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THE IMPACT OF COSTS, DEMAND, AND LABOR PRODUCTIVITY ON CHANGE IN THE NUMBER OF FIRMS: AN ECONOMETRIC APPLICATION ON THE FOREST PRODUCTS INDUSTRY OF ALABAMA, 1996-2012

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Abstract: *This study investigates the factors for changes in the number of establishments in the forest products industry, the largest manufacturing sector of Alabama. The change in the number of firms is linked to changes in two important factors, variable costs and demand. This model is estimated with annual data on the number of firms, variable costs, and inventory-output ratios (measure of demand), from 1996 to 2012. Alabama's logging, wood, paper, and furniture industries are analyzed in the study. The results suggest the increase in variable cost explained most of the decrease in the number of firms over the time period between 1996 and 2012. Decomposition analysis indicates that, within variable cost, rise in material costs led to higher decrease in the number of firms compared to the rise in labor costs. Further decomposition shows increase in labor productivity compensates for the rise in the wage rate, so that increases in wages do not contribute to the general decline in the number of firms in the forest products industries. To improve competitiveness of these firms, the government and the forest products industries should strive to control material costs and increase their labor productivity.*

JEL Classification Codes: *Q230, J30, L60, D12*

Keywords: *Forest Products Industries, Demand, Cost, Labor Productivity*

INTRODUCTION

Timberland across the United States is a significant economic fixture and one of the most important natural resources, along with farmlands and mining sites. Alabama has the second largest commercial timberland base in the south following Georgia and the third largest timberland base in the United States behind Oregon and Georgia with 22.9 million acres which is approximately 70% of the state's total land area[1]. Such an abundance of timberland in Alabama has resulted in 1,300 companies in the forest products industry (FPI) that provides employment

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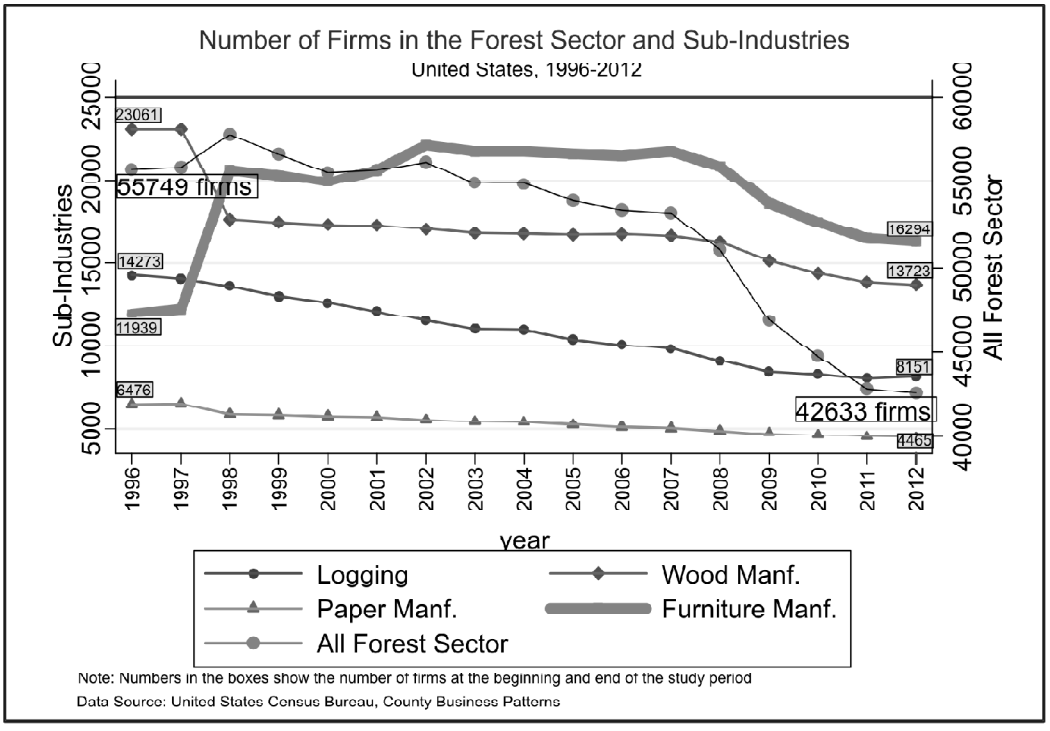
to about 12% of Alabama's total labor force.[2, 3] In addition, the industry accounts for an estimated 9% of Alabama's total GDP[5].

The forest products industry in Alabama has been experiencing a notable decline in the number of establishments, employment and production since the 1990's.[4] In fact, the decline is not restricted to Alabama. The forest product industries across the United States have also experienced this decline in the number of establishments (Collins *et al.* 2008). Figures 1 through 6 show the change in the number of establishments in the country and also in the southern states that neighbor Alabama.

Relevant literature argues there are many factors affecting the decline, such as the lack of global competitiveness (Bael and Sedjo 2006; Ince *et al.* 2007; Collins *et al.* 2008; Woodall *et al.* 2011), decreasing demand for wood and paper products (NCSSF 2005; Sample and Wallinger 2006; Collins *et al.* 2008; Woodall *et al.* 2011), broader economic recessions (Hodges *et al.* 2011), industrial consolidations (Conrad *et al.* 2010), taxes and regulations, and firm based factors such as cost, labor productivity etc. Given the importance of the industry in providing revenue and jobs to the state and the country, understanding the factors behind the decline is critical. However, only a few studies in the literature have examined the perceived

Figure 1: Number of Establishments in All Forest Sector and Sub-Industries, US



factors behind the decline. This paper analyzes how these *factors* affect the decline in the number of establishments in the forest products industry of Alabama.

Collins *et al.* (2008) discussed several factors affecting the decline, such as international currency exchange rates, global cost-competitiveness etc. Bael and Sedjo (2006) examined the impact of globalization on production place and patterns (natural or planted forestland) of the forest products industry. Woodall *et al.* (2011) reported the changes in employment, mill numbers, etc., in the forest sector of the Northern US. Keegan *et al.* (2012) assessed the impact of the 2009 economic recession on production, employment, and number of companies in the forest industry in the Western US. Hodges *et al.* (2011) also assessed the impact of the recession for the forest industry of the Southern US. Ince (2002) discussed longer-term implications of 2000-2001 recession on the forest sector of the Southern US. Conrad *et al.* (2010) investigated the effect of forest ownership and forest industry structure on the mill closure and wood supply chain in the southern US. Keegan *et al.* (2004) reported a description of the change in structure, capacity, and condition of Idaho's primary forest products industry.

Beside these studies in the literature, some studies employ input-output methods to analyze the economic contribution of the forest products industry on small communities[5]. Mainly, these studies analyze the implications of changes in forest policies, number of mills in the forest products industry, etc. on regional economies. For example, Wu *et al.* (2002) estimated the impacts of forest products trade liberalization on the US forestry sector. Carino *et al.* (1991) assessed the effect of locating a new OSB (Oriented Strand Board) plant on the economic activities in north Alabama.

