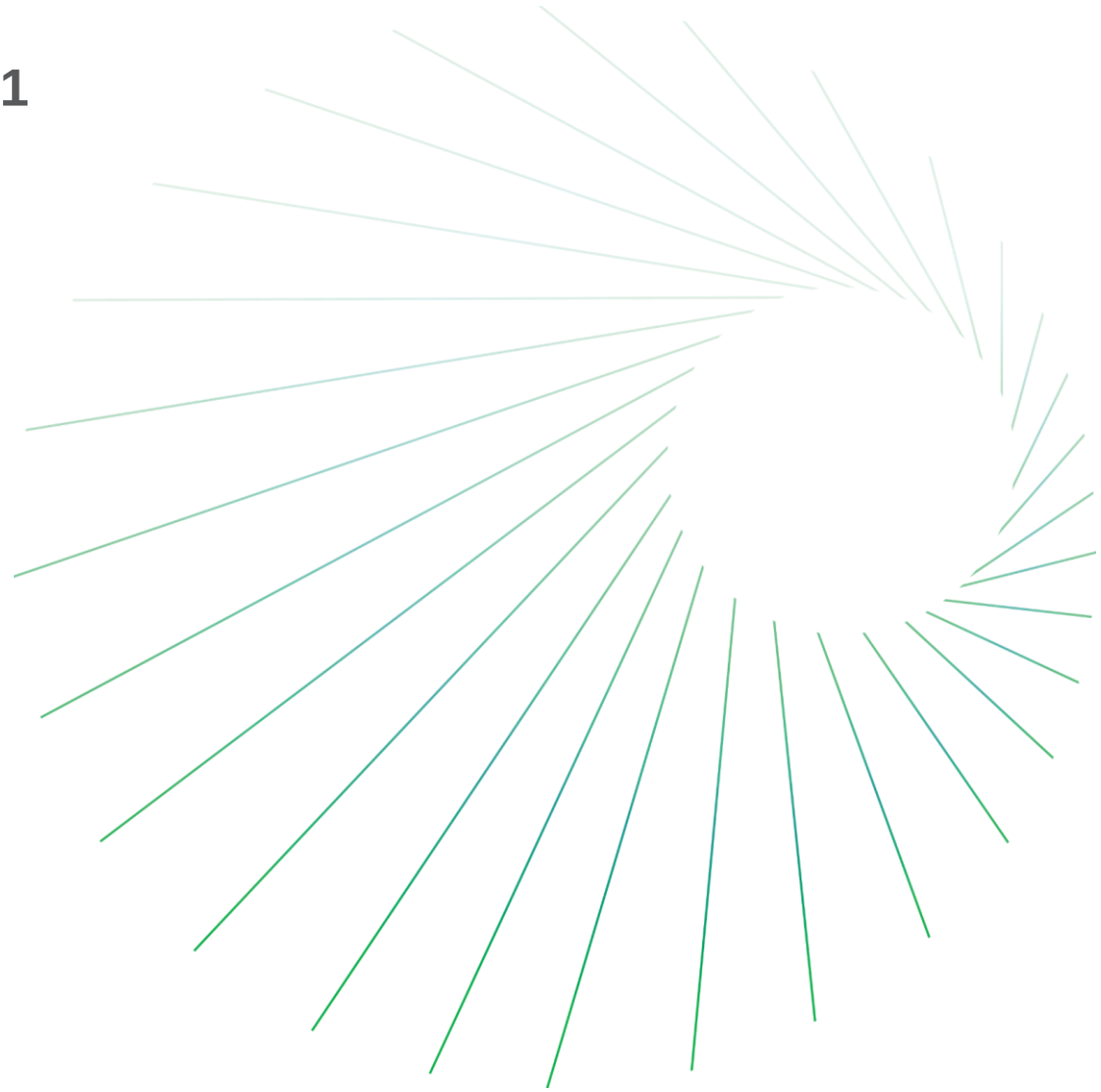
IHS Markit®

Economic impacts of transportation infrastructure

Macroeconomic, industry and state-level impact analysis of the additional highway, bridge, and public transit spending in the Infrastructure Investment and Jobs Act

September 2021



Mohsen Bonakdarpour
Executive Director, Consulting

Karen A. Campbell
Associate Director, Consulting

Patrick Newport
Executive Director, Economics

Noah Eiseman
Sr. Analyst, Consulting

Prepared for: American Road and Transportation Builders Association

Contents

Executive summary

Federal transportation spending through the Infrastructure Investment and Jobs Act (IIJA) increases investment in infrastructure. In particular, the bill proposes to raise federal funding for highways, bridges, and public transit. Infrastructure investment enhances the transportation system's operational capacity resulting in greater accessibility for individuals, households, and businesses, raising the standard of living and creating safer roadways. These investments raise the GDP of the country, increase employment, and positively affect personal disposable income and household income.

IHS Markit analysts use two models to evaluate the effects of the additional spending on highways, bridges, and public transit in the IIJA. The first model is IHS Markit's US Macroeconomic Model, showing the dynamic effects of the IIJA on the US economy. The dynamic effects are especially important for evaluating investments such as infrastructure because the initial spending impact is only one part of the effect. These investments produce capital assets that improve productivity and, therefore, have payoffs years in the future. By 2027, the GDP of the country will be $90 billion higher than without the additional highway and bridge spending in the IIJA.

The dynamic macroeconomic results show that the additional spending through the IIJA contributes an additional $488 billion of cumulative GDP by 2027; $327 billion due to the additional highway and bridge funding and $16 billion due to the additional public transit funding.

On average, employment will be nearly 200,000 higher per year 2022-27. The additional funding for highways would contribute an average of over 137,000 jobs per year from 2022 to 2027. The additional funding for public transit will generate an additional 61,000 jobs on average per year. Corporate profits and government revenue increase due to the investment of the IIJA. Corporations on average gain $17 billion per year and the government gains, due to the increase in the federal tax base, on average $60 billion per year from 2022 to2027.

Analysis of the proposed transportation spending using the industry input-output model (IMPLAN) shows the direct, indirect, and induced effects of the infrastructure investment on industries throughout the economy. The analysis of the additional highway and bridge spending found the average additional direct spending of $12.5 billion per year multiplies through the economy to average almost $42 billion per year of combined direct, indirect, and induced output; a multiplier of 3.4.

The additional public transit spending has similar impacts. The manufacturing sector will see the largest impact, after construction. While the construction sector experiences the largest benefit in terms of job creation, all other sectors experience significant impacts as well. Health care and social assistance, manufacturing, and real estate and rental and leasing combined experience 15% of the total impact on jobs supported from the highway and public transit spending.

In summary, over the 2022-27 timeframe:

- Infrastructure spending has an amplified impact on the economy leading to overall productivity enhancements and the creation of jobs.
- Every $1 million in additional infrastructure investment supports on average 21 jobs in the economy.
- Additional transportation infrastructure investment for highways and public transit contributes on average $232 of additional disposable income per household per year.
- Non-residential capital stock (i.e., the assets used to produce goods and services) increases by $21 billion, enabling potential growth, increases in productivity, and increase in production.
- The Productivity Index increases an average of 0.04%; 0.03% due to the highway and bridge investments and 0.01% due to the public transit investment.
- The Industrial Production Index increases 0.2% from 2022-27 from highway, bridge, and public transit investment.
- Every job created by the additional investment in highway and public transit in the IIJA, supports another job in the economy.
- Indirect and induced impacts from highway spending and public transit spending make up over 70% of the total sales generated by industries. The highway spending multiplies direct spending 3.4 times and public transit multiplies spending 3.3 times.
- In terms of the broader measure of overall economic activity, the additional highway spending has a GDP multiplier over the 2022-27 timeframe that averages 3.6 times. For public transit, the GDP multiplier over the timeframe averages about 3.4.

Introduction

June 26, 2021 marked the 65th anniversary of the Interstate Highway System that created the network of major federally funded roadways approved by President Dwight D. Eisenhower. It has been well documented that transportation investment fuels nation-wide economic growth, contributing significantly to the country's gross domestic product (GDP).

As the 21st century nears its first-quarter mark, investment in the infrastructure for the future is seen as a priority for policymakers. The senate recently passed the Investment in Infrastructure and Jobs Act. This act, inter alia, provides additional funding for America's highways, bridges, and public transit system. Investment helps to ensure that our transportation system operates efficiently and safely; providing increased access for individuals, households, and businesses.

Investment in our transportation infrastructure enhances mobility and provides our citizens with increased business and work opportunities that enable economic growth and well-being. Aging infrastructure makes it difficult to connect urban and rural communities, both physically and technologically. Advancing infrastructure across the country, through highway and roadway investment and public transit investment, will positively affect the health and well-being of US citizens and contribute to the development of cities countrywide. Infrastructure investment allows key economic sectors, like supply-chain and ecommerce, that work together and rely on reliable physical and technological infrastructure to grow and contribute to economic growth. It allows the US to stay competitive with countries across the world.

The Infrastructure Investment and Jobs Act introduces $1.2 trillion in spending, including $550 billion in new federal investment. From the new spending, $274 billion would go to the US Department of Transportation; $110 billion would be allocated for roads and bridges; $66 billion for passenger rail and freight; and $39 billion for public transportation. [1] The transportation sector will receive the bulk of the investment, but sectors like energy and power, broadband, and water will receive additional investments. The bill draws from over $200 billion of repurposed COVID relief funds, almost $70 billion from C-band auction (5G Services), and over $50 billion of unused federal unemployment insurance supplements. [2]

On August 10, the Infrastructure Investment and Jobs Act was passed by the Senate by a vote of 69-30. The bill is now in the House of Representatives waiting to be voted on before it moves to the president.

The American Road & Transportation Builders Association engaged IHS Markit to estimate the economic impact of the additional funding provided for transportation infrastructure in the Infrastructure Investment and Jobs Act (IIJA). The analysis of the contribution to the US economy includes annual spending for highway construction and public transit from 2022 to 2026. IHS Markit

[1] https://itsa.org/wp-content/uploads/2021/08/ITS-America-Infrastructure-Investment-and-Jobs-Act-Technology-Investments-Summary-081021-IIJARTF.pdf

[2] https://www.forconstructionpros.com/infrastructure/news/21590537/whats-in-the-bipartisan-infrastructure-packageand-how-will-we-pay-for-it

analysts employ two models: the US Macroeconomic Model and Economic Impact Assessment Model.

This assessment is timely for several reasons.

Aging infrastructure. This past year, states like California and Texas have had their electrical infrastructure tested by severe weather and natural disasters. According to the American Society of Civil Engineers' Report Card for America's Infrastructure, there is an estimated water main break every two minutes resulting in the loss of six billion gallons of water each day. Also, growing wear and tear on the roads have left 43% of our roadways in poor or mediocre condition. The ASCE scores America's Infrastructure a C-.[3]

Economic growth. The pandemic has changed key economic sectors that require additional infrastructure investment and infrastructure strengthening. The supply-chain and ecommerce industries have been highlighted heavily since March 2020. With more people staying home and ordering everything from groceries to electronics to furniture online, there has been an increase in demand at the intersection of logistics and ecommerce. Additionally, sectors like broadband internet, sustainable housing, and electrical vehicles are future-focused areas that require proper infrastructure investment. These sectors are included in the investment bill and set the groundwork for current and future economic growth opportunities.

Economic competitiveness. It is increasingly important to be able to keep pace with the investments being made by emerging countries in highways, transit, highway safety, motor carrier, research, hazardous materials, rail programs, and reducing climate change impacts.

In the following sections, this report will delve into the effects felt throughout the US economy due to the additional infrastructure investment. Spending stimulates growth in employment, disposable income, and GDP, as well as expansion in all sectors.

Macroeconomic impact on US economy

The macroeconomic impact of the additional funding provided for highways, bridges, and public transit was assessed using the IHS Markit US Macro Model. IHS Markit analysts estimate the contribution of these additional transportation infrastructure investments to the US economy from 2022 to 2027. That is, one year past the spending assumptions to pick up some of the additional dynamic effects that occur beyond the initial spending period. This comprehensive model accounts for supplier and income effects, as well as the dynamic effects of spending on the broad aggregates of the US economy (GDP, employment, income, capital stock, etc.).

Two impact assessments performed

The following two scenarios were developed for this study:

> **Additional infrastructure investments for highways and bridges** - estimates the economic impact of increasing federal investment on infrastructure for highways and bridges. The Infrastructure Investment and Jobs Act is expected to raise the level of spending on highways

[3] According to the American Society of Civil Engineers: https://infrastructurereportcard.org/ (retrieved 1 September 2021).

and bridges by over $19 billion in 2022, rising to almost $25 billion in 2026. However, this additional funding typically results in actual outlays that range from $3.2 billion to $20.3 billion in 2026.

