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economics

US Forest Products in the Global Economy

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The United States' shares of global industrial roundwood production and derivative products have declined precipitously since the 1990s. We evaluate the extent of these declines compared with those of major producing countries from 1961 to 2013. We find that the US global share of industrial roundwood peaked at 28% in 1999 but by 2013 was at 17%, with the decline attributable to a combination of cyclical factors and long-run trends. Wood products output declines are linked to low construction levels, whereas paper's decline is connected to the offshoring of US manufacturing and growth in electronic media. Prospects are for increased use of wood in construction as the housing market returns to long-run averages in the coming years. However, the paper sector is unlikely to recover to its 1990s levels of output, implying that it is unlikely that the United States will return to its historical highs in global market share of industrial roundwood production.

Keywords: forest sector, industrial roundwood, market share, timber products

Forests and forest products have long represented a substantial resource endowment in the United States. The United States has historically had and today still has the economy with the highest intensity of industrial roundwood consumption (49 ft^3/person in 2006; 35 ft^3/person in 2012) (Food and Agricultural Organization of the United Nations 2014, US Census Bureau 2014a, 2014b, 2014c) and consumes and produces more forest products than any other country. However, the size and organization of the forest products industry has changed over the past decade, reflecting changes in consumer demands, manufacturing activity, and global economic growth, raising concerns in some circles about recent shifts and long-term prospects of the sector. This article examines changes in the sector to explore how and why its global position has changed and how it might change in the future.[1]

Solidwood products and pulp and paper comprise the vast majority of the US forest products sector, and both have been affected by a combination of trends and cyclical factors. The solidwood products sector serves demands from manufacturing, housing upkeep and repair, but, most strongly, new construction. Paper and paperboard output is strongly correlated with manufacturing output in the United States. Fluctuations in both the manufacturing and the housing sectors over the past decade have affected markets for US forest products, especially during the most recent recession, which ran from the fourth quarter of 2007 to the second quarter of 2009 (National Bureau of Economic Research 2015). Underlying these fluctuations are longer term trends attributable to technology change and shifts in consumer preferences. Beyond these domestic demands for forest products, changes in the international distribution of economic activity hold implications for the forest products sector.

Domestic Markets

We look first at how consumption, production, and net trade of US forest products have changed between 1961 and 2013 (our most recent data). For continuity with later discussions of international markets, international definitions of products are used.

Industrial Roundwood

Industrial roundwood is the raw timber product that feeds the solidwood product and the pulp and paper sectors (all roundwood harvests except for fuelwood). Consumption and production of industrial roundwood provides an overall picture of the total size of the sector in terms of fiber quantity. Quantities and values of secondary products (e.g., pulp, paper, lumber, and panels) and the tertiary or final product category (e.g., furniture, books, and packaging components of consumer products) are not added to these figures because they would represent double-counting. We expand the discussion to examine trends in secondary products in the next section.

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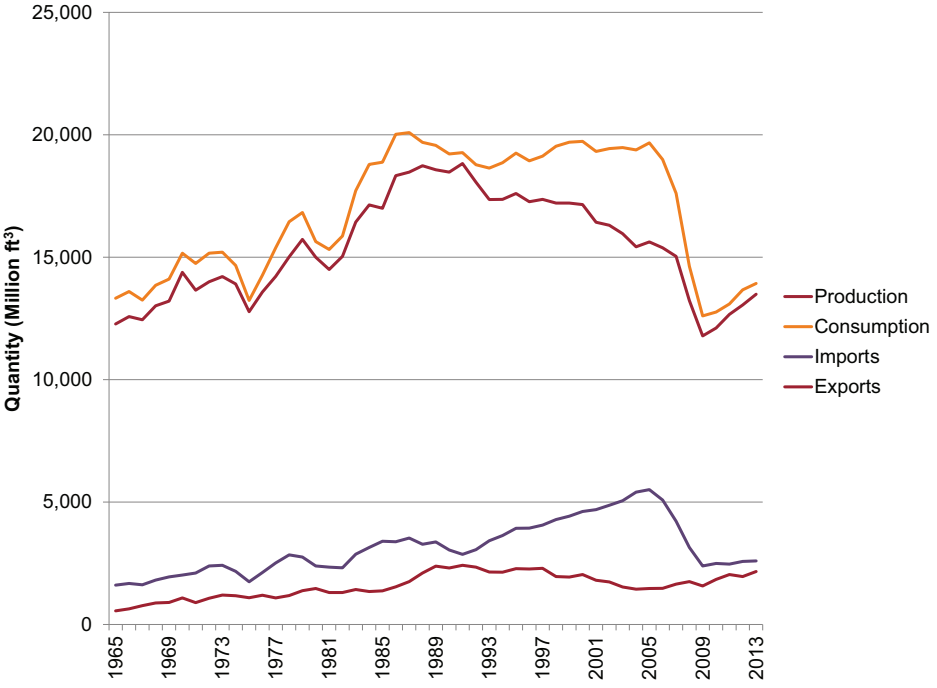

Figure 1. Production, consumption, imports, and exports of roundwood-equivalent timber products (million ft^3) in the United States, 1965–2013. (Source: Howard and Jones 2015.)

Consumption. The United States exhibited a steady expansion in the consumption of industrial roundwood from 1961 to 2005, with only slight dips in output associated with economic downturns (Figure 1). This growth aligned with growth in production of manufactured goods in the United States, which demands paper, especially for packaging. However, this growth ceased in 1999 and has stagnated or fallen along with the US manufacturing sector since then (Figure 2). Consumption growth was also aligned with an increase in the US population, which needed wood to build residences and businesses (Figures 3 and 4). The recession of 2007–2009, which was led by a strong contraction of the housing market, brought roundwood consumption in the United States to its lowest level over this period. In per capita terms, consumption levels had dropped by 40% by 2007, from 51.6 to 31.1 ft^3/person/year, compared with average levels sustained from 1990 through 2006 (Figure 5). The recovery in housing starts since 2009 has had no apparent effect on this rate.

Production. Industrial roundwood production growth strongly paralleled expansion in consumption from 1961 through 1990, and total production was roughly 95% of total consumption over this time span (Figure 1). From the early 1990s to 2005, consumption growth was fed by rapidly expanding imports of industrial roundwood. Production fell substantially with the recession and housing market contraction, and some production recovery has occurred since 2009. Production declines also aligned with reduced consumption and production of paper in the United States, generally attributable to a shrinking manufacturing sector and the emergence of electronic media and reflected in a 17.7% reduction in production capacity in the US paper and paperboard sector from its peak in 2000 to 2013 (Food and Agricultural Organization of the United Nations 2015).

Trade. Net imports of industrial roundwood-equivalent timber products averaged 1,224 million ft^3 from 1965 to 1997 (Howard and Jones 2015). The housing market expansion from 1998 through 2007 required much larger import quantities, up to 4,041 million ft^3 in 2005. Since 2007, imports have declined to near parity with exports, with net imports of industrial roundwood-equivalent timber products of 426 million ft^3 in 2011 and 436 million ft^3 in 2013. The housing market contraction in the United States from 2006 to 2009 corresponded with an import reduction, particularly in wood products from Canada, the largest foreign supplier. So although current domestic US production and consumption are at quantities not observed since before 1965, the gap between imports and exports had shrunk by 2011 to its lowest level since before 1965.

Derivative Industrial Forest Products

Industrial roundwood is used to make a variety of secondary forest products, especially lumber, panels, and paper. Understanding variations and the most recent decline in industrial roundwood production in the United States requires insights into the factors affecting the production and consumption of these secondary products. Solidwood products generally follow the construction industry, whereas paper generally tracks the manufacturing sector in the United States, and long-term trends or more permanent shifts in markets for these products affect the long-run future for timber production.

Coniferous Sawnwood. Consistent with the historical fluctuations in consump-

Management and Policy Implications

Several trends and cyclical changes in final wood products markets imply changes in the demand for timber and forest management in the United States. Although sawtimber demands are beginning to recover, the paper sector's demand for pulpwood from thinnings or final harvest is likely to decline somewhat steadily into the foreseeable future. The effect of the decline will be to put downward pressure on pulpwood prices and reduce returns from intensive forestry. Increased demand for pulpwood driven by the wood pellet market in the southeastern United States, especially for export to Europe, could limit or reverse expected price declines. However, the export component of this market is largely the result of supporting European Union energy policies, which are subject to change in the long run. Recovering housing markets should result in demand growth for softwood lumber and related products. Changes in building codes, allowing for taller and larger wood-frame construction, could lead to further growth in wood demand by the construction sector. Growing inventories of large diameter timber in the US South and Pacific Northwest imply that low-cost timber will be available for construction and manufacturing, which should help wood remain competitive against nonwood construction substitutes and stem the decline in global market share in the long run.

