Indiana Hardwood Assessment

12-20-18

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INDIANA STATE DEPARTMENT OF AGRICULTURE

Prepared for:
Indiana Department of Agriculture

This project was a joint effort by DJ Case & Associates, Purdue University Center for Regional Development, Purdue University Department of Forestry and Natural Resources, and Dr. Satish Ukkusuri, Purdue University School of Civil Engineering.

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The authors would like to acknowledge the following for their invaluable assistance with data tables and figures in this report.
Dale Gormanson and Matt Bumgardner, USDA Forest Service
Joey Gallion and Jill Flachskam, Indiana DNR Division of Forestry

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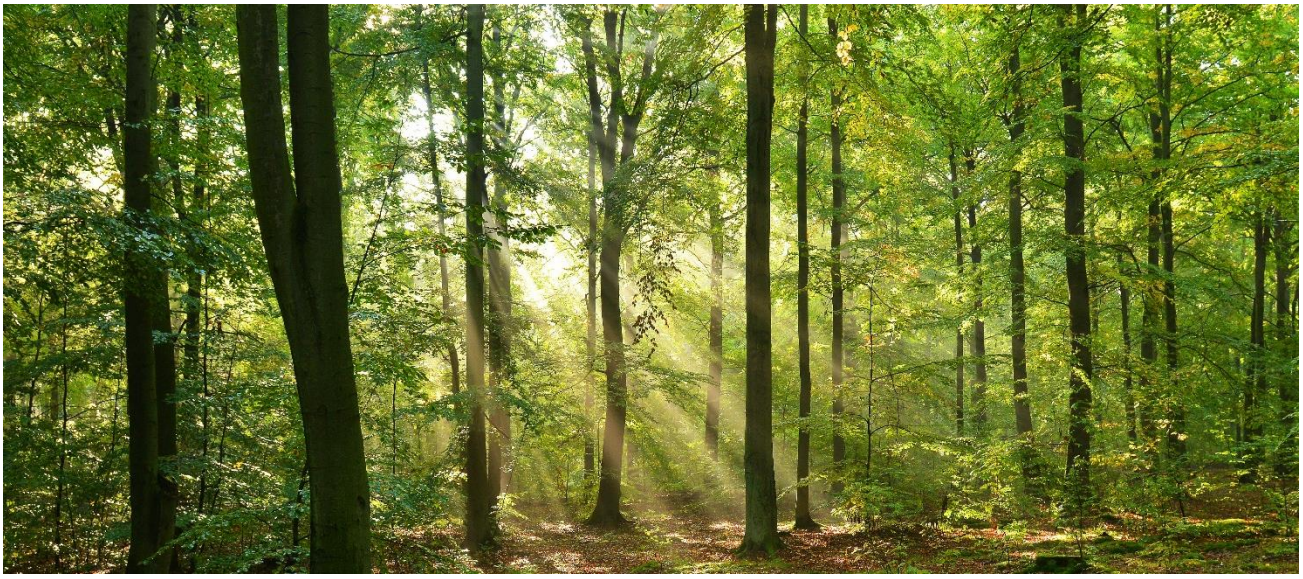


Forest Resources of Indiana

Indiana has a substantial and sustainable forest resource base (Figure 1-Figure 3) providing materials for wood-using industries as well as recreation, wildlife habitat, environmental services, and quality-of-life benefits. Indiana forests have made a gradual recovery since a low ebb in the early 20th century (Figure 4). Forest area, volume of wood, and percentage of sawtimber trees have all been on the increase. The USDA Forest Service and the IDNR Division of Forestry cooperate to provide inventory reports from public and private land to establish estimates of forest area and volume. Basic statistics are impressive.

- 4.9 million acres of forestland or 21 percent of the state
- 4.75 million acres of productive timberland not in a reserved status (the area of timberland in Indiana has steadily increased since the 1960s)
- Net volume of live trees is about 10.9 billion ft^3, a 5.3 percent increase since 2012.
- Annual net growth of all live trees ≥5 inches is 198,065,740 ft^3/year
- Net volume of sawtimber* trees is 27.2 billion board feet (board feet, Doyle rule), an increase of 9.7 percent since 2012.
- Total net annual growth outpaced harvest removals by a ratio (G:R) of 2.3:1 in 2017.
- Forestland consists mainly of sawtimber stands (nearly 80 percent), 13 percent is poletimber stands, and the balance is young regenerating stands.
- 95% of Indiana's forests are classified as hardwood forest type.
- The highest densities of forestland are in south-central Indiana.

* Sawtimber: A tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer; and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches diameter breast height (d.b.h.). Hardwoods must be at least 11.0 inches d.b.h.

Additional details on forest changes between 2012 and 2017 can be found in Appendix A.

Figure 1: Depiction of the extent of Indiana forest cover in green. Red lines indicate US Forest Service Forest Inventory Survey Units.

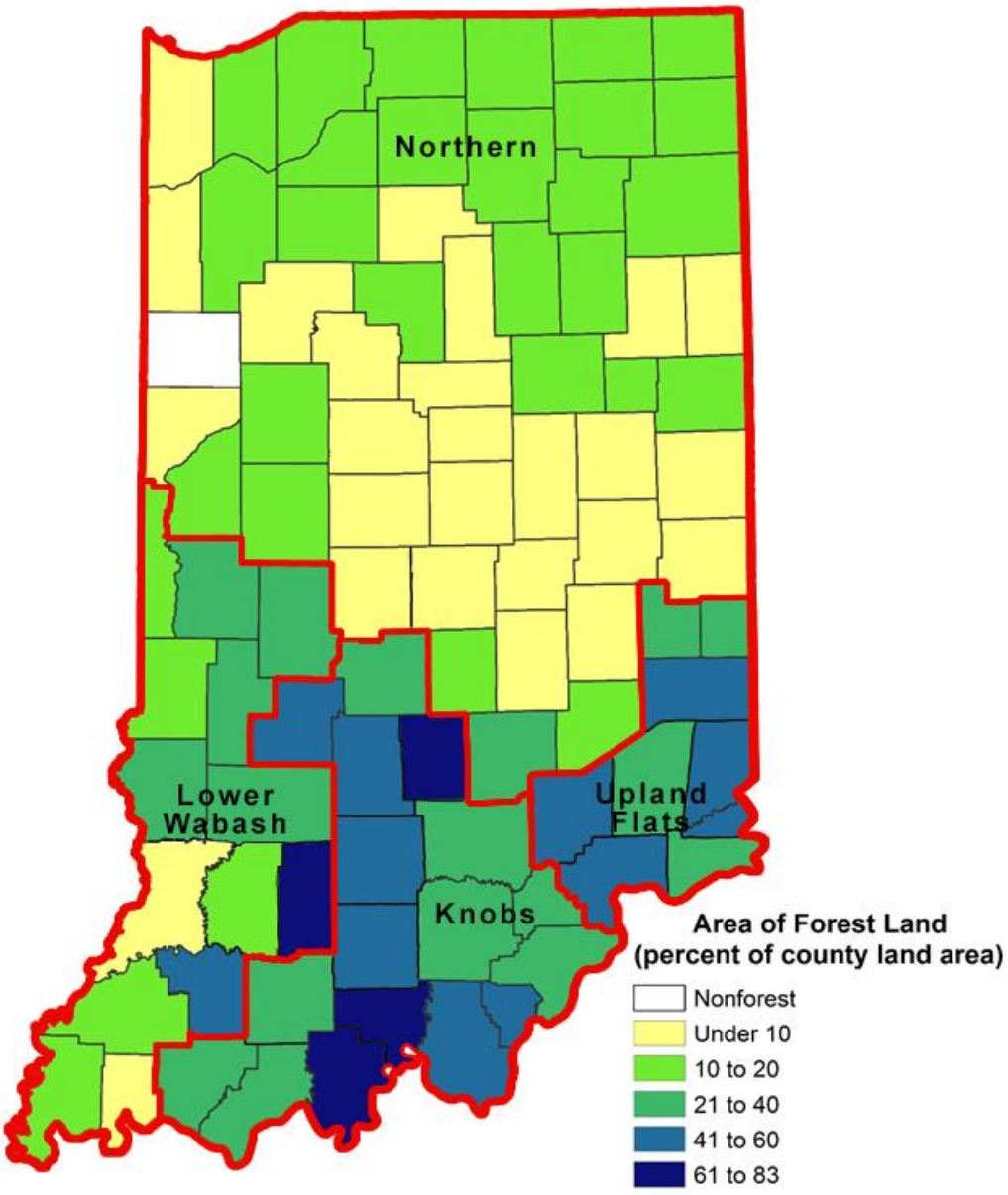


Figure 2: Percentage of county area with forested land type.

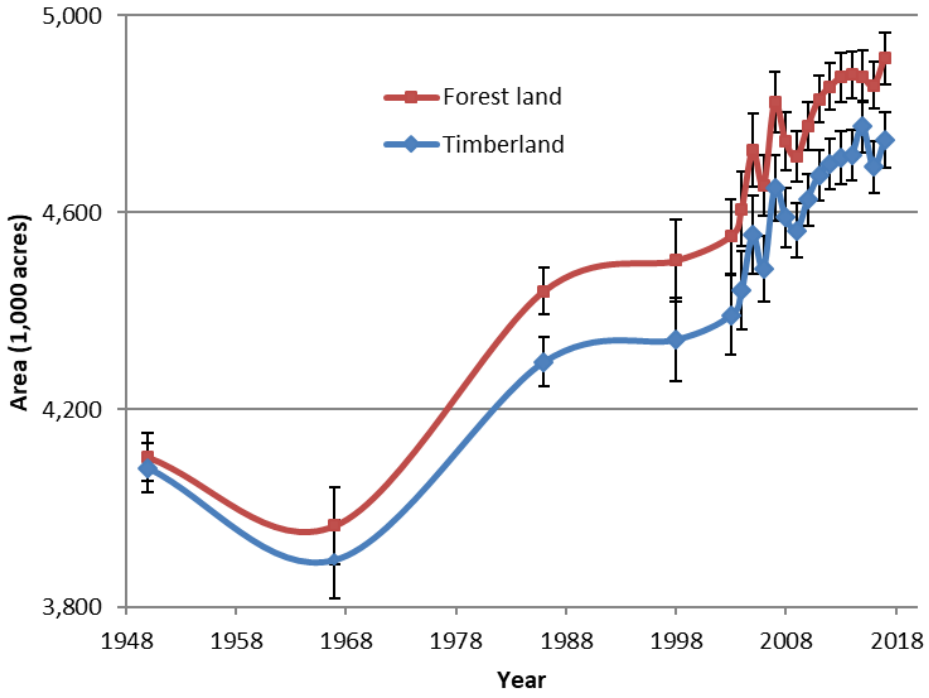


Figure 3: Area of forestland and timberland in Indiana by inventory year. Error bars represent 1 standard error or a 68-percent confidence interval.

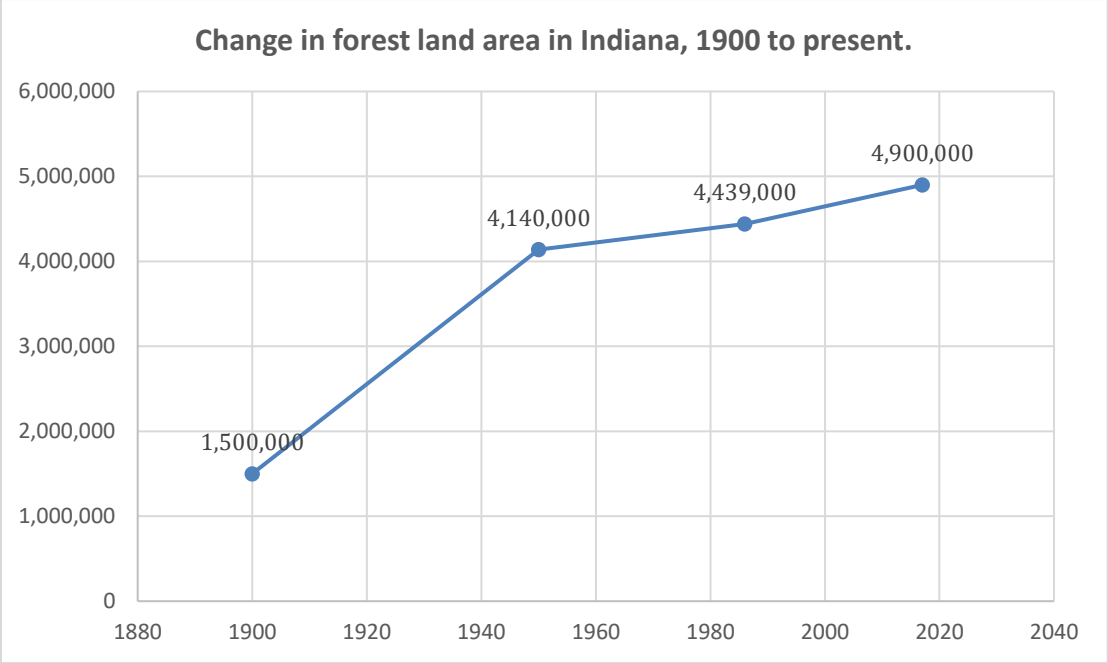


Figure 4: Change in forest land area in Indiana, 1900 to present.

The distribution of timber resources is not consistent across the state. Timberland acres and volume of sawtimber by Indiana Economic Growth regions varies from 7.5% in EGR 4 to 46% in EGR 8. Timberland acreage and volumes are summarized by Indiana Economic Growth Regions in Appendix B.

Indiana is renowned for producing high quality hardwood timber for products like grade lumber and veneer, as well as substantial amounts of industrial wood for shipping and construction purposes. This diversity of products is made possible by a diverse and productive hardwood forest resource. The volume, growth, mortality and removals of our most abundant hardwood species are listed in Table 1.

Table 1. Number, volume, biomass, growth, mortality, and removals of live trees on forest land by species of the top 11 tree species by net volume, Indiana, 2017.

Common name	Latin name	Million trees[a]	Net volume[b] (million ft³)	Aboveground biomass[a] (thousand dry tons)	Average annual net growth[b] (thousand ft³)	Average annual mortality[b] (thousand ft³)	Average annual removals[b] (thousand ft³)
Yellow-poplar	*Liriodendron tulipifera*	69.8	1,293.3	24,480.4	31,425.0	10,865.30	15,184.70
Sugar maple	*Acer saccharum*	351.4	1,179.1	34,718.4	24,483.9	6,687.80	11,741.90
White oak	*Quercus alba*	33.5	782.1	21,527.2	10,940.6	3,748.70	5,890.20
Black oak	*Quercus velutina*	33.8	574.3	15,813.0	8,455.1	5,386.00	5,363.30
Red maple	*Acer rubrum*	107.2	511.7	12,313.8	12,025.4	4,137.10	3,200.90
White ash	*Fraxinus americana*	93.4	494.0	13,573.4	-4,749.5	16,455.10	7,562.00
American sycamore	*Platanus occidentalis*	18.1	493.0	10,081.3	13,959.7	693.2	4,626.00
Northern red oak	*Quercus rubra*	25.3	442.4	12,414.6	7,993.0	6,170.50	7,854.50
Black cherry	*Prunus serotina*	99.6	381.5	9,318.6	9,414.5	3,139.50	2,993.80
Shagbark hickory	*Carya ovata*	43.8	361.4	11,422.8	6,207.9	2,433.80	1,169.90
Black walnut	*Juglans nigra*	44.0	354.0	8,705.0	12,467.4	967.00	2,805.30
						116,274.10	101,765.70
	Total all species	2,162.8	10,860.8	279,836.0	198,065.7		

[a] *Trees ≥ 1 inches in diameter*
[b] *Trees ≥ 5 inches in diameter*

Additional information about tree species group volumes by ownership and County can be found in Appendix C.

The growth-to-removals ratios of our most abundant hardwood species, with the exception of white ash*, are positive numbers (Figure 5). This means wood volume continues to accumulate in these species, as growth exceeds both mortality and removals (by a ratio of 2.3 to 1) for all inventoried Indiana tree species.

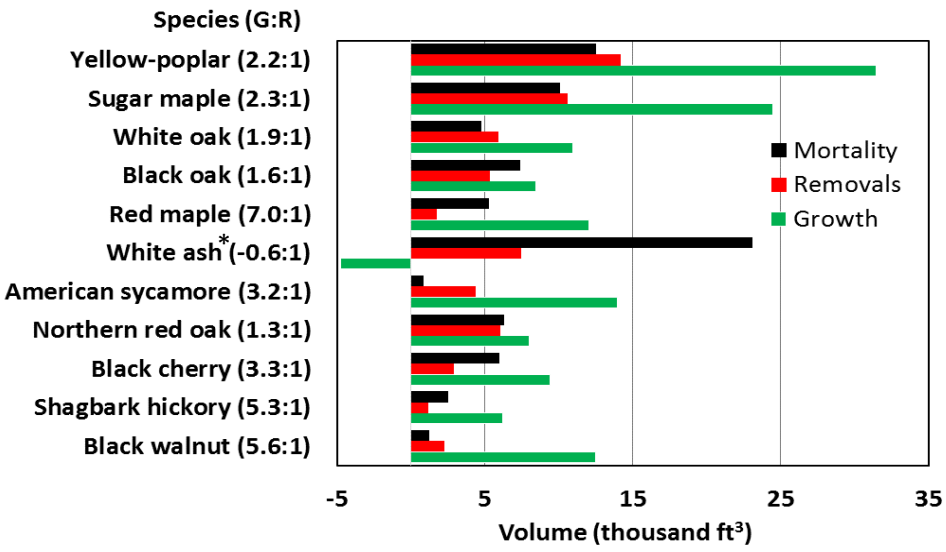


Figure 5: Average annual net growth, removals, and mortality of net volume on forest land, and growth to removals ratio (G:R) for select species, Indiana, 2017.

**White ash has experienced negative volume growth due to emerald ash borer causing extensive mortality across the state, and increased harvesting to salvage ash timber.*

Timber in Indiana is overwhelmingly hardwood species in stands dominated by sawtimber-sized trees. Sawtimber stands account for the most forest acres for the top five forest types across the state (Figure 6).

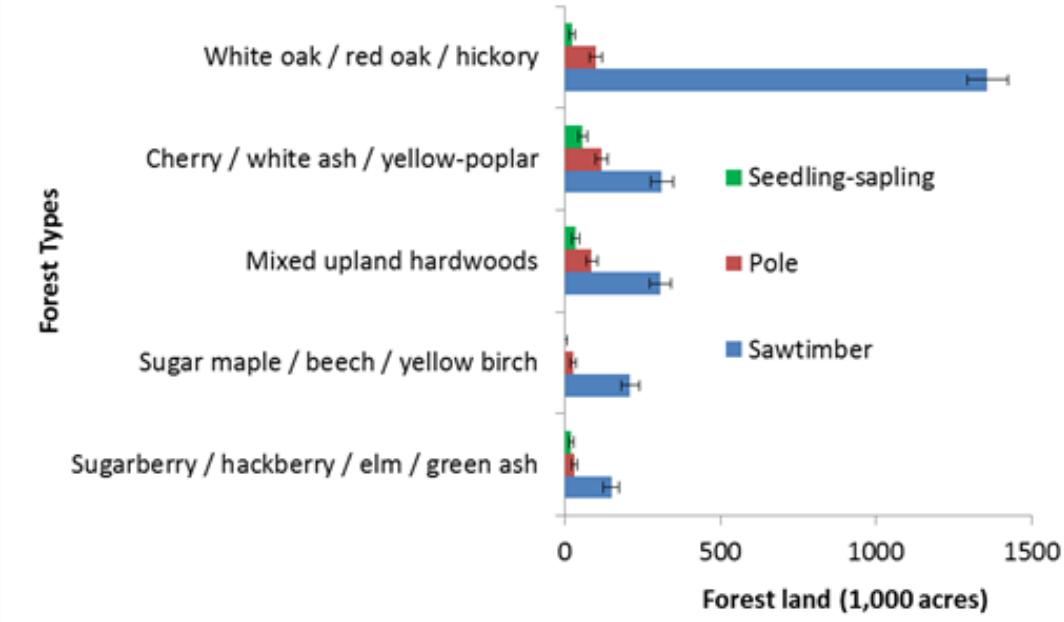


Figure 6: Area of forestland by five common forest-type groups and stand-size classes, Indiana, 2017. Error bars represent one standard error, the 68 percent confidence interval.

Forest Ownership in Indiana

Forestland in Indiana is primarily in private holdings (Figure 7), but some state and federal lands, like National and State Forests, actively manage and sell timber (Figure 8).

- Eighty-four percent or over 4.1 million acres of forest land is privately owned (Figure 7)
- State and local government owns nearly 8.0 percent or 394,000 acres of Indiana forest land
- The Federal government owns roughly 7.5 percent or 388,493 acres
- The 158,300-acre State Forest system has been certified by the Sustainable Forestry Initiative® and the Forest Stewardship Council® as meeting their sustainability standards.
- Sustainable Forestry Initiative® and the Forest Stewardship Council® sustainable "green certified" wood products from State Forests in FY 2016-2017 totaled 10,298,000 board feet equivalent, made up of 7.66 million board feet timber and 5,283 cords.

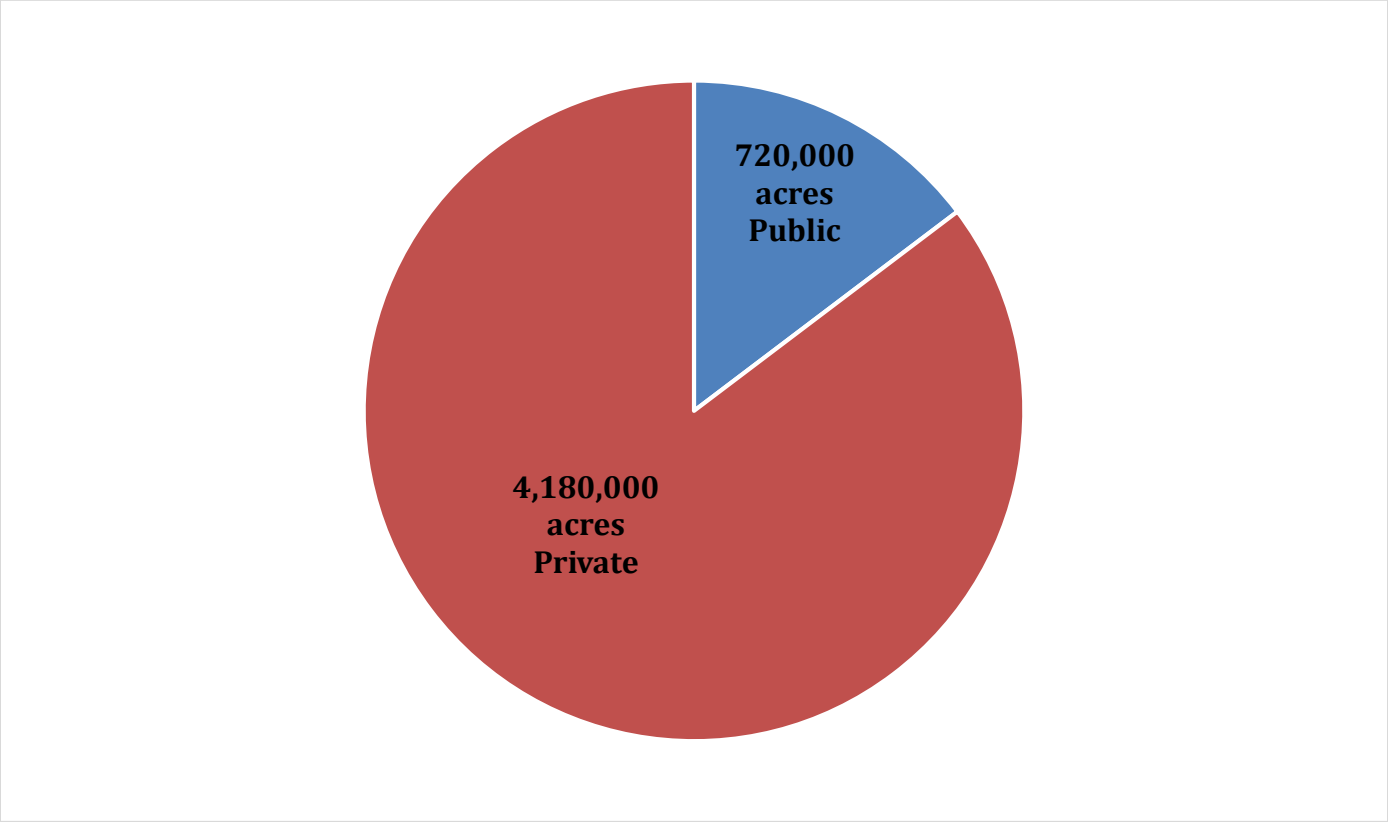


Figure 7: Ownership of Indiana Forestland, 2017.

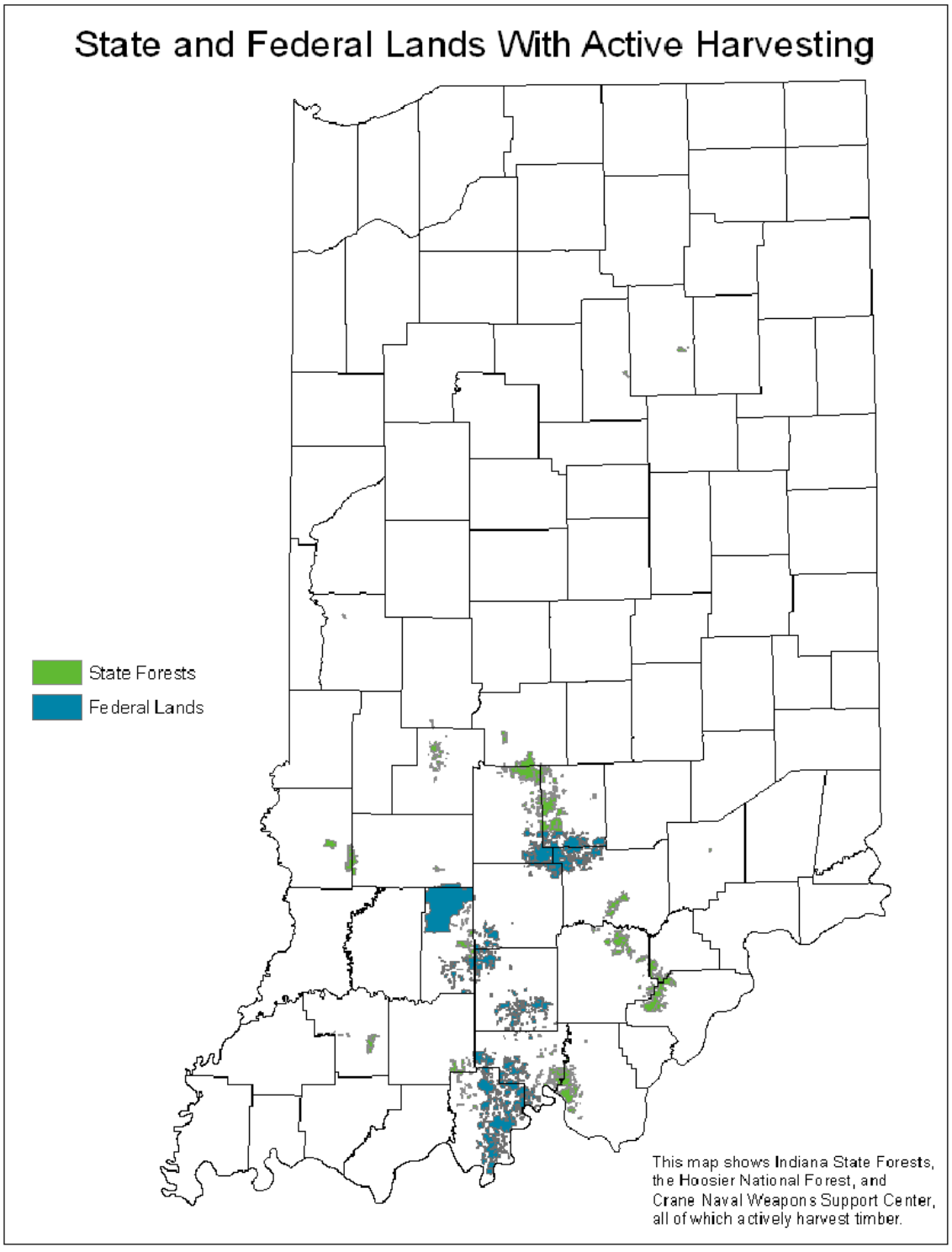


Figure 8. State and Federal ownerships with active timber harvesting programs, including state forests, national forests and other federal lands with active timber harvesting programs.

Access to Timber from Public Lands

Of the 4.9 million acres of forestland in Indiana, about 720,000 (15%) are publicly held. Most of the state-owned public acres are in parks, preserves, or otherwise off limits to harvest, leaving about 150,000 acres available for multiple-use management, including healthy and sustainable harvesting. The total acreage of timberland in Indiana has steadily increased since the 1960s, and forests are growing in volume more than 3.3 times the amount being harvested each year. Although there is a segment of the public that is opposed to harvest on state lands, there also is a segment that seeks the benefits provided by sustainable harvest (e.g., young forest created by harvest provides habitat for numerous wildlife species that cannot survive in old forest). Balancing the disparate needs and desires of diverse stakeholders is always a challenge for natural resources managers, but higher levels of harvest (conducted using best practices for sustainable forestry) could be conducted on state forests without negatively impacting forest health or sustainability.

Sustainable Forest Certification Systems

The Indiana Division of Forestry maintains certification of the IDNR State Forests through the Forest Stewardship Council and the Sustainable Forestry Initiative, ensuring that timber harvest is conducted in a healthy, sustainable way on all state lands. Private landowners also have access to the Forest Stewardship Council certification system through the Classified Forest and Wildlands program administered by the Division of Forestry. These organizations provide third-party certification of legal and sustainable forest management to established standards through independent audits, and the potential to market products coming from these forests into marketplaces preferring or requiring sustainable or "green" certification of forest products. The Division of Forestry also offers FSC chain-of-custody certification to eligible loggers and small mill owners to facilitate their marketing of FSC certified wood products.

Information on IDNR State Forest certification: https://www.in.gov/dnr/forestry/7532.htm
Information on private lands forest certification: https://www.in.gov/dnr/forestry/7536.htm
Information on the Chain-of-Custody certification: https://www.in.gov/dnr/forestry/5818.htm

Forest Resources on Private Lands

With 84 percent of the forestland base in private ownership, most of the wood products flowing to industry are coming from private lands. The majority of that private land is family and farm owners who are often not holding property primarily for timber production but may still participate in forest product markets.

- Indiana has 3,722,000 acres of private forest in holdings of 10 or more acres, with 91,000 ownerships (National Woodland Owner Survey 2016)
- The majority of ownerships are under 100 acres and the average family ownership is 37.4 acres
- Twenty one percent of family forest owners surveyed, representing an estimated 32.6 percent of the family forest acres, indicated timber products were an important or very important property objective. (National Woodland Owners Survey)
- 20 percent of ownerships surveyed, representing about 30 percent of the family forest acres, reported selling trees in the past five years. (National Woodland Owner Survey)
- The Classified Forest and Wildlands program administered by the Indiana DNR Division of Forestry has 495,335 acres of private forestland voluntarily enrolled in a Forest Stewardship Council (FSC) group certification as meeting FSC forest management standards (Figure 9).
- Timber harvested from these properties may be marketed as FSC certified wood.
- Forest landowners normally enter timber markets through sales to licensed timber buyers, industrial foresters, and sales administered by consulting foresters.

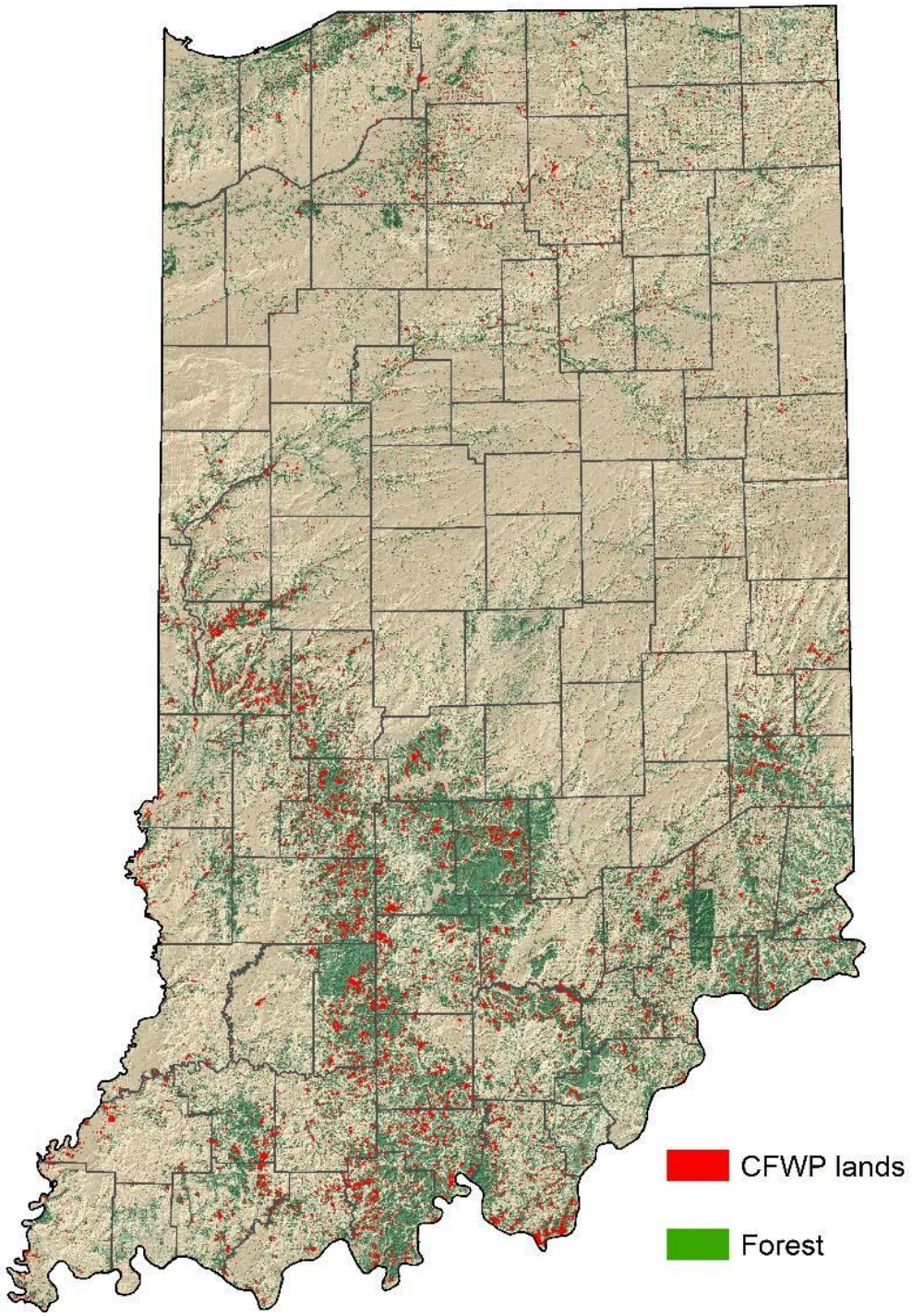


Figure 9: Classified Forest and Wildlands Program ownerships (red). CFWP has a total of over 750,000 acres enrolled and over 495,000 acres under the Forest Stewardship Council group certification.

Access to Timber from Private Lands

The hardwood industry is in a unique situation in the agricultural sector in that the producers of most of the trees used in the industry are not engaged with this production as a main or even secondary business. Most of the wood products harvested in Indiana are coming from what are termed Non-Industrial Private Forestlands (NIPFs), land owned by individuals or families who are not in the business of growing timber and rarely actively manage their property for timber production. Some owners may give very little consideration to improving the productivity, quality or sustainability of the forest resource base, and may elect to never participate in selling timber products. As mentioned earlier, 21 percent of surveyed landowners listed producing timber products as an important or very important property goal. This was one of the lowest percentages of any of the property goals surveyed (National Woodland Owners Survey 2013).

The primary forest industry in the state must spend significant time and resources canvasing landowners for forest products because of this disconnect between forest products production and the primary goals and activities of the landowners. Supporting data tables from the National Woodland Owners Survey are included in Appendix D.

Forest management practices like thinning, control of undesirable or invasive competing plants, and harvesting timber may improve the productivity, quality, and value of forests by favoring the growth and regeneration of trees meeting management objectives, including production of high-quality timber. Forests managed to provide additional growing space through thinning and harvesting may be better able to withstand droughts and disease, as trees are under less competition stress. Increasing the acres of forest being managed may result in more high-quality timber available to future markets.

Connecting more forest landowners with forest management information and assistance could raise awareness of the potential to participate in forest product markets, leading to additional income for landowners, economic motivation to keep land in forest, and an increased availability of forest products for industry. Several organizations and agencies, including Indiana DNR Division of Forestry, Purdue University Cooperative Extension Service, and the Indiana Woodland Steward Institute have programs and personnel promoting forest management to private woodland owners, but opportunities to reach a greater number of landowners exist. Raising awareness of the benefits of timber management, sources of information and assistance, and how to effectively market their timber may lead to greater participation in forest products markets by landowners. This will require an effective and coordinated outreach program to forest owners, and adequate numbers of industry, private consulting, and agency foresters to work with landowners to achieve their management goals.

Indiana Division of Forestry District Foresters have been a convenient first contact for many forest owners through on-site visits for forest management advice, management planning, entry into the Classified Forest and Wildlands program, and referral to the private sector for management practices and timber sales. Since these foresters have no economic interest in the timber that might be sold, they are regarded by many landowners as an honest broker of forest management advice. Twenty multi-county districts cover every county in the state; however, as of December 2017, four districts remained unfilled from previous retirements or resignations. Keeping all district forester positions filled (and perhaps adding additional staff) would seem to be an obvious tactic the state could use to increase the flow of timber from private lands into the hardwood industry stream.

Industry and private consulting foresters are available to assist landowners with managing and marketing timber and are accessible through the Indiana Forestry and Woodland Owners Association Directory of Professional Foresters: www.findindianaforester.org

Timber buyers must be licensed and bonded with the state of Indiana to legally purchase timber in the state. the Indiana Timber Buyer Licensing Law (I.C. 25-36.5), sponsored by the forest products industry, was created to reduce the amount of timber theft occurring in the state through a licensing system and posting of a bond. Information on the law and a searchable listing of licensed buyers can be accessed at: https://www.in.gov/dnr/forestry/2846.htm

Detailed Forest Inventory Information

The USDA Forest Service Forest Inventory and Analysis National Program (FIA) collects and compiles detailed forest inventory information on a regular schedule across the country. In Indiana, The IDNR Division of Forestry cooperates with the FIA program to make state-level information available on an annual basis. Several reports are available from the FIA and IDNR summarizing forest conditions and trends. More detailed information on species, size class, log grade, growth, and county and region can be obtained from the tables and tools in the FIA program site. These tools provide an opportunity for interested business and individuals to explore and produce reports on the regions and types of forest resources of interest to them.

