

Decline in the Pulp and Paper Industry: Effects on Backward-Linked Forest Industries and Local Economies

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Abstract

Pulp, paper, and paperboard mills consume close to 52 percent of southern roundwood, providing a significant market to southern forest landowners. Declining numbers of pulpwood-using mills and downward trends in mill capacity, however, present a growing challenge to the southern forest sector. Shrinking mill capacity affects rural communities that depend on mill demand for labor and other production inputs. This study investigates the effect of pulp mill closures on the regional and local economy, focusing on the spillover effects to forestry and forest products industry. Multiregional input–output models were built for two mill closures using Impact Analysis for Planning (IMPLAN) showing linkages among different sectors, households, and governments in the regional economy. Results revealed the different effects across wood procuring zones with areas displaying significant loss in logging activity. Significance to other forestry-related industries depended on closed mills' inputs. We compared our results with information available in the literature regarding expected economic impact from a wood pellet mill, an alternative market for small-size wood. We expect research results will provide valuable information to policymakers and managers when addressing likely future changes in the paper manufacturing industry.

Over the past decade, global production of paper and paperboard increased by more than 40 percent, led primarily by an increasing world demand for packaging and sanitary papers. Over the same period, global newsprint production declined 17 percent. Following a similar trend, in 2011 the US paper and paperboard capacity stood 14 percent below that of a decade earlier, primarily from shrinking capacity of newsprint and writing and printing papers (Food and Agriculture Organization of the United Nations [FAO] 2001, 2012b). Decreases in capacity and production can be attributed to multiple factors, including falling demand resulting from the recent economic downturn (Hodges et al. 2012) and from shifting preferences toward electronic communications, as well as increasing competition from Asian producers (FAO 2012a).

The southern region of the United States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia) produces over 75 percent of the nation's pulpwood and houses over 60 percent of the US pulp and paper mills (Piva et al. 2014). During 2012, activity by the southern pulp and paper industry (National Industry Classification System [NAICS] 322) supported close to 529,000 jobs with \$34 billion in labor income and \$64 billion of value added, accounting for 1.22 percent of the gross regional product (MIG, Inc. 2012). Paper products manufacturing (NAICS 32212) represented close to 31

percent of the value added by the pulp and paper industry. Between 2000 and 2011, however, the southern region lost 17 pulp mills, a 6 percent net drop in regional capacity. Changes in mill capacity occurred across most southern states although at varying degrees (Table 1). Pulp mills account for a large portion of the wood consumed in the south. As such, pulp mills constitute a considerable market for forestland owners and the logging industry. Furthermore, the pulp and paper industry generates economic activity in the rural areas that provide needed labor and other production inputs.

Two recent pulp mill closures include the mill in Bastrop, Louisiana, which closed in 2008, and the paper mill in Courtland, Alabama, which closed in early 2014. At the time of closure, the Bastrop mill represented close to 8 percent of Louisiana's pulp capacity and 1 percent of the

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Table 1.—Number of closed pulp mills and net change in pulping capacity, 2000 to 2011.^a

State	Closed mills (<i>n</i>)	24-h pulping capacity (tons)		Change (%)
		2000	2011	
Alabama	2	21,465	22,722	5.9
Arkansas	2	8,493	7,800	-8.2
Florida	0	8,686	8,663	-0.3
Georgia	1	20,665	20,779	0.6
Kentucky	0	2,400	2,250	-6.3
Louisiana	4	16,410	13,208	-19.5
Mississippi	2	9,005	7,704	-14.4
North Carolina	1	8,280	8,270	-0.1
Oklahoma	1	2,200	1,582	-28.1
South Carolina	0	11,213	10,183	-9.2
Tennessee	0	4,225	5,405	27.9
Texas	2	7,445	6,078	-18.4
Virginia	2	9,850	7,574	-23.1
Total	17	130,337	122,218	-6.2

^a Sources: Bentley and Steppleton (2013) and Johnson and Steppleton (2002).