Additional infrastructure investment for public transit - estimates the economic impact of increasing federal investment on infrastructure for public transit. The Infrastructure Investment and Jobs Act is expected to raise the level of spending on public transit for capital projects and operations. The annual outlays associated with the increase in funding range from $4.2 billion in 2022 to $8.6 billion in 2026.

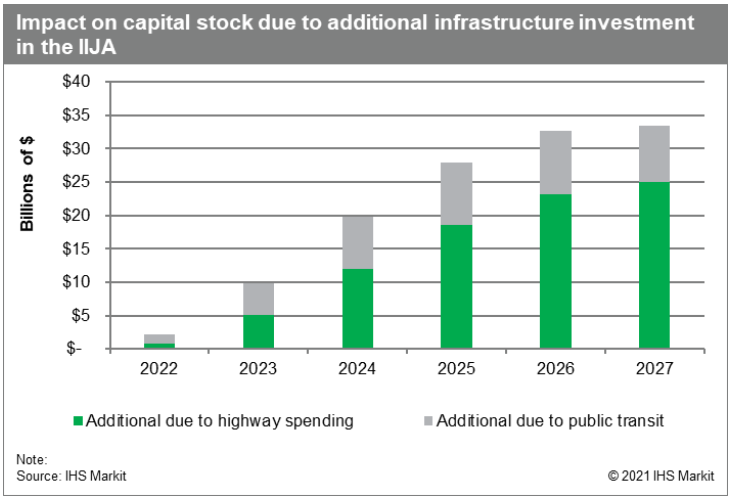
The second scenario was run on top of the first scenario to get an overall effect of transportation infrastructure spending, as well as the incremental effect of each type of additional spending. Note that no additional assumptions were made beyond the direct additional outlays. In addition, no other pieces of the IIJA were included in this analysis.

Macroeconomic results

The results show that the additional transportation infrastructure spending provided in the IIJA improves the US economy by increasing its ability to produce more goods and services (potential GDP), generating economic growth above what would have existed without this additional infrastructure spending. Furthermore, this investment in transportation infrastructure enables - the productivity and production indices to be higher than what they would have been without the additional spending. This has ripple effects, creating a positive impact on corporate profits and government revenue. Perhaps most importantly, individual households also see increases in wages, disposable income, and employment opportunities.

Capital stock

Federal investment in US infrastructure increases the capital stock in the US economy. Capital stock grows from 2022 to 2027 on average $21 billion higher per year - $14 billion per year due to additional highway spending and $7 billion per year due to public transit spending. Highway spending hits a high in 2027 at $25 billion and public transit spending hits a high in 2026 at $9 billion. This has a positive impact on US economic growth and further expands the potential amount of goods and services that could be produced domestically each year.

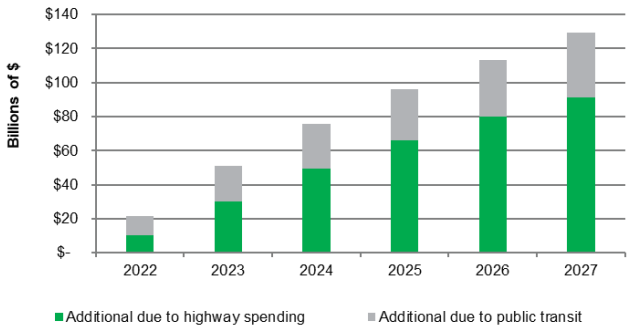


Gross domestic product

Growth in the capital stock of the US economy leads to a greater return in terms of the goods and services produced each year. This increases the productive potential of the economy, allowing GDP to grow to higher levels than those that would have been achieved without the additional infrastructure investment.

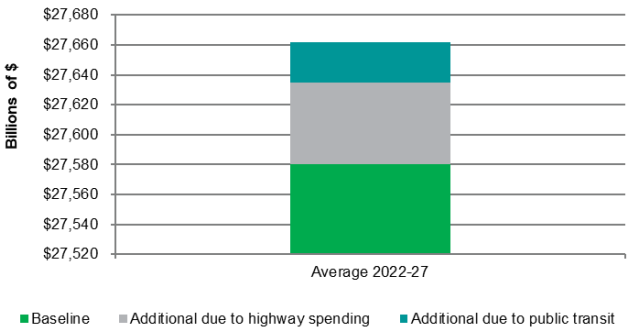
At the current level of federal investment in infrastructure, GDP would average over $27.5 trillion over the forecast period. A total accumulation of $488 billion of additional GDP is generated with the additional infrastructure investment for highways and public transit. GDP will be, on average, $82 billion higher per year from 2022-2027. GDP, over this timeframe, will hit a high in 2027 at $129 billion higher. For highway investment the increase per year averages $55 billion per year, implying a multiplier over this timeframe of 3.6. For public transit, the average increase per year is $27 billion implying a multiplier over the timeframe of about 3.4.

Impact on GDP due to additional infrastructure investment in the IIJA



Note:
Source: IHS Markit

Impact on GDP due to additional infrastructure investment in the IIJA

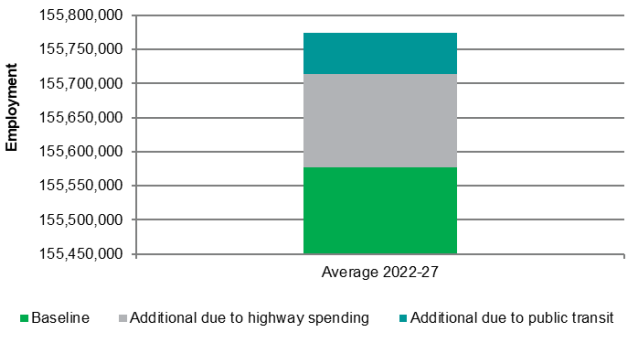


Note:
Source: IHS Markit

Employment and productivity

Investment in infrastructure requires purchasing goods and services, as well as employing people to build and improve the assets. This creates additional demand that ripples through the economy. Further, new transportation infrastructure improves productivity for commuters, as well as all the goods and services that are transported along the US highway, bridge, and public transit systems.

Impact on employment due to additional infrastructure investment in the IIJA



Note:
Source: IHS Markit

In the baseline, which shows current policy spending levels on transportation infrastructure, the total number of people employed averages just over 155,550,000. The additional infrastructure investment increases employment nearly 200,000 on average per year from 2022 to 2027 (the next section details the sectors where these jobs occur). The additional highway and bridge spending increases employment by 137,000 on average, while the public transit spending supports an additional 61,000 employees. In percentage terms, employment

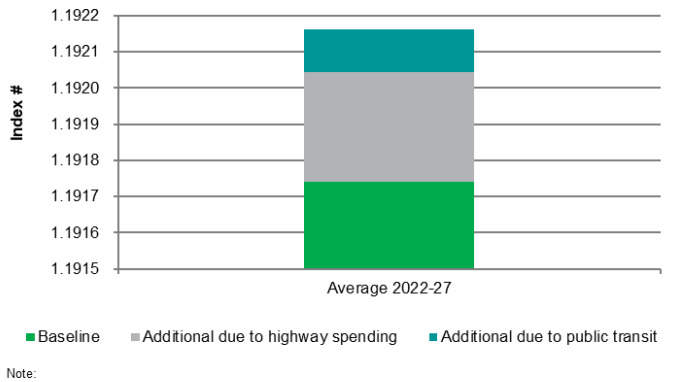
would grow an average of 0.1% and hit a six-year high at over 250,000 additional employed people in 2025.

A higher level of capital increases the potential growth of the economy because it allows more output to be produced per worker. The higher levels of transportation infrastructure capital raise the nonfarm productivity index by 0.04% on average over the forecast period (2022-27), 0.03% through the additional highway and bridge funding, and 0.01% from the increase in public transit funding.

Production

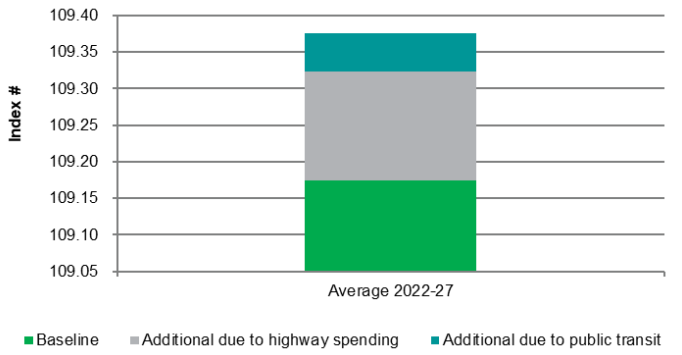
The increase in productivity and employment enables greater supply of goods and services. The production index increases on average 0.2% over the 2022–27-time horizon.

Impact on productivity due to additional infrastructure investment in the IIJA



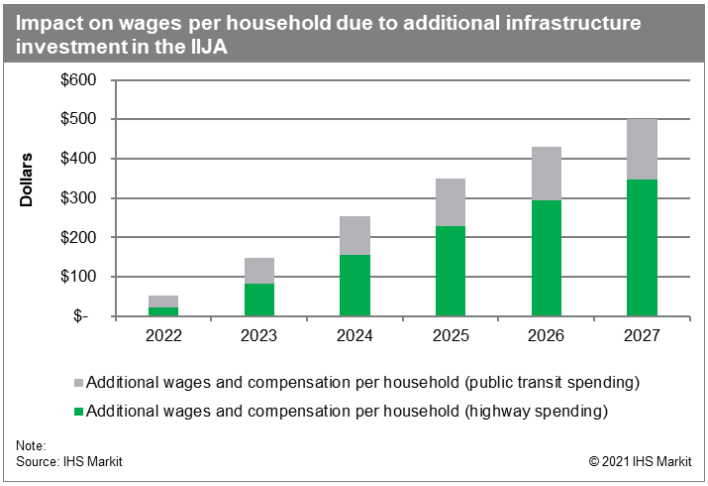
Note:
Source: IHS Markit

Impact on production due to additional infrastructure investment in the IIJA



Note:
Source: IHS Markit

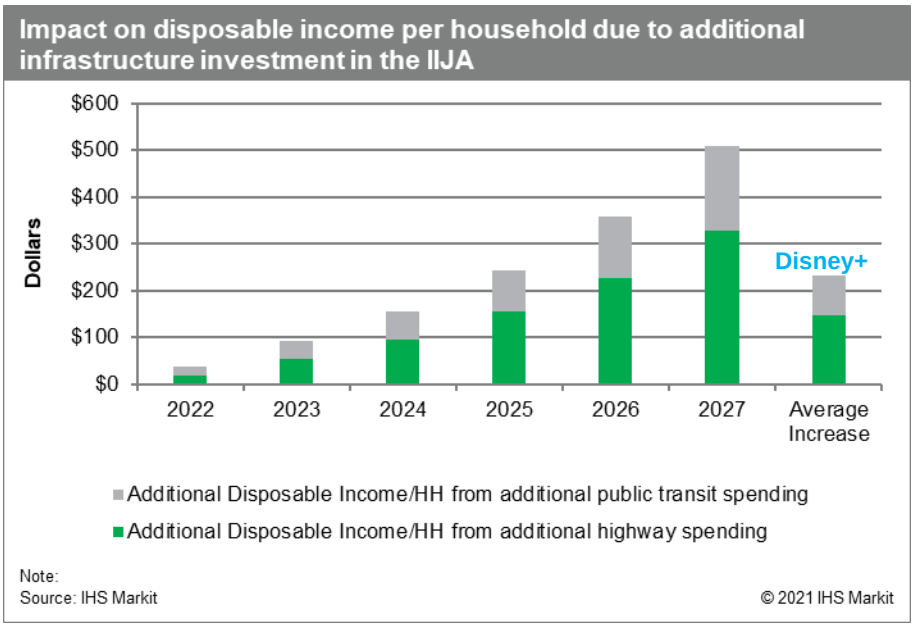
Income per household



Increases in employment, productivity, and production translate to higher wages and income for households. Wages and compensation per household accumulate to about $1,700 by 2027, or an average $361 more per household per year ($188 of that is from the additional highway spending and $172 from the additional public transit spending).

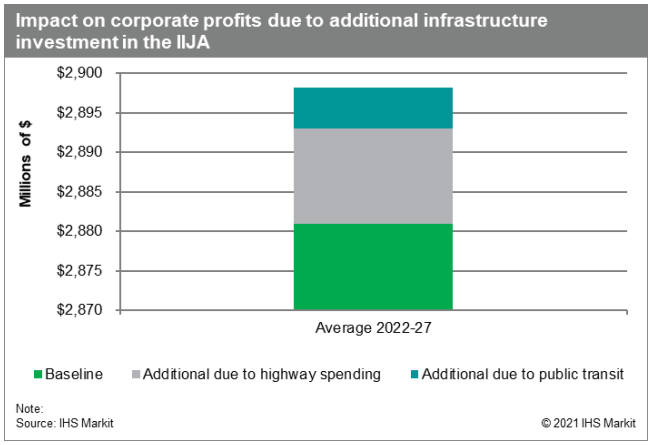
Personal disposable income (income after taxes) is, on average, 0.1% higher each year, reaching a six-year high in 2027 at $45 billion. This translates to personal disposable income per household increase on average of $232 annually 2022-27; $146 due to the additional highway funding and $87 due to the additional public transit funding.