Indiana Forest Inventory data can be retrieved from the USDA Forest Service FIA program using the data tools site. The Evalidator tool is particularly useful for developing tables of data covering specific measurements, categories, and locations: https://www.fia.fs.fed.us/tools-data/

The Indiana Division of Forestry publishes forest inventory and forest products reports regularly and posts them at https://www.in.gov/dnr/forestry/3605.htm

Indiana has an abundant, high-quality forest resource capable of producing wood for forest products on a sustainable basis. Challenges include recruiting more private forest owners to participate in forest management and markets, making more high-quality wood available to Indiana Industry. Export trends and recent reports from industry indicate competition for our high-quality logs from overseas buyers has increased, placing significant pricing pressure on buyers for local manufacturing.

Sources:

Forests of Indiana 2017, USDA Forest Service, not yet published. The published report will be available online at http://treesearch.fs.fed.us
Indiana DNR Classified Forests, Report of Continuous Forest Inventory (CFI), Summary of Years 2013-2017 https://www.in.gov/dnr/forestry/3605.htm
IN DNR State Forest Properties, Report of Continuous Forest Inventory (CFI), Summary of years 2013-2017 https://www.in.gov/dnr/forestry/3605.htm
National Woodland Owner Survey, Indiana 2013 https://www.fs.fed.us/nrs/pubs/rb/rb_nrs99.pdf
USDA Forest Service Forest Inventory and Analysis Program: https://www.fia.fs.fed.us/
The Indiana Division of Forestry publishes forest inventory and forest products reports regularly and posts them at https://www.in.gov/dnr/forestry/3605.htm

The Hardwood Ecosystem Experiment: a framework for studying responses to forest management. Gen. Tech. Rep. NRS-P-108. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station: 12-23. https://www.fs.usda.gov/treesearch/pubs/42897

Baseline of Indiana Hardwoods Industry

The hardwood industry is a significant sector within Indiana's agriculture economy. Not only is Indiana known for producing high-quality timber, the secondary manufacturing industry also adds tremendous value to both timber and the broader economy. A snapshot of the Indiana Hardwoods industry shows the state has a considerable presence along various points of the hardwoods-related supply chain relative to the United States. Nationwide, employment is dropping among the primary and secondary industries (Table 2) due to shifts in consumer demand, automation, and the changing nature of production. The same trend holds true in Indiana as well.

Table 2: Primary, Secondary and Tertiary Wood Products Sectors in U.S.

Description	2016 Jobs	2017 Estab.	'01-'16 Job Change	2016 Self Employed Jobs	Avg. Earnings Per Job
Primary	266,449	15,007	(114,189)	10.5%	$53,599
Secondary	795,943	53,025	(367,646)	19.4%	$47,749
Tertiary	73,533	4,183	(50,940)	9.1%	$54,586

Source: Purdue University via EMSI Q2:2018 Dataset.

Hardwood industries are defined as primary, secondary, or tertiary (Table 3) based on the amount of value added in the production of the final good, such as a furniture. Much of the analysis centers around the primary, secondary, and tertiary wood products industries, but researchers believe it is worth examining additional industries included in the supply chain, such as suppliers, wholesalers, and the paper-manufacturing sector. Primary wood products industries encompass raw products (e.g., logging the trees to limited manufacturing). Secondary wood products industries convert raw materials or lightly manufactured goods into hardwood related goods ready for commercial, residential, or retail consumption. Tertiary wood products industries either support the logging industry or use value-added hardwood materials as a component of the final product. Refer to Appendix J for definitions of the selected North American Industry Classification System (NAICS) codes listed in Table 3 and 4.

Table 3: Primary, Secondary and Tertiary Wood Products Industries

NAICS	Description
PRIMARY	
113110	Timber Tract Operations
113210	Forest Nurseries and Gathering of Forest Products
113310	Logging
321113	Sawmills
321114	Wood Preservation
321211	Hardwood Veneer and Plywood Manufacturing
321212	Softwood Veneer and Plywood Manufacturing
321213	Engineered Wood Member (except Truss) Manufacturing
321214	Truss Manufacturing
321219	Reconstituted Wood Product Manufacturing
321912	Cut Stock, Resawing Lumber, and Planing
NAICS	**Description**
SECONDARY	
238350	Finish Carpentry Contractors
321911	Wood Window and Door Manufacturing
321918	Other Millwork (including Flooring)
321920	Wood Container and Pallet Manufacturing
321999	All Other Miscellaneous Wood Product Manufacturing
337110	Wood Kitchen Cabinet and Countertop Manufacturing
337121	Upholstered Household Furniture Manufacturing
337122	Non-upholstered Wood Household Furniture Manufacturing
337127	Institutional Furniture Manufacturing
337211	Wood Office Furniture Manufacturing
337212	Custom Architectural Woodwork and Millwork Manufacturing
337215	Showcase, Partition, Shelving, and Locker Manufacturing
337920	Blind and Shade Manufacturing
TERTIARY	
115310	Support Activities for Forestry
321991	Manufactured Home (Mobile Home) Manufacturing
321992	Prefabricated Wood Building Manufacturing
339992	Musical Instrument Manufacturing
339995	Burial Casket Manufacturing

Additional industries related to hardwood production include suppliers, wholesalers, and the paper-manufacturing sector (Table 4). Suppliers provide goods to assist the primary, secondary or tertiary wood products industries. Wholesalers take the goods produced by the primary, secondary, and tertiary industries into the marketplace. Paper manufacturing is a set of industries that takes a hardwood byproduct (pulp) and converts it into paper products.

Table 4: Suppliers, Wholesalers and Paper Manufacturing Industries

NAICS	Description
SUPPLIERS	
325520	Adhesive Manufacturing
327910	Abrasive Product Manufacturing
332216	Saw Blade and Hand tool Manufacturing
333243	Sawmill, Woodworking, and Paper Machinery Manufacturing
333991	Power-Driven Hand tool Manufacturing
WHOLESALERS	
423210	Furniture Merchant Wholesalers
423220	Home Furnishing Merchant Wholesalers
423310	Lumber, Plywood, Millwork, and Wood Panel Merchant Wholesalers
423930	Recyclable Material Merchant Wholesalers
424110	Printing and Writing Paper Merchant Wholesalers
424130	Industrial and Personal Service Paper Merchant Wholesalers
PAPER Manufacturing	
322110	Pulp Mills
322121	Paper (except Newsprint) Mills
NAICS	**Description**
322122	Newsprint Mills
322130	Paperboard Mills
322211	Corrugated and Solid Fiber Box Manufacturing
322212	Folding Paperboard Box Manufacturing
322219	Other Paperboard Container Manufacturing
322220	Paper Bag and Coated and Treated Paper Manufacturing
322230	Stationery Product Manufacturing
322299	All Other Converted Paper Product Manufacturing

In total, these six subgroups employ over 70,000 workers (as of 2016). Over half of these employees are in the secondary wood products industries (52.9 percent, 37,144 employees). Paper manufacturing has the second largest employment figure with 9,360 workers (13.7 percent), followed by wholesalers (9,451 employees, 13.5 percent) and primary wood products industries (10.1 percent, 7,120 employees). The data sources for jobs in these industries include the Quarterly Census of Employment and Wages (QCEW) from the Bureau of Labor Statistics (BLS), Non-QCEW jobs or the types of jobs not captured by the BLS, and the self-employed.

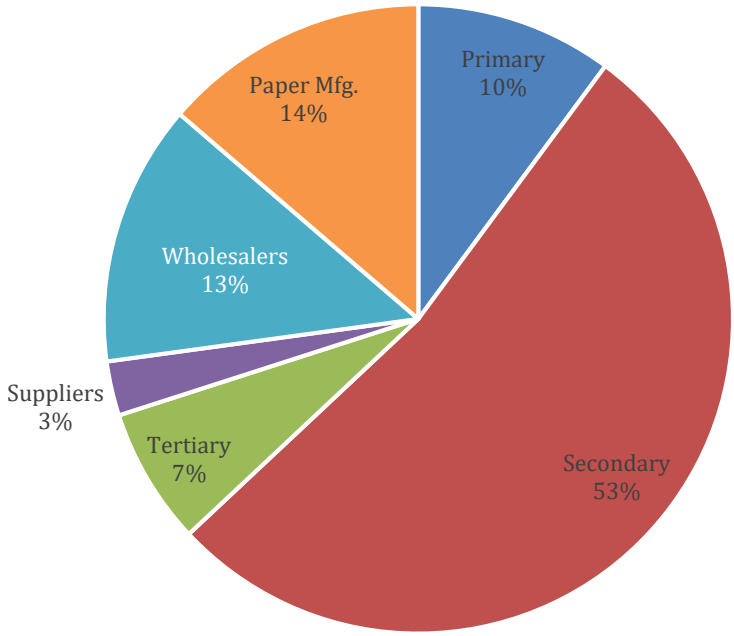


Figure 10: Indiana Hardwoods Employment Shares, 2016.

Source: Purdue University via E 1

Within these industries, most have faced employment declines over the past 15 years for a net loss of more than 19,000 jobs across all six categories. Nearly 75 percent of the employment loss has been in the primary, secondary, and tertiary wood products industries. However, there have been employment gains in several industries, just not enough to offset the declines of the remaining industries. Despite the loss of jobs, most of the primary and secondary wood products industries are doing very well, as evidenced by the positive competitive effect value. A positive competitive effect means that the state of Indiana has unique strengths that is helping it do better than what would be expected given national economic trends as well as job trends in hardwood industry-related sectors. For example, if a particular industry sector decline nationally, the industry sector in Indiana not only countered the decline but also added jobs. Likewise, two-thirds of all the hardwood industries have higher employment concentration in Indiana than is evident nationwide (value greater than 1), as reflected in the value of its location quotient (LQ). This employment concentration is especially evident in the secondary, tertiary, and paper manufacturing industries. Whereas, an LQ of 1 is the theoretical threshold for exports, a common rule of thumb is that industries with an LQ greater than 1.2 tend to export outside of the region, or in this case, Indiana.

Table 5: Indiana Hardwood Industries, 2016

NAICS	Description	2016 Jobs	2017 Estab.	'01-'16 Job Change	2016 Self Employed Jobs	Avg. Earnings Per Job	Competitive Effect 2001-2016	2016 LQ
PRIMARY								
113110	Timber Tract Operations	87	5	34	72.9%	$26,993	23	0.47
113210	Forest Nurseries and Gathering of Forest Products	0	0	(138)	n/a	$0	(132)	0.00
113310	Logging	1,510	85	181	80.4%	$26,676	217	0.58
321113	Sawmills	1,611	102	(559)	14.6%	$45,603	28	0.90
321114	Wood Preservation	161	6	(206)	21.9%	$59,361	(116)	0.78
321211	Hardwood Veneer and Plywood Manufacturing	1,450	25	(1,241)	0.8%	$50,630	(104)	4.73
321212	Softwood Veneer and Plywood Manufacturing	16	1	(34)	68.2%	$84,939	(15)	0.05
321213	Engineered Wood Member (except Truss) Manufacturing	649	9	299	3.4%	$56,827	404	5.17
321214	Truss Manufacturing	1,013	30	(327)	9.5%	$51,307	50	1.74
321219	Reconstituted Wood Product Manufacturing	44	2	7	<20%	$58,832	18	0.16
321912	Cut Stock, Resawing Lumber, and Planing	579	19	(120)	14.6%	$55,371	122	1.80
	Total Primary	**7,120**	**284**	**(2,104)**	**25.0%**	**45,544**	**494**	**1.05**
SECONDARY								
238350	Finish Carpentry Contractors	6,653	486	(1,387)	64.3%	33,698	(898)	0.91
321911	Wood Window and Door Manufacturing	1,368	27	(533)	7.8%	50,113	26	1.30
321918	Other Millwork (including Flooring)	1,499	51	(469)	15.6%	49,951	284	1.71
321920	Wood Container and Pallet Manufacturing	3,184	136	309	12.5%	41,853	558	2.36
321999	All Other Miscellaneous Wood Product Manufacturing	1,527	74	(7)	23.9%	44,387	304	2.20
337110	Wood Kitchen Cabinet and Countertop Manufacturing	10,703	256	2,594	4.4%	51,971	4,155	3.99

NAICS	Description	2016 Jobs	2017 Estab.	'01-'16 Job Change	2016 Self Employed Jobs	Avg. Earnings Per Job	Competitive Effect 2001-2016	2016 LQ
337121	Upholstered Household Furniture Manufacturing	2,451	18	602	3.0%	54,269	1,208	1.90
337122	Nonupholstered Wood Household Furniture Manufacturing	1,699	88	(2,608)	13.5%	41,605	305	2.11
337127	Institutional Furniture Manufacturing	731	17	11	<1.5%	52,704	258	1.48
337211	Wood Office Furniture Manufacturing	3,726	33	(1,679)	1.6%	49,679	750	9.86
337212	Custom Architectural Woodwork and Millwork Manufacturing	489	25	251	13.6%	48,094	105	1.01
337215	Showcase, Partition, Shelving, and Locker Manufacturing	2,527	33	(1,791)	2.2%	49,126	126	2.68
337920	Blind and Shade Manufacturing	585	8	(531)	<1.7%	40,897	(27)	2.17
	Total Secondary	**37,144**	**1,251**	**(5,237)**	**17.1%**	**46,461**	**7,157**	**2.00**
TERTIARY								
115310	Support Activities for Forestry	327	20	86	84.8%	30,112	94	0.50
321991	Manufactured Home (Mobile Home) Manufacturing	2,360	23	(4,291)	1.0%	65,166	(549)	5.01
321992	Prefabricated Wood Building Manufacturing	277	14	(692)	15.2%	56,301	(316)	0.85
339992	Musical Instrument Manufacturing	646	19	(926)	15.6%	62,812	(712)	2.04
339995	Burial Casket Manufacturing	1,329	14	(1,165)	5.5%	64,498	(16)	16.39
	Total Tertiary	**4,939**	**89**	**(6,987)**	**10.4%**	**61,890**	**(1,498)**	**2.68**
SUPPLIERS								
325520	Adhesive Manufacturing	664	18	(310)	3.9%	69,077	(203)	1.45
327910	Abrasive Product Manufacturing	220	10	82	<5%	63,585	120	1.04
332216	Saw Blade and Handtool Manufacturing	397	17	(654)	4.2%	50,051	(148)	0.67

NAICS	Description	2016 Jobs	2017 Estab.	'01-'16 Job Change	2016 Self Employed Jobs	Avg. Earnings Per Job	Competitive Effect 2001-2016	2016 LQ
333243	Sawmill, Woodworking, and Paper Machinery Manufacturing	653	21	(104)	4.6%	70,196	231	2.26
333991	Power-Driven Handtool Manufacturing	29	3	(97)	<34%	55,351	(36)	0.16
	Total Suppliers	**1,963**	**69**	**(1,083)**	**4.2%**	**64,749**	**(35)**	**1.13**
WHOLESALERS								
423210	Furniture Merchant Wholesalers	1,345	88	130	20.9%	65,049	(23)	1.07
423220	Home Furnishing Merchant Wholesalers	916	77	188	22.4%	64,884	171	0.60
423310	Lumber, Plywood, Millwork, and Wood Panel Merchant Wholesalers	2,438	155	(466)	6.5%	57,803	(57)	1.11
423930	Recyclable Material Merchant Wholesalers	3,993	212	(415)	11.0%	65,723	(539)	1.67
424110	Printing and Writing Paper Merchant Wholesalers	143	15	(33)	8.4%	104,210	22	0.56
424130	Industrial and Personal Service Paper Merchant Wholesalers	616	74	(636)	14.8%	92,611	(475)	0.49
	Total Wholesalers	**9,451**	**621**	**(1,232)**	**12.6%**	**65,865**	**(901)**	**1.06**
PAPER MANUFACTURING								
322110	Pulp Mills	0	0	0	n/a	0	0	0.00
322121	Paper (except Newsprint) Mills	111	6	(230)	<9%	86,664	(60)	0.10
322122	Newsprint Mills	0	0	0	n/a	0	0	0.00
322130	Paperboard Mills	889	8	66	0.0%	92,503	285	1.45
322211	Corrugated and Solid Fiber Box Manufacturing	4,428	66	(870)	0.3%	67,798	702	2.36

NAICS	Description	2016 Jobs	2017 Estab.	'01-'16 Job Change	2016 Self Employed Jobs	Avg. Earnings Per Job	Competitive Effect 2001-2016	2016 LQ
322212	Folding Paperboard Box Manufacturing	849	9	(822)	<1.2%	60,247	(327)	1.46
322219	Other Paperboard Container Manufacturing	536	12	(212)	2.5%	52,345	22	1.05
322220	Paper Bag and Coated and Treated Paper Manufacturing	2,009	30	(172)	1.8%	62,872	478	1.68
322230	Stationery Product Manufacturing	381	3	(141)	<2.6%	56,040	148	1.01
322299	All Other Converted Paper Product Manufacturing	428	12	(175)	6.7%	66,912	(57)	1.24
	Total Paper Manufacturing	**9,630**	**146**	**(2,556)**	**1.1%**	**67,657**	**1,190**	**1.40**
	GRAND TOTAL	**70,247**	**2,460**	**(19,199)**	**14.3%**		**6,407**	**1.57**

Source: Purdue University via EMSI Q2:2018 Dataset. Note: Highlighted NAICS have a LQ greater than 1.
Note: Refer to Appendix J for definitions of the NAICS codes.

Another interesting element to note is the prevalence of self-employed workers who either work full-time or on the side within the hardwood industry. Certain industries have a higher share of its jobs who are self-employed, which reflects the diversity of businesses and the entrepreneurial opportunities that exist for people engaged in this line of work. At the same time, the mix of establishment types should be taken into account when trying to guide the entire hardwood industry or sector into a particular direction. The diversity in establishments can promote resiliency of the hardwood sector given that jobs are not concentrated in a handful of large corporations. The prominence of self-employed workers is most evident in the primary wood products sector, which primarily works with raw or lightly value-added products.

The secondary wood products sector has the largest number of establishments, or business locations, in Indiana. Over 1,200 establishments are located around the state, mostly concentrated in the southwest and southcentral regions of the state. The second largest set of establishments is in the wholesale industry, followed by the primary wood products sector.

Supply Chains of Primary, Secondary and Tertiary Hardwoods Industries in Indiana

Economic input-output (IO) data are used to estimate supply chain linkages for primary, secondary, and tertiary hardwood industries in Indiana. The economic input-output tables track the dollar value transactions for a particular industry sector, especially the industries that are supplying raw materials, semi-finished goods and commodities, and services. It also tracts the industries that are purchasing from the selected industry sector or a group of industry sectors, such as the primary hardwood industries.

Figures 11, 12, and 13 are based on the top 15 industries that are supplying to primary, secondary and tertiary hardwood industries, respectively. The charts also show the dollar values obtained from within Indiana versus the dollar values leaking out of Indiana. For example, nearly $59 million value of sawmill products were obtained from outside of Indiana by the primary hardwood industries. The primary, secondary, and tertiary hardwood industries in total, obtained more than $230 million of sawmill products from outside of Indiana based on EMSI[1] data analysis by the project team. This indicates an area of opportunity and excess demands that can be fulfilled within Indiana. Logging is another sector with large amounts of leakages. The supply chain chart of the secondary hardwood industries contains a variety of wood product industries that have excess demands fulfilled from the outside of Indiana. For example, truss manufacturing shows leakages of more than $43 million and showcase, partition, shelving and locker manufacturing has leakages of $29 million. Other sectors include hardwood veneer and plywood, all other plastics products, wood window and door, softwood veneer and plywood, paint and coating, and wood kitchen cabinet and countertop manufacturing.

Supply chain leakages in certain hardwood related industries can benefit from the import substitution strategies including identifying Indiana businesses and informing about the excess but unmet demand within the state. It should be noted that a region or the state can simultaneously export and import the same product or commodity, which is known as the cross-hauling. The objective should be to increase the exports and close the gap or leakages by reducing the import of the same product or commodities. It should be noted that economic input-output based leakages are estimates, however, economic input-output is an established methodology in regional planning.

[1] Economic Modeling Specialists International (www.economicmodeling.com)

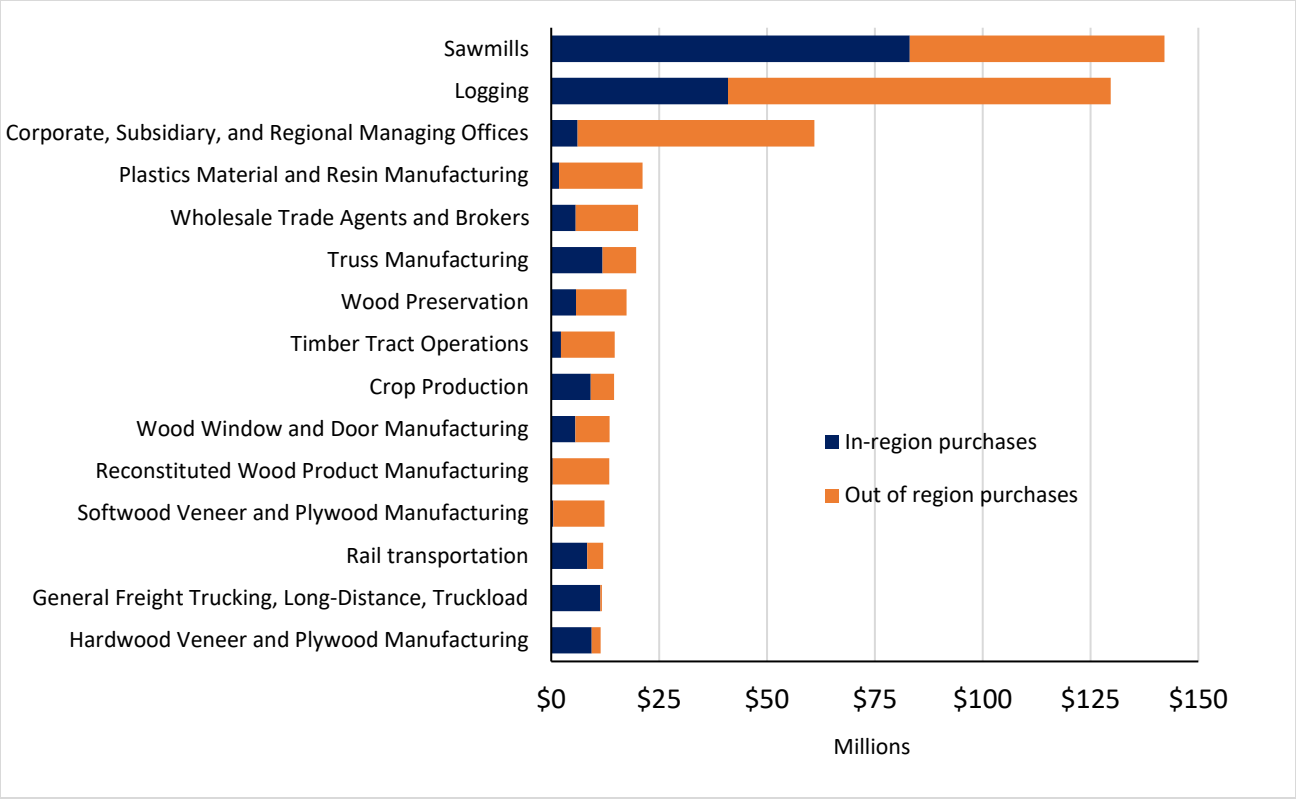


Figure 11: Primary Hardwood Industry Top 15 Supplier Industries and Leakages in Indiana 2016.
Source: EMSI 2018.2 version

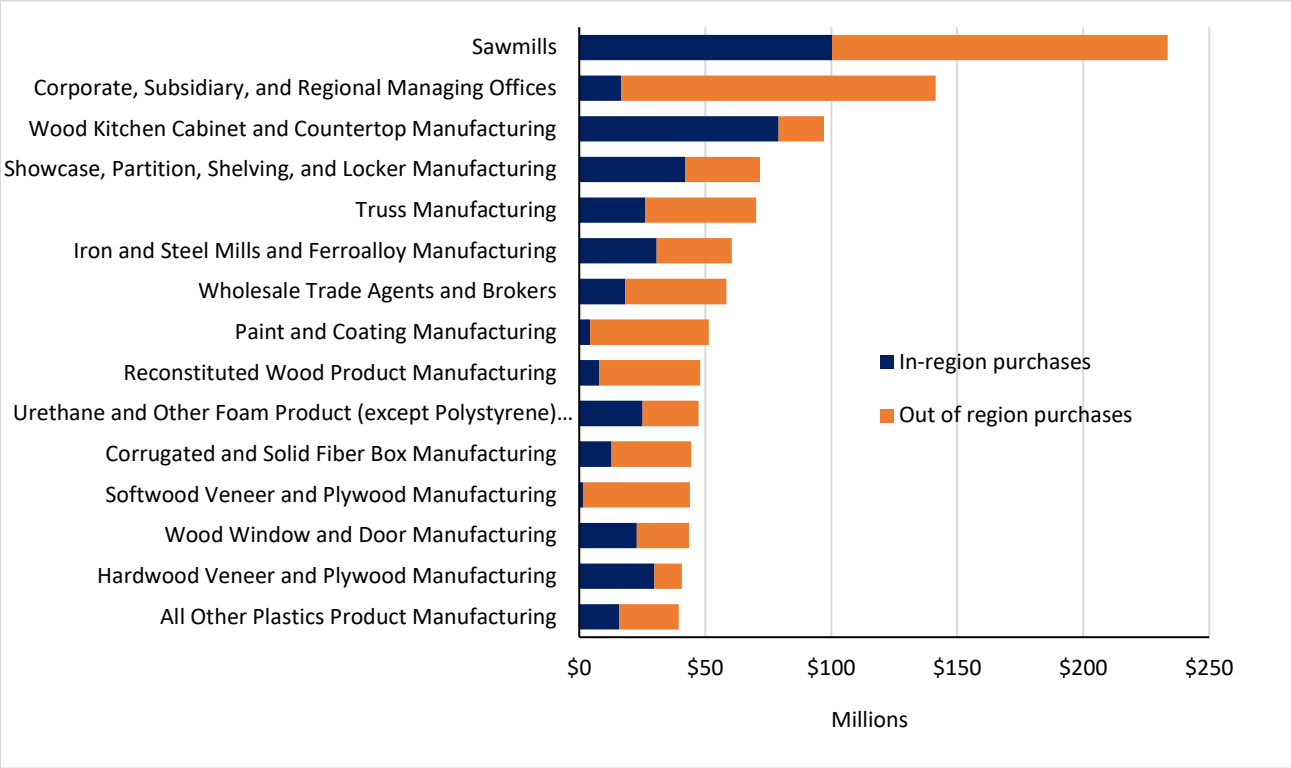


Figure 12: Secondary Hardwood Industry Top 15 Supplier Industries and Leakages in Indiana 2016. Source: EMSI 2018.2 version.

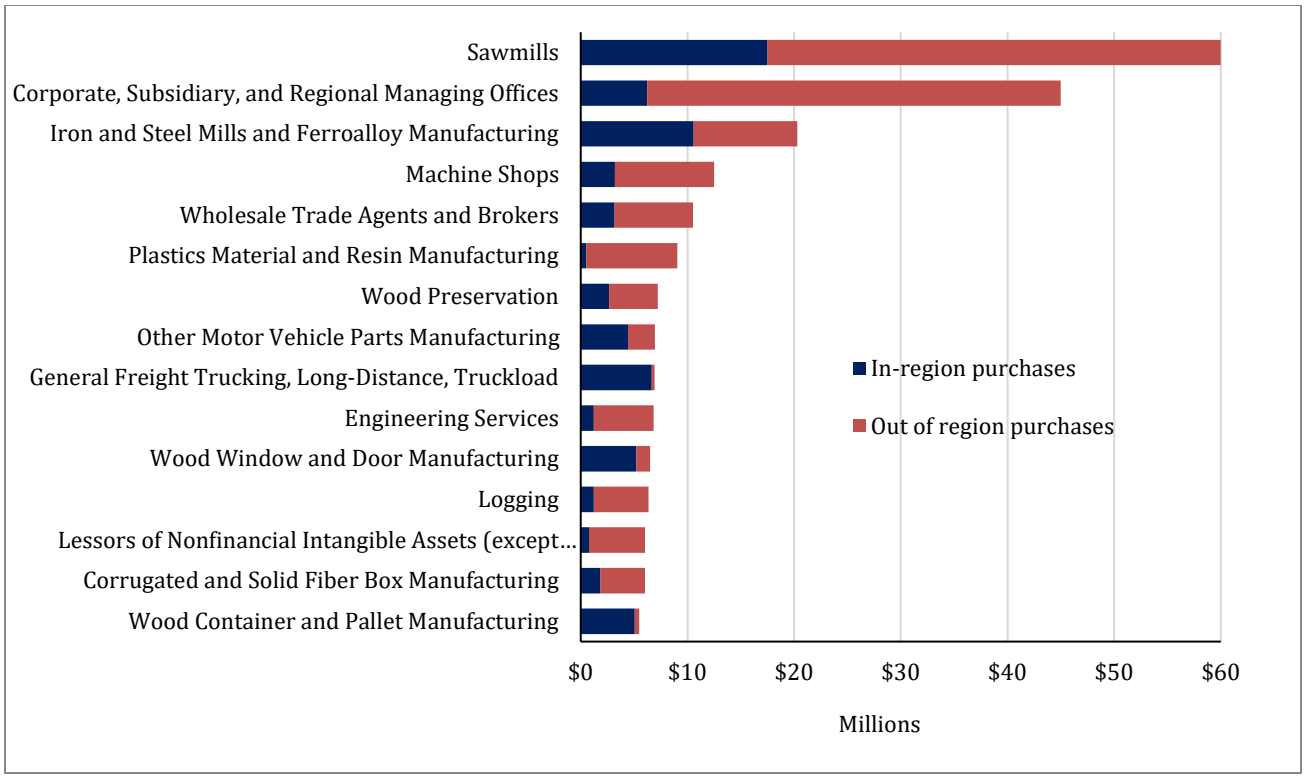
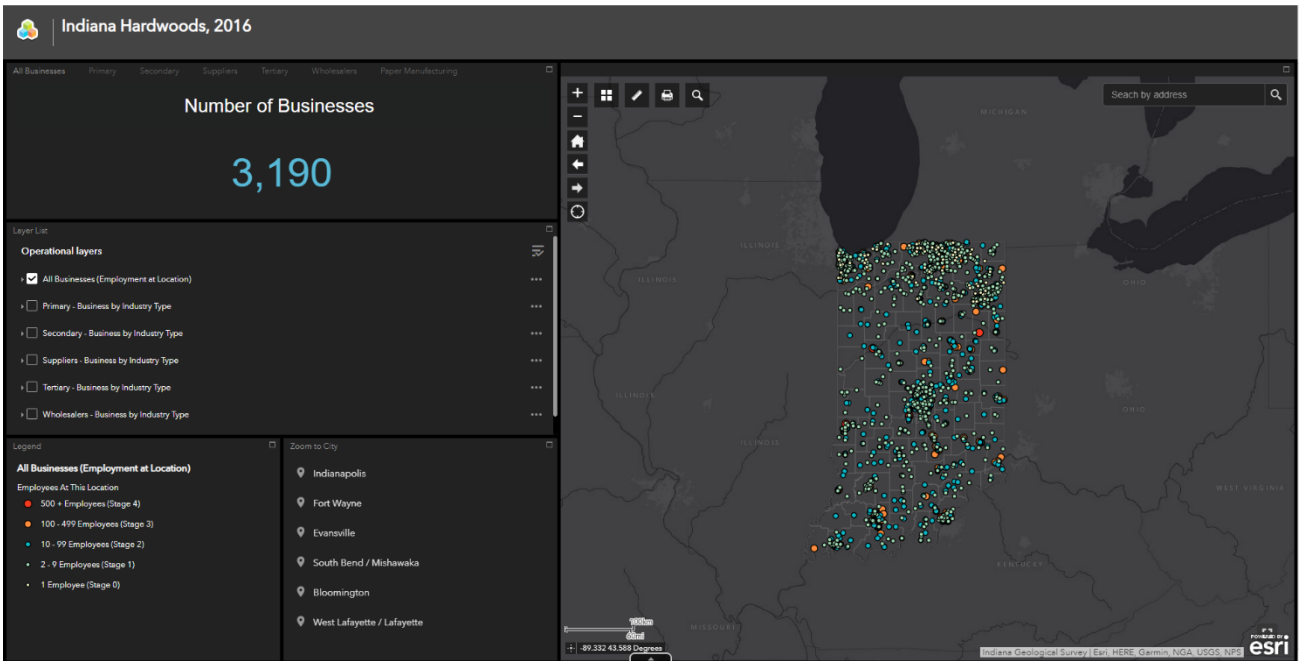


Figure 13: Tertiary Hardwood Industry Top 15 Supplier Industries and Leakages in Indiana 2016. Source: EMSI 2018.2 version.

Current Hardwood and Forest Product Facilities in Indiana

Interactive Mapping of Hardwood Industries:
The project team has developed an online interactive map of nearly 3,200 businesses (gleaned from the Hoover's database) with links to hardwoods and forest products sectors. The team began by identifying companies by their North American Industry Classification System (NAICS) six-digit level codes, and then classifying these establishments into primary, secondary, suppliers, tertiary, wholesalers, and paper manufacturing categories based on their specific NAICS codes.

In the interactive map, the establishments are shown as dots of varying sizes dependent on the number of jobs in the business. The usual mapping features of zoom-in, zoom-out, linear distance measurement, and exporting into various image types are available. We also provide a link to the tabular data, which can be downloaded, if needed. A click on any dot (business establishment) produces a pop-up feature with various details about the establishment including name, employees, physical and web address, line of business, industry type, and more. Additionally, primary, secondary, and other categories of businesses are mapped separately. A screen shot of the map and pop-up is provided below:



The URL of the Indiana Hardwood Strategy Interactive Map is: https://pcrd.maps.arcgis.com/apps/webappviewer/index.html?id=86ab79e192e94e348b638e8870844f79. The interactive map is developed based on ESRI's ArcGIS server and ArcGIS Online platforms, commercially licensed by the Purdue Center for Regional Development (PCRD).

Comparison to other States

Given the composition of hardwoods grown in Indiana, the states most comparable are located in the Eastern hardwood region. Within this region, there are six sub-regions: Southern, Mid-Atlantic, East Central, West Central, Northern and Plains (see Table 6). The Indiana State Department of Agriculture recommended that the project team focus on the East and West Central regions and add Michigan and Pennsylvania.

Table 6: Subregions and species composition in the Eastern Hardwood Region.

Region	States	Major species group
Southern	AL, AR, FL, GA, LA, MS, OK, SC, TX	Other red oaks, sweetgum, other white oak, tupelo/blackgum, select white oak
Mid-Atlantic	DE, MD, NJ, NC, VA	Yellow-poplar, other red oaks, select white oaks, soft maple
East Central	IN, KY, OH, TN, WV	Yellow poplar, select white oaks, hickory, other red oaks
West Central	IL, IA, MO	Select white oaks, other red oaks
Northern	CT, ME, MA, MI, NH, NY, PA, RI, VT, WI	Hard maple, soft maple, selected red oaks, cottonwood/aspen
Plains	KS, MN, NE, ND, SD	Cottonwood/aspen, ash

Source: US Department of Agriculture Forest Service (2015)

When looking at the comparison states, the focus rests on the primary, secondary and tertiary wood products sectors, as these are the most critical components of the hardwood industry. Of the selected states, Indiana has 13.9 percent of all the jobs, 10.1 percent of all establishments and 11 percent of all job losses over the past 15 years (see Table 7). Furthermore, Indiana commands the highest LQ in the secondary and tertiary wood products sectors. While Indiana does have an LQ greater than one in the primary wood products sector, other states (MI, TN and WV) have higher concentrations. In viewing the comparison statistics, Indiana does not have the largest number of jobs or establishments in each wood product sector, yet the state has a strong wood products concentration and has competitive advantages in most sectors (tertiary is the only exception).

Table 7: Eastern Hardwood Region Comparison; 2016.

	2016 Jobs	2017 Establishments	LQ	Competitive Effect, 2001-2016
Primary				
Pennsylvania	14,279	584	1.08	239
Michigan	10,949	570	1.11	1,759
Tennessee	8,590	389	1.25	350
Ohio	7,970	257	0.01	1,610
Kentucky	7,277	276	0.02	(527)
Indiana	**7,120**	**284**	**1.05**	**494**
Missouri	6,653	361	1.02	860
West Virginia	5,295	402	3.39	(1,324)
Illinois	2,782	151	0.20	126
Iowa	2,014	65	0.56	445
Total Primary	72,929	3,339	0.93	4,032.00
Secondary				
Pennsylvania	42,276	2,059	1.16	974
Ohio	39,251	1,911	1.17	(5,776)
Indiana	**37,144**	**1,251**	**2.0**	**7,157**
Illinois	30,958	2,248	0.82	(4,021)
Michigan	30,512	1,314	1.13	(497)
Tennessee	21,518	863	1.14	(6,626)
Missouri	19,281	1,026	1.08	(1,096)
Iowa	15,730	597	1.59	(1,624)
Kentucky	14,006	562	1.17	(2,049)
West Virginia	4,719	168	1.10	7
Total Secondary	255,395	11,999	1.18	(13,551.00)
Tertiary				
Pennsylvania	7,277	216	2.02	481
Tennessee	5,000	101	2.66	1,134
Indiana	**4,939**	**89**	**2.68**	**(1,498)**
Ohio	2,133	64	0.64	(62)
Michigan	1,625	113	0.61	(411)
Illinois	1,390	88	0.37	(409)
Missouri	831	52	0.47	(116)
Iowa	715	24	0.73	(30)

	2016 Jobs	2017 Establishments	LQ	Competitive Effect, 2001-2016
Kentucky	564	33	0.47	(3)
West Virginia	288	26	0.68	(169)
Total Tertiary	24,762	806	1.16	(1,083.00)
Grand Total	**353,086**	**16,144**	**1.12**	**(10,602)**
IN Share	13.9%	10.1%		

Source: Purdue University via EMSI Q2:2018 Dataset
Note: Highlighted states have a LQ greater than 1.

Unfortunately, all states have seen a decline in their hardwood industry sectors over the past 15 years, with the secondary wood products sector bearing the brunt of this employment change (-96,351 jobs).

For example, cabinet, millwork and wood household furniture employment was in freefall in the early 2000s before stabilizing and/or rebounding slightly in the past five years (Figures 14 and 15).

