How Clustering Dynamics Influence Lumber Utilization Patterns in the Amish-Based Furniture Industry in Ohio

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ABSTRACT

Preliminary studies have suggested that the Amish-based furniture and related products manufacturing cluster located in and around Holmes County, Ohio, uses sizeable quantities of hardwood lumber. The number of firms within the cluster has grown even as the broader domestic furniture manufacturing sector has contracted. The present study was undertaken in 2008 (spring/summer) to develop lumber use estimates specific to Amish manufacturing and provide more detail regarding the impacts of clustering on lumber consumption patterns. Results, based on 196 firms responding to a survey, suggested that lumber use ratios (bd ft per employee) differed among firms of different sizes and type of product manufactured, but in aggregate was similar to the broader US furniture industry. Red oak was the most commonly used species. Local suppliers of hardwood lumber and components were used extensively by most firms. The study confirmed that the Holmes County furniture cluster was important to regional hardwood demand, facilitated by well-developed supply chains that enable high specialization and enhance aggregate productivity among the numerous small manufacturers.

Keywords: furniture, Amish, hardwood lumber, clustering, manufacturing

A steep decline in the manufacture of wood household furniture in the United States has had a substantial impact on domestic employment and markets for hardwood lumber. From 1999 to 2008, production employment in the US nonupholstered wood household furniture industry declined by over 62%, or nearly 70,000 employees (Bureau of Labor Statistics n.d.). Nationally, hardwood lumber consumption by the furniture industry has declined from 34% of total domestic appearance-grade production (excluding material used to produce pallets and rail ties) in 1999 to just 15% in 2008 (Hardwood Market Report 2009). In the absence of a viable domestic furniture industry, US hardwood lumber demand becomes increasingly reliant on housing and remodeling markets (e.g., cabinets, flooring, and millwork), particularly for the middle and higher (i.e., appearance) grades (Luppold and Bumgardner 2008, Buehlmann et al. 2009).

This downturn in US furniture manufacturing has been precipitated largely by increasing imports from low-cost sources such as China, Vietnam, and other locations in Southeast Asia (Figure 1). A recent report from the High Point (North Carolina) International Home Furnishings Market indicated that 79% of the new offerings shown at this major biannual furniture trade show were imported (Appalachian Hardwood Manufacturers, Inc., 2006). Although not a measure of actual imported volume, such data are important because design and product trends originate at this and other large furniture markets (e.g., Las Vegas, Nevada). Based on actual volumes of domestic product shipments and imports, it is estimated that nearly 60% of the nonupholstered wood household furniture sold in the United States is imported (Cochran 2008). Given these overall trends, there have been calls in recent years for a "paradigm shift" in the US wood household furniture industry to regain manufacturing competitiveness

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(Schuler and Buehlmann 2003). Key elements of the paradigm shift include manufacture of customized products and strategic supply chain alliances, which can be facilitated by economic clustering (Schuler and Buehlmann 2003). Similarly, Dugan (2009) offers several "new rules" for the US furniture industry, including a focus on agility, niche marketing, lean production practices, and supply chain development.

One sector of the domestic furniture industry that has performed well during this period of globalization is the Amish-based manufacturing cluster located in Holmes and surrounding counties in northeastern Ohio [1]. The cluster has grown as the broader domestic furniture manufacturing industry has contracted. For example, over one-quarter of the firms operating in the cluster in 2005 had formed since 2000, even as wood furniture imports rose rapidly relative to domestic production (Bumgardner et al. 2007). Firms within this cluster appear to be using many practices associated with a new paradigm for the industry. For example, consumers of Amish-made products often are given options related to wood species, finish, and even hardware for their furniture pieces. Specialized supply chains have developed to facilitate this customization.

In this article, we review some of the competitive advantages associated with clusters and relate these advantages to the dynamics found in the Holmes County furniture cluster. We then assess how clustering affects lumber use patterns among the mostly small and specialized Amish furniture manufacturers.

