OHIO'S WOOD INDUSTRY CLUSTER

Economic Impact on State and Appalachian Ohio Geographies

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FOR

Appalachian Partnership for Economic Growth

SBA Regional Innovation Cluster Project

2017

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Executive Summary

This report evaluates the State of Ohio's wood industry cluster as part of the Appalachian Partnership for Economic Growth (APEG) U.S. Small Business Administration (SBA) Regional Innovation Cluster (RIC) grant project. The George V. Voinovich School of Leadership and Public Affairs at Ohio University conducted this study on behalf of APEG, based on the desire to assess the economic impact of the wood industry to Ohio and the Appalachian Ohio region. The report provides an overview of industry cluster analysis, reviews Ohio's wood industry cluster, and presents the findings from the economic contribution analysis methodology employed.

The methodology for this report involved a two-step process. First, the researchers organized wood industry firms into 30 distinct sectors using their North American Industry Classification System (NAICS) codes and corresponding IMPLAN codes, and then 13 cluster group categories. Next, the researchers conducted multi-industry economic contribution analyses using IMPLAN version 3.1 and an input-output methodology to determine the impact of the wood industry cluster within the 88-county State of Ohio region, and then the 32-county Appalachian Ohio region. These economic contributions were not only split out by wood industry cluster grouping (explained in greater detail in Section 3.2.), but also by county. Using 2014 data for this analysis, the researchers found:

- Ohio's wood industry contributed $24.98 billion to the state's economy in 2014.
- Full and part-time employment in Ohio's wood industry was 116,321 with $6.26 billion in wages and benefits.
- Within the 32-county Appalachian Ohio region, the wood industry's economic impact was $5.23 billion, employing 26,051 individuals with wages and benefits amounting to $1.17 billion.
- For every job created in Ohio's wood industry, an additional 1.2 jobs are created in the state.
- Across Ohio, the Pulp & Paper industry group employed the most individuals, paid the highest wages, and contributed the most to the state's economy.
- The Millwork and Wood Furniture sectors contributed $3.82 billion and $1.55 billion to the state's economy in 2014, respectively. Over 25% of Ohio's wood industry employees worked in Millwork, while more than 11% worked in the Wood Furniture sector.
- The Sawmill sector contributed $1.16 billion to the state's economy in 2014. Over 60% of the employees in this sector worked in the Appalachian Ohio region.
- Nearly 85% of Ohio's Commercial Logging employees worked in Appalachian Ohio. This sector contributed over $371 million to the state, representing about 75% of the state's total economic impact for this sector.
- Appalachian Ohio's Holmes, Ross, Vinton, Coshocton, and Pike County's wood industry clusters contributed the most to Ohio's economy in 2014, per capita.

Findings from this research indicate that while Ohio's wood products industry cluster serves as an important contributor to the state's economy, most of the value-added wood industry sectors, such as housing and wood furniture manufacturing, occur outside of the state's rural Appalachian region, where most of the wood resources (i.e., forests) exist. Despite containing most of the state's wood resources, Appalachian Ohio contains lower paying and lower on the value chain sectors compared to the rest of the state. For instance, 74.3% of total output and

86.3% of total sales from Ohio's commercial logging takes place in Appalachian Ohio, while most wood processing and manufacturing occurs outside of the region. Nevertheless, the wood industry remains large in Ohio, especially within the rural Appalachian region. There are several prospects for this 32-county region to develop workforce training programs, wood product cooperatives, and other initiatives to improve investment and value-added industry opportunities in the wood industry cluster to support Appalachian Ohio.

1. Introduction to Industry Cluster Characterization and Analysis

Industry cluster analysis is a common and widely used economic development phrase and methodology. Harvard Professor Michael Porter (2003, p. 562) defined industry clusters as a "geographically proximate group of interconnected companies, suppliers, service providers and associated institutions in a particular field, linked by externalities of various types." While various cluster definitions and approaches exist within the academic literature and professional practice, one noteworthy approach to defining clusters comes from Porter's work with the U.S. Cluster Mapping Project. The U.S. Cluster Mapping Project groups over 1,000 six-digit North American Industry Classification System (NAICS) codes into 51 traded clusters and 16 local cluster categories (U.S. Cluster Mapping Project, 2014). Traded clusters are primarily export oriented and sell products outside of the local market, while local clusters primarily serve the local market.

The U.S. Cluster Mapping Project is a respected resource commonly used for cluster identification in nearly any industry. This accessible, non-proprietary tool offers solid high-level data on employment and wages, as well as abundant data visualization tools, at the regional level. However, due to data suppression issues, it fails to provide county-level data on the number of firms and employees at the industry level. This prohibits researchers from conducting industry cluster analyses in smaller, rural geographies (e.g., counties) with the tool. Other methods must often be employed.

2. Defining Ohio's Wood Cluster

Ohio's wood products industry cluster serves as a strong sector in terms of the state's employment and economic development impacts. The businesses in this industry represent important regional economic drivers, particularly within the pulp & paper, millwork, and wood furniture manufacturing sectors. Specifically, Ohio's wood products industry contains three traded clusters (i.e., export-oriented sectors) using Porter's definitions: Forestry, Furniture, and Wood Products. These U.S. Cluster Mapping Project definitions are provided below:

- *Forestry:* "Establishments in this cluster are those that involve growing and harvesting trees. It also includes support services for these activities" (Delgado, Porter, & Stern, 2014, p. 60).

- *Furniture:* "This cluster contains establishments that manufacture furniture, cabinets, and shelving for residential homes and offices. It also includes establishments that produce manufactured homes. The products in this cluster can be made of wood, metal, plastic, and/or textiles" (Delgado, Porter, & Stern, 2014, p. 61).

- *Wood Products:* "The establishments in this cluster are primarily engaged in making upstream wood materials and manufacturing non-furniture wood products. Upstream establishments include sawmills, plywood and hardwood manufacturers, cut stock manufacturers, and wood preservation services. Downstream establishments produce windows, doors, flooring, wood containers, prefabricated wood buildings, and related products" (Delgado, Porter, & Stern, 2014, p. 62).

Tables 1–3 include the corresponding six-digit NAICS codes that comprise each of these clusters via the U.S. Cluster Mapping Project. All U.S. businesses are associated with a NAICS code (Mulangu & Clark, 2012). This classification system operates in a hierarchical manner, ranging from two- through six-digit codes that represent progressively narrower categories. Higher-level codes (i.e., two-digit) capture the largest number of firms, while the three- and four-digit NAICS codes represent subsectors and industry groups, respectively. Finally, six-digit NAICS codes incorporate the most specific firms at an industry level.

Table 1.

Forestry Cluster Components: U.S. Cluster Mapping Project

NAICS Code	Name
113110	Timber Tract Operations
112210	Forest Nurseries & Gathering Forest Products
113310	Logging
115310	Forestry Support Activities

Table 2.

Furniture Cluster Components: U.S. Cluster Mapping Project

NAICS Code	Name
337121	Upholstered Household Furniture Manufacturing
337122	Non-upholstered Wood Household Furniture Manufacturing
337124	Metal Household Furniture Manufacturing
337125	Household Furniture (except Wood and Metal) Manufacturing
337910	Mattress Manufacturing
337127	Institutional Furniture Manufacturing
337211	Wood Office Furniture Manufacturing
337214	Office Furniture (except Wood) Manufacturing
337110	Wood Kitchen Cabinet and Countertop Manufacturing
337129	Wood Television, Radio, and Sewing Machine Cabinet Manufacturing
337215	Showcase, Partition, Shelving, and Locker Manufacturing
321991	Manufactured Home (Mobile Home) Manufacturing

Table 3.

Wood Products Cluster Components: U.S. Cluster Mapping Project

NAICS Code	Name
321113	Sawmills
321114	Wood Preservation
321912	Cut Stock, Resawing Lumber, and Planing
321211	Hardwood Veneer and Plywood Manufacturing
321212	Softwood Veneer & Plywood Manufacturing
321213	Engineered Wood Member (except Truss) Manufacturing
321214	Truss Manufacturing
321219	Reconstituted Wood Product Manufacturing
321911	Wood Window and Door Manufacturing
321918	Other Millwork (including Flooring)
321920	Wood Container and Pallet Manufacturing
321999	All Other Miscellaneous Wood Product Manufacturing
321992	Prefabricated Wood Building Manufacturing

One key challenge associated with the Porter cluster definition used in the U.S. Cluster Mapping Project is that industry clusters are mutually exclusive. Therefore, NAICS codes are assigned to only one industry cluster. This is a pertinent issue for analyzing the wood cluster in Ohio given the presence and goal of expanding the multiple industries in which wood is a central component. For instance, wood furniture and cabinetry industries are not captured in the wood products cluster. The Furniture cluster could be included in the analysis as well, but it does not include upholstered furniture, metal furniture, mattress manufacturing, etc. as outlined in Table 2.

Feser and Bergman (2000) offer a strong alternative to Porter's industry cluster definitions. Their approach utilizes input-output modeling and a scoring methodology to determine the strength of inter-industry linkages. Kelton, Pasquale, and Rebelein (2008) updated the Feser and Bergman approach to correspond with the 2007 NAICS code definitions. A strength of this approach is that the clusters are not mutually exclusive and, thus, better reflect the market-based manner in which industries link across clusters. To illustrate, Sawmills belong to three clusters: Construction Materials, Paper Products, and Wood Products. This approach, different from the prior, identities four cluster definitions relevant to the wood industry in Ohio: Paper Products, Wood Products, Furniture and Household Items, and Agriculture, Hunting, & Forestry.

Tables 4–7 provide the corresponding Industry and Occupation (I-O) code (generally the corresponding six-digit NAICS code or a combination of codes), industry descriptions, and factor strength using the Kelton, et al. approach. Here, each code/industry is listed from strongest factor (i.e., strongest linkage) to weakest factor (i.e., weakest linkage) in the cluster. It should be noted that each cluster organization represents a set of industries that have strong supply chain linkages. As such, odd industries sometimes emerge in these clusters that do not appear to fit a traditional definition. Wet Corn Milling (in the Paper Products cluster) and

Mayonnaise, Dressing, & Sauce Manufacturing (in the Furniture and Household Items cluster) are examples.

Table 4.