To put this in terms of costs that households have monthly, an additional $232 per year would cover a family's subscription to Disney+ at $8 per month for over 2 years!



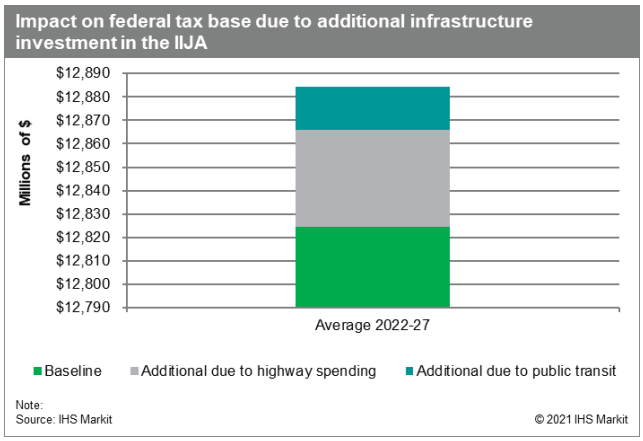
Corporate and government revenues

Although paying more in wages and salaries, corporations experience higher profits from the increase in productivity. On average, corporations gain $17 billion in profits per year from 2022 to 2027; $12 billion from the additional highway funding and $5 billion from the additional public transit funding, which is good for investors and pension funds. In percent terms, corporations average a 0.6% increase in profits per year.



Higher productivity and economic growth that drives higher wages and business profits leads to an increase in the amount of taxable income, therefore increasing the revenue to the federal government. The federal tax base is, on average, $60 billion higher each year; $42 billion from the additional highway spending and $18 billion from the additional public transit spending. This is important because increasing the tax base allows for higher government revenues without raising taxes!

Over $80 billion more in federal tax receipts will have been collected by 2027 with additional transportation infrastructure spending (all else equal), $56 billion due to the increase in highway funding and $23 billion due to the increase in the public transit funding. This also helps state and local government budgets. Their tax receipts will have accumulated $86 billion more by 2027; $57 billion from the additional highway funding and $29 billion due to the additional public transit funding.



Economic impact on industrial sectors

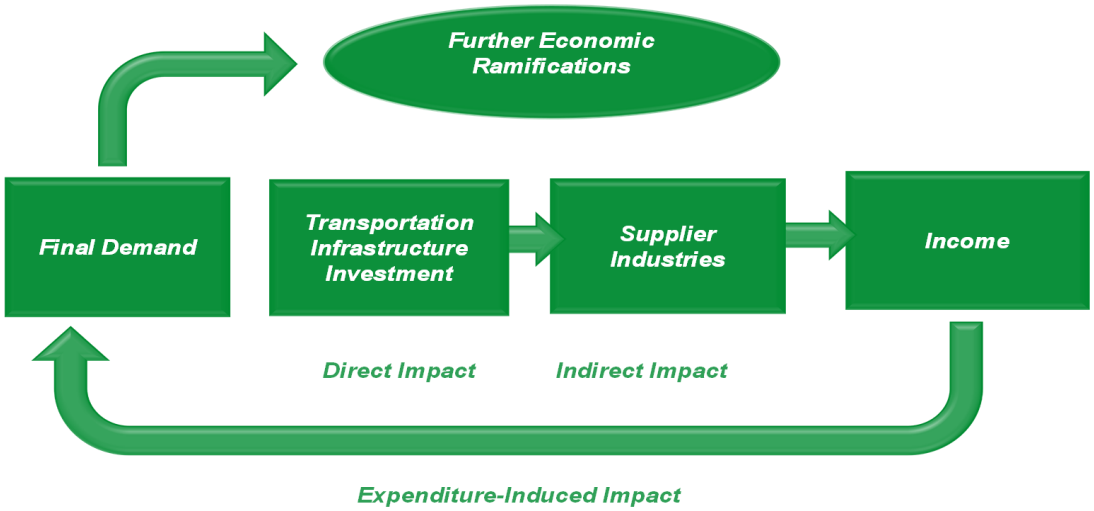
The second model used to analyze the impact of the Infrastructure Investment and Jobs Act on the US economy is the Economic Impact Assessment (EIA) Model (IMPLAN). While this model takes a static view of the spending, it traces through how the spending ripples through the economy by sector directly, indirectly and through induced effects. The descriptions of the direct, indirect, and induced contributions used for this study are as follows:

Direct contributions are generated by activity directly associated with increased capital and construction spending related to transportation infrastructure.

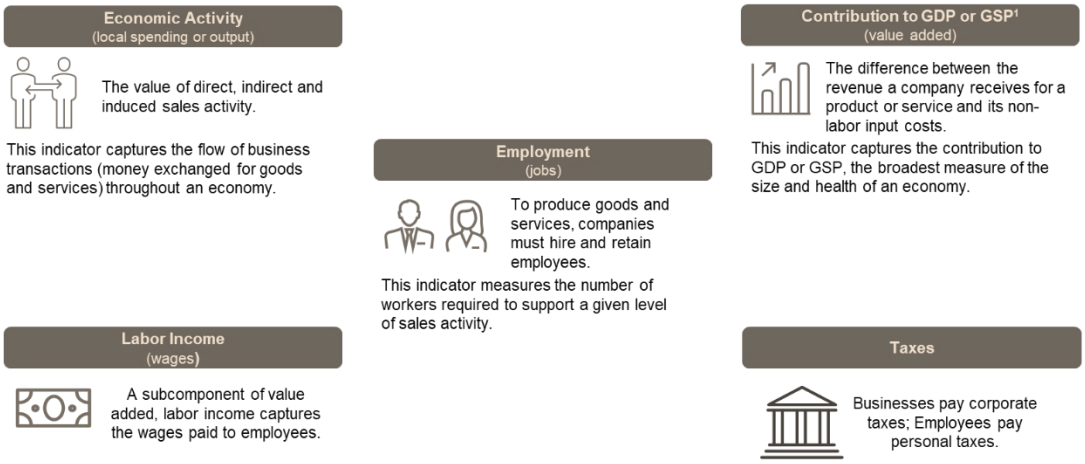
Indirect contributions are generated by the increase in activity from the suppliers of goods and services to direct sectors and its critical suppliers.

Induced contributions are solely due to changes in income, i.e., from the impacted workers from the direct and indirect industries spending their additional income on food, housing, and other consumer goods and, thereby, contributing more to the US economy.

Defining the economic contribution



Four main variables are assessed to show this impact: employment, output (sales), contribution to GDP (value-add), and labor income (wages, salaries, and benefits).



This model utilizes the input-output framework (see the appendix for details). The analysis was conducted using the same scenarios outlined in the macroeconomic section. Because this is a static model, to get the individual impacts of the two types of spending, the models were run separately. Also, because the models are static and linear, the total impact is the sum of the two.[4] The assessment period for this analysis corresponds to the spending as all assumed dynamics for the additional spending in the year take place in the model year. Thus, for this section the average is over the 2022-26 time period.

Sector-level results

The sector impact analysis shows that the additional transportation infrastructure investment provided in the IIJA impacts all major sectors of the US economy. The analysis of the highway and bridge spending, as well as the public transit spending, found that 52% of the jobs created are indirect and induced; showing that for every job created directly from the infrastructure investment, another job is created elsewhere in the economy for an employment multiplier of 2. While the construction industry experiences the largest impact as this is where the direct spending is concentrated, other sectors experience large impacts from the additional highway spending, such as health care and social assistance, manufacturing, and real estate and rental and leasing. These sectors, as well as the others, benefit from the indirect and induced spending stimulated by the increase in the highway and bridge funding.

The additional highway investment has large indirect and induced effects on output, totaling almost $30 billion of the total $42 billion of industry sales. Output experiences a multiplier of 3.4 due to the investment, driven by the large amount of indirect and induced effects.

The additional spending on infrastructure in the IIJA adds value to the US economy in more ways than one. Along our other three main metrics (besides employment): output (sales), total value added, and labor income (wages), indirect and induced effects on average make up more than 50% of the total impacts created by the additional transportation infrastructure spending. For every $1 million of

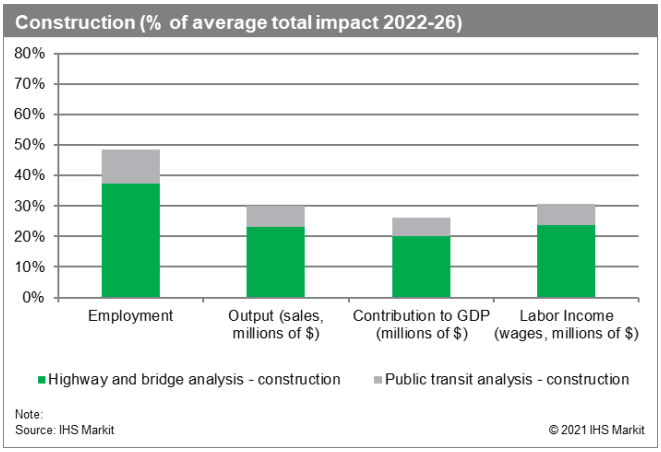
[4] While the model shows each year, this is a "model year" that rolls all the impacts from that year's spending levels into the model year. In reality these impacts might take more that one year to propagate through the supply chains, hence why we also look at the dynamic effects for the more realistic broad economic impacts. This model is useful for seeing the relative impacts on industries as well as distinguishing between direct, indirect, and induced impacts.

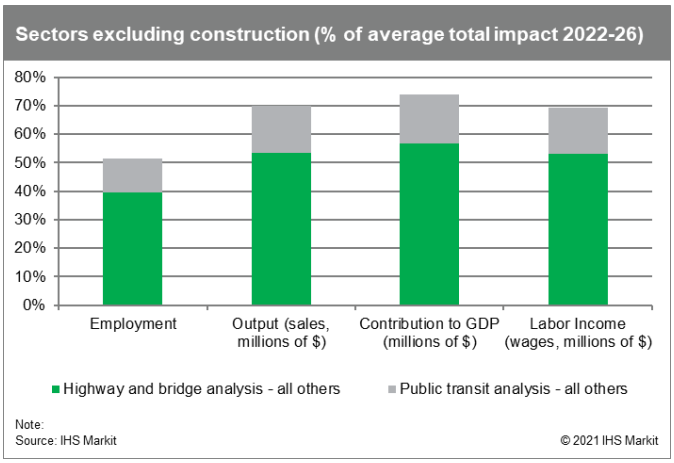
additional investment highway and bridge and public transit spending in the IIJA, 21 jobs are supported in the economy, many of those in sectors like construction and health care.

In the public transit analysis, similar impacts were found. Sales generated by the indirect and induced effects make up 70% of the total output supported by the additional public transit spending implying a multiplier of 3.3 times the initial spending.

While the additional public transit spending includes funds for day-to-day operations, the construction sector stills experience the bulk of the direct spending through maintenance and capital projects. It makes up almost 50% of the total employment impact, and 25-30% of labor income (wages), contribution to GDP, and output (sales

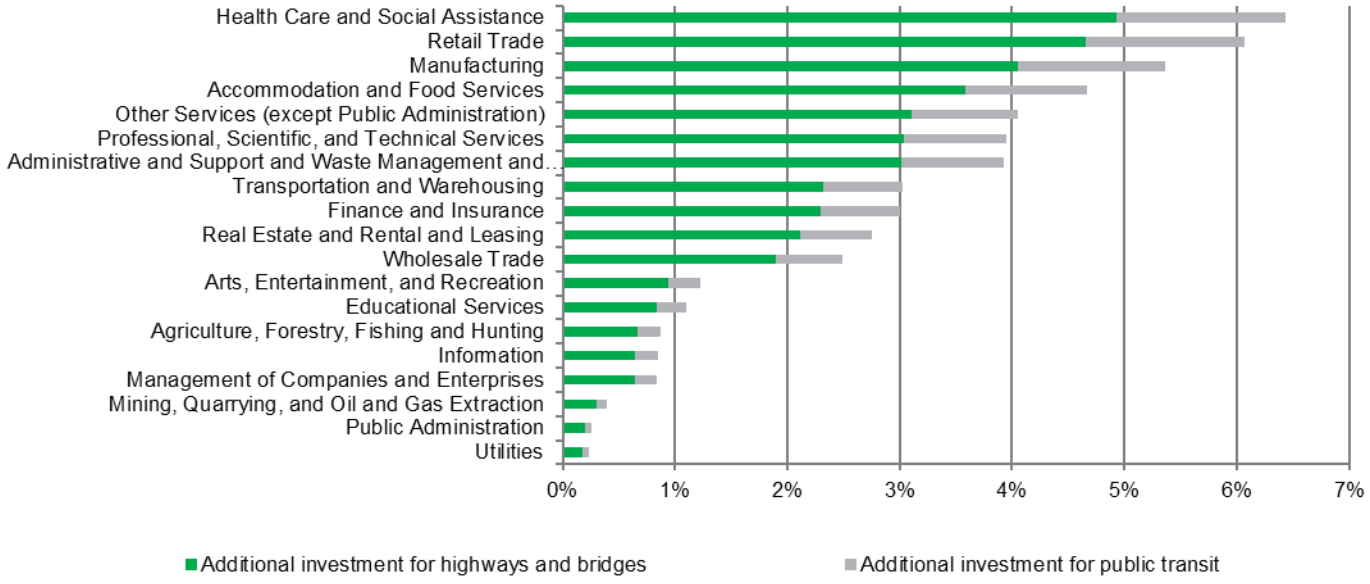
When looking at the average impact on employment excluding the construction sector, it is clear how the other sectors analyzed make up a large portion of the impact created by the infrastructure investment. The sectors health care and social assistance, retail trade, and manufacturing alone make up on average 6% of the total employment impact for the highway and bridge analysis, and the public transit analysis.





