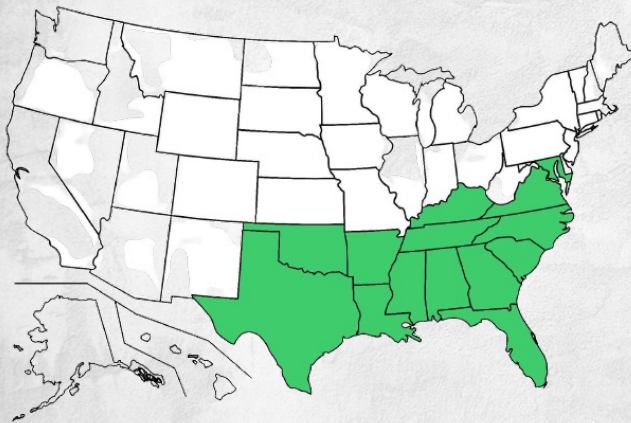


**Removing Supply-Chain Bottlenecks in the Sawmilling Sector:  
Exploratory analysis of economic benefits of road network repairs on the forestry sector in Mississippi**

USDA LSR Award # 842057



1




**Annual timber harvest is heavily skewed to the Southern United States.**

**Transportation is handled by logging operators with tractor trucks and trailers.**

2

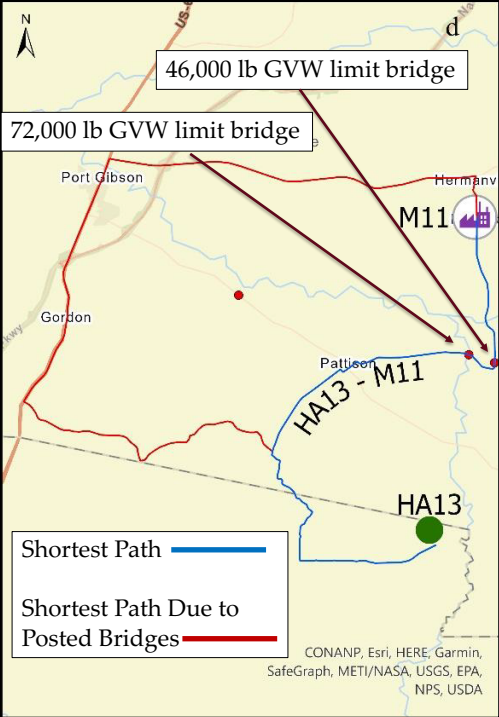
- **Transportation costs**
  - 40 – 45% of logging operational cost
- **Mississippi timber’s 2021 gate value**
  - Total → \$1.12 billion
  - Stumpage → \$ 537 million
  - Harvest and transportation → \$590 million (52%)
- **Mississippi timber’s harvest yield**
  - Total → 30.1 million tons
  - Pine Sawlogs → 15.1 million tons, 50%