Paper Products: National Supply-Chain Clusters

I-O Code	Industry Description	Factor
S322226	Surface-Coated Paperboard Manufacturing	1.068067
S323117	Books Printing	1.039256
S32222B	Coated & Uncoated Paper Bag Manufacturing	1.032994
S322231	Die-Cut Paper Office Supplies Manufacturing	1.012555
S322210	Paperboard Container Manufacturing	0.984328
S32311A	Commercial Printing	0.916961
S322110	Pulp Mills	0.897581
S511110	Newspaper Publishers	0.895761
S322299	All Other Converted Paper Product Manufacturing	0.859651
S322232	Envelope Manufacturing	0.857877
S323116	Manifold Business Forms Printing	0.856731
S32222A	Coated & Laminated Paper & Packaging Materials	0.841676
S322233	Stationery & Related Product manufacturing	0.809208
S327420	Gypsum Product Manufacturing	0.697255
S333291	Paper Industry Machinery Manufacturing	0.622966
S326130	Laminated Plastics Plate, Sheet, & Shapes	0.602579
S322291	Sanitary Paper Product Manufacturing	0.546956
S323121	Tradebinding & Related Work	0.452303
S321113	Sawmills	0.374065
S323118	Blankbook & Looseleaf Binder Manufacturing	0.373911
S325992	Photographic Film & Chemical Manufacturing	0.369568
S113300	Logging	0.366834
S311221	Wet Corn Milling	0.336016
S221200	Natural Gas Distribution	0.309665
S327910	Abrasive Product Manufacturing	0.272847
S511120	Periodical Publishers	0.189485
S511130	Book Publishers	0.173897
S339950	Sign Manufacturing	0.172361

Table 5.

Wood Products: National Supply-Chain Clusters

I-O Code	Industry Description	Factor
S321920	Wood Container & Pallet Manufacturing	1.076975
S321912	Cut Stock, Resawing Lumber, & Planing	0.923552
S321999	Miscellaneous Wood Product Manufacturing	0.888666

S113300	Logging	0.854938
S337122	Nonupholstered Wood Household Furniture Manufacturing	0.816509
S321991	Manufactured Home, Mobile Home, Manufacturing	0.712168
S321114	Wood Preservation	0.587053
S113A00	Forest Nurseries, Forest Products, & Timber Tracts	0.532533
S321992	Prefabricated Wood Building Manufacturing	0.519300
S321918	Other Millwork, Including Flooring	0.505505
S32121B	Engineered Wood Member & Truss Manufacturing	0.503045
S322110	Pulp Mills	0.447037
S339992	Musical Instrument Manufacturing	0.440374
S337110	Wood Kitchen Cabinet & Countertop Manufacturing	0.390688
S3221A0	Paper & Paperboard Mills	0.383655
S321911	Wood Windows & Door Manufacturing	0.311452
S339995	Burial Casket Manufacturing	0.311089
S337211	Wood Office Furniture Manufacturing	0.307307
S321113	Sawmills	0.282696
S337212	Custom Architectural Woodwork & Millwork	0.274795
S332995	Other Ordnance & Accessories manufacturing	0.273020
S321219	Reconstituted Wood Product Manufacturing	0.230973
S337127	Institutional Furniture Manufacturing	0.220060
S230320	Maintenance & Repair of Nonresidential Buildings	0.217651
S337121	Upholstered Household Furniture Manufacturing	0.202127
S33712A	Other Household & Institutional Furniture	0.182232

Table 6.

Furniture and Household Items: National Supply-Chain Clusters

I-O Code	Industry Description	Factor
S339950	Sign Manufacturing	0.828999
S337127	Institutional Furniture Manufacturing	0.701485
S337214	Office Furniture, Except Wood, Manufacturing	0.693691
S325211	Plastics Material & Resin Manufacturing	0.667917
S337211	Wood Office Furniture Manufacturing	0.644261
S333220	Plastics & Rubber Industry Machinery	0.528275
S339115	Ophthalmic Goods Manufacturing	0.452270
S311941	Mayonnaise, Dressing, & Sauce Manufacturing	0.427085
S326130	Laminated Plastics Plate, Sheet, & Shapes	0.422881
S335221	Household Cooking Appliance Manufacturing	0.412202
S333511	Industrial Mold Manufacturing	0.409702
S337122	Non-upholstered Wood Household Furniture Manufacturing	0.398515
S325620	Toilet Preparation Manufacturing	0.373401
S333991	Power-Driven Handtool Manufacturing	0.364351

S326110	Plastics Packaging Materials, Film & Sheet	0.363895
S111400	Greenhouse & Nursery Production	0.338910
S335228	Other Major Household Appliance Manufacturing	0.332039
S337212	Custom Architectural Woodwork & Millwork	0.330205
S335212	Household Vacuum Cleaner Manufacturing	0.317800
S33331A	Automatic Vending, Commercial Laundry & Drycleaning Machinery	0.313604
S337110	Wood Kitchen Cabinet & Countertop Manufacturing	0.310684
S337124	Metal Household Furniture Manufacturing	0.307177
S325612	Polish & Other Sanitation Good Manufacturing	0.307090
S337215	Showcases, Partitions, Shelving, & Lockers	0.274218
S325991	Custom Compounding of Purchased Resins	0.271760
S335211	Electric Housewares & Household Fan Manufacturing	0.253219

Table 7.

Agriculture, Hunting, & Forestry: National Supply-Chain Clusters

I-O Code	Industry Description	Factor
S113A00	Forest Nurseries, Forest Products, & Timber Tracts	1.011532
S114200	Hunting & Trapping	0.993824
S111335	Tree Nut Farming	0.954649
S1113A0	Fruit Farming	0.909065
S111920	Cotton Farming	0.846980
S111200	Vegetable & Melon Farming	0.721753
S1119A0	Sugarcane & Sugar Beet Farming	0.543409
S111400	Greenhouse & Nursery Production	0.476523
S111910	Tobacco Farming	0.439722
S1111B0	Grain Farming	0.366020
S1119B0	All Other Crop Farming	0.350829
S31499A	Other Miscellaneous Textile Product Mills	0.327872
S1111A0	Oilseed Farming	0.314961

The purpose of outlining these defining categories is to gain a better comprehension of the key industries and linkage factors relevant to Ohio's wood cluster. Using this quantitative analysis, as well as expert anecdotes about which industries are most relevant, the researchers work to define Ohio's wood cluster firms for the modeling, as described in the next section.

2.1. Working Wood Cluster Definition for Ohio

Considering the large number of industries included in the inter-industry linkage approach, the researchers opted to utilize a relatively narrow set of industries to establish the baseline of data on the wood cluster for Ohio. In essence, these industries represented the central types of establishments where the Appalachian Partnership for Economic Growth (APEG) provide business services and define areas where baseline data is required in the early stages of the project.

The researchers used IMPLAN version 3.1, an input-output economic development modeling software, to match the NAICS codes of 30 specific wood-related industries with their IMPLAN sector definitions:

1. Forestry, forest products, and timber tract production (IMPLAN #15)
2. Commercial logging (IMPLAN #16)
3. Sawmills (IMPLAN #134)
4. Wood preservation (IMPLAN #135)
5. Veneer and plywood manufacturing (IMPLAN #136)
6. Engineered wood member and truss manufacturing (IMPLAN #137)
7. Reconstituted wood product manufacturing (IMPLAN #138)
8. Wood windows and door manufacturing (IMPLAN #139)
9. Cut stock, resawing lumber, and planning (IMPLAN #140)
10. Other millwork, including flooring (IMPLAN #141)
11. Wood container and pallet manufacturing (IMPLAN #142)
12. Manufactured home (mobile home) manufacturing (IMPLAN #143)
13. Prefabricated wood building manufacturing (IMPLAN #144)
14. All other miscellaneous wood product manufacturing (IMPLAN #145)
15. Pulp mills (IMPLAN #146)
16. Paper mills (IMPLAN #147)
17. Paperboard mills (IMPLAN #148)
18. Paperboard container manufacturing (IMPLAN #149)
19. Paper bag and coated and treated paper manufacturing (IMPLAN #150)
20. Stationery product manufacturing (IMPLAN #151)
21. Sanitary paper product manufacturing (IMPLAN #152)
22. All other converted paper product manufacturing (IMPLAN #153)
23. Wood kitchen cabinet and countertop manufacturing (IMPLAN #368)
24. Upholstered household furniture manufacturing (IMPLAN #369)
25. Nonupholstered wood household furniture manufacturing (IMPLAN #370)
26. Institutional furniture manufacturing (IMPLAN #372)
27. Wood office furniture manufacturing (IMPLAN #373)
28. Custom architectural woodwork and millwork (IMPLAN #374)
29. Showcase, partition, shelving, and locker manufacturing (IMPLAN #376)
30. Burial casket manufacturing (IMPLAN #393)

As previously noted, tracking employment and wage data for all 30 industry sectors is challenging as data is often suppressed, sometimes even at the state level. One challenge relates to the small number of establishments in certain industry sectors and/or lower levels of employment. Researchers also encounter such data suppression when investigating rural areas, areas with a single large employer, or industries with only a few employers.

The researchers next utilized the U.S. Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) tool to, at the surface level, determine what data existed for employment for the available set of industries included in this analysis. Table 8 displays the results of this search, including the 2014 employment levels. We also calculated each industry's location quotient (LQ), which is the relative concentration of the industry in Ohio compared to the United States. Non-upholstered wood household furniture manufacturing stands out as a

heavily concentrated industry in the state with an LQ of 2.48, meaning the industry is 2.48 times more concentrated in Ohio than the national average. Five of the nine wood industries were less concentrated than the national average.

Table 8.

Wood-Related Employment in Ohio, 2014

Industry	Employment	Location Quotient
Nonupholstered wood household furniture mfg.	3,554	2.48
Converted paper product mfg.	16,461	1.59
Other wood product mfg.	8,742	1.08
Wood kitchen cabinet & countertop mfg.	4,093	1.00
Pulp, paper, & paperboard mills	2,786	0.69
Plywood & engineered wood product mfg.	1,658	0.60
Sawmills	1,449	0.46
Wood office furniture mfg.	315	0.46
Wood preservation	122	0.35
Total/Average	**39,180**	**0.97**

