Transportation Infrastructure Investment: Macroeconomic and Industry Contribution of the Federal Highway and Mass Transit Program

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EXECUTIVE SUMMARY

Federal transportation spending expands the capital stock of the US economy, drives the production and delivery of goods and services, and positively affects business and household incomes. It also enhances the transportation system's operational capacity, reducing travel times and costs. This results in greater accessibility for individuals, households and businesses,

- An additional $40 in real household income each year
- An additional $9.6 billion in real value to the US economy by 2019
- On average an additional $4.9 billion per year in federal, state and local government revenue, which covers more than 50% of the annual spending needed to cover the backlog in highway and bridge capital expenditures[2].

Clearly, transportation infrastructure investment is critical to the economic well-being of the US.

[2] Based on the estimate of current backlog at http://www.dot.gov/briefing-room/new-department-transportation-report-highway-transit-conditions-points-need-more (retrieved 22 May 2014)

- Economic Competiveness. It is increasingly important to be able to keep pace with the investments being made by emerging countries in building highways, subways, high speed rail, ports, airports and intermodal terminals.

- Transportation Reauthorization. Congressional reauthorization of the surface transportation provides the critical mechanism for the majority share of funds via different investment programs and matching formulas that pay for the construction and operational performance of our highway and transit systems. Moving Ahead for Progress in the 21

2. BROAD IMPACT ON THE US ECONOMY

The macroeconomic impact of federal highway and mass transit infrastructure spending from the HTF on the US economy was assessed using the IHS US Macro Model. IHS estimated the contribution of transportation infrastructure investment to the US economy from 2014 to 2019. This comprehensive model accounts for supplier and income effects, as well as the direct effects of spending on the broad aggregates of the US economy (GDP, employment, income, capital stock, etc.).

Cases Evaluated

The following two cases were developed for this study:

1. Base Case estimates the economic impact of the current levels of federal spending on highway and mass transit (through the Highway Trust Fund) of $54-56 billion per year over the six year forecast horizon.[4]

2. 5% year over year (yoy) Growth in Funding (Scenario 1): estimates the economic impact of increasing federal spending for highways and mass transit by 5% each year starting in 2015 amounts to $24 billion more than baseline outlays over the 2015-2019 timeframe

The table below details the inputs for these two cases. The federal Highway Trust Fund (HTF) provides the funds for both the federal highway program funding and the majority of mass transit program funding.[5]

Funding Assumptions for the Cases ($B)

For the Base Case, current and projected funding for highways and mass transit are used to impact the model. For the 5% HTF Growth Case (Scenario 1), we assume that current federal highway and mass transit program funding (that is, appropriations) grows by 5% year over year starting with the current funding amount in 2014 such that spending growth starts in 2015.

[4] This amount is estimated actual spending per year rather than the amount budgeted annually.

[5] An additional roughly $2 billion of mass transit funding comes from the federal governments general fund each year.

Methodology

IHS incorporated the expertise from its transportation and US macroeconomic groups to formulate and establish an integrated link between federal highway and mass transit spending input data and the investment block of the IHS Macroeconomic Model.

In order to estimate the impact of current federal HTF spending (the Base Case), the current amount was removed from state and local construction spending which was over the forecast period - $54 billion from 2014 to 2017, $55 billion in 2018, and $56 billion in 2019. Additionally, the model was adjusted to target reduced construction spending on public transportation – an $8 to $9 billion removal of federal mass transit outlays and a $46 to $47 billion removal of spending on highways and streets.[6]

To estimate the impact of increased spending (the 5% HTF Growth Case), state and local construction spending was increased by 5% year over year starting from the current level of funding. Additionally, the allocations of construction spending to the public transportation and highways and streets variables in the Macro model were targeted to receive these higher allocations to simulate the increases in mass transit funding and funding for public highways and streets.

Macroeconomic Results

Transportation infrastructure improves the overall performance of the US economy by enhancing the capital stock of the US.

US

The current federal spending on transportation infrastructure increases the capital stock in the US economy. This has a positive impact on US economic growth. Increasing investment in infrastructure by 5% per year would fuel even higher levels of transportation infrastructure such that by 2019, there would be $11 billion more in net new infrastructure than there would be under current federal spending levels. This would further expand the potential amount of goods and services that could be produced domestically each year.