Sector Results: Impact on all other sectors from additional infrastructure Investment

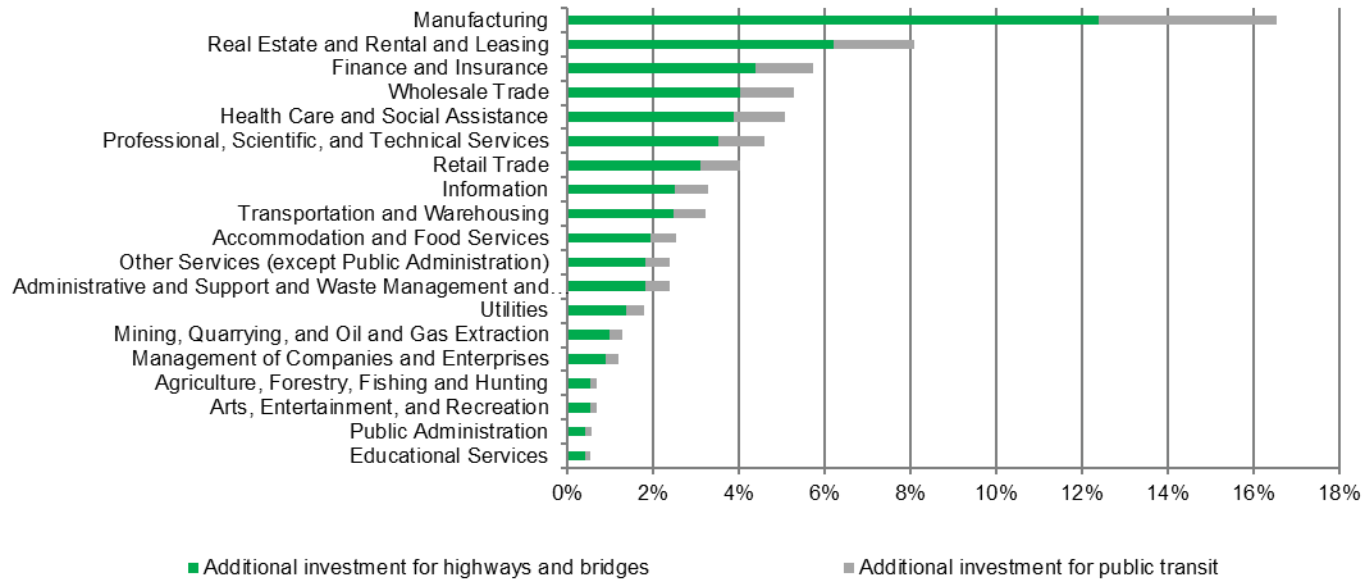
Employment impact by sector (% of average total impact 2022-26)



Note:

Source: IHS Markit

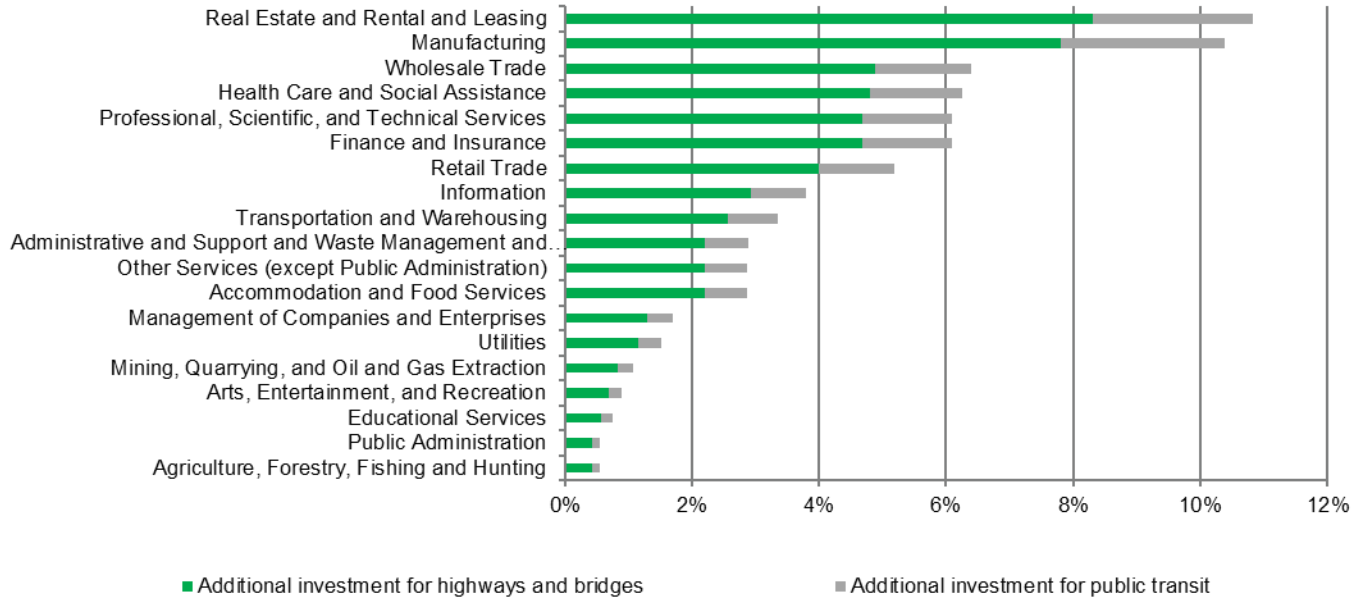
Output impact by sector (% of average total impact 2022-26)



Note:

Source: IHS Markit

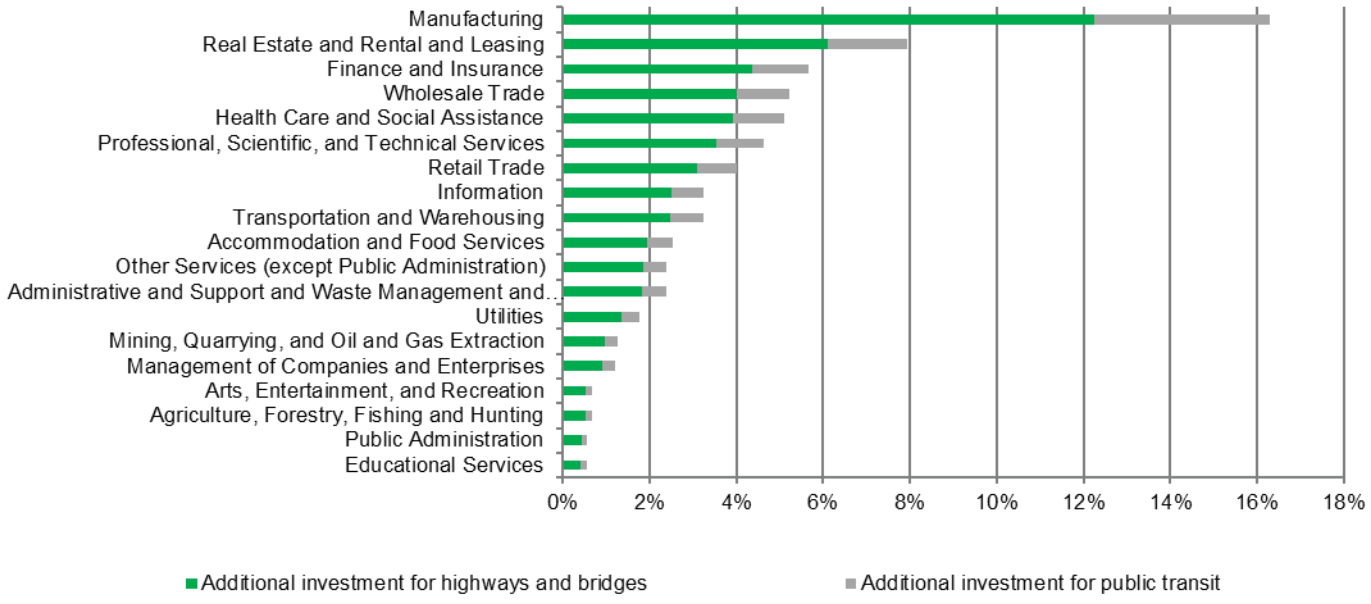
Contribution to GDP impact by sector (% of average total impact 2022-26)



Note:

Source: IHS Markit

Labor Income impact by sector (% of average total impact 2022-26)



Note:

Source: IHS Markit

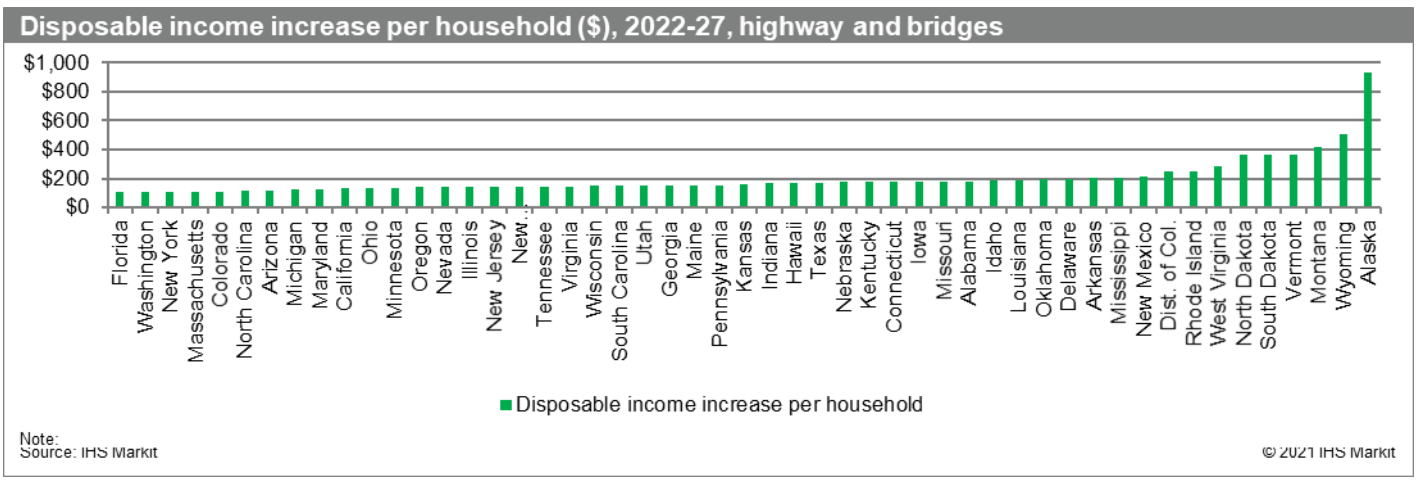
Economic impacts by state

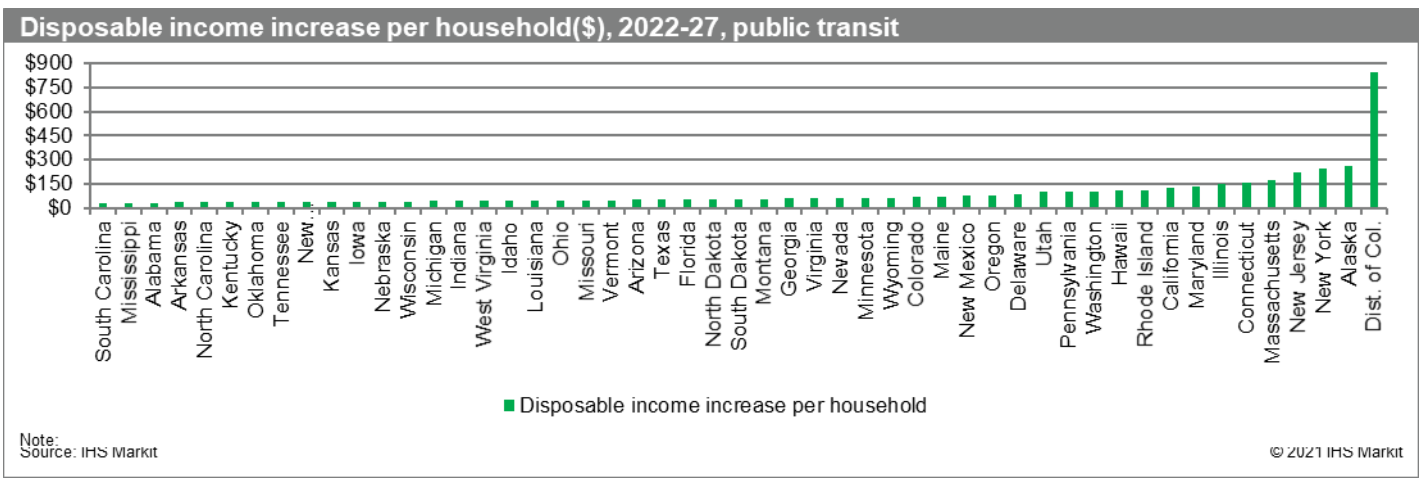
The economic impact of the additional infrastructure investment was further disaggregated to the state level. Using the average of estimated state-by-state apportionments under the Committee on Environment and Public

Works Transportation Reauthorization Act of 2021, incremental impacts on GDP, disposable income, and consumer spending were allocated to the per-household level for each state.