South’s capacity (Johnson et al. 2010). Closure of the Courtland mill resulted in a capacity drop of nearly 21 percent for the state of Alabama and of close to 4 percent for the southern region. Although varying in production size, each mill made significant contributions to the local economy. The Bastrop mill was the fourth largest employer in the Morehouse Parish area, providing close to 550 jobs and contributing the second highest labor income and sales value to the local economy. Likewise, the Courtland mill was the second largest employer in Lawrence County, supplying close to 1,100 jobs.

Previous studies reporting the impacts of mill closing or analyzing hypothetical declines in forestry-related industries on the local and state economy include works by Skurla et al. (2008, 2013) and Virginia Economic Development Partnership (VEDP 2009). Industries investigated include oriented strand board wood products manufacturing and paper and paperboard manufacturing. Spillover effects were estimated for loss of jobs ranging from fewer than 300 to 1,100. Skurla et al. (2013) and VEDP (2009) identified commercial logging and transportation as two of the most affected sectors in terms of output and/or employment. These studies evaluated mill closure impacts using single region models over study areas composed of a single county, single state, or a group of states. Single region models, however, cannot track spillover effects between local and surrounding economies. Also, these studies provide limited findings and implications of impacts to individual forest industries such as logging and sawmills.

We evaluated the significance of paper mill closures to the economy of affected areas (mill’s county, state, and

neighboring wood supplying states), via multiregional input–output analyses using Impact Analysis for Planning (IMPLAN) software and data sets. We examined the extent of the negative economic effects using the previously mentioned Bastrop and Courtland mill cases. The use of a multiregional analysis allowed us to estimate the spillover effects between the county where each mill was located and each mill’s home state and neighboring wood supplying states. Additionally, our analysis took into account the positive impacts of unemployment compensation and of federal grants for employee training awarded in both cases studied.

In recent years, growing demand for wood pellets from the European market has motivated extensive capacity building in the United States, in particular across the southern region. Wood pellet exports to Europe increased from 800,000 tons in 2011 to 2.9 million tons in 2013 (Wood Resources International 2014). Wood pellet mills consume small-size logs and residues, providing an alternative market to areas experiencing declining pulp mill capacity. However, it remains unclear how the economic contribution of a wood pellet mill compares with that of a pulp mill of similar wood consumption capacity. Therefore, we compared our results with information on wood pellet impact to the forestry and logging sectors provided in Kebede et al. (2013). We expect the information provided will prove valuable to local policymakers to address likely future changes in the paper manufacturing industry.

Methods

Study area

Louisiana’s timberland represents close to 53 percent of the state’s land area, covering over 14 million acres with a net volume of close to 24 billion ft³ (Miles 2014). During 2011 the forest sector (defined as consisting of industry groups listed in Table 2) contributed close to 1.8 percent of the state’s gross domestic product (GDP). Pulp and paper industries accounted for over 66 percent of the sector’s value added (MIG, Inc. 2012).

Forest inventory estimates place Alabama’s timberland net volume at near 36 billion ft³ covering approximately 23 million acres, or over 70 percent of the state’s land area (Miles 2014). As of 2010, the state ranked second in pulp production and third in paper production nationally. The forest sector contributed 4.5 percent of the state’s GDP in 2011, with pulp and paper industries representing 62 percent of the sector’s value added (MIG, Inc. 2012).

I-O modeling

The input–output (I-O) model, originally based on the work of Leontief, captures the interrelationship across industries using transaction matrices (Miller and Blair

Table 2.—Forest sector industry groups with corresponding NAICS and IMPLAN codes.^a

Industry group	NAICS 2007	IMPLAN 2012
Forestry	1131 and 1132	15
Logging	1133	16
Wood products	321	95–103
Pulp and paper	322	104–112
Furniture	33711, 337121, 337122, 337127, 337129, 337211, 337212, and 337215	295–297 and 299–302

^a NAICS = National Industry Classification System; IMPLAN = Impact Analysis for Planning.

2009). The I-O model can be expressed in the following matrix form:

$$X = (I - A)^{-1}Y$$

where X is a vector of gross industry outputs, Y is the vector of sales to consumers for final consumption, and A is a technical matrix of coefficients (a_{ij}) representing intermediate input supplied by industry i per unit of gross output in industry j . The matrix $(I - A)$ is the Leontief matrix, and the Leontief inverse $(I - A)^{-1}$ is a matrix of multipliers that represent the relationship between the initial change in final demand and its total impacts (Miller and Blair 2009).