Although there are a few papers in the literature that show the decline in the forest products industry, none of these papers control for possible determinants of the decline. Therefore, the analyses of these papers may have biased estimates due to otherpossible uncontrolled determinants of the decline (bias caused by omission of relevant variables)[6]. For example, Hodges *et al.* (2011) explains the decline in the industry by considering only the 2009 economic recession and ignoring all other possible determinants affecting the decline, such as globalization, industrial consolidation, and production cost etc. The econometric analyses in the current paper control for most possible determinants of the decline in the forest products industry. In addition, the above studies only consider exogenous factors (external to the firms and beyond their control such as economic crisis, demand etc.) and totally ignore endogenous factors (internal to the firms and presumably within their control such as cost of production, labor productivity etc.) that may affect the decline in the number of firms of the industry. However, some studies suggest that endogenous factors are the main cause of business failure (Peterson *et al.* 1983; Everett and Watson 1998; Headd 2001; Collins *et al.* 2008; Ames 2013). Hence,the analyses in the current study also control for endogenous factors along with exogenous factors.

Using a panel data set of Alabama counties spanning the period between 1996 and 2012, this article employs econometric analyses[7] to investigate the effect of factors determining changes in the number of establishments in the forest products industry. Specifically, the change in the number of establishments is linked to changes in two important factors, variable cost of production and demand for forest products. Within variable cost, the effect of changes in material and labor costs on changes in the number of establishments is estimated. Then, within labor cost, the effect of wages and labor productivity on the changes in the number of establishments is also estimated. The result of this analysis should then be useful to decide which factors - e.g. demand, material-labor cost, wage, or labor productivity- the industries or government[8] should aim to control or improve in order to enhance the competitiveness of the industry in local/ and global markets.

The rest of the paper is organized as follows: first, the data and empirical framework used in the paper are described; then, a section presentsthe results; followed by a final section that includes some discussion and conclusion based on the research.

The main findings are that: (1) changes in demand for forest products influenced the decline in the number of establishments much more than changes in average variable costs of production; (2) the impacts of changes in material costs on the decline are always greater than the changes in labor costs; (3) improvements in labor productivity compensate for increases in wages, may lead to an increase in the number of establishments,other things being equal.

DATA AND EMPIRICAL FRAMEWORK

Data

Table 1 shows the number of firms operating in each of the main aggregated forest based industries, Logging, Wood Products Manufacturing, Paper Products Manufacturing, and Furniture and Related Products Manufacturing. Table 2 lists the aggregated and dis-aggregated forest based industry classificationsanalyzed in this study. These industries ensure a good coverage of the forest products industry of Alabama.

Table 1
Industry Separation in the Forest Sector

All Forest Sector:	*The Forest Products Industry*			
Main Sector:	1. Logging	2. Wood Mfg.	3. Paper Mfg.	4. Furniture Mfg.
Sub Industry:		• Mills	• Pulp Mills	• Kitchen/ Household
		• Container/Pallets	• Paper/Paperboard	• Public/Office

All data for the four *main-sectors* is added leading readily to the data for *all forest sector* considered as one group. The *sub-industry*is obtained by clustering the industries which produce similar products. For example, the *sub-industry* "mills" is created by combining several industries such as sawmills and wood preserving, veneer and plywood mills, reconstituted wood products, millwork, planning mills, and flooring mills. Table 3 shows the combination of industries in order to obtain *sub-industry* classification under the forest products industry. Detailed information for the forest products industry, their North American Industry Classification System (NAICS) codes and commodity types is available in Table 2.

Table 2
Industry used in the Model

NAICS Code	*Industry/Sub-Industry*	*Commodity*
1133	Logging	· Logs
321	Wood Product Manufacturing	· Wood and related products
3211	Sawmills and Wood Preserving	· Hardwood and softwood lumber; Wood chips and ties; Wood poles, piles and posts.
321211	Hardwood Veneer and Plywood	· Hardwood veneer, including veneered panels; Hardwood plywood.
321212	Softwood Veneer and Plywood	· Softwood veneer, including veneered panels; Softwood plywood, rough, sanded and specialties.
321219	Reconstituted Wood Products	· Particleboard; Waferboard and oriented stranboard; Medium density fiberboard.
32191	Millwork	· Millwork.
321912	Planning Mills	· Cut stock and dimension; Sawn wood fence stock; Wood lath; Contract Resawing and planning.
321918	Flooring Mills	· Hardwood flooring with or without oak and maple flooring.
321920	Wood Container Pallets and Skids	· Nailed and lock-corner wood boxes; Crate shook; Wood pallets and containers.
321992	Prefabricated Wood Buildings	· Components for prefabricated stationery wood buildings; Prefabricated stationary residential (homes) and nonresidential wood buildings (motels).
322	***Paper Manufacturing***	· Pulp, paper, paperboard and related products.
32211	Pulp Mills	· Pulp, pulp mill byproducts including turpentine.
32212	Paper Mills	· Bleached Bristol, clay coated, uncoated and industrial converted paper; Sanitary tissue paper products; facial tissues and handkerchiefs; Table napkins, Toilet tissue; Paper towels;
32213	Paperboard Mills	· Bleached-Unbleached Kraft packaging; Semi chemical paperboard; Recycled paperboard.

contd. table 2

NAICS Code	*Industry/Sub-Industry*	*Commodity*
32221	Paperboard Containers and Boxes	· Corrugated and solid fiber boxes; Corrugated shipping containers for food beverages, carryout, paper, and allied products, metal machinery; Corrugated paperboards in sheet and rolls.
322222	Paper Coated & Laminated Packaging	· Coated and laminated packaging paper; Single web paper, rolls and sheets; Multiweb laminated rolls and sheets; Gummed products; Pressure sensitive products; Wall coverings; Converted foil.

Note: NAICS codes, sectors, subsectors, and associated commodities are obtained from U.S. Department of Labor, Bureau of labor Statistics, *http://data.bls.gov/pdq/querytool.jsp?survey=pc*

Table 2 (Cont.): Industry used in the Model

322223-322226	Paper Bag	· Specialty bags, bags, pouches and liners; Uncoated paper and multiwall bags; Uncoated single web paper grocers' bags and sacks and variety shopping bags; Single and double wall shipping sacks and bags
32223	Stationery Products	· Die cut paper, paperboard office supplies; Paper supplies for business machines; Envelopes; Tablets, pads and related products; Notebooks, bound with wire, staples; Loose-leaf paper fillers; Wrapped ream paper.
322291	Sanitary Paper Products	· Disposable sanitary tissue paper products.
322299	Converted Paper Products	· Molded pulp goods, egg cartoons, florist pots food trays etc.; Miscellaneous converted paper and paperboard products.
337	***Furniture and related product manufacturing***	· Furniture and Related products.
33711	Wood Kitchen Cabinets	· Stock, custom wood kitchen cabinets and related cabinetwork; Wood bathroom vanities; Wood and plastics laminated kitchen cabinets, countertops and bathroom vanity tops.
33712	Wood Household Furniture	· Upholstered wood household furniture, sofas, davenports, settees, chairs etc.
337127	Institutional furniture	· School furniture; Public building and related furniture.
337211	Wood Office Furniture	· Wood office seating, desks and extensions; Wood office files, storage units, and tablets; Panel and desking systems.

