An Econometric Approach to Applied Microeconomic Theories: The Case of Natural Resource-Based Industries

by

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Abstract

The forest products industry of Alabama has a dominant role in the state's economy. The industry has experienced a general downturn in production, employment and number of operating establishments since the mid-1990s. In this study, the possible determinants of the decline in the forest products industry of Alabama are discussed. Moreover, economic impact analyses are used to investigate how the contribution of the industry to the economy of Alabama has changed since the mid-1990s. Additionally, econometric analyses are employed to estimate the relationship between the decline in the industry and changes in the factors behind the decline. Furthermore, additional econometric analyses are employed to estimate the relationship between economic well-being and forest sector dependence in the counties of Alabama. Results showed that the forest products industry of Alabama has lost many employees, production, mills, and contribution to the economy of the state between 1996 and 2012. There is statistically significant relationship between increases in cost of production and decreases in demand for the forest products and the downturn in the industry. Forest sector dependence is significantly associated with lower economic well-being in the counties of Alabama. The results will mainly contribute to the current knowledge gap concerning the determinants and the economic implications of the decline in the forest products industry. Analyzing trends in an industry overtime provides important information to policymakers seeking to establish better policies, and for industry leaders attempting to improve the industry's competitiveness both in global and domestic markets.

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GENERAL 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. Timberland can be defined as forest land used for the production of commercial wood products. The forest products industries (e.g., logging, wood, paper, furniture manufacturing) obtain their raw material, wood, from timberlands, resulting in the production of $240 billion worth of products, while employing 1.8 million workers, which accounts for 10% of U.S. manufacturing sector employment (Newel and Eves 2009).

Alabama has the second largest commercial timberland base in the southern U.S. and the third largest timberland base in the nation behind only Georgia and Oregon (i.e., 22.9 million acres timberland, which accounts for approximately 70% of the state's total land area; FIA 2012). According to an Alabama Forestry Commission (AFC) report, timberland in Alabama is one of the most productive and sustainable resource treasures in the United States (AFC 2010). Timberlands in Alabama carry approximately 1.1 billion tons of growing stock volume which has increased 14.2% since 2000 (FIA 2012).

Such an abundance of timberland in Alabama has resulted in the forest products industry being the second largest manufacturing industry in the state, producing an estimated $14.3 billion worth of products with approximately 1300 companies in the market in 2012 (U.S. Census Bureau 2012). In addition, the industry accounts for an estimated 9% of Alabama's total

GDP (FIA 2012). 12% of Alabama's total work force is employed by the forestry sector either directly or indirectly (AFC 2012, AFA 2010).

In contrast to the increase in the forest resources that surround the forest products industry of Alabama, the industry has been experiencing a notable decline in terms of its relative contribution to the economy of the state, production, and the number of establishments and employees since the 1990's (Fickle 2014; Bentley *et al.* 2013; Hartsell and Cooper, 2013; AFC 2010; Bentley *et al.* 2008) For example, the forest products industry of Alabama has lost over 1,000 (46 percent) operation facilities of varying size, 30,000 (42 percent) employees, and nearly $3 billion (23 percent) worth of products in the last two decades. In addition, the total contribution of the industry to the economy of the state decreased by 26%, or $5 billion, between 1996 and 2012.

In the first chapter of this study, we have detail examination of the decline in the industry in terms of production, employment, number of establishments, and the contribution to the state's economy. We also discuss on the possible factors affecting the decline in the industry. In the second chapter, we employ econometric techniques to estimate the relationship between these factors and the decline in the industry. In the last chapter, we analyze the impact of the decline (i.e., decline in both industry activities and economic dependence to the industry) on economic well-being in the counties of Alabama.

In order to accomplish the above analyses, we use a county level dataset spanning the years 1996 - 2012. We apply these analyses to three different study regions: (1) Alabama as a whole; (2) rural counties only, where many forest production activities are likely to take place; and (3) the Black Belt's-West Alabama region, which is characterized by the production of an

abundance of forest products and timber resources. In the analyses, we examine four primary sub-industries, including logging, wood products manufacturing, pulp and paper products manufacturing, and furniture products manufacturing, per the North American Industry Classification System (NAICS) codes related to forestry. We choose these industries to ensure a good coverage of the forest products industry in Alabama.