Because transportation infrastructure as a vital lifeline good, investment in infrastructure also has an impact on other types of investment. In the Base Funding Case nonresidential fixed investment is 0.8%

GDP per year. Allowing this spending to grow by 5% each year for the next 5 years (2015-2019) would, on average, contribute an additional 0.1% to real GDP per year.

A higher level of capital increases the potential growth of the economy because it allows more output to be produced per worker. Higher levels of transportation infrastructure capital raise the nonfarm productivity index by 0.2% on average over the forecast period (2014-2019) in the Base Case (current spending levels). A 5% increase in spending per year would increase productivity by another 0.01% on average.

Income per Household

Higher productivity and more goods and services translate into higher wages and income for households. Real personal income per household is on average $410 more per year than it would be without the current federal infrastructure investment. For an average household, this pays for about one month of groceries, enabling families to have

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Average Contributions to Annual Household Real Income 2014-2019

Gain from Economic Growth

Higher productivity and economic growth that drives higher wages and business profits leads to increases in the amount of taxable income, therefore increasing the revenue to the

revenue from the growth effects of the investment in transportation infrastructure would cover more than half the backlog spending each year.[10]

[10] http://www.dot.gov/briefing-room/new-department-transportation-report-highway-transit-conditions-points-need-more (retrieved 29 April 2014).

3. ECONOMIC IMPACT ON INDUSTRIAL SECTORS

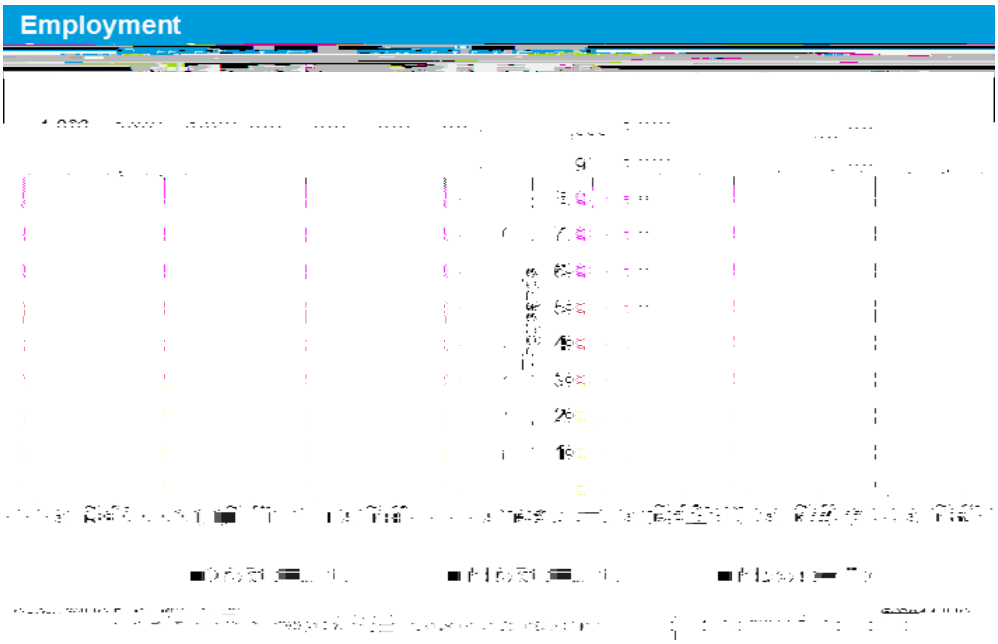
IMPLAN, a social accounting modeling system, was used to assess the direct, indirect, and induced contribution of transportation infrastructure investment on the US industrial economy. The metrics include GDP, employment and labor income. Using classic input-output analysis, the models provide a highly accurate and adaptable assessment of industrial impacts. The model database contains detailed national economic statistics and follows the accounting conventions used in the "Input-Output Study of the US Economy" by the Bureau of Economic Analysis and the rectangular format recommended by the United Nations. The social accounting model segments the contribution of transportation infrastructure investment by direct, indirect, and induced contributions. The descriptions of the direct, indirect, and induced contributions used for this study are as follows:

