DATA FOR *PROGRESS*

Economic Impacts of the US Innovation and Competition Act

Matt Mazewski and Christian Flores

March 2022

Introduction and Summary of Findings

On June 8, 2021, the U.S. Senate passed the United States Innovation and Competition Act (USICA), an ambitious piece of legislation that would dramatically increase federal investments in scientific and technological research and development (R&D). The bill has enjoyed the support of both Democratic and Republican senators, and was overwhelmingly approved by a vote of 68-32.[1]

Although USICA has received much less media attention than the Infrastructure Investment and Jobs Act (the so-called "Bipartisan Infrastructure Law"), a press release from the office of Majority Whip Dick Durbin (D-IL) maintained that it would constitute "the largest investment in U.S. science and technology leadership since the Apollo era."[2]

In this memo, we make use of the Data for Progress Jobs Model to conduct a macroeconomic analysis of USICA. **We find that the appropriations provisions of this legislation would, if enacted, contribute between $44 billion and $51 billion per year to U.S. GDP from 2022 through 2027, and would create or preserve a total of between 2.6 million and 3.0 million jobs over the same period.**

The forecasts in this memo could be underestimates of the true economic impact of USICA, since they are necessarily based on a model of the industrial structure of the U.S. economy as it currently exists. **In the case of a bill that promises to catalyze productivity-enhancing innovations across sectors, there is potential — if difficult to measure — for even greater gains than our estimates suggest.**

1 A similar but even larger bill called the America COMPETES Act cleared the House on February 4, 2022. A conference committee will now need to negotiate a compromise agreement that can pass both chambers. For our modeling purposes, however, we focus on the text of the Senate bill.

2 "Press Release: Durbin Urges Final Passage Of Bipartisan U.S. Innovation And Competition Act On Senate Floor," February 8, 2022, available at https://www.durbin.senate.gov/newsroom/press-releases/durbin-urges-final-passage-of-bipartisan-us-innovation-and-competition-act-on-senate-floor.

Overview of USICA

USICA totals over 2,300 pages and brings together a number of bipartisan proposals into a single legislative vehicle.[3] Its notable major appropriations include:[4]

- **$81 BILLION FOR THE NATIONAL SCIENCE FOUNDATION (NSF),** including for R&D of emerging technologies like artificial intelligence and quantum computing;
- **$52.7 BILLION TO SPUR INNOVATION IN THE DOMESTIC MICROELECTRONICS INDUSTRY** and to reduce reliance on imported semiconductors, thereby curbing shortages and mitigating cybersecurity threats;
- **$17.5 BILLION FOR THE DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA)**, which has historically played a role in the development of technologies that have later found valuable civilian applications, such as GPS, the internet, weather satellites, and mRNA vaccines;
- **$16.9 BILLION FOR THE DEPARTMENT OF ENERGY** to "carry out research and development and address energy-related supply chain activities within the key technology focus areas";
- **$10 BILLION FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)**, including to advance the Artemis program to land the first woman and next man on the moon and "establish sustainable lunar exploration by 2028";
- **$10 BILLION TO ESTABLISH A "REGIONAL TECHNOLOGY HUB PROGRAM,"** which would create partnerships among government, academia, private industry, and labor unions to "enable United States leadership in technology and innovation sectors critical to national and economic security."

Table 1 shows our estimates of the total domestic spending authorized by USICA over the period from 2022 to 2027, including those appropriations that may have been made anyway under current policy. These estimates omit spending that we expect would not contribute to domestic economic activity, such as Section 3250's infusion of capital to the Inter-American Development Bank, which provides financing to support economic development in Latin American and Caribbean nations.

TABLE 1: DOMESTIC USICA SPENDING, 2022-2027[5]

	2022	2023	2024	2025	2026	2027	Total
Spending (billions of dollars)	79.32	33.84	38.78	42.59	45.67	0.10	240.30

3 For a more detailed summary of USICA's provisions, see "The United States Innovation and Competition Act of 2021: Section-by-section summary," available at https://www.democrats.senate.gov/imo/media/doc/USICA%20Section-by-Section%205.19.21.pdf.