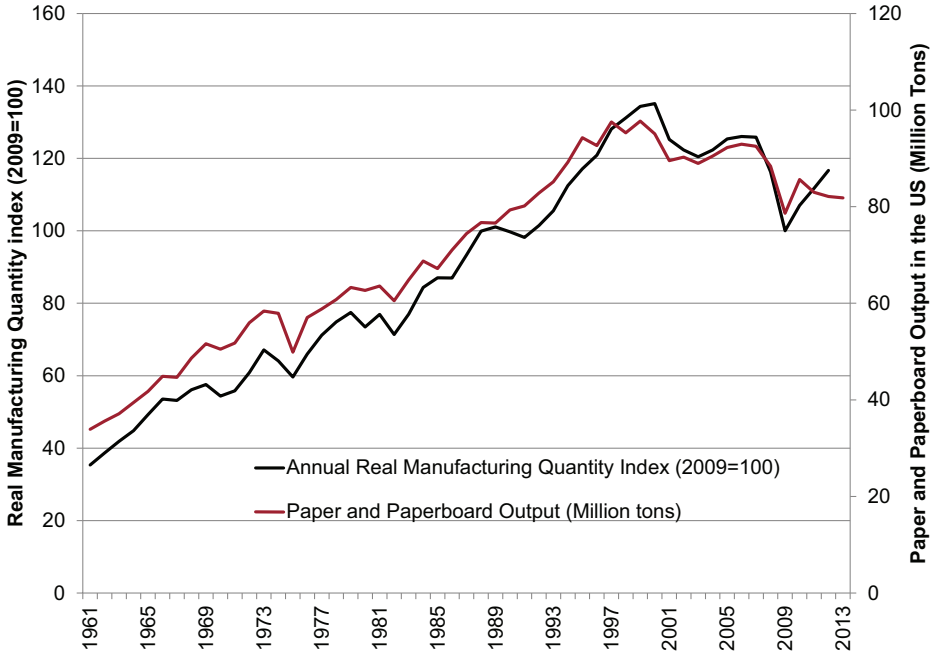

Figure 2. Real manufacturing output index (2009 = 100), 1961–2012, and paper and paperboard output (million tons), 1961–2013. (Sources: Food and Agricultural Organization of the United Nations 2014, US Department of Commerce 2014.)

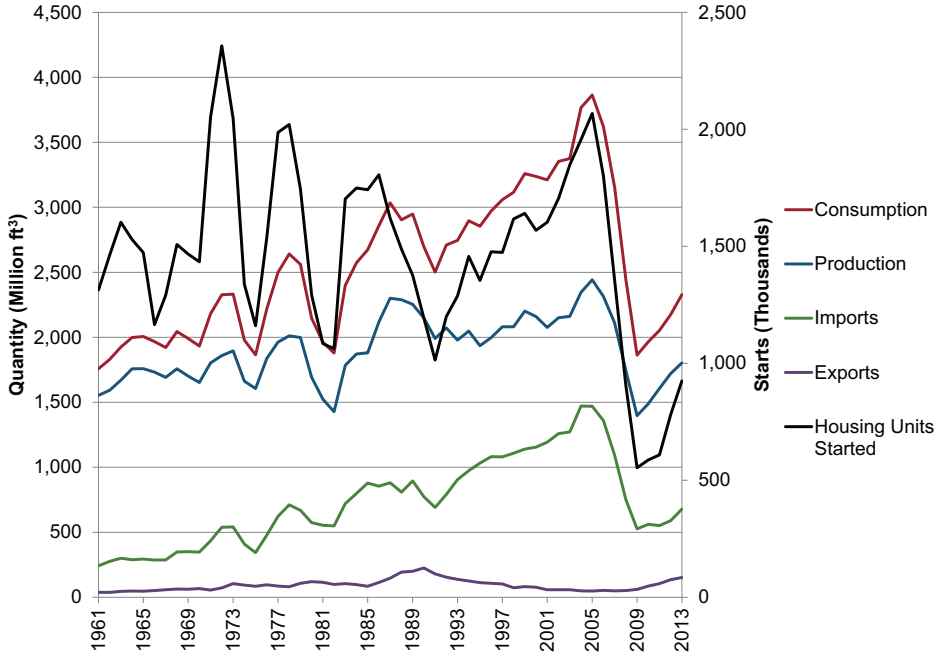

Figure 3. Housing starts and the consumption, production, imports, and exports of coniferous sawnwood (million ft³) in the United States, 1961–2013. (Sources: Food and Agricultural Organization of the United Nations 2014, US Census Bureau 2014d.)

tion, production, and imports linked to the construction sector in the United States (Figure 3), the most recent recovery of the housing market in the United States is leading all of these variables higher (see e.g., Brandeis and Hodges 2015). As of 2013, coniferous sawnwood production had increased by 405 million ft^3 (29%) from its 2009 nadir. The housing market expansion to 2006 resulted in declines in exports as well. However, as the housing market contracted, exports increased. Between 2007 and 2013, the quantity of exports of coniferous sawnwood increased by more than 210%, from 48.8 to 152.3 million ft^3. Until the early 1990s, imports were the equivalent of 23% of consumption, but subsequent consumption growth was provided by expanded imports, bringing that equivalent share to as high as 39% in 2004, near the peak of the construction boom.

Nonconiferous Sawnwood. Because much nonconiferous sawnwood is used to make furniture, flooring, cabinets, and other interior products for new houses, markets for these products also followed trends similar to those for the housing market (Figure 6). However, total production and consumption of this wood product category peaked in 1999, at 1,069 million and 1,023 million ft^3, 6 years before the peak of the previous housing cycle. This prerecession peak is partly explained by the offshoring of the hardwood furniture sector during the 1990s and early 2000s, especially to China, Viet Nam, and other Asian destinations (Schuler and Lawser 2007). Exports of nonconiferous sawnwood have exceeded imports for more than three decades and are now at record levels. Production and consumption have increased since the most recent recession to levels observed before 1990 and are now rising. The positive net trade position is largely attributable to the offshoring of the furniture sector (Luppold and Bumgardner 2013, 2014).

Plywood. Plywood production and consumption in the United States peaked in the late 1980s, and cycles in production are correlated with housing construction. The United States has been a net importer of plywood, mainly from Canada, and the most recent housing cycle greatly increased the level of imports. Although production and consumption levels have recovered since 2009, the weak recovery reveals the strong displacement of plywood by oriented strand board (OSB), as its share of panel production expands in the United States (Figure 7). Overall US plywood production capacity fell from 26,800 million ft^2 (3/8 in. basis) in 1990 to 15,580 million ft^2 in 2010, a drop of 41.9% (Adair 2010).