- Direct contributions are generated by act

Sector Results: Both Base and 5% HTF Growth Cases

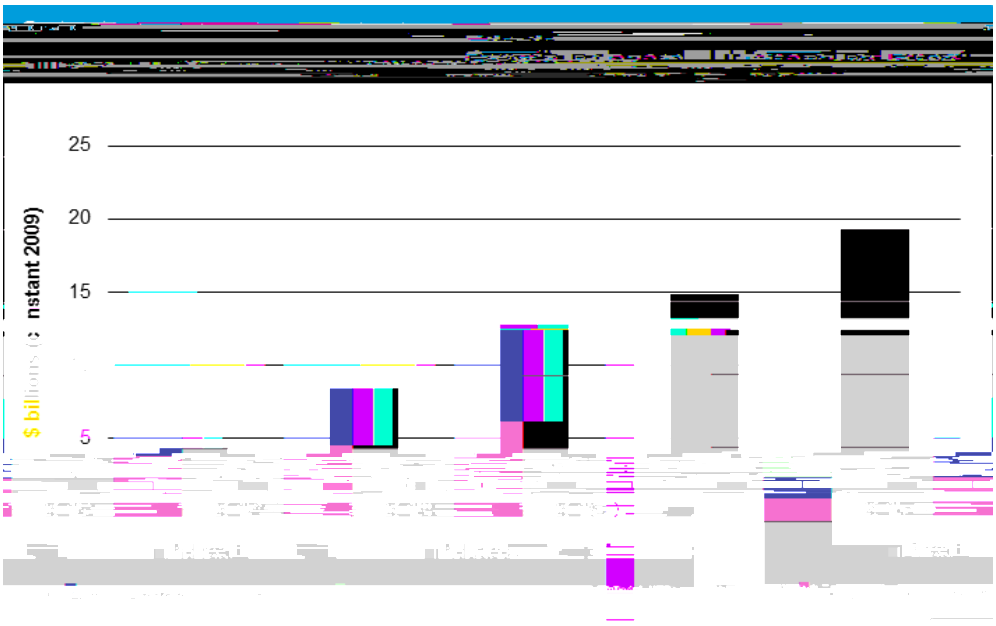
The sector breakdowns and the charts below show that approximately three-fifths of the jobs created from federal transportation infrastructure spending are indirect and induced. That is, for every 2 job

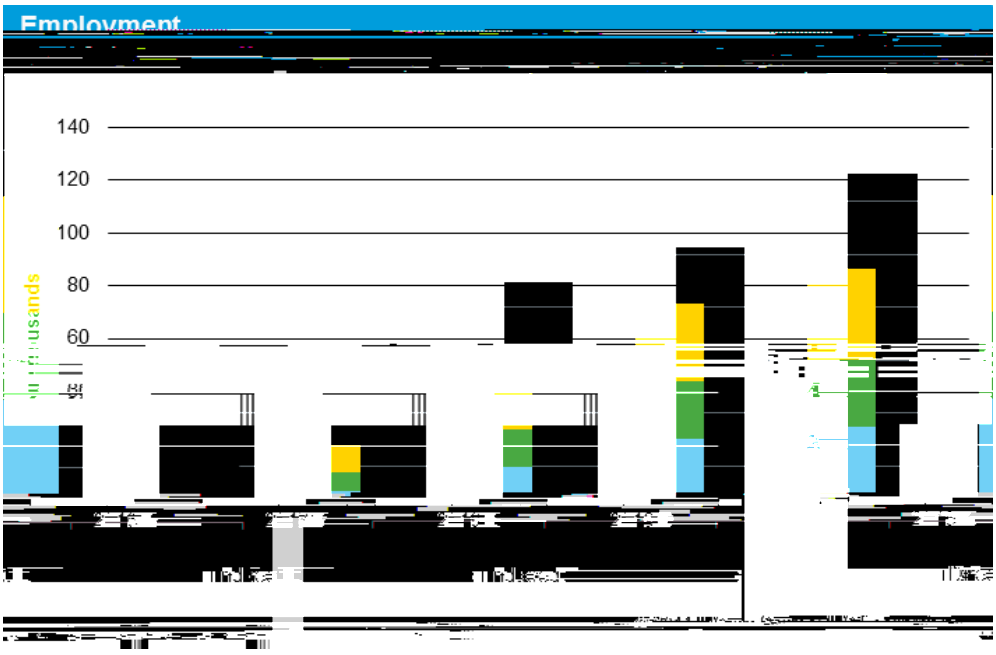
transportation and utilities sector that receives the third largest impact. Education and health services, financial activities, manufacturing and leisure and hospitality also see a large portion (28% combined) of the benefit. In the case of federal funding of the Highway Program growing each year by 5% (Scenario 1), employment gains would also continue to grow. While these employment estimates are somewhat larger than the macroeconomic analysis, it can be explained by the difference in employment concept. The macroeconomic model counts employees (people), while the IMPLAN model counts jobs. Thus one employed person could feasibly have two jobs.