4 In our modeling exercise we focus only on the spending-related provisions of the bill. Since literally hundreds of different goods are impacted by the tariff and duty changes in Division G, we treat these measures as beyond the scope of the current analysis.

5 Author calculations. We assign to 2022 spending stipulated in the bill as being for Fiscal Year 2021.

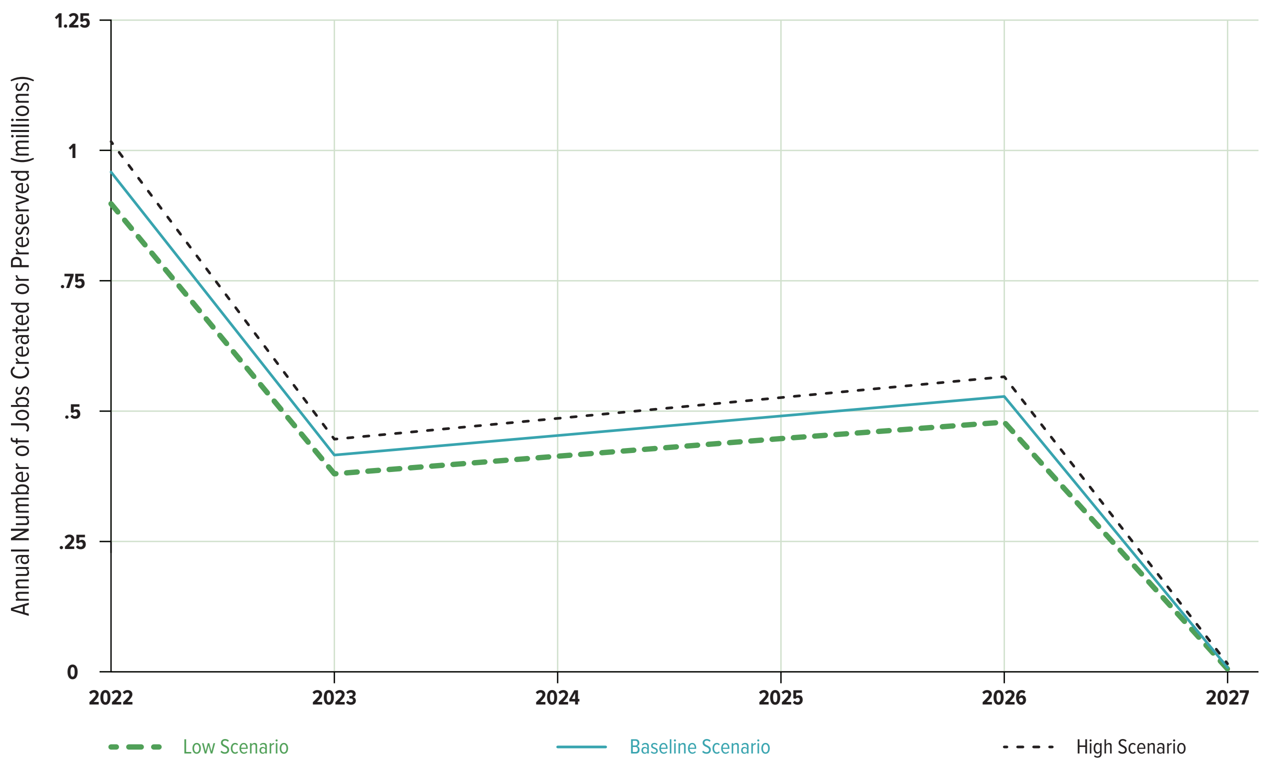
Model Results

The following table and figure display our estimation results for the aggregate employment effects of USICA from three separate model runs that are based on slightly different underlying assumptions.[6] Appendix A describes in greater detail precisely how these three scenarios differ, but this exercise allows us to offer a range of plausible jobs estimates.

