	102.111*	107.044***	209.155**
	(59.689)	(32.666)	(82.041)
Observations	28433	28433	28433
Pre-USICA outcome mean (treated counties)	1929.851	606.507	2536.358
County FE	Y	Y	Y
Year-Quarter FE	Y	Y	Y

Return

Wages, Simple D-in-D, Semi vs. High-Tech

	Semiconductor wages (1)	Semiconductor equipment & materials wages (2)	Semiconductor production, equipment & materials wages (3)
Panel A: Treatment effect post-USICA			
Treated × Post-USICA	254.233**	95.027**	268.961***
	(99.656)	(38.288)	(99.652)
Observations	36941	36941	36941
Pre-USICA outcome mean (treated counties)	822.8	409.2	923.5
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated × Post-CHIPS	261.672**	107.926**	273.105***
	(101.537)	(45.983)	(100.863)
Observations	31535	31535	31535
Pre-USICA outcome mean (treated counties)	822.8	409.2	923.5

Return

Wages, Simple D-in-D, No Imputation

	Semiconductor wages (1)	Semiconductor equipment & materials wages (2)	Semiconductor production, equipment & materials wages (3)
Panel A: Treatment effect post-USICA			
Treated × Post-USICA	328.889**	123.085**	294.889**
	(149.634)	(52.739)	(147.968)
Observations	27157	27157	27157
Pre-USICA outcome mean (treated counties)	1412	593.8	1452.8
Panel B: Treatment effect post-CHIPS, omitting 2021Q2-2022Q3			
Treated × Post-CHIPS	305.651**	141.957**	270.644*
	(145.188)	(65.103)	(142.802)
Observations	23218	23218	23218
Pre-USICA outcome mean (treated counties)	1412	593.8	1452.8

Return

Cumulative Abnormal Returns

	Event Window							
(-1,1)			(-3,3)			(-5,5)		
CAAR	SE	p-val	CAAR	SE	p-val	CAAR	SE	p-val
Panel A: USICA Introduction (May 18, 2021)								
0.0273***	0.4848	0.0000	0.0338***	0.4002	0.0000	0.0430***	0.4698	0.0000
Panel B: USICA Senate Passage (June 8, 2021)								
-0.0117***	0.5856	0.0070	-0.0105	0.6266	0.1440	0.0014	0.6169	0.5490
Panel C: CHIPS Senate Passage (July 28, 2022)								
-0.0152	1.5295	0.1580	-0.0016	0.9623	0.6600	-0.0107	0.9821	0.3940

Notes: Cumulative Average Abnormal Returns (CAARs) around major semiconductor policy events are calculated as follows (using the Stata estudy command). We first calculate Abnormal Returns (ARs) by estimating the regression $R_{it} = \gamma_i R_{mt} + \alpha_i + \varepsilon_{it}$, where R_{it} is firm i's return and R_{mt} is the S&P 500's return, over the period 250 days to 30 days before the event, and then defining $AR_{it} = R_{it} - \widehat{\gamma}_i R_{mt} - \widehat{\alpha}_i$ for the indicated event window. The ARs are averaged across firms and then summed across the event window to get CAARs. Inference is based on the Boehmer–Musumeci–Poulsen (BMP) test. Windows are indicated in days. The sample excludes Global Foundries and Skywater, who began trading on October 28, 2021 and April 21, 2021, respectively. *p $<$0.10; **p $<$0.05; ***p $<$0.01.

Return Sample