Direct, Indirect and Induced Impact on Output

Similar to the Macro Model results, which found for every $1 of federal highway investment approximately $2 of real GDP is produced, the IMPLAN model shows similar returns: every dollar of real current direct federal spending on output returns $1.82 in output through indirect and induced effects.





4. CONCLUSION

Both the macroeconomic and sector analysis show that there are substantial benefits to the economy from the federal investment in highways and mass transit (funded via the Highway Trust Fund). These benefits accrue because federal spending on transportation infrastructure invests in the capital stock of the U.S. economy, which increases WKH HFRQRP\¶V DELOLW\ goods and services (a larger capital base). Transportation infrastructure investment, though, is a particularly valuable form of capital because it enables all other sectors to be more efficient by connecting key suppliers more quickly, reducing employee commute times by alleviating congestion and making travel safer, and allowing other transportation capital to be more productive by reducing downtime for maintenance from traveling on poor quality roads.

The benefits of this investment can be quantified in terms of the additional output created by higher productivity. Both the macroeconomic and sector analysis estimated approximately $1.80 to $2.00 in additional real goods and services for every $1 spent. The benefits can be seen in the labor market as the analysis shows that the current federal highway and mass transit program supports more than 780,000 jobs at peak and 614,000 more jobs per year on average.

The increased employment and output that the higher productivity of the capital stock enables allows for larger incomes for households. The average household earns approximately $410 more real dollars each year than they otherwise would without the federal highway and mass transit funding. If this funding were increased by 5% per year, households would see, on average, an additional $40 per year in real income, thus helping to improve the standard of living

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The Macroeconomic model was run under the base case assuming no current (and projected) levels of federal highway spending in order to estimate the contribution of current spending to the baseline forecast.

The current spending levels for the Highway and Mass Transit funding were provided by the client. Spending levels ranged from $54 - $56 billion (current) dollars under the Base Case. In Scenario 1, investment variables were targeted to grow at 5% per year. In the Macro Model, federal dollars are already captured in state & local construction. Therefore, the major entry point to assess the federal highway and mass transit infrastructure investment impact is Real State & Local Construction Spending. State and Local Investment in Highway & 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 Mass Transit construction sectors.

Since the inputs were given in nominal dollars and the target variable is real, the inputs were adjusted by the construction sector pricing variable to estimate real spending amount for application in the model.

The tables below provide the details of the key indicators from the Macro Model. The %DVHOLQH tables list the IHS baseline without current federal highway and mass transit funding. The Base Case is the impact of the federal highway and mass transit funding on the baseline and Scenario 1 is the 5% per year.

Key Macroeconomic Indicators						
	2014	2015	2016	2017	2018	2019
Gross Domestic Product (Billion of 2009 $)						
Baseline (less federal infrastructure spending)	16,105	16,595	17,158	17,714	18,235	18,733
BASE CASE (current federal infrastructure spending)	16,196	16,726	17,293	17,833	18,330	18,815
Scenario 1: 5% increase in federal infrastructure	16,196	16,734	17,305	17,846	18,341	18,824
Current Contribution, $	90.6	131.4	135.3	119.1	95.1	81.4
Scenario 1 Contribution, $	0.0	7.8	11.8	12.4	11.3	9.6
Industrial Production						
Baseline (less federal infrastructure spending)	102	106	110	113	116	119
BASE CASE (current federal infrastructure spending)	103	107	11TBT1 0 0 1	42.8	475.3690 0 0 1	523.35 4383

Key Macroeconomic Indicators (Continued)						
	2014	2015	2016	2017	2018	2019
Employment -Trade, Transportation and Utilities (Millions)						
Baseline (less federal infrastructure spending)	26	27	27	28	28	28
BASE CASE (current federal infrastructure spending)	26	27	27	28	28	28
Scenario 1: 5% increase in federal infrastructure	26	27	27	28	28	28
Current Contribution	0.05	0.07	0.10	0.09	0.06	0.02
Scenario 1 Contribution	0.00	0.00	0.01	0.01	0.01	0.01
Investment in Nonresidential Land Transportation (Billion $)						
Baseline (less federal infrastructure spending)	13	12	12	11	12	12
BASE CASE (current federal infrastructure spending)	13	12	12	11	12	12
Scenario 1: 5% increase in federal infrastructure	13	12	12	11	12	12
Current Contribution, $	0.01	0.03	0.04	0.06	0.09	0.13
Scenario 1 Contribution, $	0.00	0.00	0.00	0.00	0.01	0.01
Investment in Transportation Equipment (Billion $)						
Baseline (less federal infrastructure spending)	225	234	247	258	267	274
BASE CASE (current federal infrastructure spending)	231	243	253	260	268	275
Scenario 1: 5% increase in federal infrastructure	231	243	254	261	268	276
Current Contribution, $						