TABLE 2: AGGREGATE EMPLOYMENT EFFECTS, 2022-2027

	2022	2023	2024	2025	2026	2027	TOTAL
Annual Number of Jobs Created or Preserved — Low Scenario	880,093	371,771	422,297	456,450	480,360	791	2,611,762
Annual Number of Jobs Created or Preserved — Baseline Scenario	947,793	400,369	454,781	491,562	517,311	852	2,812,668
Annual Number of Jobs Created or Preserved — High Scenario	1,015,492	428,967	487,266	526,673	554,262	913	3,013,573

Figure 1 — Aggregate Employment Effects, 2022-2027



6 Estimates of employment increases are obtained by using data from the Bureau of Economic Analysis (BEA) to calculate the ratio of gross output to employment in each industry in 2020 (the most recent year for which data are available), and then multiplying the output effects from our model by these ratios.

Since nearly a third of the proposed spending in USICA would take place in the first fiscal year after enactment, we find that the jobs effects would be similarly frontloaded. In Table 3 we show a breakdown of total job creation by industry from the baseline scenario. We find that about half of these jobs are concentrated in the area of administrative and support services, and that eight out of the 20 industries we consider together account for about 95 percent of the employment effects. These also include education, manufacturing, healthcare, government, and professional, scientific, and technical services — a category that takes in R&Dt.

TABLE 3: AGGREGATE EMPLOYMENT EFFECTS BY INDUSTRY FROM BASELINE SCENARIO, TOTAL FOR 2022-2027[7]

Industry	Total Number of Jobs Created or Preserved (2022-2027) — Baseline Scenario
Administrative and Support Services	1,403,867
Transportation and Warehousing	381,929
Educational Services	200,586
Manufacturing	178,745
Health Care and Social Assistance	169,160
Public Administration/Government	132,567
Construction	99,974
Professional, Scientific, and Technical Services	94,302
Finance and Insurance	42,197
Wholesale Trade	26,311
Management of Companies and Enterprises	22,703
Information	16,673
Accommodation and Food Services	12,381
Other Services	10,699
Retail Trade	9,846
Agriculture, Forestry, Fishing and Hunting	3,392
Utilities	3,107
Mining, Quarrying, and Oil and Gas Extraction	2,088
Real Estate and Rental and Leasing	1,976
Arts, Entertainment, and Recreation	165
TOTAL	2,812,668

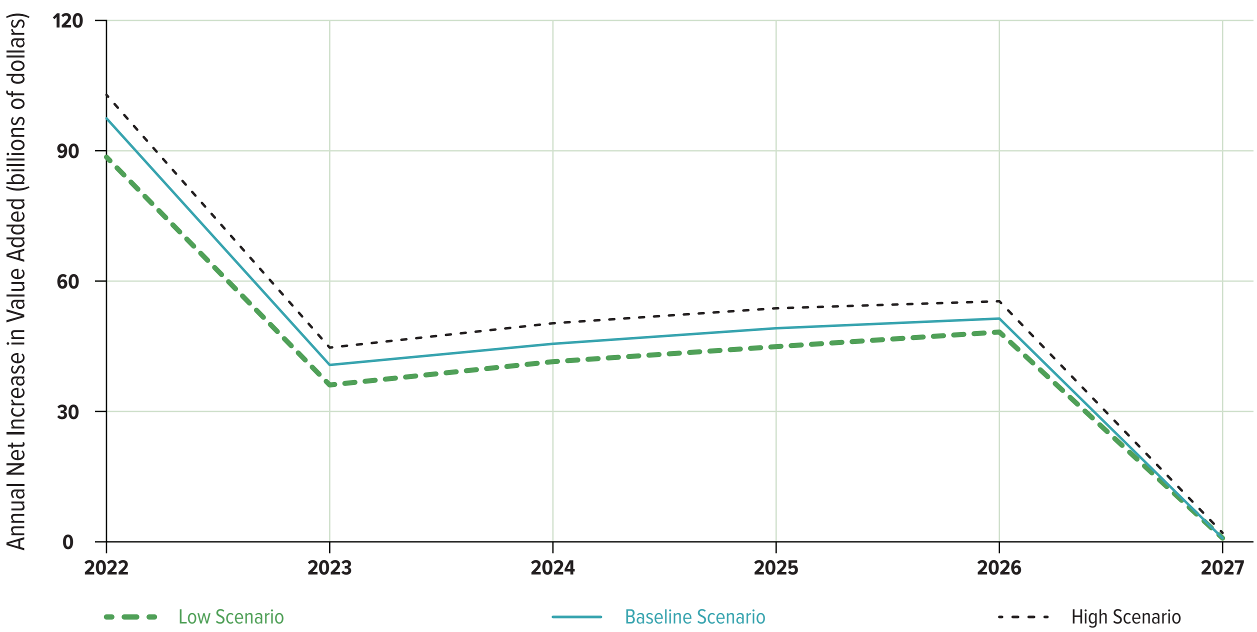
7 The industry categories here correspond to two-digit North American Industry Classification System (NAICS) codes, also known as "sectors."