Competitive Advantages of Economic Clustering

Clusters, or geographic concentrations of interconnected companies in a given field, can promote competitive advantage to manufacturers through increased productivity, rapid innovation, and new business formation (Porter 1998). Clusters are not uncommon in forest-based industries in the United States. In the Pacific Northwest, analysis of three different clusters revealed several factors important to success, including proximity to regional markets, availability of skilled labor, a plentiful raw material supply, and formation of new complementary businesses through spinoff ventures (Braden et al. 1998). Other case studies of wood products clusters throughout the United States and Europe confirmed many of these success factors and added others, including the importance of stakeholder cooperation, entrepreneurial thinking among the clustered firms and associated organizations, leadership, and, often times, adequate funding sources (Aguilar et al. 2009). Cluster theory has been proposed as a framework for promoting economic development within communities adjacent to or embedded by US national forests (Rojas 2007) and development of bioenergy opportunities (Bratkovich et al. 2009). In Europe, examples of successful furniture-related manufacturing clusters are found in northern Italy and Denmark (Schuler and Buehlmann 2003).

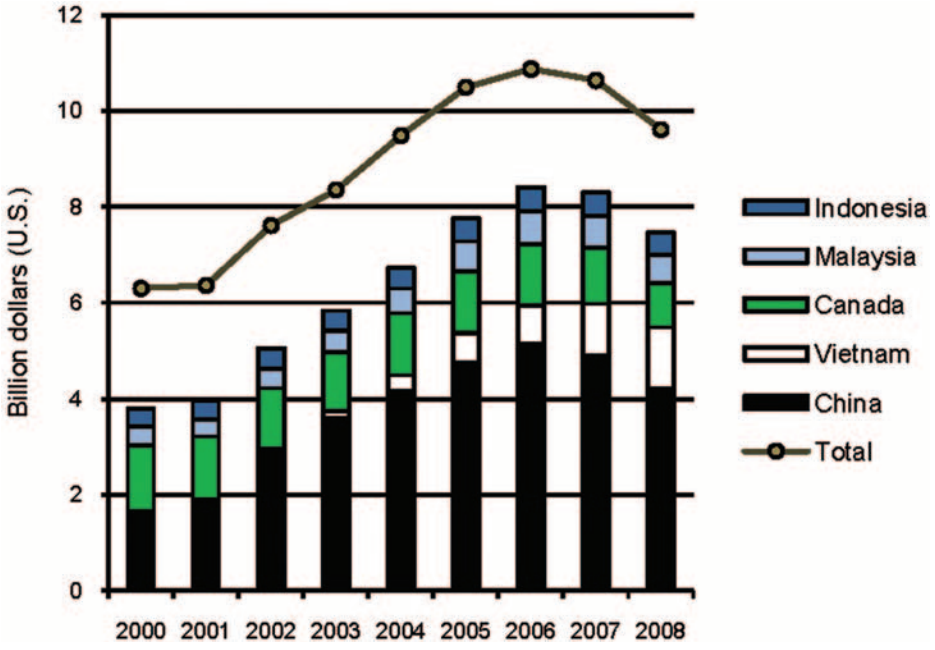

Figure 1. Major sources (top five for 2008) of nonupholstered wood household furniture imported by the United States, 2000–2008. (Source: International Trade Administration n.d..)

Mottiar and Ingle (2007), studying a wood furniture manufacturing district in Ireland, developed the concept of interpreneurship, which merges elements of entrepreneurship (focused on the individual), and intrapreneurship (focused on the firm). Interpreneurship was used by these authors to explain the success of the cluster in terms of strong interfirm relations among the numerous small firms embedded in the local community, as well as a social milieu, which was defined as "… a close link between society and firms; the relationships between the actors in the economy are not purely economic" (Mottiar and Ingle 2007, p. 669). This setting resulted in cooperation and information exchange among firms, creating a social network that allowed individual firms to benefit from the growth of the cluster as a whole. The cooperation came in a variety of forms, ranging from joint marketing and product development to sharing machinery. The authors concluded that the success of the local economy was dependent on the local industry as a whole, not individual firms or products (Mottiar and Ingle 2007). Bresnahan et al. (2001) add to this notion with their findings from multiple international case studies that, once established, clusters enabled opportunities to take advantage of regional economies of scale rather than at the level of individual firms.