The computerized I-O modeling system, IMPLAN, enables construction of I-O models and social accounting matrices that show linkages among different sectors, households, and governments in the regional economy (MIG, Inc. 2012). In addition, IMPLAN v. 3 uses a doubly constrained gravity model to estimate trade flows between regions allowing for multiregional input-output analysis (MRIO; Lindall et al. 2006). A multiregional analysis not only quantifies the effects of the initial change on other regions but also incorporates feedback effects (i.e., the effects of changes in other regions on the main study area) for improved impact estimates (Hugh and Litz 1996). IMPLAN gathers data from the US Bureau of Economic Analysis, the Bureau of Labor Statistics, and other sources to provide a complete set of balanced social accounting matrices (MIG, Inc. 2012).

IMPLAN models generate estimates of economic effects on three main components—direct, indirect, and induced effects. Direct effects represent all activity by the studied industry. The total effect represents the total contribution of the industry to the state's economy and comprises the direct effects plus indirect (capturing all sales by the industry's supply chain) and induced (measuring households spending) effects. Within these components IMPLAN provides estimates of employment, labor income, value added, and output. Employment includes the number of full-time and part-time jobs, and labor income comprises wages and salaries. Value added provides a measure of the sector's contribution to the GDP, and total output represents the value of production.

IMPLAN analysis

We estimated the effect from change in employment on the paper industry (NAICS 32212, IMPLAN sector 105) using IMPLAN software and associated data sets for 2008 and 2012. We ran IMPLAN using number of jobs as a proxy for industry sales and adjusted the negative impacts of the closure of mills by including effects of unemployment benefits and of national emergency grant (NEG) funding. Unemployment compensation provides disposable income to dismissed employees, lowering the negative induced impacts. We assumed employees collected unemployment compensation for 26 weeks, the maximum time allowed by each state, giving us an upper bound of unemployment compensation. The resulting disposable income was modeled using the spending pattern for a household income between \$15,000 and \$25,000. Similarly, NEGs provide funds that generate economic activity in the study area. National emergency grants provide assistance to states experiencing significant job losses due to unforeseen economic events. Grants provide funds for training of

terminated employees to increase occupational skills and opportunities to access jobs in other areas (US Department of Labor [USDL] 2014). We evaluated the federal grant effect using IMPLAN's industry spending pattern for vocational rehabilitation services (NAICS 6243). We could not obtain information to allocate direct expenses related to the grant awards; therefore, we assumed only indirect and induced effects. As a result, our figures likely underestimate the grants' significance. All monetary values are expressed in 2014 dollars.

For IMPLAN modeling of the Bastrop mill, we assumed 2008 as the event's year and the loss of 550 jobs in Morehouse Parish, Louisiana. We assumed all employees collected unemployment compensation during 2009 at a rate of \$209/wk, net of federal and state taxes. Additionally, we modeled \$250,000 of NEG funding received during 2009 (USDL 2014). In the Courtland paper mill case, we assumed the loss of 1,096 jobs occurring in Lawrence County, Alabama. Although the majority of the labor force resided outside the county, we opted to model the direct effect using only Lawrence County. This facilitated comparisons to the Bastrop mill results. We estimated the impact for the full year, although closure occurred in March 2014. We evaluated unemployment assuming 700 employees, which corresponds to the total number of jobs minus employees reported either transferring to other plants (316 employees) or receiving job offers from other employers (80 employees; Berry 2014). Close to 200 employees remained at the plant after closing; therefore, we divided unemployment into 2 years. In this manner we planned for 500 employees claiming unemployment during 2014 and 200 employees during 2015. We calculated total unemployment benefits based on an average \$252/wk, according to data on weekly claims for the period of December 2013 to April 2014 (Alabama Department of Labor 2014). Additionally, we included \$825,000 of NEG funding received in 2014 (USDL 2014). Although the award amounts to over \$1 million, in our analysis we used only the amount awarded to date.