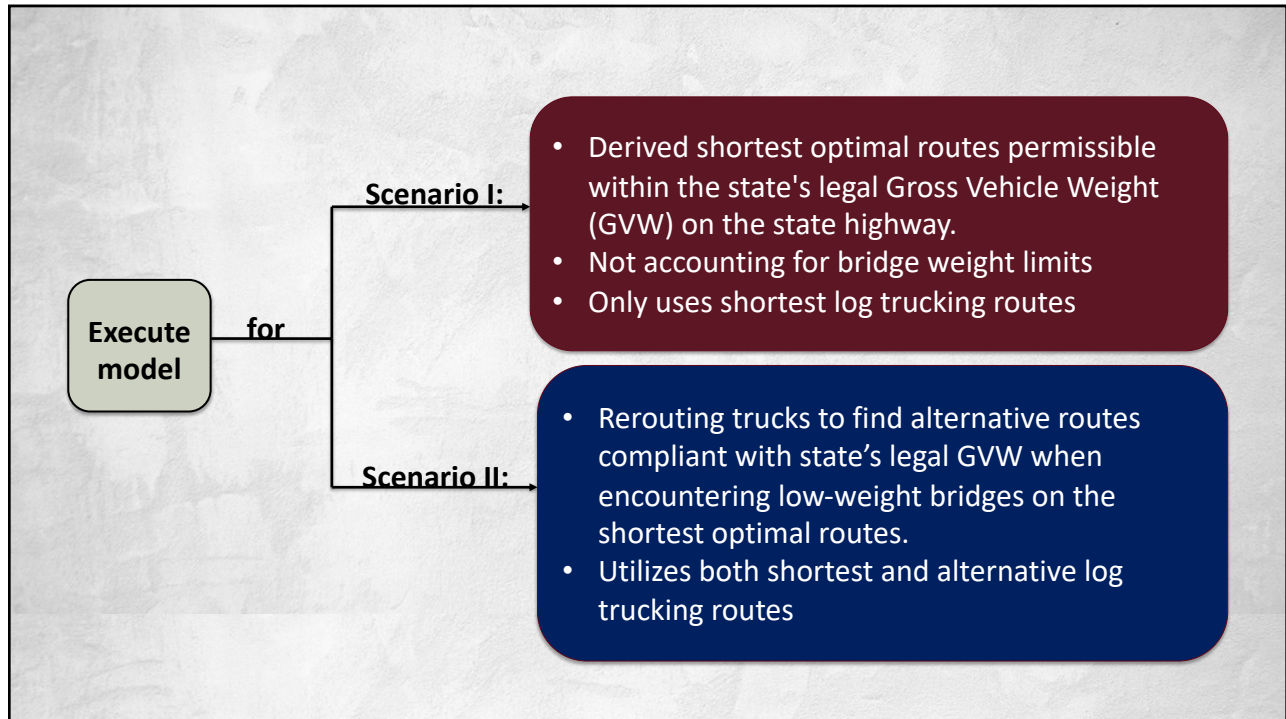
3

- Closed or posted bridges in Mississippi → over 3,000 (ARTBA, 2023; MDOT, 2023)
- Impact of these bridges on transportation cost in the forestry sector is yet to be explored.

This harvest site and mill pair, for example, had a 13 mile longer haul



4



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## Results from Optimization Work

- About 25% of the identified shortest optimal routes connecting harvest sites and softwood sawmills had restricted bridges along them.
- Around 37% of the mills experienced increased transportation costs due to restricted bridges.
- Restricted bridges led to a 4.07% transportation cost increase, amounting to \$0.34/tons; from \$8.35 to \$8.69.
- ~ \$4 million added cost difference based on our sample.


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## Question(s)?

- How can we utilize cost estimates from increased distance traveled for sawtimber logging trucks to determine economic outcomes in the logging industry and allied industries?
- Bonus: How are greenhouse gas emissions altered as a result?

**Help Identify Bridges in Need of Repair/Replacement**

The Arkansas Department of Transportation's 2024-2033 Draft Program of Bridge and Pavement Improvement Projects identifies more than 1,100 bridges in need of repair in the state.



These bridges are identified by county with an estimated cost of repair over the next 10 years with a stated goal of repairing or replacing every structurally deficient and posted bridge in Arkansas.

During a recent meeting between the Arkansas Forestry Association, Arkansas Timber Producers Association and ARDOT, the agency expressed a willingness to add additional bridges to the list as identified by the timber and forest products sector. AFA and ATPA are asking for your help in identifying bridges in your area that you believe are in need of repair or replacement. If the bridge has already been identified, great. If not, we will ask ARDOT to add it to the list. ARDOT also shared information about the **Local Bridge Program**, [Local Bridge Program - Arkansas Department of Transportation \(ardot.gov\)](#) which provides funding to local public agencies for improvements to bridges that are on public roads that are not on the Federal-aid-Highway System, known as Off-System bridges. It is possible that AFA and ATPA could help facilitate discussions with these agencies to bring attention to this opportunity. You can also find **Arkansas Bridge Information** at this link [Arkansas Bridge Information - Arkansas Department of Transportation \(ardot.gov\)](#).

Please be as specific as possible in identifying the location of the bridge by providing the state road or highway and county where the bridge is located, whether the bridge is in a low, moderate or high traffic area, and the level of urgency/priority you believe should be place on the bridge to ensure the efficient and safe flow of timber and forest products.





Please send this information to [mbraswell@arkforests.org](mailto:mbraswell@arkforests.org) or [lboccarossa@sbcglobal.net](mailto:lboccarossa@sbcglobal.net) by March 15, 2024.