Porter (1998) describes the cooperation and competition in clusters in terms of interfirm vertical integration. Although the competition lies with rivals competing for customers (such competition is critical to cluster success), the cooperation is vertical. Clusters offer a specialized supplier base that can lower transaction and inventory costs. Furthermore, the proximity of suppliers and manufacturers enhances communications among firms and fosters closer, more informal relationships. For example, success in boat building clusters in Australia was found to be associated with manufacturers that involved their suppliers in helping solve problems and discussing design and production requirements (Jones 1996). In the Holmes County furniture cluster, an example of such collaboration between manufacturers and suppliers is associated with Ohio Certified Stains, a program where finish suppliers

work with manufacturers to develop and adhere to a set of color standards that enables consistency among products made by multiple manufacturers and enables placement of semicustomized orders by consumers in retail showrooms (Terreri 2008).

The Holmes County Furniture Cluster

Background

Economic clusters have been defined as, "… critical masses—in one particular place—of unusual competitive success in particular fields" (Porter 1998, p. 78). This definition seems to be an accurate characterization of the Holmes County furniture cluster. For example, a preliminary assessment found that this cluster, comprising, roughly, a two-county area [2], consumed 11% of the volume of hardwood lumber produced in the state of Ohio, or 19% of the lumber used in appearance-based applications (i.e., excluding pallets and rail ties). The corresponding volume was approximately 43 mmbf, aggregated across more than 400 mostly small shops. The mean number of employees for firms in the cluster was 7.2, the median was 4.0, and the mode was 2 (Bumgardner et al. 2007). Conversely, the typical size of a furniture firm in the broader US industry is approximately 27 employees, derived by dividing the number of paid employees by the number of establishments (US Census Bureau 2008a).

Associations have formed to promote the interests of firms in Holmes County, as have trade shows that serve as opportunities for individual manufacturers to present new products and meet with existing and potential retail customers. For example, in its 2nd year, the Ohio Hardwood Furniture Market, a furniture trade show held in Holmes County and coordinated by The Hardwood Furniture Builder's Guild (a committee within the Holmes County Chamber of Commerce) attracted 120 exhibitors. Amish furniture firms from surrounding states (e.g., Indiana, Pennsylvania) also have started exhibiting at the show [3].

Interfirm Dynamics

Within the Holmes County furniture cluster, which consists of numerous small firms and a few relatively large firms, the structure resembles a multicentered industrial district, which is defined by Brookfield (2008, p. 408) as, "… an industrial district made up of a number of [locally-owned] firms, possibly even including some large firms, but absent a dominate one." In such districts, firms have been found to be more specialized than nondistrict firms, attributable to being part of a "system of network production" (Brookfield 2008). This specialization arises in two ways: (1) firms outsource inputs to a greater degree and (2) they have fewer product lines. Specialization also is evident in the Holmes County furniture cluster. As one Amish manufacturer there has stated, "What the cluster does is it spreads out the investment risk. Many of the shops, therefore, specialize in a relatively narrow field of production" (Terreri 2008, p. 21).

In Holmes County, firm specialization also is consistent with Mottiar and Ingle's (2007) view of embeddedness within an industrial district, where important motivations for firms are to remain viable and continue living in the area. For example, very small Amish firms may reach a point where they do not wish to grow beyond a customer base that can be served by the family members already employed, because furniture making has become a way to pursue an at-home occupation as farming becomes increasingly unviable (Kreps et al. 1994, Lowery and Noble 2000). These firms might choose to work with a larger firm to manufacture specific products for the larger firm's line. In this way, they rely on the larger firm for product development, marketing, and distribution as the larger firm expands its sales (Terreri 2008). Similarly, Bresnahan et al. (2001) found that the growth of at least some of the startup firms within clusters was an indication of cluster success, and that the larger firms eventually helped form the vertical linkages that enhanced continued cluster growth; however, many other firms within the clusters investigated preferred to remain small.

Mottiar and Ingle's (2007) notion of a professional milieu in clusters also seems evident from a quote from an Amish manufacturer in Holmes County, "We sell parts to and buy from our competitors. You either know them or know of them" (Terreri 2008, p. 21). Unique interfirms linkages are the result. According to Porter (1998), repeated market exchanges are common among proximal companies within clusters.

Study Objectives

The first objective of this study was to estimate total lumber use by the Holmes County furniture cluster. The results from preliminary research have suggested that Amish furniture manufacturing was exerting substantial influence on regional hardwood lumber demand, but that further research was warranted; the initial estimates were based on application of an input productivity ratio derived from secondary data for the broader US furniture industry (17,433 bd ft/employee) and not Amish manufacturing specifically.