Although we applied the direct impact to the county where each mill was located, we captured spillover effects using IMPLAN's MRIO functionality. Both MRIO analyses included the remaining counties for the mill's corresponding state plus two neighboring states identified as significant sources of wood resources. In the Bastrop mill case, we included Arkansas and Mississippi, and in the Courtland case, we included Tennessee and Mississippi. We provide results for expected effects to each area's economy along with specific effect to backward-linked forest sector industries. We also provide impact effects for the truck and rail transportation industries (NAICS 484 and 482, IMPLAN sectors 335 and 333, respectively), both of which play a significant role in the wood supply chain.

Data sources

Information on pulpwood production, mill capacity, and employment came from the USDA Forest Service Forest Inventory and Analysis Timber Product Output (TPO) program. The TPO program for the US southern region conducts annual surveys of primary pulp industries (mills using logs, whole or chipped, to produce wood pulp) including pulp mills, as well as paper and paperboard mills that feature wood pulp production. Figures on unemployment compensation were gathered from the corresponding

Table 3.—Mill closures' economic impact by impact type and area affected.

Mill location	Impact type and area	No. of jobs	Economic impact		
			Labor income (millions of \$)	Value added (millions of \$)	Output (millions of \$)
Courtland, AL	Direct effect				
	Lawrence, AL	-1,096	-142.3	-416.1	-1,078.0
	Total	-1,096	-142.3	-416.1	-1,078.0
	Indirect and induced effect				
	Lawrence, AL	-1,122	-36.2	-77.3	-156.5
	Alabama ^a	-1,568	-85.5	-132.8	-265.9
	Tennessee	-648	-35.6	-55.1	-134.4
	Mississippi	-369	-18.4	-24.5	-55.4
	Total	-3,707	-175.7	-289.7	-612.2
	Total effect	-4,803	-318.0	-705.8	-1,690.2
Bastrop, LA	Direct effect				
	Morehouse, LA	-550	-72.3	-122.6	-434.5
	Total	-550	-72.3	-122.6	-434.5
	Indirect and induced effect				
	Morehouse, LA	-577	-26.8	-50.6	-106.3
	Louisiana ^a	-1,015	-55.9	-92.0	-217.7
	Arkansas	-60	-3.0	-4.9	-13.5
	Mississippi	-201	-10.2	-18.9	-42.1
	Total	-1,853	-95.9	-166.4	-379.6
	Total effect	-2,403	-168.2	-289.0	-814.1

^a Area excluding the county or parish where the mill was located.

state's labor department. We obtained data on awarded national emergency grants from the USDL.

Results

We estimated that closure of the Alabama mill would affect approximately 4,800 jobs, resulting in a loss of nearly \$320 million in labor income and a drop of over \$700 million in total value added across the three states included in the analysis (Table 3). As expected, a large proportion of the total impact corresponded to cessation of activity by the Courtland mill (direct effect). The closure's direct impact accounted for close to 23 percent of the total employment loss, 45 percent of the decline in labor income, and 59

percent of the decline in total value added. Although most of the impact affected Alabama, results showed 13 percent (approximately 650 jobs) of the expected change in employment and 8 percent (or \$55 million dollars) of the anticipated drop in value added affecting Tennessee.

Over one-third of the total impact resulting from the Courtland mill closure will be felt by forest sector industries (Table 4). After pulp and paper, the logging industry appears to be the forest sector's group most affected, with close to 370 jobs impacted (2% of the study area's logging employment). Transportation was also identified among the top sectors affected, with an estimated loss of 190 jobs and a decrease in value added of over \$15 million.

Table 4.—Total effect of mill closures on the forest sector, transportation, and other sectors of the economy.