Results show that: (1) the forest products industry of Alabama has shown a decline in the number of employees and mills, as well as production between 1996 and 2012; (2) the contribution of the industry to the economy of the state has decreased significantly; (3) many older, smaller, and less efficient mills have closed resulting from a substitution of capital for labor in the industry; (4) there is a statistically significant relationship between increases in cost of production and decreases in demand for the forest products as well as the downturn in the industry; (5) forest sector dependence is significantly associated with lower per capita income due to the forest sector's negative impact on average wages and average schooling level within the counties; (6) increases in forest sector dependence within counties is positively related to the number of low income families and negatively related to the number of high income families; and (7) forest sector dependence is also associated with lower poverty rates within the counties of Alabama.

Findings of this study are likely to be applicable to the forest products industries within the southern U.S. because the industry structures (e.g., demand for the products of these industries, and the cost structures of the industries) are similar and they are related to each other. The results of this study will mainly contribute to the current knowledge gap concerning the determinants and the economic implications of the decline in the forest products industry. Analyzing trends in an industry overtime provides important information to policymakers

seeking to establish better policies, and for the industry leaders attempting to improve the industry's competitiveness both in global and domestic markets.

CHAPTER I - Detailed Analysis of Recent Trends in the Forest Products Industry of Alabama, 1996-2012

Abstract: The forest products industry of Alabama, which has a dominant role in the state's economy, has experienced a general decline since the mid-1990s. Using a county level dataset spanning the years 1996 - 2012, we analyze the total economic contribution of the industry to the economy of the state. We examine changes in production, employment, and the number of operating establishments in the forest products industries of Alabama as a whole sector, and four primary sub-industries including logging, wood products manufacturing, pulp and paper products manufacturing, and furniture products manufacturing. We also discuss the possible factors behind the decline in the State's forest products industry. Our analyses showed that the forest products industry has experienced a general downturn in terms of economic contributions, production, employment, and the number of establishments between 1996 and 2012. Moreover, our analyses indicate that many older, smaller, and less efficient mills were closed in the last two decades. Also, substantial capital substitution for labor occurred in the forest product industries over the same period.

Keywords: Forest products industry, decline, economic contribution, production, employment, number of establishments.

1. Introduction

The forest products industry is the second largest manufacturing industry in the state, producing an estimated ~ $14.3 billion worth of products with approximately 1300 companies in the market in 2012 (U.S. Census Bureau 2012). However, the industry has been experiencing a notable decline in terms of its relative contribution to the economy of the state, production, and the number of establishments and employees between 1996 and 2012 (Fickle 2014; Bentley *et al.* 2013; Hartsell and Cooper, 2013; AFC 2010; Bentley *et al.* 2008) For example, the forest products industry of Alabama has lost over 1000 (46 percent) operation facilities of varying size, 30,000 (42 percent) employees, and nearly $3 billion (23 percent) worth of products in the last two decades. In addition, the total contribution of the industry on the economy of the state decreased by 26%, or $5 billion, between 1996 and 2012. In fact, the decline is not unique to Alabama. Forest product industries across the United States have also experienced a decline in their number of establishments, employment, and production levels over the last two decades (Bentley *et al.* 2013; Collins *et al.* 2008; Hartsell and Cooper, 2013; Johnson *et al.* 2011). There are many factors affecting the decline in the forest products industries, such as the lack of global competitiveness, decreasing demand for wood and paper products, broader economic recessions, industrial consolidations, taxes and regulations, and firm based factors such as cost, labor productivity, *etc*. To date, only a few studies have examined the effect of these factors on the health of the industry in detail. Although the economic contribution of the industry to the state economy, in terms of employment, production *etc*., has changed over time, no study to date has analyzed and compared its contribution over more than one time period. In this study, we examine the decline in the forest products industries of Alabama and analyze the factors affecting the decline in the industry by examining existing papers, datasets, and reports along

with many other sources of information. We also employ economic impact analyses to investigate how the contribution of the industry to both the economy of Alabama as a whole and the economy of western region of the state has changed since the mid-1990s.

The decline in production, employment, and number of establishments in the forest products industry of Alabama must be analyzed in detail, with special attention given to questions about the decline, since the industry contributes significantly to the economy of Alabama. Given the importance of the industry in providing revenue and jobs to the region, as stated above, understanding the factors behind the decline is critical.