In Table 4 and Figure 2 we show the projections from our three model runs[8] of the impact USICA would have on U.S. gross domestic product over the same 2022-2027 period.

TABLE 4: AGGREGATE EFFECTS ON VALUE ADDED/GDP, 2022-2027

	2022	2023	2024	2025	2026	2027	TOTAL
Annual Net Increase in Value Added — Low Scenario (billions of 2022 dollars)	89.85	38.38	43.10	46.37	48.72	0.10	**$266.52**
Annual Net Increase in Value Added — Baseline Scenario (billions of 2022 dollars)	96.76	41.33	46.42	49.94	52.47	0.11	**$287.03**
Annual Net Increase in Value Added — High Scenario (billions of 2022 dollars)	103.67	44.29	49.74	53.51	56.22	0.11	**$307.54**

Figure 2 — Aggregate Effects on Value Added/GDP, 2022-2027



8 As noted earlier, Appendix A describes the differences among the three scenarios in greater detail.

The annual average contribution to GDP over this period is therefore between around $44 billion and $51 billion per year. To put this in context, the Federal Reserve's estimate of annual GDP from the last quarter of 2021 was nearly $24 trillion, meaning that these contributions would be on the order of 0.2 percent of current GDP.[9]

In addition to modeling the aggregate employment effects, we can also consider the likely distribution of jobs across states. To that end, we take the industry-specific employment estimates we obtain from our model and allocate them across states in proportion to observed industry employment shares from the American Community Survey (ACS).[10]

The following table shows the breakdown by state of cumulative jobs created or preserved due to USICA (i.e., the sum of direct, indirect, and induced effects[11]) in the baseline scenario over the period 2022-2027. To give a sense of the scale of these effects, we also report average annual job creation over this period as a percentage of total state employment.[12]

9 See Federal Reserve Bank of St. Louis: FRED Economic Data: Gross Domestic Product, available at https://fred.stlouisfed.org/series/GDP.

10 Although ACS data are available through 2020, we make use of the 2019 data to avoid potential issues with the reliability of survey results and the resulting sampling weights from the early phase of the pandemic.

11 See Appendix A for a detailed explanation of these three categories of effects.

12 We measure total state employment using the 2019 ACS as well.

TABLE 5: TOTAL EMPLOYMENT EFFECTS BY STATE, 2022-2027

State	Cumulative Number of Jobs Created or Preserved, 2022-2027 — Baseline Scenario	Average Annual Employment Effect as % of Total State Employment (2019 ACS)
AL	33,505	0.22%
AK	8,171	0.33%
AZ	57,713	0.25%
AR	16,009	0.17%
CA	372,634	0.28%
CO	66,120	0.31%
CT	31,052	0.24%
DE	7,934	0.24%
DC	12,948	0.48%
FL	187,007	0.27%
GA	91,245	0.26%
HI	15,347	0.30%
ID	12,705	0.21%
IL	120,475	0.27%
IN	45,438	0.20%
IA	20,282	0.18%
KS	23,424	0.23%
KY	27,379	0.19%
LA	34,062	0.24%
ME	11,282	0.24%
MD	68,391	0.31%
MA	76,344	0.29%
MI	69,266	0.21%
MN	49,504	0.24%
MS	15,868	0.18%
MO	44,257	0.21%
MT	7,708	0.21%
NE	14,036	0.20%
NV	24,198	0.23%
NH	11,522	0.22%
NJ	91,528	0.29%
NM	18,253	0.28%
NY	172,438	0.26%
NC	84,309	0.24%
ND	5,359	0.18%
OH	89,774	0.22%
OK	27,794	0.22%
OR	34,830	0.24%
PA	100,678	0.23%
RI	9,715	0.25%
SC	37,638	0.23%
SD	5,298	0.17%
TN	51,882	0.23%
TX	252,319	0.26%
UT	27,101	0.24%
VT	4,925	0.21%
VA	93,065	0.30%
WA	71,082	0.27%
WV	10,570	0.20%
WI	43,699	0.21%
WY	4,585	0.23%
TOTAL:	2,812,668	0.25%