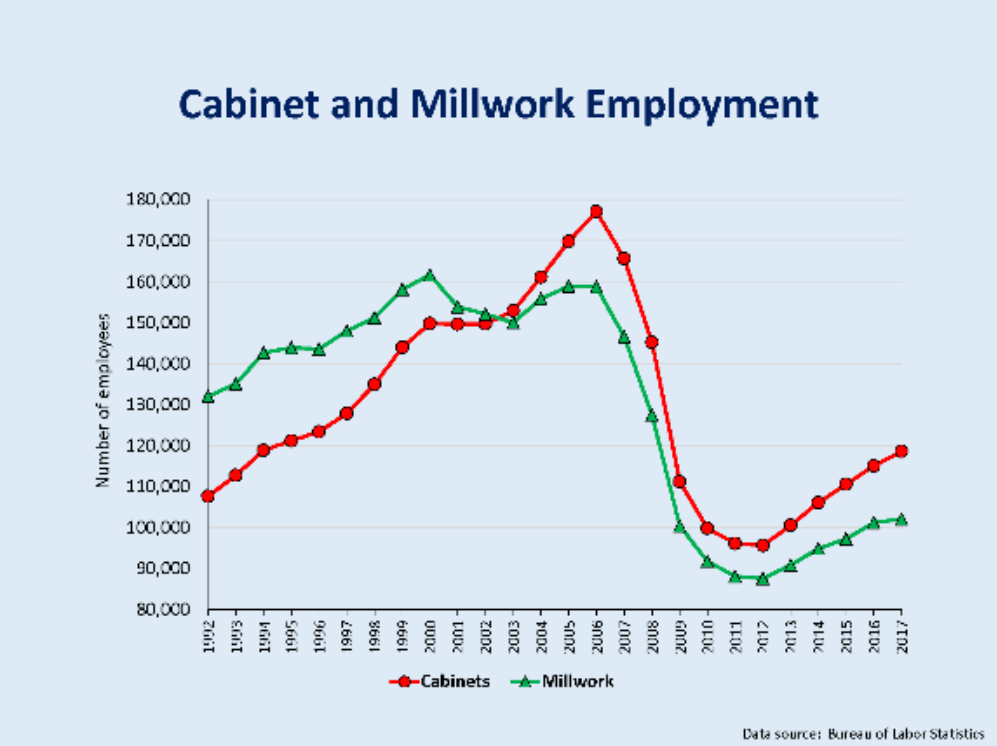


Figure 14. Cabinet and Millwork Employment trends in the U.S.

Figure 15. Wood Household Furniture Employment trends in the U.S.

Similarly, the number of firms in millwork, wood household furniture, and cabinets have been in steady decline (Figures 16 and 17).

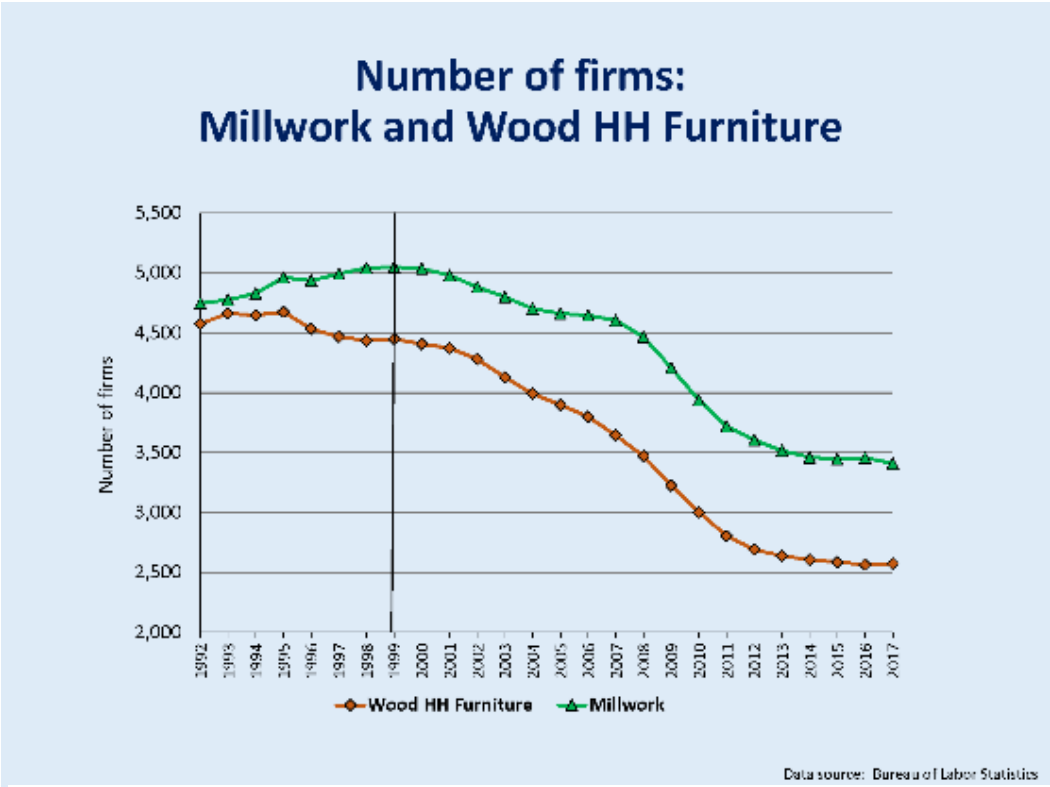


Figure 16: Number of Millwork and Wood Household Furniture Firms in the U.S.

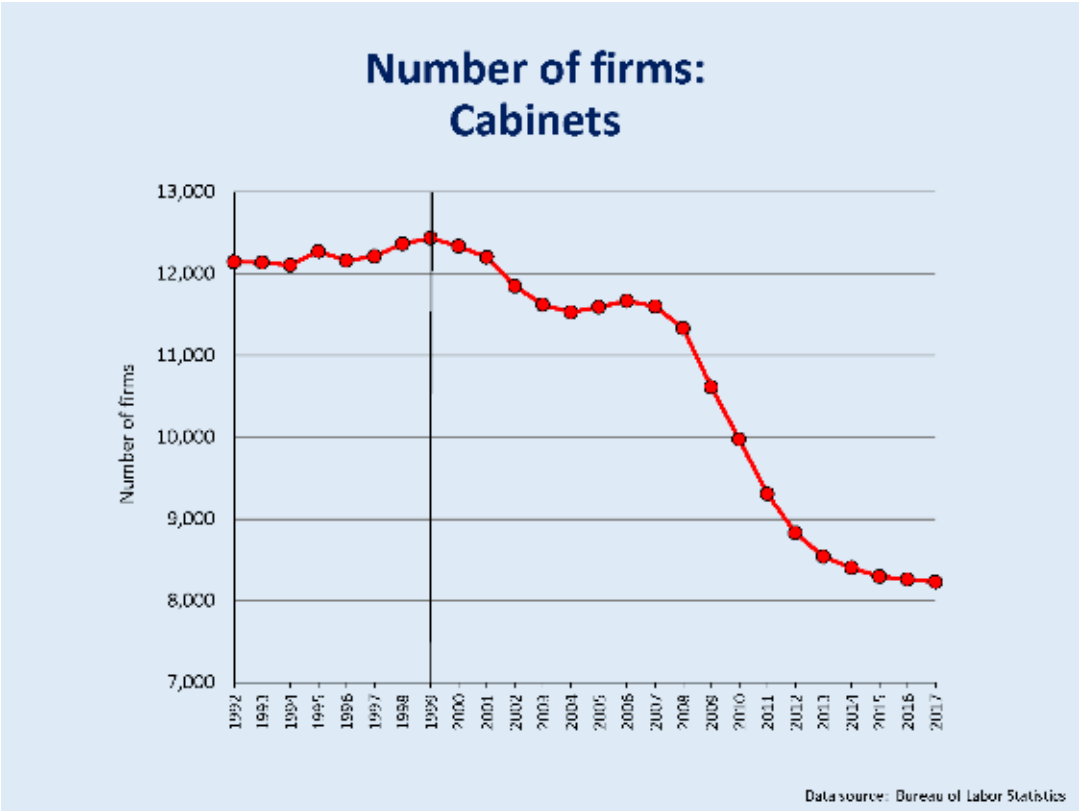


Figure 17: Number of Cabinetry Firms in the U.S.

However, with the reduction in the number of firms doing secondary manufacturing, there has been an increase in the size of the remaining firms (Figures 18 and 19).

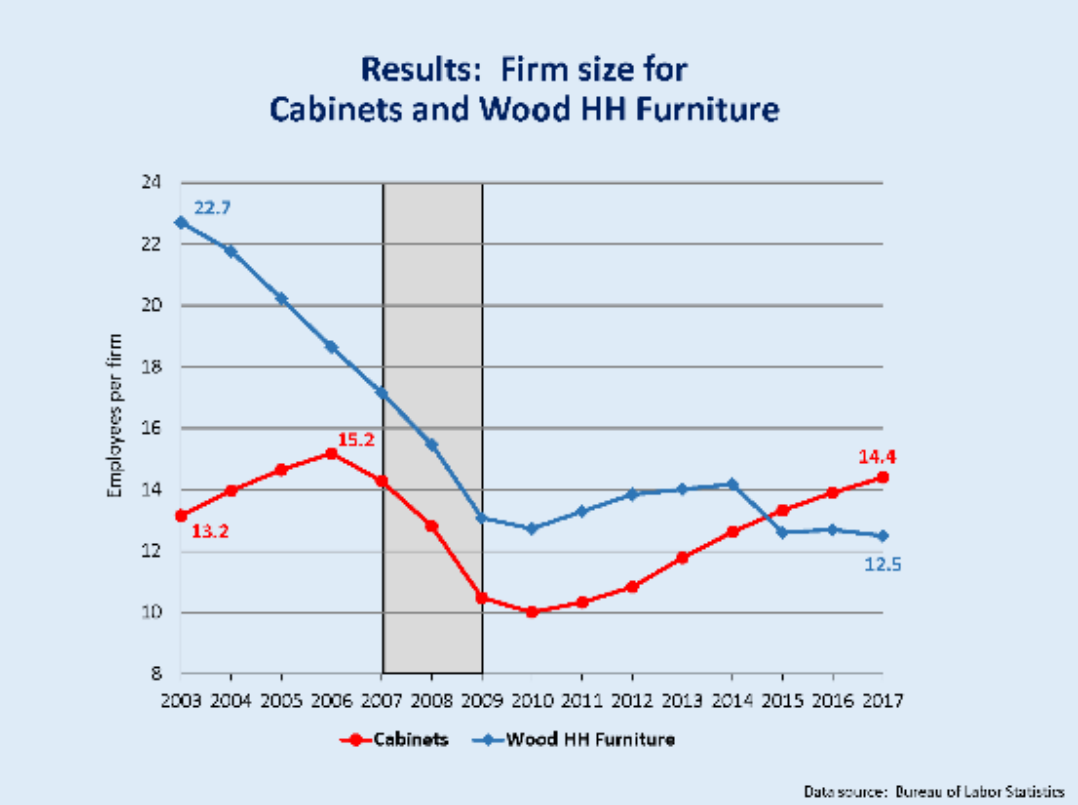


Figure 18: Firm size for Cabinets and Wood Household Furniture in the U.S.

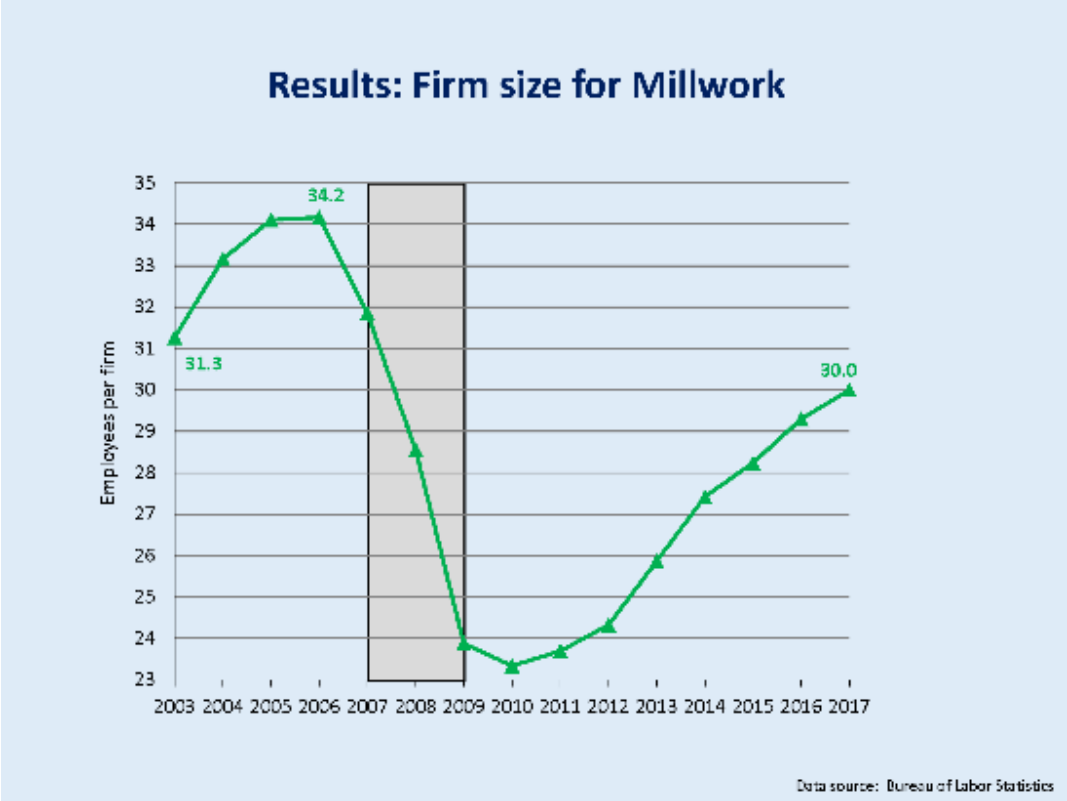


Figure 19: Firm size for Millwork in the U.S.

This has also resulted in a significant increase in firm size for hardwood sawmills (Figure 20).

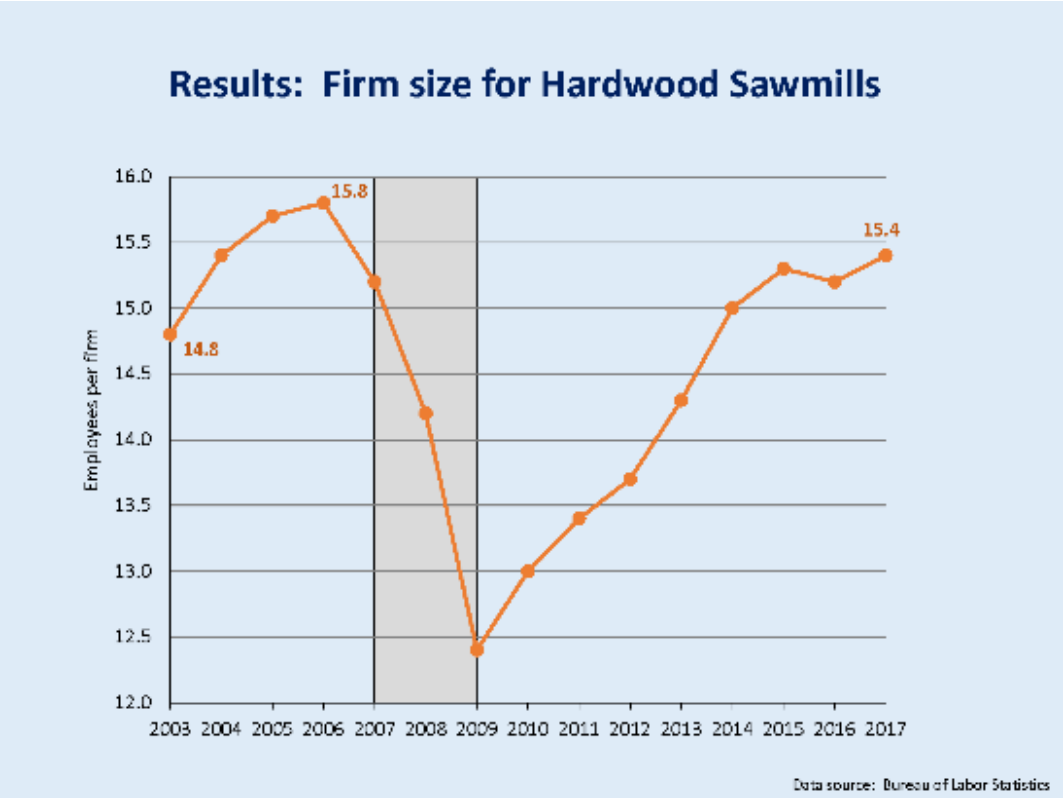


Figure 20. Size of Hardwood Sawmills in the U.S.

Even with the loss of number of firms and employees, the increase in firm size in secondary manufacturing and hardwood sawmills indicates that opportunity still exists in these sectors in Indiana.

Some states have not had as severe job losses over the years, at least relative to expectations, and have remained competitive. This is most true in the primary wood product sector than in any other sector. It is interesting to look at the secondary wood product sector as most states had a lower job growth than predicted based on national and industry trends, yet Indiana, Pennsylvania and West Virginia managed to show a competitive advantage in this area – indicating that industry strength and other unique factors exist to make the businesses in each state successful. In the tertiary wood product sector, only two states have both a high LQ and competitive effect, namely, Pennsylvania and Tennessee.

When asked about competition with other states, Indiana hardwood company representatives do not express many concerns. Their biggest worry is competition with foreign companies. Recommendations are offered to help address this challenge:

- Consider adding a master logger program (like Kentucky and Missouri have) to improve skill level of the workforce
- Like Virginia, South Carolina, and Texas, offer enticement packages with tax breaks and even low-rent or free facilities. Indiana could make sales calls to attract other business to the state
- Consider investing (like Kentucky) in new technologies for power (solar and wind) to run facilities. There is the potential for burning biomass to help generate power.

One representative captures a common feeling this way: "Other states are not really our competitors: They take some raw materials from us; we take some from them." In general, most feel there is nothing major other states are doing that Indiana should adopt.

Exports

Tracking Indiana's exports in the arena of wood products necessitates the use of the United States Department of Agriculture's Global Agricultural Trade Statistics (GATS). This data portal is relatively user-friendly and provides a great deal of data over a 13-year period (2004-2017). Its primary limitation is the lack of detailed information due to aggregation of specific tree species into larger categories such as "non-coniferous" or even "coniferous." This limitation can be especially challenging when greater granularity is desired for sustainability topics of specific species. The second limitation is that export data are presented in value terms and they lack the ability to analyze the results by weight. Thus, one must approximate the volume exported using average prices paid for the wood product in order to ascertain relative export volumes. The third limitation is that the data primarily capture raw and lightly value-added products, thus not capturing one of Indiana's largest sectors—secondary wood products. The following section shows the top 25 countries importing Indiana's wood products, ranked by value of shipments in 2017. The top ten imported items and their trends by each top 20 country are listed, in addition to the top 25 exported wood products.

Many of the hardwood industries have an LQ greater than 1.0, and 26 industry sectors have an LQ greater than 1.2, which indicate the prevalence of exports among these industries. Indeed, Indiana has seen a steady growth in the value of exports in raw and lightly value-added products from 2004 to 2017 (14.7 percent), despite a temporary dip following the recession (see Table 8). Since the end of the recession, the export rebound has been strong (39 percent). Some key observations:

- The top 25 exported raw or minimally value-added products comprise 93 percent of all Indiana exported goods in this category
- The 2017 value of exports were at its highest point since 2004, totaling $268.1 million
- Growth over the past 13 years has not been consistent with periods of volatility
- Export of logs, regardless of type, has increased in the past decade
- Some minimal value-added products are seeing growth, in particular wooden staves for barrels, wood waste, veneer and paperboard products in addition to paper

Table 8: Top 25 Exported Wood Products from Indiana (in Thousands $2017), 2004-2017.

		Value					Change		
2017 Rank	**Wood Product**	**2004**	**2007**	**2012**	**2016**	**2017**	**2004-2017**	**2007-2017**	**2012-2017**
1	Sawn Sheet Wood Nesoi	$ 84,475	$ 103,523	$ 47,945	$ 51,594	$ 48,249	-42.9%	-53.4%	0.6%
2	Adhesive Paper	$ 17,324	$ 27,026	$ 43,568	$ 37,093	$ 42,508	145.4%	57.3%	-2.4%
3	Lumber, Non-Coniferous	$ 12,576	$ 11,139	$ 16,129	$ 23,899	$ 24,490	94.7%	119.9%	51.8%
4	Paper And Paper Nesoi	$ 5,417	$ 3,062	$ 7,925	$ 18,201	$ 22,794	320.8%	644.4%	187.6%
5	Lumber, Oak	$ 15,617	$ 19,047	$ 16,784	$ 17,296	$ 19,682	26.0%	3.3%	17.3%
6	Logs, Non-Coniferous	$ 7,989	$ 16,054	$ 10,644	$ 14,457	$ 15,158	89.7%	-5.6%	42.4%
7	Logs, Oak	$ 8,300	$ 13,988	$ 7,490	$ 13,453	$ 14,248	71.7%	1.9%	90.2%
8	Other Articles Of Wood, Nesoi	$ -	$ -	$ -	$ -	$ 11,768	n/a	n/a	n/a
9	Wooden Casks	$ 1,999	$ 6,187	$ 3,664	$ 11,445	$ 8,979	349.2%	45.1%	145.1%
10	Ash Lumber	$ -	$ 2,922	$ 4,819	$ 9,450	$ 8,734	n/a	198.9%	81.2%
11	Logs, Poles, Conifer	$ 2,725	$ 2,823	$ 1,736	$ 3,960	$ 7,808	186.5%	176.6%	349.8%
12	Ties, Wood, Imprg	$ 1,198	$ 1,971	$ 2,828	$ 6,326	$ 7,229	503.4%	266.8%	155.6%
13	Veneer, Coniferous	$ 8,139	$ 2,176	$ 606	$ 131	$ 6,552	-19.5%	201.1%	981.2%
14	Waste, Scrap Chemical	$ 238	$ 1,186	$ 652	$ 6,255	$ 5,114	2048.7%	331.2%	684.4%
15	Paper, Kraft, 150-22	$ 398	$ 7,823	$ 7,557	$ 6,066	$ 5,109	1183.7%	-34.7%	-32.4%
16	Paper, Kraft, >225g	$ 19	$ 10,703	$ 8,376	$ 2,891	$ 4,937	25884.2%	-53.9%	-41.1%
17	Veneer, Tropical	$ 1,624	$ 1,431	$ 2,366	$ 5,550	$ 4,892	201.2%	241.9%	106.8%
18	Paperboard, Clay	$ 60	$ 261	$ 397	$ 1,150	$ 4,782	7870.0%	1732.2%	1104.5%
19	Non-Conifer Wood, Other	$ -	$ 3,826	$ 7,515	$ 5,388	$ 3,034	n/a	-20.7%	-59.6%

2017 Rank	Wood Product	2004	2007	2012	2016	2017	2004-2017	2007-2017	2012-2017
20	Cherry Lumber	$ -	$ 1,988	$ 1,847	$ 4,054	$ 2,085	n/a	4.9%	12.9%
21	Maple (Ex Jap) Lumber	$ -	$ 3,624	$ 1,645	$ 1,148	$ 1,708	n/a	-52.9%	3.8%
22	Testliner, <=150	$ 950	$ 1,416	$ -	$ 1,709	$ 1,673	76.1%	18.1%	n/a
23	Other Articles Of Bamboo, Nesoi	$ -	$ -	$ -	$ -	$ 1,368	n/a	n/a	n/a
24	Paper, Coated/Impreg	$ 2,979	$ 2,563	$ 993	$ 911	$ 1,248	-58.1%	-51.3%	25.7%
25	Paperboard, >150-225	$ 16	$ -	$ -	$ 12	$ 1,140	7025.0%	n/a	n/a
Top 25 Total		$ 168,098	$ 237,136	$192,848	$242,439	$268,152	14.7%	13.1%	39.0%
Share of All Indiana Exports		77.1%	77.5%	83.2%	89.3%	92.8%			

Source: USDA Global Agricultural Trade System (GATS)
Note: Definitions of the wood products listed are in the appendix. Nesoi indicates not elsewhere stated or included. Zeros are represented by the dashes. The producer price index for wood products manufacturing is used to estimate values in $2017.

Canada and China remain Indiana's top two markets importing raw and lightly value-added products between 2004 and 2017 (see Table 9). Volatility exists among the remaining top 25 export markets, with a split between growth and decline of imports from Indiana. Despite these ebbs and flows among countries in terms of their importing habits, the value of exports has returned to pre-recession levels. A few takeaways:

- The top 25 Indiana export markets now import 94 percent of all raw or lightly value-added wood products exported from Indiana
- Canada is the dominant market for Indiana hardwood products and China has emerged as the second largest market in the past five years. Tariffs may impact these rankings.
- Germany and Spain have dropped from being in the top five export markets in the past five years, replaced by Mexico and Japan.
- Export growth is not uniform across all countries, rather ebbs and flows occur with a few very strong spikes

Table 9: Top 25 Export Markets for Indiana Hardwood Products (in Thousands $2017), 2004-2017.

		Value					Change		
2017 Rank	Country	2004	2007	2012	2016	2017	2004-2017	2007-2017	2012-2017
1	Canada	$124,625	$169,284	$125,846	$104,978	$117,682	-5.6%	-30.5%	-6.5%
2	China	$19,143	$21,545	$26,830	$46,280	$55,377	189.3%	157.0%	106.4%
3	Mexico	$2,834	$18,421	$17,998	$29,542	$20,804	634.1%	12.9%	15.6%
4	Japan	$6,046	$8,316	$15,651	$15,258	$10,415	72.3%	25.2%	-33.5%
5	Spain	$20,193	$26,131	$5,093	$8,102	$8,625	-57.3%	-67.0%	69.3%

2017 Rank	Country	2004	2007	2012	2016	2017	2004-2017	2007-2017	2012-2017
6	Vietnam	$1,211	$2,905	$3,810	$6,766	$7,530	521.9%	159.2%	97.6%
7	Brazil	$374	$4,842	$5,294	$4,316	$6,743	1702.1%	39.3%	27.4%
8	Germany(*)	$21,281	$32,382	$14,096	$9,458	$6,273	-70.5%	-80.6%	-55.5%
9	United Kingdom	$6,687	$10,262	$8,151	$7,681	$5,871	-12.2%	-42.8%	-28.0%
10	Ireland	$1,114	$5,744	$1,624	$6,263	$5,099	357.7%	-11.2%	213.9%
11	India	$712	$851	$1,198	$4,118	$4,191	489.0%	392.2%	249.9%
12	Portugal	$1,329	$2,510	$1,424	$3,057	$3,858	190.4%	53.7%	171.0%
13	Taiwan	$5,986	$2,651	$1,579	$2,884	$3,487	-41.7%	31.5%	120.8%
14	Belgium-Luxembourg(*)	$4,469	$7,991	$1,613	$1,962	$2,917	-34.7%	-63.5%	80.9%
15	Italy(*)	$3,994	$8,670	$2,244	$2,608	$2,880	-27.9%	-66.8%	28.4%
16	Turkey	$209	$1,212	$2,109	$1,676	$2,477	1087.7%	104.3%	17.4%
17	Philippines	$510	$535	$2,321	$2,185	$2,289	348.5%	328.2%	-1.4%
18	Lithuania	$6	$191	-	$2,418	$2,056	33418.0%	977.3%	n/a
19	Australia(*)	$1,948	$4,192	$2,976	$2,602	$2,055	5.5%	-51.0%	-31.0%
20	Malaysia	$3,914	$2,826	$1,724	$2,794	$2,026	-48.2%	-28.3%	17.5%
21	South Africa	$1,253	$2,080	$1,521	$3,302	$1,954	56.0%	-6.0%	28.5%
22	Austria	$501	$410	$1,612	$2,445	$1,263	152.3%	208.2%	-21.6%
23	Indonesia	$3,761	$2,381	$930	$967	$1,062	-71.8%	-55.4%	14.2%

2017 Rank	Wood Product	2004	2007	2012	2016	2017	2004-2017	2007-2017	2012-2017
24	Korea, South	$2,191	$3,030	$1,578	$1,204	$1,047	-52.2%	-65.4%	-33.6%
25	Pakistan	$7	-	$327	$542	$962	12969.2%	n/a	194.2%
Top 25 Total		$226,585	$331,463	$241,582	$264,949	$272,655	20.3%	-17.7%	12.9%
Share of All Indiana Exports		84.7%	88.6%	89.9%	87.9%	94.4%			

Source: USDA Global Agricultural Trade System (GATS)

Given that Canada is the largest market for Indiana's hardwood products, at least in the raw or lightly value-added hardwood products, it is worth exploring what they import. Appendix E contains a full listing of products imported by each country along with the import values. The top two products imported by Canada include adhesive paper and sawn sheet wood, which is comprised of 43.3 percent of all Indiana hardwood goods. While Canada is the largest market at $117.7 million and growing, it has yet to reach the 2008 value of nearly $173 million (in $2017 value). The nominal value of exports in 2008 to Canada was $141.9 million.

Imports

The GATS database has the capability to look at imported products into the United States, yet not at the state level by Harmonized Codes (6-digit). A limited set of customs ports can be examined, of which the two closest to Indiana include St. Louis, MO, and Chicago, IL. Therefore, the top 20 imports from these two ports are pulled to examine what raw or lightly value-added products are coming in close to Indiana borders. It is not expected that all these products land in Indiana, but it does give a view of what are the most prominent products entering the country that relate to raw or lightly valued-added wood products in our vicinity.

Table 10 and Table 11 show the top 20 imported wood-related products to each respective port. In Chicago, the main wood product imported has been a plywood product, yet it primarily surfaced in 2017. In prior years, the main product would have been wooden frames used for paintings, photographs, mirrors or other products of that nature. The St. Louis port has had two primary products imported: wooden staves and hoops and a thick fiberboard. In both ports, the top 20 raw/lightly value-added wood products comprise over 80 percent of the incoming wood products (in 2017). Similar to the summary of exported goods, a considerable amount of volatility exists amongst the imported wood products, thus limiting a detailed trend analysis.

Table 10: Wood Related Products Imported to Chicago, IL Port (in nominal Thousands $); 1998-2017.

Product	1998 Value	2004 Value	2010 Value	2016 Value	2017 Value	Share of Total (2017)
Plywood Of Wood Sheets, N/O 6 Mm Thick Each	$ -	$ -	$ -	$ -	$ 69,431	17.7%
Wooden Frames For Paintings, Photographs, Mirrors	$ 12,590	$ 47,971	$ 45,519	$ 38,744	$ 33,512	8.6%
Builder's Joinery and carpentry of wood, of wood	$ -	$ -	$ -	$ -	$ 22,301	5.7%
Plywood sheets n/o 6mm thick, outer ply of non-coniferous wood	$ -	$ -	$ -	$ -	$ 16,792	4.3%
Doors Of Wood, Other Than French Doors	$ 3,647	$ 9,947	$ 14,244	$ 17,371	$ 16,287	4.2%
Standard Wood Moldings Of Pine (Pinus Spp.) Continuous	$ 1,308	$ 711	$ 5,206	$ 8,829	$ 16,128	4.1%
Multi-Ply Paper & Paperboard Nesoi, Coat W/Kaolin/	$ -	$ 28	$ 3,308	$ 10,697	$ 14,507	3.7%
Wood Marquetry And Inlaid Wood; Wooden Articles Of	$ 11,043	$ 11,391	$ 10,529	$ 14,729	$ 14,095	3.6%
Wooden Statuettes And Other Wood Ornaments	$ 9,897	$ 12,350	$ 7,216	$ 13,977	$ 11,530	2.9%
Veneered Panels And Similar Laminated Wood W/ At L	$ -	$ -	$ 7,887	$ 15,511	$ 10,801	2.8%
Plywood sheets n/o 6mm thick, outer ply of non-coniferous	$ -	$ -	$ -	$ -	$ 10,350	2.6%
Non-tropical Non-coniferous Veneer Sheets And Sheets	$ -	$ 6,033	$ 4,354	$ 8,085	$ 8,137	2.1%
Fiberboard Of A Density Over 0.5 But Not Over 0.8	$ -	$ -	$ 5,106	$ 7,634	$ 7,742	2.0%
Paper, Paperboard, Cellulose Wadding And Webs	$ -	$ -	$ 8,344	$ 6,211	$ 7,179	1.8%

Product	1998 Value	2004 Value	2010 Value	2016 Value	2017 Value	Share of Total (2017)
Builders' joinery and carpentry of wood, of bamboo	$ -	$ -	$ -	$ -	$ 6,278	1.6%
Other non-coniferous wood, continuously shaped	$ -	$ -	$ -	$ -	$ 5,476	1.4%
Fiberboard Nesoi, Of A Thickness Exceeding 9 Mm	$ -	$ -	$ 971	$ 6,592	$ 5,472	1.4%
Tableware and kitchenware of wood other than of bamboo	$ -	$ -	$ -	$ -	$ 5,161	1.3%
Veneered Panels And Similar Laminated Wood Nesoi	$ -	$ -	$ -	$ 4070	$ 4833	1.2%
Wooden Jewelry Boxes, Silverware Chests, Microscope; boxes not lined with textile fabrics	$ 1,201	$ 1826	$ 3453	$ 3497	$ 4568	1.2%
All Other Wood Products	$ 78,130	145,670	$ 173,674	$ 217,669	$ 72,131	18.4%

Source: USDA Global Agricultural Trade System (GATS).

Table 11: Wood Related Products Imported to St. Louis, MO Port (in nominal Thousands $); 1998-2017.

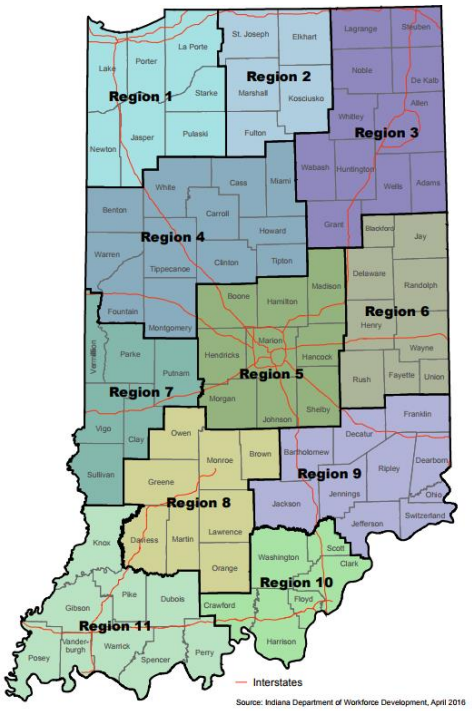
Product	1998 Value	2004 Value	2010 Value	2016 Value	2017 Value	Share of Total (2017)
Wooden Staves And Hoops; Tight Barrelheads Of Soft	$ 11,576	$ 8,381	$ 12,145	$ 15,416	$ 15,881	25.8%
Fiberboard Of A Thickness Exceeding 9 Mm, Edgework	$ -	$ -	$ 747	$ 4,983	$ 8,742	14.2%
Wooden Statuettes And Other Wood Ornaments	$ 2,307	$ 2,450	$2,764	$ 2,836	$ 3,552	5.8%
Toothpicks of bamboo	$ -	$ -	$ -	$ -	$ 3,247	5.3%
Plywood sheets n/o 6mm thick, outer ply of non-coniferous	$ -	$ -	$ -	$ -	$ 2,939	4.8%
Builder's Joinery and carpentry of wood	$ -	$ -	$ -	$ -	$ 2,000	3.3%
Plywood sheets n/o 6mm thick, outer ply of non-coniferous	$ -	$ -	$ -	$ -	$ 1,945	3.2%
Standard Coniferous Wood Moldings, Other Than Of Pine	$ -	$ -	$ 489	$ 433	$ 1,538	2.5%
Doors Of Wood, Other Than French Doors	$ 1,026	$ 805	$ 1,473	$ 884	$ 1,466	2.4%
Wood Marquetry and Inlaid Wood; Wooden Articles Of Furniture	$ 1,565	$ 1,885	$ 969	$ 1,460	$ 1,465	2.4%
Non-coniferous Wood in Chips or Particles	$ 9	$ -	$ 60	$ 763	$ 1,225	2.0%
Standard Wood Moldings of Pine (Pinus Spp.) Continuous	$ -	$ 99	$ 29	$ 859	$ 1,173	1.9%
Tableware and kitchenware of bamboo, other than bamboo	$ -	$ -	$ -	$ -	$ 961	1.6%

Product	1998 Value	2004 Value	2010 Value	2016 Value	2017 Value	Share of Total (2017)
Other non-coniferous wood, continuously shaped along edges and faces	$ -	$ -	$ -	$ -	$ 928	1.5%
Multi-Ply Paper & Paperboard Nesoi, Coat W/Kaolin/	$ -	$ -	$ 185	$ 322	$ 805	1.3%
Wooden Broom and Mop Handles, 1.9 Cm Or More In Diameter	$ 64	$ -	$ 400	$ 539	$ 735	1.2%
Edge-glued lumber of bamboo	$ -	$ -	$ -	$ -	$ 733	1.2%
Paper, Paperboard, Cellulose Wadding and Web	$ -	$ -	$ 315	$ 1,174	$ 708	1.2%
Other non-coniferous wood flooring, whether or not continuously shaped along its edges or faces	$ -	$ -	$ -	$ -	$ 696	1.1%
Wooden Frames for Paintings, Photographs, Mirrors	$ 484	$ 3,691	$ 3,059	$ 965	$ 694	1.1%
All Other Wood Products	$ 9,973	$ 20,321	$ 20,418	$ 20,786	$ 5,408	8.8%

Taxes Paid by Indiana Hardwood Industry

The hardwoods industry pays its fair share of taxes at the local, state and federal levels. This section provides an analysis of taxes and the hardwoods industry's economic contribution within the state using the economic growth regions (EGR) classifications (Figure 21. Economic Growth Regions (EGR) in Indiana.).

Figure 21. Economic Growth Regions (EGR) in Indiana.



As can be expected, regions in the state with a heavier presence of hardwood production, manufacturing and related industries pay a higher amount of taxes. The IMPLAN software is used to show the estimated amount of taxes that are paid by the hardwood industry firms and their respective tax categories. Table 12 highlights the taxes collected at the state and local levels and Table 13 shows the federal taxes paid. The sum of the regions does not add up perfectly with the state or federal tax values due to several regions having suppressed employment data from EMSI and the IMPLAN input-output data are used to estimate the employment, labor income and proprietor income. It is important to note that the data tables reflect the total taxes that came directly from the hardwood industry firms, and does not include additional taxes paid via the indirect and induced effects from the economic contribution model.