Note: NAICS codes, sectors, subsectors, and associated commodities are obtained from U.S. Department of Labor, Bureau of labor Statistics, *http://data.bls.gov/pdq/querytool.jsp?survey=pc*

Table 3
Sub-Industries Used in the Study

Sub-Industries used in the Regression Analysis	*Industries combined to obtain sub-industry classification*
Mills	Sawmills and Wood Preserving (3211) Veneer and Plywood Mills (321211, 321212) Reconstituted Wood Products (321219) Millwork (32191) Planning (321912) Flooring Mills (321918)
Container and Pallet	Wood Container (32192) Wood Pallets and Skids (32192) Prefabricated Wood Buildings (321992)
Paper and Paperboard mills	Paper Mills (32212) Paperboard Mills (32213)
Pulp Mills and Other Paper	Pulp Mills (32211) Paperboard Containers and Boxes (32221) Paper Coated & Laminated Packaging (322222, 322221) Bags (322223-322226) Sanitary Paper Products (322291) Stationery Products (32223) Converted Paper Products (322299)
Kitchen and Household Furniture	Wood Kitchen Cabinets (33711) Wood Household Furniture (33712) Upholstered Household Furniture (337121)
Public, office and Other furniture	Wood Office Furniture (337211) Public Building Furniture (337127) Wood TV and Radio Cabinets (337129)

The data for the number of establishments in these industries is obtained from the County Business Patterns database of the United States Census Bureau, which is an annual series providing subnational economic data by industry including the number of establishments, employment, and annual payrolls[9].

Table 4 shows the yearly data series used to calculate each variable of the model. Except the number of establishments' data, all the data are in current-year dollar values and obtained from the IMPLAN (IMpact analysis for PLANning) datasets. IMPLAN is a regional economic impact modeling system that employs regional social accounting matrices (SAM). Since 1976, IMPLAN has been providing a set of benchmark economic data for analysts, educators, businesses, and local governments to create accurate economic impact studies. Studies examined the accuracy of IMPLAN data by comparing it with primary datasets from state

Table 4
Data Series Used in Measuring the Variables.

Variables Name	*Description*
# of Firms	*Total number of establishments in the FPI.*[1]
O	Output; the value of industry production including sales and inventory.
INV	Inventory; Stocks of goods held by the firm over a period of time.
S=O-INV	Total sales (in million dollars).
I/S=INV/S	*Inventory-sales ratio (in million dollars).*
PPI	Producer Price Index (1982=100) for the main sectors of the FPI.[2]
$Q=S/PPI_{sector}$	Quantity produced in each sectors of the FPI.
VA	Value added; The difference between an industry's or an establishments total output and the cost of its intermediate inputs.
M=O-VA	Material cost of production (in million dollars).
L	Labor compensation; total payroll cost of the employee paid by the employer.
AVC=(M+L)/Q	Average variable cost (in million dollars).
AMC=M/Q	Average Material Cost
ALC=L/Q	Average Labor Cost
N	Number of Employment; the annual average of monthly jobs include all full-time, part time, and temporary positions. 1 job lasting 12 months = 2 jobs lasting 6 months each = 3 jobs lasting 4 months each.
PD=O/N	Labor Productivity.

[1] U.S. Census Bureau; County Business Patterns, *http://www.census.gov/econ/cbp/index.html*
[2] U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Indexes, *http://www.bls.gov/ppi/data.htm*
Note: All data series except number of firms and producer price index are obtained from IMPLAN Group LLC, IMPLAN System (data and software), *www.implan.com.*

governments, and they concluded the IMPLAN dataset accurately represented the economic structure of the states and sub-regions of the states (Hotwedt et al.1988; Bairak and Hughes 1996). Comprehensive and detailed documentation of the IMPLAN dataset, including definitions of the variables and various types of data sources used for the construction of the data is available on the webpage for the IMPLAN group.[10]

It is valuable to have all the data from a single source because this ensures homogeneity of definitions and consistency in data collection method. This also allows the data from the various sub-sectors to be combined in order to representsall forest sectors as one group.

As the data set did not contain any variables that could be used to model demand for forest products, it was necessary to use a demand proxy. Inventory-Sales ratio (I/S) is used as a demand proxy in this study. This ratio represents the annual percentage rate of change of the ratio of an industry's average inventory to

Figure 2: Number of Establishments in All Forest Sector and Sub-Industries, Georgia

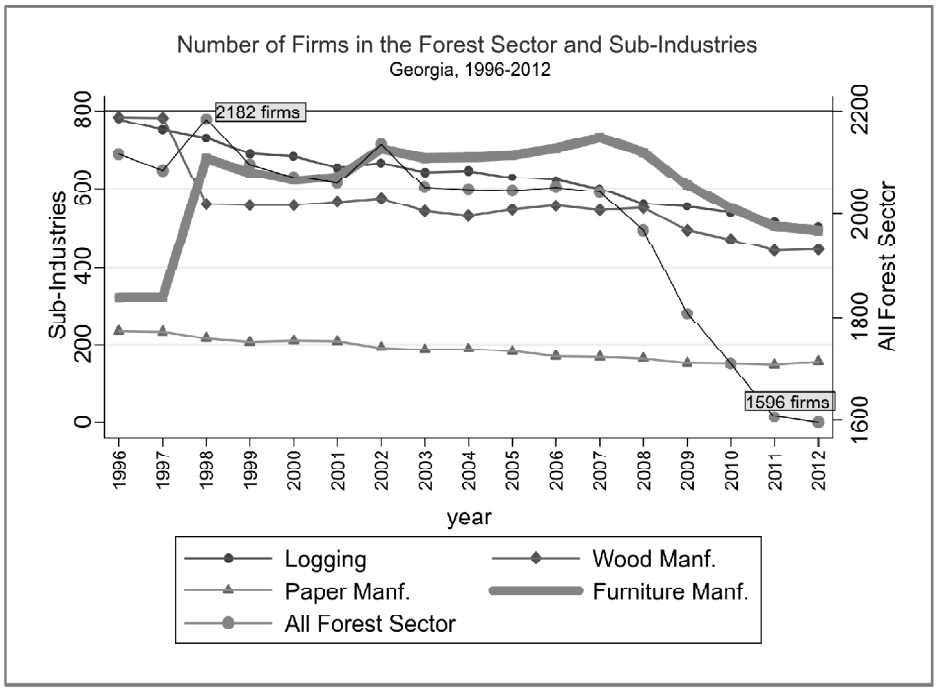


Figure 3: Number of Establishments in All Forest Sector and Sub-Industries, Mississippi

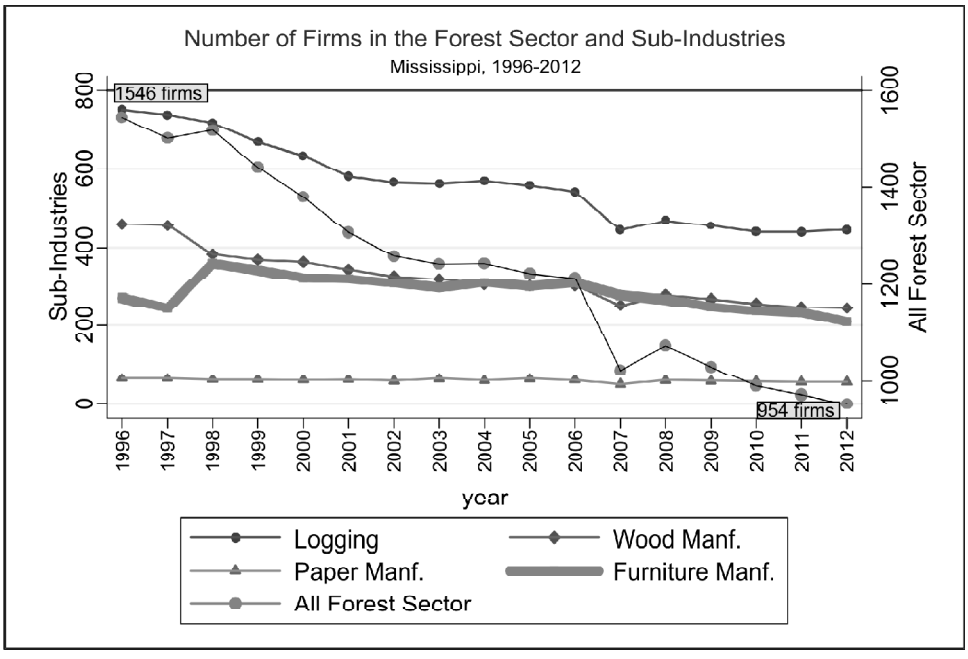


Figure 4: Number of Establishments in All Forest Sector and Sub-Industries, Florida