Conclusion

Passage of USICA would be a landmark achievement for U.S. innovation policy and would help to preserve America's historical stature as a leader in science and technology. As the House and Senate work to reconcile their different versions of the legislation, there may even be opportunities for progressives to strengthen it further.[13] Our analysis shows that USICA would be a major boon in terms of job creation and economic activity, contributing hundreds of billions of dollars to GDP over the next half-decade and generating or sustaining a total of between 2.6 million and 3.0 million jobs. These findings complement earlier work by Data for Progress making the case for USICA's investments as one element in a policy strategy to address the root causes of the recent increase in inflation.[14]

A limitation of I-O analysis in a setting such as this is that our model of the economy is based on measurements of the current input requirements of various industries and the linkages among sectors. But innovation is an important determinant of productivity and a driver of long-run economic growth, and is likely to reshape the economy in ways that are difficult to forecast.[15] For that reason, there may very well be additional benefits that flow from USICA's investments in R&D that cannot be easily modeled — especially when looking beyond the window over which this spending is actually scheduled to take place.

13 Jake Higdon, July 28, 2021, "A Bipartisan Innovation Bill Scraped Through the Senate and Heads to the House. Could This Notch a Win for Progressives?" Available at https://www.dataforprogress.org/blog/usica-innovation-manufacturing-progressive.

14 Matt Mazewski, January 10, 2022, "How Build Back Better and USICA Can Strengthen Supply Chains and Fight Inflation," available at https://www.dataforprogress.org/blog/2022/1/10/how-build-back-better-and-usica-can-strengthen-supply-chains-and-fight-inflation.

15 See, for instance, Joseph Stiglitz and Bruce Greenwald (2014), Creating a Learning Society: A New Approach to Growth, Development, and Social Progress, New York: Columbia University Press.

Appendix A: Background on Input-Output Modeling

In this section, we describe the basics of the I-O framework used to generate our estimates, as well as some of the assumptions and methodological choices that are specific to our analysis. Appendix B contains even more detail about the mathematics underlying the model.

An I-O model is a simplified representation of an economy that uses data on the inputs that various industries require to produce their final outputs in order to illustrate the linkages among different sectors.[16] Knowing what these linkages look like allows policy analysts to understand how an initial increase or decrease in spending by governments, firms, or consumers — what economists would refer to as a change in *autonomous spending* — will filter through the economy, and what will be its ultimate effect on certain macroeconomic indicators of interest, such as GDP or aggregate employment.

Input-output modeling assumes that such a change in autonomous spending has three types of effects on output and employment:

- **DIRECT EFFECTS —** the incremental economic activity and jobs created by the production of *final* goods and services brought about by the new spending;
- **INDIRECT EFFECTS —** the incremental economic activity and jobs created by the production of the *intermediate inputs* to those final goods and services; and
- **INDUCED EFFECTS —** the incremental economic activity and jobs created by the expenditures of workers who are paid to produce these final and intermediate goods and services.

To model direct and indirect effects, we can make use of data on industry-level input requirements made available by the Bureau of Economic Analysis (BEA), which publishes a variety of different tables that can be used to construct an I-O model.[17] One of these tables is known as the *direct requirements matrix*, which shows, for each of a specified set of industries, how many dollars of inputs are required to be purchased from each of the other industries in order to produce one dollar of its output.

Another is known as the *total requirements matrix* or the *Leontief inverse matrix*, after the economist Wassily Leontief, a pioneer of I-O analysis. This shows, for each industry, how many dollars of goods each of the other industries must ultimately produce in order for the initial industry to produce one dollar of its output, taking into account the production of intermediate inputs. Thus, the total requirements matrix allows one to isolate indirect effects by comparing to estimates that would be obtained from calculations based on the direct requirements matrix alone.