The data are separated to show the primary, secondary and tertiary wood products apart from all the hardwood industries used for this study. This is to allow for comparison with a previous

study done by the Indiana Department of Natural Resources (IDNR), as well as to see the values from the "core" industries within the hardwoods industry. Amongst the primary, secondary and tertiary wood products, region 11 paid the most in local and state taxes for 2016 ($21.9 million) followed by Region 2 ($24.8 million) and Region 9 ($19.1 million). This correlates with the heavier presence of hardwood manufacturing in these regions–namely within the secondary wood products category. Inclusion of the suppliers, wholesalers and paper manufacturing distorts this storyline as regions with a smaller presence of the primary, secondary and tertiary wood products, yet a larger footprint in all the other hardwood categories, emerge as top tax-paying regions (EGR 5, EGR 1 and EGR 2). EGR 2 is unique in that the region has a strong manufacturing sector that transcends across the secondary wood products category and all the other hardwoods industries.

Table 12: State and Local Taxes Directly Paid by Indiana Hardwood Industry, 2016.

	State and Local Taxes				
	Employee Compensation	Tax on Production and Imports	Households	Corporations	Total
Primary, Secondary and Tertiary Wood Products					
State	$ 3,079,507	$ 45,723,052	$ 69,087,404	$ 2,879,858	$120,769,821
EGR 1	$ 160,103	$ 1,539,514	$ 3,950,563	$ 86,779	$ 5,736,959
EGR 2	$ 498,072	$ 8,774,833	$ 14,964,052	$ 595,741	$ 24,832,698
EGR3	$ 309,424	$ 4,742,260	$ 9,068,444	$ 436,830	$ 14,556,958
EGR 4	$ 174,017	$ 1,990,844	$ 2,143,739	$ 49,981	$ 4,358,581
EGR 5	$ 324,528	$ 6,528,566	$ 9,379,448	$ 142,900	$ 16,375,442
EGR 6	$ 140,439	$ 2,062,265	$ 3,153,787	$ 31,769	$ 5,388,260
EGR 7	$ 85,198	$ 1,520,952	$ 1,391,516	$ 45,757	$ 3,043,423
EGR 8	$ 291,433	$ 3,672,630	$ 3,220,245	$ 210,510	$ 7,394,818
EGR 9	$ 286,973	$ 12,722,407	$ 5,900,132	$ 254,591	$ 19,164,103
EGR 10	$ 304,404	$ 6,172,140	$ 4,905,251	$ 145,646	$ 11,527,441
EGR 11	$ 520,638	$ 6,745,574	$ 13,615,750	$ 1,054,557	$ 21,936,519
All Hardwoods					
State	$ 5,301,506	$ 298,347,498	$124,232,259	$ 6,281,234	$434,162,497
EGR 1	$ 397,691	$ 75,703,626	$ 11,825,355	$ 1,121,889	$ 89,048,561
EGR 2	$ 780,611	$ 54,441,113	$ 29,997,841	$ 1,335,800	$ 86,555,365
EGR3	$ 565,743	$ 42,660,455	$ 16,490,892	$ 699,826	$ 60,416,916
EGR 4	$ 310,389	$ 13,460,788	$ 3,707,660	$ 158,612	$ 17,637,449
EGR 5	$ 818,714	$ 74,449,840	$ 21,479,937	$ 986,254	$ 97,734,745
EGR 6	$ 399,619	$ 12,121,796	$ 6,412,386	$ 73,387	$ 19,007,188
EGR 7	$ 159,575	$ 5,330,805	$ 3,190,389	$ (21,518)	$ 8,659,251
EGR 8	$ 335,257	$ 9,699,882	$ 3,722,446	$ 305,304	$ 14,062,889
EGR 9	$ 59,580	$ 1,376,400	$ 1,578,328	$ 17,499	$ 3,031,807
EGR 10	$ 406,271	$ 15,910,061	$ 6,458,680	$ 218,785	$ 22,993,797
EGR 11	$ 654,639	$ 28,670,474	$ 17,068,794	$ 1,721,246	$ 48,115,153

Source: IMPLAN using EMSI employment data.

When looking at federal taxes, IMPLAN also includes taxes paid by proprietors in addition to the categories referenced in the local and state tax table. Amongst the primary, secondary and tertiary wood products industry, EGR 2 has the largest federal tax bill, outpacing EGR 11, largely due to higher employee compensation, proprietor income and household federal taxes. When all hardwood industries are included, EGR 2 paid the most in federal taxes followed by EGR 5. These two regions had the highest employee compensation tax bills–which likely means the wages paid to the workers in this region was higher coupled with a sizable workforce–thus driving a higher household federal tax rate as well. In 2016, EGR 7 had corporations with negative profits for the year–thus, no taxes were paid and the table reflects a negative value. Interestingly, in the all hardwoods section of the table, when the primary, secondary and tertiary wood products taxes are removed, several EGRs had negative profits for 2016 and did not pay taxes. This underscores the importance of the primary, secondary and tertiary wood products in generating taxes for Indiana.

Table 13: Federal Taxes Directly Paid by Indiana Hardwood Industry, 2016.

Federal Taxes						
	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations	Total
Primary, Secondary and Tertiary Wood Products						
State	$290,097,430	$ 8,976,328	$ 5,612,483	$158,442,270	$25,667,712	$488,796,223
EGR 1	$ 16,163,533	$ 489,233	$ 221,649	$ 9,050,577	$ 773,449	$ 26,698,441
EGR 2	$ 70,820,083	$ 1,195,436	$ 1,043,758	$ 34,303,223	$ 5,309,744	$112,672,244
EGR3	$ 38,426,400	$ 1,764,099	$ 612,778	$ 20,719,591	$ 3,893,393	$ 65,416,261
EGR 4	$ 9,182,636	$ 318,933	$ 198,585	$ 4,904,988	$ 445,471	$ 15,050,613
EGR 5	$ 42,760,371	$ 4,568,924	$ 771,912	$ 29,004,996	$ 1,531,190	$ 78,637,393
EGR 6	$ 8,824,192	$ 2,046,113	$ 198,744	$ 7,214,832	$ 283,155	$ 18,567,036
EGR 7	$ 6,028,037	$ 325,647	$ 176,061	$ 3,185,344	$ 407,821	$ 10,122,910
EGR 8	$ 14,395,137	$ 433,365	$ 380,076	$ 7,391,180	$ 1,876,246	$ 24,476,004
EGR 9	$ 25,050,427	$ 428,372	$ 1,603,721	$ 13,473,110	$ 2,269,132	$ 42,824,762
EGR 10	$ 23,012,823	$ 479,673	$ 610,862	$ 11,188,703	$ 1,298,118	$ 36,590,179
EGR 11	$ 63,188,756	$ 290,834	$ 922,211	$ 31,131,932	$ 9,399,095	$ 104,932,828
All Hardwoods						
State	$499,415,466	$22,946,271	$ 36,622,011	$284,909,266	$55,983,618	$899,876,632
EGR 1	$ 40,149,691	$ 4,009,565	$ 10,899,320	$ 27,091,399	$ 9,999,217	$ 92,149,192
EGR 2	$110,993,860	$11,198,217	$ 6,475,721	$ 68,766,309	$11,905,767	$209,339,874
EGR3	$ 70,257,858	$ 3,095,501	$ 5,512,434	$ 37,678,410	$ 6,237,435	$122,781,638
EGR 4	$ 16,378,793	$ 395,446	$ 1,342,702	$ 8,483,323	$ 1,413,683	$ 28,013,947
EGR 5	$ 86,572,821	$ 3,696,706	$ 9,264,181	$ 49,492,940	$ 8,790,326	$157,816,974
EGR 6	$ 25,109,310	$ 2,101,679	$ 1,168,201	$ 14,669,439	$ 654,087	$ 43,702,716
EGR 7	$ 11,290,426	$ 1,497,024	$ 617,077	$ 7,303,178	$ (191,787)	$ 20,515,918
EGR 8	$ 16,559,781	$ 525,830	$ 1,003,828	$ 8,543,842	$ 2,721,127	$ 29,354,408
EGR 9	$ 5,200,875	$ 583,805	$ 173,502	$ 3,604,155	$ 155,969	$ 9,718,306
EGR 10	$ 30,713,902	$ 514,681	$ 1,574,632	$ 14,732,020	$ 1,949,996	$ 49,485,231
EGR 11	$ 79,452,283	$ 294,127	$ 3,919,640	$ 39,027,196	$15,341,185	$ 138,034,431

Source: IMPLAN using EMSI employment data.

Economic Contribution Analysis

Indiana has over 70,000 individuals employed in the hardwoods industry, thus the industry contributes in several ways to the state's economy. Using the IMPLAN software, which has an economic input-output matrix that captures the cascading effects of spending a dollar in one industry through its expenditure patterns within the larger economy, one can estimate the labor income, output, value-added and taxes paid by an industry or business. Our analysis focuses on the economic contribution that the existing hardwood industry provides to Indiana, and not on the potential impact of a new proposed hardwood company. As such, we are measuring what already exists and as such, our analysis is less an economic impact analysis and more an economic contribution analysis. See Appendix F for a glossary of terms and additional explanation of the IMPLAN software.

Two different definitions of the hardwoods industries are employed to quantify the economic activity generated by Indiana's hardwoods industries. The following results first examine the "core" of the hardwoods industry, encompassing the primary, secondary and tertiary wood products. Next, the analysis looks at an expanded definition of the hardwoods industry, which includes suppliers, wholesalers and the paper manufacturing sectors that are part of the supply chain. Lastly, the analysis is conducted at the state level and subsequently divided by the state's economic growth regions.

To begin the analysis, IMPLAN industry sectors were matched with the pre-determined list of hardwood NAICS codes. Next, the model's structural accounting matrix (SAM) was adjusted to ensure that each hardwood industry was only producing its primary product (trade flows) and only purchasing the amount allocated in each scenario. Using employment as the known fact for each industry, the IMPLAN input-output matrix populated the industry sales, compensation and proprietor income. At the regional level, several industry sectors are reported as having less than 10 employees (via EMSI), therefore matrices are created to estimate the direct sales based on the IMPLAN generated output in the region. The IMPLAN model populated the employment, compensation and proprietor income columns based on the estimated direct sales.

Primary, Secondary and Tertiary Wood Products

Key findings (state level):

- The primary, secondary and tertiary wood products industry directly contributes $3.0 billion dollars of added value to Indiana. When the indirect and induced effects generated by these three wood products categories are considered, the total value added increases to $5.5 billion.
- For every dollar of added value generated by the primary, secondary and tertiary wood product industries, an additional $0.83 is generated by firms and employees of those firms that support these hardwoods products.
- The primary, secondary and tertiary wood products' employment multiplier is 1.71, meaning for every person directly employed in these hardwood industries, an additional 0.71 persons is hired throughout the state's economy.
- Approximately $366 million was paid in local and state taxes by the primary, secondary and tertiary wood products industries. An additional $825.2 million was paid in federal taxes, totaling $1.1 billion in taxes in 2016 by these three wood products industries.

Table 14 highlights the economic contribution by the "core" wood products within Indiana. It is important to not be alarmed that the total direct employment for Indiana does not align perfectly with the EMSI figures (a difference of just under 2,000 workers). Given that IMPLAN adjusts the employment numbers based on the output generated in the state, approximate numbers are sufficient. Of the 47,000 known workers in these three wood products sectors, an additional 15,000 workers exist as they supply the wood products industries through goods or services (indirect). Based on the employment of workers at the wood products' industries, as well as those employed in the indirectly affected industries, an additional 18,000 jobs are supported through their consumptions and expenditures. Therefore, the employment multiplier is 1.71, meaning for every job in the primary, secondary and tertiary wood products industry, an additional 0.71 jobs are supported by the industry's economic activity.

Table 14: Indiana's Primary, Secondary and Tertiary Wood Products' Economic Contribution, 2016.

	Employment	Labor Income	Employee Compensation	Output	Total Value Added
Direct Effect	47,226	$2,600,941,423	$55,074	$8,746,099,011	$3,012,099,444
Indirect Effect	15,483	$715,931,326	$46,239	$2,250,750,771	$1,124,445,592
Induced Effect	18,280	$765,162,989	$41,858	$2,437,641,840	$1,386,188,953
Total Effect	**80,989**	**$4,082,035,738**	**$50,402**	**$13,434,491,623**	**$5,522,733,989**
Multiplier	1.71	1.57	-	1.54	1.83

In looking at the labor income generated, a rough calculation of labor income divided by employment yields an average employee compensation of $55,074 per worker. Bear in mind the labor income includes wages and salaries, as well as benefits and employer contributions to government social insurance. The indirect and induced effect jobs command a lower average employee compensation in the low $40,000 range, hence a smaller multiplier effect of 1.57.

Beyond the employment footprint, the primary, secondary and tertiary wood products sectors contribute economically via sales of its goods and services. Commonly referred to as the output, we must use caution in only referring to the output without taking into consideration the expenditures incurred to generate the output. Thus, the output is referred to as "headline numbers." It could also be regarded as the "gross" economic activity because of the domino effect of economic transactions. In relation to the total output or total footprint, total value added would be the "net" economic activity as it eliminates transaction duplications. Total value added contributes to the official GDP figures reported at national or state levels, thus is a more accurate appraisal of the contribution the core wood products to state's economy. In this scenario, the primary, secondary and tertiary wood products industry's total value added was $5.5 billion, with 54.5 percent derived directly from the core hardwood industries. Thus, for every dollar of added value generated by these industries, and additional $0.83 of economic activity ripples throughout the state.

The economic activity also extends to the amount of taxes businesses pay at the local, state and federal levels. At the state and local level, these industries paid $366 million in taxes in 2016, most of which were spent on production and imports followed by household taxes. Nearly a third of these taxes came directly from the hardwood industries themselves. At the federal level, $825 million in taxes was paid, mostly within the employee compensation and household taxes (Table 15).

Table 15: Tax Contributions of Indiana's Primary, Secondary and Tertiary Wood Products, 2016.

Tax Type	State and Local	Federal
Employee Compensation	$4,731,015	$445,673,746
Proprietor Income	-	$17,308,083
Tax on Production and Imports	$243,342,541	$29,870,180
Households	$108,624,276	$249,114,538
Corporations	$9,344,033	$83,281,851
Total	**$366,041,865**	**$825,248,398**
Share from Direct	33.0%	59.2%

All Hardwoods

Key findings (state level)

- Expanding the definition of the hardwoods industry to include wholesalers, suppliers and the paper manufacturing sector yields an additional $2.7 billion in direct value added. This number swells to $10.4 billion once the ripple effects of the hardwoods industries' expenditures throughout the state's economy are taken into account.
- For every dollar of added value generated by Indiana's hardwoods industries, an additional $0.80 is generated by firms and employees of those firms that support the production of hardwood products.
- The employment multiplier for the hardwoods industry is 1.85, meaning that every person directly employed in hardwoods triggers an additional 0.85 persons to be hired throughout the state.
- The hardwoods industry paid $8.3 million in local and state taxes and an additional $1.5 billion in federal taxes, totaling $2.3 billion in 2016.

The inclusion of additional industries within the hardwoods supply chain (wholesalers, suppliers and paper manufacturing) naturally increases the amount of economic activity within Indiana. A bump of 23,000 additional workers directly employed in the hardwoods industry has an economic ripple effect throughout the economy. Given that the additional hardwoods industries include more manufacturing jobs, it is not surprising that the average direct employee compensation rises to $66,188 per worker. However, the indirect and induced effect average employee compensation remains in the $40,000 range. The total value added increases by an additional $2.7 billion with the inclusion of more hardwood industries and yields a total economic contribution of $10.3 billion (see Table 16).

Table 16: Indiana's Hardwoods Industry Economic Contribution, 2016.

	Employment	Labor Income	Employee Compensation	Output	Total Value Added
Direct Effect	70,425	$4,661,320,311	$66,188	$16,979,855,108	$5,781,095,460
Indirect Effect	27,129	$1,339,935,929	$49,392	$4,191,924,372	$2,093,603,064
Induced Effect	33,078	$1,384,375,636	$41,852	$4,410,267,687	$2,507,924,568
Total Effect	**130,631**	**$7,385,631,876**	**$56,538**	**$25,582,047,168**	**$10,382,623,092**
Multiplier	1.85	1.58	-	1.51	1.80

The amount of taxes paid at the local, state and federal levels also increased with the inclusion of more industries in the hardwoods definition. Table 17 outlines the amount of taxes paid by category. Similar to the "core" wood products industries, most of the expenditures locally are within the production and imports of goods and services (74 percent). At the federal level, the majority of the taxes were paid via employee compensation followed by households.

Table 17: Tax Contributions of Indiana's Hardwoods Industry, 2016.

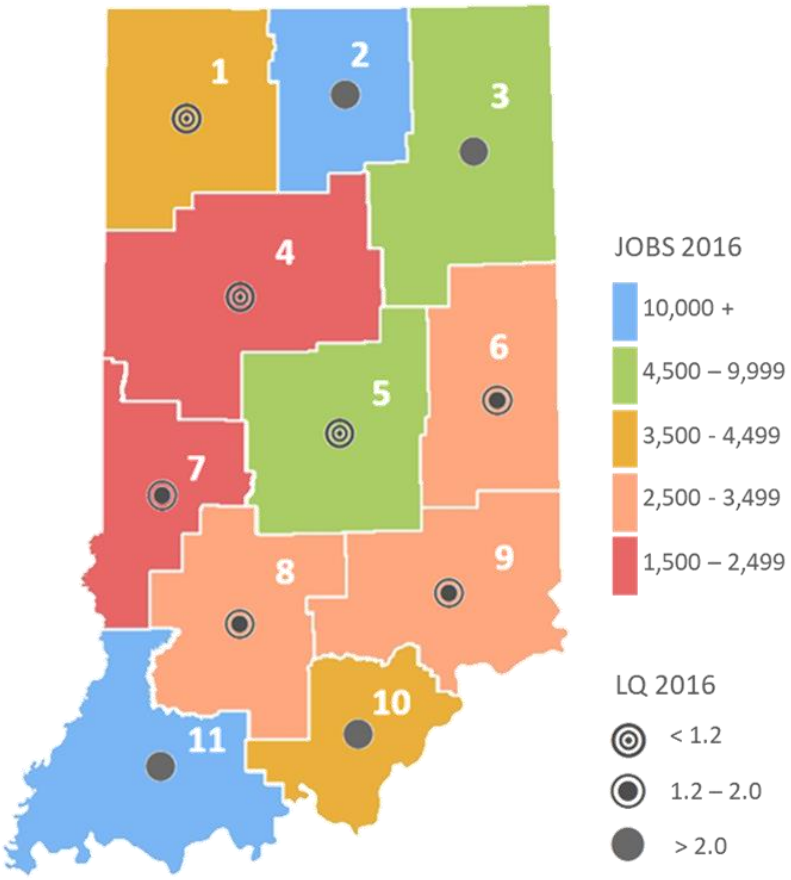
Tax Type	State and Local	Federal
Employee Compensation	$8,351,570	$786,739,286
Proprietor Income	-	$37,883,869
Tax on Production and Imports	$634,936,674	$77,938,173
Households	$196,932,490	$451,637,040
Corporations	$18,281,047	$162,936,005
Total	**$858,501,781**	**$1,517,134,373**
Share from Direct	50.6%	59.3%

Regional findings

- Region 2 (Elkhart, Fulton, Kosciusko, Marshall and St. Joseph counties) ranks consistently first in the number of employees, labor income, output and value-added generation throughout the state's economy – both directly and through all total economic activity. This trend holds true whether one is focusing solely on the primary, secondary and tertiary wood products industries or is examining the expanded definition of hardwoods, which includes wholesalers, suppliers and the paper manufacturing sectors.
- Region 11 (southwest corner) commands the second highest employment, labor income, output and value-added economic activity for the primary, secondary and tertiary wood product industries.
- Inclusion of wholesalers, suppliers and paper manufacturing in the hardwoods industry definition elevates region 5's economic activity significance within the state.

Throughout Indiana, regions differ in the type of hardwoods industries that exist in their borders and the number of jobs those industries provide (Figure 22).

Figure 22. Map of Indiana location quotient by Economic Growth Regions.



In the southern portion of the state, a higher concentration of the primary and secondary wood products industries exists, whereas in the northern part of the state, a different segment of the secondary wood products exists in addition to the tertiary wood products. In the central portion of the state, suppliers and wholesalers congregate, and the paper-manufacturing sector is dispersed statewide. Despite these geographical differences, it still helps to understand the amount of economic activity generated by the hardwoods industry. The following tables break out the regional contributions by employment, labor income, output, value added and taxes.

Table 18: Indiana Hardwoods Industry Employment by EGRs, 2016.

	Direct	Indirect	Induced	Total	Multiplier	Total Rank
Primary, Secondary and Tertiary Wood Products						
State	47,226	15,483	18,280	80,989	1.71	n/a
EGR 1	2,302	805	823	3,931	1.71	7
EGR 2	11,114	2,852	3,416	17,382	1.56	1
EGR3	6,937	1,945	2,274	11,155	1.61	3
EGR 4	1,839	473	436	2,748	1.49	9
EGR 5	5,203	2,547	2,718	10,467	2.01	4
EGR 6	2,265	534	602	3,401	1.50	8
EGR 7	1,204	323	307	1,835	1.52	10
EGR 8	2,818	742	715	4,276	1.52	6
EGR 9	1,201	365	251	1,817	1.51	11
EGR 10	3,866	950	921	5,736	1.48	5
EGR 11	8,831	2,081	2,887	13,800	1.56	2
All Hardwoods						
State	70,425	27,129	33,078	130,631	1.85	n/a
EGR 1	6,607	2,354	2,470	11,431	1.73	5
EGR 2	15,372	4,696	6,555	26,623	1.73	1
EGR3	10,578	3,810	4,279	18,667	1.76	3
EGR 4	2,697	756	757	4,210	1.56	10
EGR 5	10,267	5,228	6,232	21,726	2.12	2
EGR 6	3,812	1,290	1,320	6,422	1.68	7
EGR 7	1,805	699	715	3,218	1.78	11
EGR 8	3,130	829	824	4,783	1.53	9
EGR 9	3,639	1,017	935	5,592	1.54	8
EGR 10	4,703	1,284	1,227	7,214	1.53	6
EGR 11	10,562	2,897	3,709	17,168	1.63	4

Note: The numbers do not add up perfectly to the state total due to some categories not having EMSI employment numbers and IMPLAN estimating the number of employees, labor income, output and value added based on an estimated direct sales value, derived using a matrix calculation from the I-O tables within IMPLAN.

Table 19: Labor Income Economic Contribution of Indiana's Hardwoods Industry, 2016.

	Direct	Indirect	Induced	Total	Multiplier	Avg. Direct Employee Compensation
Primary, Secondary and Tertiary Wood Products						
State	$2,600,941,423	$ 715,931,326	$ 765,162,989	$4,082,035,738	1.57	$ 55,074.35
EGR 1	$ 145,857,981	$ 31,342,638	$ 31,793,889	$ 208,994,508	1.43	$ 63,348.09
EGR 2	$ 603,122,907	$ 139,938,996	$ 137,248,675	$ 880,310,577	1.46	$ 54,266.95
EGR3	$ 348,281,295	$ 76,718,502	$ 85,904,668	$ 510,904,465	1.47	$ 50,209.40
EGR 4	$ 84,634,989	$ 14,752,990	$ 15,182,608	$ 114,570,587	1.35	$ 46,028.27
EGR 5	$ 353,730,980	$ 126,928,943	$ 126,814,967	$ 607,474,891	1.72	$ 67,991.94
EGR 6	$ 117,600,691	$ 19,118,816	$ 22,307,957	$ 159,027,463	1.35	$ 51,918.12
EGR 7	$ 55,879,232	$ 12,044,340	$ 11,102,621	$ 79,026,193	1.41	$ 46,405.75
EGR 8	$ 129,731,632	$ 25,190,237	$ 24,461,650	$ 179,383,519	1.38	$ 46,030.85
EGR 9	$ 57,622,582	$ 12,655,655	$ 8,763,787	$ 79,042,023	1.37	$ 47,976.07
EGR 10	$ 187,567,659	$ 38,672,048	$ 32,571,537	$ 258,811,245	1.38	$ 48,517.82
EGR 11	$ 517,864,517	$ 95,682,896	$ 114,480,960	$ 728,028,372	1.41	$ 58,638.39
All Hardwoods						
State	$4,661,320,311	$1,339,935,929	$1,384,375,636	$7,385,631,876	1.58	$ 66,188.43
EGR 1	$ 430,832,081	$ 100,472,263	$ 95,327,802	$ 626,632,146	1.45	$ 65,205.74
EGR 2	$1,173,371,942	$ 243,470,456	$ 263,313,613	$1,680,156,010	1.43	$ 76,331.24
EGR3	$ 633,617,070	$ 165,629,783	$ 161,660,081	$ 960,906,935	1.52	$ 59,901.31
EGR 4	$ 146,729,165	$ 25,593,503	$ 26,324,685	$ 198,647,353	1.35	$ 54,402.55
EGR 5	$ 817,771,701	$ 284,790,807	$ 290,924,567	$1,393,487,075	1.70	$ 79,653.47
EGR 6	$ 244,332,870	$ 55,885,650	$ 48,932,916	$ 349,151,435	1.43	$ 64,092.87
EGR 7	$ 126,301,073	$ 30,750,397	$ 25,806,148	$ 182,857,618	1.45	$ 69,989.16
EGR 8	$ 149,906,382	$ 28,526,695	$ 28,174,717	$ 206,607,795	1.38	$ 47,891.68
EGR 9	$ 219,324,315	$ 43,182,144	$ 32,718,425	$ 295,224,884	1.35	$ 60,265.12
EGR 10	$ 247,269,704	$ 53,875,782	$ 43,424,220	$ 344,569,706	1.39	$ 52,572.53
EGR 11	$ 649,403,072	$ 138,736,829	$ 147,057,505	$ 935,197,406	1.44	$ 61,485.78

Note: The numbers do not add up perfectly to the state total due to some categories not having EMSI employment numbers and IMPLAN estimating the number of employees, labor income, output and value added based on an estimated direct sales value, derived using a matrix calculation from the I-O tables within IMPLAN.

Table 20: Economic Contribution Output of Indiana's Hardwood Industries by EGR's, 2016.

	Direct	Indirect	Induced	Total	Multiplier
Primary, Secondary and Tertiary Wood Products					
State	$8,746,099,011	$2,250,750,771	$2,437,641,840	$13,434,491,623	1.54
EGR 1	$ 432,329,639	$ 101,261,259	$ 101,771,490	$ 635,362,388	1.47
EGR 2	$1,953,950,959	$ 413,075,304	$ 419,040,540	$ 2,786,066,803	1.43
EGR3	$1,198,782,823	$ 249,792,575	$ 284,873,930	$ 1,733,449,328	1.45
EGR 4	$ 292,430,162	$ 49,421,321	$ 51,967,426	$ 393,818,909	1.35
EGR 5	$1,074,572,191	$ 341,572,957	$ 369,730,295	$ 1,785,875,443	1.66
EGR 6	$ 326,629,037	$ 59,866,357	$ 72,716,690	$ 459,212,083	1.41
EGR 7	$ 232,895,281	$ 40,121,395	$ 36,990,199	$ 310,006,876	1.33
EGR 8	$ 515,660,920	$ 84,726,693	$ 84,575,577	$ 684,963,189	1.33
EGR 9	$ 204,083,809	$ 39,854,057	$ 30,629,912	$ 274,567,778	1.35
EGR 10	$ 720,055,062	$ 119,967,945	$ 111,118,721	$ 951,141,728	1.32
EGR 11	$1,682,946,870	$ 297,734,425	$ 369,746,729	$ 2,350,428,024	1.40
All Hardwoods					
State	$16,979,855,108	$4,191,924,372	$4,410,267,687	$25,582,047,168	1.51
EGR 1	$ 1,497,015,929	$ 312,130,550	$ 305,113,699	$ 2,114,260,177	1.41
EGR 2	$ 3,638,219,201	$ 699,316,988	$ 803,827,153	$ 5,141,363,342	1.41
EGR3	$ 2,587,900,130	$ 536,991,137	$ 536,090,790	$ 3,660,982,057	1.41
EGR 4	$ 556,797,734	$ 84,648,336	$ 90,101,049	$ 731,547,119	1.31
EGR 5	$ 2,663,701,047	$ 768,212,784	$ 848,190,588	$ 4,280,104,419	1.61
EGR 6	$ 962,235,906	$ 183,724,549	$ 159,442,527	$ 1,305,402,982	1.36
EGR 7	$ 567,229,740	$ 110,865,547	$ 85,978,953	$ 764,074,240	1.35
EGR 8	$ 579,757,654	$ 95,868,794	$ 97,413,515	$ 773,039,964	1.33
EGR 9	$ 975,770,665	$ 133,236,921	$ 114,372,133	$ 1,223,379,719	1.25
EGR 10	$ 1,013,515,564	$ 168,358,284	$ 148,145,499	$ 1,330,019,347	1.31
EGR 11	$ 2,344,626,489	$ 437,968,284	$ 474,961,376	$ 3,257,556,150	1.39

Note: The numbers do not add up perfectly to the state total due to some categories not having EMSI employment numbers and IMPLAN estimating the number of employees, labor income, output and value added based on an estimated direct sales value, derived using a matrix calculation from the I-O tables within IMPLAN.

Table 21: Value Added Economic Contribution of Indiana's Hardwoods Industries, 2016.

	Direct	Indirect	Induced	Total	Multiplier
Primary, Secondary and Tertiary Wood Products					
State	$3,012,099,444	$1,124,445,592	$1,386,188,953	$ 5,522,733,989	1.83
EGR 1	$ 158,461,734	$ 53,111,428	$ 59,118,199	$ 270,691,360	1.71
EGR 2	$ 687,376,072	$ 212,336,138	$ 244,208,513	$ 1,143,920,724	1.66
EGR3	$ 408,215,809	$ 125,579,049	$ 160,325,416	$ 694,120,274	1.70
EGR 4	$ 93,069,241	$ 25,583,475	$ 29,861,770	$ 148,514,485	1.60
EGR 5	$ 378,926,504	$ 191,736,454	$ 217,591,818	$ 788,254,775	2.08
EGR 6	$ 123,831,107	$ 31,105,916	$ 41,828,715	$ 196,765,738	1.59
EGR 7	$ 63,293,278	$ 19,235,655	$ 20,931,062	$ 103,459,995	1.63
EGR 8	$ 160,086,460	$ 41,018,743	$ 47,890,737	$ 248,995,940	1.56
EGR 9	$ 61,358,935	$ 21,098,377	$ 18,041,228	$ 100,498,540	1.64
EGR 10	$ 212,548,314	$ 60,452,791	$ 65,089,099	$ 338,090,204	1.59
EGR 11	$ 657,293,387	$ 148,871,376	$ 208,361,318	$ 1,014,526,082	1.54
All Hardwoods					
State	$5,781,095,460	$2,093,603,064	$2,507,924,568	$10,382,623,092	1.80
EGR 1	$ 657,608,936	$ 167,568,516	$ 177,239,266	$ 1,002,416,719	1.52
EGR 2	$1,401,189,617	$ 364,876,469	$ 468,445,248	$ 2,234,511,334	1.59
EGR3	$ 769,229,367	$ 264,547,645	$ 301,709,324	$ 1,335,486,335	1.74
EGR 4	$ 181,350,354	$ 43,536,176	$ 51,775,567	$ 276,662,097	1.53
EGR 5	$1,024,712,793	$ 426,161,500	$ 499,198,782	$ 1,950,073,076	1.90
EGR 6	$ 266,792,179	$ 89,021,411	$ 91,725,801	$ 447,539,390	1.68
EGR 7	$ 129,560,387	$ 49,691,183	$ 48,649,567	$ 227,901,137	1.76
EGR 8	$ 198,756,174	$ 46,921,934	$ 55,160,030	$ 300,838,138	1.51
EGR 9	$ 265,460,245	$ 66,818,115	$ 67,368,302	$ 399,646,662	1.51
EGR 10	$ 292,090,391	$ 84,608,863	$ 86,778,666	$ 463,477,920	1.59
EGR 11	$ 897,053,386	$ 216,261,210	$ 267,652,316	$ 1,380,966,911	1.54

Note: The numbers do not add up perfectly to the state total due to some categories not having EMSI employment numbers and IMPLAN estimating the number of employees, labor income, output and value added based on an estimated direct sales value, derived using a matrix calculation from the I-O tables within IMPLAN.

Table 22: Indiana Hardwoods Industry's State and Local Taxes Contributions, 2016.

State and Local Taxes						
	Employee Compensation	Tax on Production and Imports	Households	Corporations	Total	% Direct
Primary, Secondary and Tertiary Wood Products						
State	$4,731,015	$243,342,541	$108,624,276	$9,344,033	$366,041,865	33.0%
EGR 1	$223,895	$11,856,709	$5,672,064	$385,236	$18,137,904	31.6%
EGR 2	$696,720	$44,408,467	$21,983,558	$1,712,115	$68,800,860	36.1%
EGR3	$450,796	$30,003,505	$13,310,539	$1,195,213	$44,960,053	32.4%
EGR 4	$232,796	$7,685,947	$2,904,811	$204,021	$11,027,575	39.5%
EGR 5	$567,857	$37,874,884	$16,076,287	$1,106,027	$55,625,055	29.4%
EGR 6	$212,554	$9,030,646	$4,235,347	$222,798	$13,701,345	39.3%
EGR 7	$120,565	$5,246,966	$1,967,824	$148,702	$7,484,057	40.7%
EGR 8	$396,820	$12,070,324	$4,458,540	$450,544	$17,376,228	42.6%
EGR 9	$84,192	$5,368,991	$2,160,629	$123,341	$7,737,153	39.2%
EGR 10	$407,691	$17,628,756	$6,787,969	$479,457	$25,303,873	45.6%
EGR 11	$710,112	$35,337,413	$19,208,157	$1,971,509	$57,227,191	38.3%
All Hardwoods						
State	$8,351,570	$634,936,674	$196,932,490	$18,281,047	$858,501,781	50.6%
EGR 1	$600,803	$101,481,385	$17,153,135	$2,078,463	$121,313,786	73.4%
EGR 2	$1,146,066	$116,487,935	$42,821,002	$3,393,597	$163,848,600	52.8%
EGR3	$849,820	$88,515,005	$25,029,496	$2,197,990	$116,592,311	51.8%
EGR 4	$413,011	$22,114,554	$5,026,916	$429,745	$27,984,226	63.0%
EGR 5	$1,377,751	$136,666,021	$36,653,576	$3,224,743	$177,922,091	54.9%
EGR 6	$584,586	$27,281,498	$9,145,717	$548,062	$37,559,863	50.6%
EGR 7	$246,381	$13,976,168	$4,597,984	$235,701	$19,056,234	45.4%
EGR 8	$455,803	$19,044,521	$5,136,367	$585,980	$25,222,671	55.8%
EGR 9	$376,978	$24,266,275	$7,958,558	$617,047	$33,218,858	57.7%
EGR 10	$547,635	$30,855,768	$9,029,499	$680,291	$41,113,193	55.9%
EGR 11	$912,335	$65,463,053	$24,673,599	$2,972,174	$94,021,161	51.2%

Note: The numbers do not add up perfectly to the state total due to some categories not having EMSI employment numbers and IMPLAN estimating the number of employees, labor income, output and value added based on an estimated direct sales value, derived using a matrix calculation from the I-O tables within IMPLAN.

Table 23: Indiana Hardwoods Industry's Federal Tax Contributions, 2016.

Federal Taxes							
	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations	Total	% Direct
Primary, Secondary and Tertiary Wood Products							
State	$445,673,746	$17,308,083	$29,870,180	$249,114,538	$83,281,851	$825,248,398	59.2%
EGR 1	$22,603,823	$888,872	$1,707,053	$12,994,464	$3,433,544	$41,627,756	64.1%
EGR 2	$99,065,458	$3,170,027	$5,282,347	$50,394,565	$15,259,802	$173,172,199	65.1%
EGR3	$105,536,577	$5,023,897	$11,437,598	$57,187,421	$19,590,331	$198,775,824	61.8%
EGR 4	$12,284,324	$481,898	$766,667	$6,646,362	$1,818,405	$21,997,656	68.4%
EGR 5	$60,046,590	$4,196,881	$4,712,969	$37,042,134	$9,857,842	$115,856,416	67.9%
EGR 6	$13,355,429	$2,315,553	$870,301	$9,689,088	$1,985,759	$28,216,130	65.8%
EGR 7	$8,530,335	$458,815	$607,373	$4,504,581	$1,325,354	$15,426,458	65.6%
EGR 8	$19,600,640	$702,243	$1,249,142	$10,233,341	$4,015,623	$35,800,989	68.4%
EGR 9	$7,349,300	$727,372	$676,787	$4,933,854	$1,099,315	$14,786,628	65.7%
EGR 10	$30,821,244	$953,552	$1,744,733	$15,483,117	$4,273,319	$53,275,965	68.7%
EGR 11	$86,184,918	$1,284,271	$4,831,100	$43,918,772	$17,571,740	$153,790,801	68.2%
All Hardwoods							
State	$786,739,286	$37,883,869	$77,938,173	$451,637,040	$162,936,005	$1,517,134,373	59.3%
EGR 1	$60,655,334	$5,068,967	$14,610,637	$39,297,124	$18,525,005	$138,157,067	66.7%
EGR 2	$162,957,200	$14,701,668	$13,856,134	$98,161,809	$30,246,579	$319,923,390	65.4%
EGR3	$105,536,577	$5,023,897	$11,437,598	$57,187,421	$19,590,331	$198,775,824	61.8%
EGR 4	$21,794,039	$665,768	$2,205,908	$11,501,852	$3,830,248	$39,997,815	70.0%
EGR 5	$145,686,767	$6,923,238	$17,006,065	$84,455,242	$28,741,611	$282,812,923	55.8%
EGR 6	$36,731,350	$2,733,604	$2,629,170	$20,922,407	$4,884,784	$67,901,315	64.4%
EGR 7	$17,432,207	$1,813,358	$1,617,838	$10,525,328	$2,100,763	$33,489,494	61.3%
EGR 8	$22,514,040	$829,600	$1,970,892	$11,789,106	$5,222,741	$42,326,379	69.4%
EGR 9	$32,907,099	$853,938	$3,058,882	$18,173,582	$5,499,639	$60,493,140	70.8%
EGR 10	$41,400,998	$1,154,729	$3,053,821	$20,595,968	$6,063,323	$72,268,839	68.5%
EGR 11	$110,728,330	$1,643,616	$8,949,681	$56,415,309	$26,490,503	$204,227,439	67.6%

Note: The numbers do not add up perfectly to the state total due to some categories not having EMSI employment numbers and IMPLAN estimating the number of employees, labor income, output and value added based on an estimated direct sales value, derived using a matrix calculation from the I-O tables within IMPLAN.