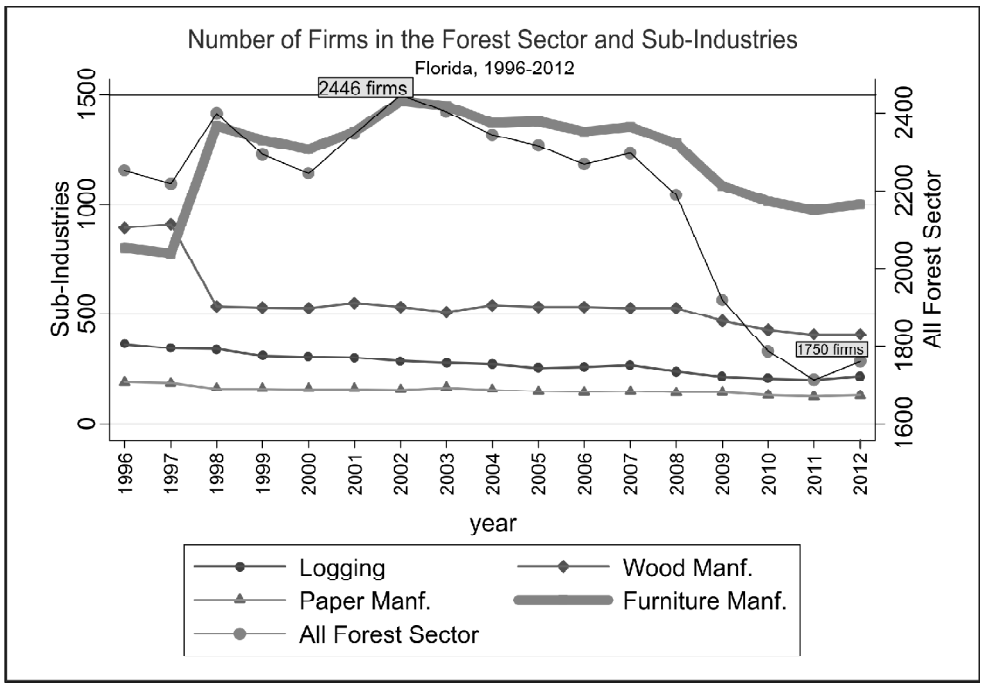


Figure 5: Number of Establishments in All Forest Sector and Sub-Industries, Louisiana

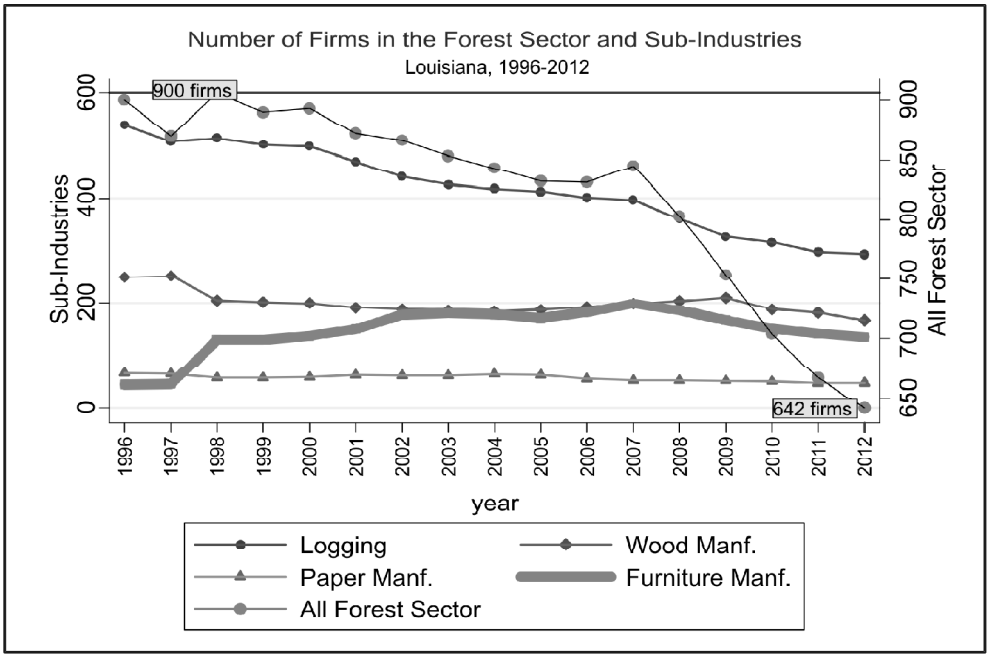
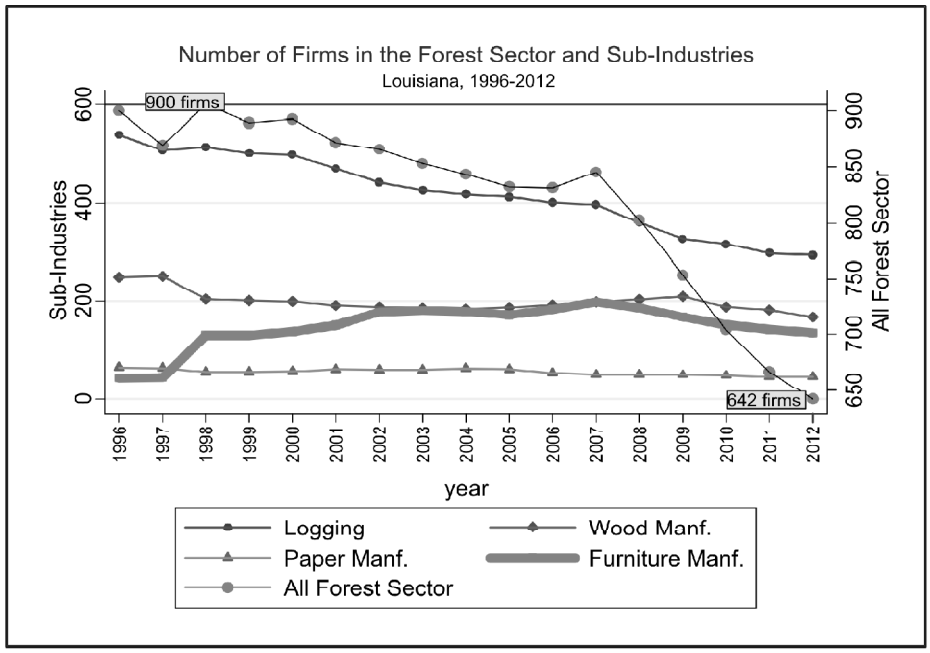


Figure 6: Number of Establishments in All Forest Sector and Sub-Industries, South Carolina



its value of shipments. High level of demand is associated with a negative change in the ratio, while a large positive change in the ratio is indicative of slack demand for the products of the forest sector. This proposition has been supported by numerous studies on the relationship between cost, demand, and price expectations on industry prices (Wilder *et al.* 1977; DeRosa and Goldstein 1982; Buongiorno and Lu 1989).