The decline not only affects the forest products industry but also has a somewhat negative impact on timberlands in Alabama. That means foreign competition can force the establishments in an unhealthy forest sector out of business. Moreover, if foreign forest products displace domestic forest products, local timber will lose profitability. Therefore, timberlands that have historically been managed for timber production will increasingly be managed for other purposes, such as residential, industrial development, suburban, exurban, recreational, or ecological conservation, resulting in the timberland being removed from timber production (Bailey *et al.* 2011; Collins *et al.* 2008; Bael and Sedjo 2006).

The results of this study will contribute to the current knowledge gap about which factors cause the decline, and how, as well as the economic implications of the decline for timber-dependent regions within the state of Alabama. Analyzing the changes in the economic contributions of the forest products industries to the economies of the states over time provides important information to policymakers and the industry leaders for making beneficial tax policies and restrictions and for improving their competitiveness in domestic and global markets.

The rest of the study is organized as follows: (2) literature review; (3) data and methods; (4) decline in the forest products industry of Alabama and its economic impacts; (5); regional variations (6) economic impact analysis of the decline; (7) discussion of the factors related to the decline in the forest products industry of Alabama; and (8) conclusions.

2. Literature Review

There are only a few studies in the literature that have examined the decline in the forest products industries and the perceived causes behind the declines. Specifically, previous studies have generally hypothesized that the decline in the forest products industries was due to: (1) lack of global competitiveness (Bael and Sedjo 2006; Ince *et al.* 2007; Collins *et al.* 2008; Woodall *et al.* 2011); (2) decreasing demand for the forest products (NCSSF 2005; Sample and Wallinger 2006; Collins *et al.* 2008; Woodall *et al.* 2011); or (3) economic recessions (Hodges *et al.* 2011).

A comprehensive study on the relationship between global competition in manufacturing and the forest products industries came from Bael and Sedjo (2006). Using a country level dataset, Bael and Sedjo (2006) examined the impact of globalization on the forest products industries in the world over the past few decades. Particularly, the study assessed whether or not forest products produced in industrialized temperate regions were now being produced (or shifted) into developing tropical regions, whether forest products industries preferred to use natural forests or planted forests for raw materials, and whether employment in the industry moved to tropical developing regions from industrial temperate regions because of globalization in manufacturing industries over the past few decades. They showed that the forest products industries have been shifting to developing countries in subtropical regions because of technological innovations, reduced costs of transportation, increasing mobility of labor and capital, and suitable biological conditions. Ince *et al.* (2007) discussed structural changes in the

forest sector of the United States due to changes in globalization of manufacturing. They hypothesize that economic globalization accelerated largely due to irreversible structural changes in forest products markets in the United States starting in the early 1990s. They showed that globalization and import competition caused survival of more capital intensive and productive forest products industries in the forest products market.

The following studies assessed how these factors, such as globalization, changing demand, and recessions *etc.*, have influenced the forest products industries in different parts of the United States over the past few decades. Woodall *et al.* (2011a), for example, analyzed the recent downward trends in the forest products industries in the United States in terms of production and the number of employees and mills. They showed that the structural changes in the overall economy, economic recessions, the collapse of the housing market, off-shoring of furniture production, globalization of manufacturing, and expanded use of electronic communications media have contributed to a decline in output, employment, and the number of mills in U.S. forest products industries since the late 1990s. Their study also points to some potential future prospects for growth including increased secondary products manufacturing and wood-based energy in the United States. Collins *et al.* (2008) discussed several factors affecting the decline in the forest products industries in the United States, such as international currency exchange rates, global cost-competitiveness, shifting production from large to small-diameter timber, shifting demand for wood from the developed world to Africa, Asia, and Latin America, etc. Their study also suggested possible future opportunities for the forest products industry of the United States, such as increases in mill efficiency, labor productivity, market share both at home and abroad, and wood-based energy.

Woodall *et al.* (2011b) focused on the northern United States and assessed the downturn in the forest products industries. They showed that the forest products industries within this region have also experienced a notable decline in employment, mill numbers, wood consumption, and forest harvests since 2000. They suggested the lack of global competition, ascent of electronic media, and decreases in housing starts are the main factors behind the decline in the forest products industries in the northern U.S. Similar to the study of Woodall *et al.* (2011b), Keegan *et al*. (2012) assessed the impacts of the recent unfavorable economic conditions on production, employment, the number of operating facilities, timber harvest, timber processing capacity, and exports in the forest products industries in the western region of the United States. They showed that every primary establishment in the western forest sector suffered curtailment during the last decade because of the decline in housing starts and economic recessions. In addition, capacity utilization at timber-using facilities, employment and mill numbers fell significantly in the western forest sector. They suggested exports of finished forest products and logs are likely to increase in the near future because of strong demand from China and weak demand in the United States.