A second objective was to develop a better understanding of lumber use patterns within the cluster, including analysis of input productivity, species use, and distribution channels for hardwood lumber. Porter (1998) claims that productivity, driven in part by the presence of deep and specialized supply chains, is a major competitive advantage arising from clusters. The interfirm dynamics evident in the Holmes County furniture cluster might be enhancing the cluster's overall productivity even though most firms are very small, and smaller firms are known to have lower productivity levels than larger firms (Tambunan 2005), specifically in terms of input productivity (Punches et al. 1995). Furthermore, a reliance on outsourcing of specialized manufacturing inputs has been associated with multicentered clusters (Brookfield 2008). Thus, it might be expected that although most of the furniture firms in Holmes County would be consuming limited quantities of hardwood lumber directly, component manufacturers in the cluster would be relatively larger lumber consumers and important to supplying the furniture firms with value-added products that require less processing before assembly. However, to date, primary information on wood use by Amish furniture manufacturers has been unavailable to evaluate this premise.

Such information also provides valuable cues as to the functioning of the cluster in the broader furniture market. Anecdotal evidence suggests that red oak (*Quercus* spp., mostly *rubra* L.) is the primary species used by cluster firms (Terreri 2008), even though demand has shifted from red oak to more diffuse-porous species such as cherry (*Prunus serotina* Ehrh.) and maple (*Acer* spp.) in the US marketplace for appearance-based products such as furniture (Luppold and Bumgardner 2007). For example, only 3% of the bedroom and dining room showings at the 2008 High Point Furniture Market were in red oak, while cherry, maple, rubberwood (*Hevea brasiliensis* Muell. Arg.), and white oak (*Quercus alba* L.) were 12, 9, 9, and 7%, respectively (Appalachian Hardwood

Manufacturers, Inc., 2008). Ash (*Fraxinus* spp.), walnut (*Juglans nigra* L.), and birch (*Betula* spp.) also were higher than red oak.

Methods

A questionnaire was developed with input from several manufacturers and suppliers working in the Holmes County furniture cluster. Although not formally pretested, the questionnaire was discussed line by line in two separate group meetings with these representatives. For the present study, the "Holmes County region" was defined as Holmes County and portions of five surrounding counties in northeastern Ohio, representing an area of approximately 1,000 mi^2. A map was provided on the questionnaire to make clear to respondents the geographic definition of the cluster for the purposes of the study.

A packet containing the seven-page questionnaire, a cover letter, and postage-paid return envelope was sent in mid-May of 2008 to 569 firms. The sampling frame was *The Furniture Book: A Complete Guide to the Furniture Manufacturers and Wholesalers in Ohio's Amish Country* (Anonymous 2005). A reminder postcard was sent to nonrespondents in mid-June. Last, a second packet (containing a duplicate questionnaire, postage-paid return envelope, and updated cover letter) was sent to all nonrespondents in late June. Dennis (2003) recommends that mail surveys of small business owners include at least three contacts to improve the response rate. All mailings originated from (and were returned to) the Ohio Agricultural Research and Development Center in Wooster, Ohio.

A total of 196 usable questionnaires were returned for an adjusted response rate of 43.4% after removing undeliverable addresses and those respondents that were not manufacturers (e.g., finishers, suppliers, and distributors). Over 96% of respondents indicated that they were the firm owner or co-owner; the remainder indicated they were shop managers, with the exception of one who indicated being a worker.

On inspection of the data, it was apparent that a small number of the lumber use figures provided by respondents were unrealistic given the number of employees employed at the firm and/or the number and type of furniture pieces manufactured. Some appeared overly high (e.g., 65,000,000 bd ft) and others seemed too low (e.g., 100 bd ft). Such values were removed from the data set for four respondents. Furthermore, lumber use responses were altered for two respondents because it seemed apparent from other data provided that a correctable error had occurred.