Challenges to Growth

The hardwood industry faces a number of challenges to growth in Indiana. This section summarizes these challenges across six broad categories:

- Transportation
- Technology
- Regulatory Environment
- Workforce
- Consumer Demand
- Additional Challenges

The last category (Additional Challenges) is a list of other challenges that were brought up by members of the hardwood industry during phone or in-person interviews.

Transportation

Transportation systems play a vital role in the economic viability of the Indiana hardwood industry sector. In general, our assessment found transportation connectivity and asset performance in Indiana to be quite satisfactory, with some notable areas for improvement. Following are key points from the full transportation report *Hardwood Logistics Strategy*, which is found in Appendix G (under separate cover).

- Known as the "Crossroads of the Nation," Indiana has 14 Interstates and 235 state roads, with over 11,000 miles of combined highways.
- The Indiana Department of Transportation lists 8% of Indiana's 19,245 bridges as structurally deficient, which was more than Ohio (6.9%) but less than Kentucky (8.1%), Illinois (8.6%) or Michigan (11%). Many of these structurally deficient bridges occur in southern Indiana, where much of the hardwood industry and resources occur. Trucks bearing heavy hardwood loads may need to be re-routed to avoid these bridges, increasing transit time and fuel costs.
- Indiana spent the least amount on road construction projects as compared to Illinois, Ohio, Kentucky, and Michigan (2012 data).
- Indiana has two roadway bottlenecks that made it into the 2018 list of the nation's top 100 bottlenecks—both in Indianapolis [I-65 at I-70 (south)(40th) and I-65 at I-70 (north) (33rd)]. Since I-65 is a primary north-south artery, and since most of Indiana's hardwood industry is located in the northern and southern ends of the state, improvement to these bottlenecks would help transportation of hardwood material and products.
- There is need for improved connectivity between local roads and main roads in southern counties. The proposed Mid-States Corridor in Dubois County should help, although estimated completion date isn't until 2028 (and some industry representatives were concerned that new roads that bypass small communities might have unintended negative consequences to other sectors of those local economies).
- Indiana has 44 railroad carriers, but currently, railroad connectivity is not dense enough for the hardwood industry. Most hardwoods are transported by truck. There is a need to connect the

hardwood hubs in southern Indiana counties (e.g., Dubois) with the main railway terminals in Chicago.

- The railroad industry operates intermodal terminals that service Indiana in Avon, Indianapolis, Louisville (KY), and Cincinnati (OH). There is need for an additional intermodal terminal between Indianapolis and the Ohio River to assist with consolidation of hardwood materials and products.
- Indiana has access to four ports (Mount Vernon, Burns Harbor, Jeffersonville, and Greater Cincinnati), but these currently do not handle much hardwood freight. They are primarily used for corn and other agricultural products. This could change if foreign demand for raw logs continues to rise.
- Indiana recently (2017) increased weight limits on most Indiana roads and highways to 97,000 pounds for trucks that haul "from the point of harvest to the point of first destination bark logs, sawdust, wood chips, or agricultural commodities."
- Fuel prices are an important component of transportation costs. Indiana maintains a low tax rate on diesel fuel—lower than the national average and all adjacent states except Michigan. Overall average diesel fuel costs are lower in Indiana than all neighboring states except Kentucky.
- Availability of trucks and drivers is a huge issue across the hardwood industry. Long hours, competition with other industries, low unemployment rate and age restrictions have greatly reduced the number of trucks and drivers available to transport hardwood materials and products. Indiana should consider lowering the minimum age required for long-haul licensing from 21 to 18. This would likely increase the number of drivers available (the long-haul lifestyle is likely to be more appealing to younger drivers who have not yet established families, etc.).

Technology

There seems to be a love-hate relationship with technology in Indiana's hardwood industry. Many companies are small, family-owned, and often somewhat averse to new business practices—especially practices, technology or equipment that require substantial investment to implement.

- High start-up cost is biggest barrier to more automation.
- There is growing interest in implementing automation and robotic technology, especially to solve labor problems in difficult, more dangerous, entry-level positions. Use of vacuum technology for lifting/moving material could reduce or eliminate some of the complaints that laborers have about the physically demanding nature of the hardwood industry.
- Small, family-owned business are tight-knit, embedded in local communities, and reluctant to introduce automation that displaces workers. On the other hand, most have continual trouble finding suitable workforce. This creates a "Catch-22." They bemoan the loss of jobs to foreign companies, but automation is their hedge against labor uncertainty.
- Some companies cannot automate—the work they do (or portions of it) requires human touch.
- Management of many local companies are still holding to the "old ways" – resisting standardization and inventory minimization. However, it is changing.

Regulatory Environment

Many sectors of modern industry hold up "governmental regulations" as being major burdens to business, but this does not seem to be the case for the Indiana hardwoods industry. We found no major concerns. If anything, industry representatives were happy to have the protections, so long as the playing field is level among the competition. Although minor, a few concerns were raised.

- Truck weight restrictions need adjustment. It is difficult to estimate a truck's weight when it picks up logs on a remote site. Need more than the current 15% leeway for trucks that are over the weight limit.
- The state should consider allowing larger/heavier loads, especially on interstates. Perhaps even on county roads, but not during the spring because of the freeze/thaw cycle.
- Enforcement of air quality regulations can be sporadic and not applied evenly across the state. Paperwork requirement is significant—adds cost to doing business. Regulation enforcers can be inflexible: some are more concerned with the letter of the law than its spirit.
- There was an isolated concern that a new EPA regulation would not permit companies to burn wood for heat/energy due to new dioxin study.
- Tariffs are having major implications on all manner of hardwood products. As of this writing, this issue was still in flux and had not reached a new equilibrium.

There were no real concerns about taxes. Several are getting local abatements. Several mentioned that Indiana did away with the state inventory tax, which allows them to stockpile materials when price is low.

Workforce

The ability to find, maintain and replace qualified workers is the biggest challenge reported by most Indiana hardwood companies. Many companies are reaching out 50-75 miles to find workers, and turnover can be nearly 30% per year. To make this issue even more compelling: A number of hardwood companies said they would expand production if they had a more reliable source of qualified labor. Specific issues related to the workforce:

- Huge difficulty finding entry-level manual labor, despite good wages and benefits
- Shortage of qualified engineers—architectural and mechanical
- Fewer people want to work in wood processing factories and mills. Current workers are retiring with no back-filling
- Hard to compete for entry-level workers with other industries that pay more and/or that have "easier" work
- Unemployment rate is low (competing for labor with RV industry, warehouses, shipping centers)
- Younger generation "doesn't want to work that hard"
- High school graduates are pushed to go to college, even if that might not be a good fit
- A number of firms mentioned it can be difficult to find workers who can pass a drug screen

A few recommendations from industry members for addressing the workforce problems:

- Increased state funding for industrial arts programs. Stop "automatically" encouraging all high school students to go to college. When student loans are factored in, some people can make more money by going straight into the trades.
- Provide incentives for immigrant workers. Might need language assistance programs.

Consumer Demand

Understanding the needs and vision of new consumers is essential for product development, and the demographic characteristics of consumers are changing rapidly and shouldn't be ignored. Although the Baby Boom Generation continues to have major influence in the marketplace, that trend is changing. Globally Millennials have already outnumbered Boomers for decades, and in the U.S. Millennials are expected to overtake Boomers as the largest population in the U.S. in 2019 (Figure 23).

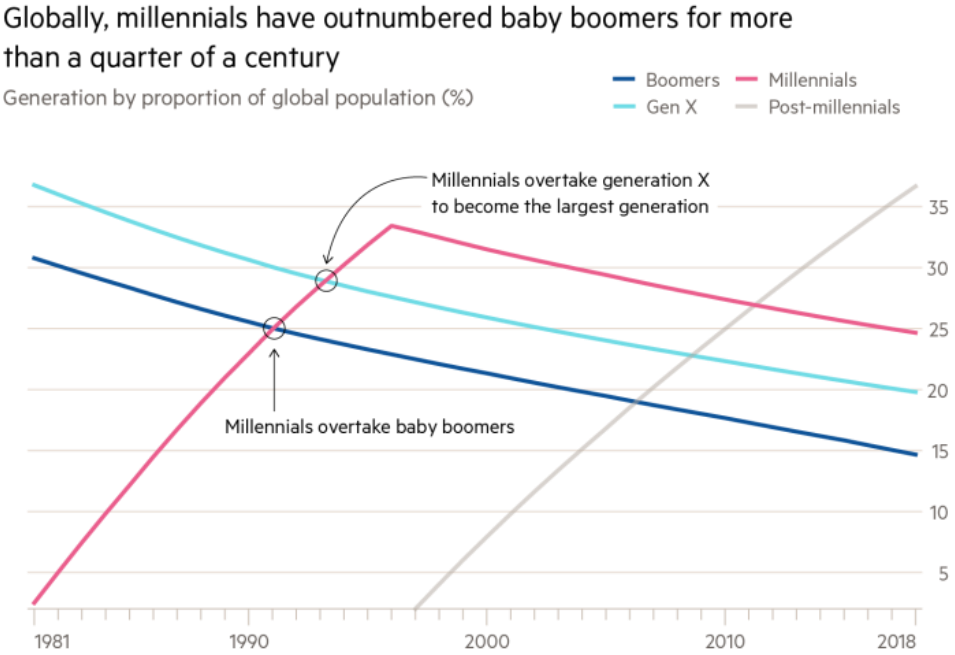


Figure 23. Global population trends and rise of Millennials. Financial Times, June 2018.

As this younger population swells, consumer preferences among Millennials will continue to exert greater and greater influence on buying patterns. What do we know about them?

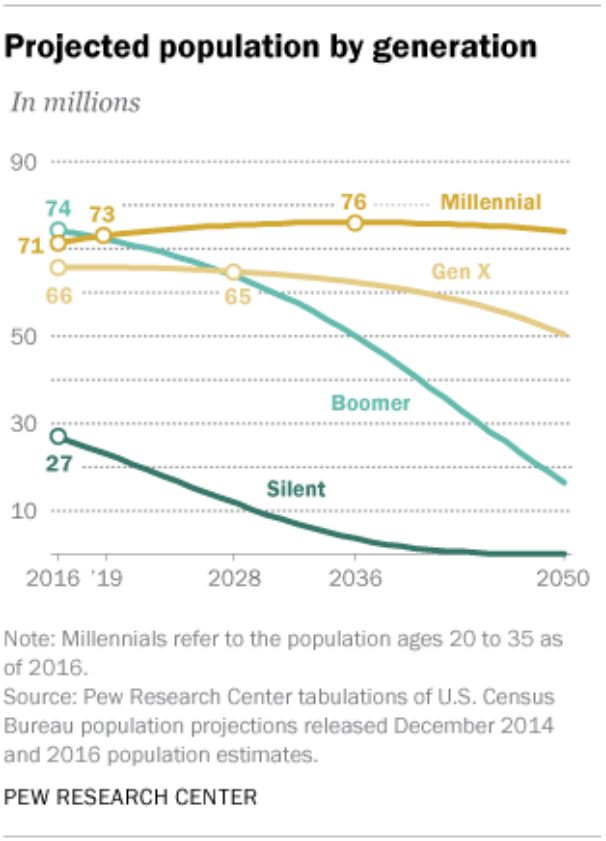


Figure 24: Generational projected population trends. (Pew Research and U.S. Census data)

According to the U.S. Chamber Foundation, Millennials are the most well-educated generation in American history, and as a digitally-native generation they are very technology savvy, yet they hold different values than previous generations. They often live in multigenerational households and create multifunctional spaces in their homes. Pets are seen as family members. When making purchases, they scan products, rely on product references online and from friends or peers than from "experts", engage and connect before making decisions. They are skeptical of large corporations and instead seek smaller or local brands, natural and organic products. Boston Consulting Group's study of The Millennium Consumer noted that "Companies will have to understand, accept, and embrace the characteristics of and values of this generation if they are to create and market relevant products and services that resonate with them and meet their needs."

As noted in a Brookings study on real estate trends, these changes in demographics have potentially huge impacts and implications on the housing market. As baby boomers downsize and move into new homes, Millennials will be setting out on their careers and will potentially provide more first-time homebuyers in the market than ever before (almost 77% intend to live in urban areas) – and the converging generations in the housing market are looking for smaller homes, in walkable, accessible communities, and built with green environmentally-friendly materials and smart growth approaches.

Kitchen design is changing under the Millennial influence

National and international trends show that today's kitchen is more than a place where we cook; it is where life happens: family and friends gather, breakfast and other meals are eaten, schedules are coordinated; it's a space for the family office, a hub for electronics (TV, computers); working space for laundry/folding, waste and recycling, home for pets, and more. In new kitchen designs consumers seek open floorplans, increased light, simplicity, clean lines, uncluttered space, natural materials, functionality, and customization.

In Indiana, consumers still appreciate traditional kitchens design with solid wood kitchen cabinets more than average; however, painted kitchen cabinet doors in pastel or dark colors are on the rise. The primary reason is that wooden floors (not always real wood) are very popular, and interior designers and architects are looking for contrasting colors and tones to complement the flooring. In addition, the "IKEA look" (smooth, painted wood or artificial substrate) is the popular current style, and Millennials are less likely to invest in "heirloom" furniture like their parents and grandparents did.

Office design is changing under the Millennial influence

Just as they prefer open floor plan designs in their homes, Millennials are changing office space function in similar ways. They tend not to seek or prefer large, private offices. They would rather work in open space. Face-to-face interaction is important. They are much more likely to want smooth, painted wood office furniture—or even steel, composite or plastic furniture. They like furniture with a useful, playful vibe. They want comfort (with an emphasis on softness and upholstery) and the feel of home, because they are working long hours. Integration with electronics is critical. Another trend Millennials are pushing is the home office, where they keep the clean, open look just as they have in the rest of their homes.

Consumer values when purchasing furniture

What matter most to Millennials when they purchase furniture?

- Price – special offers, no additional fees, quality
- Selection – styles, color choices, quality construction
- Reputation – timely delivery, customer service
- Shipping Options – speed, haul away, white glove service
- Delivery Options – delivery radius, curbside delivery
- Flexible design – customizable, modular, custom builds
- Product Sustainability—environmental stewardship is important for some—focusing on material selection and sustainable manufacturing.

Additional Challenges

- Global competition (cheap labor, especially in Asia) and fashion/style choices are probably the biggest challenges to the Indiana hardwood industry. Currently, the quality of U.S.-made wood products is keeping the industry healthy, but overseas competition is catching up fast.
- Given the ample supply of high-quality forest resources in Indiana (see *Forest Resources of Indiana* section), it is hard to imagine that supply of wood could be a challenge to growth, but in some sectors that is the case. There are companies in Indiana that would increase production/sales right now if they could access more timber at fair market prices (assuming they could get workers—see *Workforce* section).
- Some industry members are concerned about public perceptions of the industry. Some end users think of industry members as irresponsible stewards or as interfering with nature because they cut trees. This sentiment prevents harvest on state and national forests.
- There isn't much incentive for landowners to grow or harvest high-quality trees (e.g., white oak and black walnut). Need ways to encourage more sustainable harvest on private lands.
- The area and wood volume of Indiana timberland has been increasing, but future changes in land use and ownership patterns could reduce the amount of timberland available for wood production.
- Loss of markets for sawdust, bark and chips. Paper companies are closing, and about the only options are mulch, animal bedding and localized use for energy/heat. This is a large and growing concern. Must find new ways to monetize these byproducts.

Target Companies and Locations

An objective of this project was to identify market opportunities and companies that were ripe for expansion in and/or into Indiana. The project team's assessment did not detect any obvious areas for such expansion. The hardwood industry appears to be reasonably healthy at the present time, but also seems reluctant to expand/grow. The memory of the significant downturn the industry experienced in the early 2000s is still fresh in the minds of many companies, and the difficulty in finding labor and/or resources is stifling the growth mentality.

In interviews across the industry, we found no companies that were considering expansion beyond their current locations (or only through acquisition, not by new construction). Several would expand on their current sites (open new lines, run more shifts, etc.) if they had reliable access to labor and/or raw materials. Few seemed interested in further vertical integration. Similarly, none could identify any other companies (domestic or foreign) that might be interested in expanding operations into Indiana.

When pressed for ideas about *types* of companies that might do well in Indiana, a few ideas were offered:

- Wood-Mizer (portable saw mills)
- Cross-laminated timber (CLT). There are no hardwood CLT plants in the US right now (there are several that use softwood). This would provide opportunities for using low-grade lumber
- A pellet plant for the biofuels industry would create a new market for scrap
- A plywood mill would be a great addition to the Indiana industry. It would be close to needed resources and could feed the cabinet and RV industries' need for plywood
- Look for other opportunities to do manufacturing with poplar, beech and cottonwood, since Indiana produces a lot of it
- Invest in thermally modified hardwoods (A natural, non-toxic process that heats wood in the absence of oxygen, causing changes to the chemical structures of cell wall components to increase its durability and resistance to moisture changes.)

When asked about locations that would be optimal for expansion, industry representatives talked mostly in generalities, since none had plans for expansion in the near future.

- Put facilities close to the forests and/or close to roads (south of Indianapolis, especially west of I-65 was area mentioned most frequently)
- The area between Goshen and South Bend also mentioned—good supply of Amish labor, but high demand from RV industry right now
- The Louisville-Jasper-New Albany area has workers and manufacturers at multiple levels (i.e., from industrial to mom-and-pop shops)

Key Findings

Although this project did not identify a "smoking gun" or obvious gaps in specific sectors of Indiana's hardwood industry that will yield windfalls for the industry or the state, there were a number of opportunities for strengthening the industry and leading to long-term growth. These are not listed in priority order and are numbered for ease of reference only.

1. Availability of qualified workforce appears to be the biggest challenge to growth. Look for ways to attract new workers to Indiana, encourage/incentivize existing workers (especially young people) to try the hardwood industry, and encourage longevity.
    - Provide information to high school guidance offices about the benefits of entering the hardwood-related trades right out of high school.
    - The recruitment of new loggers to replace those retiring was brought forward as an impending need for the industry and a potential bottleneck for production.
    - Consider adding a master logger program (like KY and MO) to improve the skill level of the workforce and replace retiring loggers.

2. Transportation is probably the second largest challenge to growth. Look for ways to reduce barriers and increase opportunities.
    - Consider lowering the age requirement for CDL license to 18 to encourage more young people to enter that workforce. Provide additional/specialized training for younger drivers.
    - Look for ways to incentivize truck drivers to stay in the profession.
    - Look for ways to incentivize truck drivers to select hardwood loads over other options.
    - Improve the highway bottlenecks around Indianapolis.
    - Build an inter-modal terminal south of Indianapolis.
    - Make an integrated database of structurally deficient bridges and bridge clearances easily available to the industry transportation sector.

3. Availability of wood is another challenge to growth. With the abundance of high-quality hardwood lumber grown in Indiana, there is no reason why availability should be a problem.
    - Seek more direct engagement with private forest landowners in Indiana, informing them about healthy forest management and the benefits/importance of periodic harvest.
    - Develop a communication strategy for identifying and contacting private landowners, encouraging them to work with professional foresters to grow healthy forests and harvest at appropriate times.
    - Develop communications products, as needed, to support the private landowner communication strategy.
    - Fill all open district forester positions at Indiana DNR Division of Forestry. Encourage DNR to add positions to further and more effectively engage private landowners.
    - Develop a communication strategy to effectively communicate the benefits of healthy forest management to Indiana citizens, encouraging more active management on public and private lands. The strategy will need specific goals, objectives, target audiences and key messages. It should be based on social science research (surveys, focus groups, etc.) to identify messages that are shown to be effective with key target audiences.

- As part of the communication strategy, consider providing information to educators (e.g., through the Natural Resources Teacher Institute, Project Learning Tree, etc.) to inform young people about the importance of forest health and management.
- Implement communication strategies and evaluate effectiveness against stated objectives.

4. Focus on areas with competitive advantages (positive economic metrics)

   Primary sectors:
   - Based on economic metrics of competitive effects (positive value from 2001 to 2016) and location quotient (LQ greater than 1.2 in 2016), Engineered Wood Member Manufacturing, Truss Manufacturing, Cut Stock-Resawing Lumber and Planing are the three appropriate primary sectors. Despite suffering employment losses from 2001 to 2016, Truss Manufacturing stands out because more than 1,000 jobs and 30 establishments are associated with this sector in Indiana. The other two sectors have a lower number of establishments, but strong economic metrics.
   - Although Hardwood Veneer and Plywood Manufacturing has negative value in its competitive effect from 2001 to 2016, it should be given serious consideration as a focus area, because it has nearly 1,500 jobs and 25 establishments. Competitive effect is a dynamic indicator and can change dependent on the period.

   Secondary sectors:
   - There are several industry sectors with positive economic metrics. A few worthy of note, based on the high number of jobs and establishments, include Wood Container and Pallet Manufacturing, Wood Kitchen Cabinet and Countertop Manufacturing, Upholstered Household Furniture Manufacturing, Nonupholstered Wood Household Furniture Manufacturing, Wood Office Furniture Manufacturing, and Showcase-Partition-Shelving and Locker Manufacturing. These sectors have thousands of jobs and many establishments and form the core of the secondary group of industries.

   Tertiary sectors:
   - None of the tertiary sectors meet both of the criteria we employ as economic metrics over the 2001 to 2016 period. A few major ones that can be considered because of large number of jobs and high LQ values include Mobile/Manufactured Home Manufacturing and Burial Casket Manufacturing.

   Suppliers:
   - Sawmill-Woodworking and Paper Machinery Manufacturing is the only sector that meets the economic criteria.

   Wholesalers:
   - None of the sectors meet the criteria

   Paper Manufacturing:
   - Based on economic metrics (competitive effect and LQ) and number of jobs and establishments, two sectors that stand out are Corrugated and Solid Fiber Box Manufacturing and Paper Bag and Coated and Treated Paper Manufacturing.

5. Reduce Leakages
   Based on leakage analysis of primary, secondary and tertiary sectors, it is evident that Sawmills have experienced major leakages (a portion of Indiana's demands are being met by sawmills located outside the state). The leakage for 2016 in Sawmills was more than $230 Million. Logging also has leakages of over $80 Million. Efforts should be made to reach out to sawmills and logging companies to inform them about the unmet demand and how they can expand their existing capacity. There should be an effort to identify businesses within Primary, Secondary, and Tertiary Hardwood sectors that are using sawmills and logging as inputs in their production and connect them with logging and sawmill establishments. At the same time efforts should be made to assess challenges faced by logging and sawmills. Even 5-10% of reduction in leakages would be a significant economic contribution to the state.

6. Facilitate firm growth and development
   - Focus on maintaining and expanding Indiana's primary and secondary manufacturing sectors—that is where Indiana has the greatest competitive advantage.
   - Develop a "Summary" document that presents specific, targeted results from this report in a popular, graphical fashion—for use with business leaders, legislators, chambers of commerce and others who are interested in facilitating growth in the hardwood sector.
   - Use the dynamic mapping database of hardwood industries to contact appropriate firms to ask what they need to foster growth. Facilitate communication among and between hardwood industries in the database to ensure they know all the options for buying/selling within Indiana.
   - Update the dynamic mapping database every year to keep the data current and assess any changes in distribution.
   - Develop informational materials encouraging secondary manufacturers to buy their raw materials from Indiana sources (and provide contact info or database).
   - Consider joining forces with Indiana's Small Business Development Center system to determine how best to work with the myriad self-owned hardwood businesses to build long-term business plans, options for securing capital (if needed), and marketing strategies.
   - Exporting products is not easy or intuitive. Assist firms that have exportable products with setting up the needed processes.
   - Investigate potential uses for sawdust, bark and chips. Make connections between and among Indiana firms in the database (e.g., are there paper/cardboard manufacturers that need raw material?).
   - Investigate Hardwood Cross-Laminated Timber (HCLT) opportunities. CLT has many advantages over other products in construction (negative carbon footprint, healthier living space, green material, etc.), but its use is only beginning to catch on. And construction standards and practices are for softwood CLT. Hardwood CLT may have other advantages over softwood, but HCLT is in its infancy. Need to push product testing, new building codes, creating markets and increasing manufacturing. If successful, HCLT could be a long-term solution to the hardwood byproduct issue.
   - Develop business enticement packages (like Virginia, South Carolina, and Texas offer) with tax breaks and even low-rent or free facilities for firms that expand into Indiana.
   - Make sales calls to attract other businesses to the state (coordinate with IHLA board members, using their contacts as appropriate, as well as contacts from the dynamic mapping database).

- Investing in new technologies for power (solar and wind) to run facilities. There is the potential for burning biomass to help generate power.
- Look for opportunities in nanofibers and other newly develop products and technologies.

7. Promote use of wood to consumers
   - Consider a promotion campaign to celebrate the use of wood products to consumers. Wood is the ultimate "green" sustainable material—it is renewable, recyclable, biodegradable, locally produced/processed (often by passionate people in family-owned companies), and widely available—features highly sought by many consumers. Any such promotion campaign should be developed with specific goals, objectives, and target audiences, and should be closely integrated with communication strategies recommended in "Availability of Wood" section above.
   - Communicate to consumers that a healthy wood products industry is a major factor in keeping forested landscapes in Indiana.

Appendix A. Indiana forest statistics, change between 2012 and 2017

	2017 Estimate	Sampling error (percent)	2012 Estimate	Sampling error (percent)	Percent change since 2012
Forest Land					
Area (1,000 acres)	4,913.3	1.1	4,855.3	1.0	1.2
Number of all live trees ≥1 inch diameter (million trees)	2,162.8	2.3	2,191.1	1.8	-1.3
Net volume of all live trees ≥5 inches diameter (million ft^3)	10,860.8	1.9	10,316.0	1.5	5.3
Net volume of sawtimber trees (million bd ft--Doyle rule)	27,155.2	2.3	24,743.6	1.9	9.7
All live tree aboveground biomass (1,000 oven-dry tons)	279,836.0	1.7	268,141.2	1.4	4.4
Annual net growth of all live trees ≥5 inches (thousand ft^3/yr)	198,065.7	5.4	246,428.7	4.1	-19.6
Annual mortality of all live trees ≥5 inches (thousand ft^3/yr)	154,127.2	5.7	112,371.8	5.7	37.2
Annual harvest removals of all live trees ≥5 inches (thousand ft^3/yr)	87,428.5	12.8	77,249.8	14.5	13.2
Annual other removals of all live on forest land (thousand ft^3/yr)	14,337.2	30.4	9,028.1	36.3	58.8
Timberland					
Area (1,000 acres)	4,747.6	1.2	4,702.2	1.1	1.0
Number of all live trees ≥1 inch diameter (million trees)	2,079.6	2.4	2,107.0	1.9	-1.3
Net volume of all live trees ≥5 inches diameter (million ft^3/yr)	10,482.4	2.0	9,970.9	1.6	5.1
Net volume of sawtimber trees (million bd ft--Doyle rule)	26,229.4	2.4	24,199.0	1.9	8.4
All live tree aboveground biomass (1,000 oven-dry tons)	270,163.4	1.8	259,012.5	1.5	4.3
Annual net growth of growing stock trees ≥5 inches (thousand ft^3/yr)	189,379.8	4.8	224,267.7	4.0	-15.6
Annual mortality of growing stock trees ≥5 inches (thousand ft^3/yr)	110,822.5	6.6	82,037.4	6.7	35.1
Annual harvest removals of growing stock trees ≥5 inches (thousand ft^3/yr)	77,513.0	13.2	73,075.2	14.9	6.1
Annual other removals of growing-stock on timberland (thousand ft^3/yr)	10,285.6	33.6	8,142.7	42.6	26.3

From *Forests of Indiana*, 2017.

Appendix B. Timberland acreage and volumes by Economic Growth Regions

Economic growth region	Area (acres)	Timberland (acres)	Percent timberland	Sawtimber volume (billion bd ft)	bd ft/acre
1	2,070,177	229,596	11.1%	0.909	3,959
2	1,473,881	210,052	14.3%	1.124	5,351
3	2,829,770	392,737	13.9%	1.633	4,158
4	3,079,330	230,097	7.5%	1.238	5,380
5	2,265,179	274,947	12.1%	1.508	5,485
6	1,911,024	199,018	10.4%	1.021	5,130
7	1,546,006	421,190	27.2%	2.394	5,684
8	2,109,948	970,238	46.0%	6.616	6,819
9	2,236,113	725,947	32.5%	4.172	5,747
10	1,298,076	538,124	41.5%	2.591	4,815
11	2,323,388	555,608	23.9%	3.025	5,444
Grand Total	23,142,891	4,747,554	20.5%	26.231	5,525

Appendix C. Tree species group volumes by ownership and county

Net volume of sawtimber trees, in million board feet (Doyle rule), on timberland by major species group, species group, species, and ownership group, Indiana, 2017.

			Ownership group					
Major species group	**Species group**	**Species**	**Forest Service**	**Other federal**	**State and local government**	**Private**	**Other**	**All owners**
Softwood species	Loblolly and shortleaf pine	Shortleaf pine	66.8	2.5	2.8	3.2	- -	75.3
Softwood species	Loblolly and shortleaf pine	Total	66.8	2.5	2.8	3.2	- -	75.3
Softwood species	Other yellow pines	Scotch pine	- -	- -	- -	2.8	- -	2.8
Softwood species	Other yellow pines	Virginia pine	9.2	2.1	39.0	73.5	- -	123.8
Softwood species	Other yellow pines	Total	9.2	2.1	39.0	76.3	- -	126.6
Softwood species	Eastern white and red pine	Red pine	- -	- -	29.8	17.0	- -	46.8
Softwood species	Eastern white and red pine	Eastern white pine	44.7	- -	14.1	184.9	- -	243.8
Softwood species	Eastern white and red pine	Total	44.7	- -	43.9	202.0	- -	290.6
Softwood species	Cypress	Baldcypress	- -	- -	- -	- -	- -	- -
Softwood species	Cypress	Total	- -	- -	- -	- -	- -	- -
Softwood species	Other eastern softwoods	Eastern redcedar	9.5	2.5	1.3	94.7	- -	107.9
Softwood species	Other eastern softwoods	Tamarack (native)	- -	- -	0.3	- -	- -	0.3
Softwood species	Other eastern softwoods	Norway spruce	- -	- -	15.7	- -	- -	15.7

Major species group	Species group	Species	Forest Service	Other federal	State and local government	Private	Other	All owners
Softwood species	Other eastern softwoods	Blue spruce	- -	- -	- -	- -	- -	- -
Softwood species	Other eastern softwoods	Total	9.5	2.5	17.3	94.7	- -	123.9
Softwood species	Total	Total	130.2	7.1	102.9	376.2	- -	616.4
Hardwood species	Select white oaks	White oak	271.1	147.4	209.1	1,588.3	- -	2,215.9
Hardwood species	Select white oaks	Swamp white oak	- -	- -	- -	57.1	- -	57.1
Hardwood species	Select white oaks	Bur oak	- -	- -	0.9	43.8	- -	44.8
Hardwood species	Select white oaks	Swamp chestnut oak	- -	- -	- -	11.9	- -	11.9
Hardwood species	Select white oaks	Chinkapin oak	3.3	9.0	12.7	212.4	- -	237.3
Hardwood species	Select white oaks	Total	274.3	156.4	222.7	1,913.6	- -	2,567.0
Hardwood species	Select red oaks	Cherrybark oak	- -	- -	- -	21.2	- -	21.2
Hardwood species	Select red oaks	Northern red oak	86.5	36.0	175.4	1,147.0	- -	1,444.8
Hardwood species	Select red oaks	Shumard oak	4.9	- -	11.0	- -	- -	15.9
Hardwood species	Select red oaks	Total	91.4	36.0	186.3	1,168.2	- -	1,481.9
Hardwood species	Other white oaks	Chestnut oak	52.6	- -	74.4	207.2	- -	334.2
Hardwood species	Other white oaks	Post oak	4.2	- -	1.4	9.4	- -	15.1
Hardwood species	Other white oaks	Total	56.8	- -	75.8	216.6	- -	349.3
Hardwood species	Other red oaks	Scarlet oak	35.6	4.7	18.5	88.2	- -	147.0
Hardwood species	Other red oaks	Northern pin oak	- -	- -	- -	2.6	- -	2.6
Hardwood species	Other red oaks	Shingle oak	- -	- -	- -	131.4	- -	131.4

Major species group	Species group	Species	Forest Service	Other federal	State and local government	Private	Other	All owners
Hardwood species	Other red oaks	Pin oak	2.4	40.5	12.0	597.1	- -	651.9
Hardwood species	Other red oaks	Black oak	139.1	92.3	92.5	1,364.0	- -	1,687.9
Hardwood species	Other red oaks	Total	177.1	137.4	123.0	2,183.2	- -	2,620.8
Hardwood species	Hickory	Mockernut hickory	- -	1.3	- -	20.3	- -	21.6
Hardwood species	Hickory	Water hickory	- -	- -	- -	4.4	- -	4.4
Hardwood species	Hickory	Bitternut hickory	11.5	3.1	15.1	578.9	- -	608.7
Hardwood species	Hickory	Pignut hickory	82.5	49.0	75.5	584.1	- -	791.2
Hardwood species	Hickory	Pecan	- -	- -	- -	9.9	- -	9.9
Hardwood species	Hickory	Shellbark hickory	- -	- -	- -	- -	- -	- -
Hardwood species	Hickory	Shagbark hickory	14.1	16.5	35.2	793.1	- -	858.9
Hardwood species	Hickory	Total	108.2	69.9	125.9	1,990.8	- -	2,294.8
Hardwood species	Yellow birch	Yellow birch	- -	- -	- -	- -	- -	- -
Hardwood species	Yellow birch	Total	- -	- -	- -	- -	- -	- -
Hardwood species	Hard maple	Black maple	- -	- -	- -	5.5	- -	5.5
Hardwood species	Hard maple	Sugar maple	67.3	43.1	121.9	2,029.7	- -	2,261.9
Hardwood species	Hard maple	Total	67.3	43.1	121.9	2,035.2	- -	2,267.5
Hardwood species	Soft maple	Red maple	17.5	23.1	45.6	910.4	- -	996.5
Hardwood species	Soft maple	Silver maple	- -	- -	139.8	462.2	- -	602.0
Hardwood species	Soft maple	Total	17.5	23.1	185.4	1,372.5	- -	1,598.5
Hardwood species	Beech	American beech	14.5	43.8	65.9	611.4	- -	735.7

Major species group	Species group	Species	Forest Service	Other federal	State and local government	Private	Other	All owners
Hardwood species	Beech	Total	14.5	43.8	65.9	611.4	- -	735.7
Hardwood species	Sweetgum	Sweetgum	5.0	2.3	32.8	186.2	- -	226.3
Hardwood species	Sweetgum	Total	5.0	2.3	32.8	186.2	- -	226.3
Hardwood species	Tupelo and blackgum	Blackgum	3.8	- -	11.5	136.1	- -	151.4
Hardwood species	Tupelo and blackgum	Total	3.8	- -	11.5	136.1	- -	151.4
Hardwood species	Ash	White ash	22.7	15.5	48.4	1,012.5	- -	1,099.1
Hardwood species	Ash	Black ash	- -	- -	- -	- -	- -	- -
Hardwood species	Ash	Green ash	- -	- -	6.8	369.3	- -	376.1
Hardwood species	Ash	Blue ash	- -	- -	3.2	39.3	- -	42.4
Hardwood species	Ash	Total	22.7	15.5	58.4	1,421.1	- -	1,517.7
Hardwood species	Cottonwood and aspen	Eastern cottonwood	- -	- -	143.9	1,176.8	- -	1,320.8
Hardwood species	Cottonwood and aspen	Bigtooth aspen	1.7	1.2	10.5	28.8	- -	42.1
Hardwood species	Cottonwood and aspen	Quaking aspen	- -	- -	- -	- -	- -	- -
Hardwood species	Cottonwood and aspen	Total	1.7	1.2	154.5	1,205.6	- -	1,362.9
Hardwood species	Basswood	American basswood	- -	23.3	6.4	288.0	- -	317.7
Hardwood species	Basswood	Total	- -	23.3	6.4	288.0	- -	317.7
Hardwood species	Yellow-poplar	Yellow-poplar	163.8	285.2	282.5	3,427.5	- -	4,159.0
Hardwood species	Yellow-poplar	Total	163.8	285.2	282.5	3,427.5	- -	4,159.0
Hardwood species	Black walnut	Black walnut	3.1	4.9	17.2	681.8	- -	707.0
Hardwood species	Black walnut	Total	3.1	4.9	17.2	681.8	- -	707.0

Major species group	Species group	Species	Forest Service	Other federal	State and local government	Private	Other	All owners
Hardwood species	Other eastern soft hardwoods	Boxelder	- -	- -	- -	37.0	- -	37.0
Hardwood species	Other eastern soft hardwoods	Ohio buckeye	- -	- -	- -	0.9	- -	0.9
Hardwood species	Other eastern soft hardwoods	River birch	0.4	- -	- -	17.1	- -	17.6
Hardwood species	Other eastern soft hardwoods	Northern catalpa	- -	- -	- -	12.5	- -	12.5
Hardwood species	Other eastern soft hardwoods	Sugarberry	- -	- -	- -	1.2	- -	1.2
Hardwood species	Other eastern soft hardwoods	Hackberry	0.8	2.2	0.8	332.6	- -	336.5
Hardwood species	Other eastern soft hardwoods	Butternut	- -	- -	- -	- -	- -	- -
Hardwood species	Other eastern soft hardwoods	American sycamore	31.5	8.7	24.1	1,537.8	- -	1,602.1
Hardwood species	Other eastern soft hardwoods	Black cherry	4.4	15.5	46.1	540.4	- -	606.5
Hardwood species	Other eastern soft hardwoods	Black willow	- -	- -	- -	8.2	- -	8.2
Hardwood species	Other eastern soft hardwoods	Sassafras	0.8	3.6	15.6	191.2	- -	211.1
Hardwood species	Other eastern soft hardwoods	Winged elm	- -	- -	- -	- -	- -	- -
Hardwood species	Other eastern soft hardwoods	American elm	1.3	5.9	2.6	131.1	- -	140.9
Hardwood species	Other eastern soft hardwoods	Siberian elm	- -	- -	- -	15.1	- -	15.1

Major species group	Species group	Species	Forest Service	Other federal	State and local government	Private	Other	All owners
Hardwood species	Other eastern soft hardwoods	Slippery elm	0.4	- -	- -	68.7	- -	69.1
Hardwood species	Other eastern soft hardwoods	Total	39.6	35.9	89.3	2,893.9	- -	3,058.7
Hardwood species	Other eastern hard hardwoods	Flowering dogwood	- -	- -	- -	- -	- -	- -
Hardwood species	Other eastern hard hardwoods	Common persimmon	- -	- -	1.5	18.9	- -	20.4
Hardwood species	Other eastern hard hardwoods	Honeylocust	- -	1.4	3.6	88.6	- -	93.6
Hardwood species	Other eastern hard hardwoods	Kentucky coffeetree	- -	- -	- -	5.9	- -	5.9
Hardwood species	Other eastern hard hardwoods	White mulberry	- -	- -	- -	2.5	- -	2.5
Hardwood species	Other eastern hard hardwoods	Red mulberry	- -	- -	- -	- -	- -	- -
Hardwood species	Other eastern hard hardwoods	Black locust	- -	3.4	0.4	70.8	- -	74.6
Hardwood species	Other eastern hard hardwoods	Rock elm	- -	- -	- -	- -	- -	- -
Hardwood species	Other eastern hard hardwoods	Total	- -	4.8	5.6	186.6	- -	197.0
Hardwood species	Total	Total	1,046.8	882.7	1,765.0	21,918.5	- -	25,613.0
Total	Total	Total	1,177.0	889.8	1,867.9	22,294.7	- -	26,229.4

Columns and rows may not add to their totals due to rounding. Table cells without observations are indicated by - -.