Hodges *et al.* (2011) also analyzed the decline in production, employment, exports, and the number of establishments in the forest products industries of the southern U.S during the period of economic recession between 2006 and 2009. They also assessed the effects of the recession on forest area, management activities, wages, and the total contribution of the forest products industries on the economies of the southern states. They showed that the recession caused substantial decline in southern forest products industries, particularly those industries most closely tied to the housing market. They also showed that developments in wood-based energy, rebounding paper consumption, and expanding export markets offer potential growth

opportunities in the future. Brandeis *et al.* (2012) also studied recent changes in the forest products industries in the southern region of the United States between 2005 and 2012. They found that the number of primary wood-using mills, the number of workers in these mills, and mill output have decreased due to unfavorable economic conditions between 2005 and 2012. In addition, they showed that the number of timberland acres harvested was decreasing, while the removed volume from those decreasing acres increased over the same period. Using a survey of consulting foresters, Conrad *et al.* (2010) examined how changes in forest ownership and forest industry structure affected the mill closure and wood supply chain in the southern United States. They found a negative relationship between mill closures and timber prices. Their results indicate institutional owners, such as timber investment management organizations and real estate investment trusts, may negatively affect the number of mills since they are more likely than owners of the forest products companies to convert timberland to development. Ince (2002) discussed implications of longer-term economic conditions and the 2000-2001 economic recession on the pulp and paper sector in the southern region of the United States. They showed the recession had negatively impacted growth in the pulp and paper sector, as well as pulpwood markets in the South. However, they suggested fiber products, such as pulp, paper, and composite products like oriented strand board, account for most of the projected growth in industrial wood resource consumption. According to their results, this demand for fiber products is a crucial element of longer term timber supply and demand.

Beside these studies that tracked economic trends of the forest products industries and determined the factors behind the trends, some studies employed input-output methods to analyze the economic contributions of the forest products industry to local and regional

economies[1]. Mainly, these studies analyzed the economic impacts of changes in forestry policies (i.e., tax policies), number of mills and employees in the forest products industry *etc.*, on regional economies. Dahal *et al.* (2015), for example, examined the economic contribution of the forest products industries on the economies of the southern region of the United States during 2007-2009 economic recession periods. Their findings indicated that the loss of jobs in the forest products industry had a greater negative impact on the economies of the region than the industry's decline in production during the same period. They suggested this disproportionate impact of the recession on employment and production provides evidence of capital substitution for labor and increased productivity in the forest products industries of the southern region of the United Sates. Brandeis and Guo (2015) examined how the regional and local economies in the southern region of the United States have been affected by pulp mill closures within the region. They also examined the spillover effects of the closures on forestry and the forest products industries in these regions. Their analysis showed that the closures have significantly affected the forest-related sectors primarily within the state where the closing mills were located as well as the sectors in neighboring states. Wu *et al.* (2002) estimated the impacts of forest products trade liberalization on the US forestry sector. They also examined the effect of technological progress in US forestry production compared to the rest of the world. Ferrante *et al.* (2001) investigated the incremental economic and environmental impacts resulting from changes in forest products tariff reductions. Similarly, Das *et al.* (2005) used an input-output model to analyze the effects associated with environmental and technological policy shifts in the US forest sector. Carino *et al.* (1991) assessed the effect of opening a new OSB (Oriented Strand Board) plant on the economic activities in north Alabama.

[1] See Leontief (1986), or Miller and Blair (2009) for more details in input-output method.