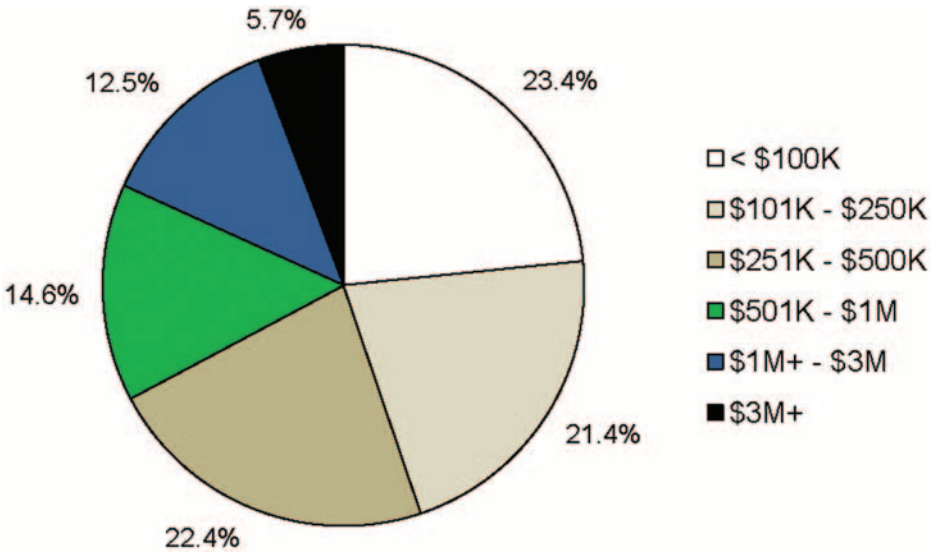

Figure 2. Breakdown of the sample by sales category for 2007.

Assessment of Potential Nonresponse Bias

Potential nonresponse bias in the survey was assessed in two ways. First, sample statistics were compared with known population parameters developed from *The Furniture Book* (Anonymous 2005), as discussed by Bumgardner et al. (2007). The mean employment and establishment year in the sample was 7.6 (median = 4.0) and 1994 (median = 1996), respectively, which compared favorably with mean values of 7.2 for employees (median = 4.0) and 1994 (median = 1996) for establishment year for the population. Furthermore, Bumgardner et al. (2007) reported a total of 2,723 manufacturing employees in the Holmes County furniture cluster; the sample included 1,433 employees or 52.6% of that total, which compared favorably with the survey response rate of 43.4% (for developing lumber use estimates, the effective response rate of 52.6% is used in the remainder of the article since it likely is a better reflection of the production capacity of the sample). Finally, the proportion of non-Amish owned firms was reported to be approximately 15% for the overall Holmes County furniture cluster (Bumgardner et al. 2007); this figure was 14% for the sample (based on those respondents indicating they powered their shops with either single-phase or three-phase connections to the electric grid), suggesting close agreement between the sample and population.

Table 1. Product types manufactured in the cluster.

Product type	Percent of Respondents[a]
Household furniture	80.6
Office furniture	35.7
Cabinets	29.1
Components and dimension	20.5
Moldings/millwork	7.1
Institutional/contract furniture	5.6
Outdoor furniture[b]	2.6

[a] Because respondents checked all categories that applied, column totals to more than 100%.
[b] Firms in which their production was strictly outdoor furniture were not included in the study. Outdoor furniture listed here was from firms also producing interior furniture.

In addition, early respondents (first round and reminder card) were compared with late respondents (second round) on several demographic variables. No significant differences were found for the following variables: gross sales for 2007 ($P = 0.15$, based on a chi-square test), proportion producing household furniture ($P = 0.36$, based on a z-test for proportions), number of furniture pieces produced per year ($P = 0.38$, based on a t-test), establishment year ($P = 0.92$, based on a t-test), number of employees ($P = 0.41$, based on a t-test), and ratio of lumber use per employee ($P = 0.86$, based on a t-test). Thus, nonresponse bias was assumed not to be a major factor when interpreting the results.

Results

Background Characteristics

The distribution of respondents by sales category for 2007 showed that respondents

Table 2. Wood use estimates for responding firms.

Wood use measure	Quantity (bf)
Lumber consumed by responding firms	16,987,153
Dimension consumed by responding firms	3,437,529
Dimension consumed, adjusted up for associated lumber consumption[a]	5,288,506
Total lumber consumption by responding firms (sum of rows 1 and 3)	22,275,659[b]

[a] Assuming 65% yield of dimension from hardwood lumber (Buehlmann et al. 1998).
[b] Based on the effective response rate of 52.6%, total lumber use for the cluster was estimated to be 42.3 mmbf.