Net volume of growing-stock trees (at least 5 inches d.b.h.), in million cubic feet, and sawtimber trees, in million board feet (Doyle rule), on timberland by inventory unit, county, and major species group, Indiana, 2017

		Sawtimber major species group				
Inventory unit	**County**	**Pine**	**Other softwoods**	**Soft hardwoods**	**Hard hardwoods**	**All sawtimber species**
Lower Wabash	Clay	3.5	- -	129.1	237.4	370.0
Lower Wabash	Daviess	- -	- -	289.8	132.2	422.0
Lower Wabash	Gibson	- -	- -	30.4	124.6	155.0
Lower Wabash	Greene	20.5	- -	421.7	174.2	616.4
Lower Wabash	Knox	- -	- -	181.7	63.4	245.1
Lower Wabash	Martin	1.3	1.2	334.4	648.9	985.9
Lower Wabash	Parke	- -	- -	214.2	303.6	517.8
Lower Wabash	Pike	92.6	- -	190.7	128.5	411.8
Lower Wabash	Posey	- -	- -	84.4	145.8	230.2
Lower Wabash	Putnam	7.7	- -	346.0	379.1	732.8
Lower Wabash	Sullivan	2.1	- -	97.0	140.8	239.9
Lower Wabash	Vanderburgh	- -	- -	156.3	11.2	167.5
Lower Wabash	Vermillion	- -	- -	64.1	65.7	129.8
Lower Wabash	Vigo	- -	- -	243.2	160.2	403.4
Lower Wabash	Total	127.7	1.2	2,783.2	2,715.6	5,627.7
Knobs	Brown	- -	- -	155.3	785.5	940.8
Knobs	Clark	35.6	- -	219.6	264.7	519.9
Knobs	Crawford	8.9	0.8	98.4	428.0	536.1
Knobs	Dubois	0.5	- -	211.3	314.9	526.7
Knobs	Floyd	- -	- -	32.0	158.0	190.0
Knobs	Harrison	17.2	9.4	161.7	360.7	548.9
Knobs	Jackson	19.1	3.0	262.7	372.5	657.3
Knobs	Lawrence	14.1	3.3	346.6	442.9	806.9
Knobs	Monroe	19.3	19.9	456.9	530.9	1,027.0
Knobs	Morgan	8.5	- -	372.8	484.0	865.3

Inventory unit	County	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All sawtimber species
Knobs	Orange	44.7	15.0	294.6	400.1	754.4
Knobs	Owen	4.4	- -	582.5	476.0	1,062.9
Knobs	Perry	57.4	7.1	118.7	472.7	656.0
Knobs	Scott	6.7	- -	31.7	39.6	77.9
Knobs	Spencer	2.5	- -	100.2	151.0	253.8
Knobs	Warrick	2.6	- -	156.1	218.9	377.5
Knobs	Washington	7.4	7.6	228.5	474.0	717.5
Knobs	Total	249.0	66.0	3,829.5	6,374.3	10,518.9
Upland Flats	Dearborn	0.7	28.3	36.9	174.8	240.7
Upland Flats	Fayette	- -	0.9	57.4	131.8	190.1
Upland Flats	Franklin	- -	1.9	262.7	251.4	516.0
Upland Flats	Jefferson	3.4	10.2	226.1	250.6	490.2
Upland Flats	Jennings	34.6	- -	263.2	337.5	635.2
Upland Flats	Ohio	- -	0.4	7.7	16.0	24.2
Upland Flats	Ripley	- -	0.4	237.3	352.4	590.1
Upland Flats	Switzerland	- -	9.6	51.6	107.5	168.7
Upland Flats	Union	- -	1.2	66.5	68.9	136.6
Upland Flats	Total	38.6	52.9	1,209.5	1,690.8	2,991.8
Northern	Adams	- -	- -	- -	18.7	18.7
Northern	Allen	- -	- -	65.5	274.7	340.1
Northern	Bartholomew	- -	3.5	214.5	211.7	429.7
Northern	Blackford	8.3	- -	5.9	8.5	22.7
Northern	Boone	- -	- -	2.9	35.6	38.5
Northern	Carroll	- -	- -	15.9	41.0	56.9
Northern	Cass	- -	- -	28.1	97.9	125.9
Northern	Decatur	7.3	- -	268.8	143.6	419.7
Northern	De Kalb	- -	- -	68.8	15.0	83.9
Northern	Delaware	1.3	- -	2.5	4.4	8.2
Northern	Elkhart	- -	- -	151.9	73.0	224.9
Northern	Fountain	- -	- -	125.2	140.9	266.0

Inventory unit	County	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All sawtimber species
Northern	Fulton	- -	- -	65.0	27.8	92.8
Northern	Grant	- -	- -	45.1	130.3	175.4
Northern	Hamilton	- -	- -	26.6	45.0	71.6
Northern	Hancock	- -	- -	2.1	53.5	55.6
Northern	Hendricks	2.4	- -	60.7	82.2	145.4
Northern	Henry	- -	- -	27.2	14.2	41.4
Northern	Howard	- -	- -	33.1	24.3	57.3
Northern	Huntington	- -	- -	79.0	53.4	132.4
Northern	Jasper	- -	- -	62.9	34.0	96.9
Northern	Jay	- -	- -	115.0	126.2	241.3
Northern	Johnson	- -	- -	19.0	101.2	120.3
Northern	Kosciusko	- -	- -	303.7	105.8	409.5
Northern	Lagrange	31.2	0.3	108.7	44.9	185.2
Northern	Lake	- -	- -	- -	- -	- -
Northern	La Porte	15.9	- -	162.2	276.6	454.7
Northern	Madison	- -	- -	13.2	56.8	70.0
Northern	Marion	- -	- -	57.5	22.4	80.0
Northern	Marshall	0.5	- -	100.3	64.8	165.5
Northern	Miami	- -	- -	44.8	22.6	67.4
Northern	Montgomery	- -	- -	33.0	185.6	218.6
Northern	Newton	- -	- -	1.8	11.0	12.7
Northern	Noble	- -	- -	73.2	96.4	169.6
Northern	Porter	- -	- -	27.3	54.3	81.6
Northern	Pulaski	- -	- -	62.2	115.9	178.1
Northern	Randolph	- -	- -	13.4	133.3	146.8
Northern	Rush	- -	- -	58.7	43.7	102.4
Northern	St. Joseph	- -	- -	55.1	175.4	230.5
Northern	Shelby	- -	- -	27.2	34.7	61.8
Northern	Starke	- -	- -	13.8	70.7	84.4
Northern	Steuben	- -	- -	36.9	166.9	203.8
Northern	Tippecanoe	- -	- -	9.6	66.4	76.0
Northern	Tipton	- -	- -	8.4	4.8	13.1
Northern	Wabash	- -	- -	44.8	83.2	128.1
Northern	Warren	- -	- -	111.0	70.7	181.7
Northern	Wayne	- -	- -	31.6	100.2	131.8
Northern	**Wells**	- -	- -	4.3	48.0	52.3
Northern	**White**	- -	- -	48.5	127.0	175.4

Inventory unit	County	Pine	Other softwoods	Soft hardwoods	Hard hardwoods	All sawtimber species
Northern	**Whitley**	10.2	- -	115.5	18.6	144.3
Northern	**Total**	77.1	3.8	3,052.3	3,957.8	7,091.0
Total	**Total**	492.5	123.9	10,874.5	14,738.5	26,229.4

Columns and rows may not add to their totals due to rounding. Table cells without observations are indicated by - -.

Appendix D. Selected data from National Woodland Owner Survey Indiana 2013

From National Woodland Owner Survey Indiana 2013 - https://www.fs.fed.us/nrs/pubs/rb/rb_nrs99.pdf
Table IN-6 (2013). Estimated area and estimated number of family forest and woodland ownerships (10+ acres) by size of forest/woodland holdings∗, Indiana, 2011-2013

	Totals				Percentages				
	Acres	SE[a]	Ownerships	SE[a]	Acres	SE[a]	Ownerships	SE[a]	n
	thousands				percent				
Size of forest/woodland holdings (acres)									
10-19	469	76	37	6	14.6	2.4	42.7	7.6	34
20-49	952	100	31	3	29.6	3.2	36.1	4.6	69
50-99	814	94	12	1	25.3	3.0	14.3	2.0	59
100-199	566	82	5	<1	17.6	2.6	5.4	<1.0	41
200-499	276	60	1	<1	8.6	1.9	1.3	<1.0	20
500-999	97	36	<1	<1	3.0	1.1	<1.0	<1.0	7
1,000-4,999	41	24	<1	<1	1.3	<1.0	<1.0	<1.0	2
5,000-9,999	–	–	–	–	–	–	–	–	0
10,000+	–	–	–	–	–	–	–	–	0
Total[c]	3,215	85	85	6	100.0	–	100.0	–	232

∗ The average forest/woodland holding is 37.4 acres (SE=2.5) for family forest and woodland ownerships with 10+ acres in Indiana. [a] SE = standard error [b] Excluded from percentages. [c] Totals may differ across tables and subtables. See footnote a under Table 2 for an explanation. Note: Data may not add to totals due to rounding.

Table IN-11 (2013). Estimated area and estimated number of family forest and woodland ownerships (10+ acres) by reason for owning forest and woodland, Indiana, 2011-2013. Numbers include ownerships that rated an objective as very important or important on a five-point Likert scale.

	Totals				Percentages				
	Acres	SE[a]	Ownerships	SE[a]	Acres	SE[a]	Ownerships	SE[a]	n
	thousands				percent				
Reason[b]									
To enjoy beauty or scenery.	2,456	111	66	5	77.7	4.1	78.3	8.4	178
To protect nature or biological diversity.	2,139	115	60	6	69.2	4.3	72.5	8.3	155
To protect water resources.	1,821	115	49	5	59.5	4.2	60.0	7.6	132
To protect or improve wildlife habitat.	2,097	115	59	5	68.8	4.4	72.6	8.5	152
For land investment.	1,725	115	42	4	55.8	4.1	50.3	6.4	125
Is part of my home site/primary residence.	1,683	114	51	5	54.0	4.0	61.3	7.7	122

Is part of my cabin or vacation home site.	552	81	10	2	18.3	2.7	12.7	3.0	40
Is part of my farm or ranch.	1,545	113	38	4	50.0	4.0	46.1	6.1	112

	Totals				Percentages				
	Acres	SE[a]	Ownerships	SE[a]	Acres	SE[a]	Ownerships	SE[a]	n
	thousands				percent				
For privacy.	1,821	115	51	5	58.4	4.1	60.3	7.4	132
To raise my family.	1,394	111	38	5	45.1	3.8	46.0	6.3	101
To pass land on to my children or other heirs.	2,208	114	58	5	69.9	4.1	68.6	7.7	160
For firewood.	745	91	20	3	24.2	3.1	24.1	4.4	54
For timber products.	1,021	102	18	3	32.6	3.4	21.1	3.6	74
For nontimber forest products.	193	50	5	2	6.2	1.6	5.7	2.1	14
For hunting.	1,394	111	31	4	44.7	3.8	37.2	4.9	101
For recreation, other than hunting.	1,352	110	35	4	43.6	3.8	41.5	5.8	98
Other.	83	33	2	<1	2.6	1.1	1.9	<1.0	6
No answer[c]	28	19	<1	<1	–	–	–	–	1

[a] SE = standard error [b] Categories are not mutually exclusive. [c] Includes only ownerships that responded to none of the items above. Number of ownerships not responding varies for each item and they are excluded from the percentages accordingly.

Table IN-17 (2013). Estimated area and estimated number of family forest and woodland ownerships (10+ acres) by activities that cut or removed trees∗, Indiana, 2011-2013

	Totals				Percentages				
	Acres	SE[a]	Ownerships	SE[a]	Acres	SE[a]	Ownerships	SE[a]	n
	thousands				percent				
Firewood cut or removed[b]									
For personal use	1,686	121	44	5	53.4	4.1	52.1	7.2	108
For sale	232	58	4	2	7.4	1.9	5.2	1.9	15
For other reasons	217	56	7	3	6.9	1.8	8.1	3.1	14
Not harvested	1,176	112	32	4	37.3	3.7	37.0	5.7	76
No answer[c]	46	27	1	1	–	–	–	–	3
Logs cut or removed[b]									
For personal use	356	71	5	2	11.3	2.3	6.4	2.1	23
For sale	1,470	118	28	4	46.6	4.0	33.2	5.2	94
For other reasons	77	34	2	1	2.5	1.1	2.6	1.3	5
Not harvested	1,454	118	51	6	46.1	4.0	60.4	8.1	94
No answer[c]	46	27	1	1	–	–	–	–	3
Wood chips cut or removed[b]									
For personal use	15	15	<1	<1	<1.0	<1.0	<1.0	<1.0	1
For sale	46	27	<1	<1	1.5	<1.0	<1.0	<1.0	3
For other reasons	–	–	–	–	–	–	–	–	0
Not harvested	3,094	95	85	6	98.0	4.2	99.3	10.2	199

No answer[c]	46	27	1	1	–	–	–	–	3
Unwanted trees cut or removed[b]									
For personal use	634	91	22	4	20.1	2.9	26.0	5.4	41
For sale	201	54	4	1	6.4	1.7	4.1	1.6	13
For other reasons	650	92	11	2	20.6	3.0	13.0	2.9	41
Not harvested	1,686	121	49	5	53.4	4.1	57.1	7.5	109

	Totals				Percentages				
	Acres	SE[a]	Ownerships	SE[a]	Acres	SE[a]	Ownerships	SE[a]	n
	thousands				percent				
No answer[c]	46	27	1	1	–	–	–	–	3
Other timber products cut or removed[b]									
For personal use	46	27	2	1	1.5	<1.0	1.9	1.2	3
For sale	15	15	<1	<1	<1.0	<1.0	<1.0	<1.0	1
For other reasons	124	43	4	2	3.9	1.4	5.0	2.4	8
Not harvested	2,970	101	79	6	94.1	4.2	92.9	9.7	191
No answer[c]	46	27	1	1	–	–	–	–	3

∗ The acre values represent the estimated amount of forest/woodland owned by people who have done the specific activity, not the total acreage on which the activity has occurred. [a] SE = standard error [b] Categories are not mutually exclusive. [c] Excluded from percentages.

Table IN-18 (2013). Estimated area and estimated number of family forest and woodland ownerships (10+ acres) by types of timber products and trees cut or removed (simplified for comparisons with 2002-2006 data)∗, Indiana, 2011-2013

	Totals				Percentages				
	Acres	SE[a]	Ownerships	SE[a]	Acres	SE[a]	Ownerships	SE[a]	n
	thousands				percent				
Products[b]									
Logs	1,702	121	34	4	53.1	4.1	39.0	5.5	109
Firewood	1,980	122	54	6	61.8	4.2	62.0	7.9	127
Wood chips	62	31	<1	<1	1.9	<1.0	<1.0	<1.0	4
Unwanted trees	1,470	118	37	5	45.9	3.9	42.2	6.3	94
Other	186	52	6	2	5.8	1.6	7.0	2.7	12
No answer[c]	46	27	1	1	–	–	–	–	3

∗ The acre values represent the estimated amount of forest/woodland owned by people who have done the specific activity, not the total acreage on which the activity has occurred. [a] SE = standard error [b] Categories are not mutually exclusive. [c] Excluded from percentages.

Appendix E. GATS trade flows from Indiana to partner countries and products imported; 2004-2017

(in $Thousands) Country	2004 Value	2008 Value	2012 Value	2016 Value	2017 Value
Canada	**101,585**	**141,876**	**108,541**	**100,647**	**117,682**
Adhesive Paper	16,682	27,128	31,971	27,710	31,309
Sawn Sheet Wood Nesoi	27,343	23,202	16,870	15,428	19,619
Other Articles Of Wood, Nesoi	-	-	-	-	11,498
Paper And Paper Nesoi	3,443	3,292	6,434	8,307	8,126
Ties, Wood, Impregnated	1,198	5,205	2,828	6,326	7,229
Lumber, Non-Coniferous	4,858	1,936	2,482	3,836	5,241
Paper, Kraft, 150-22	371	7,706	7,382	5,919	4,989
Paper, Kraft, >225g	19	14,634	7,477	2,880	4,869
Paperboard, Clay	38	105	397	1,057	4,670
Lumber, Oak	4,345	3,311	5,633	3,626	4,490
China	**15,604**	**16,218**	**23,141**	**44,371**	**55,377**
Logs, Non-Coniferous	2,043	1,719	4,915	10,108	10,923
Logs, Oak	774	1,297	3,529	8,868	9,100
Lumber, Oak	338	798	949	3,591	8,903
Ash Lumber	-	350	3,259	7,787	7,351
Lumber, Non-Coniferous	1,033	464	1,883	4,853	7,095
Logs, Poles, Coniferous	1,436	458	1,223	2,600	5,310
Sawn Sheet Wood Nesoi	8,108	10,184	4,459	2,962	2,561
Cherry Lumber	-	60	148	1,972	1,581
Adhesive Paper	23	-	1,566	455	1,298
Maple (Ex Jap) Lumber	-	77	181	7	555

Country	2004 Value	2008 Value	2012 Value	2016 Value	2017 Value
Mexico	**2,310**	**15,960**	**15,523**	**28,323**	**20,804**
Paper And Paper Nesoi	1,447	538	342	9,360	13,888
Waste, Scrap Chemical	25	3,617	435	3,778	2,400
Sawn Sheet Wood Nesoi	312	553	870	1,078	559
Paper, Coated/Impregnated	11	80	140	396	464
Waste, Scrap Of Pape	-	42	-	94	390
Non-Conifer Wood Other	-	186	2,373	2,240	380
Lumber, Non-Coniferous	-	116	3,353	4,607	373
Other Articles Of Bamboo, Nesoi	-	-	-	-	312
Wooden Cases	4	336	97	332	285
Clothes Hangers	-	-	-	-	211
Japan	**4,928**	**6,553**	**13,499**	**14,629**	**10,415**
Lumber, Oak	1,812	2,496	5,483	7,314	3,777
Lumber, Non-Coniferous	1,696	52	3,303	4,459	3,664
Logs, Oak	626	562	476	655	541
Logs, Non-Coniferous	32	1,557	1,498	381	502
Sawn Sheet Wood Nesoi	253	521	179	517	436
Maple (Ex Jap) Lumber	-	277	754	393	411
Ash Lumber	-	-	139	387	389
Cherry Lumber	-	-	597	424	320
Wooden Casks	-	-	5	17	138
Oriented Strand Board	-	-	-	-	99
Spain	**16,460**	**13,846**	**4,393**	**7,768**	**8,625**
Sawn Sheet Wood Nesoi	10,333	9,614	2,972	5,950	4,641
Veneer, Tropical	-	-	-	411	1,262
Veneer, Coniferous	1,815	-	-	-	989
Lumber, Oak	2,276	436	1,200	841	826
Wooden Casks	-	-	-	-	448
Lumber, Non-Coniferous	283	52	89	165	282
Logs, Oak	1,154	1,350	20	172	90
Logs, Non-Coniferous	134	300	20	-	29
Paperboard, Plastics	-	-	-	-	29
Adhesive Paper	-	-	-	27	17

Country	2004 Value	2008 Value	2012 Value	2016 Value	2017 Value
Vietnam	**987**	**1,802**	**3,286**	**6,487**	**7,530**
Lumber, Non-Coniferous	104	136	1,083	2,544	2,997
Logs, Oak	33	22	444	1,410	1,556
Lumber, Oak	67	629	1,150	503	940
Logs, Non-Coniferous	291	146	157	873	855
Sawn Sheet Wood Nesoi	420	393	45	214	653
Veneer, Tropical	-	-	57	420	269
Maple (Ex Jap) Lumber	-	184	17	18	70
Veneer, Coniferous	72	-	58	-	52
Poles, Treated	-	-	-	-	51
Other Articles Of Bamboo, Nesoi	-	-	-	-	39
Brazil	**305**	**3,726**	**4,566**	**4,138**	**6,743**
Adhesive Paper	29	3,203	3,388	3,185	5,013
Plywood, Tropical	-	-	-	3	702
Sawn Sheet Wood Nesoi	31	3	1,022	815	539
Paper And Paper Nesoi	-	-	-	9	313
Plywood, Non-Conifer	-	-	-	79	126
Paper, Tarred,	-	-	-	39	26
Musical Instruments	6	-	-	-	18
Other Articles Of Wood, Nesoi	-	-	-	-	6
Adhesive Paper Nesoi	29	-	-	-	-
Builders Joinery	-	8	-	-	-
Germany	**17,347**	**21,617**	**12,158**	**9,068**	**6,273**
Sawn Sheet Wood Nesoi	10,194	12,993	6,786	6,526	3,956
Veneer, Coniferous	410	92	378	-	659
Lumber, Non-Coniferous	351	274	816	484	617
Logs, Non-Coniferous	334	1,428	351	1,300	415
Veneer, Tropical	128	-	39	218	282
Wooden Pallets	-	-	-	181	169
Adhesive Paper	-	-	93	46	65
Paper And Paper Nesoi	3	-	261	64	51
Paperboard, Plastics	-	-	-	-	15
Lumber, Oak	1,493	1,860	907	-	14

Country	2004 Value	2008 Value	2012 Value	2016 Value	2017 Value
United Kingdom	**5,451**	**7,111**	**7,030**	**7,364**	**5,871**
Logs, Poles, Coniferous	-	-	12	1,010	2,219
Lumber, Non-Coniferous	649	71	1,118	710	1,074
Sawn Sheet Wood Nesoi	1,787	2,296	1,823	986	617
Adhesive Paper	-	161	130	39	169
Paperboard, Plastics	-	-	3	14	97
Ash Lumber	-	175	-	-	90
Lumber, Oak	792	214	16	114	86
Chemical Wood Pulp, Soda	-	-	-	-	77
Other Articles Of Bamboo, Nesoi	-	-	-	-	62
Logs, Non-Coniferous	305	1,489	759	195	23
Ireland	**908**	**3,969**	**1,401**	**6,005**	**5,099**
Wooden Casks	389	1,892	1,086	5,700	4,847
Veneer, Coniferous	-	-	-	-	104
Logs, Poles, Coniferous	3	-	-	50	56
Other Articles Of Wood, Nesoi	-	-	-	-	47
Lumber, Non-Coniferous	139	88	47	-	26
Other Articles Of Bamboo, Nesoi	-	-	-	-	19
Adhesive Paper	-	-	3	-	-
Coniferous Wood Shaped	-	-	-	-	-
Logs, Non-Coniferous	-	140	-	-	-
Logs, Oak	26	117	-	-	-
India	**580**	**302**	**1,033**	**3,948**	**4,191**
Waste, Scrap Chemical	-	6	41	2,452	2,700
Logs, Non-Coniferous	-	40	307	407	557
Sawn Sheet Wood Nesoi	50	127	148	171	430
Logs, Oak	-	69	155	119	208
Waste, Scrap Of Paper	17	-	-	312	136
Waste Or Scrap Kraft	-	-	20	3	57
Adhesive Paper	-	-	-	302	20
Lumber, Non-Coniferous	-	-	-	30	19
Paper, Kraftliner	-	-	7	62	15
Waste Or Scrap Mechanical	54	-	-	-	14
Portugal	**1,083**	**3,421**	**1,228**	**2,931**	**3,858**
Sawn Sheet Wood Nesoi	592	3,144	1,120	2,480	2,740
Veneer, Coniferous	26	-	-	-	631

Country	2004 Value	2008 Value	2012 Value	2016 Value	2017 Value
Logs, Oak	160	72	-	334	286
Logs, Non-Coniferous	-	68	-	-	129
Coniferous Wood Shaped	-	-	-	-	40
Lumber, Oak	240	71	-	-	17
Veneer, Meranti Red	-	-	-	-	10
Paper And Paper Nesoi	-	-	30	-	5
Ash Lumber	-	-	-	-	-
Lumber, Non-Coniferous	9	-	-	29	-
Taiwan	**4,879**	**2,224**	**1,362**	**2,765**	**3,487**
Adhesive Paper	120	-	7	1,271	1,365
Logs, Oak	113	49	650	939	1,024
Sawn Sheet Wood Nesoi	3,427	711	30	122	355
Logs, Non-Coniferous	265	166	232	123	212
Lumber, Non-Coniferous	153	450	123	14	180
Wood In Chips, Non-Coniferous	-	-	-	80	101
Other Articles Of Wood, Nesoi	-	-	-	-	60
Logs, Poles, Coniferous	65	308	62	31	52
Lumber, Oak	89	160	27	31	50
Wooden Pallets	3	-	-	-	42
Belgium-Luxembourg	**3,643**	**4,369**	**1,391**	**1,881**	**2,917**
Sawn Sheet Wood Nesoi	3,044	3,834	888	1,031	1,377
Veneer, Coniferous	-	-	-	-	692
Veneer, Tropical	-	-	-	380	466
Adhesive Paper	-	-	252	324	338
Wooden Cases	-	-	6	-	23
Other Articles Of Wood, Nesoi	-	-	-	-	9
Paper, Coated/Impregnated	-	-	6	-	8
Semi-Chemical Wood	-	-	-	-	4
Ash Lumber	-	-	-	-	-
Logs, Non-Coniferous	-	290	-	-	-
Italy	**3,256**	**4,621**	**1,935**	**2,500**	**2,880**
Sawn Sheet Wood Nesoi	1,503	1,757	120	1,135	1,348
Veneer, Coniferous	-	-	-	-	718
Logs, Non-Coniferous	238	1,429	956	540	387
Lumber, Non-Coniferous	409	365	588	292	335
Wooden Cases	-	-	31	-	75
Paperboard, Plastics	-	-	-	-	10

Country	2004 Value	2008 Value	2012 Value	2016 Value	2017 Value
Musical Instruments	41	-	-	-	7
Ash Lumber	-	17	-	201	-
Clothes Hangers	-	-	-	10	-
Fibreboard Not Work	-	-	-	-	-
Turkey	**170**	**1,215**	**1,819**	**1,607**	**2,477**
Lumber, Non-Coniferous	-	-	74	632	1,407
Sawn Sheet Wood Nesoi	-	973	1,078	830	503
Logs, Non-Coniferous	-	18	31	137	370
Veneer, Coniferous	170	-	-	-	197
Ash Lumber	-	-	384	-	-
Coniferous Wood Shaped	-	-	-	-	-
Doors, Frames	-	16	-	-	-
Logs, Oak	-	23	37	-	-
Lumber, Oak	-	17	44	8	-
Musical Instruments	-	-	-	-	-
Philippines	**416**	**276**	**2,002**	**2,095**	**2,289**
Wooden Casks	-	-	-	2,052	2,284
Medium Density Fiberboard	-	-	-	-	5
Adhesive Paper	-	176	-	-	-
Ash Lumber	-	-	11	-	-
Cherry Lumber	-	-	3	-	-
Doors, Frames	4	-	-	-	-
Logs, Non-Coniferous	-	-	-	-	-
Lumber, Coniferous	4	-	-	-	-
Lumber, Non-Coniferous	-	-	31	3	-
Lumber, Oak	-	-	-	-	-
Lithuania	**5**	**11**	**-**	**2,318**	**2,056**
Sawn Sheet Wood Nesoi	-	-	-	2,184	2,053
Sawdust, Wood Waste	-	-	-	-	3
Builders Joinery	5	-	-	-	-
Doors, Frames	-	-	-	-	-
Logs, Non-Coniferous	-	-	-	-	-
Logs, Oak	-	-	-	-	-
Logs, Poles, Coniferous	-	-	-	14	-
Lumber, Oak	-	-	-	-	-
Musical Instruments	-	11	-	-	-
Veneer, Tropical	-	-	-	120	-

Country	2004 Value	2008 Value	2012 Value	2016 Value	2017 Value
Australia	**1,588**	**3,083**	**2,567**	**2,495**	**2,055**
Other Articles Of Bamboo, Nesoi	-	-	-	-	768
Sawn Sheet Wood Nesoi	407	1,620	732	708	723
Adhesive Paper	9	47	308	702	215
Builders' Joinery And Carpentry Of Wood, Nesoi	-	-	-	-	133
Other Articles Of Wood, Nesoi	-	-	-	-	99
Paperboard, >225	-	-	-	-	18
Lumber, Coniferous	-	-	-	-	15
Musical Instruments	198	61	7	3	15
Paper And Paper Nesoi	-	-	14	4	15
Veneer, Coniferous	-	-	-	-	14
Malaysia	**3,190**	**1,885**	**1,487**	**2,679**	**2,026**
Sawn Sheet Wood Nesoi	1,203	1,442	1,429	2,548	1,751
Lumber, Non-Coniferous	160	38	-	-	192
Lumber, Oak	178	109	-	33	41
Veneer, Coniferous	964	-	-	-	23
Paper And Paper Nesoi	-	-	21	-	14
Tools, Broom Handles	-	-	-	-	5
Adhesive Paper	-	-	-	5	-
Adhesive Paper Nesoi	-	-	6	-	-
Builders Joinery	6	-	-	-	-
Chem Wood Pulp, Soda	-	-	-	-	-

Appendix F. Glossary of Terms and Details about IMPLAN software used in economic contribution analysis

Economic Impact: The net changes in new economic activity associated with an industry, event, or policy in an existing regional economy. The key term is "new".[2]

Economic Contribution: The gross change in economic activity associated with an industry, event, or policy in an existing regional economy.[3]

Economic Activity: Dollars spent within region that are attributable to a given industry, event or policy.[4]

Direct Effects: Refers to the increase in final demand or employment in the local economy (county) specifically attributed to the hardwoods industry.

Employee Compensation: The total cost of labor to an employer. It includes wages and salaries as well as benefits and employer contributions to government social insurance. In this study, compensation includes both employee compensation and proprietor's income. However, these are typically reported separately.

Indirect Effects: A measure of the change in dollars or employment caused when the industry increases their purchases of goods and services from suppliers and, in turn, those suppliers purchase more inputs and so on throughout the economy.

Induced Effects: The result from the household spending of employees in an industry and their suppliers—whether in dollars or employment. Induced spending will react to changes in output along the economic supply chain. Those output changes also result in changes in household income and spending of suppliers' employees. Induced effects represent the change in overall economic output and employment resulting from such household spending changes.

Multiplier: The multiplier is the extent of the economic response in a particular geographic area associated with a change in the direct effects. For example, multiply every dollar of the hardwoods industry's expenditures in 2016 by 1.51 to find an estimate of the total contribution of this activity to the local economy. Another way to look at it is that every dollar of output supports $0.51 in additional economic activity in the state.

Tax Effects: The IMPLAN model tracks the federal, state and local government tax collection that would be associated with the direct and ripple effects' economic activity. For example, household spending at retailers generates state sales tax. In addition, those retailers also pay property taxes to local governments.

[2] Watson, P., Wilson, J., Thilmany, D. and Winter, S. 2007. "Determining Economic Contributions and Impacts: What is the difference and why do we care?" Pedagogy in Regional Studies, JRAP 37(2): 140-146.
[3] ibid
[4] ibid

Total Effects: The sum of the direct, indirect and induced effects, otherwise known as the size of the economic contribution to the economy. Term used interchangeably with ripple effects or economic footprint.

Analysis-by-Parts: A technique by which you can split the "stemming ripple effects" of an Industry Change into its individual impact components--budgetary spending pattern and income within the IMPLAN software.

Information about the IMPLAN Software

IMPLAN is built on a mathematical input-output (I-O) model that expresses relationships between sectors of the economy in a chosen geographic location. Using a traditional input-output analysis, IMPLAN can measure the economic effects of an event, such as construction of a new plant or expanded sales at a business, or the economic contribution of an existing entity such as an industry, university or business. The input-output model defines the flow of dollars through the economy contingent on the assumption of fixed relationships between producers and their suppliers. Dollars spent outside of the defined economy are omitted, which would include imported items, purchased goods originating from the defined economy or commuting employees who conduct household spending elsewhere.

The concept of input-output modeling is the inter-industry relationships within the defined geographic area will estimate an economy's response to economic changes. Thus, a demand increase for a certain product or service causes a chain reaction of results, captured via the multiplier effect. Impacted parties would include the producer of the product, its employees, suppliers, the supplier's employees and beyond – showcasing the total effect of change is greater than the original demand. The multiplier, the ratio of total effect to direct effect, helps quantify in simple terms the estimated effect resulting from the change in original demand. Each industry has a unique output multiplier due to different inter-industry relationships with firms within and outside the defined economy.

The multiplier is a great tool, but often does not answer all the desired questions. Most want answers with regard to quantity of jobs impacted, effects on the economy due to the change (increase or decrease) as well as the anticipated compensation per job resulting from the impact on jobs. The IMPLAN software allows the user to construct models measuring the flow of dollars from purchasers to producers within the defined economy. Data within the models will set up the precise equations which answers questions about the impact of a new company, a plant closing or greater product demand.

Local, regional and national production, employment and trade data sources are used by IMPLAN to construct its input-output model. Examples of such data sources include U.S. Census Bureau's annual *County Business Patterns* report and the U.S. Bureau of Labor Statistics' annual *Covered Employment and Wages* report. Despite gathering large quantities of data from government sources, the company behind IMPLAN also estimates unavailable data, such as county-level production data or suppressed data due to confidentiality of easily identifiable individual companies.

Appendix G. Hardwood Logistics Strategy (Transportation Report)

Report

HARDWOOD LOGISTICS STRATEGY

Sponsored by the Indiana State Department of Agriculture (ISDA)

Identification of current challenges to growth in the industry, domestically and internationally, related to transportation

Professor Satish Ukkusuri, Purdue University

July 2018 (revised 10-5-18)

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1 IDENTIFICATION OF CURRENT CHALLENGES TO GROWTH IN HARDWOOD INDUSTRY RELATED TO TRANSPORTATION

This part of the report will highlight the hardwood supply chain, the current state of the Indiana transportation system and some of the transportation challenges that affect the hardwood industry. Transportation is one major component of the hardwood supply chain as it involves the movements of hardwood commodities from the forests to the sawmills to the final customers (figure 1). The state of the transportation system and the constraints it imposes influence the costs and efficiency of the hardwood industry. Therefore, a better understanding of the current infrastructure systems is necessary to create a strategic and tactical plan for transportation optimization. As such, the following subsections will provide an overview of a recent status of Indiana transportation systems. Figure 1 is an example that shows the relationships between transportation and components of a hardwood furniture supply chain. The arrows in figure 1 are only representative. In some cases, the raw logs are directly shipped overseas which will change the arrows in figure 1.

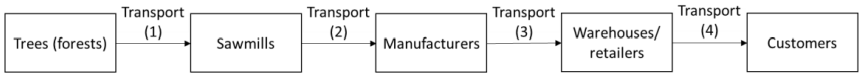


Figure 1. Wood furniture supply chain (adapted and modified from [1])

Note: - Transport (1): mainly transport locally.

- Transport (2): local, state, or interstate transport.
- Transport (3): state, interstate, or international transport.
- Transport (4): local or state transport.

1.1 Review of Indiana Transportation System

Transportation systems in Indiana play a vital role for improving safety, mobility, and economic growth. Indiana Department of Transportation (INDOT) has invested $1.2 billion for construction projects in 2012 [2]. As a reference point, the construction projects in neighboring states are - Illinois DOT spent 1.94 billion [3], Ohio DOT spent 1.68 billion [4], Kentucky DOT spent 1.24 billion [5], and Michigan DOT spent 2.1 billion [6]. In general, the transportation connectivity and asset performance are quite satisfactory (see table 2). This is also echoed by some of the respondents in our interviews: "Infrastructure is good here in Indiana. Container availability is more on East or West Coast, so sometimes there's a shortage of equipment for transportation, but that's minor". We have reviewed various documents

from Indiana Department of Transportation and other sources. The quality of Indiana transportation systems is summarized in the table below.

Table 1 Quality of Indiana transportation systems

Transportation segment	Key facts
Pavement roughness performance	96,571 miles of public roads [7], with 11.2% in poor/ mediocre condition, 78.5% in good or excellent condition [2], [1].
Annual total extra vehicle repairs/ operating costs due to driving on roads in need of fixing	$1.249 billion ($225 per motorist) [7]
Structurally deficient Bridges	1,533 of the 19,245 (8%). (As a comparison, the percentage in neighboring states such as Illinois was 8.6%, Ohio was 6.9%, Kentucky was 8.1%, and Michigan was 11%) Bridges' median age is 43 years old. $244,436,307 has been spent on bridge capital projects in 2013 [7]
Freight flow	73.2 million short tons of cargo in 2014 (ranking 12 nationally) [7]
Railways	4,075 miles of rail across the Indiana state (ranking 9 by mileage nationally) [7]
Waterways	350 miles of inland waterways (ranking 23 nationally) [7]

The congestion on Indiana highways is lower than many other states. The level of congestion relates to transportation cost since it impacts the time that hardwood supplies spend in the transportation network. Indiana highways and railways have the lowest congestion networks as compared to the neighboring states [8]. The average marginal cost per mile by region in 2016 is illustrated in Table 2. The Midwest has the lowest operational cost by truck which includes vehicle-based (fuel costs, truck lease or purchase payments, repair and maintenance, tolls, etc.) and driver-based (driver wages and benefits) costs.

Table 2. Average marginal cost per mile by region, 2016 [9]

	Midwest	Northeast	Southeast	Southwest	West
Motor Carrier Costs	$1.540	$1.655	$1.597	$1.541	$1.701

Figure 2 displays the average truck speeds on main interstate highways in Indiana and neighboring states in 2014.

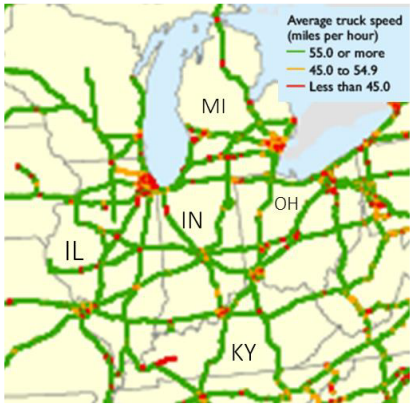


Figure 2. Average truck speeds on selected interstate highways in Midwest (2014) [8]

In 2018 top 100 US truck bottleneck list, Indiana, Illinois, Kentucky, Ohio, and Michigan, have 2, 3, 1, 3, and 2 bottlenecks respectively in the top 100. The bottleneck locations and performance metrics are summarized in Table 3. As can be seen below, Indiana is relatively on par or better than the other Midwest states.