3. Data and Methods

In this study, we analyze both primary and secondary wood-using establishments (i.e., mills) in the forest products industry of Alabama and report state-wide totals. Primary establishments are those that convert recently harvested trees (i.e., industrial round wood) from forests to some form of primary wood products, such as lumber, wood panels, paper *etc*. Secondary establishments use products from primary establishments as inputs to produce a variety of consumer products and goods, called secondary wood products (e.g., furniture, wood fixtures, molding, trusses and other engineered wood products). Based on the North American Industry Classification System (NAICS) codes, our analyses in this study includes the following four major industries; (1) logging, NAICS: 113, (2) wood products manufacturing, NAICS: 321, (3) pulp and paper products manufacturing, NAICS: 322, and (4) furniture products manufacturing, NAICS: 337[2]. These are four major NAICS codes that are related to forestry. Including these industries in the analysis ensures that the forest sector in Alabama is well represented in the study. Table A 1 in Appendices lists the aggregated and disaggregated forest based industry classifications analyzed in this study. These industries are obtained by clustering

[2] North American Classification System (NAICS), formerly known as Standard Industrial Classification (SIC) system, is developed by the US Economic Classification Policy Committee to classify business establishments for the purpose of collecting, analyzing, and publishing statistical data of North American countries. NAICS is frequently used not only for statistical purposes but also for various administrative, regulatory, taxation, etc., purposes. State governments offer tax incentives or apply regulatory programs to businesses classified in specified NAICS industries. More information about NAICS see the link: http://www.census.gov/eos/www/naics/

the sub-industries that produce similar products. For example, the industry "Wood Products Manufacturing, NAICS: 321" is generated by combining several sub-industries such as sawmills and wood preserving (NAICS: 3211), veneer and plywood mills (NAICS: 321211), reconstituted wood products (NAICS: 321219), millwork (NAICS: 32191), planning mills (NAICS: 321912), and flooring mills (NAICS: 321918). Detailed information about what sub-industries are operating under each industry, their NAICS codes and produced commodity types is provided in Table A 1 in Appendices.

Data for the industries considered in this study comes from a variety of different data sources. Data for the number of establishments within these industries are available in the County Business Patterns database of the United States Census Bureau, which is an annual series providing sub-national economic data by industry including the number of establishments, employment, and annual payrolls. The database also provides the number of establishments by employment-size classes by detailed industry in the United States[3]. Employment information for industries included in the analysis is primarily derived from the County Business Patterns database and the Quarterly Census of Employment and Wages datasets of the Bureau of Labor Statistics as well[4].

Data for the output, labor income, value-added of the forest products industries comes from the IMPLAN (IMpact analysis for PLANning) datasets. IMPLAN is a regional economic impact modeling system that provides a set of benchmark economic data for analysts, educators, businesses, and local governments *etc.*, to create accurate economic impact studies. Studies have

[3] http://www.census.gov/econ/cbp/index.html

[4] http://www.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables

examined the accuracy of IMPLAN data and concluded that the IMPLAN dataset accurately represented the economic structure of the states and sub-regions within the states (Hotwedt *et al.*1988; Bairak and Hughes 1996). Output is defined as the total monetary (US$) value of production by an industry in a calendar year and it includes the value added, taxes, profits, compensation, and intermediate expenditures of the production process between the industries. The definition of labor income used by IMPLAN is all forms of employment income, including employee compensation (the total cost of employees, including wages and salaries, health and retirement benefits, and social security and unemployment taxes) and Proprietor income (consists of payments received by self-employed individuals and unincorporated business owners. This income also includes the capital consumption allowance and is recorded on Federal Tax form 1040C). Value-added shows the difference between an industry's total output and the costs of intermediate inputs, such as consumption of goods and services purchased from other industries. In other words, value-added consists of employee compensation and taxes (IMPLAN Group, LLC, IMPLAN system, data and software)[5].

Input-output analysis is used to analyze the contribution of the forest products industries on the economy of Alabama. IMPLAN version 3.0 economic modeling tools along with the associated datasets for each year between 1996 and 2012 were used. The IMPLAN system employs regional social accounting matrices (SAM) in combination with classic input-output analysis for modeling the regional economic impact of a given change or event in the activities within an economy. Using SAM matrices and input-output modeling, IMPLAN computes a variety of multipliers including output, labor income, and value added *etc.*, for each sector in an economy. Construction of these multipliers allows users to separate an industry's effects on a