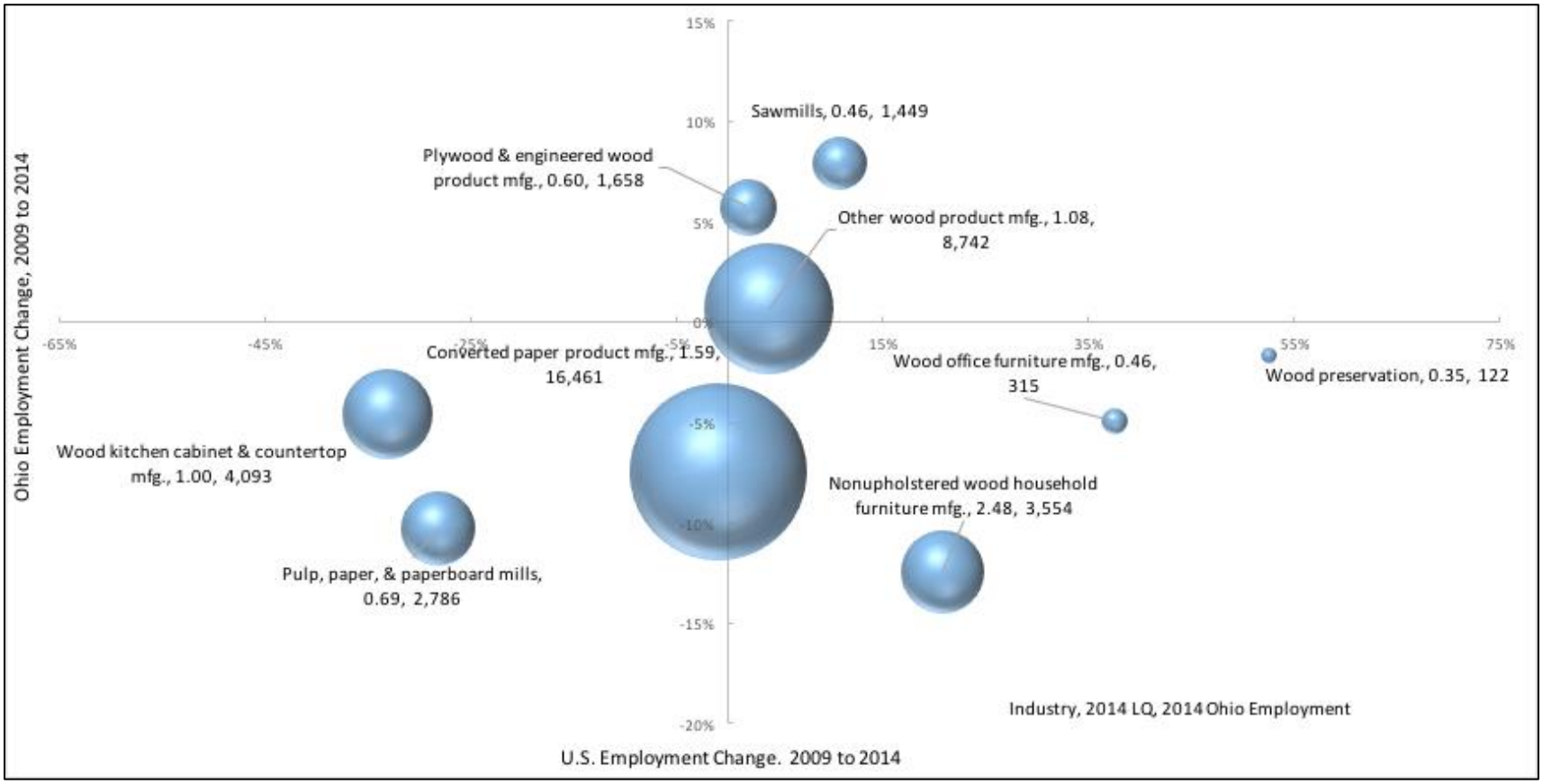
Note. Calculated from Quarterly Census of Employment and Wages data (2014)

Using these same nine industries, the researchers then proceeded to conduct a 'shift-share analysis' using employment changes to understand the competitiveness of the wood industry in Ohio. Data limitations necessitated that the categories range from three-digit to six-digit NAICS code designations depending on the most granular data level where data was not suppressed.

Figure 1 shows the percentage change in each industry in Ohio and the United States from 2009 to 2014. Being present in the upper right quadrant indicates an industry has grown in both areas. The lower left quadrant indicates an industry has declined in employment in both Ohio and the United States. The upper left quadrant indicates that the industry has grown nationally but declined in Ohio, while the lower right quadrant indicates that the industry has grown in Ohio but declined nationally. The size of each bubble represents the relative employment size in Ohio. The LQ and employment figure is included within each industry label.

Figure 1.

Ohio vs. U.S. Wood Industry Employment Change, 2009–2014

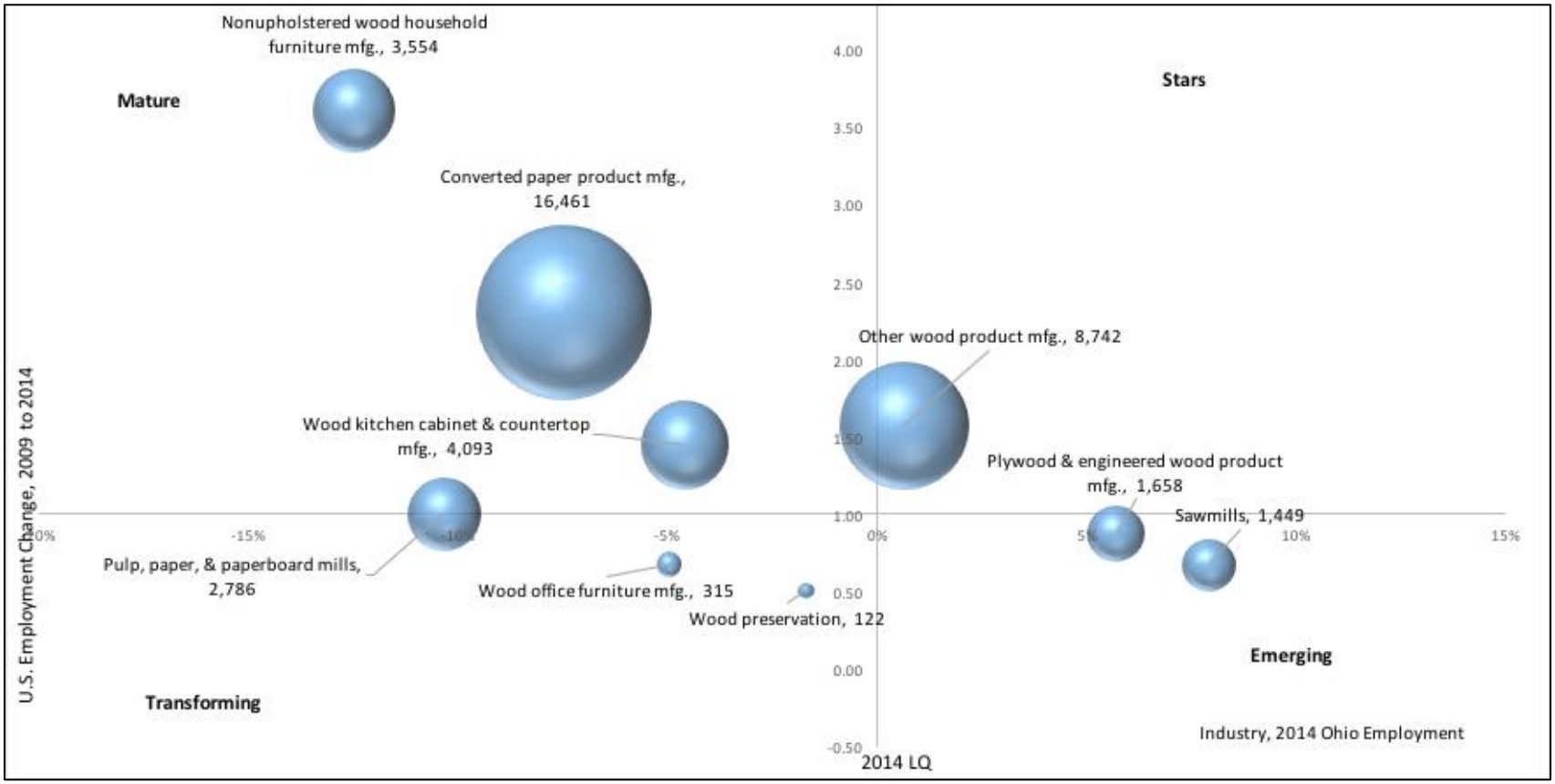


Measuring the relative change in LQ is a common technique for determining the direction of a group of industries. The Purdue Center for Regional Development (2014) classifies the four quadrants in this type of analysis as Stars, Emerging, Transforming, and Mature industries or clusters. As seen in Figure 2, the upper right quadrant represents Star industries that are more concentrated than the national average and are higher growth industries or clusters. If these trends continue, then they will become more dominant over time. The bottom right are Emerging industries or clusters, which are under-represented but growing quickly. As such, they should move into the Star category over time. The upper left quadrant represents Mature industries or clusters that are more concentrated, yet declining in employment. Finally, the lower left quadrant represents industries that have lower employment levels and are less concentrated, and thus these industries/clusters are 'Transforming' and may be less competitive.

Taken as represented, the data demonstrates that Ohio has a Star industry (i.e., Other Wood Product Manufacturing) and emerging industries in Plywood and Engineered Wood Product Manufacturing and Sawmills. Only Wood Office Furniture Manufacturing and Wood Preservation are transforming. The other six wood industries included here are either transforming or mature.

Figure 2.

Ohio Wood Industry Bubble Chart, 2014



Nevertheless, caution must be used in interpreting these charts as statewide data is used due to data suppression, meaning this may not accurately reflect the concentration of certain wood industries in certain geographies, such as in Appalachian Ohio. Further, some small proprietors, including Amish furniture manufacturers in the eastern part of the state, may be unrepresented or underrepresented in the Quarterly Census of Employment and Wage data.

3. Wood Cluster Contribution Analysis

Having a better understanding of how to define Ohio's wood cluster, as well as a preliminary sense of which industry sectors are performing well relative to national averages, the researchers proceeded to conduct a multi-industry economic contribution analysis of wood to Ohio. An economic contribution analysis assesses the portion of a region's economy (in terms of jobs, labor income, taxes, etc.) that can be attributed to an existing business, industry, event, policy, or program. It was appropriate to conduct a multi-industry economic contribution analysis for this research since more than one industry is being examined as part of the same activity. The following sections review the prior literature on clusters and wood's impact to Ohio and the methodology employed for this research.

3.1. Review of the Literature

The phrase 'industry clusters' is widely used and acknowledged in prior literature. Clusters have been defined as "geographic concentrations of interconnected companies and institutions in a particular field" (Porter, 1998, p. 78) that are "linked by similar needs such as production inputs, specialized labor, and technology" (Hagadone & Grala, 2012, p. 16). Put another way, industry clusters represent a geographic concentration of interrelated businesses, vendors, service providers, academic institutions, and other relevantly affiliated organizations surrounding a specific industry (Feser & Bergman, 2000; Morgan, 2007; Slaper & Ortuzar, 2015). These clusters often interact via public-private partnerships (Matoon & Wang, 2014) and such networking may breed job creation, entrepreneurial development, and other economic development related activities such as competitive advantages and increased earnings (Brun & Jolley, 2011).

There are a number of key actors and drivers that play a role in the operations and progress of an industry cluster. To exemplify, interdependent firms must often work together due to the inability of independent firms to produce a finished product in isolation (Kuah, 2002). Mottiar and Ingle (2007) further indicated flexibility, viability, and geographic proximity as drivers of successful clusters. Finally, there must be high competitive success in a particular field, as well as local demand for a product, to produce a regional industry cluster (Boari, 2001).