Table 3. Summary of bottlenecks in Indiana and its neighboring states. Speed is in miles/hour [10]

State	Locations	National congestion ranking	Average speed	Peak average speed	Non-peak average speed
Indiana	Indianapolis, IN: I-65 at I-70 (North)	33	49.3	42.8	51.9
	Indianapolis, IN: I-65 at I-70 (South)	40	49.5	44.2	51.9
Illinois	Chicago, IL: I-290 at I-90/I-94	3	25.9	21.2	27.7
	Chicago, IL: I-90 at I-94 (North)	21	31.0	18.3	37.5
	Chicago, IL: I-90 at I-94 (South)	35	41.3	34.7	46.7
Kentucky	Louisville, KY: I-65 at I-64/I-71	10	44.5	37.4	47.6
Ohio	Cincinnati, OH: I-71 at I-75	9	46.3	39.1	48.8
	Cincinnati, OH: I-75 at I-74	54	46.4	39.4	49.1
	Dayton, OH: I-75 at US 35	92	48.0	41.6	51.0
Michigan	Port Huron, MI: I-94 at I-69	12	29.3	30.2	29.0
	Detroit, MI: I-94 at I-75	57	44.7	36.4	48.8

As such, the state should take actions to manage congestion at these bottlenecks since these bottlenecks make the freight industry less competitive. Furthermore, given that most of the hardwood industry is in the southern and northern counties of Indiana, an improvement of local roads is needed for improving the connectivity of the local hardwood transportation

to the main highways. The improvements include providing good maintenance, upgrading roads to increase the weight limits of the highways near the hardwood commodities and constructing additional roads to improve connectivity to main sawmills.

In fact, the top five counties which are the most significant to the Indiana wood industry are Dubois, Elkhart, Bartholomew, Marion, and Lagrange. INDOT and local governments have constructed new highways in these counties to improve the transportation systems. The table below displays a list of proposed new highways and bridges which will be constructed during 2018-2021 (there is no new project in Elkhart, Marion, and Lagrange County).

Table 4. Proposed new highways and bridge in Dubois and Bartholomew Counties

Work type	Location	District	Plan
Dubois County [11]			
Mid-States Corridor	From Owensboro (Kentucky) go around Huntingburg and Jasper and continue north to connect to Interstate 69.	Jasper	Studies for the project is distributed into two phrases: Phrase I (2018-2021) and Phrase II (2021-2023). Road design and property acquisition are from 2024-2026. The estimated completion is around 2028.
Bartholomew County [12]			
New Bridge, Concrete Construction	Over Louisville and Indiana Railroad on State Road 46	Seymour	The project is planned to complete in 2020.

The construction of the Mid-States Corridor through Dubois County will improve accessibility to the main hubs, such as Indianapolis or Chicago. The corridor will potentially bring benefits to the wood product industry for Dubois County. In fact, the economic impact to the area which the corridor passes through is estimated at about $2.4 to $3.2 million over 20 years after its completion [11]. The exact impact on the hardwood industry in terms of reduced transportation costs is difficult to assess within the scope of this project.

1.2 Specific modes and intermodal transportation

As the "crossroads of America," there are 14 interstate highways they go through Indiana, including I-64, I-65, I-69, I-70, I-74, I-80, I- 90, I-94, I-164, I-265, I-275, I-465, I-469, and I-865 (https://www.in.gov/). The length of Indiana highways is over 11,000 miles

(https://www.in.gov/). INDOT operates and maintains 235 state roads. In addition, an example of the Indiana extra heavy duty highways networks are illustrated in Figure 3.

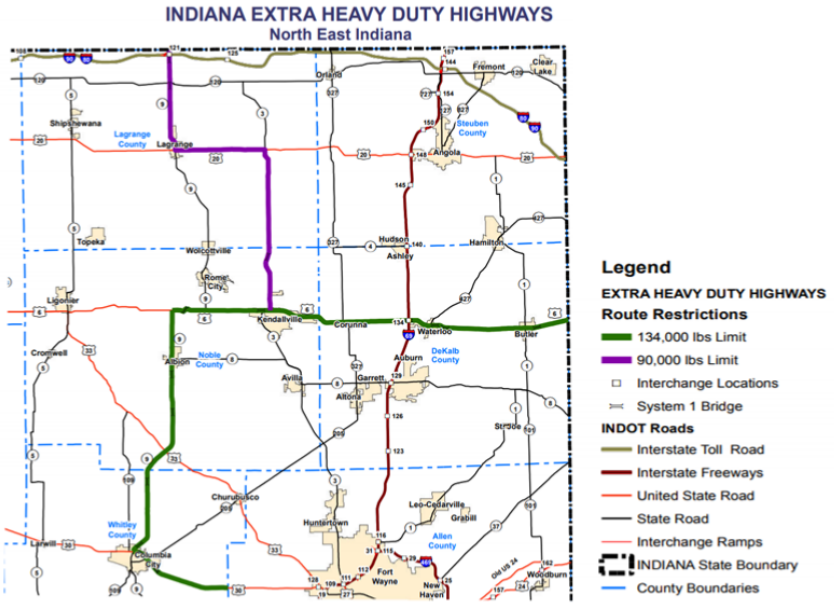


Figure 3. Indiana extra heavy-duty highways – North East Indiana (https://www.in.gov)

The Indiana freight rail system is operated by 44 railroad carriers including five Class I railroads, 39 Class II and III railroads (Table 3). The railroad class is defined by the Federal Surface Transportation Board based on carrier's annual revenue. Out of 3,884 active route miles, 2,315 route miles (60%) are operated by class I carriers, and the remaining miles are operated by class II and III carriers. Based on our review, the connectivity of the railroad network is not sufficiently dense for hardwood movements. There is an opportunity to connect the hardwood hubs in Indiana counties (e.g. Dubois) to the main railway terminals in Chicago. Currently, most of the hardwood commodities in Indiana is transported by truck but this can be balanced with better railroad connectivity to the Chicago network.

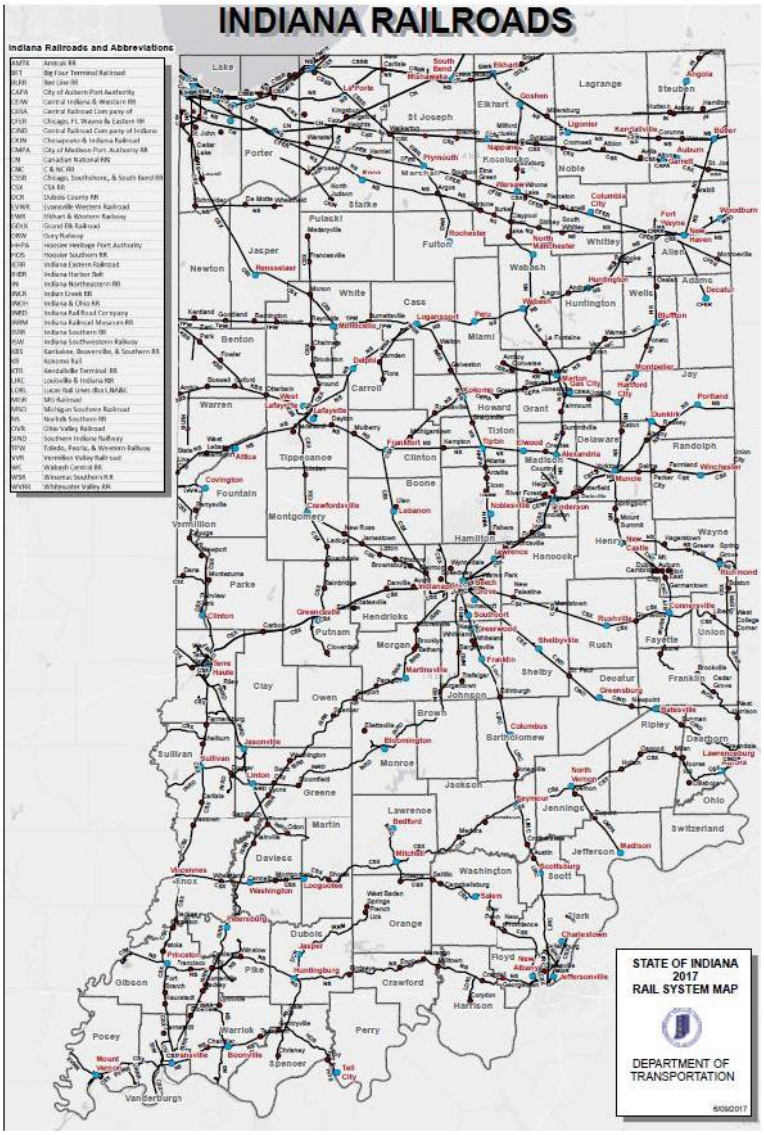


Figure 4. Indiana railroads map [13]

The list of Indiana railroad carriers is presented in the table follows.

Table 5. Indiana railroad carriers [14]

Class I railroads
Canadian National Railway
Canadian Pacific
CSX Transportation
Norfolk Southern Corporation
Union Pacific Railroad
Regional (class II) railroads
The Indiana & Ohio Railway
The Indiana Rail Road
Local (class II) railroads
Bee Line
Central Railroad of Indiana
Central Railroad of Indianapolis
Chesapeake and Indiana Railroad Company
Chicago, Ft. Wayne & Eastern Railroad
Chicago, South Shore, & South Bend RR
City of Auburn Port Authority
Dubois County Railroad
Elkhart & Western Railroad Co.
Evansville Western Railway
Fulton County, LLC
Gary Railway Company
Grand Elk Railroad
Honey Creek/Bunge Corporation
Hoosier Southern Railroad
Indiana Eastern Railroad
Indiana Northeastern Railroad Company
Indiana Southern Railroad, Inc.
Kankakee, Beaverville & Southern Railroad
Louisville & Indiana Railroad Company
Lucas Rail Lines
Madison Railroad
Ohio Valley Railroad Company
Southern Indiana Railway
U S Rail Corporation
Toledo, Peoria & Western Railroad Corp.
Switching and terminal (class III) railroads
C & NC Railroad Corporation
Central Indiana & Western Railroad
Indian Creek Railroad
Indiana Harbor Belt Railroad Company
Indiana Southwestern Railway Company
Kendallville Terminal Railway Company
Maumee & Western Railroad Company
MG Rail, Inc.
Vermillion Valley Railroad Company
Wabash Central Railroad Corporation
Winamac Southern Railway Company

Because of the limited nature of port activity for hardwood transportation (as can be seen from Figure 12, Figure 13, and Figure 16), we will not summarize the various ports in Indiana. They can be found at (http://www.portsofindiana.com/).

Intermodal Terminals

The railroad industry operates two intermodal terminals, which are Senate Avenue (Indianapolis) and Gest Street (Cincinnati, OH) (Figure 6). In addition, railways also have access to all three ports of Indiana, which facilitate the intermodal transportation. But most of the

port facilities do not handle hardwood currently. This could change if the demand for raw logs increases from the overseas market. Currently, they are primarily used for corn and other agriculture products.

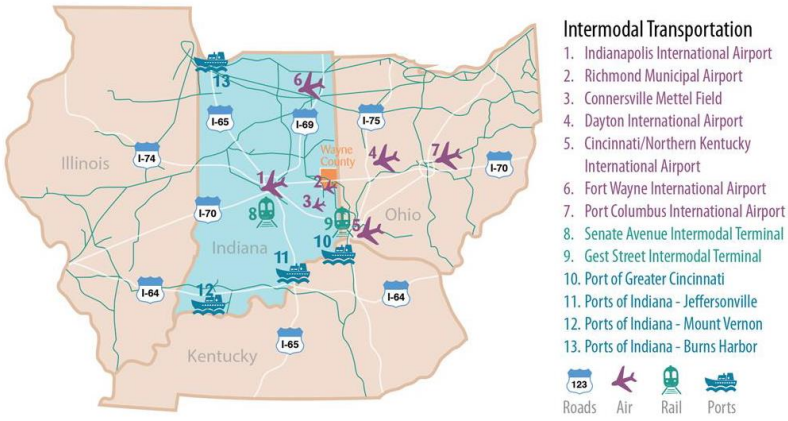


Figure 5. Indiana intermodal transportation (http://www.portsofindiana.com/)

The highway, railway, and port systems as well as intermodal hubs provide good accessibility, both internally and externally, for the Indiana hardwood industry. As the "crossroads of America," Indiana provides convenient access to the West and East coasts via highways and railways. In addition, direct connections to the Great Lakes and the Gulf of Mexico create advantages for Indiana firms that heavily rely on international export. However, the southern areas of the state would benefit from more connection to some major northern consumption hubs (e.g., Chicago) to reduce the transportation costs [1]. In addition, the railway system plays a significant role for importing various materials for the furniture industry from the eastern counties of Indiana but the current rail connectivity is inadequate. One of the stakeholder respondents identified the need for an intermodal hub close to Indianapolis since there are many saw mills within 50-75 miles radius. The intermodal transportation, especially railway integration, is significant for larger companies to consolidate shipments and utilize railway facilities. There is a need for an intermodal hub in southern Indiana to allow for better connectivity with neighboring transportation hubs. The integration will provide less dependence on road networks; therefore, it may shorten transport times.

1.3 Truck weight limits on state, federal, and county roads

The truck weight limits in Indiana are governed by the 1975 "Bridge Formula" as state law stipulated in IC 9-20-40-1 (Table 6). The formula is used to calculate the maximum legal gross weight and axle weights allowed for a vehicle or combination of vehicles.

$$W = 500\{[(LN) \div (N-1)] + 12N + 36\}$$

W = the overall gross weight on any group of two or more consecutive axles, to the nearest 500 pounds.

L = the distance between the extreme of any group of two or more consecutive axles. (The measurement is taken at center of the wheel hubs).

N = the number of axles in the group under consideration, except that two consecutive sets of tandem axles may carry a gross load of 34,000 pounds each, providing the first and last axles of the consecutive sets of tandem axles are at least 36 feet apart or more.

Table 6. Summary of Indiana Truck Weight Limits for Vehicles in Regular Operations [15]

	State and Interstate Highways	Heavy Duty Highways	Extra Heavy-Duty Highways
Single Axle	20,000 lbs.	22,400 lbs.	18,000 lbs. 65,000 lbs. (on one specified intersection)
Tandem Axle	34,000 lbs.	36,000 lbs. (18,000 lbs. for each axle)	32,000 lbs.*
Tridem Axle	50,000 lbs. with lift axle, 48,000 lbs. otherwise		
Gross Weight	80,000 lbs.	80,000 lbs. 90,000 lbs. on Indiana Toll Road**	134,000 lbs. 90,000 lbs. (on one specified intersection) 264,000 lbs. (on one specified intersection)
Other	800 lbs. per inch width of tire 1.5 percent scale tolerance	800 lbs. per inch width of tire 1.5 percent scale tolerance	800 lbs. per inch width of tire 1,650 lbs. per inch width of tire (on one specified intersection) 1.5 percent scale tolerance

*An axle in an axle combination may not exceed 13,000 lbs. per axle, or 26,000 lbs. total for a two-axle group, except for one tandem group, which may weigh 16,000 lbs. per axle, or 32,000 lbs. total (Ind. Code Ann. §9-20-5-5).

**Statute (Ind. Code Ann. §9-20-4-1(b) (4)) calls for the DOT to make rules on weight limits for the toll road. The 90,000-lb. limit is not in the statute but was confirmed by the State for this report.

Most of the trucks that carry hardwood are capped at 80,000 pounds. This could potentially be revised given the bulk nature of the products and to make the industry more competitive. Perhaps some of the major interstates and local roads in the north and south can benefit from a higher weight limit. In fact, Indiana has increased weight limit to 97,000 pounds for trucks which haul "from the point of harvest to the point of first destination bark, logs, sawdust, wood chips, or agricultural commodities" (Indiana Code P.L. 154-2017). A negative consequence of the higher weight limits is the costs associated with pavement deterioration and the maintenance costs with fixing these roads. In addition, some studies have shown the safety risk (increase in severity of crashes) on roadways with heavy load trucks. An exact cost benefit analysis of the higher weigh limits for the hardwood industry is beyond the scope of this report. A few of the stakeholders responded that the weight limits are a concern. In general, truck weight limits influence hardwood delivery consolidation. The local transportation system can be improved to facilitate a higher consolidation and truck weight (e.g., for transport (1) and (2) in Figure 1) which will potentially reduce the hardwood firms' costs.

By comparison, other neighboring states, (Illinois, Kentucky, Ohio, and Michigan) have similar truck weight limits for vehicles in regular operations as Indiana (presented in column 'State and interstate highways' in Table 6), except the weight limit for tridem axle of Illinois, Kentucky, Ohio states are lower, which are 48,000 lbs., 42,500 lbs., and 48,000 lbs., respectively [15]. For the 'Other' group, Ohio and Michigan provide limits of 650 lbs. and 700 lbs. per inch width of tire, respectively, which are also lower than the limits in Indiana [15]. However, regarding federal truck weight limits, Michigan allows much heavier weight on all interstate routes and designated state highways than the other four states, as can be seen in Table 7. Indiana should consider increasing the weight limit, which is important for the hardwood industry.

Table 7. State exceptions to federal truck weight limits [15]

State	Maximum GVW	Maximum Axle Weights	Applicable routes
Indiana	127,400 lbs. Single: 22,400 lbs.	127,400 lbs. Single: 22,400 lbs.	Some sections of I-80/90, and I90
Illinoi	-	-	-
Kentucky	-	-	-
Ohio	127,400/ 115,000 lbs.	Single: 21,000 lbs Tandem: 34,000 lbs	Some sections of I-76, I80, and OH-7

Michigan	164,000 lbs. Single: 18,000 lbs.	164,000 lbs. Single: 18,000 lbs.	All Interstate routes & designated State highways

1.4 Weight Limits on Bridges

Legally, any truck that travels Indiana roadways has to follow restrictions on dimensions and weights as below: "13 feet 6 inches in height; 8 feet 6 inches in width; 40 feet in length for a single vehicle; 60 feet in length for a two-vehicle combination. If a two-vehicle combination is connected by a fifth wheel hook-up, there is not an overall length limit, but the trailer and load length cannot exceed 53 feet. Weight regulations are: 80,000 pounds gross vehicle weight; 12,000 pounds on the steering axle; 20,000 pounds on a single axle; 34,000 pounds on a tandem axle; 800 pounds per inch of rim width and subject to the above axle weights" [16].

There are 19,245 bridges in Indiana. Out of these there are 9,902 (51 %) in fair condition, and 1,464 bridges (7.6 %) in poor conditions [17]. The total structurally deficient (SD) bridges are 1,533 (7.97%). The Federal Highway Administration [18] defines SD bridges "are characterized by deteriorated conditions of significant bridge elements and potentially reduced load-carrying capacity." The SD "bridges typically require significant maintenance and repair to remain in service, and would eventually require major rehabilitation or replacement to address the underlying deficiency." A bridge "does not meet current design standards (for criteria such as lane width), either because the volume of traffic carried by the bridge exceeds the level anticipated when the bridge was constructed and/or the relevant design standards have been revised" is considered as functionally obsolete (FO). "Addressing functional deficiencies may require the widening or replacement of the structure." A mapping of the bridges that are SD is presented in Figure 6. As shown in the figure, many SD bridges are located in middle or south of Indiana where sawmills are located. This is critical for the hardwood industry, since trucks have to transport heavy loads and may be at risk as they go through those SD bridges. Consequently, trucks may have to be re-routed, leading to longer travel time and lower weight limits and utilization. As such, the transportation cost (e.g., fuels) and operation cost (e.g., wages for drivers due to longer working time, vehicle maintenance costs, etc.) will increase for hardwood transportation in Indiana.

Bridges' clearance is also considered in the logistics route selection. Figure 7 presents bridges' clearance on the interstates, US highways, and state routes. Dots and colors are illustrated for clearance levels.

The two tools presented in Figure 6 and Figure 7 are useful to identify SD or FO (if any) and minimum clearance of bridges on a planned route. Since a bridge's condition, weight limit, and clearance are helpful information to plan transportation routes, it is necessary to integrate this information into one single tool so truck drivers of the hardwood industry can do route planning more efficiently to avoid structurally deficient bridges and ones that do not have proper clearance.

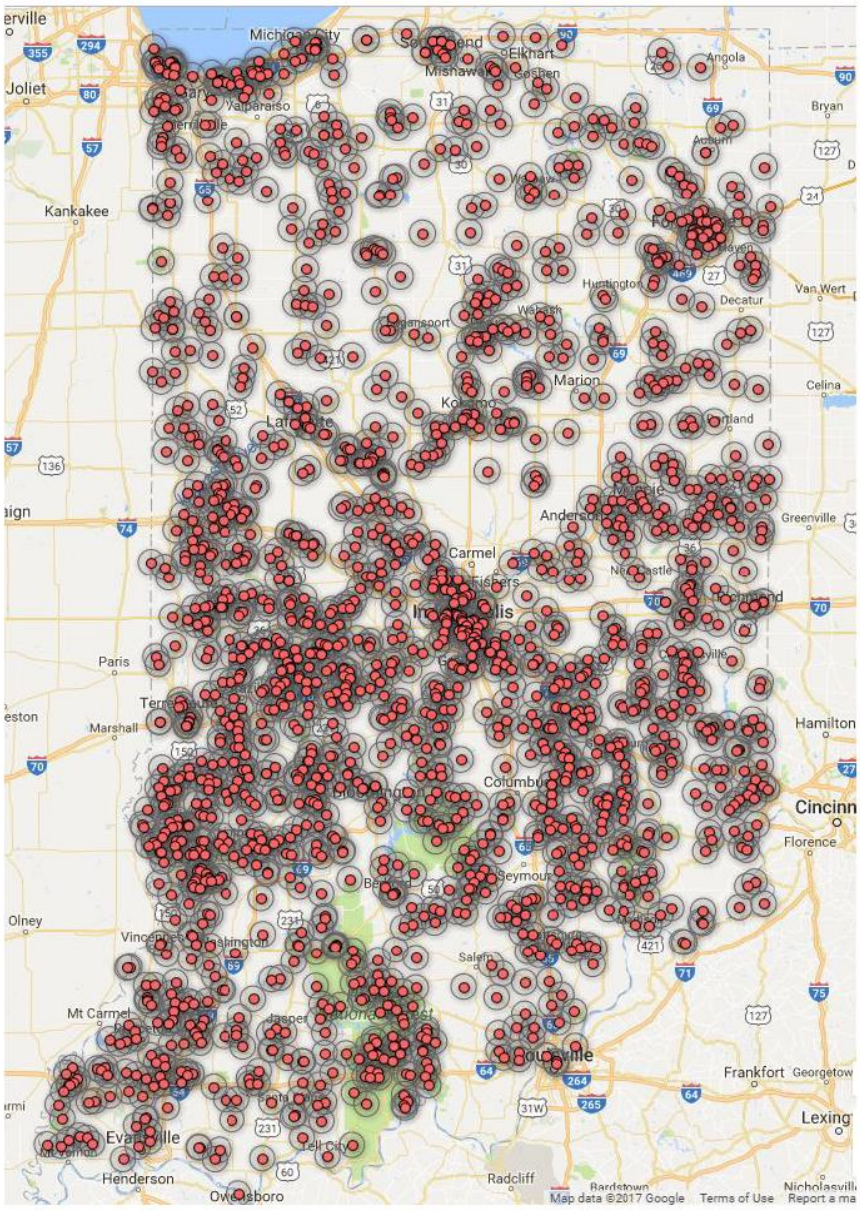


Figure 6. Mapping structurally deficient bridges (red dots) [19]

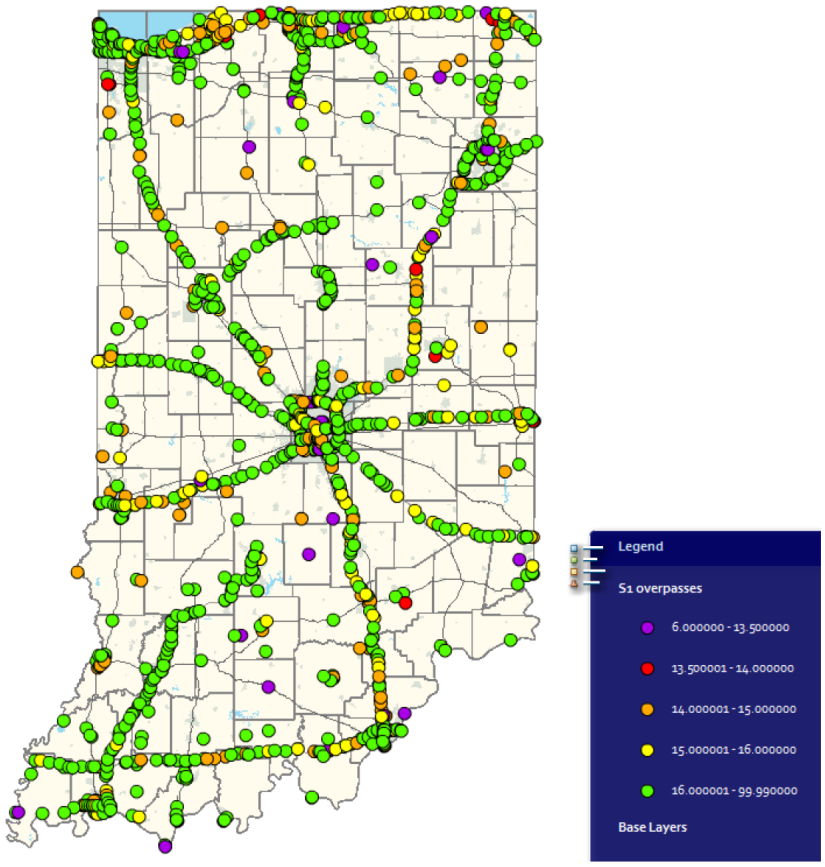


Figure 7. INDOT bridges' clearance [20]

1.5 Identifying transfer hubs/intermodals/appropriate collection and shipping routes

In transportation, it is likely that a shipment will be transported from origin to destination by multiple modes. Some possible combinations can be air-truck, sea-truck, sea-rail, rail-truck, sea-rail-truck, truck-sea-truck, or truck-rail-truck. In such intermodal chains, transfer hubs play a significant role for efficient transport. In this project, hardwoods can be transported through the sea and transferred to roadways or railways at ports in the Indiana area, such as Jeffersonville, Mount Vernon, and Burns Harbor (Indiana), and Greater Cincinnati (Ohio). The Burn Harbor port can be accessed from the Atlantic Ocean and the Great Lake, while the other three ports can be reached from the Gulf of Mexico via the Mississippi river.

Since air is not a preferred mode due to the cost/ton being about 12.5 times that of truck [21] (modal shares can be seen in Figure 12 and Figure 13), we will not review it as a candidate for the multimodal transfers. As discussed earlier for railways, Senate Avenue Intermodal Terminal and Gest Street Intermodal Terminal are the two terminals where freight can be transferred. The intermodal transport hubs are connected by highways, such as I-64, I-65, I-69, I-70, I-74, and I-75. However, these are not convenient since they are far away from most of the saw mills in the area. A conveniently located intermodal transfer hub is needed after an analysis of the hardwood commodity flows data over the last few years and projections for the future. The siting of the facility can be an extension of the current project by ISDA.

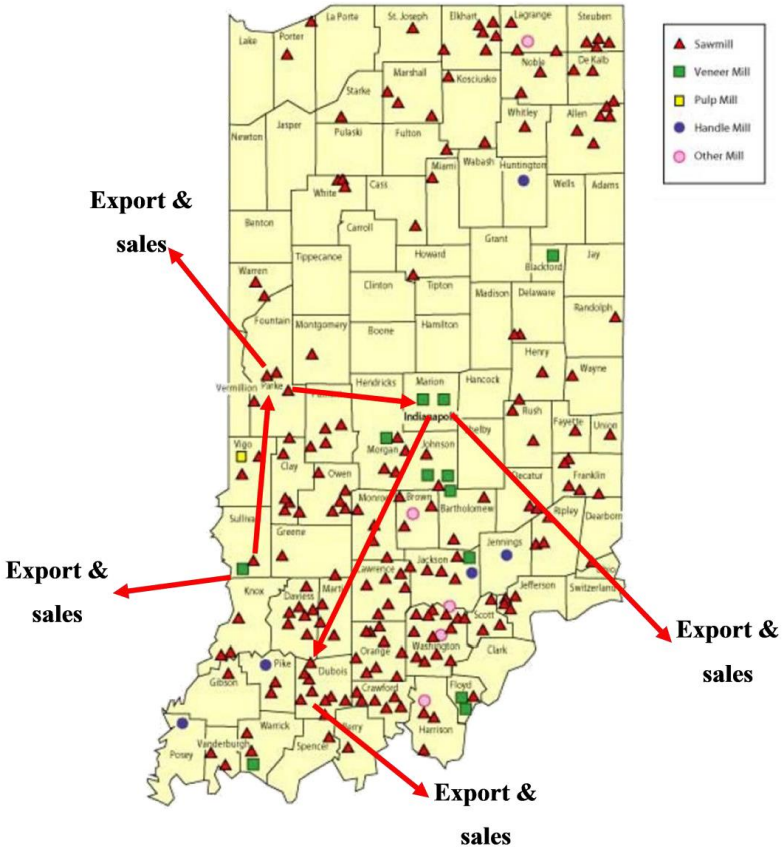


Figure 8. Wood mills facilities locations [22] and wood products industry supply chain in Indiana [1]

Wood mills facilities, however, are an important factor to decide transfer hubs and transportation routings. As can be seen from Figure 8, the majority of wood mills facilities are located in the Southern part of Indiana where forests mainly cover the area. Only several sawmills are situated in the Indiana Northeastern parts.

A large volume of hardwood is exported out of Indiana; therefore, it is important to have appropriately located facilities to cater to the transportation demand and transport the supply. The state government should study the needs of hardwood firms to prepare alternative scenarios, develop plans, and construct better infrastructure systems. More generally, to optimize the hardwood transport, it is necessary to know the wood products (e.g., oak, cherry, spruce, and fir), quality/quantity, origins/destinations (spatial locations), and demand trends. This data should be collected from the hardwood trucking industry, proprietary data sources such as TRANSEARCH and Federal Highway commodity flow data (summarized at the end of this report). TRANSEARCH is a privately maintained comprehensive market research database for intercity freight traffic flows compiled by Global Insight, formerly Reebie Associates. The database includes information describing commodities (by Standard Transportation Commodity Classification (STCC) code), tonnage, origin and destination markets, and mode of transport. Data are obtained from Federal, state, provincial agencies, trade and industry groups, and a sample of motor carriers. Forecasts of commodity flows for up to 25 years also are available. Another source is the database revenue vehicle inventory which provides revenue vehicles by mode and type of service on agency property. The Global Agricultural Trade System (GATS) also includes forest products trade flow statistics. Furthermore, the EMSI database provides state export and import data which can be used for identifying hardwood flows to and from Indiana and then comparing it with neighboring states.

Those datasets should be obtained to derive insights for better siting of intermodal facilities for the hardwood industry and as well as providing additional input for the stakeholders.

1.6 Requirements for domestic and international transports

Other than the truck weights, additional requirements should also be considered once planning for hardwood transportation, especially importing products. International transport requires permits and wooden treatments, while domestic transport needs to follow truck size and weight regulations.

1.6.1 *Importing wood products to the US*

As other imported products, wood products also must fulfil the US custom clearance and duties (unless exempted). Various requirements are applied depending on the products' country of origin and the wooden product category as of U.S. Customs and Border Protection (BCP)'s specifications. Also, the US Department of Agriculture has published regulations to prevent pests, diseases and other biosecurity risks being imported along with wood products into the states (biosecurity import conditions). All timber and timber products need to apply for Import Permit that specifies treatments (e.g., heat or chemical) for the shipments must be followed before being imported into the US. A summary of the US import requirements and procedure is presented in Table 8.

Table 8. US import requirements and procedures ([23] or otherwise cited)

Person in charge	Works to be done
Entry of goods	
The owner, purchaser, or designated licensed customs broker (i.e. the importer of record)	To legally enter the US: • Imported goods must arrive within the port of entry, • Delivery of the merchandise must be authorized by CBP, • Estimated duties must be paid. Within 15 calendar days of the date shipment arrives at a US, entry documents should be filed for the goods with the port director at the goods' port of entry. • Import permit • Evidence of right to make entry, • Commercial invoice or a pro forma invoice when the commercial invoice cannot be produced, • Packing lists, if appropriate, • Other documents necessary to determine merchandise admissibility.
Examination of goods	
CBP's officers	• The value of the goods for customs purposes and their dutiable status, • Whether the goods must be marked with their country of origin or require special marking or labeling. • Whether the shipment contains prohibited articles, • Whether the goods are correctly invoiced, • Whether the goods are more than the invoiced quantities or a shortage exists, • Whether the shipment contains illegal narcotics.

Person in charge	Works to be done
Classification, Appraisement, and Liquidation	
Commercial importers and CBP's officers	Classification should be provided by commercial importers Appraisement and liquidation are determined by the CBP's officers
Restricted merchandise and countries of origin	
Commercial importers	Commercial importers should contact CBP for the permitted items to be imported to the US, especially from Cuba, Iran, North Korea, Sudan, Syria, and Burma. Wood products containing bark that are imported from China may not be allowed, to prevent the spread of wood-boring insects in the US. [24]

1.6.2 *Domestic transports*

There is no Federal length limit for truck tractor-semitrailers except for combination vehicles. Trailer length is at least 48 feet on a semitrailer operating in any truck tractor-semitrailer combination or at least 28 feet on a semitrailer or trailer operating in a truck tractor-semitrailer-trailer (twin-trailer) combination on the national network. Moreover, vehicle width is 102 inches which may not include safety devices (e.g., mirror, handholds). Federal height limit also does not exist. State standards range from 13.6 feet to 14.6 feet. All presented information is gathered from US DOT. Federal Highway Administration (2015) ([15]).

1.7 Policies for bulk goods movement/freight (forest and wood product) for Indiana

This section will provide additional information impacting bulk goods movement, such as diesel taxations, diesel prices, and foreign-trade zones.

In the Transportation Energy Data Book, the 2015 US oil consumption of the transportation sector accounts for about 70% of the total [25]. In which, light-duty vehicles consume 61%, and 21% oil is consumed by medium and heavy-duty vehicles. As such, oil price plays a remarkable role in the transportation sector. The recent increases in fuel cost have increased the transportation cost in the hardwood industry. In fact, most vehicles operated in the hardwood industry use diesel. Table 9 summaries diesel taxes (2015) and average annual diesel prices of Indiana and neighboring states. As can be observed, Indiana taxes diesel much lower than federal rate as well as Illinoi, Kentucky, and Ohio states. It is interesting that Michigan taxes diesel lowest, but its final diesel price is highest in the five states. Moreover,

the Indiana average diesel price is lower than that of national and neighboring states Illinois, Ohio, and Michigan. This is in fact an advantage for the Indiana logistics sector.

Table 9. Diesel taxes (2015) [26] and average annual diesel prices (as of May 2, 2018) [27]

State	Diesel taxes		Diesel prices	
	Tax rate (%)	% compared to national	Price ($/gallon)	% compared to national
Indiana	**16**	**63.5%**	**2.412**	**95.6%**
Illinoi	22	87.3%	2.469	97.8%
Kentucky	22	87.3%	2.236	88.6%
Ohio	28	111.1%	2.473	98.0%
Michigan	15	59.5%	2.554	101.2%
National	**25.2**	**100.0%**	**2.524**	**100.0%**

Foreign-trade zones (FTZs) "are secure areas under U.S. Customs and Border Protection (CBP) supervision that are generally considered outside CBP territory upon activation" [28]. FTZs which are close to the hardwoods firms' locations will provide more convenient, therefore, save associated costs for the firms. Table 10 shows numbers of FTZs for the five study states.

Table 10. List of numbers of FTZs by state [29]

State	Numbers of FTZs
Indiana	6
Illinoi	8
Kentucky	3
Ohio	9
Michigan	7

In addition to improving the transportation network as discussed earlier, warehousing systems, and distribution systems, alternative policies to bring reduce state/local taxes, diesel rates, and gasoline prices are still needed to leverage the hardwood industry. Those policies will possibly enhance, indirectly, hardwood products to domestic and international market.

1.8 Other Issues

Based on our interviews of the stakeholders, we also identified other issues that are challenges to the hardwood industry. We will compare the situation of these with neighboring states:

- A few stakeholders identified the difficulty with finding truck drivers. Given the long hours of the job, technological changes, competition with other industries, low unemployment rate and age restrictions (at least 21 years old), there has been a challenge in finding trucks and truck drivers who are willing to do long haul transportation. Due to truck drivers' shortages, many trucking companies have offered signing bonuses or pay raises to attract more drivers [30]. However, for the long term, some other issues relating the driver shortages should also be addressed. Many drivers are concerned about the perception of their job from citizens and major retailers. Some other drivers are concerned about the lifestyle since most of the time is spent on road. Another issue was lack of healthy food on the roads [30]. These issues need to be addressed in the future to attract more drivers to the hardwood industry.

Table 11. Employment of heavy and tractor-trailer truck drivers, May 2017 [31]

State	Employments
Indiana	45,650 – 182,370
Illinoi	45,650 – 182,370
Kentucky	23,640 – 43,600
Ohio	45,650 – 182,370
Michigan	45,650 – 182,370

Table 12. Annual mean wage of heavy and tractor trailer truck drivers, May 2017 [31]

State	Annual mean wage
Indiana	$44,300 – $46,600
Illinoi	$46,960 – $56,250
Kentucky	$42,260 – $44,260
Ohio	$42,260 – $44,260
Michigan	$19,630 – $42,180

- Lack of containers was also identified as an issue. The time to load the containers is too high (more than 2 days). This is related to the lack of sufficient number of workers in this industry.
- Getting flatbed trailers is also getting difficult due to competition from other logistics industries.

2 REVIEW OF THE DATA SOURCES OF HARDWOOD FLOW MOVEMENTS

2.1 Federal level

In this section, data related to hardwood flows will be studied at federal level as well as Indiana state level. Trends in U.S. - North American wood and wood products since January 2006 to February 2018 (value in millions) [32] are presented in Figures 9-11. Before 2009, wood and wood products of the US, US trading with Canada, and imports to the US were much higher than the later period (i.e. 2010-2018), possibly because of the economic crisis in 2008-2009. Since 2010, those trends fluctuated but are fairly stable around three billion dollars. In addition, the US trade with Mexico did not change significantly from 2006 to 2018.