Table 3. Number of firms and employees, lumber use per employee (in bd ft), and lumber consumption by firm category.

	Small furniture firms (1–5 employees)	Large furniture firms (6 or more employees)	Components firms
Number of firms[a]	83	40	24
Number of employees	312	744	377
Lumber use per employee (mean)[b,c]	7,986	10,846	31,786
90% Confidence interval for the mean	(6,168; 9,803)	(8,172; 13,521)	(22,723; 40,850)
Total lumber consumption	2,491,632	8,069,424	11,983,322

[a] Does not total to 196 because of some missing values for lumber use and/or firm size used to calculate ratios.
[b] The associated medians were 5,712; 7,035; and 26,044, respectively, suggesting the means were reasonable measures of central tendency for each group.
[c] Weighted average (by number of employees) equal to 15,732 bd ft/employee.

were fairly evenly distributed across categories up to the $500 thousand mark (Figure 2). Sixty-seven percent had gross sales of $500,000 or less and about one-quarter had sales of less than $100,000, suggesting the small nature of most firms. Slightly more than 5% of the sample had sales of $3 million or more. These figures confirm the "multicentered" nature of the cluster. These data also were used to develop an estimate of total sales for the cluster. By assigning each respondent a sales figure representing the midpoint of the category they selected, the sample accounted for approximately $148,606,000 in sales in 2007; extrapolating by the effective response rate of 52.6% gave an estimated total gross sales figure of $282.5 million. An estimate of $280.7 million was provided by Bumgardner et al. (2007) using secondary data sources, suggesting close agreement. This represents approximately 3% of total US production of nonupholstered wood household furniture (Cochran 2008).

The average firm operated 42.7 hours/week; the most common response to this question was 45 hours/week. For 66% of respondents, wood products manufacturing was their sole occupation. Among those with multiple occupations, 46% counted wood products manufacturing as their "full-time" occupation, and 29% indicated that farming or agribusiness was their full-time occupation. Slightly over one-half (54%) of respondents indicated they lost sales volume in 2007 compared with 2006; a plurality of the sample (25%) indicated sales volume was off by about 10%. The timing of the study is noteworthy, with these answers being based on 2007, just before (or including) the recession beginning in late 2007–2008; the study results should be interpreted with this caution.

Although the majority of respondents were furniture manufacturers, several product types were represented. As shown in Table 1, over 80% of respondents indicated that they produced household furniture. Additionally, 36% produced office furniture and 6% produced institutional/contract furniture. Nearly 21% produced components (defined as ready to assemble) or dimension (defined as squares, blocks, and edge-glued products) to support manufacturing both within and outside the cluster. Thus, the region supports a variety of related wood products production, although furniture is clearly the primary final product. Approximately 69% of furniture production, on average, was sold in stores dedicated to Amish-made products, showing the importance of this channel to the Holmes County furniture cluster. As described previously, many Amish-dedicated stores allow for semicustomized orders of Amish products (choice of species, finish, and hardware), a key component of the Amish model.

Lumber Use Volume

A variety of wood material types were used by respondents to make products. Nearly all firms used some hardwood lumber, and a majority also used hardwood dimension (defined on the questionnaire as squares, blocks, and edge-glued products) and plywood. Most plywood is used for drawer bottoms and the backs of larger pieces (dressers, hutches, entertainment centers and more). Dimension has had some value added but requires further processing at the furniture shop. About 40% of respondents also reported using components (e.g., chair parts, drawer fronts, and so on, that are ready for assembly into complete pieces). Thus, most firms desire some preprocessing of materials by upstream suppliers.

For the present study, the primary interest was in use of hardwood lumber and dimension, given that most Amish furniture is solid wood construction and these materials typically are measured in bd ft [4]. The volume of dimension consumption by firm was adjusted upward (by 35%) to form a lumber equivalent, because associated lumber consumption would be higher because of production losses related to cutting-to-size, defecting, and more (Buehlmann et al. 1998). Wood use in components was accounted for by the hardwood lumber used by component manufacturers in the sample. Thus, all wood use estimates are based on bd ft of hardwood lumber consumed. As shown in Table 2, lumber use for responding firms was 22.3 mmbf. Based on the effective response rate of 52.6%, total lumber use for the cluster was estimated to be 42.3 mmbf.