Particleboard. This product category includes nonstructural and structural panels made from wood particles, including OSB, which has strength and other properties comparable to those of plywood, as well as waferboard and flaxboard (Figure 8). Most of the quadrupling of production and consumption from the early 1980s was due to the emergence of OSB. The housing market cycle also has a strong effect on this product category. The use of OSB in housing construction has increased faster than growth in domestic OSB production, however, so imports of this category have risen since the

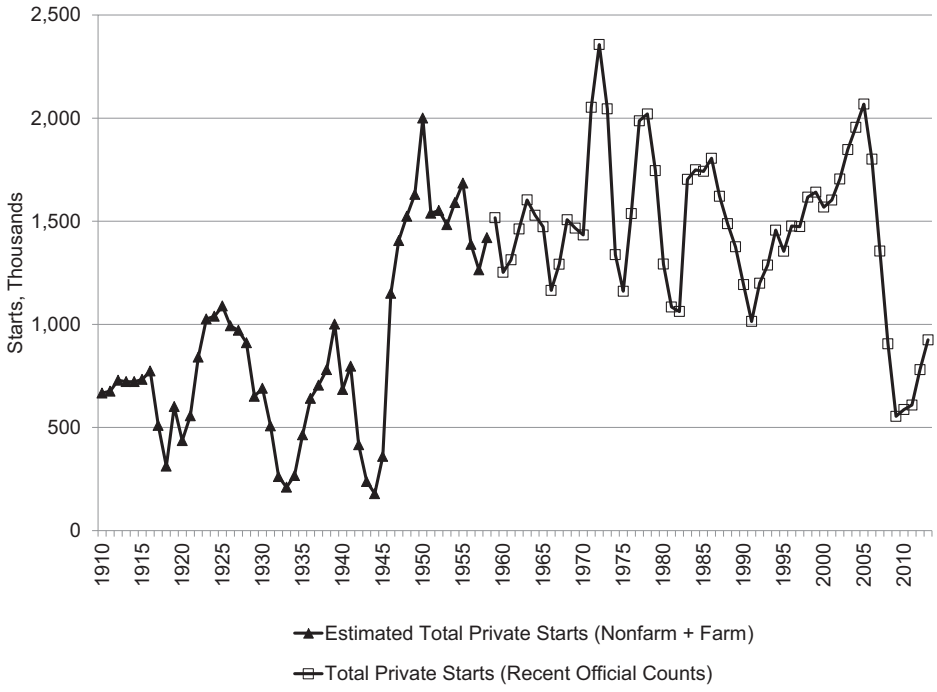

Figure 4. Total US housing starts, 1910–2013. (Sources: 1910–1958: Siskind 1979, p. 16; 1959–2013: US Census Bureau 2014d.)

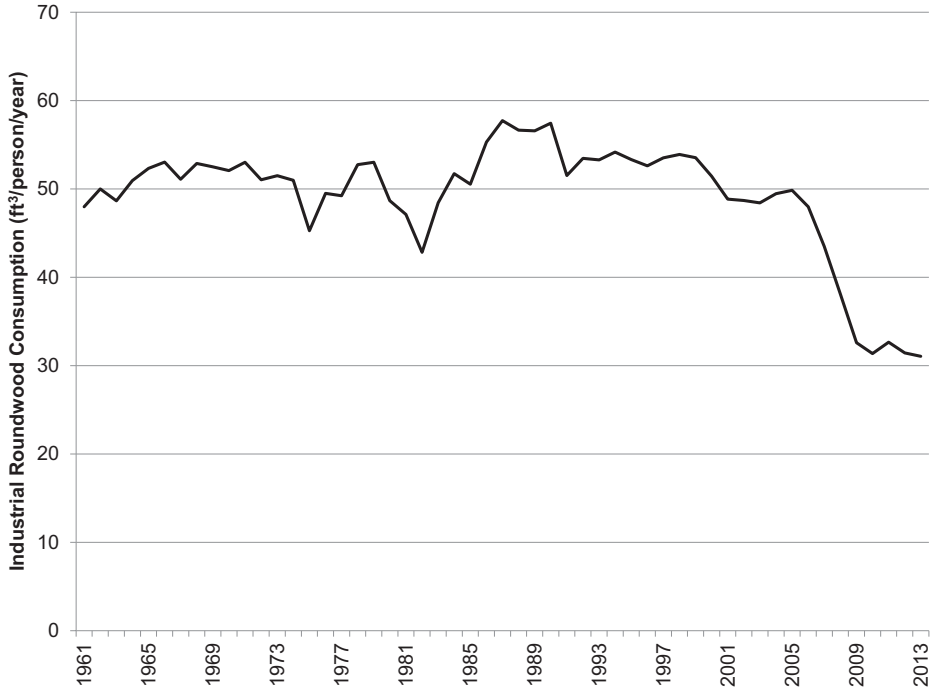

Figure 5. Annual consumption per capita of industrial roundwood in the United States (ft^3/person/year), 1961–2013. (Sources: US Census Bureau 2014a, 2014b, 2014c, Food and Agricultural Organization of the United Nations 2014.)

early 1990s, whereas exports represent less than 5% of total production.

Fiberboard. Fiberboard is a nonstructural panel used in buildings, especially interior applications, such as wall systems (Figure 9). Low- and medium-density fiberboard is often used as an insulator, whereas high-density fiberboard (hardboard) is demanded for any number of applications, including indoor walls and furniture. Like those of plywood and particleboard, imports of fiberboard rose steeply from the early 1990s to the peak of the most recent housing cycle and then dropped precipitously with the housing market contraction. However, production and consumption remained high, even through the 2007–2009 recession, and today are near historical peaks in the United States, indicating strong demands outside of housing construction.

Newsprint. Production and consumption of newsprint is unrelated to the size of the manufacturing sector in the United States (Figure 10) but is tied to consumer demands for reading material and print advertising. Newsprint consumption declined by 70% between 2000 and 2013. Analysts attribute most of the decline to the burgeoning growth in electronic media and associated declines in newspaper consumption and the use of paper in advertising (e.g., Skog et al. 2012). Indeed, data (Food and Agricultural Organization of the United Nations 2014) indicate that newsprint apparent consumption per capita in 2013 was 78% lower than the historical peak observed in 1987, a trend that Latta et al. (2015) ascribed mostly to electronic media substitution. Such trends are beginning to be observed in Europe (Hetemäki and Hurmekoski 2014). Consumption of newsprint rose steadily from 1961 to its 1987 apex, wavered until 2000, and then declined. Imports, primarily from Canada, provided nearly 50% of newsprint consumed in the United States and fell in similar fashion over this period. The small amount of newsprint exports changed little since 1995, although with consumption declines, they comprise a rising share of domestic US production, now accounting for one-third of US output.

Printing and Writing Paper. Like newsprint, printing and writing paper production and consumption in the United States fell precipitously beginning in the early 2000s (Figure 11). Whereas 2004 marked the most recent high water mark for consumption, the decline since has been steep, falling by 36% since 2004 and continuing to fall after the recession. Analysts (e.g., Skog et al. 2012) attribute much of the decline to the same forces affecting the newsprint sector: a shrinkage in advertising and media use of paper in favor of electronic modes of information delivery.

Other Paper and Paperboard. This product category includes all forms of paper besides newsprint and printing and writing paper: paperboard, wrapping paper, packaging paper, and household and sanitary papers. The wrapping, packaging, and board components

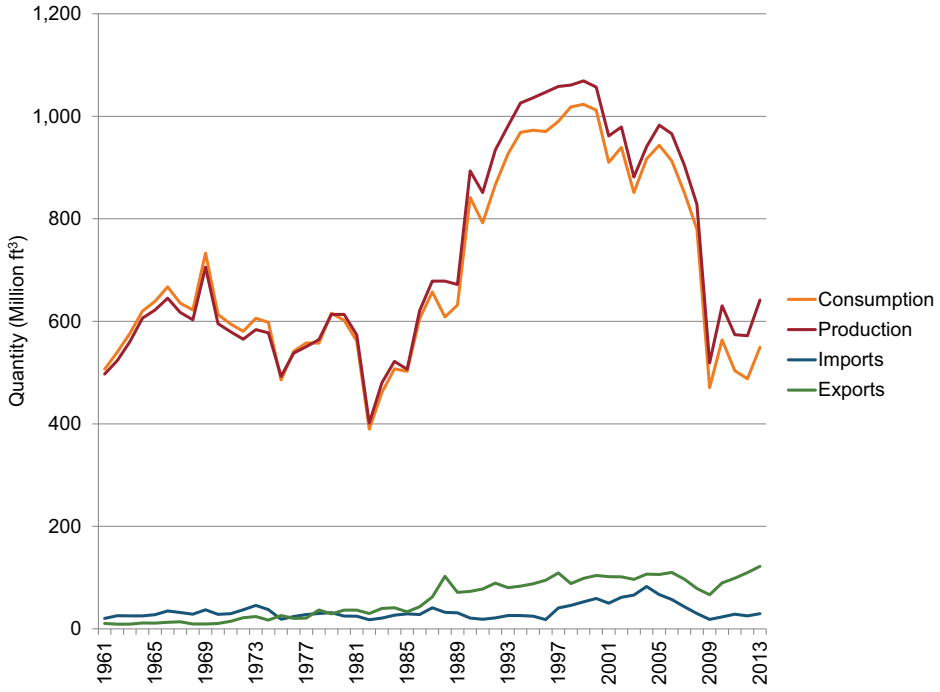

Figure 6. Consumption, production, imports, and exports of nonconiferous sawnwood (million ft^3) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