The five states receiving the greatest economic impacts from the proposed additional infrastructure investment for highway and bridges are Texas, California, Florida, New York, and Pennsylvania. These states account for more than 32% of the total national impact. Smaller states still experience substantial impacts. States like Iowa and Vermont experience GDP increases of $677 million and $280 million, respectively. Smaller states also experience the largest impact at the per household level. The five states receiving the greatest per household economic impacts are Alaska, Wyoming, Montana, Vermont, and South Dakota.

The additional infrastructure investment for public transit has the largest impact on the District of Columbia, Alaska, New York, New Jersey, and Massachusetts at the per household level. When it comes to disposable income per household in the public transit case, the top five states make up 37% of the total contribution, while in the highway and bridges analysis it makes up 25%.





Additional infrastructure investment for highway and bridges - state-by-state impacts

State by state economic impacts 2022-27						Per household economic impacts 2022-27			
State	Gross domestic product ($million)	Disposable income ($million)	Consumer spending ($million)	State and local tax receipts ($million)	Number of households	Gross state product increase per household	Disposable income increase per household	Consumer spending increase per household	State and local tax receipts increase per household
Alabama	$1,045	$376	$384	$181	2,054,313	$509	$183	$187	$88
Alaska	$691	$248	$254	$120	266,160	$2,595	$933	$953	$450
Arizona	$1,008	$362	$370	$175	3,026,188	$333	$120	$122	$58
Arkansas	$713	$256	$262	$124	1,245,203	$573	$206	$210	$99
California	$5,055	$1,818	$1,857	$876	13,631,950	$371	$133	$136	$64
Colorado	$745	$268	$274	$129	2,436,987	$306	$110	$112	$53
Connecticut	$692	$249	$254	$120	1,404,799	$492	$177	$181	$85
Delaware	$233	$84	$86	$40	421,703	$552	$199	$203	$96
Dist. of Col.	$220	$79	$81	$38	318,386	$690	$248	$254	$120
Florida	$2,609	$938	$958	$452	9,031,364	$289	$104	$106	$50
Georgia	$1,778	$640	$653	$308	4,234,014	$420	$151	$154	$73
Hawaii	$233	$84	$86	$40	486,612	$479	$172	$176	$83
Idaho	$394	$142	$145	$68	746,149	$528	$190	$194	$92
Illinois	$1,958	$704	$719	$339	5,022,958	$390	$140	$143	$68
Indiana	$1,312	$472	$482	$228	2,746,768	$478	$172	$175	$83
Iowa	$677	$243	$249	$117	1,347,436	$502	$181	$185	$87
Kansas	$520	$187	$191	$90	1,182,547	$440	$158	$162	$76
Kentucky	$915	$329	$336	$159	1,868,964	$490	$176	$180	$85
Louisiana	$967	$348	$355	$168	1,824,035	$530	$191	$195	$92
Maine	$254	$91	$93	$44	602,780	$422	$152	$155	$73
Maryland	$828	$298	$304	$143	2,343,867	$353	$127	$130	$61
Massachusetts	$836	$301	$307	$145	2,746,122	$305	$110	$112	$53
Michigan	$1,450	$522	$533	$251	4,114,641	$352	$127	$129	$61
Minnesota	$898	$323	$330	$156	2,334,610	$385	$138	$141	$67
Mississippi	$666	$240	$245	$115	1,151,121	$579	$208	$213	$100
Missouri	$1,304	$469	$479	$226	2,569,208	$507	$183	$186	$88
Montana	$565	$203	$208	$98	481,540	$1,173	$422	$431	$203
Nebraska	$398	$143	$146	$69	813,761	$489	$176	$180	$85
Nevada	$500	$180	$184	$87	1,283,673	$390	$140	$143	$68
New Hampshire	$228	$82	$84	$39	570,273	$399	$144	$147	$69
New Jersey	$1,375	$495	$505	$238	3,456,156	$398	$143	$146	$69
New Mexico	$506	$182	$186	$88	863,737	$586	$211	$215	$102
New York	$2,312	$831	$849	$401	7,721,898	$299	$108	$110	$52
North Carolina	$1,436	$517	$528	$249	4,475,221	$321	$115	$118	$56
North Dakota	$342	$123	$126	$59	340,594	$1,004	$361	$369	$174
Ohio	$1,846	$664	$678	$320	4,908,875	$376	$135	$138	$65
Oklahoma	$873	$314	$321	$151	1,598,592	$546	$197	$201	$95
Oregon	$688	$248	$253	$119	1,775,803	$388	$139	$142	$67
Pennsylvania	$2,260	$813	$830	$392	5,328,269	$424	$153	$156	$74
Rhode Island	$301	$108	$111	$52	427,193	$705	$254	$259	$122
South Carolina	$922	$332	$339	$160	2,203,369	$419	$151	$154	$73
South Dakota	$388	$140	$143	$67	380,940	$1,020	$367	$375	$177
Tennessee	$1,164	$419	$427	$202	2,911,185	$400	$144	$147	$69
Texas	$5,372	$1,932	$1,973	$931	11,185,769	$480	$173	$176	$83
Utah	$478	$172	$176	$83	1,140,552	$419	$151	$154	$73
Vermont	$280	$101	$103	$48	273,386	$1,022	$368	$376	$177
Virginia	$1,402	$504	$515	$243	3,444,542	$407	$146	$149	$71
Washington	$934	$336	$343	$162	3,212,819	$291	$105	$107	$50
West Virginia	$602	$216	$221	$104	752,614	$800	$288	$294	$139
Wisconsin	$1,036	$373	$381	$180	2,492,347	$416	$150	$153	$72
Wyoming	$353	$127	$130	$61	249,975	$1,411	$508	$518	$245
TOTAL	$54,562	$19,623	$20,042	$9,460	131,451,972	$28,451	$10,232	$10,450	$4,933

Additional infrastructure investment for public transit - state-by-state impacts

State by state economic impacts 2022-27					Per household economic impacts 2022-27				
State	Gross domestic product ($million)	Disposable income ($million)	Consumer spending ($million)	State and local tax receipts ($million)	Number of households	Gross state product per household	Disposable income per household	Consumer spending per household	State and local tax receipts per household
Alabama	$158	$69	$63	$29	2,054,313	$77	$34	$31	$14
Alaska	$158	$69	$63	$29	266,160	$594	$260	$236	$109
Arizona	$354	$155	$140	$65	3,026,188	$117	$51	$46	$21
Arkansas	$98	$43	$39	$18	1,245,203	$79	$34	$31	$14
California	$3,850	$1,681	$1,527	$707	13,631,950	$282	$123	$112	$52
Colorado	$372	$163	$148	$68	2,436,987	$153	$67	$61	$28
Connecticut	$511	$223	$203	$94	1,404,799	$363	$159	$144	$67
Delaware	$87	$38	$34	$16	421,703	$205	$90	$81	$38
Dist. of Col.	$614	$268	$244	$113	318,386	$1,930	$843	$765	$354
Florida	$1,080	$472	$429	$198	9,031,364	$120	$52	$47	$22
Georgia	$575	$251	$228	$106	4,234,014	$136	$59	$54	$25
Hawaii	$124	$54	$49	$23	486,612	$254	$111	$101	$47
Idaho	$76	$33	$30	$14	746,149	$102	$44	$40	$19
Illinois	$1,752	$765	$695	$322	5,022,958	$349	$152	$138	$64
Indiana	$270	$118	$107	$50	2,746,768	$98	$43	$39	$18
Iowa	$120	$53	$48	$22	1,347,436	$89	$39	$35	$16
Kansas	$105	$46	$42	$19	1,182,547	$89	$39	$35	$16
Kentucky	$152	$67	$60	$28	1,868,964	$82	$36	$32	$15
Louisiana	$187	$82	$74	$34	1,824,035	$103	$45	$41	$19
Maine	$98	$43	$39	$18	602,780	$163	$71	$65	$30
Maryland	$724	$316	$287	$133	2,343,867	$309	$135	$123	$57
Massachusetts	$1,097	$479	$435	$201	2,746,122	$399	$174	$158	$73
Michigan	$404	$177	$160	$74	4,114,641	$98	$43	$39	$18
Minnesota	$336	$147	$133	$62	2,334,610	$144	$63	$57	$26
Mississippi	$85	$37	$34	$16	1,151,121	$74	$32	$29	$14
Missouri	$278	$121	$110	$51	2,569,208	$108	$47	$43	$20
Montana	$62	$27	$25	$11	481,540	$129	$56	$51	$24
Nebraska	$73	$32	$29	$13	813,761	$90	$39	$36	$17
Nevada	$182	$80	$72	$34	1,283,673	$142	$62	$56	$26
New Hampshire	$49	$22	$20	$9	570,273	$87	$38	$34	$16
New Jersey	$1,752	$765	$695	$322	3,456,156	$507	$221	$201	$93
New Mexico	$150	$66	$60	$28	863,737	$174	$76	$69	$32
New York	$4,407	$1,925	$1,748	$809	7,721,898	$571	$249	$226	$105
North Carolina	$361	$158	$143	$66	4,475,221	$81	$35	$32	$15
North Dakota	$43	$19	$17	$8	340,594	$127	$55	$50	$23
Ohio	$528	$231	$209	$97	4,908,875	$108	$47	$43	$20
Oklahoma	$138	$60	$55	$25	1,598,592	$86	$38	$34	$16
Oregon	$312	$136	$124	$57	1,775,803	$176	$77	$70	$32
Pennsylvania	$1,240	$541	$492	$228	5,328,269	$233	$102	$92	$43
Rhode Island	$111	$48	$44	$20	427,193	$260	$114	$103	$48
South Carolina	$145	$63	$58	$27	2,203,369	$66	$29	$26	$12
South Dakota	$49	$21	$19	$9	380,940	$128	$56	$51	$24
Tennessee	$252	$110	$100	$46	2,911,185	$86	$38	$34	$16
Texas	$1,329	$580	$527	$244	11,185,769	$119	$52	$47	$22
Utah	$261	$114	$103	$48	1,140,552	$228	$100	$91	$42
Vermont	$30	$13	$12	$6	273,386	$111	$48	$44	$20
Virginia	$484	$211	$192	$89	3,444,542	$141	$61	$56	$26
Washington	$754	$329	$299	$138	3,212,819	$235	$102	$93	$43
West Virginia	$76	$33	$30	$14	752,614	$101	$44	$40	$19
Wisconsin	$235	$103	$93	$43	2,492,347	$94	$41	$37	$17
Wyoming	$36	$16	$14	$7	249,975	$146	$64	$58	$27
TOTAL	$26,725	$11,673	$10,602	$4,909	131,451,972	$10,740	$4,691	$4,261	$1,973

Conclusion

The macroeconomic, state, and industry impact analyses show the wide-reaching and substantial benefits of additional transportation infrastructure investment. Everyone in the economy benefits from the transportation system, whether they drive a car, ride a rail, or get Amazon deliveries. Federal spending on transportation infrastructure increases the capital stock of the US economy, increasing the economy's ability to produce goods and services, leading to more job opportunities and higher GDP. People in sectors like construction, health care and social assistance, and manufacturing will experience growth in salaries and wages. Additionally, states like California, Texas, and Florida will continue to make large contributions to national GDP. With more efficient highway, bridges, and transit systems, the US economy will be better equipped to connect supply chains to one another and support growing industries like technology and ecommerce. Quality of life for US citizens will also improve. Improved infrastructure will reduce travel and commute times, making travel safer and less difficult. Increased disposable income per household will also provide families a little extra money to spend on services like streaming or music subscriptions, for example.