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## IMPLAN (Economic Impact Analysis for Planning)

- Tracks the inter-linkages of industries and businesses
- 546 (2022 model) sectors linked with NAICS code, representing entire industries in the economy
- Models: US, States, Counties, Zip Codes, MSAs

MAIN RAW DATA SOURCES

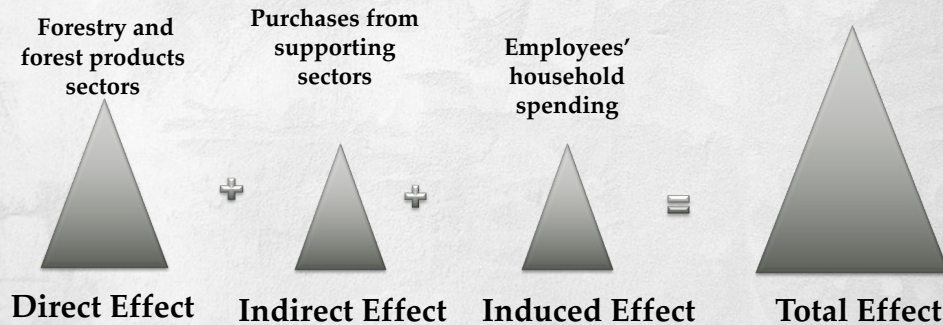
 U.S. Bureau of Economic Analysis (BEA)
 U.S. Department of Agriculture (USDA)
 U.S. Bureau of Labor Statistics (BLS)
 U.S. Census Bureau



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## Input-Output Modeling and Related Terminology

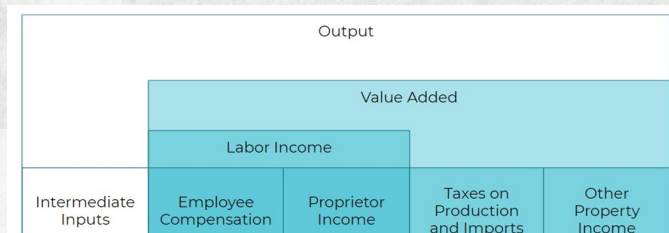
- I-O models track the inter-linkages of sectors and businesses in the economy



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## Each Impact Is Measured By

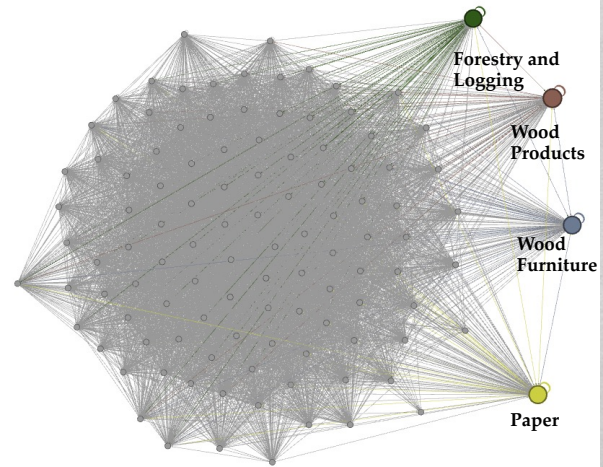
- Employment**- number of full and part time jobs, not FTEs
  - Most important >>> **Not People**
- Labor Income**- the sum of employee wages and benefits plus proprietor income
- Value-Added**- payments made to workers (labor income), interest, profits, indirect business taxes
- Industrial Output**- total value of production
  - Labor income and Value-Added are components of Industrial Output



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## Input Output Analysis

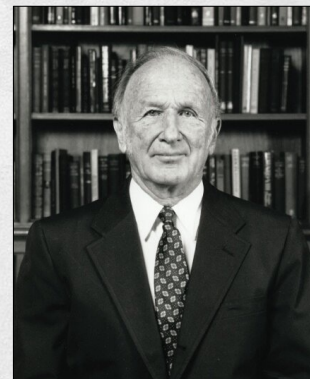
- Often determine total impacts on economy
  - Assumes relationships are constant
  - Provides a snapshot
- These typically provide the best/worst case of the impact. Think of a hole created in a spiderweb.
- Point Estimates



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## Putting it All to Work: *Economic Impact*

- Primarily used for determining *net* changes created by singular occurrence
- If workforce development targets timber and logging industry, must consider
  - What industries may be negatively impacted?  
Agriculture, Energy, Mining, etc.
- If a mill closes, must consider
  - Govt payments- unemployment, etc.
  - Include indirect effects?