A contemporary example of an emerging industry cluster concerns the State of Ohio's wood resources. With an estimated 8.05 million acres of untapped forest land (McConnell, 2012), Ohio has noteworthy potential in commercial logging, sawmill, pulp and paper, and the wood manufacturing sector, among others. In fact, Ohio's wood furniture industry has performed relatively well despite a steep decline in manufacturing of wood household furniture in the U.S over the past decade (Bumgardner, Graham, Goebel, & Romig, 2011). According to Bamgardner, Romig, & Luppold (2008), Ohio's success, in part, stems from a competitive

advantage in finely crafted Amish wood manufacturing in the eastern part of the state. To illustrate, Holmes County, Ohio has a large Amish population and a prominent wood furniture manufacturing cluster, including localized assembly and production, as well as distribution networks to larger manufacturing centers in Ohio, Indiana, and Pennsylvania (Bumgardner, Romig, & Luppold, 2008).

Very few academic or white paper reports have quantitatively assessed the impact of the wood industry to Ohio's economy. In one of the first relevant studies, the Ohio Department of Natural Resources (2006) found that Ohio's forest products industry contributed $15.1 billion to Ohio's economy and employed over 119,000 people with annual payrolls of $4 billion. More recently, McConnell (2012) calculated, using 2010 data, this industry contribution at $22.05 billion, with approximately 118,000 jobs and "wages and benefits amounting to $5.69 billion" (p. 1). Coronado, McConnell, and Matthews (2015) determined that the total wood economic impacts amounted to $21.9 billion with 106,000 employees in 2011. Finally, the United States Forest Service (2010) ranked Ohio in the top 10 of states nationally in terms of wood-related production and employment figures (for furniture, wood container and pallet manufacturing, millwork, and others). Taken as a whole, these studies have indicated, despite some fluctuation, that the wood industry is an important and vibrant aspect of Ohio's economy.

3.2. Methodology

In order to complete the multi-industry economic contribution analysis, the researchers customized the IMPLAN model so that each sector in the analysis made 100% of its primary commodity. This was done so the commodity value would not be changed by another industry that may produce the focus industry's primary product as a byproduct. Trade flows were also customized so that the local use ratio for each sector is 0. This was completed so that no purchases from these industries were allowed beyond the amount specified in the analysis, which is the direct effect of each industry.

These customizations were completed before running the analysis for both the 88-county Ohio study area and the 32-county Appalachian Ohio study area. The 32-county Appalachian Ohio area ranges from Ashtabula County in the far northeast, all the way to Clermont in the Southwest, as illustrated in Figure 3.

Figure 3.

32 Appalachian Ohio Counties

Note. Figure developed by author.

The methodology utilized allowed the researchers to assess the direct effects of the 30 wood industry sectors (detailed in Section 2.1.) and use an input-output model with IMPLAN software to further measure indirect and induced effects without overstating economic results. IMPLAN data is based on BLS' QCEW (ES-202) and the Bureau of Economic Analysis' Regional Economic Information System. The researchers used 2014 data, as this was the most recent data available at the time of reporting. The key input used was industry sales per sector, as derived directly from the software.

For ease of reporting, among other reasons, the researchers grouped the 30 distinct industry sectors into 13 related groups. While some groups inherently have more industries than others (e.g., Pulp & Paper), the group analysis approach offers the advantage of understanding how the surface-level groups are performing relative to others. These groupings are displayed in Table 9.

Table 9.

Ohio Wood Cluster Industry Groups

Industry Group	**Sector (IMPLAN Number)**
Resources	Forestry, forest products, and timber tract production (15)
Commercial Logging	Commercial logging (16)
Pulp & Paper	Pulp mills (146); Paper mills (147); Paperboard mills (148); Paperboard container manufacturing (149); Paper bag and coated treated paper manufacturing (150); Stationary product manufacturing (151); Sanitary paper product manufacturing (152); All other converted paper product manufacturing (153)
Sawmill	Sawmills (134); Cut stock, resawing lumber, and planning (140)
Wood Container & Pallet	Wood container and pallet manufacturing (142)
Engineered Wood Member & Truss	Engineered wood member and truss manufacturing (137)
Reconstituted Wood Products	Reconstituted wood product manufacturing (138)
Veneer & Plywood	Veneer and plywood manufacturing (136)
Millwork	Custom architectural woodwork and millwork (374); Wood kitchen cabinet and countertop manufacturing (368); Showcase, partition, shelving, and locker manufacturing (376); Wood windows and door manufacturing (139); Other millwork, including flooring (141); All other miscellaneous wood product manufacturing (145); Burial casket manufacturing (393)
Wood Furniture	Nonupholstered wood household furniture manufacturing (370); Institutional furniture manufacturing (372); Wood office furniture manufacturing (373)
Upholstered Household Furniture	Upholstered household furniture manufacturing (369)
Manufacturing Services	Wood preservation (135)
Manufactured Housing	Manufactured home (mobile home) manufacturing (143); Prefabricated wood building manufacturing (144)

Note. IMPLAN's old sectors combined "Sawmills and wood preservation" into one category, whereas their new sectors separate these out into "Sawmills" (134) and "Wood preservation" (135).

Moreover, the following are key terms used in the output results of this modeling as defined by IMPLAN Group LLC (2015). Figure 4 further helps describe how total economic impact is a function of direct, indirect, and induced impacts.

- *Direct effect*: The series of initial changes in production.

- *Employment*: The annual average of monthly jobs in that industry (this is the same definition used by QCEW, BLS, and BEA nationally). Thus, one job lasting 12 months = two jobs lasting 6 months each = three jobs lasting 4 months each. A job can be either full-time or part-time.

- *Indirect effect*: The impact of local industries buying goods and services from other local industries.

- *Induced effect*: The response by an economy to an initial change (i.e., direct effect) that occurs though re-spending of income received by a component of value-added.

- *Labor income*: All forms of employment income, including employee compensation (i.e., wages and benefits) and proprietor income.

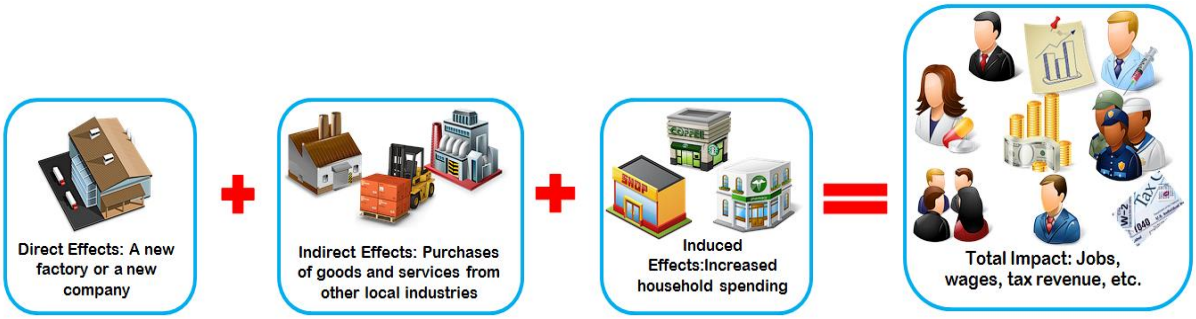
- *Multiplier*: Total production requirements within the study area for every unit of production sold to final demand. In this study, Type SAM (Social Accounting Matrix) multipliers are used.

- *Output*: The value of industry production. In IMPLAN, these are annual production estimates for the year of the data set and are in producer prices. For manufacturers, this would be sales plus or minus the change in inventory. For service sectors production, it is sales. For retail and wholesale trade, output is gross margin and not gross sales.

- *Value-added*: The difference between an industry's total output and the cost of its intermediate inputs. It equals gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from other industries or imported). Value added consists of compensation of employees, taxes on production and imports less subsidies (formerly indirect business taxes and nontax payments), and gross operating surplus.

Figure 4.

Description of Total Economic Impact



These key terms are used throughout the findings section of this report.

4. Findings

This section details the results of the multi-industry economic contribution analysis of the wood industry for both the entire State of Ohio, as well as the 32 Appalachian Ohio counties as a single region. Economic contribution by sector, by county, and by Ohio Local Development District follows the broad-level results.

4.1. Economic Contribution of the Wood Industry to Ohio

As displayed in Table 10, the total economic impact, or the total output or value of production, of the wood industry in Ohio was $24,979,730,630 in 2014. The total value-added for the industry was $9,114,183,475, and 116,321 average annual jobs were supported. Table 10 also details the direct, indirect, induced, and total effects of the industry on Ohio, along with multipliers that indicate how many additional jobs are supported by one job in the industry. For instance, in the case of employment, each additional job in the wood industry supports 1.20 other full- or part-time positions (subtract one to accommodate for the additional job created).

Table 10.

Contribution Summary of the Wood Industry in Ohio, 2014

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	52,890	$3,021,033,719	$3,555,271,892	$14,900,770,640
Indirect Effect	30,606	$1,858,523,976	$3,006,423,965	$5,669,191,289
Induced Effect	32,825	$1,397,759,149	$2,552,487,618	$4,409,768,702
Total Effect	*116,321*	*$6,277,316,844*	*$9,114,183,475*	*$24,979,730,630*
Multiplier	**2.20**	**2.08**	**2.56**	**1.68**

Next, Table 11 shows the tax impacts of the wood industry in Ohio. The data shows that the jobs in this industry generated a total (i.e., direct, indirect, and induced) of $712,477,496 of tax revenue to state and local government from all sources. Household taxes are comprised of personal income tax, motor vehicle license, non-tax fines and fees, property taxes, and other taxes. Tax on production and imports includes motor vehicle license, property tax, sales tax, severance tax, S/L non-taxes, and other taxes.

Federally, $1,327,996,130 of tax revenue is generated to the federal government. Proprietor incomes specifically generated $32,037,042 from employee contributions, as shown below. Impacts of corporations is comprised of only profit tax, federally.

Table 11.

Tax Impacts of the Wood Industry in Ohio, 2014

	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Total State and Local Tax	$18,543,440	$0	$516,114,908	$171,500,667	$6,318,481
Total Federal Tax	$639,018,912	$32,037,042	$71,637,824	$417,072,928	$168,229,424

4.2. Economic Contribution of the Wood Industry to Appalachian Ohio

Table 12 illustrates that the total economic impact or contribution of the wood industry specific to the 32 Appalachian Ohio county region was $5,226,441,440 in 2014. The total value-added for the industry was $1,655,970,972, and 26,052 average annual jobs were supported. For this geography, each additional job in the industry supports 0.71 other full- or part-time positions, less than the entire State of Ohio figures suggest. Roughly one-fifth of the total economic contribution of the wood industry throughout the state comes from the Appalachian Ohio region.

Table 12.