Series of yearly rates of change of variables were estimated as follows:

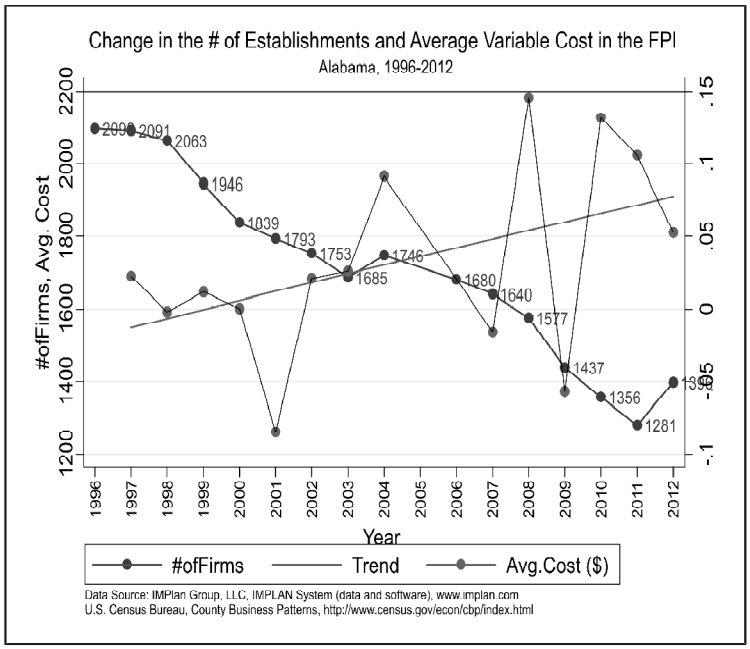
(1) $\Delta X = (X_t - X_{t-1}) / (X_{t-1})$ for t = 1996 to t = 2012

where X is the variable of interest.

Empirical Framework / Model

Previous studies suggest that factors, like economic crisis, demand for forest products, and globalization of the industry, have an influence on the changes in the number of establishments (Hodges *et al.* 2011; Collins *et al.* 2008). As explained previously, this paper hypothesizes that, along with these factors, firm characteristics such as variable cost of production, wage rates, labor productivity, are additional determining factors in the decline of the number of establishments of the forest products industry of Alabama. Figures 7 and 8 show the changing

Figure 7: Percentage Changes from the previous year in the Number of Establishments, Average Variable Cost, and Inventory-Sales Ratio (Demand) in the Forest Products Industry of Alabama between 1996 and 2012. (Note: The higher the inventory-sales ratio, the lesser the demand for the products of the forest industry)



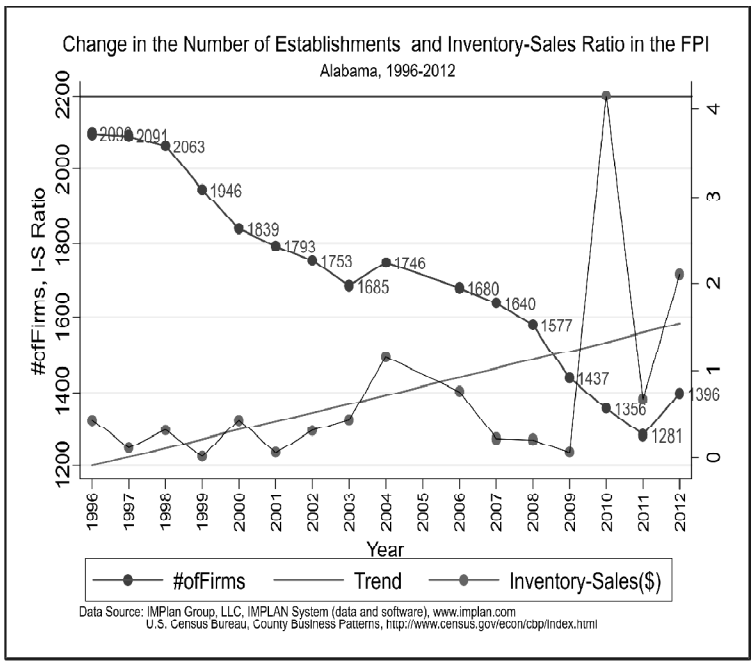
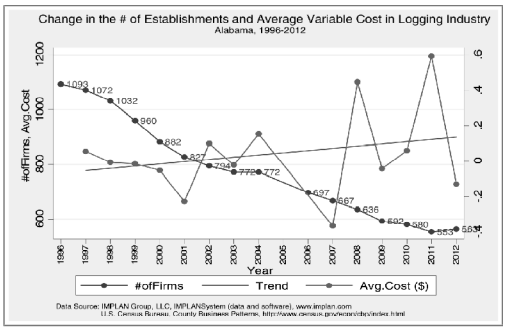
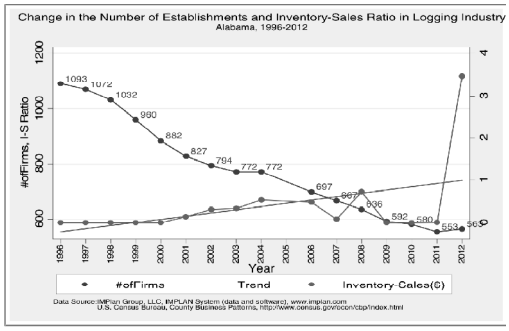
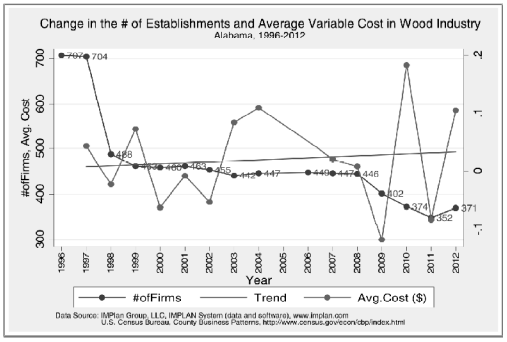
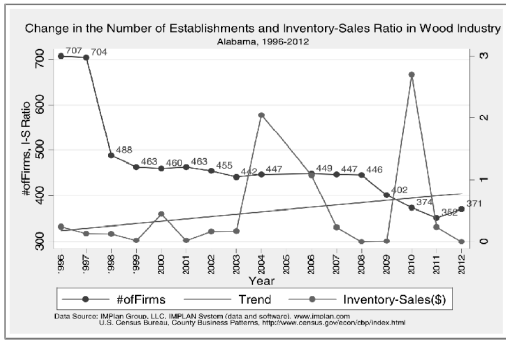


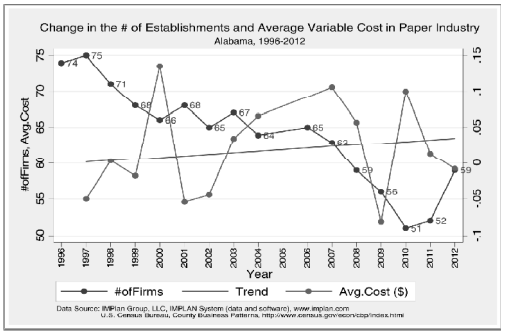
Figure 8: Percentage Changes from the previous year in the Number of Establishments, Average Variable Cost, and Inventory-Sales Ratio (Demand) in the Main Industry of the Forest Sector in Alabama between 1996 and 2012