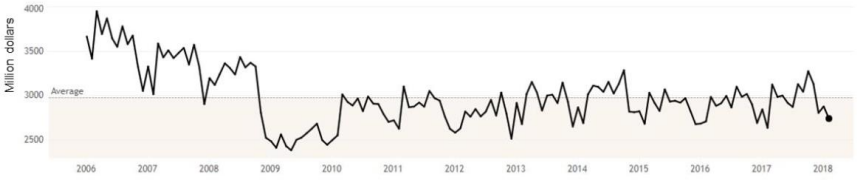


Figure 9. U.S. Total wood and wood products [32]

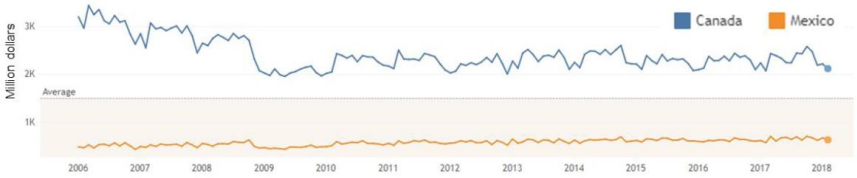


Figure 10. U.S. wood and wood products flows with Canada and Mexico [32]

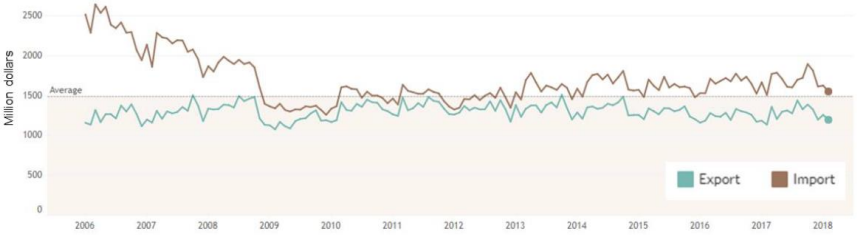


Figure 11. U.S. - North American wood and wood products flows by Exports and Imports [32]

Figures 12 and 13 show the U.S.- North American wood and wood products transported by different modes, from January 2016 to February 2018 (value in millions of dollars). Wood and wood products were mainly imported to the US by truck and rail transportation, whereas trucks was the main mode used for exporting [33].

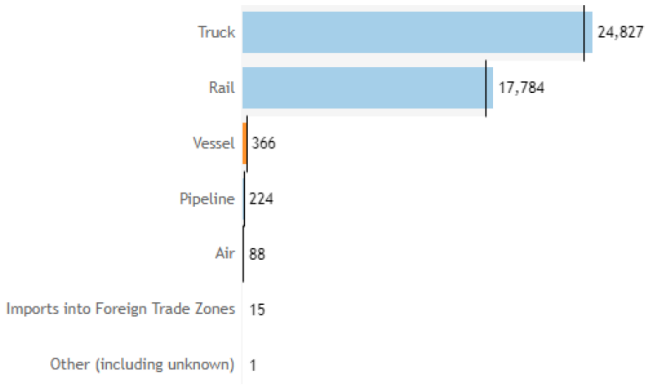


Figure 12. Import - January 2016 to February 2018 (value in millions) [33]

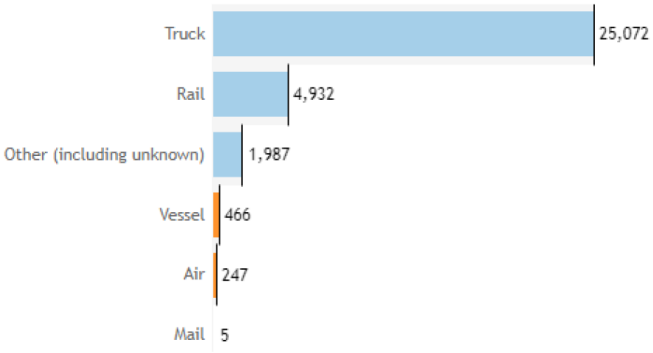


Figure 13. Export - January 2016 to February 2018 (value in millions) [33]

2.2 Indiana level

Regarding Indiana wood industry, Table 13 and Figure 14 illustrates the shipment values of wood products. As can be observed, about 70% of shipment values came from outbound and inbound shipments from/to Indiana. Only about 10% of the hardwood product was exported. The internal shipment values within Indiana accounted for around 18%. In addition, the rail waybills' values of the lumber, wood products, furniture, and fixtures revalues increased from 2012 to 2015, but slightly decreased in 2016 as shown in Figure 15. The rail waybills were recorded from Chicago-Gary-Kenosha (IL-IN-WI) transportation route.

Table 13. Wood product manufacturing shipment values (2012) [34]

O-D	Shipment values (Dollars)
IN-IN	1.871.932
IN-Others	3.637.140
IN-Exp	1.052.402
Others-IN	3.969.702

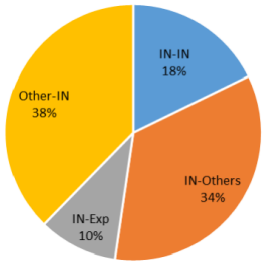


Figure 14. Wood product manufacturing shipment values (2012) [34]

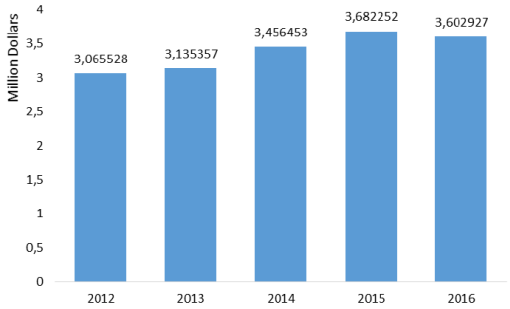
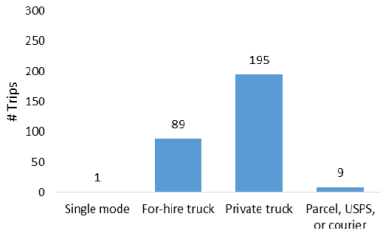
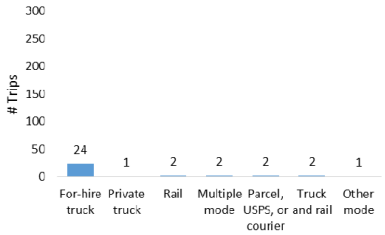


Figure 15. Lumber, wood products, furniture, and fixtures revalues (rail waybills) (Chicago-Gary-Kenosha, IL-IN-WI) [35]

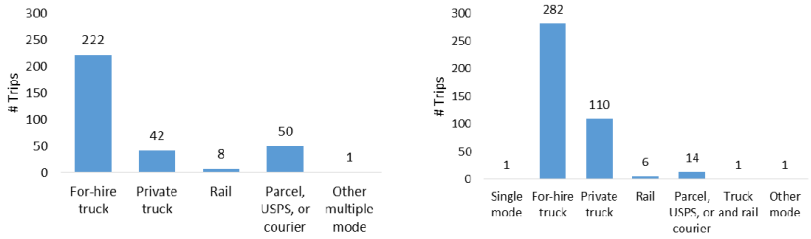
Regarding the transportation modes, the main modes for interstate and within Indiana state transport were for-hire trucks and private trucks, respectively, as presented in Figure 16. Figure 17 displays trip distributions in the hardwood industry. About 70% trips were made between Indiana and other states. The internal transportation took about 28% of the total trips.



a) Within Indiana



b) Export from Indiana



c) Outbound from Indiana to other states d) Inbound from other states to Indiana

Figure 16. Mode of transportation (Wood product manufacturing-2012) [36]

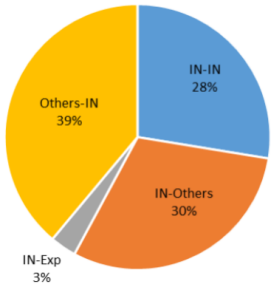


Figure 17. Trip distributions [36]

2.3 Hardwood flow movements

In this section, the detailed information of each commodity (furniture, logs, and wood products) and flow movements (i.e. within Indiana, outbound from Indiana, and inbound to Indiana) are presented by years (tables 12-14). The data was collected and classified into 'Values', 'Tons', 'Ton-miles', and 'Current values'. The 'Values' have been adjusted to the base year of 2012, while the 'Current values' reflect the actual dollar values for the reported year. Predictions for the future year 2045 are also included in the last column. For the hardwood shipments within Indiana, wood products were the biggest shares - in both tons and ton-miles, but furniture brought the highest values among three commodities. Similar trends were observed for hardwood shipments outbound from Indiana and inbound to Indiana. Notably, the hardwood shipments within Indiana had larger shares than outbound and inbound shipments.

Table 14. Hardwood shipments within Indiana [37]

	1997		2002		2007		2012		2013		2014		2015		2045	
Commodity	Constant $ (Within)	Percentage (Within)	Constant $ (Within)	Percentage (Within)	Constant $ (Within)	Percentage (Within)	Constant $ (Within)	Percentage (Within)	Constant $ (Within)	Percentage (Within)	Constant $ (Within)	Percentage (Within)	Constant $ (Within)	Percentage (Within)	Constant $ (Within)	Percentage (Within)
Values																
	4,308.66	**4%**	**5,577.22**	**4%**	**4,673.13**	**3%**	**5,511.31**	**4%**	**5,840**	**3.7%**	**6,098**	**3.7%**	**6,236**	**3.7%**	**8,761**	**3.6%**
Furniture	1,600.84	1%	2,823.45	2%	2,017.30	1%	3,402.32	2%	3,508	2.2%	3,697	2.3%	3,814	2.3%	5,792	2.4%
Logs	504.36	0%	66.87	0%	192.05	0%	67.20	0%	71	0.0%	73	0.0%	76	0.0%	63	0.0%
Wood prods.	2,203.46	2%	2,686.90	2%	2,463.77	1%	2,041.79	1%	2,261	1.4%	2,328	1.4%	2,346	1.4%	2,907	1.2%
Tons																
	11,132.84	**4%**	**6,556.55**	**2%**	**7,417.69**	**2%**	**7,098.36**	**3%**	**7,721**	**3.2%**	**7,971**	**3.2%**	**8,100**	**3.3%**	**9,409**	**2.8%**
Furniture	356.88	0%	452.45	0%	346.33	0%	693.88	0%	716	0.3%	755	0.3%	779	0.3%	1,188	0.4%
Logs	8,201.82	3%	1,869.70	1%	3,168.15	1%	1,603.49	1%	1,695	0.7%	1,735	0.7%	1,817	0.7%	1,502	0.5%
Wood prods.	2,574.14	1%	4,234.40	1%	3,903.21	1%	4,800.99	2%	5,309	2.2%	5,481	2.2%	5,504	2.2%	6,720	2.0%
Ton-miles																
	954.17	**4%**	**542.36**	**2%**	**670.70**	**3%**	**430.13**	**3%**	**469**	**3.8%**	**488**	**3.8%**	**492**	**3.8%**	**607**	**3.4%**
Furniture	29.57	0%	41.59	0%	27.87	0%	80.03	1%	83	0.7%	87	0.7%	90	0.7%	139	0.8%
Logs	719.75	3%	175.05	1%	289.36	1%	16.06	0%	17	0.1%	17	0.1%	18	0.1%	15	0.1%
Wood prods.	204.85	1%	325.72	1%	353.48	1%	334.03	3%	369	3.0%	384	3.0%	384	3.0%	453	2.5%
Current values																
									6,020	**3.8%**	**6,463**	**4.0%**	**6,626**	**4.4%**		
Furniture									3,531	2.2%	3,776	2.3%	3,951	2.6%		
Logs									81	0.1%	98	0.1%	94	0.1%		
Wood prods.									2,409	1.5%	2,588	1.6%	2,581	1.7%		

Table 15. Hardwood shipments outbound from Indiana [37]

	1997		2002		2007		2012		2013		2014		2015		2045	
Commodity	Constant $ (Outbound)	Percentage (Outbound)	Constant $ (Outbound)	Percentage (Outbound)	Constant $ (Outbound)	Percentage (Outbound)	Constant $ (Outbound)	Percentage (Outbound)	Constant $ (Outbound)	Percentage (Outbound)	Constant $ (Outbound)	Percentage (Outbound)	Constant $ (Outbound)	Percentage (Outbound)	Constant $ (Outbound)	Percentage (Outbound)
Values																
	8,259.18	**4%**	**7,223.04**	**3%**	**9,941.72**	**3%**	**4,764.11**	**2%**	**5,198**	**1.7%**	**5,627**	**1.8%**	**5,913**	**1.8%**	**9,671**	**1.5%**
Furniture	5,219.32	2%	4,563.33	2%	7,381.84	3%	3,248.24	1%	3,508	1.2%	3,793	1.2%	4,032	1.2%	6,821	1.1%
Logs	809.32	0%	27.64	0%	63.53	0%	23.38	0%	23	0.0%	24	0.0%	22	0.0%	84	0.0%
Wood prods.	2,230.53	1%	2,632.06	1%	2,496.35	1%	1,492.49	1%	1,667	0.6%	1,810	0.6%	1,859	0.6%	2,765	0.4%
Tons																
	4,381.02	**3%**	**4,225.97**	**2%**	**2,879.32**	**2%**	**3,676.80**	**2%**	**4,104**	**2.2%**	**4,441**	**2.3%**	**4,565**	**2.2%**	**6,364**	**1.9%**
Furniture	633.43	0%	575.12	0%	866.51	0%	555.27	0%	599	0.3%	644	0.3%	683	0.3%	1,213	0.4%
Logs	1,941.81	1%	424.88	0%	108.01	0%	46.14	0%	41	0.0%	44	0.0%	41	0.0%	137	0.0%
Wood prods.	1,805.78	1%	3,225.98	2%	1,904.81	1%	3,075.39	2%	3,465	1.9%	3,753	1.9%	3,841	1.9%	5,014	1.5%
Ton-miles																
	2,144.44	**3%**	**2,246.72**	**3%**	**2,332.69**	**3%**	**2,026.92**	**3%**	**2,229**	**2.8%**	**2,438**	**2.9%**	**2,495**	**2.9%**	**3,656**	**2.5%**
Furniture	461.41	1%	414.17	0%	612.54	1%	407.21	1%	440	0.5%	475	0.6%	501	0.6%	842	0.6%
Logs	722.93	1%	189.19	0%	43.41	0%	65.32	0%	61	0.1%	68	0.1%	64	0.1%	261	0.2%
Wood prods.	960.10	1%	1,643.36	2%	1,676.74	2%	1,554.39	2%	1,728	2.1%	1,895	2.2%	1,930	2.2%	2,553	1.8%
Current values																
									5,394	**1.7%**	**5,974**	**1.8%**	**6,306**	**1.9%**		
Furniture									3,551	1.1%	3,896	1.2%	4,200	1.3%		
Logs									26	0.0%	32	0.0%	27	0.0%		
Wood prods.									1,817	0.6%	2,046	0.6%	2,079	0.6%		

Table 16. Hardwood shipments inbound to Indiana [37]

	1997		2002		2007		2012		2013		2014		2015		2045	
Commodity	Constant $ (Inbound)	Percentage (Inbound)	Constant $ (Inbound)	Percentage (Inbound)	Constant $ (Inbound)	Percentage (Inbound)	Constant $ (Inbound)	Percentage (Inbound)	Constant $ (Inbound)	Percentage (Inbound)	Constant $ (Inbound)	Percentage (Inbound)	Constant $ (Inbound)	Percentage (Inbound)	Constant $ (Inbound)	Percentage (Inbound)
Values																
	6,377.42	**3%**	**7,277.73**	**3%**	**7,350.76**	**3%**	**6,486.23**	**2%**	**6,726**	**2.2%**	**6,971**	**2.2%**	**7,027**	**2.2%**	**14,292**	**2.3%**
Furniture	2,624.00	1%	3,744.42	1%	3,879.80	1%	3,744.20	1%	3,706	1.2%	3,876	1.2%	3,962	1.2%	10,047	1.6%
Logs	350.54	0%	74.01	0%	66.69	0%	44.49	0%	43	0.0%	45	0.0%	47	0.0%	41	0.0%
Wood prods.	3,402.88	2%	3,459.30	1%	3,404.27	1%	2,697.54	1%	2,977	1.0%	3,051	1.0%	3,018	0.9%	4,204	0.7%
Tons																
	10,965.29	**4%**	**6,176.94**	**2%**	**5,458.01**	**2%**	**4,771.07**	**2%**	**5,185**	**2.0%**	**5,313**	**2.0%**	**5,287**	**2.0%**	**8,285**	**2.1%**
Furniture	588.25	0%	672.99	0%	780.34	0%	769.22	0%	752	0.3%	788	0.3%	808	0.3%	2,142	0.5%
Logs	5,895.60	2%	950.55	0%	209.33	0%	44.64	0%	51	0.0%	52	0.0%	55	0.0%	39	0.0%
Wood prods.	4,481.44	2%	4,553.40	2%	4,468.34	2%	3,957.22	2%	4,382	1.7%	4,473	1.7%	4,424	1.7%	6,104	1.5%
Ton-miles																
	4,199.30	**3%**	**3,091.75**	**3%**	**3,083.95**	**3%**	**3,017.34**	**3%**	**3,236**	**2.9%**	**3,320**	**2.9%**	**3,326**	**2.9%**	**6,002**	**3.7%**
Furniture	279.89	0%	425.49	0%	531.98	0%	698.72	1%	660	0.6%	699	0.6%	725	0.6%	2,296	1.4%
Logs	1,459.22	1%	257.61	0%	63.45	0%	53.34	0%	56	0.1%	55	0.0%	61	0.1%	44	0.0%
Wood prods.	2,460.20	2%	2,408.65	2%	2,488.52	2%	2,265.28	2%	2,520	2.3%	2,565	2.2%	2,540	2.2%	3,662	2.2%
Current values																
									7,167	**2.2%**	**7,636**	**2.2%**	**7,728**	**2.3%**		
Furniture									3,933	1.2%	4,159	1.2%	4,325	1.3%		
Logs									49	0.0%	61	0.0%	58	0.0%		
Wood prods.									3,184	1.0%	3,416	1.0%	3,345	1.0%		

SUMMARY

In summary, the transportation sector in Indiana is relatively robust for the development of the hardwood industry. However, specific challenges should be addressed to make this industry competitive. Further data collection should be done to identify candidate locations for hardwood processing and consolidation. Here is a summary of the key points:

- Improvement of the key bottleneck interstates and local roads is needed to reduce the transportation costs of the hardwood industry.
- An intermodal terminal within a 50-75 miles radius of Indianapolis will allow better access to rail and trucking facilities and lower the transportation costs for the hardwood industry.
- Increase in weight limits on Indiana roadways should be considered to make the industry competitive. At least, these weight limits should be comparable to neighboring states. Introducing seasonal weight limits for certain areas can also be make the hardwood industry more competitive by increasing the weight limits during certain months of the year when the hardwood commodity flows are high.
- An integrated database of structurally deficient bridges and bridge clearances should be easily provided to allow better routing of hardwood products.
- Various incentive programs including better salaries should be developed to attract more truck drivers.
- Relaxing the age limit from 21 years to 18 years for operating trucks can potentially solve the shortage of truck drivers.
- Commodity flow data of the hardwood industry should be integrated from various sources to have a better understanding of the important corridors for future growth. Commodity flows within Indiana should also be collected.
- Based on the current and future predictions of flow, a methodology should be developed for identifying processing plants.
- Better integration of the hardwood flows in southern Indiana and northern Indiana should be coordinated by developing a statewide plan.
- Develop a platform which can easily be integrated to the logistics/ hardwood industry systems. Provide incentives to encourage firms to share truck routing, commodity, weight, and other information on the platform. The collected data is valuable for developing hardwood strategies.

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APPENDIX H: Shift-Share Analysis of Hardwood Industries

NAICS	Description	2016 Jobs	National Trend	Industry Trend	Cumulative Expected Change	Actual Job Growth	Competitive Effect 2001-2016
			A	B	C = A+B	D	D-C
PRIMARY							
113110	Timber Tract Operations	87	9	2	11	34	23
113210	Forest Nurseries and Gathering of Forest Products	0	23	(29)	(6)	(138)	(132)
113310	Logging	1,510	224	(260)	(36)	181	217
321113	Sawmills	1,611	366	(953)	(587)	(559)	28
321114	Wood Preservation	161	62	(152)	(90)	(206)	(116)
321211	Hardwood Veneer and Plywood Manufacturing	1,450	454	(1,591)	(1,137)	(1,241)	(104)
321212	Softwood Veneer and Plywood Manufacturing	16	8	(27)	(19)	(34)	(15)
321213	Engineered Wood Member (except Truss) Manufacturing	649	59	(164)	(105)	299	404
321214	Truss Manufacturing	1,013	226	(603)	(377)	(327)	50
321219	Reconstituted Wood Product Manufacturing	44	6	(17)	(11)	7	18
321912	Cut Stock, Resawing Lumber, and Planing	579	118	(360)	(242)	(120)	122
	Total Primary	**7,120**	**1,556**	**(4,154)**	**(2,598)**	**(2,104)**	**494**
SECONDARY							
238350	Finish Carpentry Contractors	6,653	1,356	(1,845)	(489)	(1,387)	(898)
321911	Wood Window and Door Manufacturing	1,368	321	(880)	(559)	(533)	26
321918	Other Millwork (including Flooring)	1,499	332	(1,085)	(753)	(469)	284
NAICS	Description	2016 Jobs	National Trend	Industry Trend	Cumulative Expected Change	Actual Job Growth	Competitive Effect 2001-2016
			A	B	C = A+B	D	D-C

321920	Wood Container and Pallet Manufacturing	3,184	485	(734)	(249)	309	558
321999	All Other Miscellaneous Wood Product Manufacturing	1,527	259	(570)	(311)	(7)	304
337110	Wood Kitchen Cabinet and Countertop Manufacturing	10,703	1,368	(2,929)	(1,561)	2,594	4,155
337121	Upholstered Household Furniture Manufacturing	2,451	312	(918)	(606)	602	1,208
337122	Nonupholstered Wood Household Furniture Manufacturing	1,699	727	(3,640)	(2,913)	(2,608)	305
337127	Institutional Furniture Manufacturing	731	121	(368)	(247)	11	258
337211	Wood Office Furniture Manufacturing	3,726	912	(3,341)	(2,429)	(1,679)	750
337212	Custom Architectural Woodwork and Millwork Manufacturing	489	40	106	146	251	105
337215	Showcase, Partition, Shelving, and Locker Manufacturing	2,527	728	(2,645)	(1,917)	(1,791)	126
337920	Blind and Shade Manufacturing	585	188	(692)	(504)	(531)	(27)
	Total Secondary	**37,144**	**7,149**	**(19,543)**	**(12,394)**	**(5,237)**	**7,157**
TERTIARY							
115310	Support Activities for Forestry	327	41	(49)	(8)	86	94
321991	Manufactured Home (Mobile Home) Manufacturing	2,360	1,122	(4,864)	(3,742)	(4,291)	(549)
321992	Prefabricated Wood Building Manufacturing	277	163	(539)	(376)	(692)	(316)
NAICS	Description	2016 Jobs	National Trend	Industry Trend	Cumulative Expected Change	Actual Job Growth	Competitive Effect 2001-2016

			A	B	C = A+B	D	D-C
339992	Musical Instrument Manufacturing	1,329	421	(1,570)	(1,149)	(1,165)	(16)
339995	Burial Casket Manufacturing	646	265	(479)	(214)	(926)	(712)
	Total Tertiary	**4,939**	**2,012**	**(7,501)**	**(5,489)**	**(6,987)**	**(1,498)**
SUPPLIERS							
325520	Adhesive Manufacturing	664	164	(271)	(107)	(310)	(203)
327910	Abrasive Product Manufacturing	220	23	(61)	(38)	82	120
332216	Saw Blade and Handtool Manufacturing	397	177	(683)	(506)	(654)	(148)
333243	Sawmill, Woodworking, and Paper Machinery Manufacturing	653	128	(463)	(335)	(104)	231
333991	Power-Driven Handtool Manufacturing	29	21	(82)	(61)	(97)	(36)
	Total Suppliers	**1,963**	**514**	**(1,562)**	**(1,048)**	**(1,083)**	**(35)**
WHOLESALERS							
423210	Furniture Merchant Wholesalers	1,345	205	(52)	153	130	(23)
423220	Home Furnishing Merchant Wholesalers	916	123	(106)	17	188	171
423310	Lumber, Plywood, Millwork, and Wood Panel Merchant Wholesalers	2,438	490	(899)	(409)	(466)	(57)
423930	Recyclable Material Merchant Wholesalers	3,993	744	(620)	124	(415)	(539)
424110	Printing and Writing Paper Merchant Wholesalers	143	30	(85)	(55)	(33)	22
424130	Industrial and Personal Service Paper Merchant Wholesalers	616	211	(372)	(161)	(636)	(475)
	Total Wholesalers	**9,451**	**1,802**	**(2,133)**	**(331)**	**(1,232)**	**(901)**
PAPER MANUFACTURING							
322110	Pulp Mills	0	0	0	0	0	0
322121	Paper (except Newsprint) Mills	111	57	(227)	(170)	(230)	(60)

NAICS	Description	2016 Jobs	National Trend	Industry Trend	Cumulative Expected Change	Actual Job Growth	Competitive Effect 2001-2016
			A	B	C = A+B	D	D-C
322122	Newsprint Mills	0	0	0	0	0	0
322130	Paperboard Mills	889	139	(358)	(219)	66	285
322211	Corrugated and Solid Fiber Box Manufacturing	4,428	894	(2,466)	(1,572)	(870)	702
322212	Folding Paperboard Box Manufacturing	849	282	(777)	(495)	(822)	(327)
322219	Other Paperboard Container Manufacturing	536	126	(360)	(234)	(212)	22
322220	Paper Bag and Coated and Treated Paper Manufacturing	2,009	368	(1,018)	(650)	(172)	478
322230	Stationery Product Manufacturing	381	88	(377)	(289)	(141)	148
322299	All Other Converted Paper Product Manufacturing	428	102	(220)	(118)	(175)	(57)
	Total Paper Manufacturing	**9,630**	**2,056**	**(5,802)**	**(3,746)**	**(2,556)**	**1,190**

APPENDIX I: Emsi Class of Worker Definitions

The jobs data in the Emsi model are comprised of four classes. The jobs. LQ, competitive shifts, etc. are based on QCEW, Non QCEW, and Self Employed classes of jobs. The supply chain charts are based on the input-output (IO) model and include all the four classes of workers. This Appendix includes definitions of the four classes as provided by the Emsi (www.economicmodeling.com).

QCEW (Quarterly Census of Employment and Wages): A form of the BLS QCEW dataset that has been modified slightly by EMSI. Suppressions have been removed, public sector employment has been reorganized, and county and NAICS changes have been modified in past years for consistency. This dataset is designed to match QCEW in almost all cases, and should be used by clients who wish to match official sources.

Non QCEW: Attempts to cover jobs which fall under an employer-employee relationship but are not covered by QCEW. The major types of employment covered in this set include military jobs, railroad jobs, many nonprofit and religious workers, certain salespersons, miscellaneous Federal Government and some other government workers.

Self Employed: Covers people who, when responding to Census surveys, consider self-employment to be a significant part of their income or time spent working. Most people normally considered "self-employed" would fall into this dataset.

Extended Proprietors: Covers the same type of jobs as the "self-employed" dataset, but these jobs represent miscellaneous labor income for persons who do not consider it a primary job. Includes minor or underreported self-employment, investments trusts and partnerships, certain farms and tax-exempts nonprofit cooperatives. This dataset is normally only used for Input-Output purposes, since investments and partnership in particular will be overrepresented in certain sectors.

Source: Economic Modeling Specialists, International (Emsi)

APPENDIX J: Definitions of NAICS Codes Listed in Table 3 and 4

Table 24: Primary, Secondary and Tertiary Wood Products Industries

NAICS	Description	Definitions
PRIMARY		
113110	Timber Tract Operations	This industry comprises establishments primarily engaged in the operation of timber tracts for the purpose of selling standing timber.
113210	Forest Nurseries and Gathering of Forest Products	This industry comprises establishments primarily engaged in (1) growing trees for reforestation and/or (2) gathering forest products, such as gums, barks, balsam needles, rhizomes, fibers, Spanish moss, ginseng, and truffles.
113310	Logging	This industry comprises establishments primarily engaged in one or more of the following: (1) cutting timber; (2) cutting and transporting timber; and (3) producing wood chips in the field.
321113	Sawmills	This U.S. industry comprises establishments primarily engaged in sawing dimension lumber, boards, beams, timbers, poles, ties, shingles, shakes, siding, and wood chips from logs or bolts. Sawmills may plane the rough lumber that they make with a planing machine to achieve smoothness and uniformity of size.
321114	Wood Preservation	This U.S. industry comprises establishments primarily engaged in (1) treating wood sawed, planed, or shaped in other establishments with creosote or other preservatives, such as alkaline copper quat, copper azole, and sodium borates, to prevent decay and to protect against fire and insects and/or (2) sawing round wood poles, pilings, and posts and treating them with preservatives.
321211	Hardwood Veneer and Plywood Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing hardwood veneer and/or hardwood plywood.

NAICS	Description	Definitions
321212	Softwood Veneer and Plywood Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing softwood veneer and/or softwood plywood.
321213	Engineered Wood Member (except Truss) Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing fabricated or laminated wood arches and/or other fabricated or laminated wood structural members.
321214	Truss Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing laminated or fabricated wood roof and floor trusses.
321219	Reconstituted Wood Product Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing reconstituted wood sheets and boards.
321912	Cut Stock, Resawing Lumber, and Planing	This U.S. industry comprises establishments primarily engaged in one or more of the following: (1) manufacturing dimension lumber from purchased lumber; (2) manufacturing dimension stock (i.e., shapes) or cut stock; (3) resawing the output of sawmills; and (4) planing purchased lumber. These establishments generally use woodworking machinery, such as jointers, planers, lathes, and routers to shape wood.
SECONDARY		
238350	Finish Carpentry Contractors	This industry comprises establishments primarily engaged in finish carpentry work. The work performed may include new work, additions, alterations, maintenance, and repairs.
321911	Wood Window and Door Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing window and door units, sash, window and door frames, and doors from wood or wood clad with metal or plastics.
321918	Other Millwork (including Flooring)	This U.S. industry comprises establishments primarily engaged in manufacturing millwork (except wood windows, wood doors, and cut stock).
321920	Wood Container and Pallet Manufacturing	This industry comprises establishments primarily engaged in manufacturing wood pallets, wood box shook, wood boxes, other wood containers, and wood parts for pallets and containers.

NAICS	Description	Definitions
321999	All Other Miscellaneous Wood Product Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing wood products (except establishments operating sawmills and preservation facilities; establishments manufacturing veneer, engineered wood products, millwork, wood containers, pallets, and wood container parts; and establishments making manufactured homes (i.e., mobile homes) and prefabricated buildings and components).
337110	Wood Kitchen Cabinet and Countertop Manufacturing	This industry comprises establishments primarily engaged in manufacturing wood or plastics laminated on wood kitchen cabinets, bathroom vanities, and countertops (except freestanding). The cabinets and counters may be made on a stock or custom basis.
337121	Upholstered Household Furniture Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing upholstered household-type furniture. The furniture may be made on a stock or custom basis.
337122	Non-upholstered Wood Household Furniture Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing nonupholstered wood household-type furniture and freestanding cabinets (except television, stereo, and sewing machine cabinets). The furniture may be made on a stock or custom basis and may be assembled or unassembled (i.e., knockdown).
337127	Institutional Furniture Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing institutional-type furniture (e.g., library, school, theater, and church furniture). Included in this industry are establishments primarily engaged in manufacturing general purpose hospital, laboratory, and dental furniture (e.g., tables, stools, and benches). The furniture may be made on a stock or custom basis and may be assembled or unassembled (i.e., knockdown).
337211	Wood Office Furniture Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing wood office-type furniture. The furniture may be made on a stock or custom basis and may be assembled or unassembled (i.e., knockdown).
337212	Custom Architectural Woodwork and Millwork Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing custom designed interiors consisting of architectural woodwork and fixtures utilizing wood, wood products, and plastics laminates. All of the industry output is made to individual order on a job shop basis and requires skilled craftsmen as a labor input. A job might include custom manufacturing of display fixtures, gondolas, wall shelving units, entrance and window architectural detail, sales and reception counters, wall paneling, and matching furniture.

NAICS	Description	Definitions
337215	Showcase, Partition, Shelving, and Locker Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing wood and nonwood office and store fixtures, shelving, lockers, frames, partitions, and related fabricated products of wood and nonwood materials, including plastics laminated fixture tops. The products are made on a stock or custom basis and may be assembled or unassembled (i.e., knockdown). Establishments exclusively making furniture parts (e.g., frames) are included in this industry.
337920	Blind and Shade Manufacturing	This industry comprises establishments primarily engaged in manufacturing one or more of the following: venetian blinds, other window blinds, and shades; curtain and drapery rods and poles; and/or curtain and drapery fixtures. The blinds and shades may be made on a stock or custom basis and may be made of any material.
TERTIARY		
115310	Support Activities for Forestry	This industry comprises establishments primarily engaged in performing particular support activities related to timber production, wood technology, forestry economics and marketing, and forest protection. These establishments may provide support activities for forestry, such as estimating timber, forest firefighting, forest pest control, treating burned forests from the air for reforestation or on an emergency basis, and consulting on wood attributes and reforestation.
321991	Manufactured Home (Mobile Home) Manufacturing	This U.S. industry comprises establishments primarily engaged in making manufactured homes (i.e., mobile homes) and nonresidential mobile buildings. Manufactured homes are designed to accept permanent water, sewer, and utility connections and although equipped with wheels, they are not intended for regular highway movement.
321992	Prefabricated Wood Building Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing prefabricated wood buildings and wood sections and panels for prefabricated wood buildings.
339992	Musical Instrument Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing musical instruments (except toys).
339995	Burial Casket Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing burial caskets, cases, and vaults (except concrete).

Source: U.S. Census Bureau

Table 25: Suppliers, Wholesalers and Paper Manufacturing Industries

NAICS	Description	Definitions
SUPPLIERS		
325520	Adhesive Manufacturing	This industry comprises establishments primarily engaged in manufacturing adhesives, glues, and caulking compounds.
327910	Abrasive Product Manufacturing	This industry comprises establishments primarily engaged in manufacturing abrasive grinding wheels of natural or synthetic materials, abrasive-coated products, and other abrasive products.
332216	Saw Blade and Hand tool Manufacturing	This U.S. industry comprises establishments primarily engaged in (1) manufacturing saw blades, all types (including those for power sawing machines) and/or (2) manufacturing nonpowered handtools and edge tools.
333243	Sawmill, Woodworking, and Paper Machinery Manufacturing	This U.S. industry comprises establishments primarily engaged in (1) manufacturing sawmill and woodworking machinery (except handheld), such as circular and band sawing equipment, planing machinery, and sanding machinery, and/or (2) manufacturing paper industry machinery for making paper and paper products, such as pulp making machinery, paper and paperboard making machinery, and paper and paperboard converting machinery.
333991	Power-Driven Hand tool Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing power-driven (e.g., battery, corded, pneumatic) handtools, such as drills, screwguns, circular saws, chain saws, staplers, and nailers.
WHOLESALERS		
423210	Furniture Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of furniture (except hospital beds, medical furniture, and drafting tables).
423220	Home Furnishing Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of home furnishings and/or housewares.
423310	Lumber, Plywood, Millwork, and Wood Panel Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of lumber; plywood; reconstituted wood fiber products; wood fencing; doors and windows and their frames (all materials); wood roofing and siding; and/or other wood or metal millwork.
423930	Recyclable Material Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of automotive scrap, industrial scrap, and other recyclable materials. Included in this industry are

NAICS	Description	Definitions
		auto wreckers primarily engaged in dismantling motor vehicles for the purpose of wholesaling scrap.
424110	Printing and Writing Paper Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of bulk printing and/or writing paper generally on rolls for further processing.
424130	Industrial and Personal Service Paper Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of kraft wrapping and other coarse paper, paperboard, converted paper (except stationery and office supplies), and/or related disposable plastics products.
PAPER Manufacturing		
322110	Pulp Mills	This industry comprises establishments primarily engaged in manufacturing pulp without manufacturing paper or paperboard. The pulp is made by separating the cellulose fibers from the other impurities in wood or other materials, such as used or recycled rags, linters, scrap paper, and straw.
322121	Paper (except Newsprint) Mills	This U.S. industry comprises establishments primarily engaged in manufacturing paper (except newsprint and uncoated groundwood paper) from pulp. These establishments may manufacture or purchase pulp. In addition, the establishments may also convert the paper they make.
322122	Newsprint Mills	This U.S. industry comprises establishments primarily engaged in manufacturing newsprint and uncoated groundwood paper from pulp. These establishments may manufacture or purchase pulp. In addition, the establishments may also convert the paper they make.
322130	Paperboard Mills	This industry comprises establishments primarily engaged in manufacturing paperboard (e.g., can/drum stock, container board, corrugating medium, folding carton stock, linerboard, tube) from pulp. These establishments may manufacture or purchase pulp. In addition, the establishments may also convert the paperboard they make.
322211	Corrugated and Solid Fiber Box Manufacturing	This U.S. industry comprises establishments primarily engaged in laminating purchased paper or paperboard into corrugated or solid fiber boxes and related products, such as pads, partitions, pallets, and corrugated paper without manufacturing paperboard. These boxes are generally used for shipping.

NAICS	Description	Definitions
322212	Folding Paperboard Box Manufacturing	This U.S. industry comprises establishments primarily engaged in converting paperboard (except corrugated) into folding paperboard boxes without manufacturing paper and paperboard.
322219	Other Paperboard Container Manufacturing	This U.S. industry comprises establishments primarily engaged in converting paperboard into paperboard containers (except corrugated, solid fiber, and folding paperboard boxes) without manufacturing paperboard.
322220	Paper Bag and Coated and Treated Paper Manufacturing	This industry comprises establishments primarily engaged in one or more of the following: (1) cutting and coating paper and paperboard; (2) cutting and laminating paper, paperboard, and other flexible materials (except plastics film to plastics film); (3) manufacturing bags, multiwall bags, sacks of paper, metal foil, coated paper, laminates, or coated combinations of paper and foil with plastics film; (4) manufacturing laminated aluminum and other converted metal foils from purchased foils; and (5) surface coating paper or paperboard.
322230	Stationery Product Manufacturing	This industry comprises establishments primarily engaged in converting paper or paperboard into products used for writing, filing, art work, and similar applications.
322299	All Other Converted Paper Product Manufacturing	This U.S. industry comprises establishments primarily engaged in converting paper or paperboard into products (except containers, bags, coated and treated paper, stationery products, and sanitary paper products) or converting pulp into pulp products, such as egg cartons, food trays, and other food containers from molded pulp.

Source: U.S. Census Bureau