Mill case	Sector	No. of jobs	Economic impact			
			Labor income (millions of \$)	Value added (millions of \$)	Output (millions of \$)	
Courtland, AL	Forest sector ^a	-1,707	-178.9	-455.0	-1,184.5	
	Forestry	-53	-3.2	-3.5	-6.5	
	Logging	-371	-21.8	-16.6	-35.7	
	Wood products	-132	-6.4	-8.3	-29.8	
	Pulp and paper	-1,151	-147.5	-426.6	-1,112.6	
	Transportation	-190	-10.6	-15.5	-35.4	
	All other sectors	-2,906	-128.4	-235.3	-470.4	
	Total	-4,803	-318.0	-705.8	-1,690.2	
	Bastrop, LA	Forest sector ^a	-932	-92.2	-152.3	-535.0
		Forestry	-78	-3.1	-4.4	-10.8
Logging		-190	-9.5	-15.6	-50.2	
Wood products		-71	-3.4	-4.3	-16.7	
Pulp and paper		-593	-76.2	-128.0	-457.3	
Transportation		-96	-5.2	-8.7	-17.0	
All other sectors		-1,375	-70.8	-128.0	-262.1	
Total		-2,403	-168.2	-289.0	-814.1	

^a Furniture not listed (no effect to report).

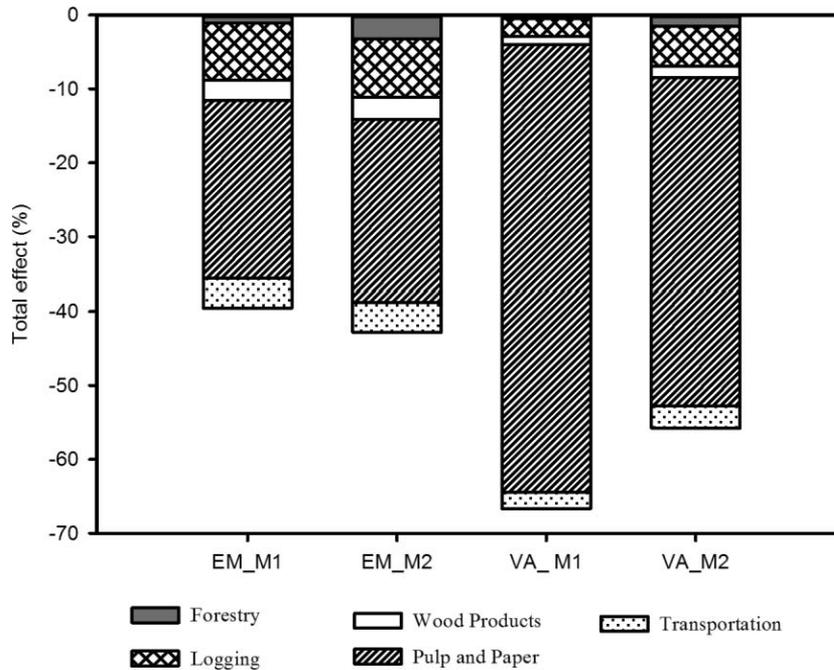


Figure 1.—Courtland (M1) and Bastrop (M2) mill closure's employment (EM) and value added (VA) impacts on the forest and transportation industries as percentage of total effects.

IMPLAN estimates placed the total impact of the Bastrop mill closure in the vicinity of 2,400 jobs, with close to \$170 million of associated labor income and total loss in value added of nearly \$290 million (Table 3). Among the two neighboring states included in the analysis, Mississippi appeared the most affected, accounting for an estimated 8 percent (approximately 200 jobs) of all the employment loss and close to 7 percent (or nearly \$19 million) of the drop in total value added. Close to 930 jobs, or 40 percent of the total employment loss, affected the area's forest sector (Table 4). Logging showed as the sector's second most impacted industry with a loss of 190 jobs, or 20 percent of the forest sector's employment loss.

Results across mills revealed similar effects on total impacted employment, with the loss of one job in the paper mill industry resulting in an average loss of three additional jobs to the economy of the area. However, impact significance (i.e., the impact as the percentage of the area's total effects) varied across forest sector industries (Fig. 1). Compared with the Courtland mill, closure of the Bastrop mill resulted in a slightly higher percentage of impact on supporting forest sector industries, although the absolute value was smaller. Impact on employment in the forest sector industries accounted for 39 percent of the total employment impact (15% excluding the mill itself) in the case of the Bastrop mill and close to 36 percent in the case of the Courtland mill (12% excluding the mill itself). In terms of value added, however, we observed a higher impact on the forest sector (close to 65% of the area's value added) from the Courtland closure, resulting mostly from the mill itself rather than other forest sector industries. Likewise, the forest sector experienced over half of the loss in value added associated with the Bastrop closure. However, in the Bastrop case, logging and forestry activity made up a larger percentage of the study area's loss in value added, compared with the Courtland mill (Fig. 1).