Overall, the additional infrastructure investment is shown to have wide reaching effects from the national to the household level, improving the lives of families and the health of the economy. By 2027, an additional $488 billion worth of goods and services will have produced (i.e., accumulated GDP) and total employment will be on average 200,000 higher per year, peaking at 250,000 higher in 2025.

The benefits of additional infrastructure investment for highways and bridges can be quantified in terms of additional output and employment opportunities. The average yearly investment of $16.3 billion (combined highway, bridge, and public transit) ripples through the economy to produce a total of $55.8 billion of economic output (sales) for an overall multiplier of 3.4. Employment also increases, on average, by almost 200,000 per year. Indirect and induced employment growth makes up on average over 50% of this job growth in the economy. For every $1,000,000 of additional investment in the transportation infrastructure, 21 jobs are supported, 11 of those being indirectly and induced elsewhere in the economy.

For highways and bridges, the average direct spending of $12.5 billion per year multiplies through the economy to average $42 billion per year of sales, a multiplier of 3.4. More than 70% of sales generated by the transportation infrastructure investment comes from indirect and induced effects.

While the benefits of additional infrastructure investment for public transit is smaller than the highway and bridge spending, it still creates reverberating impacts throughout the US economy. The average direct spending of $3.8 billion per year multiplies through the economy to average $12.8 billion per year of sales, a multiplier of 3.3. Indirect and induced output effects make up a similar 70% of sales generated by the spending, but at a lower magnitude adding up to almost $10 billion versus the $30 billion generated from highway and bridge spending. Through additional public transit investment, more than 80,000 jobs are supported per year from 2022 to 2026, more than half of which are from indirect and induced effects. Over 38,000 jobs are supported directly from the federal spending.

APPENDIX A - Macroeconomic methodology

The US Macroeconomic model was run using our August 2021 forecast. This forecast incorporates all assumptions regarding infrastructure spending under current law (i.e., without assuming additional funding from the IIJA).

ARTBA provided the assumptions on the funding and outlays. These assumptions describe the funding outlays that are expected to be spent from 2022 to 2026. These funding numbers align from the funding allocations in Infrastructure Investment and Jobs Act and were scored by the Congressional Budget Office (CBO). The CBO conducts due diligence on the budgetary and economic issues of all bills brought to Congress. [5]

In the Macro Model, federal dollars are already captured in state and local construction. Therefore, the major entry point to assess the federal highway and public transit infrastructure investment impact is real state and local construction spending. State and local investment in highway and streets and state and local investment in public transportation were also targeted to achieve the assumed spending changes specifically in the highway and streets and public transit construction sectors, respectively.

Highway and Bridges Funding Scenarios for IHS Markit Macro and EIA Model (Millions of $)							
	2020	2021	2022	2023	2024	2025	2026
Scenario 1							
Federal Highway Program Funding							
Total Core Obligations			57,473	58,765	60,096	61,314	62,657
Guaranteed Capital Appropriations			8,237	8,237	8,237	8,237	8,237
Funding Over Baseline			19,345	20,637	21,968	23,186	24,529
Outlays from Funding Over Baseline			3,205	8,863	13,192	17,070	20,259
Hiway Construction Put in Place	99,887	96,600	103,079	113,003	118,466	122,204	125,834
Baseline Funding							
Federal Highway Program Funding	46,365	46,365	46,365	46,365	46,365	46,365	46,365
Outlays	48,265	46,896	46,004	46,477	47,510	49,570	51,548
Highway Construction Put in Place	99,887	96,600	98,242	99,912	101,611	103,338	105,095

Transit Funding Scenarios for IHS Macro Model (Millions of $)							
	2020	2021	2022	2023	2024	2025	2026
Scenario 1							
Total Transit Funding (Formula, Discretionary, Appropriated)			20,755	21,034	21,390	21,679	22,042
Capital			13,349	13,529	13,758	13,943	14,177
Operations			7,406	7,505	7,632	7,736	7,865
Funding over Baseline							
Capital			5,262	5,442	5,671	5,857	6,090
Operations			2,919	3,019	3,146	3,249	3,379
Outlays from Funding over Baseline							
Capital			1,316	3,518	4,438	4,869	5,257
Operations			2,919	3,019	3,146	3,249	3,379
Baseline Funding							
Total Transit Funding (Formula, Discretionary, Appropriated)		12,573	12,573	12,573	12,573	12,573	12,573
Capital		8,087	8,087	8,087	8,087	8,087	8,087
Operations		4,486	4,486	4,486	4,486	4,486	4,486

[5] "Introduction to CBO" (PDF). Congressional Budget Office. Retrieved September 9th, 2021.

APPENDIX B - Sector impact methodology

Using the same outlay assumptions that were provided for the macroeconomic analysis, for each year of the highway and bridge analysis, federal spending was allocated to the new construction sector (96%) and maintenance and repair sector (4%) in the IMPLAN model. The additional infrastructure investment assumption can be found in the "Outlays from funding over baseline" line. In the IMPLAN model new construction encompasses the capital expenditures of improving and expanding highway and bridge capacity.

To perform the public transit analysis, the IMPLAN model was run again using the increase in public transit assumptions. To best allocate the additional spending for public transit, five sectors were targeted, the two previous ones and three additional sectors. Capital and operations funding under the "Outlays from funding over baseline" section were used, adding an additional funding source to the model. The percentage of funding allocated to each of the five sectors were in proportion to estimates from IHS Markit's internal Business Market Insight (BMI) database.

- Construction of new nonresidential structures = 92.3% of capital funding
- Maintenance and repair of nonresidential structures = 3.8% of operational funding
- Construction machinery manufacturing = 2.1% of capital funding
- Light truck and utility vehicle manufacturing = 1.4% of capital funding
- Heavy duty truck manufacturing = 0.4% of capital funding

APPENDIX C - Model documentations

IHS Markit US Macroeconomic Model

The model's theoretical position

As an econometric dynamic equilibrium growth model, the IHS Markit model strives to incorporate the best insights of many theoretical approaches to the business cycle: Keynesian, New Keynesian, neoclassical, monetarist, and supply-side. In addition, the IHS Markit model embodies the major properties of the neoclassical growth models developed by Robert Solow. This structure guarantees that short-run cyclical developments will converge to robust long-run equilibrium.

In growth models the expansion rate of technical progress, the labor force, and the capital stock determine the productive potential of an economy. Technical progress and the capital stock are governed by investment, which in turn must be in balance with post-tax capital costs, available savings, and the capacity requirements of current spending. As a result, monetary and fiscal policies will influence the short- and the long-term characteristics of such an economy through their impacts on national saving and investment.

A modern model of output, prices, and financial conditions is melded with the growth model to present the detailed, short-run dynamics of the economy. In specific goods markets the interactions of a set of supply and demand relations jointly determine spending, production, and price levels. Typically, the level of inflation-adjusted demand is driven by prices, income, wealth, expectations, and financial conditions. The capacity to supply goods and services is keyed to a production function combining the basic inputs of labor hours, energy usage, and the capital stocks of business equipment and structures, and government infrastructure. The "total factor productivity" of this composite of tangible inputs is driven by expenditures on research and development (R&D) that produce technological progress.

Prices adjust in response to gaps between current production and supply potential and to changes in the cost of inputs. Wages adjust to labor supply-demand gaps (indicated by a demographically adjusted unemployment rate), current and expected inflation (with a unit long-run elasticity), productivity, tax rates, and minimum wage legislation. The supply of labor positively responds to the perceived availability of jobs, to the after-tax wage level, and to the growth and age-sex mix of the population. Demand for labor is keyed to the level of output in the economy and the productivity of labor, capital, and energy. Because the capital stock is largely fixed in the short run, a higher level of output requires more employment and energy inputs. Such increases are not necessarily equal to the percentage increase in output because of the improved efficiencies typically achieved during an upturn. Tempering the whole process of wage and price determination is the exchange rate; a rise signals prospective losses of jobs and markets unless costs and prices are reduced.

For financial markets the model predicts exchange rates, interest rates, stock prices, loans, and investments interactively with the preceding GDP and inflation variables. The Federal Reserve sets the supply of reserves in the banking system and the fractional reserve requirements for deposits. Private sector demands to hold deposits are driven by national income, expected inflation, and by the deposit interest yield relative to the yields offered on alternative investments. Banks and other thrift institutions, in turn, set deposit yields based on the market yields of their investment opportunities with comparable maturities and on the intensity of their need to expand reserves to meet legal requirements. In other words, the contrast between the supply and demand for reserves sets the critical short-term interest rate for interbank transactions, the federal funds rate. Other interest rates are keyed to this rate, plus expected inflation, US Treasury borrowing requirements, and sectoral credit demand intensities.

The old tradition in macroeconomic model simulations of exogenous fiscal or environmental policy changes was to hold the Federal Reserve's supply of reserves constant at baseline levels. While this approach makes static analysis easier in the classroom, it sometimes creates unrealistic policy analyses when a dynamic model is

appropriate. In the IHS Markit model, "monetary policy" is defined by a set of targets, instruments, and regular behavioral linkages between targets and instruments. The model user can choose to define unchanged monetary policy as unchanged reserves or as an unchanged reaction function in which interest rates or reserves are changed in response to changes in such policy concerns as the price level and the unemployment rate.

Monetarist aspects:

The model pays due attention to valid lessons of monetarism by carefully representing the diverse portfolio aspects of money demand and by capturing the central bank's role in long-term inflation phenomena.

The private sector may demand money balances as one portfolio choice among transactions media (currency, checkable deposits), investment media (bonds, stocks, short-term securities), and durable assets (homes, cars, equipment, structures). Given this range of choice, each medium's implicit and explicit yield must therefore match expected inflation, offset perceived risk, and respond to the scarcity of real savings. Money balances provide benefits by facilitating spending transactions and can be expected to rise nearly proportionately with transactions requirements unless the yield of an alternative asset changes.

Now that even demand deposit yields can float to a limited extent in response to changes in Treasury bill rates, money demand no longer shifts quite as sharply when market rates change. Nevertheless, the velocity of circulation (the ratio of nominal spending to money demand) is still far from stable during a cycle of monetary expansion or contraction. The simple monetarist link from money growth to price inflation or nominal spending is therefore considered invalid as a rigid short-run proposition.

Equally important, as long-run growth models demonstrate, induced changes in capital formation can also invalidate a naive long-run identity between monetary growth and price increases. Greater demand for physical capital investment can enhance the economy's supply potential in the event of more rapid money creation or new fiscal policies. If simultaneous, countervailing influences deny an expansion of the economy's real potential, the model will translate all money growth into a proportionate increase in prices rather than in physical output.

"Supply-side" economics:

Since 1980, "supply-side" political economists have pointed out that the economy's growth potential is sensitive to the policy environment. They focused on potential labor supply, capital spending, and savings impacts of tax rate changes. The IHS model embodies supply-side hypotheses to the extent supportable by available data, and this is considerable in the many areas that supply-side hypotheses share with long-run growth models. These features, however, have been fundamental ingredients of our model since 1976.

Rational expectations:

As the rational expectations school has pointed out, much of economic decision-making is forward looking. For example, the decision to buy a car or a home is not only a question of current affordability but also one of timing. The delay of a purchase until interest rates or prices decline has become particularly common since the mid-1970s when inflation and interest rates were very high and volatile. Consumer sentiment surveys, such as those conducted by the University of Michigan Survey Research Center, clearly confirm this speculative element in spending behavior.

However, households can be shown to base their expectations, to a large extent, on their past experiences: they believe that the best guide to the future is an extrapolation of recent economic conditions and the changes in those conditions. Consumer sentiment about whether this is a "good time to buy" can therefore be successfully modeled as a function of recent levels and changes in employment, interest rates, inflation, and inflation expectations.

Similarly, inflation expectations (influencing financial conditions) and market strength expectations (influencing inventory and capital spending decisions) can be modeled as functions of recent rates of increase in prices and spending.

This largely retrospective approach is not, of course, wholly satisfactory to pure adherents to the rational expectation's doctrine. In particular this group argues that the announcement of macroeconomic policy changes would significantly influence expectations of inflation or growth prior to any realized change in prices or spending. If an increase in government expenditures is announced, the argument goes, expectations of higher taxes to finance the spending might lead to lower consumer or business spending in spite of temporarily higher incomes from the initial government spending stimulus. A rational expectations theorist would thus argue that multiplier effects will tend to be smaller and more short-lived than a mainstream economist would expect.

These propositions are subject to empirical evaluation. Our conclusions are that expectations do play a significant role in private sector spending and investment decisions; but until change has occurred in the economy, there is very little room for significant changes in expectations in advance of an actual change in the variable about which the expectation is formed. The rational expectations school thus correctly emphasizes a previously understated element of decision making but exaggerates its significance for economic policymaking and model building.