Induced effects result from the fact that a portion of the income earned by firms in a given industry when selling their outputs will be paid out as labor income for workers, who will then spend some of that income on purchases of consumer goods. The question of how best to model induced effects is itself a potentially complicated one, but for the sake of simplicity, in our baseline model run we choose to

16 For further background on I-O modeling, see Ronald E. Miller and Peter D. Blair (2009), Input-Output Analysis: Foundations and Extensions, 2nd Ed. Cambridge, U.K.: Cambridge University Press.

17 For our purposes here, all of the BEA tables that we use rely on an industry classification scheme involving 71 industries based on the North American Industry Classification System (NAICS). To access these tables, see the Bureau of Economic Analysis webpage on "Input-Output Accounts Data," available at https://www.bea.gov/industry/input-output-accounts-data.

follow the approach of Pollin, Garrett-Peltier, Heintz, and Hendricks (2014),[18] who assume on the basis of relevant macroeconomic research that consumer spending has a multiplier of approximately 1.4. That is, each dollar of economic activity associated with the direct and indirect effects of a change in autonomous spending by governments or firms will ultimately generate total economic activity of $1.40. In the "low scenario" we reduce this to 1.3, while in the "high scenario" we increase it to 1.5.

The requirements matrices allow us to assess the impact of a change in autonomous spending on the *gross output* of every industry, including both intermediate goods sold to other producers and final goods sold to consumers. If we are interested in computing the total impact of an initial stimulus on GDP, we need estimates of *value added* in each industry, which subtract off the costs of intermediate outputs.

To that end, we obtain measures of both gross output and value added by industry from the BEA for each year, and use these to calculate industry-specific ratios of value added to output. Thus, we can take the gross output figures derived from our model and convert them into estimates of value added, which we can then sum across industries in order to obtain an estimate of the total impact on GDP in that year.

18 Robert Pollin, Heidi Garrett-Peltier, James Heintz, and Bracken Hendricks (2014), "Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities," available at https://peri.umass.edu/fileadmin/pdf/Green_Growth_2014/GreenGrowthReport-PERI-Sept2014.pdf.

Appendix B: Matrix Algebra of I-O Modeling

In algebraic terms, we let the direct requirements matrix be denoted by A, the dimension of which is 71-by-71. The entry in the ith row and the jth column of A indicates how many dollars of industry i's output need to be purchased by industry j in order to produce one dollar of j's output.

Suppose we want to consider the direct economic effect of spending a certain amount of money on purchasing the product of industry j. We can model this spending with a vector X consisting of a single column and 71 rows, where the entry in the jth row, which we denote by x_j, is the amount that we want to spend on product j (and the entries in every other row are zero, if we are not purchasing anything else).

Premultiplying X by the matrix A gives us the product vector AX, which shows how much input we require (in dollars) from each of the industries in order to produce x_j dollars of industry j's output. (Simple matrix algebra shows that the entries of AX will be equal to the entries in the jth column of A multiplied by the scalar x_j.)

However, this calculation only provides us with a partial picture of the total impact that the initial influx of autonomous spending represented by vector X will have on the economy. This is because each of the industries that provide the inputs to allow industry j to produce its output will itself have to purchase inputs from other industries, and each of *those* industries will have to purchase *its* own inputs, and so on. The *direct* effect of the spending represented by vector X will be AX, but the inputs needed to produce AX will be given by A^2X, the inputs needed to produce A^2X by A^3X, and so on.

Therefore, the total effect on the economy, *direct* effects plus *indirect* effects, will be given by the infinite sum:

$$AX + A^2X + A^3X + A^4X + \dots$$

Through algebraic manipulation, it can be shown that this sum is equal to

$$(I-A)^{-1}X$$

where the matrix $(I-A)^{-1}$ is known as the *total requirements matrix* or the *Leontief inverse matrix*.

The entry in the ith row and jth column of the total requirements matrix gives the total amount of production (in dollars) by industry i that is brought about when industry j produces one dollar of final output. Thus, multiplying this matrix by the spending vector X gives the total economic impact of that initial stimulus.