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For each year of the analysis, federal spending was allocated to the new construction sector (96%) and maintenance and repair sector (4%) in the IMPLAN model. In the IMPLAN model new construction encompasses the capital expenditures of improving and expanding highway and mass transit capacity. Further allocation was made from each of these sectors to machinery and trucks. The relative proportion of Highway and Mass Transit construction spending that goes WR PDFKLQHU\ DQG WUXFNV ZDV FDOFXODWHG XVLQJ (&, LQSXW RXWSXW GDWD IURP , + 6 ¶ database. The proportion of spending was subtracted from the construction sector and passed to the three machinery and truck sectors. The three sectors for machinery and trucks investmen were

Employment Contribution - Base Case

(Number of Workers)

	2014	2015	2016	2017	2018	2019
Construction	333,933	330,462	327,240	323,373	325,398	327,019
Agriculture	8,777	8,674	8,574	8,467	8,515	8,557
Mining	7,275	7,191	7,111	7,024	7,065	7,100
Trade, Transportation and Utilities	110,210	108,837	107,496	106,129	106,715	107,249
Manufacturing	60,559	59,588	58,583	57,739	57,978	58,266
Information	9,766	9,646	9,531	9,411	9,463	9,511
Financial activities	59,764	59,052	58,365	57,637	57,966	58,255

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Value Added Contribution - Base Case

($M)

	2014	2015	2016	2017	2018	2019
Construction	20,287	20,076	19,880	19,645	19,768	19,867
Agriculture	415	410	406	401	403	405
Mining	1,453	1,436	1,419	1,402	1,410	1,417
Trade, Transportation and Utilities	8,779	8,667	8,555	8,445	8,490	8,532
Manufacturing	8,196	8,062	7,927	7,818	7,855	7,898
Information	1,960	1,936	1,913	1,889	1,900	1,909
Financial activities	11,096	10,964	10,837	10,702	10,764	10,817
Professional and business services	9,428	9,314	9,204	9,088	9,139	9,184
Education and health services	3,905	3,859	3,814	3,767	3,788	3,807
Leisure and hospitality	1,996	1,972				

Output Contribution - Base Case

($M)

	2014	2015	2016	2017	2018	2019
Construction	49,162	48,652	48,177	47,608	47,906	48,145
Agriculture	1,117	1,104	1,092	1,078	1,084	1,090
Mining	2,332	2,304	2,278	2,250	2,263	2,274
Trade, Transportation and Utilities	13,421	13,248	13,077	12,908	12,976	13,041
Manufacturing	29,391	28,843	28,256	27,807	27,886	28,020
Information	3,596	3,553	3,511	3,467	3,486	3,504
Financial activities	16,061	15,871	15,687	15,491	15,580	15,658
Professional and business services	13,294	13,134	12,978	12,815	12,887	12,951
Education and health services	5,944	5,873	5,806	5,733	5,766	5,795
Leisure and hospitality	3,384	3,343	3,304	3,263	3,282	3,298
Other services	2,815	2,783	2,752	2,718	2,734	2,747
Government	601	594	586	579	582	585
Total	**141,118**	**139,301**	**137,504**	**135,716**	**136,432**	**137,107**
Direct	50,104	49,456	48,818	48,187	48,445	48,687
Indirect	46,113	45,475	44,827	44,217	44,428	44,643
Induced	44,902	44,370	43,858	43,311	43,560	43,777
Total	**141,118**	**139,301**	**137,504**	**135,716**	**136,432**	**137,107**

Source: IHS Economics

Employment Contribution - Scenario 1

(Number of Workers)