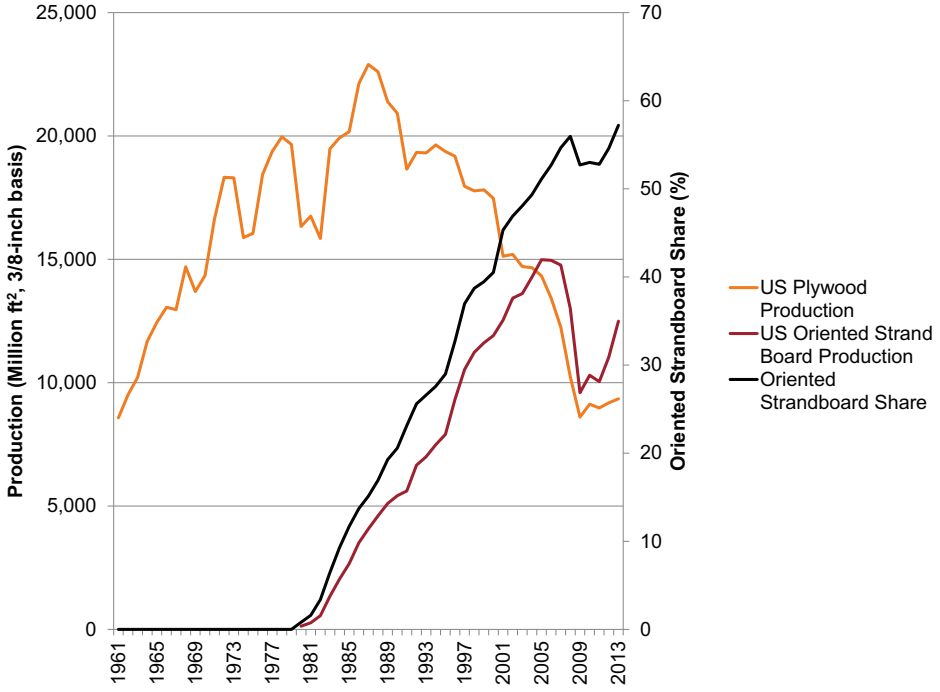

Figure 7. Production of plywood and OSB in the United States, 1961–2013. (Sources: Adair 2010, APA 2014.)

are closely tied to the demands of the manufacturing sector, accounting for 82% of the other paper and paperboard category from 2010 to 2013 (Food and Agricultural Organization of the United Nations 2014). The remaining share is composed of products (e.g., tissues and sanitary papers) that are more closely tied to income and population. US production of other paper and paperboard increased rather steadily from the early 1960s through 1999 but has generally stagnated since then (Figure 12). In contrast to newsprint and printing and writing paper, the United States has maintained a trade surplus in volume terms since at least 1961, and this surplus continued through 2013.

Wood Pulp. Wood pulp is an intermediate product and input to all kinds of paper produced in the United States and globally (Figure 13). The United States has maintained nearly balanced production and consumption, so net exports have been near zero. In recent years, production has exceeded consumption, as foreign demand has increased—notably in China. Hence, wood pulp not used directly for domestic paper manufacture has a ready export market.

Recovered Paper. Recovered paper is used primarily in the paper industry as recycled fiber input, a growing share of the fiber used by the paper industry in the United States and abroad (Figure 14). In other words, recovered paper is a substitute for industrial roundwood in the paper industry. The United States has historically produced a large quantity of recovered paper, consistent with its high paper consumption. Production of recovered paper has increased faster than paper consumption, and exports have increased. Since 2005, production exceeded 49 million tons/year, and exports grew by nearly one-third. Destination markets for these exports include China, whose imports from all sources increased from 2 million in 1993 to more than 33 million tons by 2013.

International Markets

Since the 1960s, the United States has led the world in industrial roundwood production, although its share of global production has declined from a peak of 28% in 1998 to less than 18% by 2013 (Figure 15), according to the Food and Agricultural Organization of the United Nations (2014). Part of the decline is attributable to growth in Russia and New Zealand. Since 1995, Russia has had the greatest net exports of wood in the world, with net exports peaking at 1,779 million ft^3 in 2006 before declining to 634 million ft^3 in 2013. Whereas economies throughout the world were affected by the global recession—changes are especially evident in Canada and several European countries—data reveal that the wood products sectors in the United States and Canada were affected to a greater extent than those of the rest of the world's major producers.[2] As well as being the largest producer, the United States has been the world's largest consumer of industrial roundwood from 1961 to 2013, and the recent recession had a disproportionate impact on US wood consumption. After growing steadily from 8,769 million ft^3/year in 1961 to 14,953 million ft$^{3/}$ in 2005, US consumption re-

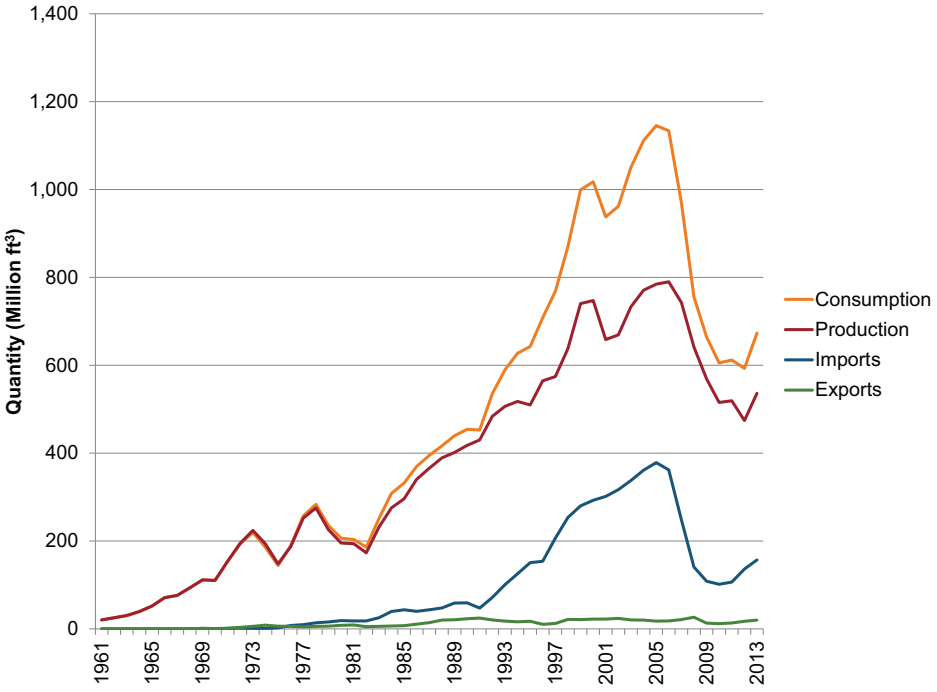

Figure 8. Consumption, production, imports, and exports of particleboard (million ft³) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

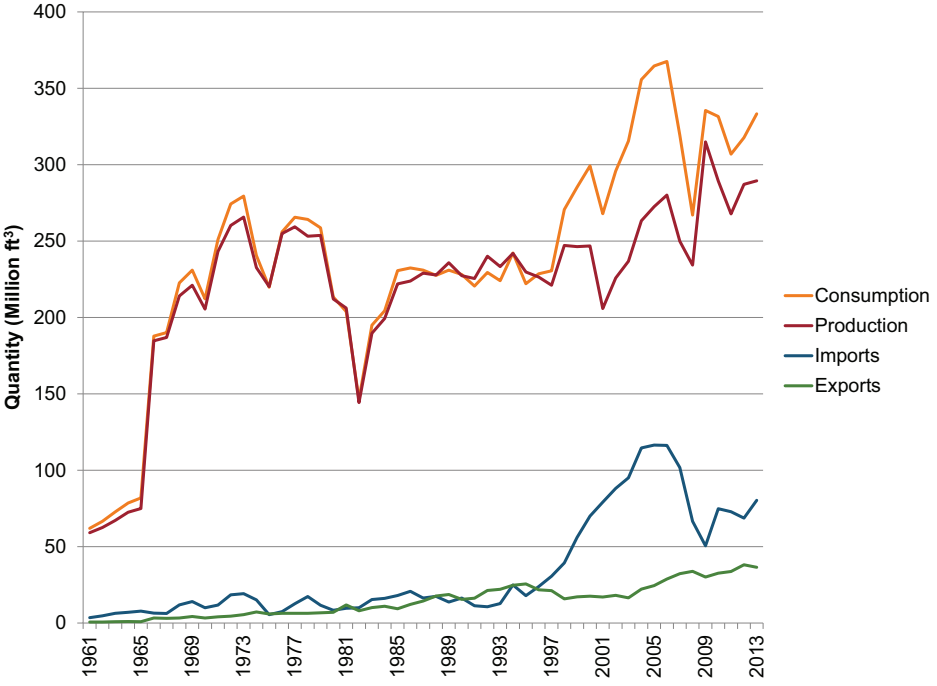

Figure 9. Consumption, production, imports, and exports of fiberboard (million ft³) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

ceded with the housing market to about 10,012 million ft^3 by 2010. At the same time, the United States has been a world leader in industrial roundwood exports and since 1963 has had positive net exports. In 2013, the United States had net exports of 546 million ft^3.