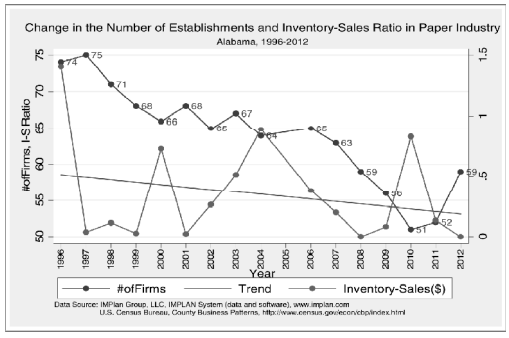


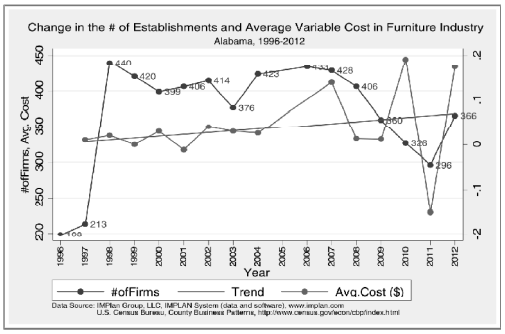


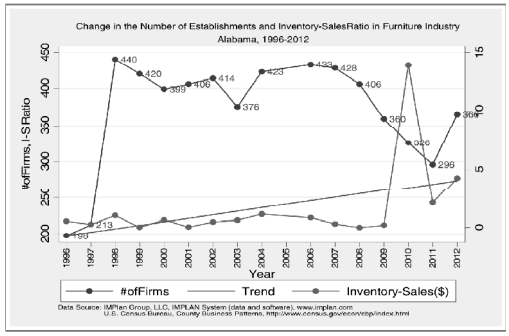












trend in the number of establishments of the forest products industry, demand (inventory-sales ratio) and average variable cost between 1996 and 2012.

Following the guidelines described above, we estimated the equations depicted below:

$$F_{c,t} = \beta_0 + \beta_1(\Delta I/S)_{c,t} + \beta_2 (\Delta AVC)_{c,t} + \varepsilon_{c,t} \quad (2)$$

$$F_{c,t} = \beta_0 + \beta_1(\Delta I/S)_{c,t} + \beta_{21} (\Delta MC)_{c,t} + \beta_{22} (\Delta LC)_{c,t} + \varepsilon_{c,t} \quad (3)$$

$$F_{c,t} = \beta_0 + \beta_1(\Delta I/S)_{c,t} + \beta_{21} (\Delta MC)_{c,t} + \beta_{221}(\Delta W)_{c,t} + \beta_{222}(\Delta LP)_{c,t} + \varepsilon_{c,t} \quad (4)$$

where $F_{c,t}$ stands for the number of establishments in the forest products industry in county c in year t.

In order to control for the change in demand for forest products, all the models include $I/S_{c,t}$, inventory-sales ratio, as a demand proxy. It represents the change in demand for the forest products industry in county c in year t. The higher the inventory-sales ratio in each county, the lesser the demand for the products of the industry, so the expected sign of $I/S_{c,t}$ will be negative. All models include $I/S_{c,t}$ as a percentage change from the previous year.

In equation (2), average variable cost, $AVC_{c,t}$, is included to indicate the impact of cost of production on the number of establishments in county c in year t. The change in the number of establishments due to the change in $AVC_{c,t}$ can be decomposed further to analyze the impact of material cost, $MC_{c,t}$, and that of labor cost, $LC_{c,t}$. Therefore, equation (3) includes material cost, $MC_{c,t}$, and labor cost, $LC_{c,t}$ to show how components of $AVC_{c,t}$ impact the change in the number of establishments separately. Another decomposition is that of the labor cost, $LC_{c,t}$, into a wage effect, $W_{c,t}$, and a labor productivity effect, $LP_{c,t}$, which is achieved in the equation (4). These decomposition analyses can be used to determine the importance of each component of change in the number of establishments, not only in terms of the statistical significance, but also in terms of the magnitude of the effects (Buongiorno and Lu 1989). Application of similar decomposition analyses can be found in Kako (1978, 1980), Rockel and Buongiorno (1982), Buongiorno and Lu (1989), and Hoekstra and Bergh (2002). Average variable costs, material and labor costs, wages, and labor productivity all appear in the models of this study as a percentage change from the previous year.

The summary statistics of all the variables of the model are reported in Table 5.

RESULTS

The results obtained from estimating equations (2-4) are reported in this section. The tables include regression results for *sub-industry*, *main-sectors*, and *all forest sectors* (sum of all *main-sector)*. The *main-sectors* group includes Logging, Wood Products Manufacturing, Paper Products Manufacturing, and Furniture and Related

Table 5
Summary Statistics

Sectors	*Variable*	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*
113-Logging	**# of Firms**	446	12	8.70	0	57
	Av. Var. Cost	446	0.04	0.27	-0.52	1.66
	Inventory/Sales	446	1.13	2.72	-2.49	6.86
321-Wood Manf.	**# of Firms**	242	7	6.34	0	52
	Av. Var. Cost	242	0.02	0.11	-0.43	1.23
	Inventory/Sales	244	2.54	2.47	-6.54	8.68
322-Paper Manf.	**# of Firms**	66	3	2.20	1	13
	Av. Var. Cost	66	0.02	0.09	-0.38	0.59
	Inventory/Sales	66	2.06	1.62	-1.70	6.32
337-Furniture	**# of Firms**	278	8	7.15	0	49
Manf.	**Av. Var. Cost**	278	0.04	0.21	-0.80	3.48
	Inventory/Sales	278	1.32	2.48	-5.07	8.92
All Forest Sectors	**# of Firms**	1,109	8	7.55	0	57
	Av. Var. Cost	1,109	0.03	0.21	-0.81	3.84
	Inventory/Sales	1,109	1.56	2.60	-6.54	10.27

Note: N represents the number of observations used in each regression analysis for each industry. County and year means are also reported for each industry. Means for all forest sector group are for county year industry.

Products Manufacturing. The *all forestsectors* group simply represents all forest products industries in Alabama. The result tables present the results from the specification where the number of establishments in the forest products industry of Alabama is the dependent variable. Each column presents the output of the regression for each industrylisted at the top of the columns. Numbers of observations in regressions differ due to the availability of data for the forest products industry in each county of the state[11]. The last two rows in the tables provide the sample means of the dependent and independent variables included in the regressions. Standard errors are clustered at the county level and reported in the parentheses in each table. The tables also include semi-elasticities at means in the brackets.