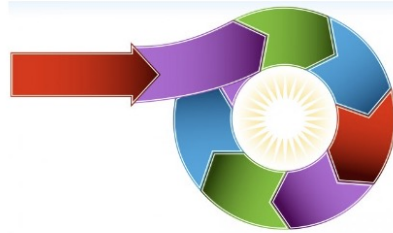
When a butterfly flutters its wings in one part of the world, it can eventually cause a hurricane in another. -Edward Lorenz

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## US Environmentally-Extended Input-Output (USEEIO) Models

US Environmentally-Extended Input-Output (USEEIO) is a family of models designed to bridge the gap between traditional economic calculations, sustainability, and environmental decision-making. It provides a robust resource for estimating the potential impacts—environmental and economic—associated with the production or consumption of goods and services.

Developed by EPA researchers in support of the Agency's [sustainable materials management program](#), USEEIO melds data on economic transactions between 389 industry sectors with a wealth of environmental information, including data on land, water, energy and mineral use, air pollution, nutrients, and toxics.



Input-output (IO) economic models look beyond the initial impact of new spending to capture increased economic activities, including direct, indirect, and induced spending. EPA-developed USEEIO models bridge the gap between traditional IO calculations, sustainability, and environmental decision-making.

- Criteria and Hazardous Air Emissions
- Commercial Non-Hazardous Waste Excluding Construction
- Commercial Non-Hazardous Waste From Construction Activities
- Commercial RCRA-Defined Hazardous Waste
- Greenhouse Gases**
- Point Source Industrial Releases to Ground
- Land Use
- Mineral Extraction
- Nitrogen and Phosphorus Releases from Agriculture
- Pesticide Releases
- Water Withdrawals
- Point Source Releases to Water

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## Methodology

- Route Chaser
  - Investigated changes in variable costs; fixed paid regardless
  - Labor, fuel, lubricants, brakes, tires, maintenance, repair
    - Plus margins for wholesalers, retailers, and transporters
- Disaggregated total cost difference- \$4 million- using ratios of variable cost categories to the total
- Both Gross and Net Effects determined

	WEIGHTS PER ROUTE CHASER	LOWER 95% CI	AVG	UPPER 95% CI
Fuel	48%	\$553,100	\$1,971,500	\$3,488,300
Brakes	24%	\$271,300	\$967,200	\$1,711,300
Tires	14%	\$163,900	\$584,000	\$1,033,400
Major Maintenance	2%	\$18,800	\$67,000	\$118,600
Minor Repair	2%	\$26,000	\$93,000	\$164,500
WHOLESALE	4%	\$45,900	\$163,600	\$289,600
TRANSPORT	3%	\$34,400	\$122,800	\$217,200
RETAIL	3%	\$34,400	\$122,800	\$217,200

Labor Income	Logging	Trucking
Employee Compensation	62%	98%
Proprietor Income	38%	2%
Industry Proportion	81%	19%

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DIFFERENCE		DIRECT EFFECTS 2023 \$\$\$\$	
LOWER 95% CI		-\$1,148,000	
AVG		-\$4,091,800	
UPPER 95% CI		-\$7,239,900	
<b>Results</b>			
GROSS ECONOMIC IMPACT OF EXTRA VARIABLE COSTS INCURRED DUE TO EXTRA MILES HAULING.			
Difference	GROSS DIFFERENCE ACROSS ECONOMY, 2023 \$\$\$\$		Economic Multiplier
LOWER 95% CI	-\$1,437,100		
AVG	-\$5,122,300		1.25
UPPER 95% CI	-\$9,063,200		
NET ECONOMIC IMPACT OF EXTRA VARIABLE COSTS INCURRED DUE TO EXTRA MILES HAULING. ASSUMES EQUAL AMOUNT from direct effects FLOWS TO EMPLOYEE COMPENSATION AND PROPRIETOR INCOME.			
Difference	NET TOTAL DIFFERENCE ACROSS ECONOMY, 2023 \$\$\$\$		
LOWER 95% CI	-\$1,132,500		
AVG	-\$4,036,600		0.99
UPPER 95% CI	-\$7,142,200		

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## Results (Economic)

- The logging sector and its proprietors bear a large burden due to the posted bridges, approx. \$4 million in lost profitability.
  - Money that could have been put to other, perhaps better, uses; opportunity cost
    - Reinvesting in capital- both physical and human; others...
  - Results could be from \$1.1 million to as high as \$9.1 million using bootstrap confidence interval. Provides broader ranges for IMPLAN outcomes.
- Multiplier effects across the economy led to an additional \$1.0 million of incurred costs by allied industries, indirect and induced combined.
  - \$5.1 million
  - Industries impacted- primarily those associated with fuel processing, manufacturing of trucks, trailers, and components, and distribution from producer to retailer