[5] www.implan.com

study area into direct, indirect, induced, and total effects. Direct effects represent the initial change in the industry itself. Indirect effects concern inter-industry transactions. Induced effects reflect changes in household expenditures in the study that are due to income changes in the directly and indirectly affected industries. Total effects include the direct, indirect and induced effects. For example, if there is an increase in demand for wood manufacturing industries of Alabama, the industry must increase production (i.e., output) to meet this new higher level of demand (direct effect). In order to produce additional output, the industry must purchase additional inputs, such as purchases from other businesses (indirect effect) and labor (induced effects). In this study IMPLAN is used to examine how the total contribution of the forest products industry as a whole as well as each sub-industry (i.e., logging, wood, paper and furniture manufacturing) to the state economy has changed over the last two decades. Specifically, three measures including labor income, value-added, and output, are evaluated to determine the contribution of the industry on the state's economy. Since data for output, labor income, and value-added of the forest products industries of Alabama are provided in nominal US dollar values by IMPLAN, in the analyses of this study, they are transformed into real US dollar values using the producer price index, with 1996 as the base year and the results reported in the tables are in 1996 US dollars. The economic impact analyses are applied both on the state of Alabama as a whole and a ten county region (Clarke, Choctaw, Greene, Hale, Marengo, Monroe, Perry, Sumter, Washington, Wilcox) in West Alabama , which is highly dependent to the forest sectors and characterized by the production of an abundance of forest products industry and timber resources. The reason for having economic impact analysis for only this region (i.e., for only these counties) is because the economy is less diverse here (i.e., average number of

sectors in this region is fewer compared to the state's average) and the impact of a change in the industry can be more dramatic in this region compared to more urbanized regions of the state.

4. Decline in the Forest Products Industry of Alabama

Alabama's forest products industry has been a major contributor not only to the economy of the state but also to the economy of the nation for the past several decades. The industry makes important contributions to these economies by supplying wood products, employment, income, and tax revenue. The forest products industry of Alabama is one of largest producers of particular forest products (i.e., pulp and paper) not only in the nation but also in the world. In 2010, the forest products industry of Alabama was ranked as the 2nd largest industry in the Unites States and the 8th largest in the world in terms of pulp production. Moreover, the forest products industry in Alabama is the 3rd largest in the nation, and the 12th largest in the world in terms of paper production (AFC 2012). In addition, the industry ranked 7th in the United States in lumber production and 8th in wood panel production as of 2010 (Bureau of Economic Analysis, BEA). The forest products industry is the 2nd largest manufacturing industry in the state, following the automotive industry. According to the North American Industry Classification System (NAICS), the forest products industry of Alabama contains the following four major sub-industries; logging (NAICS: 113), wood products manufacturing (NAICS: 321), pulp and paper products manufacturing (NAICS: 322), and furniture products manufacturing (NAICS: 337)[6]. Based on data for these four major sub-industries, approximately 1,300 establishments in the forest

[6] These four sub-industries in the forest products industry of Alabama do not fully represent the scope of the decline in the industry, but provide a sense of the magnitude of decline in the state's forest industry and related economies.

products industry produced an estimated $14.3 billion[7] worth of products in 2012, which accounts for approximately 8% of the gross domestic product (GDP) of the state (BEA and IMPLAN, 2012)[8]. The pulp and paper products industries accounted for $9.5 billion, wood products accounted for $3 billion, furniture products accounted for $1.2 billion, and the logging industry accounted for the remaining $0.5 billion of total production. The value-added contribution of the forest products industry was estimated at $4.87 billion in 2012, which accounts for approximately 2.6% of total value added in Alabama. The value of the forest products industry comprised 12.3% of the value of all manufacturing sectors in the state during 2010 (AFC 2012). Stumpage revenue of approximately $595.8 million was generated from the sale of all forest products in 2012, which was an increase of 16.4% from 2011 (FIA 2012). The forest products industry of Alabama employed nearly 50,000 full-time and part-time employees, with an annual payroll of $2.5 billion in 2012. Additionally, the forest products industry employed approximately 100,000 Alabamians indirectly. Overall, 12% of the total work force of Alabama was employed by the forestry sector either directly or indirectly (AFC 2012, AFA 2010).

The forest products industry of Alabama boomed right after World War II and continued growing until nearly the end of the 20th century, spurred by the availability of abundant forests that support the industry, growing population, and the increasing demand for both paper products and building materials (Fickle 2014). However, since the mid 1990's, the booming forest

[7] In 2012 US dollar values.