Table 6 presents the impact of demand and average variable cost on the number of establishments in each *sub-industry* of the forest sector. The results are obtained from estimating equation (2) with random effects estimator. The dependent variable is the number of firms in the mentioned industry. Each column corresponds to a sub-industry whose major industry is listed at the top. Unit of observation is county-year. Clustered standard errors are presented in parentheses. In Table 5, we also provide in brackets the semi-elasticity of number of firms with respect to the control variables. Inventory-sales ratio (measure of demand) and the average variable cost have a negative effect on the number of establishments in each *sub-industry* generally. However, they are not statistically significant in some regressions. The

Table 6
Impact of Inventory-Output Ratio and Average Cost on the Number of Firms in the Forest Products Industry of Alabama, 1996 to 2012

	Dependent Variable: Number of Firms in the Forest Products Industry					
	(1)	(2)	(3)	(4)	(5)	(6)
	"Main-Sectors in the Forest Product Industry"					
	321-Wood Manf.		*322-Paper Manf.*		*337-Furniture Manf.*	
	"Sub-industries"					
	Mills	*Container, Pallet*	*Pulp Mills, Other Paper*	*Paper, Paperboard Mills*	*Kitchen, Household Furn.*	*Public/ Office Other Furn.*
Inventory/Sales	-0.11**	-0.02	-0.10*	0.07	-0.02	-0.04
	(0.06)	(0.05)	(0.06)	(0.07)	(0.08)	(0.03)
	[-0.27]	[-0.04]	[0.17]	[-0.02]	[-0.03]	[-0.10]
Av. Var. Cost	-0.14	-0.92*	-0.69	-0.41**	0.45	0.31
	(0.97)	(0.56)	(0.59)	(0.2)	(0.37)	(0.32)
	[-0.003]	[-0.07]	[-0.07]	[-0.03]	[0.01]	[0.08]
Constant	6.11***	2.27***	1.10***	1.12***	5.28***	1.09***
	(0.64)	(0.34)	(0.26)	(0.24)	(0.64)	(0.36)
Observations	182	142	51	69	316	54
Number of County	63	47	20	35	62	23
	Means in the Regressions					
# of Firms	5	1	1	0.3	5	0.5
Inventory/Sales	2.38	1.72	2.51	2.31	1.62	2.80
Av. Var. Cost	0.02	0.02	0.03	0.02	0.04	0.05

Note: The outcome variable is the number of firms in the forest products industry. Each column presents the Sales of the regression where the impact of inventory-Sales ratio and average cost pertaining to the subsectors listed at the top is included. Last three rows provide the sample means of the dependent variable and the inventory-Sales ratio and average cost included in that regression. Combinations of subsectors are as follow; Mills: Sawmills and Wood Preserving (3211), Veneer and Plywood Mills (321211, 321212), Reconstituted Wood Products (321219), Millwork (32191), Planning (321912), Flooring Mills (321918).Container and Pallet: Wood Container (32192), Wood Pallets and Skids (32192), Prefabricated Wood Buildings (321992).Pulp Mills and Other Paper: Pulp Mills (32211), Paperboard Containers and Boxes (32221), Paper Coated & Laminated Packaging (322222, 322221), Bags (322223-322226), Sanitary Paper Products (322291), Stationery Products

reason for this could be the small number of observations for each sub-industry. Therefore, *main-sectors* of the forest sector which have more available and complete data are the only sectors analyzed in the rest of this study.

Table 7 presents results obtained from estimation of equation (2) over the *main-sectors*and *all forest sectors* in Alabama. The coefficient of Inventory to Sales Ratio has the expected negative sign in all regressions. The coefficients are significantly

Table 7
Impact of Inventory-Sales Ratio and Average Cost on the Number of Firms in the Main Forest Products Sectors of Alabama, 1996 to 2012.

	Dependent Variable: Number of Firms in the Forest Products Industry				
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
	"Main-Sectors in the Forest Product Industry"				
	113-Logging	*321-Wood Manf.*	*322-Paper Manf.*	*337-Furniture Manf.*	*All Forest sectors*
Inventory/Sales	-0.42***	-0.11**	-0.02	-0.09	**-0.25*** **
	(0.07)	(0.06)	(0.05)	(0.07)	**(0.04)**
	[-0.48]	[-0.29]	[-0.05]	[-0.13]	**[-0.39]**
Av. Var. Cost	-1.96***	-1.83*	-0.19	-2.36***	**-1.22*** **
	(0.38)	(1.03)	(0.75)	(0.88)	**(0.36)**
	[-0.34]	[-0.06]	[-0.01]	[-0.15]	**[-0.13]**
Constant	10.95***	7.43***	3.35***	8.42***	**7.70*** **
	(0.95)	(0.70)	(0.457)	(1.09)	**(0.48)**
Observations	446	242	66	278	**1,109**
Num. of County	66	64	20	50	**67**
			Means in the regressions		
Num. of Firms:	12	7	3	8	**8**
Inventory/Sales	1.13	2.54	2.06	1.32	**1.57**
Av. Var. Cost	0.04	0.02	0.02	0.04	**0.03**

Note: The outcome variable is the number of firms in the forest products industry. Each column presents the Sales of the regression where the impact of inventory-Sales ratio and average cost pertaining to the sectors listed at the top is included. Last three rows provide the sample means of the dependent variable and the inventory-Sales ratio and average cost included in that regression. Robust standard errors are in parentheses. Semi-elasticities at means are in brackets. *, **, and *** indicate statistical significance at 10%, 5% and 1%, respectively.

different from zero in the logging and wood manufacturing industries. They are also significant in the *all forest sectors*group (Column 5). The semi-elasticity for inventory to sales ratio for *all forest sectors* groups is 0.39. This implies a 2.5% increase in ratio of sales to inventory, in other words 2.5% decrease in demand, decreases number of establishments by one.

Except for the paper manufacturing industry, the coefficients of average variable cost are significant in all industries. This indicates that in *all forest sectors* group (column 5), an 8% increase in $AVC_{c,t}$ will reduce the number of establishments by 1. Results are similar for each *main-sectors*in the industry, separately. Moreover, the effect of variable cost is largest in the logging sector due to the relatively fast rate of growth invariable cost. A 3% increase in average variable cost of the logging sector will decrease the number of firms by one. This is because energy/fuel proportionately a larger percentage of the variable cost for the logging sector than

the other industries in the forest sector. Also, logging is the most labor-intensive industry compared to the other industry in the study (Ince et al. 2007). Yet, the results show the effect of variable cost on the paper industry is smallest (hundred percent increase in variable costs will cause one closing firm in the paper industry). This is because the industry uses more fixed cost, such as capital, rather than variable cost.

The results of Table 7 suggest the impact of average variable cost on the decline is smaller compared to demand in each industry of the forest sector. In other words, the impact of demand (exogenous factors) on the decline in the number of establishments is much larger compared to the impact from the production cost (endogenous factors) of the forest sector. These results are consistent with the literature that suggests the establishments in the industry have closed due mostly to decreasing demand. However, according to the these results, it can be said that average variable cost of production, such as material cost, wages, taxes, energy prices, and labor productivity etc., have still non-negligible influence on the decline in the number of establishments.

Table 8
Impact of Material Cost, Labor Cost and Inventory-Sales Ratio on the Number of Firms in the Main Forest Products Sectors of Alabama, 1996 to 2012.

Dependent Variable: Number of Firms in the Forest Products Industry					
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
	113-Logging	*321-Wood Manf.*	*322-Paper Manf.*	*337-Furniture Manf.*	*All Forest Sectors*
Inventory/Sales	-0.39***	-0.12**	-0.04	-0.09	**-0.25*** **
	(0.08)	(0.06)	(0.06)	(0.07)	**(0.04)**
	[-0.44]	[-0.30]	[-0.08]	[-0.12]	**[-0.38]**
Material cost	-0.43	-0.96	1.45	-1.38*	**-0.21**
	(0.41)	(0.88)	(1.003)	(0.79)	**(0.31)**
	[-0.07]	[-0.03]	[0.10]	[-0.14]	**[-0.02]**
Labor Cost	-0.05*	-0.66	-1.29***	-0.69	**-0.04***
	(0.03)	(0.53)	(0.39)	(0.53)	**(0.02)**
	[-0.03]	[0.04]	[0.08]	[-0.01]	**[-0.01]**
Constant	10.68***	7.44***	3.32***	8.42***	**7.61*** **
	(0.92)	(0.70)	(0.46)	(1.08)	**(0.47)**
Observations	445	242	66	278	**1,108**
Number of County	66	64	20	50	

Note: The outcome variable is the number of firms in the forest products industry. Each column presents the Sales of the regression where the impact of inventory-Sales ratio and average cost pertaining to the sectors listed at the top is included. Last three rows provide the sample means of the dependent variable and the inventory-Sales ratio and average cost included in that regression. Robust standard errors are in parentheses. Semi-elasticities at means are in brackets. *, **, and *** indicate statistical significance at 10%, 5% and 1%, respectively.