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## Results (Economic)

- While the Gross effects were similar to that calculated by the optimization model, the 1.25 multiplier showed ripple effects that increased the number
  - For every \$1M, \$250K of impact generated elsewhere
- *Accruals to value added offset all (!) multiplier effects*

GROSS DIFFERENCE ACROSS ECONOMY, 2023 \$\$\$\$	Economic Multiplier
-\$5,122,300	1.25
NET TOTAL DIFFERENCE ACROSS ECONOMY, 2023 \$\$\$\$	
-\$4,036,600	0.99

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## Break Downs for IMPLAN Gross Results

Impact	Employment	Labor Income	Value Added	Output
Direct	-4	-\$355,800	-\$708,300	-\$3,679,600
Indirect	-4	-\$213,700	-\$415,600	-\$1,045,700
Induced	-2	-\$101,800	-\$208,700	-\$386,600
Total	-10	-\$672,700	-\$1,335,300	-\$5,122,300

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## Impacts for Labor Changes

Impact	Employment	Labor Income	Value Added	Output
Direct	0	0	0	0
Indirect	0	0	0	0
Induced	7	\$285,900	\$585,900	\$1,085,700

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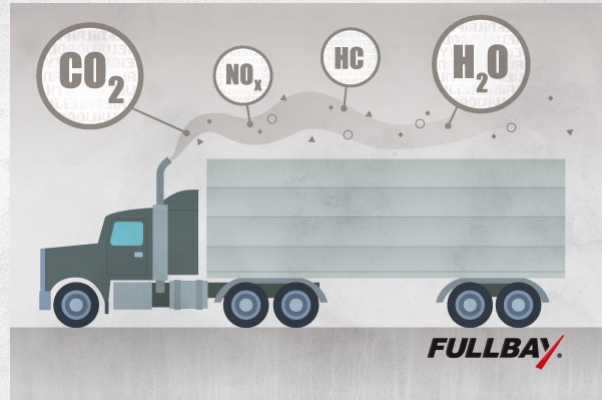
## Break Downs for IMPLAN Net Results

Impact	Employment	Labor Income	Value Added	Output
Direct	-4	-\$355,800	-\$708,300	-\$3,679,600
Indirect	-4	-\$213,700	-\$415,600	-\$1,045,700
Induced	5	\$275,100	\$377,200	\$699,100
Total	-3	-\$294,400	-\$746,700	-\$4,036,600

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## Results (Environmental)

- Initial estimates indicate an increased emission of greenhouse gases from route differences mostly attributed to CO<sub>2</sub> emissions.
- Most occurs in the manufacturing sector. Keep in mind this is only emissions created by additional purchases, not the emissions from additional over-road miles traveled.



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### Labor Spending Related Emissions

Greenhouse Gas	Environmental Output (kg)
Carbon dioxide	103,610
Methane	211
Nitrous oxide	10.8
Miscellaneous	0.11
<b>Grand Total</b>	<b>103,830</b>

### Industry Activity Related Emissions

Greenhouse Gas	Environmental Output (kg)
Carbon dioxide	821,920
Methane	4,040
Nitrous oxide	22.4
Miscellaneous	0.47
<b>Grand Total</b>	<b>825,990</b>

\*Values may not sum to totals due to rounding

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## Conclusions from Analysis

- The IMPLAN system (I-O modeling generally), allow us to track the lost revenue calculated from the optimization analysis.
- Further, new features allow us to make broad inference to related environmental effects. 100k tons of Greenhouse gas emissions created just from softwood sawmill activity.
- Initial IMPLAN results do not indicate a large loss in jobs, but large losses to the logging industry in terms of direct and indirect output.
- Accounting for these results across all other industries, estimated impacts exceed \$5 million
  - Before value added reinvestments and savings provided some offset

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## Final Thoughts and Comments

- Assessing how restricted bridges impact hauling costs for logistics-dependent sectors.
- Identifying most cost-effective log trucking routes.
- Could provide priority ranking for maintenance and upgrade of the closed and posted bridges based on their impact on the local economy.
- Even with only softwood sawmills accounted for, 1.5 million value added lost to MS economy.
- Emissions impacts and other broad measures, need a lot more investigation here.
- Should account for this measure in the priority rankings to utilize new federal funds available (e.g. inflation reduction act).

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