Coniferous Sawnwood Production Share

The United States has led the world in production of coniferous sawnwood (lumber) since even before the beginning of the data shown in Figure 15, as it has long been a net importer of coniferous sawnwood, largely from Canada. The United States' dominance in production has narrowed since the late 1990s. The decline from the late 1990s, when global production share was more than 22%, can be attributed not just to declining domestic production but also to increased production in Russia, China, and other countries with significant coniferous resources. The most recent recovery in the US share from the 2010 low of 15.6% to the 2013 share of about 17.2% is consistent with the partial construction market recovery, and a continuing construction recovery is likely to bring this share closer to its 1961 to 2012 average of 18.5%. However, countries with a significant comparative advantage in coniferous sawnwood (Canada, Finland, Sweden, and now Russia) are exporting far more than they import.

Nonconiferous Sawnwood Production Share

As for coniferous sawnwood, the United States has been a world leader in production of nonconiferous (hardwood) sawnwood (lumber) since 1961 (Figure 15). The US share of global markets grew from less than 15% in the early 1980s to a peak of 39.6% in 2000. Its subsequent decline to about 18% reflects multiple factors. One is rapidly increasing production in China, which rose from less than 100 million to more than 12,081 million ft^3 between 2000 and 2013 and since 2009 has led all countries in nonconiferous sawnwood production. Another factor is the offshoring of the US furniture sector, largely to China (Schuler and Lawser 2007). Finally, the US share has declined as the output of tropical hardwood sawnwood has expanded in Indonesia, Malaysia, and Brazil. It is unlikely that the US global share will return to its historical dominance, especially as long as China can obtain the imported wood needed to support its furniture sector and as other rapidly growing Asian economies and Brazil produce and consume tropical hardwood to manufacture furniture and other hardwood products to satisfy burgeoning domestic consumption.

Plywood Production Share

The US share of global production of plywood has been on a long-run decline since the early 1960s, falling from more than 52% in 1965 to approximately 11% by 2009 (Figure 15), when it leveled off. The United States lost its lead in plywood production to China in 2003. Throughout

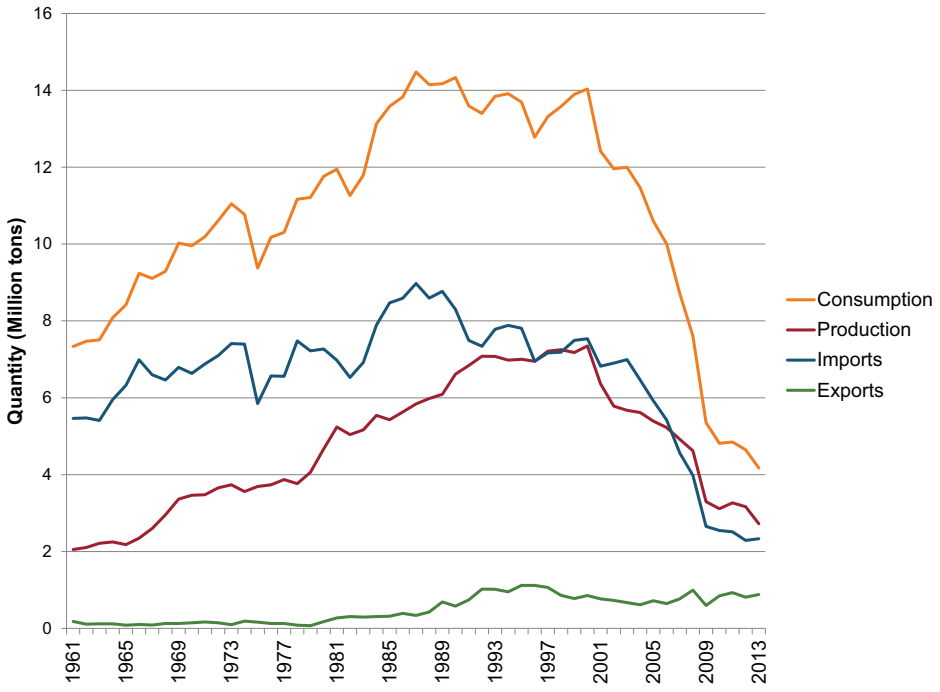

Figure 10. Consumption, production, imports, and exports of newsprint (million tons) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

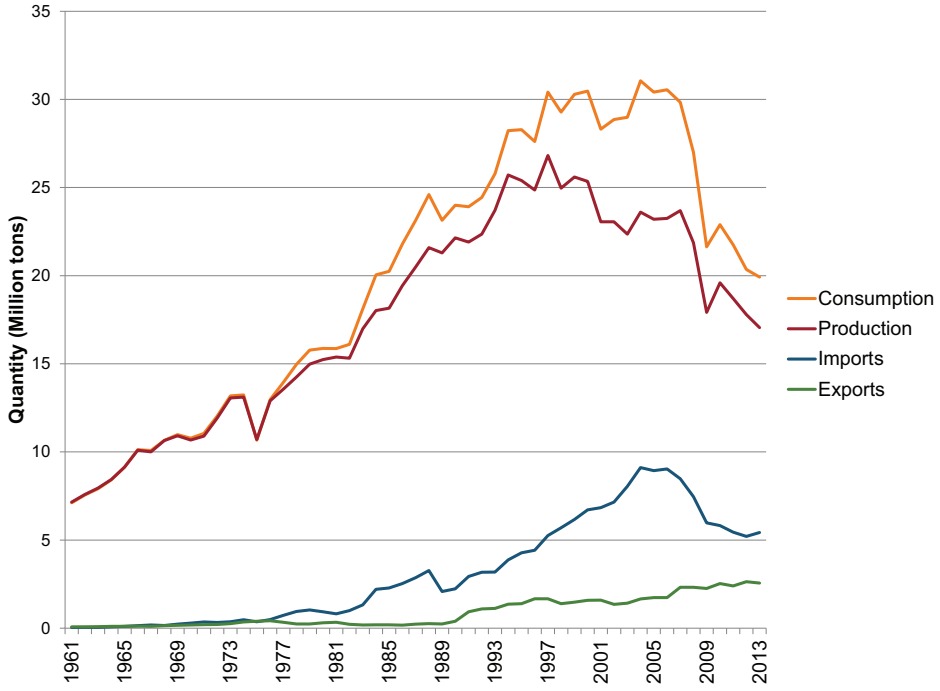

Figure 11. Consumption, production, imports, and exports of printing and writing paper (million tons) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

nearly the entire 1961–2013 span of data, the United States has imported more plywood than it has exported. In the 1980s to early 1990s, total US plywood exports grew to as high as 57 million ft^3 and nearly on a par with imports. But by 1998, exports were again on the decline, whereas import quantity was increasing rapidly. The steep decline in the US share of plywood output is linked in multiple ways to growth in Asia's economies over several decades. Given that the US market is shifting toward more production and consumption of OSB (Figure 7), it is unlikely that the US global share of plywood production will increase and more likely is that it will continue to shrink.