	2014	2015	2016	2017	2018	2019
Construction	-	10,403	19,998	30,541	35,498	46,133
Agriculture	-	273	524	800	929	1,207
Mining	-	226	435	663	771	1,002
Trade, Transportation and Utilities	-	3,426	6,569	10,023	11,642	15,130
Manufacturing	-	1,876	3,580	5,453	6,325	8,220
Information	-	304	582	889	1,032	1,342
Financial activities	-	1,859	3,567	5,443	6,324	8,218
Professional and business services	-	3,979	7,635	11,652	13,535	17,590
Education and health services	-	2,186	4,194	6,401	7,436	9,663
Leisure and hospitality	-	1,734	3,327	5,078	5,899	7,666
Other services	-	1,343	2,577	3,934	4,571	5,940
Government	-	122	234	357	414	538
Total	-	**27,731**	**53,221**	**81,233**	**94,374**	**122,649**
Direct	-	10,231	19,661	30,025	34,897	45,354
Indirect	-	7,469	14,312	21,831	25,350	32,943
Induced	-	10,032	19,248	29,377	34,127	44,352
Total	-	**27,731**	**53,221**	**81,233**	**94,374**	**122,649**

Source: IHS Economics

Value Added Contribution - Scenario 1

($M)

	2014	2015	2016	2017	2018	2019
Construction	-	632	1,215	1,855	2,157	2,803
Agriculture	-	13	25	38	44	57
Mining	-	45	87	132	154	200
Trade, Transportation and Utilities	-	273	523	798	926	1,204
Manufacturing	-	254	484	738	857	1,114
Information	-	61	117	178	207	269
Financial activities	-	345	662	1,011	1,174	1,526
Professional and business services	-	293	562	858	997	1,296
Education and health services	-	121	233	356	413	537
Leisure and hospitality	-	62	119	182	211	274
Other services	-	58	111	170	197	256
Government	-	8	16	24	28	36
Total	**-**	**2,166**	**4,154**	**6,340**	**7,365**	**9,572**
Direct	-	628	1,205	1,841	2,140	2,781
Indirect	-	721	1,381	2,107	2,446	3,179
Induced	-	817	1,568	2,393	2,780	3,612
Total	**-**	**2,166**	**4,154**	**6,340**	**7,365**	**9,572**

Source: IHS Economics

Labor Income Contribution - Scenario 1

($M)

	2014	2015	2016	2017	2018	2019
Construction	-	583	1,121	1,712	1,990	2,586
Agriculture	-	11	21	32	37	48
Mining	-	17	32	48	56	73
Trade, Transportation and Utilities	-	164	314	479	556	723
Manufacturing	-	127	242	368	427	555
Information	-	27	51	79	91	119
Financial activities	-	104	200	306	355	461
Professional and business services	-	240	459	701	814	1,058
Education and health services	-	108	208	317	368	478
Leisure and hospitality	-	41	80	122	141	183
Other services	-	52	99	151	175	228
Government	-	8	16	24	28	37
Total	**-**	**1,481**	**2,842**	**4,338**	**5,040**	**6,550**
Direct	-	575	1,105	1,687	1,961	2,548
Indirect	-	449	861	1,313	1,524	1,980
Induced	-	457	877	1,339	1,555	2,021
Total	**-**	**1,481**	**2,842**	**4,338**	**5,040**	**6,550**