Lumber Input Productivity

To assess the input productivity characteristics of the cluster, three categories were established: small furniture firms (1–5 employees, $n = 109$), large furniture firms (6 or more employees, $n = 52$), and components firms ($n = 28$) [5], which also were a mix of smaller and larger firms, but not numerous enough to separate based on size. Lumber use and input productivity measures by firm size and type of product manufactured are shown in Table 3. Modest increases in input productivity were noted when moving from the small to large furniture firm categories. Lumber use per employee increased from 7,986 to 10,846 bd ft (although the confidence intervals for the two means overlapped, thus any differences are negligible; a *t*-test also suggested that the difference was not significant, $P = 0.14$). Although these

Table 4. Species of lumber consumed in the cluster.

Species category	Percent of total volume[a]
Red oak	45.5
Cherry	17.0
Yellow-poplar	11.2
Soft maple	8.2
White oak	6.2
Hard maple	3.8
Hickory	3.0
Walnut	1.4
Pine	1.2
Other	2.5

[a] These figures were very similar in terms of percent of total volume in the cluster (shown) and average percentages calculated across firms for each species (ignoring volume), suggesting that smaller firms and larger firms were similar in their species use.

Table 5. Suppliers of hardwood lumber for the cluster, furniture, and component firms.

Source	Furniture firms (average)	Furniture firms (percent of total volume)	Component firms (average)	Component firms (percent of total volume)
	(%)			
From local distributors and sawmills	90.7	85.7	71.9	38.9
From other distributors and sawmills	6.7	10.7	23.1	58.8
Other	2.6	3.6	5.0	2.3

figures were well lower than the broader furniture industry ratio of 17,433 bd ft/employee (Bumgardner et al. 2007), component firms had a ratio three to four times higher than furniture firms. Over one-half (53%) of total lumber use was by component firms, which accounted for only 26% of the total employees and just 14% of the number of firms in the sample. The weighted average lumber use ratio across categories was 15,732 bd ft/employee. Thus, although the small size of even "large" firms in the cluster seemed to reduce lumber input productivity compared with the broader industry, inclusion of the component producers, many supplying local furniture producers, works to drive up ratios comparable with the overall industry.

There was evidence of clustering effects for the location of component firms near the furniture producers. For the average component firm, 53% of their product sales stayed within the Holmes County region, and 73% stayed within Ohio. Moreover, furniture producers within the cluster sourced over 90% of their components, on average, from local shops.

Wood Species Use

A variety of hardwood species were used in production, although only a few were commonplace. Most notably, red oak, cherry, and yellow-poplar (*Liriodendron tulipifera* L.) each accounted for at least 10% of total consumption (Table 4), measured by summing total consumption for each species across firms (firms provided information on the proportion of each species they used in addition to their total consumption). Much of the yellow-poplar is used for nonexposed parts such as drawer sides, whereas red oak and cherry are used as visible surfaces. Red oak was the dominant species used, accounting for nearly one-half of total consumption (45%). Nationally, production of red oak lumber (including graded lumber for appearance-based uses and industrial lumber for use as pallets and railway ties) was about a one-third of total production in 2007 (US Census Bureau 2008b); therefore, it seems that Amish manufacturing is accounting for a disproportionate volume of red oak consumption and is therefore an important regional source of appearance-grade demand for this species.

Lumber Distribution Channels

A final consideration was the channels by which lumber was procured by manufacturers in the cluster. As shown in Table 5, the vast majority of lumber received by furniture manufacturers was locally oriented (within the cluster), whether measured as total volume or as average percent of volume. This indicates that furniture firms, regardless of size, were quite similar in their local lumber sourcing patterns. However, the situation appeared somewhat different for component firms. Although the majority of lumber purchases were local on average, nonlocal sources became the majority based on total volume. This finding suggests that smaller component firms tended to source locally while the largest of these firms (the largest users in the cluster) sought lumber from suppliers over a wider geographic range. Overall, local suppliers of hardwood lumber play a major role in the cluster, although these suppliers do not necessarily procure all their logs (in the case of sawmills) or lumber/dimension (in the case of distributors) locally. Such reliance on local business relationships between lumber suppliers and manufacturers is consistent with Porter's (1998) notion that deep and specialized supply chains are common within clusters.