Particleboard Production Share

The US share of global production of particleboard has ranged between 13 and 26% and has declined since the turn of the century (Figure 15). The US share rose from about 15% in the early 1960s to a peak of 26.3% in 1999 but has since dropped to 14.4% by 2013. The United States was the world's single largest producer of particleboard from 1961 until surpassed by China in 2013. Since the 1980s, global production of particleboard has been rising steadily and at a rate faster than in the United States. This market remains dynamic, but it appears unlikely that the United States will realize substantial growth in market share for particleboard.

Wood Pulp Production Share

The United States has been a global leader in wood pulp production, averaging more than one-third of the world's output from 1961 to 2000 (Figure 15). Since then, its share has dropped steadily, to 28.3% in 2013. The decline in share is probably a natural outgrowth of the United States' historical subordinate position to Canada, Finland, and Sweden in global markets and in the past decade to Brazil, an emergent competitor in global markets. The decline in US share is most consistent with the declining domestic use of paper by the manufacturing sector as well as falling consumption of paper in print media. The United States has had a favorable balance of trade (positive net exports) in market pulp since 2007, and wood pulp exports have been increasing, even as domestic paper production in the United States has faded.

Paper and Paperboard Production Share

The United States has been a global leader in paper and paperboard production, but its global share of this production has been declining, from more than 40% in the early 1960s to its 2013 share of 18.3% (Figure 15). Multiple factors have contributed to this decline. First, Canada, Finland, and Sweden, the most competitive paper producers globally, and other countries in Europe (notably Germany) have maintained or increased their production of paper and paperboard much more rapidly than the United States. Second, China's paper output has increased strongly, from less than 10

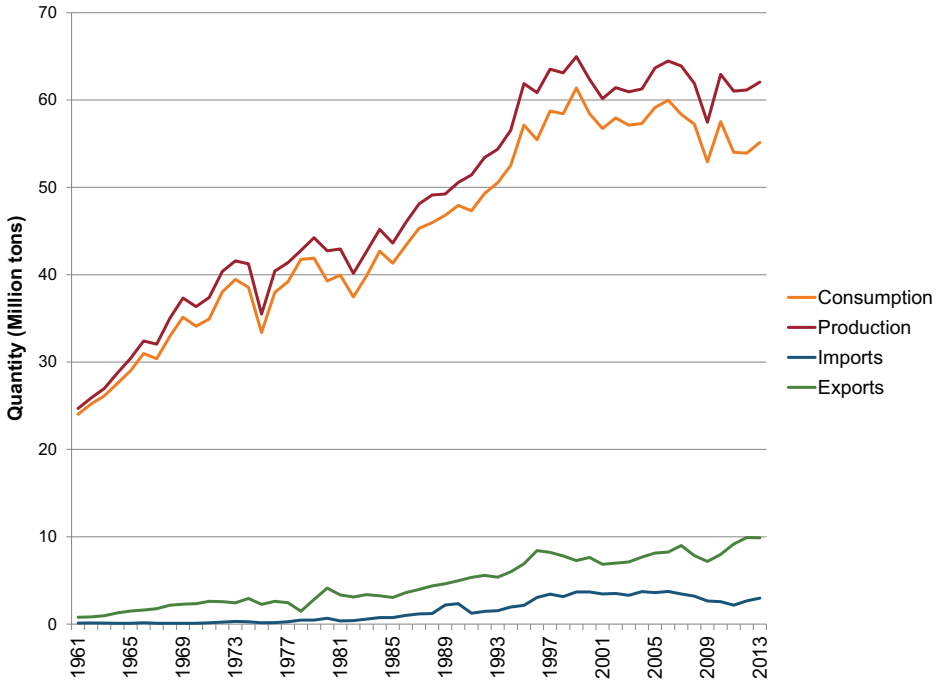

Figure 12. Consumption, production, imports, and exports of other paper and paperboard (million tons) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

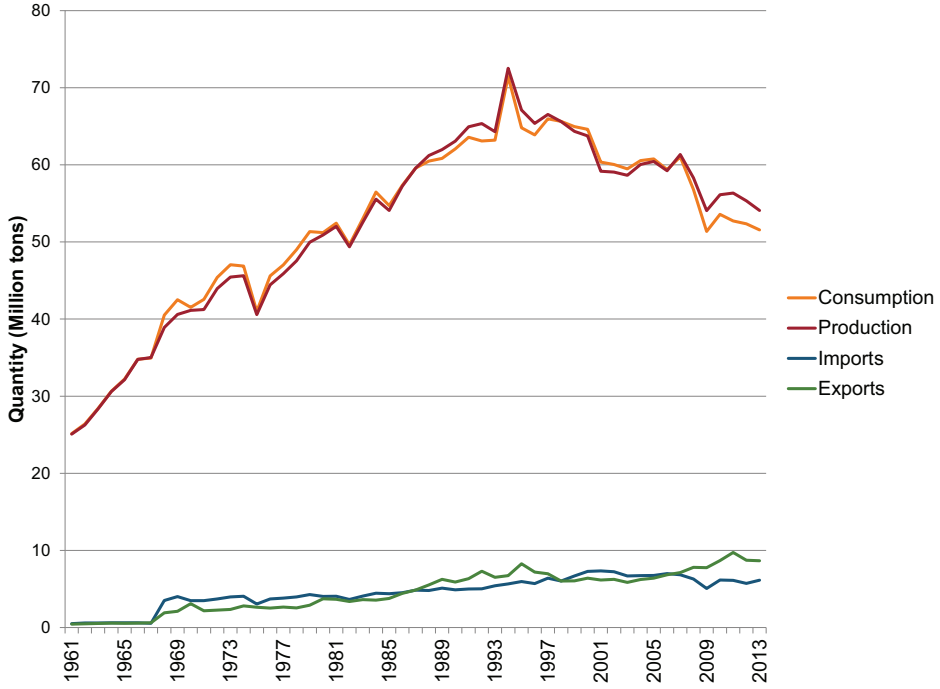

Figure 13. Consumption, production, imports, and exports of total wood pulp (million tons) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

million tons in 1983 to more than 100 million tons by 2010, enabling it to surpass the United States in production by 2008 onward. A large portion of production growth in China has been driven by a strong increase in China's own domestic demand. Nevertheless, by 2010, China had emerged as a net exporter of paper and paperboard. Third, the rising use of electronic media has put downward pressure on consumption and hence the incentives perceived by US manufacturers to make printing and writing paper and newsprint for the domestic market.

Discussion and Conclusions

US forest products consumption and production are heavily correlated with US economic activity. Solidwood products output correlates most strongly with housing construction. Paper and paperboard production correlates very strongly with total manufacturing output. We observe a change from paper and paperboard output growth to output decline in 1998, correlated with the same pattern for overall manufacturing activity. Further, the most recent production declines are coupled with negative consumption trends begun in the 1980s for newsprint and in the 2000s for printing and writing. Product mix, raw material (timber) harvest, and labor demand have all been strongly affected by technological changes through this time period. Policy also has important influences on production and trade: we observe a change in the relationship between US consumption and production levels in 1992 for softwood lumber, when the United States substantially reduced timber harvesting from its federal lands, thereby reducing available timber supply. In 1986, the Pacific Northwest accounted for 26% of total timber harvests, but by 1996 the region's share had dropped to 15% (Haynes 2003). The effects of this reduction in federal harvests were significant and negative for most wood processors, forest sector employment, income, and federal revenue sharing with counties. The decline in federal timber production also led to increased domestic prices and increased demand for imports, largely from Canada, as well as a greater reliance on private southeastern US timber to meet domestic demands (Wear and Murray 2004). Since 1992, investments in intensive forestry in the South have expanded greatly, as forest plantations essentially doubled between 1990 and 2010 (Wear and Greis 2012). A shift in the industry structure from integrated wood products firms to institutional investors focused exclusively on land and timber (organized by timber investment management organizations and real estate investment trusts) facilitated this strong "capitalization" of forestry in the region (Zhang et al. 2012) and suggests a more economically responsive timber sector (Butler and Wear 2013).