In Table 8, we include material cost and labor cost instead of average variable cost in the regressions (equation 3). In most of the industry, a larger part of the decline in the number of establishments can be attributed to changes in the cost of materials than to changes in labor cost. This could be in part because material cost has a much larger share in the production process compared to labor cost in all industry. In most industries, materials constituted 77 to 80% of the average variable cost. For example, in *all forest sectors* group (Column 5), a one percent increase in material cost will decrease the number of establishments by 0.02. Similarly, a one percent increase in labor cost will reduce the number of establishments in *all forestsectors* group by 0.01.

Finally, the results of the last decomposition analysis are shown in Table 9. In this table, the effect of labor cost on the number of establishments is separated into

Table 9
Impact of Material Cost, Wages, Labor Productivity and Inventory-Sales Ratio on the Number of Firms in the Main Forest Products Sectors of Alabama, 1996 to 2012

Dependent Variable: Number of Firms in the Forest Products Industry					
	(1)	*(2)*	*(3)*	*(4)*	*(5)*
	113-Logging	*321-Wood Manf.*	*322-Paper Manf.*	*337-Furniture Manf.*	*All Forest Sectors*
Inventory/Sales	-0.50***	-0.12**	-0.04	-0.09	**-0.29*** **
	(0.08)	(0.05)	(0.05)	(0.06)	**(0.04)**
	[-0.56]	[-0.30]	[-0.08]	[-0.12]	**[-0.44]**
Material cost	0.26	-1.67	0.21	-1.92*	**0.25**
	(0.37)	(1.17)	(1.35)	(1.01)	**(0.34)**
	[0.04]	[-0.06]	[0.01]	[-0.19]	**[0.03]**
Wages	-1.32***	-1.04	-1.06**	-0.28	**-0.84*** **
	(0.33)	(0.72)	(0.45)	(0.72)	**(0.20)**
	[-0.26]	[-0.06]	[-0.12]	[-0.01]	**[-0.10]**
Labor productivity	2.95***	1.27	2.43**	-0.67	**2.08*** **
	(0.51)	(1.04)	(0.96)	(0.90)	**(0.37)**
	[0.38]	[0.04]	[0.20]	[-0.08]	**[0.22]**
Constant	10.53***	7.45***	3.24***	8.55***	**7.51*** **
	(0.92)	(0.71)	(0.42)	(1.10)	**(0.46)**
Observations	445	242	66	278	**1,108**
Num. of County	66	64	20	50	**67**

Note: The outcome variable is the number of firms in the forest products industry. Each column presents the Sales of the regression where the impact of inventory-Sales ratio and average cost pertaining to the sectors listed at the top is included. Last three rows provide the sample means of the dependent variable and the inventory-Sales ratio and average cost included in that regression. Robust standard errors are in parentheses. Semi-elasticities at means are in brackets. *, **, and *** indicate statistical significance at 10%, 5% and 1%, respectively.

a wage effect and a labor productivity effect. For example, in *all forest sectors* group, a 10% percent increase in the wage rate will cause one firm closing in the forest products industry. However, 5% increase in labor productivity will led to an increase in the number of establishment by 1. A similar situation can be observed in each *main sectors* of Alabama's forest products industries. Except for the wood manufacturing industry, improvements in labor productivity compensate for increases in wages;this may lead to an increase in the number of establishments in the forest products industry.

CONCLUSION

Using a panel data set of Alabama counties, from 1996 to 2012, this paper estimates the impact of demand and average variable cost on change in the number of establishments in the forest products industry of the state. In order to control the demand for forest products, inventory-sales ratio is used as a demand proxy in all analyses. Average variable cost includes material cost, wages, and labor productivity. The paper covers four major forest products industries in Alabama, logging, wood manufacturing, paper manufacturing, and furniture manufacturing. We use consistent measures of average variable cost and demand that are obtained from the IMPLAN (IMpact analysis for PLANning) datasets[12].

The estimated models of this paper implied some interesting, and apparently general, results. First, during the period 1996 to 2012, major driving factor of the decline in the number of establishments is decreasing demand for forest products rather than the average variable cost of production[13].The results show a 2.5% increase in ratio of sales to inventory, in other words 2.5% decrease in demand for forest products, decreases number of establishments by one.This finding is consistent with evidence from the literature (NCSSF 2005; Sample and Wallinger 2006; Collins et al. 2008; Woodall et al. 2011). However, the results suggest that average variable cost of production, such as material cost, wages, taxes, energy prices, and labor productivity etc., have still significant influence on the decline in the number of establishments.According to the results of this study, an 8% increase will cause one closed firm in the industry.

Second, within average variable cost, cost of materials explains a greater share of the decline in number of firms compared to labor cost. Third, a factor that offsets the reducing effect of wages is labor productivity. Increases in labor productivity compensate for the rise in the wage rates, so that observable increases in wages do not contribute to the general decline in the number of establishments in the forest products industry.

Implications of these findings suggest that the forest products industry of Alabama, and government policies[14] should aim to keep demand high and material cost low to stop the decline in the industry.In addition, since the forest products

industry is not able to reduce wage rates, they should strive to enhance their labor productivity through capital investment and labor training programs. These changes in demand, material cost and labor productivity are crucial in order to control the decline in the number of establishments and to improve the competitiveness of the industry in global markets. Unfortunately, this study does not report which materials, such as wood, energy, taxes etc., are most crucial for each industry. Future studies may separately estimate the impacts of each material cost on the decline in the forest products industry. Also, it may be useful in future studies to include fixed costs, like capital and rent, in their estimation.Including those details would lead to more accurate estimates of impacts of cost on the decline of firms in the forest-based industries.

Notes

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5. FIA 2012, Forest inventory & Analysis. *http://www.srs.fs.fed.us/pubs/su/su_srs067.pdf*
6. AFC, 2012, Alabama Forestry Commission, Forest Resource Report 2012. *http://www.forestry.alabama.gov/PDFs/AFCAnnualReport2012.pdf*
7. AFA 2010, Alabama Forestry Association, Alabama Forest Facts. *http://afa.affiniscape.com/associations/13323/files/FINALforestryfacts08.pdf*
8. AFC 2010, Alabama forestry commission, Forests at the Crossroads. *http://www.forestry.alabama.gov/PDFs/Forests_at_the_Crossroads-AL-State_Assessement.pdf*
9. See Leontief (1986), or Miller and Blair (2009) for more details in input-output method.
10. For omitted variable bias, see Chapter 8 in Greene (2002).
11. The current study is the first study in the literature which employs econometric analyses for the determinants of the decline in the number of establishments in the forest products industry.
12. Government can improve the industry by acting better tax or trade policies.
13. *http://www.census.gov/econ/cbp/index.html*
14. *www.implan.com*
15. Not all counties have all industries.
16. *www.implan.com*
17. See Figure 7 to see the changing trend in demand for forest products.
18. Tax and trade policies.

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