Contribution Summary of the Wood Industry in Appalachian Ohio, 2014

Impact Type	Employment	Labor Income	Total Value Added	Output
Direct Effect	15,261	$745,695,030	$888,819,280	$3,762,253,062
Indirect Effect	5,687	$255,018,358	$435,707,333	$874,545,117
Induced Effect	5,106	$172,835,099	$331,444,360	$589,643,261
Total Effect	*26,052*	*$1,173,548,489*	*$1,655,970,972*	*$5,226,441,440*
Multiplier	**1.71**	**1.57**	**1.86**	**1.39**

Finally, Table 13 displays the tax impacts of the wood industry in Appalachian Ohio. In this instance, from all sources, the wood industry employment generated a total of $165,893,323 of tax revenue to state and local government and an extra $286,824,545 to the federal government.

Table 13.

Tax Impacts of the Wood Industry in Appalachian Ohio, 2014

	Employee Compensation	Proprietor Income	Tax on Production and Imports	Households	Corporations
Total State and Local Tax	$5,011,657	$0	$124,071,421	$35,529,611	$1,280,634
Total Federal Tax	$139,285,880	$10,512,149	$17,164,060	$85,765,600	$34,096,856

4.3. Economic Contribution by Wood Cluster Industry Group

The researchers also utilized the 13 industry sector groupings outlined in Table 9 to better understand the economic contribution per group. Figure 5 displays the results of the wood industry contribution per group (top five) for the entire state of Ohio. Pulp & Paper, which contains the largest number of specific industry sectors (8), contributed the most to the state's economy, followed by Millwork, Wood Furniture, and Sawmill, respectively.

Figure 5.

Ohio Wood Industry: Economic Contribution by Sector, 2014

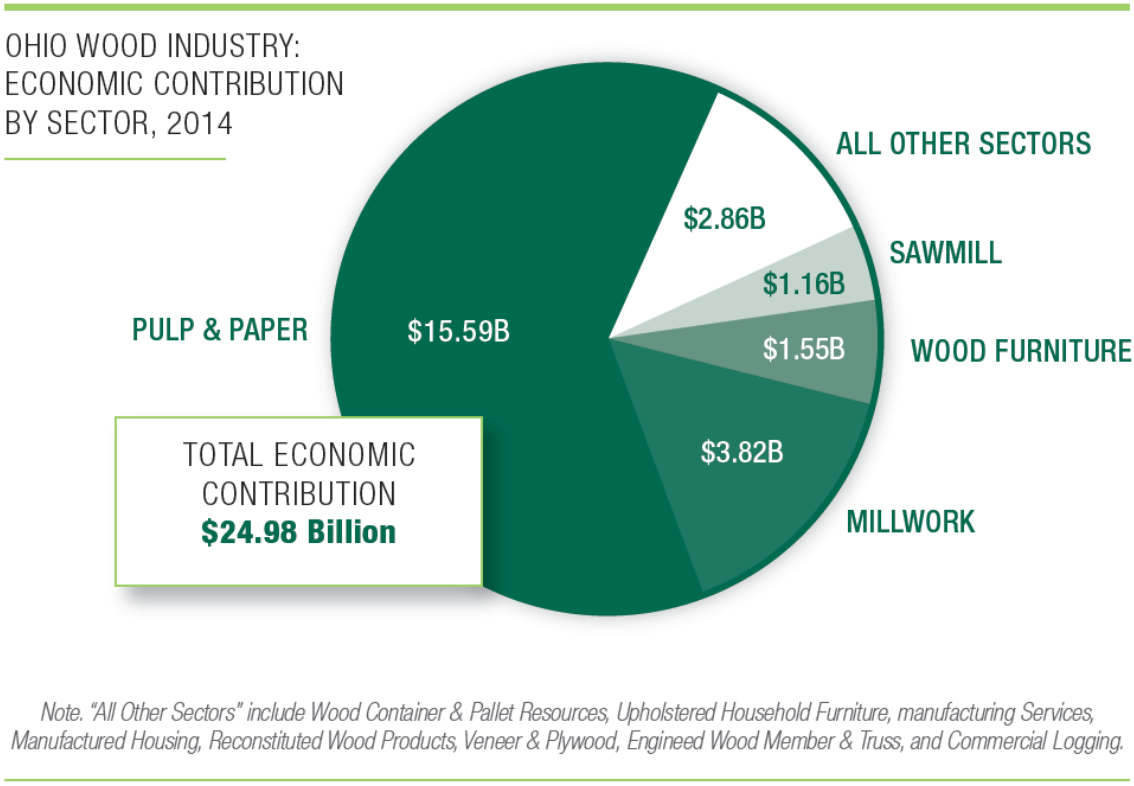
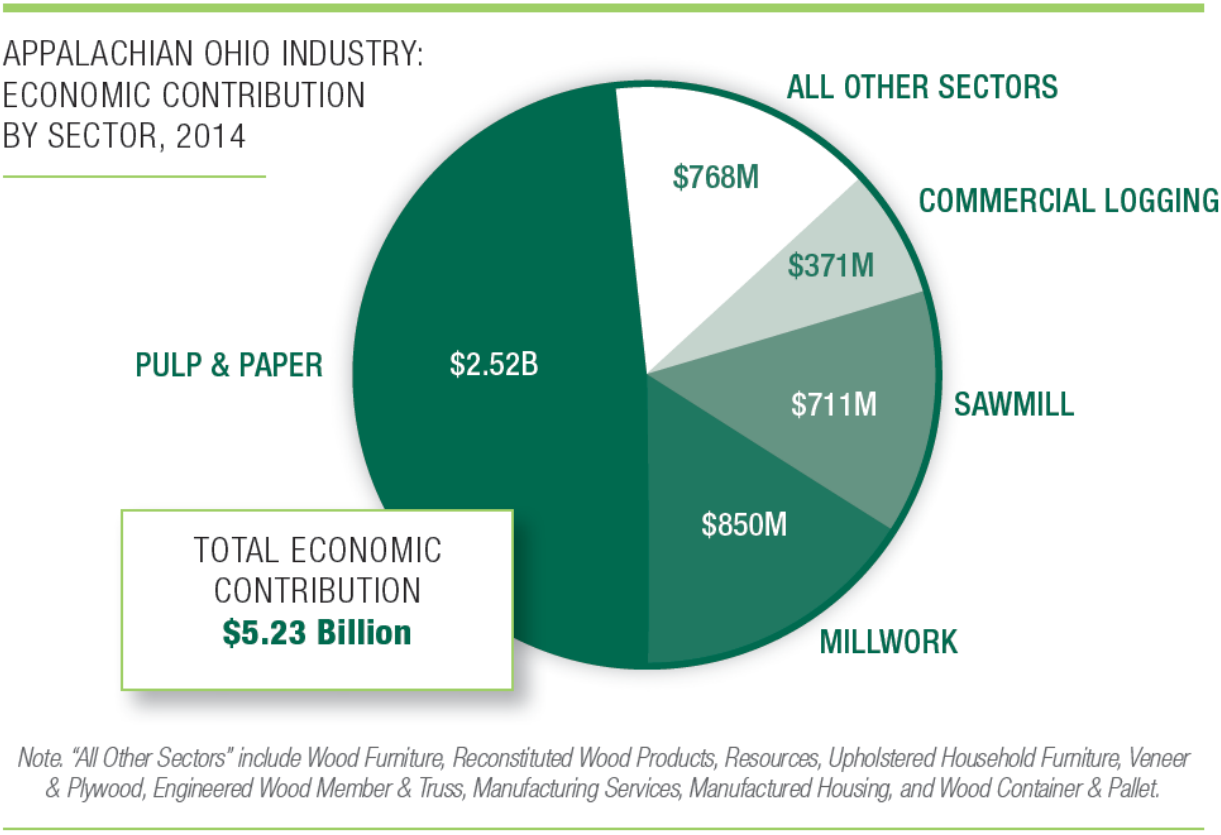


Figure 6 displays these same per-group results for the Appalachian Ohio region. Pulp & Paper also emerges here as the key economic contributor to the region, though to a lesser percentage extent. Millwork is a distant second at roughly $850 million, and Sawmill is the third-highest contributor. The commercial logging industry group also appears in the Appalachian Ohio analysis, perhaps suggesting that a lot of the timber extraction activity occurs in the region.

Figure 6.

Appalachian Ohio Wood Industry: Economic Contribution by Sector, 2014



Note. "All Other Sectors" include Wood Furniture, Reconstituted Wood Products, Resources, Upholstered Household Furniture, Veneer & Plywood, Engineered Wood Member & Truss, Manufacturing Services, Manufactured Housing, and Wood Container & Pallet.

The detailed results of each of the economic contributions per the 13 industry groups, including employment, labor income, value added, and output, for all effect categories, are found in Appendix A. Table 14 shows a higher level of detail around the industry group contributions, yet, more importantly, displays the percentage of economic impact specifically from Appalachian Ohio in each of the groups. A majority (over 50%) of the contributions from Commercial Logging, Sawmill, Manufacturing Services, and Manufactured Housing came from the Appalachian Ohio region.

Table 14.

Industry Group Contributions – Percentage from Appalachian Ohio

	Ohio	**Appalachian Ohio**	**Percent**
Commercial Logging	$499,834,940	$371,170,718	74.3%
Sawmill	$1,160,438,234	$710,990,589	61.3%
Manufacturing Services	$145,315,909	$78,093,209	53.7%
Manufactured Housing	$189,306,422	$100,949,049	53.3%
Resources	$14,662,813	$4,191,772	28.6%
Upholstered Household Furniture	$130,739,782	$36,620,096	28.0%
Millwork	$3,822,447,050	$850,951,750	22.3%
Engineered Wood Member & Truss	$340,522,563	$63,944,636	18.8%
Wood Container & Pallet	$1,051,159,495	$191,148,169	18.2%
Wood Furniture	$1,552,318,899	$255,191,266	16.4%
Pulp & Paper	$15,591,469,337	$2,525,413,377	16.2%
Veneer & Plywood	$287,307,649	$37,776,809	13.1%
Reconstituted Wood Products	$194,207,535	0	0.0%
Total/Average	**$24,979,730,628**	**$5,226,441,440**	**20.9%**

Taking the labor income value and dividing by employment, the research team also developed wage rankings by industry grouping, both in the Ohio (Table 15) and Appalachian Ohio (Table 16) geographies. The Pulp & Paper industry group paid the highest wages across the board. Manufactured Housing paid the second highest wages in Appalachian Ohio. There were no individuals working in Reconstituted Wood Products in Appalachian Ohio, explaining the $0 amount. Taken as a whole, wood industry employees made less in Appalachian Ohio compared to the entire state ($42,539.00 compared to $47,458.52).

Table 15.

Wage Ranking by Industry Grouping - Ohio

	Amount
Pulp & Paper	$75,642.26
Reconstituted Wood Products	$59,361.24
Wood Furniture	$50,178.63
Commercial Logging	$49,175.80
Resources	$49,011.56
Manufactured Housing	$48,322.84
Millwork	$47,846.73
Engineered Wood Member & Truss	$43,906.88
Veneer & Plywood	$43,607.88
Wood Container & Pallet	$40,069.77
Sawmill	$38,243.27
Upholstered Household Furniture	$36,571.63
Manufacturing Services	$35,022.27
Average	**$47,458.52**

Table 16.