Discussion and Conclusion

The Holmes County furniture cluster is characterized by many small, Amish-owned and -operated firms producing household furniture and related wood products. This study indicated that the cluster consumes a significant volume of hardwood lumber, approximately 42 mmbf annually. Although this result was consistent with previous findings as to the cluster's importance to regional demand for hardwood lumber (Bumgardner et al. 2007), the present study provided additional information by detailing lumber use by company type and size, which sheds light on the input productivity associated with the cluster.

In aggregate, ratios of lumber use per employee were similar to the broader furniture industry. However, ratios were much higher among the component firms in the cluster compared with the furniture firms. Thus, although few in relative number, it seems that more than one-half of hardwood lumber use by the overall cluster is accounted for by component manufacturers, and this material then goes to furniture shops to be processed further and assembled, or is exported outside the cluster. This likely is a reflection, in part, on the small size and specialized nature of most of the furniture firms—there is a division of labor and well-defined supply chains within the cluster and local supply sources are important. It thus seems evident that clustering enables these small firms to reach aggregate lumber input productivity levels comparable with the broader industry. As stated by Porter (1998, p. 80), "A cluster allows each member to benefit as if it had greater scale or as if it had joined with others without sacrificing its flexibility." This aggregate productivity affords the numerous small firms the opportunity to remain flexible and maintain a desired lifestyle, e.g., family-based at-home employment in the Holmes County area. As

one respondent commented when asked on the questionnaire why the cluster had grown, "Farms weren't available … by working together [the Holmes County region] grew to be a great source for furniture." One of the "new rules" for competitiveness in the US furniture industry is to stay small while mastering a specific area of expertise (Dugan 2009), which clustering in a multicentered district helps the Amish firms to achieve through specialization (Brookfield 2008).

Nearly one-half of total production for the cluster was in red oak in 2007, suggesting that Amish manufacturing is an important regional source of demand for red oak given recent declines in popularity for this species. Interestingly, anecdotal evidence from discussions with manufacturers within the cluster suggests that red oak use likely was proportionally even higher within recent years, indicating that firms are moving toward designs more consistent with the broader marketplace and diversifying as the cluster grows. As one respondent indicated, a limitation to future growth of the cluster was "building oak country style furniture." Porter (1998) discusses the "collective inertia" that can form within clusters if companies become too inward looking and thus unable to perceive the need for innovation. However, it also can be said that the cluster has developed and grown to date by focusing on this niche. Going forward, exposure to broader markets might be reflected in changes in the species mix used.

Similar to previous work based on different methods, a total value of shipments from the Holmes County furniture cluster of approximately $280 million was derived in the present study, which represents about 3% of total US production, this among approximately 400 mostly small firms operating within roughly a two-county area. Although a relatively small portion of the overall US wood furniture industry, the model used in the cluster is consistent with a "paradigm shift" (Schuler and Buehlmann 2003) and thus an example of what can work in the US-based industry. In the past, a large US furniture plant would complete the entire production process under one roof, from lumber procurement and drying, to manufacture of components in the rough mill, to final product assembly and finishing. In the Holmes County furniture cluster, firms are smaller and more specialized but interconnected. The presence of this successful manufacturing cluster helps sustain regional forest-based economies and provides more diversification for domestic appearance-grade hardwood lumber markets beyond those directly related to housing construction and remodeling.

Endnotes

[1] A variety of wood products are manufactured by the Amish community in the Holmes County region, but household furniture is the principal product. For consistency, the term "Holmes County furniture cluster" is used throughout this article.

[2] Although most of the firms are concentrated in a two-county area (Holmes and Wayne; Ohio has 88 total counties), portions of the cluster extend into some surrounding counties, for a total area covering approximately 1,000 mi^2 (Lowery and Noble 2000).

[3] This information was sourced from the program of the 2009 Ohio Hardwood Furniture Market.

[4] Respondents reported that, on average, 89% of their total wood material costs were for solid wood materials (i.e., excluding plywood and composite panels). Luppold and Bumgardner (2009) reported that solid wood materials comprised about 57% of total wood material costs for the broader household furniture industry.

[5] Although mostly components firms, five were producers of dimension products. Lumber use by these five firms was reduced to account for the proportion of their production that was consumed locally, which was counted as dimension use by the furniture firms.

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