The IHS Markit model allows a choice in this matter. On the one hand, the user can simply accept IHS Markit's judgments and let the model translate policy initiatives into initial changes in the economy, simultaneous or delayed changes in expectations, and subsequent changes in the economy. On the other hand, the user can manipulate the clearly identified expectations variables in the model, i.e., consumer sentiment, and inflation expectations. For example, if the user believes that fear of higher taxes would subdue spending, the consumer sentiment index could be reduced accordingly. Such experiments can be made "rational" through model iterations that bring the current change in expectations in line with future endogenous changes in employment, prices, or financial conditions.

Theory as a constraint:

The conceptual basis of each equation in the IHS Markit model was thoroughly worked out before the regression analysis was initiated. The list of explanatory variables includes a carefully selected set of demographic and financial inputs. Each estimated coefficient was then thoroughly tested to be certain that it meets the tests of modern theory and business practice. This attention to equation specification and coefficient results has eliminated the "short circuits" that can occur in evaluating a derivative risk or an alternative policy scenario. Because each equation will stand up to a thorough inspection, the IHS model is a reliable analytical tool and can be used without excessive iterations. The model is not a black box: it functions like a personal computer spreadsheet in which each interactive cell has a carefully computed, theoretically consistent entry and thus performs logical computations simultaneously.

IMPLAN model

Impact Analysis for Planning (IMPLAN) is a widely used, commercially available model for input/output analysis. Minnesota IMPLAN Group, Inc. is responsible for the production of the IMPLAN data, model, and software. Using classic input/output analysis in combination with region-specific social accounting matrices and multiplier models, IMPLAN provides a highly accurate and adaptable model for its users. The IMPLAN database contains country, state, zip code, and federal economic statistics that are specialized by region. IMPLAN accounts closely follow the accounting conventions used in the "Input-Output Study of the US Economy" by the US Bureau of Economic Analysis (BEA) and the rectangular format recommended by the United Nations. The IMPLAN system was designed to serve three functions:

- Data retrieval
- Data reduction and model development
- Impact analysis

Comprehensive and detailed data coverage of the entire United States by geography and the ability to incorporate user-supplied data at each stage of the model-building process provide a high degree of flexibility both in terms of geographic coverage and model formulation. There are two components to the IMPLAN system: the software, which performs the calculations and provides an interface for the user to make final-demand changes, and databases, which provide all information to create regional IMPLAN models.

The IMPLAN system consists of two major parts:

- A national-level technology matrix
- Estimates of sectoral activity for final demand, final payments, industry output, and employment for each detailed geography in the United States along with the aggregate region

Input-output accounting describes commodity flows from producers to intermediate and final consumers. The total industry purchases of commodities, services, employment compensation, value added, and imports are equal to the value of the commodities produced.

Purchases for final use (final demand) drive the model. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the region (imports and value added) stop the cycle.

These indirect and induced effects (the effects of household spending) can be mathematically derived. The derivation is called the Leontief inverse. The resulting sets of multipliers describe the change of output for each and every regional industry caused by a one-dollar change in final demand for any given industry.

Creating regional input-output models requires a tremendous amount of data. The costs of surveying industries within each region to derive a list of commodity purchases (production functions) are prohibitive. IMPLAN was developed as a cost-effective means to develop regional input-output models.

IMPLAN easily allows the user to:

- Develop multiplier tables
- Develop a complete set of social accounting matrix (SAM) accounts
- Change any component of the system, production functions, trade flows, or database

- Generate type I, II, or any true SAM multiplier internalizing household, government, and/or investment activities
- Create custom impact analysis by entering final-demand changes
- Obtain any report in the system to examine the model's assumptions and calculations

Database

Each database has information for these components for all 546 industrial sectors in the IMPLAN model. This 546-sector scheme was revised in 2018 and was originally the basis for the BEA's Benchmark Input-Output Study. This scheme is nearly six-digit NAICS for manufacturing and more aggregate for service sectors. By necessity, IMPLAN's sectoring is very similar; however, in some cases, six-digit NAICS code data have been aggregated for certain IMPLAN sectors. A full NAICS-to-IMPLAN mapping document can be downloaded from www.implan.com.

Employment is total wage and salary and self-employed jobs in a region. In the 1985 database, employment was measured as full-time equivalent jobs. This meant total employment in a region would generally be below most published estimates because these are generally full-time and part-time workers. In the 1990 and subsequent databases, employment includes full-time and part-time workers. Employment in the 1990 and subsequent databases are measured in total jobs.

There are four subcomponents for value added:

- Employee compensation
- Proprietary income
- Other property-type income
- Indirect business taxes

Employee compensation is wage and salary payments, as well as benefits, including health and life insurance, retirement payments, and any other noncash compensation. This provides a measure of income to workers paid by employers.

Proprietary income consists of payments received by self-employed individuals as income. This would be recorded on Federal Tax Form 1040C. This includes income received by private business owners, doctors, lawyers, and so forth. Any income a person receives for payment of self-employed work is counted here.

Other property-type income consists of payments from rents, royalties, and dividends. This includes payments to individuals in the form of rents received on property, royalties from contracts, and dividends paid by corporations. This also includes corporate profits earned by corporations.

Indirect business taxes consist primarily of excise and sales taxes paid by individuals to businesses. These taxes are collected during the normal operation of these businesses but do not include taxes on profit or income. Goods and services purchased for their ultimate use by an end user are called final demands. For a region, this would include exports since those are a final use for that product. In an input-output framework, final demands are allocated to producing industries with margins allocated to the service sectors (transportation, wholesale and retail trade, insurance) associated with providing that good to the final user.

Thus, final demands are in producer prices. There are 13 subcomponents for final demands:

- Personal consumption expenditures (PCE)—nine income levels
- Federal government military purchases
- Federal government nonmilitary purchases
- Federal government capital formation purchases
- State and local government noneducation purchases
- State and local government education purchases
- State and local government capital formation purchases
- Inventory purchases
- Capital formation
- Foreign exports
- State and local government sales
- Federal government sales
- Inventory sales

All final demands in the original data are on a commodity basis. The distinction between industries and commodities is as follows from the 1972 Input-Output Definitions and Conventions Manual:

- An input-output industry is a grouping of establishments, as classified by Standard Industrial Classification (SIC)[6].
- An input-output commodity consists of the characteristic products of the corresponding input-output industry wherever made. There are several industries that have no commodities. This is a result of departures from the strict SIC. Also, some commodities have no associated industry. An example of this is noncomparable imports.

PCE consists of payments by individuals/households to industries for goods and services used for personal consumption. Individuals tend to buy little directly from industries other than retail trade. In an input-output table, though, purchases made by individuals for final consumption are shown as payments made directly to the industry producing the good. PCE is the largest component of final demand.

Federal government purchases are divided between military and nonmilitary uses and capital formation. Federal military purchases are those made to support national defense. Goods range from food for troops to missile launchers. Nonmilitary purchases are made to supply all other government functions. Payments made to other governmental units are transfers and are not included in federal government purchases.

State and local government purchases are divided between public education and noneducation and capital formation. Public education purchases are for elementary, high school, and higher education. Noneducation purchases are for all other government activities. These include state government operations and operations including police protection and sanitation. Private-sector education purchases are not counted here. Private education purchases show up in IMPLAN sectors 495 and 496.

Inventory purchases are made when industries do not sell all output created in one year. This is generally the case. Each year, a portion of output goes to inventory. Inventory sales occur when industries sell more than they

[6] The IMPLAN sector scheme is currently based on NAICS definitions and is revised as necessary after each five-year economic census is released.

produce and need to deplete inventory. Inventory purchases and sales generally involve goods-producing industries (e.g., agriculture, mining, and manufacturing).

Capital formation is private expenditures made to obtain capital equipment. The dollar values in the IMPLAN database are expenditures made to an industrial sector producing the capital equipment. The values are not expenditures by the industrial sector.

Foreign exports are demands made to industries for goods for export beyond national borders. These represent goods and services demanded by foreign parties. Domestic exports are calculated during the IMPLAN model creation and are not part of the database.

The national transactions matrix is based on the most current BEA National Benchmark Input-Output Model. It is resectored to IMPLAN industrial sectoring. We use our IMPLAN data for the current year to update the most recent National Benchmark study.

IMPLAN multipliers

The notion of a multiplier rests on the difference between the initial effect of a change in final demand and the total effects of that change. Total effects can be calculated either as direct and indirect effects, or as direct, indirect, and induced effects. Direct effects are production changes associated with the immediate effects or final-demand changes. Indirect effects are production changes in backward-linked industries caused by the changing input needs of directly affected industries (for example, additional purchases to produce additional output). Induced effects are the changes in regional household spending patterns caused by changes in household income generated from the direct and indirect effects.

Five different sets of multipliers are estimated by IMPLAN corresponding to five measures of regional economic activity: total industry output, personal income, total income, value added, and employment. For each set of multipliers, four types of multipliers are generated: Type I, Type II, Type SAM, and Type III.

Type I multiplier:

A Type I multiplier is the direct effect produced by a change in final demand, plus the indirect effect divided by the direct effect. Increased demands are assumed to lead to increased employment and population with the average income level remaining constant. The Leontief inverse (Type I multipliers matrix) is derived by inverting the direct coefficients matrix. The result is a matrix of total requirement coefficients, the amount each industry must produce for the purchasing industry to deliver one dollar’s worth of output to final demand.

Type II multipliers:

Type II multipliers incorporate induced effects resulting from household expenditures from new labor income. The linear relationship between labor income and household expenditure can be customized in the IMPLAN Professional® software. The default relationship is PCE and total household expenditures. Each dollar of workplace-based income is spent based on the SAM relationship generated by IMPLAN. The second possibility is a Regional Input-Output Modeling System (RIMS II) style of Type II multiplier, where PCE is adjusted to represent only the spending of the disposable income portion of labor income. In this way, there is a direct one-to-one relationship to labor income and PCE. Then, a ratio that the user can specify is applied to convert total income to disposable income before the rounds of induced effects are calculated.

Type SAM

Type SAM multipliers are the direct, indirect, and induced effects, where the induced effect is based on information in the social account matrix. This relationship accounts for social security and income tax leakage, institution savings, and commuting. It also accounts for interinstitutional transfers. This multiplier is flexible, in that you can include any institutions you want. In other words, if you want to create a model closed to households and state and local government, you can. If you select this option, an additional dialog box with be displayed allowing you to select the institutions you want to include.

Output multipliers

This report shows the total industry output multipliers and per capita personal consumption expenditures. Output multipliers can be used to gauge the interdependence of sectors; the larger the output multiplier, the greater the interdependence of the sector on the rest of the regional economy. A Type I entry represents the value of production (from direct and indirect effects) required from all sectors by a particular sector to deliver one dollar's worth of output. Type II, SAM, and III add in the induced requirements.

Example: If a Type I multiplier for the dairy farm industry is 1.0943, for each dollar of output produced by the dairy farm sector, 0.0943 dollar's worth of indirect output is generated in other local industries. If the Type SAM dairy farm multiplier is 1.3140, 0.3140 dollar of indirect and induced output is generated in other local industries. The induced output would be 1.3140 minus 1.0943, or 0.2197 dollar for each dollar of output produced by the dairy farm sector.

Labor income multipliers

The labor income multiplier report shows the direct, indirect, and induced employee compensation plus proprietor income effects generated per dollar of output. The Type I personal income multiplier is the direct and indirect employee compensation plus proprietor income divided by the direct income. The Type II, Type SAM, and Type III multipliers add the induced effects component.

Example: If the Type I multiplier for the dairy farm sector is 1.4761 and the Type SAM multiplier is 2.7067, then for each dollar of direct income generated by this industry, 0.4761 dollar of indirect and 1.2306 dollars of induced income are generated.

Employee compensation multipliers

Employee compensation represents all payroll costs of wage and salary workers. The Type I, Type SAM, Type II, or Type III total income multipliers are listed in this report, along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Proprietor income multiplier

Proprietor income is the income earned by the owners of a private, nonincorporated business—i.e., the self-employed. The Type I, Type SAM, Type II, and Type III total income multipliers are listed in this report, along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Other property-type income

Other property-type income represents corporate income, rental income, and interest. The Type I, Type II, Type SAM, and Type III total income multipliers are listed in this report, along with the direct, indirect, and induced total income effects generated from the production of one dollar's output.

Value-added multipliers

Type I, Type II, Type SAM, and Type III value-added multipliers are listed in this report, along with the direct, indirect, and induced value-added effects generated from the production of one dollar of output. Value-added includes employee compensation, proprietary income, other property-type income, and indirect business taxes.

Employment multipliers

Type I, Type II, Type SAM, and Type III employment multipliers are listed in this report along with the direct, indirect, and induced employment effects from the production of $1 million of output. Employment is in terms of full-time and part-time jobs.