Wage Ranking by Industry Grouping - Appalachian Ohio

	Amount
Pulp & Paper	$72,730.24
Manufactured Housing	$54,226.57
Commercial Logging	$49,006.02
Veneer & Plywood	$48,616.76
Engineered Wood Member & Truss	$45,602.60
Millwork	$42,663.18
Wood Furniture	$38,950.07
Sawmill	$37,886.36
Wood Container & Pallet	$35,715.92
Manufacturing Services	$30,973.40
Upholstered Household Furniture	$30,276.91
Resources	$23,819.97
Reconstituted Wood Products	$0.00
Average	**$42,539.00**

4.4. Economic Contribution by Appalachian Ohio County

The research team also conducted a multi-industry economic contribution analysis by county for the 32-county Appalachian Ohio region. The ranked economic impact/contribution results are displayed below in Table 17. The researchers further divided each contribution figure by population to create a normalized, per capita dollar amount to better compare across counties, which is shown in Table 18. Controlling for population, in order, the top five county contributors for wood were Holmes, Ross, Vinton, Coshocton, and Pike.

Table 17.

Appalachian Ohio Economic Contribution Total Ranking, 2014

County	Economic Impact
Ross	$1,089,089,586
Holmes	$660,056,870
Tuscarawas	$450,056,071
Ashtabula	$337,654,662
Mahoning	$302,193,622
Clermont	$246,517,735
Coshocton	$224,830,827
Pike	$149,598,932
Jackson	$110,829,304
Vinton	$106,397,822
Scioto	$105,822,389
Columbiana	$94,574,178
Hocking	$91,688,600
Trumbull	$77,680,059
Jefferson	$71,749,538
Highland	$68,484,363
Guernsey	$66,914,823
Muskingum	$65,636,740
Washington	$63,654,682
Adams	$47,860,509
Carroll	$40,612,339
Noble	$34,924,711
Harrison	$31,383,999
Gallia	$29,754,813
Brown	$27,125,355
Athens	$19,191,095
Belmont	$16,817,312
Perry	$16,782,664
Morgan	$15,517,599
Meigs	$4,594,083
Monroe	$4,287,480

Lawrence	$3,283,756
Total	**$4,675,566,518**

Table 18.

Appalachian Ohio Economic Contribution Per Capita Ranking, 2014

County	**Economic Impact per Capita**
Holmes	$15,036.15
Ross	$14,114.87
Vinton	$8,021.55
Coshocton	$6,157.05
Pike	$5,294.41
Tuscarawas	$4,850.37
Ashtabula	$3,404.63
Jackson	$3,384.31
Hocking	$3,191.94
Noble	$2,431.57
Harrison	$2,019.17
Adams	$1,701.47
Guernsey	$1,690.20
Highland	$1,590.99
Carroll	$1,440.82
Scioto	$1,369.73
Mahoning	$1,295.83
Clermont	$1,223.05
Jefferson	$1,059.91
Morgan	$1,045.45
Washington	$1,039.89
Gallia	$978.87
Columbiana	$894.86
Muskingum	$764.84
Brown	$614.86
Perry	$468.63
Trumbull	$378.60
Athens	$296.56
Monroe	$296.40
Belmont	$242.11
Meigs	$196.91
Lawrence	$53.29
Total	**$86,549.29**

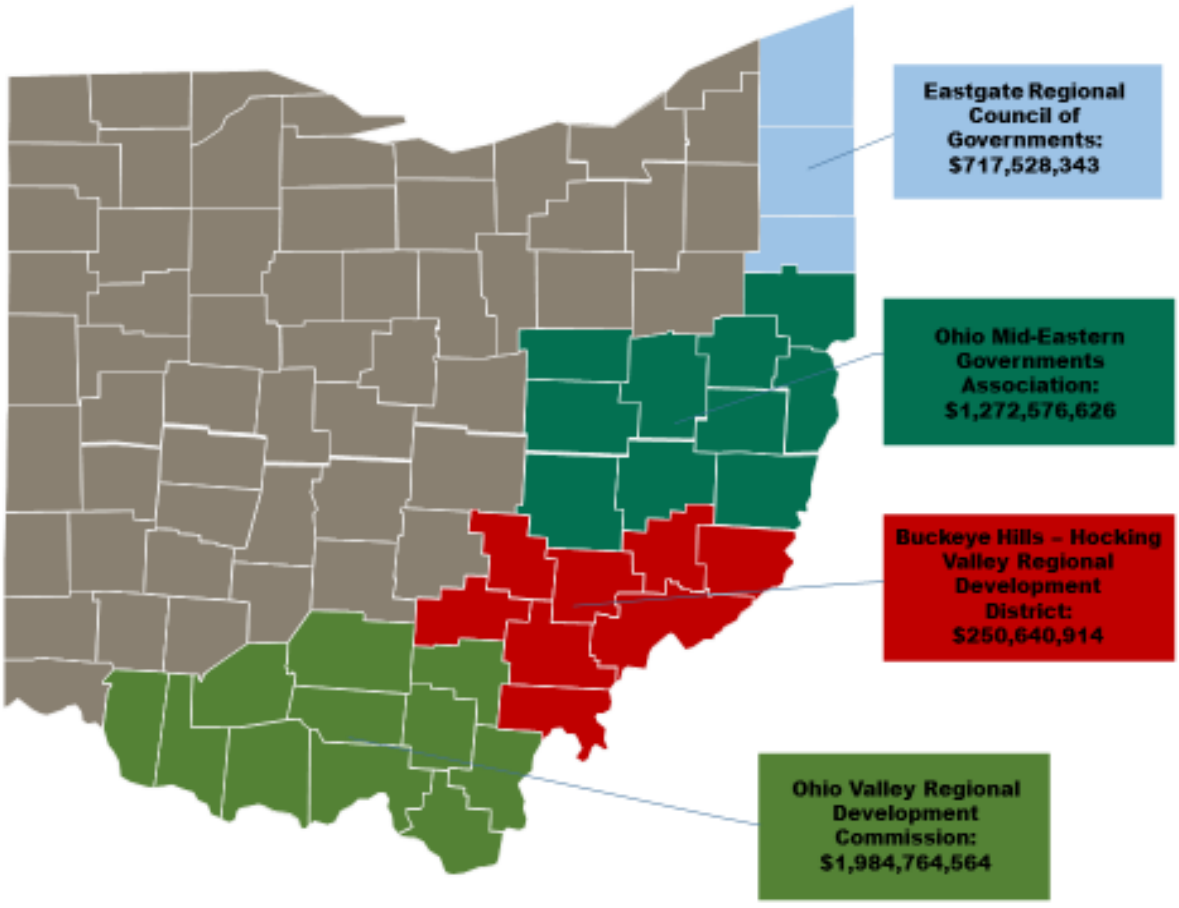
The full details of this county-level analysis, including employment, labor income, value added, and output, for all effect categories, can be found in Appendix B.

4.5. Economic Contribution by Ohio Economic Development District

Taking the county totals (not per capita amounts), the researchers also determined the economic contribution of the wood industry to each of the four Economic Development Districts that exist within Ohio's Appalachian region (see Figure 7). These include the Buckeye Hills – Hocking Valley Regional Development District, Eastgate Regional Council of Governments, Ohio Mid-Eastern Governments Association (OMEGA), and the Ohio Valley Regional Development Commission (OVRDC). Occasionally termed as Local Development Districts (LDDs), these organizations work as planning and development organizations guided by the Appalachian Regional Commission and the U.S. Economic Development Administration.

Figure 7.

Wood Contribution by Ohio Economic Development District



The OVRDC region had the largest economic impact at almost $2 billion, but also includes the most counties (11). On a per-county basis, the Eastgate Regional Council of Governments actually saw the highest economic impact at $239,176,114 ($717,528,343 divided by 3 counties).

5. Conclusion

Ohio's wood cluster represents a large industry for the state that has strong economic impact metrics across the board. The wood industry in the state represents a historically large, and still prominent, industry cluster, as evidenced in the nearly $25 billion it contributes to Ohio's economy and more than 115,000 it employs. Continual support and enhancement of this cluster may breed additional job creation and other economic development activities and benefits.

The Appalachian region of Ohio has a specific competitive advantage in high quality hardwoods, which seem to be harvested and shipped elsewhere in the state and region for higher value-added and higher paying activities. For instance, no activity in the Reconstituted Wood Products group and only 16.4% of the Wood Furniture Manufacturing occurs in the 32-county Appalachian Ohio region, yet these groups pay the second and third highest wages in the state, respectively.

The Appalachian Ohio region has a strong wood industry cluster, and great potential to enhance it. The region also has an advantage in finely crafted Amish wood manufacturing in the OMEGA region, such as in Holmes County. Perhaps enriching education about this cluster, both for potential workers as well as for policymakers and business stakeholders, can contribute to its future growth. Workforce training for individuals and businesses may be another strategy to improve the economic competitiveness of the wood industry cluster, especially in the Appalachian part of the state. Additional technical assistance from key regional partners and economic development organizations in the region, and throughout the state, could further help wood business growth, and perhaps enlarge the number of firms exporting as traded clusters. Economies of scale and cooperative models (e.g., a dry kiln cooperative to collectively dry hardwood lumber for furniture making and flooring) may help keep some of the higher end of the value chain impacts in the Appalachian region.

Overall, the wood industry cluster is, by nearly every metric, a strong contributor to the State of Ohio. The Pulp & Paper and Millwork industries employ roughly 80,000 people alone, and collectively contribute over $19 billion to the state's economy. Informed stakeholders in the heavily forested Appalachian region of Ohio should strive to retain and grow the regional workforce in this cluster to meet future demands of the industry. Certain strategies may be able to help improve investment and value-added industry opportunities in the Appalachian wood cluster by attracting more household and wood products manufacturing firms. Understanding, supporting, and enhancing the wood products industry cluster will help strengthen the state and region's economic, labor force, and overall development opportunities.

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Appendix A.