Source: IHS Economics

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IHS GMM

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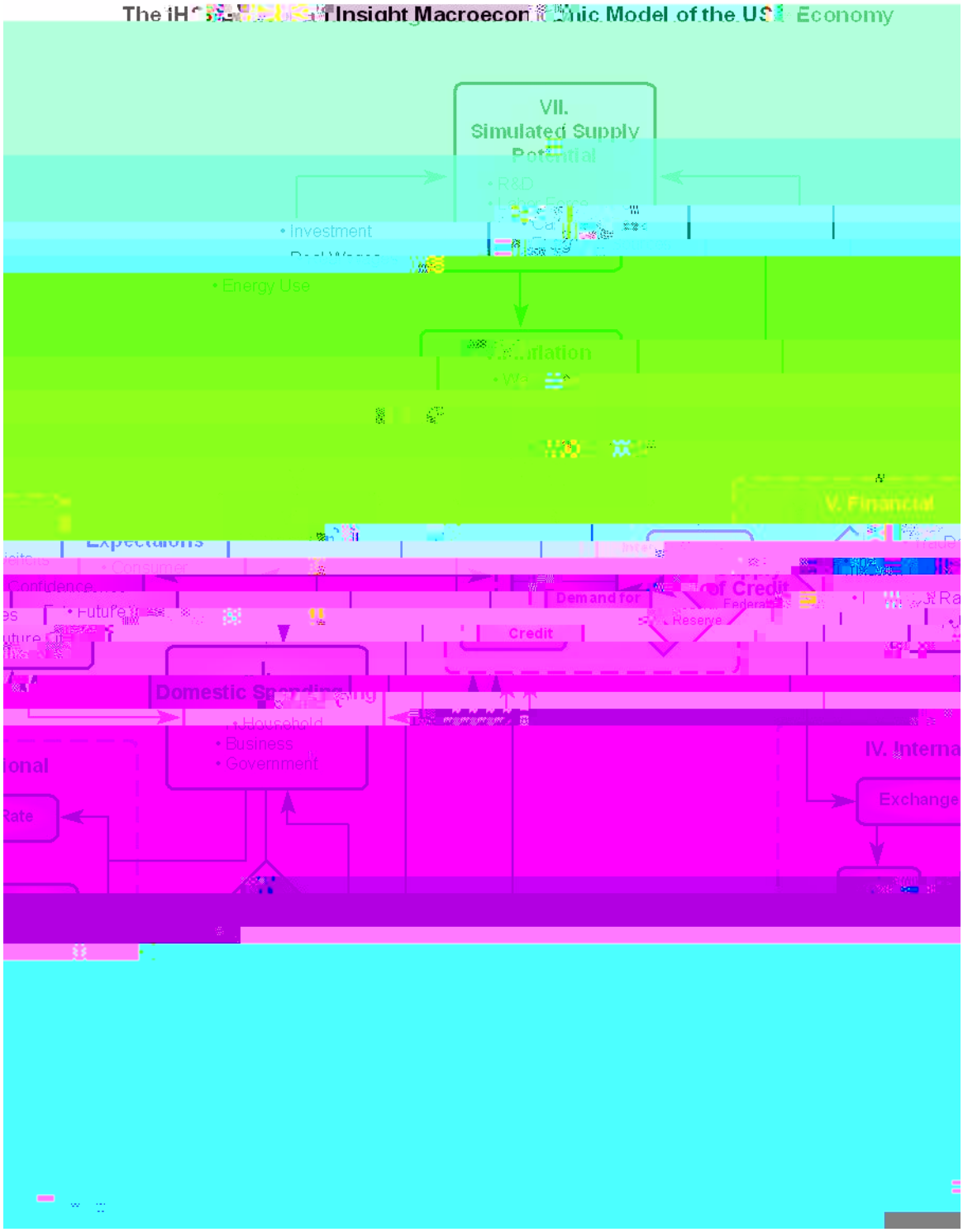
As an econometric dynamic equilibrium growth model, the IHS model strives to incorporate the best insights of many theoretical approaches to the business cycle: Keynesian, New Keynesian, neoclassical, monetarist, and supply-

Figure C-


VII.
Simulated Supply
• Investment
• Energy Use
V. Financial
Expectations
Demand for
Credit
Domestic Spending
• Household
• Business
• Government
IV. Interna
Exchange

IHS Methodology

To assess the direct, indirect, and induced economic impacts of the investment in transportation infrastructure, IHS used a customized version of the IMPLAN modeling environment. The base IMPLAN model closely follows the accounting conventions used in the US Bureau of Economic Analysis study, Input-Output Study of the US Economy, and is flexible enough to evaluate changes via the value of output or employment from the source industry. IHS customized the environment by updating worker productivity rates based on its proprietary Business Market Insights database, which IHS economists believe produces more conservative estimates of employment impacts.