Overall, the US forest products sector has undergone changes that are both cyclical, tied to markets in sectors that use wood and that fluctuate with the domestic economy, and long-term, linked to changes in

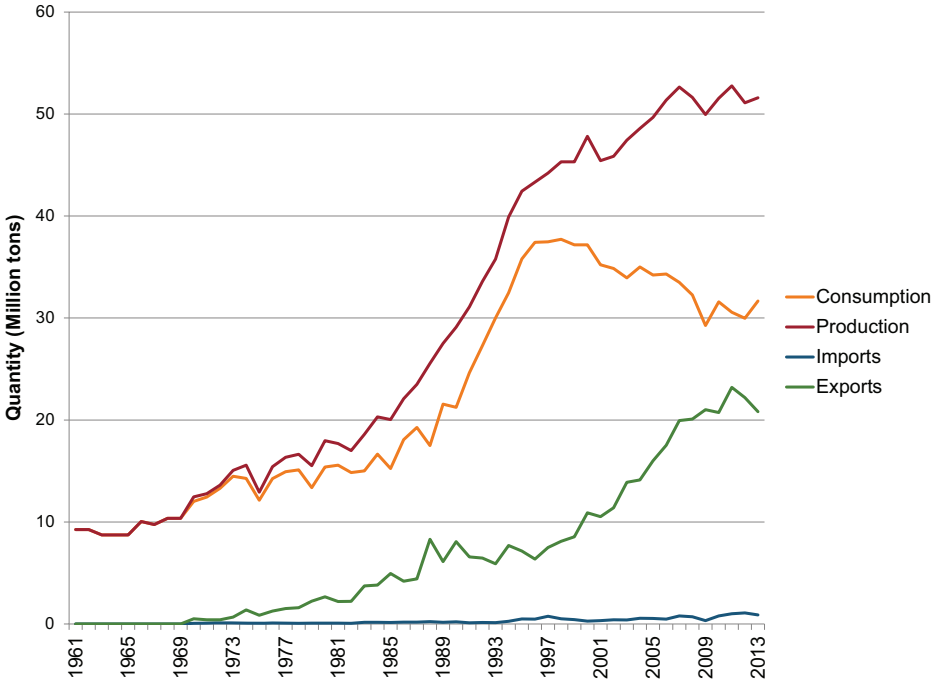

Figure 14. Consumption, production, imports, and exports of recovered paper (million tons) in the United States, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

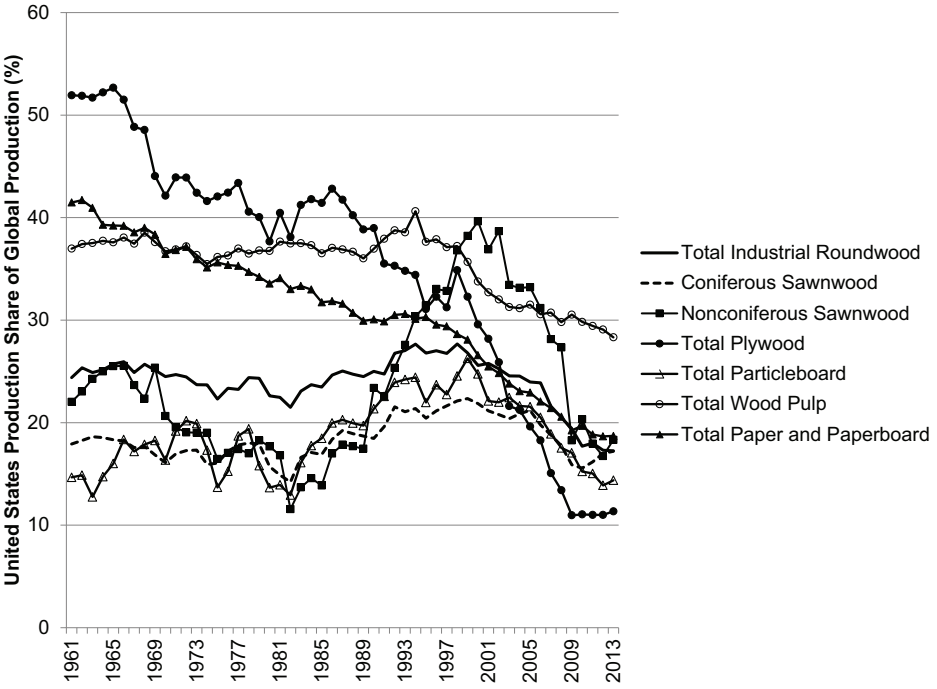

Figure 15. United States share of global output by major product category, 1961–2013. (Source: Food and Agricultural Organization of the United Nations 2014.)

multiple factors that are particular to output markets: evolution in tastes and preferences, changes in technology, and global economic growth. The overall trend in the US share of global production has been negative in most categories, with changes in some product categories evident since the 1960s and changes in other categories emerging since the late 1990s. Although government and industry decisionmakers are not powerless in the face of changes outside the sector, the means of intervention to slow or reverse these changes are limited, and it seems unlikely that most long-run trends can be interrupted. Indeed, part of the evolving position of the United States is due to substantial shifts—mainly growth—in production and consumption overseas, phenomena that are little affected by US government policy. This position decline is, however, primarily tied to shifting consumer preferences and the economic vitality of the construction and manufacturing sectors within the United States.

Solidwood products are most tightly linked to markets for new housing. Housing construction activity in turn has long been linked to the business cycle through the income/savings preferences of consumers. However, commencing in 2007, the latest recession was led by a housing market contraction in the United States, and housing starts fell in unprecedented fashion, thereby amplifying the implications of the downturn for the wood products sector. Housing starts fell between 2006 and 2009 to levels not observed in the United States since the World War II years, and the trough in housing starts has been sustained for longer than in any previous postwar business cycle (Figure 4). Future solidwood demands depend strongly on the course of housing demand. Much of the most recent rise in housing starts has occurred in the multifamily dwelling category of five or more families per unit, which has increased its share of the total number of housing starts since the peak of the previous cycle. This share averaged 17.5% between January 1998 and December of 2006 and has averaged 32% since January of 2012. Multifamily dwellings use less wood per person.

The paper and paperboard sector is most strongly influenced by total manufacturing output in the United States, which responds to business cycles, but less dramatically than does housing starts. Between 1961 and 1998, manufacturing output grew rather steadily, with downticks marking recessions. After reaching a maximum level in 1998, manufacturing output in the United States began to fall, with a deep trough coincident with the latest recession and an increase back to trend between 2009 and 2013. Paper and paperboard output follows the same trend, with the exception of the recent recovery, and this is at least partially attributable to the steep declines in production and consumption of newsprint (Figure 10) and printing and writing paper (Figure 11). The subcomponents of the manufacturing sector reveal more about the connections between manufacturing levels and paper and paperboard demands. Some sectors most highly correlated with the output of

the paper and paperboard industry are associated with subcomponents that have declined with the paper sector: printing, support activities for printing, food processing, cereal manufacturing, and others. Subcomponents with recent increases in output, including petroleum and aircraft and vehicle manufacturing, are not intensive users of paper and paperboard. This change in the composition of manufacturing outputs is at least a partial explanation for why pulp and paperboard output fell while manufacturing activity increased from 2009 to 2013.

An uncertain future demand for forest products output in the United States is the wood energy sector, and several studies have explored the effects of hypothetical growth in bioenergy (e.g., USDA Forest Service 2012). However, long-anticipated demands for forest bioenergy feedstocks remain unrealized in the United States because of a number of factors, including declines in energy prices and confounding policy. Furthermore, the use of wood energy in the paper sector has declined in concert with paper production. Growth has been largely limited to wood pellets produced in the United States and exported to Europe (primarily to the United Kingdom), to burn for electricity to meet targets described in the Renewable Energy Directive of the European Union (Abt et al. 2014). Although the production of wood pellets has more than doubled since 2011, so far it accounts for about 2% of total US industrial roundwood output. Little growth in the use of wood to produce energy is evident in the United States, and continuing uncertainty in US policy regarding wood bioenergy is unlikely to be quickly resolved. Combined with lower fossil fuel prices, this policy uncertainty makes short-term increases in the use of wood to produce domestic energy unlikely.

A limited set of policy initiatives could have some, but limited, influence on future consumption and production of forest products in the United States. One way to increase wood consumption in the United States is to create policies and programs that stimulate or allow for greater rates of wood use in construction, particularly for multifamily and nonresidential construction. Policy might generally address existing building codes' treatment of wood frame structures. Presently, the International Building Code standards applied in the United States generally limit multifamily wood-frame structures to no more than 5 stories, 85 ft in height, and 270,000 square feet (Continuing Education Center 2014). Along these lines, the White House Rural Council has announced plans and funding to promote wood use in tall building construction (Office of the White House 2014). Initiatives in Europe (e.g., the Forest-based Sector Technology Platform) and Canada (e.g., Innovawood, a private sector initiative) to expand the use of wood in construction might also mean that wood production and export opportunities could expand even in the midst of other declines in wood consumption. The treatment of forest products in renewable energy policies in both the United States and Europe could also influence overall wood consumption, and carbon accounting applied to forest biomass might favor wood use over substitute materials such as concrete and steel in current/future carbon credit markets.