Detailed Economic Contribution by Wood Cluster Industry Group

RESOURCES

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	81	$3,969,936	$4,240,413	$8,172,894
Indirect Effect	34	$908,917	$1,279,557	$2,167,478
Induced Effect	32	$1,370,597	$2,501,566	$4,322,441
Total Effect	147	$6,249,451	$8,021,536	$14,662,813
Multiplier	**1.81**	**1.57**	**1.89**	**1.79**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	35	$833,699	$994,158	$2,673,037
Indirect Effect	24	$318,787	$429,142	$838,173
Induced Effect	6	$199,374	$382,613	$680,562
Total Effect	65	$1,351,861	$1,805,912	$4,191,772
Multiplier	**1.86**	**1.62**	**1.82**	**1.57**

COMMERCIAL LOGGING

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	3,093	$152,100,742	$163,571,495	$294,589,264
Indirect Effect	405	$18,573,207	$30,616,554	$54,241,793
Induced Effect	1,129	$47,882,961	$87,390,918	$151,003,883
Total Effect	4,626	$218,556,911	$281,578,967	$499,834,940
Multiplier	**1.50**	**1.44**	**1.72**	**1.70**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	2,676	$131,140,101	$140,946,540	$254,329,300
Indirect Effect	409	$11,110,734	$16,976,721	$32,431,637
Induced Effect	733	$24,707,812	$47,466,588	$84,409,781
Total Effect	3,818	$166,958,647	$205,389,849	$371,170,718
Multiplier	**1.43**	**1.27**	**1.46**	**1.46**

PULP & PAPER

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	19,678	$1,488,488,340	$1,871,628,902	$9,558,322,826
Indirect Effect	18,908	$1,169,007,118	$1,907,068,436	$3,626,614,723
Induced Effect	17,910	$762,779,286	$1,392,975,604	$2,406,531,788
Total Effect	56,516	$3,420,274,743	$5,171,672,943	$15,591,469,337
Multiplier	**2.87**	**2.30**	**2.76**	**1.63**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	3,279	$238,482,445	$322,006,855	$1,851,514,280
Indirect Effect	2,586	$125,496,018	$224,460,270	$459,373,719
Induced Effect	1,856	$62,897,914	$120,577,630	$214,525,378
Total Effect	7,722	$426,876,377	$667,044,755	$2,525,413,377
Multiplier	**2.35**	**1.79**	**2.07**	**1.36**

SAWMILL

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	2,737	$104,671,838	$122,421,617	$674,276,245
Indirect Effect	1,692	$102,878,122	$166,830,752	$298,942,919
Induced Effect	1,394	$59,343,348	$108,366,541	$187,219,070
Total Effect	5,823	$266,893,308	$397,618,910	$1,160,438,234
Multiplier	**2.13**	**2.55**	**3.25**	**1.72**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	2,055	$77,856,470	$92,240,895	$506,027,389
Indirect Effect	885	$41,090,592	$69,362,806	$135,031,081
Induced Effect	605	$20,502,407	$39,307,293	$69,932,119
Total Effect	3,545	$139,449,469	$200,910,994	$710,990,589
Multiplier	**1.73**	**1.79**	**2.18**	**1.41**

WOOD CONTAINER & PALLET

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	4,636	$185,763,468	$201,462,100	$597,810,303
Indirect Effect	1,155	$73,218,257	$116,869,045	$219,562,332
Induced Effect	1,740	$74,103,044	$135,321,750	$233,786,859
Total Effect	7,531	$333,084,769	$453,652,896	$1,051,159,495
Multiplier	**1.62**	**1.79**	**2.25**	**1.76**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1,096	$39,144,651	$42,672,361	$136,388,779
Indirect Effect	174	$8,194,248	$13,351,775	$26,934,009
Induced Effect	241	$8,158,071	$15,639,840	$27,825,381
Total Effect	1,510	$55,496,970	$71,663,976	$191,148,169
Multiplier	**1.38**	**1.42**	**1.68**	**1.40**

ENGINEERED WOOD MEMBER & TRUSS

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1,071	$47,024,267	$51,012,756	$193,921,371
Indirect Effect	456	$28,376,274	$43,885,627	$78,503,314
Induced Effect	507	$21,584,642	$39,416,939	$68,097,879
Total Effect	2,034	$96,985,184	$134,315,323	$340,522,563
Multiplier	**1.90**	**2.06**	**2.63**	**1.76**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	249	$11,355,048	$12,281,394	$45,458,122
Indirect Effect	69	$3,196,214	$5,106,628	$9,934,120
Induced Effect	74	$2,507,490	$4,807,036	$8,552,394
Total Effect	392	$17,058,752	$22,195,058	$63,944,636
Multiplier	**1.57**	**1.50**	**1.81**	**1.41**

RECONSTITUTED WOOD PRODUCTS

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	244	$14,484,143	$21,234,990	$119,264,259
Indirect Effect	208	$12,879,229	$23,970,348	$50,231,389
Induced Effect	184	$7,832,810	$14,303,920	$24,711,887
Total Effect	636	$35,196,182	$59,509,257	$194,207,535
Multiplier	**2.61**	**2.43**	**2.80**	**1.63**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	0	0	0	0
Indirect Effect	0	0	0	0
Induced Effect	0	0	0	0
Total Effect	0	0	0	0
Multiplier	**0**	**0**	**0**	**0**

VENEER & PLYWOOD

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	637	$27,778,218	$33,617,747	$165,481,750
Indirect Effect	381	$24,277,270	$40,079,294	$74,798,987
Induced Effect	350	$14,905,797	$27,220,541	$47,026,912
Total Effect	1,367	$66,961,286	$100,917,582	$287,307,649
Multiplier	**2.15**	**2.41**	**3.00**	**1.74**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	101	$4,910,293	$5,844,823	$26,699,638
Indirect Effect	41	$1,972,813	$3,506,653	$7,028,870
Induced Effect	35	$1,186,786	$2,275,503	$4,048,301
Total Effect	177	$8,069,892	$11,626,979	$37,776,809
Multiplier	**1.75**	**1.64**	**1.99**	**1.41**

MILLWORK

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	13,445	$643,299,303	$702,652,185	$2,150,113,339
Indirect Effect	4,928	$284,509,850	$445,639,809	$834,480,880
Induced Effect	6,236	$265,571,245	$484,971,608	$837,852,832
Total Effect	24,610	$1,193,380,398	$1,633,263,602	$3,822,447,050
Multiplier	**1.83**	**1.86**	**2.32**	**1.78**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	3,651	$155,763,274	$175,614,925	$601,720,253
Indirect Effect	991	$41,925,591	$66,939,320	$133,038,496
Induced Effect	1,005	$34,066,787	$65,308,505	$116,193,001
Total Effect	5,647	$231,755,652	$307,862,750	$850,951,750
Multiplier	**1.55**	**1.49**	**1.75**	**1.41**

WOOD FURNITURE

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	5,969	$299,516,233	$320,932,448	$864,693,909
Indirect Effect	1,830	$107,161,467	$171,410,100	$320,254,750
Induced Effect	2,734	$116,443,147	$212,644,342	$367,370,240
Total Effect	10,533	$523,120,846	$704,986,890	$1,552,318,899
Multiplier	**1.76**	**1.75**	**2.20**	**1.8**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1,416	$55,153,298	$59,504,693	$179,108,702
Indirect Effect	276	$11,364,098	$18,787,575	$36,951,357
Induced Effect	339	$11,471,147	$21,995,438	$39,131,207
Total Effect	2,031	$77,988,544	$100,287,706	$255,191,266
Multiplier	**1.43**	**1.41**	**1.69**	**1.42**

UPHOLSTERED HOUSEHOLD FURNITURE

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	445	$16,274,375	$17,231,485	$76,905,029
Indirect Effect	155	$9,697,856	$16,086,009	$30,380,334
Induced Effect	175	$7,434,255	$13,576,050	$23,454,418
Total Effect	774	$33,406,486	$46,893,543	$130,739,782
Multiplier	**1.74**	**2.05**	**2.72**	**1.70**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	162	$4,904,860	$5,210,311	$26,912,296
Indirect Effect	36	$1,682,966	$2,884,313	$5,834,291
Induced Effect	34	$1,135,607	$2,177,220	$3,873,509
Total Effect	231	$7,723,433	$10,271,844	$36,620,096
Multiplier	**1.43**	**1.57**	**1.97**	**1.36**

MANUFACTURING SERVICES

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	202	$7,074,498	$9,595,163	$86,357,620
Indirect Effect	220	$13,654,890	$22,238,477	$40,268,084
Induced Effect	139	$5,924,340	$10,818,265	$18,690,205
Total Effect	561	$26,653,728	$42,651,905	$145,315,909
Multiplier	**2.78**	**3.77**	**4.45**	**1.68**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	137	$4,243,356	$5,906,316	$57,789,169
Indirect Effect	100	$4,715,623	$7,784,187	$15,033,481
Induced Effect	46	$1,545,032	$2,962,558	$5,270,559
Total Effect	282	$10,504,012	$16,653,061	$78,093,209
Multiplier	**2.06**	**2.48**	**2.82**	**1.35**

MANUFACTURED HOUSING

OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	633	$30,588,358	$35,670,591	$110,861,831
Indirect Effect	235	$13,381,517	$20,449,955	$38,744,305
Induced Effect	296	$12,583,676	$22,979,572	$39,700,286
Total Effect	1,162	$56,553,552	$79,100,118	$189,306,422
Multiplier	**1.84**	**1.85**	**2.22**	**1.71**

APPALACHIAN OHIO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	404	$21,907,535	$25,596,009	$73,632,097
Indirect Effect	96	$3,950,674	$6,117,943	$12,115,883
Induced Effect	132	$4,456,672	$8,544,136	$15,201,069
Total Effect	632	$30,314,880	$40,258,088	$100,949,049
Multiplier	**1.56**	**1.38**	**1.57**	**1.37**

Appendix B.

Detailed Economic Contribution by Appalachian Ohio County

ADAMS

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	343.6	$13,458,810	$14,419,744	$37,016,910
Indirect Effect	46.9	$1,382,045	$2,325,176	$5,053,296
Induced Effect	57.3	$1,301,018	$3,169,162	$5,790,303
Total Effect	447.7	$16,141,872	$19,914,083	$47,860,509
Multiplier	**1.30**	**1.20**	**1.38**	**1.29**

ASHTABULA

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	877	$44,661,972	$56,310,384	$273,618,700
Indirect Effect	293.4	$10,197,213	$17,783,350	$36,839,246
Induced Effect	248.3	$7,538,307	$14,914,184	$27,196,716
Total Effect	1,418.60	$62,397,492	$89,007,918	$337,654,662
Multiplier	**1.62**	**1.40**	**1.58**	**1.23**

ATHENS

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	274.8	$2,720,287	$3,349,042	$15,266,727
Indirect Effect	33.1	$591,961	$1,011,208	$2,098,450
Induced Effect	16.3	$511,153	$1,028,866	$1,825,918
Total Effect	324.1	$3,823,402	$5,389,116	$19,191,095
Multiplier	**1.18**	**1.41**	**1.61**	**1.26**

BELMONT

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	60.4	$2,764,606	$3,185,581	$12,108,049
Indirect Effect	22.2	$824,939	$1,306,418	$2,380,103
Induced Effect	19.6	$654,945	$1,331,388	$2,329,160
Total Effect	102.2	$4,244,489	$5,823,387	$16,817,312
Multiplier	**1.69**	**1.54**	**1.83**	**1.39**