Discussion

Using I-O modeling, we analyzed and compared the impacts of paper mill closures on regional and local economies, but unlike previous studies (i.e., Skurla et al. 2008, 2013; VEDP 2009), our research focused on the significance to forestry-related industries. The IMPLAN analyses showed both closures resulting in considerable impacts on the economy of the areas studied, primarily to the state where the mill was located. Overall, we observed a higher loss across all economic measures from closure of the Courtland mill. However, owing to the different input mix between the two mills, closure of the larger mill resulted in a lower impact on other forestry-related industries, as a percentage of total effect. In the case of the Courtland mill, a smaller share of each dollar spent is directed toward inputs from other forestry industries compared with a dollar spent by the Bastrop mill. One should note that although a significant portion of the estimated impact corresponded to the mill itself (direct effect), spillover to other sectors of the economy were substantial. In both cases analyzed, over half of the estimated employment loss occurred across supply chain industries, a point worth considering when designing programs to assist displaced workers.

IMPLAN is a static model providing estimates of expected effect from examined changes in economic conditions, in this case the loss of jobs resulting from mill closures. However, we expect remaining industries to adjust to the change in availability of resources, therefore changing the effects on the study area. Effects estimated by IMPLAN will be affected by the extent and swiftness of the adjustments the remaining industries adopt and should therefore be considered as a reference line. Effects to the logging industry, for instance, could be felt over a larger area than that modeled, as remaining mills modify wood procurement areas. Likewise, other industries using small-

size wood such as a panel mill or a wood pellet mill might be attracted to the area given the change in resource availability. For instance, Drax Biomass International invested in a new wood pellet plant in Bastrop, Louisiana. Construction started in 2013, with mill operation beginning in 2015. The plant has a capacity of 450,000 tons of pellets per year, providing 47 direct jobs to the area (Drax Biomass 2012, Wood Bioenergy 2015).

Kebede et al. (2013) estimated the impact of wood pellet cofiring on the economy of seven counties in south and west Alabama based on a shock to the forestry and logging sectors. Differences in modeling approach, regions modeled, years of analysis, and type of multipliers applied make the work by Kebede et al. (2013) not directly comparable to our analysis. However, a rough comparison offers primary linkage of the effects on forestry and logging industries and how they affect the regional economy. In general, multipliers for a larger area should be larger than those for a smaller area, because most goods and services can be obtained within the larger area, thus minimizing leakages. Multipliers for forestry and logging from our paper mill analyses, covering three states, were much lower than those reported in the study by Kebede et al. (2013), which covered seven counties. This indicates that one job in the wood pellet mill would have a higher impact on forestry and logging than one job in the paper mill.

A wood pellet mill operates with fewer employees than a pulp and paper mill (lower direct impact), but can consume a high volume of wood. For instance, the Drax Bastrop pellet mill operating at 60 percent capacity would require close to 675,000 green tons of raw materials (assuming 55% wood moisture content) but only a fraction of the employees that the closed Bastrop paper mill supported. Therefore, although providing higher impact on forestry and logging, the wood pellet's lower direct impact, and associated lower induced effects, will likely result in a smaller overall economic contribution by comparison. Nonetheless, a wood pellet mill could provide significant activity to logging industries and a venue to support forest management, although likely at lower stumpage prices than traditional pulpwood. With thinning interventions as a tool to manage stand fuel loads and control pest outbreaks commonly associated with dense stands, availability of a substitute market for small wood could certainly be beneficial to forest landowners.

Although IMPLAN's snapshot of likely effects of mill closures can provide valuable information to local planners and administrators, further research is needed analyzing the dynamic response of the sector to changes in wood procurement resulting from mill capacity changes. Changes in mill capacity can have far-reaching effects, with impacts spreading across state lines, as shown by the cases examined. Future research looking into wood flow across the region and the forest industry's level of adaptability to varying products demand would provide information to help managers deal with future shifts in capacity.

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