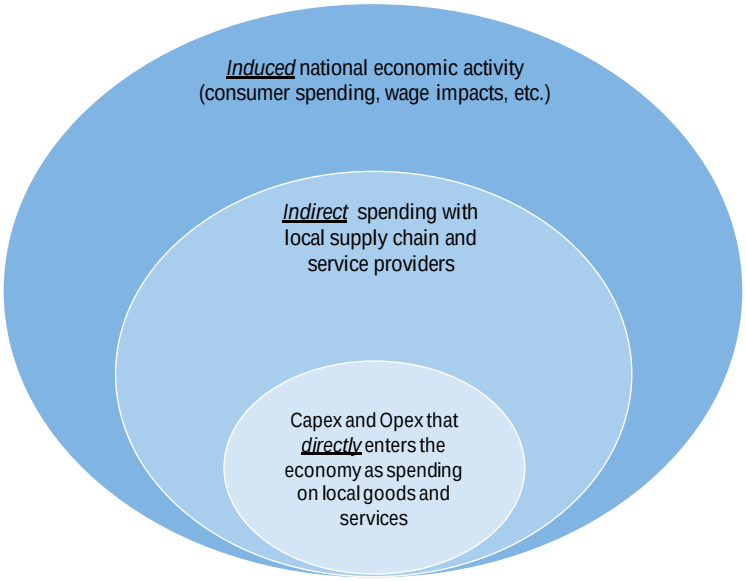
About IMPLAN

IMPLAN, short for "Impact Analysis for Planning," is a widely used, commercially available model for conducting input-output analysis. Based on a social account matrix framework, IMPLAN provides a balanced set of 440 industry sector matrices that map the sale dyads of inter-industry transactions and consumer-industry transactions. When additional transactions occur, IMPLAN rebalances the matrices, therein estimating how transactional activity ripples through the economy. The additional activity, in turn, drives changes in employment, wages, GDP contribution and government revenues.

The economic ripples fall into three main categories, as defined below:

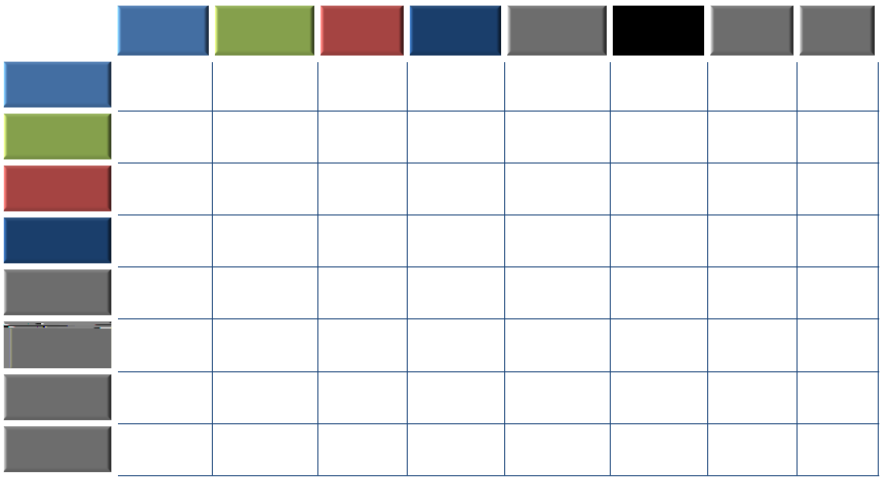
- Direct Effects: are the direct responses of an economy to changes in the final demand of a given industry or set of industries. In the model developed for this project, direct effects capture the impacts of direct employment and production associated with transportation infrastructure spending.
- Indirect Effects (also known as Supplier Effects): refer to the response of an economy to subsequent final demand shifts within industries that serve the direct industries. In essence, the indirect effects capture the response of extended supply chains.
- Induced Effects (also known as Income Effects): refer to the response of an economy to changes in household spending attributable to income generated by the direct and indirect effects

Three Levels of Economic Impact



The figure below shows the structure and fiscal flows of a typical Social Account Matrix (SAM), which presents the transactions that occur within an economy as a matrix. The columns of a SAM represent expenditures (or spending), while the rows represent income. The key components (or accounts) appear in both the Columns and the Rows of the SAM, representing the dual role each account plays in the economy. As such, a SAM not only captures the transactional activity within an economy, but all the linkages between industrial sectors, households and institutions as well.

Social Accounting Matrix Captures Expenditure-to-Income Flows



A Social Accounting Matrix (SAM) provides a complete, consistent and balanced representation of all activity within an economy. An Expenditure (or spending) within an economy flows down a column and then leftward along the corresponding income row. For example, consider

Consumer Spending([S H Q G L W X U H V I O R Z G R Z Q W K H ³ + R X V H K R O G ´ F
appU R S U L D W H ³ & R P P R G L W \ ´ U R Z

The following graphic populates the SAM framework with the classes of transactions that link expenditures (columns) to income (rows). A SAM is similar to double entry bookkeeping where each entry is a transaction that has both a price and a quantity dimension, and that identifies both its source and destination. Therefore, the total expenditures by each account must be exactly equal to the total receipts for the account, i.e. the respective row and column totals must equate. This means, for example, that total domestic demand (the commodity row) equals total domestic supply (the commodities column)