BROWN

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	90.1	$3,016,952	$3,704,756	$22,955,576
Indirect Effect	27.2	$877,958	$1,273,577	$2,729,637
Induced Effect	15.5	$375,881	$790,101	$1,440,142
Total Effect	132.7	$4,270,791	$5,768,434	$27,125,355
Multiplier	**1.47**	**1.42**	**1.56**	**1.18**

CARROLL

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	200.2	$6,359,539	$7,333,655	$33,038,715
Indirect Effect	45.5	$1,226,020	$1,976,996	$4,759,168
Induced Effect	23.1	$609,320	$1,458,329	$2,814,456
Total Effect	268.8	$8,194,879	$10,768,981	$40,612,339
Multiplier	**1.34**	**1.29**	**1.47**	**1.23**

CLERMONT

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	615.2	$34,016,714	$39,412,094	$177,392,894
Indirect Effect	306.7	$14,277,030	$22,773,850	$41,527,555
Induced Effect	222	$7,814,076	$15,754,215	$27,597,286
Total Effect	1,143.90	$56,107,820	$77,940,159	$246,517,735
Multiplier	**1.86**	**1.65**	**1.98**	**1.39**

COLUMBIANA

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	275.5	$10,164,976	$12,268,382	$76,204,982
Indirect Effect	81.5	$3,404,218	$5,731,999	$11,540,477
Induced Effect	62.1	$1,912,248	$3,774,813	$6,828,719
Total Effect	419.1	$15,481,442	$21,775,193	$94,574,178
Multiplier	**1.52**	**1.52**	**1.77**	**1.24**

COSHOCTON

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	420.6	$28,282,061	$34,744,224	$173,205,820
Indirect Effect	259.9	$9,507,732	$16,161,486	$34,911,216
Induced Effect	158.1	$4,496,414	$9,109,676	$16,713,791
Total Effect	838.7	$42,286,207	$60,015,386	$224,830,827
Multiplier	**1.99**	**1.50**	**1.73**	**1.30**

GALLIA

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	132	$10,078,847	$10,437,104	$21,545,451
Indirect Effect	17.8	$668,133	$1,115,536	$2,211,512
Induced Effect	55.9	$1,682,645	$3,260,391	$5,997,851
Total Effect	205.7	$12,429,625	$14,813,030	$29,754,813
Multiplier	**1.56**	**1.23**	**1.42**	**1.38**

GUERNSEY

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	202.2	$13,260,325	$14,862,505	$51,681,176
Indirect Effect	80	$2,327,242	$3,520,120	$7,244,591
Induced Effect	78.6	$2,360,104	$4,496,994	$7,989,056
Total Effect	360.7	$17,947,671	$22,879,618	$66,914,823
Multiplier	**1.78**	**1.35**	**1.54**	**1.29**

HARRISON

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	136.9	$6,138,205	$7,085,418	$23,775,280
Indirect Effect	33	$1,641,988	$2,603,225	$4,928,907
Induced Effect	20.6	$606,706	$1,549,755	$2,679,812
Total Effect	190.5	$8,386,899	$11,238,399	$31,383,999
Multiplier	**1.39**	**1.37**	**1.59**	**1.32**

HIGHLAND

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	209.3	$9,178,255	$10,767,570	$56,573,242
Indirect Effect	58	$2,019,055	$3,365,763	$7,138,644
Induced Effect	43.5	$1,181,444	$2,661,873	$4,772,477
Total Effect	310.8	$12,378,754	$16,795,206	$68,484,363
Multiplier	**1.48**	**1.35**	**1.56**	**1.21**

HOCKING

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	644.1	$13,844,065	$16,640,895	$79,199,020
Indirect Effect	58.2	$1,498,529	$2,773,341	$6,815,871
Induced Effect	49	$1,264,125	$3,164,615	$5,673,709
Total Effect	751.3	$16,606,719	$22,578,851	$91,688,600
Multiplier	**1.17**	**1.20**	**1.36**	**1.16**

HOLMES

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	3,043.20	$153,922,746	$171,528,537	$524,303,836
Indirect Effect	722.8	$24,317,519	$38,316,936	$79,649,980
Induced Effect	535.9	$14,852,407	$31,873,160	$56,103,054
Total Effect	4,301.90	$193,092,671	$241,718,633	$660,056,870
Multiplier	**1.41**	**1.25**	**1.41**	**1.26**

JACKSON

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	479.1	$23,018,240	$25,908,251	$91,089,654
Indirect Effect	75.7	$3,187,702	$4,719,172	$8,851,469
Induced Effect	104	$3,196,533	$6,292,201	$10,888,181
Total Effect	658.8	$29,402,475	$36,919,624	$110,829,304
Multiplier	**1.38**	**1.28**	**1.43**	**1.22**

JEFFERSON

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	159	$9,706,698	$11,198,765	$49,909,087
Indirect Effect	76.4	$4,042,252	$7,178,708	$13,872,660
Induced Effect	69.1	$2,388,228	$4,538,598	$7,967,791
Total Effect	304.5	$16,137,177	$22,916,071	$71,749,538
Multiplier	**1.92**	**1.66**	**2.05**	**1.44**

LAWRENCE

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	22.7	$241,367	$313,252	$2,185,751
Indirect Effect	31.3	$239,270	$348,546	$908,090
Induced Effect	1.8	$48,798	$106,443	$189,916
Total Effect	55.8	$529,436	$768,241	$3,283,756
Multiplier	**2.46**	**2.19**	**2.45**	**1.50**

MAHONING

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	913.2	$46,432,855	$53,337,552	$199,973,794
Indirect Effect	386.1	$19,042,704	$29,308,716	$55,227,469
Induced Effect	411.8	$15,954,730	$27,393,490	$46,992,360
Total Effect	1,711.20	$81,430,289	$110,039,759	$302,193,622
Multiplier	**1.87**	**1.75**	**2.06**	**1.51**

MEIGS

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	27.6	$1,018,193	$1,127,113	$3,797,446
Indirect Effect	5.1	$119,837	$196,227	$439,045
Induced Effect	3.3	$81,913	$202,981	$357,591
Total Effect	36.1	$1,219,943	$1,526,321	$4,594,083
Multiplier	**1.31**	**1.20**	**1.35**	**1.21**

MONROE

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	26.9	$1,821,088	$1,914,711	$3,389,406
Indirect Effect	2.7	$74,173	$133,962	$317,532
Induced Effect	5	$115,585	$318,967	$580,542
Total Effect	34.6	$2,010,846	$2,367,640	$4,287,480
Multiplier	**1.29**	**1.10**	**1.24**	**1.26**

MORGAN

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	75.8	$3,579,130	$3,971,639	$12,398,232
Indirect Effect	20	$397,252	$656,524	$1,864,892
Induced Effect	12.5	$255,867	$653,665	$1,254,475
Total Effect	108.3	$4,232,249	$5,281,828	$15,517,599
Multiplier	**1.43**	**1.18**	**1.33**	**1.25**

MUSKINGUM

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	256.9	$12,791,573	$14,619,693	$47,459,222
Indirect Effect	64.4	$2,487,386	$4,128,797	$8,291,066
Induced Effect	82.4	$3,020,705	$5,602,900	$9,886,451
Total Effect	403.7	$18,299,664	$24,351,390	$65,636,740
Multiplier	**1.57**	**1.43**	**1.67**	**1.38**

NOBLE

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	107.5	$5,105,100	$6,244,858	$29,326,188
Indirect Effect	25.6	$1,192,244	$1,759,013	$3,762,794
Induced Effect	16.8	$418,265	$1,038,903	$1,835,729
Total Effect	149.9	$6,715,609	$9,042,774	$34,924,711
Multiplier	**1.39**	**1.32**	**1.45**	**1.19**

PERRY

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	79.4	$2,593,920	$3,069,210	$13,755,671
Indirect Effect	15.8	$526,123	$939,231	$2,093,754
Induced Effect	7.7	$199,382	$517,932	$933,239
Total Effect	102.9	$3,319,424	$4,526,373	$16,782,664
Multiplier	**1.30**	**1.28**	**1.47**	**1.22**

PIKE

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	443.9	$25,118,898	$27,734,002	$120,264,606
Indirect Effect	110.8	$5,995,694	$9,647,955	$17,874,196
Induced Effect	98.4	$3,094,037	$6,635,858	$11,460,130
Total Effect	653.1	$34,208,630	$44,017,814	$149,598,932
Multiplier	**1.47**	**1.36**	**1.59**	**1.24**

ROSS

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1,196.40	$114,480,002	$161,015,500	$852,949,029
Indirect Effect	774.7	$35,105,639	$72,323,231	$156,975,979
Induced Effect	706.7	$23,991,248	$46,108,531	$79,164,578
Total Effect	2,677.80	$173,576,889	$279,447,261	$1,089,089,586
Multiplier	**2.24**	**1.52**	**1.74**	**1.28**

SCIOTO

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	813.2	$11,037,556	$13,812,552	$82,779,921
Indirect Effect	108.7	$4,766,267	$7,377,313	$14,320,715
Induced Effect	79.5	$2,730,924	$5,017,368	$8,721,753
Total Effect	1,001.40	$18,534,747	$26,207,234	$105,822,389
Multiplier	**1.23**	**1.68**	**1.90**	**1.28**

TRUMBULL

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	284.4	$14,490,807	$16,404,367	$58,258,631
Indirect Effect	76	$3,195,785	$4,930,462	$9,506,599
Induced Effect	86.2	$2,982,233	$5,659,203	$9,914,829
Total Effect	446.6	$20,668,825	$26,994,032	$77,680,059
Multiplier	**1.57**	**1.43**	**1.65**	**1.33**

TUSCARAWAS

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	1,591.10	$66,114,982	$76,679,575	$338,010,093
Indirect Effect	450	$19,730,884	$33,236,663	$65,076,831
Induced Effect	449.6	$13,484,136	$26,435,955	$46,969,147
Total Effect	2,490.70	$99,330,002	$136,352,192	$450,056,071
Multiplier	**1.57**	**1.50**	**1.78**	**1.33**

VINTON

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	491	$20,754,778	$23,351,540	$92,907,509
Indirect Effect	76.7	$2,218,077	$3,458,860	$8,375,598
Induced Effect	45.7	$938,016	$2,949,550	$5,114,715
Total Effect	613.4	$23,910,872	$29,759,950	$106,397,822
Multiplier	**1.25**	**1.15**	**1.27**	**1.15**

WASHINGTON

Impact Type	Employment	Labor Income	Value Added	Output
Direct Effect	236.1	$10,275,172	$11,313,472	$45,452,049
Indirect Effect	66.5	$3,030,752	$5,305,219	$10,221,440
Induced Effect	64.3	$2,538,667	$4,708,901	$7,981,193
Total Effect	366.9	$15,844,591	$21,327,593	$63,654,682
Multiplier	**1.55**	**1.54**	**1.89**	**1.40**