This article has focused largely on the demand side of US forest products markets, especially as influenced by international markets for secondary products. The US comparative advantage also depends on its timber supply. The overall timber supply in the United States has grown in the last several decades, reflecting a strong investment in private forests in the South. In the longer run, we might expect that the strong resource endowment of the United States and its shift toward production from planted forests will continue to support a strong comparative advantage in wood products, especially if other countries reduce their timber inventories. The slide in consumption of paper brought about by a declining manufacturing sector and electronic media substitution, combined with the steep contraction of the construction sector, have reduced harvests, allowing for further expansion in US timber supply. Although reduced harvests have eroded short-run incentives for reinvestments in intensive timber management, an expanded timber supply can be seen as the groundwork for possible growth of the US market share over the long run.

Endnotes

1. This article is a condensed version of Prestemon et al. (2015), which provides additional details on forest product outputs and trade.
2. Detailed graphics showing the levels of production of the United States and the world's main producing and consuming countries for industrial roundwood and derivative forest products are available in Prestemon et al. (2015).

Literature Cited

Abt, K.L., R.C. Abt, C.S. Galik, and K.E. Skog. 2014. *The effect of policies on pellet production and forests in the US South.* USDA For. Serv., Gen. Tech. Rep. SRS-GTR-202, Southern Research Station, Asheville, NC. 33 p.

Adair, C. 2010. *Structural panel and engineered wood yearbook.* APA Economics Rep. E176, APA—The Engineered Wood Association, Tacoma, WA. 80 p.

APA. 2014. *Engineered wood statistics, second quarter 2014.* APA—The Engineered Wood Association, Tacoma, WA. 9 p.

Brandeis, C., and D.G. Hodges. 2015. Forest sector and primary forest products industry contributions to the economies of the southern states: 2011 update. *J. For.* 113(2):205–209.

Butler, B., and D.N. Wear. 2013. Forest ownership. P. 103–122 in *The Southern Forest Futures Project: Technical report*, Wear, D.N., and J.G. Greis (eds.). USDA For. Serv., Gen. Tech. Rep. GTR-SRS-178, Southern Research Station, Asheville, NC.

Continuing Education Center. 2014. *Multistory wood construction.* Available online at continuingeducation.construction.com/article.php?L=285&C=883&P=3; last accessed Jan. 9, 2015.

Food and Agricultural Organization of the United Nations. 2014. *FAOSTAT.* Available online at faostat.fao.org/site/626/default.aspx#ancor; last accessed Aug. 19, 2014.

Food and Agricultural Organization of the United Nations. 2015. *Pulp and paper production capacities.* [Various issues, 1968 to 2014.] Available online at www.fao.org/forestry/statistics/81757/en/; last accessed Sept. 2, 2015.

Haynes, R.W. (tech. ed.). 2003. *An analysis of the timber situation in the United States: 1952 to 2050.* USDA For. Serv., Gen. Tech. Rep. PNW-GTR-560, Pacific Northwest Research Station, Portland, OR. 134 p.

Hetemaki, L., and E. Hurmekoski. 2014. Forest products market outlook. P. 15–32 in *What science can tell us 6: Future of the European forest-based sector: Structural changes towards bioeconomy*, Hetemaki, L., M. Lindner, R. Mavsar, and M. Korhonen (eds.). European Forest Institute, Joensuu, Finland. 108 p.

Howard, J.L., and K. Jones. 2015. *US timber production, trade, consumption and price statistics 1965–2013.* USDA For. Serv., Res. Pap. FPL-RP-679, Forest Products Laboratory, Madison, WI. 99 p.

Latta, G., A. Plantinga, and M. Sloggy. 2015. The effects of Internet use on global demand for paper products. *J. For.* In press.

Luppold, W.G., and M.S. Bumgardner. 2013. Factors influencing changes in US hardwood log and lumber exports from 1990 to 2011. *BioResources* 8(2):1615–1624.

Luppold, W.G., and M.S. Bumgardner. 2014. Changes in the international trade balance of US hardwood products from 1990 to 2013. *BioResources* 9(4):7086–7098.

National Bureau of Economic Research. 2015. *US business cycle expansions and contractions*. Available online at www.nber.org/cycles.html; last accessed Jan. 9, 2015.

Office of the White House. 2014. *WoodWorks.* Available online at www.woodworks.org; last accessed Oct. 22, 2014.

Prestemon, J.P., D.N. Wear, and M.O. Foster. 2015. *The global position of the US wood products industry.* USDA For. Serv., Gen. Tech. Rep. SRS-GTR-204, Southern Research Station, Asheville, NC. 24 p.

Schuler, A., and S. Lawser. 2007. The US furniture industry: Yesterday and today…will there be a tomorrow? *Wood Dig.* 6:20–22.

Siskind, D. 1979. *Revised housing starts, 1910–1958*. Draft report. 16 p. Available online at www.michaelcarliner.com/files/Data/CB82Hous_Start_Revised_History1945-82.pdf; last accessed Oct. 2, 2014.

Skog, K.E., D.B. McKeever, P.J. Ince, J.L. Howard, H.N. Spelter, and A.T. Schuler. 2012. *Status and trends for the US forest products sector: A technical document supporting the Forest Service 2010 RPA assessment.* USDA For. Serv., Gen. Tech. Rep. FPL-GTR-207, Forest Products Laboratory, Madison, WI. 35 p.

US Census Bureau. 2014a. *Historical national population estimates: July 1, 1900 to July 1, 1999*. Available online at www.census.gov/popest/data/national/totals/pre-1980/tables/popclockest.txt; last accessed Sept. 30, 2014.

US Census Bureau. 2014b. *Intercensal estimates of the resident population by sex and age for the United States: April 1, 2000 to July 1, 2010*. Available online at www.census.gov/popest/data/intercensal/national/nat2010.html; last accessed Sept. 30, 2014.

US Census Bureau. 2014c. *Annual estimates of the resident population for the United States, regions, states, and Puerto Rico: April 1, 2010 to July 1, 2013 (NST-EST2013-01)*. Available online at www.census.gov/popest/data/national/totals/2013/index.html; last accessed Sept. 30, 2014.

US Census Bureau. 2014d. *Housing units started: United States—Not seasonally adjusted total units (thousands of units)*. Available online at www.census.gov/econ/currentdata/dbsearch?program=RESCONST&startYear=1959&endYear=2013&categories=STARTS&dataType=TOTAL&geoLevel=US&notAdjusted=1&submit=GET+DATA; last accessed Oct. 1, 2014.

US Census Bureau. 2014e. *Characteristics of new housing*. Available online at www.census.gov/econ/currentdata/dbsearch?program=RESCONST&startYear=1959&endYear=2013&categories=STARTS&dataType=TOTAL&geoLevel=US&notAdjusted=1&submit=GET+DATA; last accessed Oct. 7, 2014.

USDA Forest Service. 2012. *Future of America's forest and rangelands: Forest Service 2010 Resources Planning Act assessment*. USDA For. Serv., Gen. Tech. Rep. WO-87, Washington, DC. 198 p.

US Department of Commerce. 2014. *Industry economic accounts*. Available online at www.bea.gov/industry/index.htm#annual; last accessed Sept. 19, 2014.

Wear, D.N., and B.C. Murray. 2004. Federal timber restrictions, interregional spillovers, and the impact on US softwood markets. *J. Environ. Econ. Manage*. 47(2):307–330.

Wear, D.N., and J.G. Greis. 2012. *The Southern Forest Futures Project: Summary report*. USDA For. Serv., Gen. Tech. Rep. SRS-168, Southern Research Station, Asheville, NC. 54 p.

Zhang, D., B.J. Butler, and R. Nagubadi. 2012. Institutional timberland ownership in the US South: Magnitude, location, dynamics, and management. *J. For.* 110(7):355–361.