Example: If a dairy farm Type I employment multiplier is 1.1158, for each job created directly by the dairy farm industry, 0.1158 job is created indirectly.

Appendix D. Glossary of key economic terminology

Capital stock	refers to items that are already-produced, durable goods or any nonfinancial asset that works for the production of goods or services.
Consumption	Public or government consumption added to private consumption gives total Consumption, a key element of the formula used to calculate Gross Domestic Product (GDP = Consumption + Investment + Government Spending + [Exports – Imports]). Public Consumption refers to expenditure, including imputed expenditure, incurred by general government on both individual consumption goods and services and collective consumption services. Private Consumption refers to households' expenditure, including imputed expenditure, on individual consumption of goods and services.
Corporate profits (with IVA and CC Adj)	This measure–profits from current production–is the income that arises from current production, measured before income taxes, of organizations treated as corporations in the national income and product accounts (NIPAS). With several differences, this income is measured as receipts less expenses as defined in Federal tax law. Among these differences are: Receipts exclude capital gains and dividends received; expenses exclude bad debt, depletion, and capital losses; inventory withdrawals are valued at current cost; and depreciation is on a consistent accounting basis and valued at current replacement cost.
Direct impacts	The first-order responses throughout the economy due to direct sales transactions
Economic impact analysis	A study that examines the direct, indirect, and induced impacts of the independent operators' production activities and supply chain spending.
Employment	This includes wages, salaries, and self-employment jobs within the economy.
Gross domestic product (GDP)	Gross Domestic Product (GDP) is a measure of the total size of an economy. It represents the total market value of all final goods and services within a country in a given period of time. There are several approaches to calculating GDP, all of which should, in theory, produce the same result. The most common of these is the expenditure method, which is what IHS Markit uses: GDP = Consumption + Investment + Government Spending + (Exports– Imports)
Indirect impacts	The follow-on supply chain or purchasing network activities that are initiated by direct spending.
Induced impacts	The response of the economy to marginal changes in consumer spending from employees of the direct and indirect businesses.
Industrial Production	Industrial Production is measured in index form and represents real output produced by manufacturing, mining, electric, and gas industries of the country within a certain period of time. The index is usually calculated using the industrial-
Input-output analysis	This analysis utilizes an input-output table that represents a particular economy and depicts the flows of related economic transactions that take place within the country. It also shows the economic interconnections that exist between different components of the economic system, i.e., production activities, the government and supplier enterprises.

Labor income	This captures all forms of employment income, including employee compensation (wages and benefits, employer-paid payroll taxes, unemployment taxes, etc.) and proprietor income (payments received by self-employed individuals and unincorporated businesses).
Labor Productivity	a concept used to measure the efficiency of the worker and is calculated as the value of output produced by a worker per unit of time, such as an hour. By comparing the individual productivity with average, it can be identified whether a particular worker is under-performing or not.
Output	The total value of all goods and services produced within an economy.
Personal disposable income	Total after-tax income received by persons; it is the income available to persons for spending or saving.
Potential GDP	in theory refers to the maximum output an economy can produce using its existing economic resources. It represents an economy's long-run aggregate supply. At this level of output, the economy will fully utilize all its resources and work full
Supply chain	The network of suppliers that provides goods and services in support of the direct industry activity.
Value added	The difference between the revenue received for a product or service and its non-labor input costs. It is also understood as the difference between the value of sale and the cost of its required non-labor inputs.
Wage and salary disbursements	The monetary remuneration of employees, including the compensation of corporate officers; commissions, tips, and bonuses; voluntary employee contributions to certain deferred compensation plans, such as 401(k) plans; and receipts in kind that represent income. Accruals and disbursements differ in the treatment of retroactive payments. In the national income and product accounts (NIPAs), wage and salary accruals are the appropriate measure for gross domestic income (GDI) and wage and salary disbursements is the appropriate measure for personal income.

Appendix E. Detailed Macroeconomic Results

Key macroeconomic variables						
	2022	2023	2024	2025	2026	2027
Gross domestic product (in billions)						
Baseline	$ 24,588	$ 25,633	$ 26,855	$ 28,123	$ 29,447	$ 30,836
With additional highway spending	$ 24,598	$ 25,663	$ 26,904	$ 28,189	$ 29,527	$ 30,928
Additional due to highway spending	$ 10	$ 30	$ 49	$ 66	$ 80	$ 91
With public transit and highway spending	$ 24,610	$ 25,684	$ 26,930	$ 28,219	$ 29,560	$ 30,966
Additional due to public transit	$ 12	$ 21	$ 26	$ 30	$ 33	$ 38
Employment						
Baseline	152,481,600	154,479,950	155,493,225	156,249,275	156,954,650	157,800,150
With additional highway spending	152,510,375	154,578,350	155,659,625	156,448,675	157,142,725	157,941,250
Additional due to highway spending	28,775	98,400	166,400	199,400	188,075	141,100
With public transit and highway spending	152,548,100	154,655,275	155,752,800	156,529,975	157,196,000	157,964,850
Additional due to public transit	37,725	76,925	93,175	81,300	53,275	23,600
Non-residential capital stock (in billions)						
Baseline	$ 24,618	$ 25,583	$ 26,537	$ 27,475	$ 28,400	$ 29,326
With additional highway spending	$ 24,618	$ 25,588	$ 26,549	$ 27,493	$ 28,423	$ 29,351
Additional due to highway spending	$ 1	$ 5	$ 12	$ 19	$ 23	$ 25

IHS Markit®

Percentage increase due to additional highway spending	0.00%	0.02%	0.04%	0.07%	0.08%	0.09%
With public transit and highway spending	$ 24,620	$ 25,592	$ 26,557	$ 27,503	$ 28,433	$ 29,359
Additional due to public transit	$ 1	$ 5	$ 8	$ 9	$ 9	$ 8
Percentage increase due to additional public transit spending	0.01%	0.02%	0.03%	0.03%	0.03%	0.03%
Industrial production (index)						
Baseline	104.27	106.37	108.35	110.28	112.06	113.72
With additional highway spending	104.33	106.52	108.55	110.48	112.23	113.83
Additional due to highway spending	0.06	0.15	0.20	0.20	0.17	0.10
Percentage increase due to additional highway spending	0.06%	0.14%	0.19%	0.19%	0.15%	0.09%
With public transit and highway spending	104.39	106.62	108.63	110.54	112.26	113.82
Additional due to public transit	0.06	0.09	0.08	0.06	0.02	(0.00)
Percentage increase due to additional public transit spending	0.06%	0.09%	0.08%	0.05%	0.02%	0.00%
Non-farm productivity (index)						
Baseline	1.13	1.15	1.18	1.20	1.23	1.26
With additional highway spending	1.14	1.15	1.18	1.20	1.23	1.26
Additional due to highway spending	0.00	0.00	0.00	0.00	0.00	0.00
Percentage increase due to additional highway spending	0.02%	0.03%	0.03%	0.03%	0.02%	0.03%

IHS Markit®

With public transit and highway spending	1.14	1.15	1.18	1.20	1.23	1.26
Additional due to public transit	0.00	0.00	0.00	0.00	0.00	0.00
Percentage increase due to additional public transit spending	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%
Corporate profits - before tax (in billions)						
Baseline	$ 2,710	$ 2,697	$ 2,797	$ 2,902	$ 3,024	$ 3,157
With additional highway spending	$ 2,715	$ 2,708	$ 2,812	$ 2,917	$ 3,038	$ 3,168
Additional due to highway spending	$ 5	$ 12	$ 15	$ 15	$ 14	$ 11
Percentage increase due to additional highway spending	0.19%	0.44%	0.53%	0.53%	0.46%	0.35%
With public transit and highway spending	$ 2,721	$ 2,716	$ 2,818	$ 2,922	$ 3,041	$ 3,171
Additional due to public transit	$ 5	$ 7	$ 6	$ 5	$ 4	$ 3
Percentage increase due to additional public transit spending	0.20%	0.27%	0.23%	0.17%	0.12%	0.10%
Federal tax base (in billions)						
Baseline	$ 11,619	$ 12,105	$ 12,718	$ 12,962	$ 13,390	$ 14,153
With additional highway spending	$ 11,625	$ 12,131	$ 12,765	$ 13,022	$ 13,452	$ 14,202
Additional due to highway spending	$ 6	$ 26	$ 47	$ 60	$ 62	$ 49
Percentage increase due to additional highway spending	0.05%	0.22%	0.37%	0.46%	0.46%	0.35%
With public transit and highway spending	$ 11,633	$ 12,153	$ 12,791	$ 13,048	$ 13,470	$ 14,211
Additional due to public transit	$ 9	$ 22	$ 27	$ 26	$ 18	$ 9

IHS Markit®

Percentage increase due to additional public transit spending	0.08%	0.18%	0.21%	0.20%	0.14%	0.06%
Real potential GDP (in billions)						
Baseline	$ 20,217	$ 20,714	$ 21,226	$ 21,750	$ 22,270	$ 22,785
With additional highway spending	$ 20,217	$ 20,716	$ 21,231	$ 21,759	$ 22,283	$ 22,801
Additional due to highway spending	$ 0	$ 2	$ 5	$ 10	$ 13	$ 16
With public transit and highway spending	$ 20,217	$ 20,717	$ 21,234	$ 21,763	$ 22,288	$ 22,806
Additional due to public transit	$ 0	$ 1	$ 3	$ 4	$ 5	$ 5
Personal disposable income (in billions)						
Baseline	$ 18,355	$ 19,133	$ 20,064	$ 21,071	$ 22,137	$ 23,269
With additional highway spending	$ 18,358	$ 19,140	$ 20,076	$ 21,092	$ 22,168	$ 23,313
Additional due to highway spending	$ 2	$ 7	$ 13	$ 21	$ 31	$ 45
With public transit and highway spending	$ 18,360	$ 19,145	$ 20,084	$ 21,104	$ 22,185	$ 23,338
Additional due to public transit	$ 3	$ 5	$ 8	$ 12	$ 18	$ 25
Federal tax receipts (in billions)						
Baseline	$ 1,965	$ 2,062	$ 2,162	$ 2,267	$ 2,378	$ 2,497
With additional highway spending	$ 1,966	$ 2,068	$ 2,173	$ 2,281	$ 2,392	$ 2,507
Additional due to highway spending	$ 1	$ 6	$ 11	$ 14	$ 14	$ 9
With public transit and highway spending	$ 1,968	$ 2,074	$ 2,180	$ 2,286	$ 2,395	$ 2,507

IHS Markit®

Additional due to public transit	$ 2	$ 5	$ 6	$ 6	$ 3	$ 1
Wages and salaries disbursements (in billions)						
Baseline	$ 10,966	$ 11,521	$ 12,065	$ 12,625	$ 13,214	$ 13,844
With additional highway spending	$ 10,969	$ 11,532	$ 12,086	$ 12,656	$ 13,253	$ 13,888
Additional due to highway spending	$ 3	$ 11	$ 21	$ 31	$ 39	$ 44
With public transit and highway spending	$ 10,973	$ 11,541	$ 12,100	$ 12,672	$ 13,270	$ 13,907
Additional due to public transit	$ 4	$ 9	$ 13	$ 16	$ 17	$ 19
Consumption (in billions)						
Baseline	$ 16,575	$ 17,261	$ 18,073	$ 18,959	$ 19,930	$ 20,976
With additional highway spending	$ 16,578	$ 17,271	$ 18,090	$ 18,983	$ 19,960	$ 21,013
Additional due to highway spending	$ 3	$ 10	$ 17	$ 24	$ 30	$ 37
With public transit and highway spending	$ 16,582	$ 17,278	$ 18,100	$ 18,995	$ 19,974	$ 21,030
Additional due to public transit	$ 4	$ 7	$ 10	$ 12	$ 14	$ 18
State and local tax receipts (in billions)						
Baseline	$ 2,278	$ 2,367	$ 2,472	$ 2,584	$ 2,702	$ 2,829
With additional highway spending	$ 2,279	$ 2,372	$ 2,481	$ 2,596	$ 2,717	$ 2,845
Additional due to highway spending	$ 1	$ 5	$ 9	$ 12	$ 14	$ 16
With public transit and highway spending	$ 2,280	$ 2,376	$ 2,486	$ 2,602	$ 2,723	$ 2,851
Additional due to public transit	$ 2	$ 4	$ 5	$ 6	$ 6	$ 6

IHS Markit®

Number of Households	130.01	131.44	132.69	133.93	135.09	136.21
Number of Households with highway and public transit	130.02	131.45	132.70	133.94	135.10	136.22

IHS Markit®

IHS Markit Customer Care:

CustomerCare@ihsmarkit.com
Americas: +1 800 IHS CARE (+1 800 447 2273)
Europe, Middle East, and Africa: +44 (0) 1344 328 300
Asia and the Pacific Rim: +604 291 3600

IHS Markit®