[8] Gross domestic product (GDP) shows the economic value of all goods and services produced by the labor and capital located in region over a specific time period. GDP for a state is derived as the sum of the GDP originating in all industries in the state.

products industry has been experiencing a notable decline in production as well as the number of establishments and employees (Fickle 2014; Bentley *et al.* 2013; Hartsell and Cooper, 2013; AFC 2010; Bentley *et al.* 2008). Figure 1.1 through Figure 1.3 show the decline in the number of establishments, employment, and production in the industry between 1996 and 2012. During this period, the primary sub-industries, logging, wood products manufacturing, paper products manufacturing, and furniture product manufacturing industries lost 516 (47 percent), 348 (49 percent), 28 (30 percent), and 195 (40 percent), for a total of 1,087 **(46 percent)** operating facilities of varying size, respectively. The industry also lost approximately 30,000 **(42 percent)** employees between 1996 and 2012. In addition, the estimated value of the production of the industry has decreased from nearly $11.7 billion to $9 billion **(23 percent)** in the last 16 years[9]. By comparison, the number of establishments, employment, and production in the retail industry declined by **33%**, **29%**, and **6%,** respectively, over the same period (US Census Bureau, County Business Patterns).

During the time frame considered in this study, (i.e., 1996-2012), the United States experienced two economic crises, with the first occurring in 2001 and the second between 2007 and 2009. Also, the United States economy was affected negatively by the global energy crisis of 2003[10]. Losses in the forest products industry within Alabama increased substantially during

[9] The value of the production of the industry is transformed into 1996 US dollar values using producer price index.

[10] Economic crises are determined using the National Bureau of Economic Research (NBER), Business Cycle Expansions and Contractions (recessions) reports. In 2001 (between March and November), US economy had a general downturn due to information technology bubble or stock market bubble. In 2003, Global energy crisis negatively influenced the US economy. Between

these particular time periods. Therefore, we divide the study time period into three parts and analyze the decline in the industry for these three time periods separately. The first time period we considered is between 1996 and 2001, which is right before the first US economic recession. The second time period, which is between 2001 and 2006, includes the 2001 and 2003 economic crises. The last time period is between 2006 and 2012 that includes "US housing bubble" during the period between 2007 and 2009.

In each time period, the employment level in the forest products industry of Alabama generally declined. Between 1996 and 2001, for example, the logging industry (NAICS 113) lost more than 1,000 (14 percent) jobs, the wood products manufacturing (NAICS 321) lost approximately 6,000 (21 percent) jobs, the paper manufacturing industry (NAICS 322) lost 2,500 (13 percent) jobs. On the other hand, the furniture products manufacturing industry (NAICS 337) increased the number of employees in its facilities by 21% (2,785 jobs) over the same period. However, a net 6,759 people (10 percent of total forestry jobs) lost their jobs in the forest products industry of Alabama between 1996 and 2001. During the next five years, 2001-2006, the losses totaled almost 800 (11 percent) for the logging industry and 2,600 (15 percent) for the paper products manufacturing industry. Over the same period, on the other hand, approximately 1,100 and 800 jobs were created in wood products manufacturing industry and furniture product manufacturing industry, respectively (5 percent increase in the number of employees in these two particular sub-industries). Overall, the forest products industry of Alabama as a whole lost a net 1,400 (2 percent) employees between 2001 and 2006. The biggest

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2007 and 2009 (from December 2007 to June 2009), there was another economic recession called US housing bubble, which dramatically affected many parts of the US economy (NBER, http://www.nber.org/cycles/cyclesmain.html).

decline in employment in the industry happened during the third time period between 2006 and 2012. The industry as a whole, for example, lost over 21,000 (35 percent) employees during this period. All the sub-industries experienced greater losses in the number of employees during the same period. For example, the wood products manufacturing industry lost over 9,000 (40 percent) jobs, furniture product manufacturing lost more than 8,000 (50 percent) jobs, paper products manufacturing lost approximately 1,900 (13 percent) jobs, and the logging industry lost 1,630 (27 percent) jobs (US Census Bureau, County Business Patterns; see Figure 1.4).

Output of the industry decreased by 5% in the first time period (1996-2001) and by 27% during the third time period (2006-2012); however, it increased 11% in the second time period (2001-2006) (IMPLAN data, LLC). Between 1996 and 2001, output from the wood (NAICS 321) and paper (NAICS 322) products manufacturing industries decreased from $3.8 billion to $3.6 billion (6 percent) and from $5.85 billion to $5.56 billion (5 percent), respectively, while conversely output from the logging (NAICS 113) industry and furniture (NAICS 337) products manufacturing industry increased from $1.15 billion to $1.19 billion (3 percent) and from $740 million to $770 million (4 percent), respectively. Output levels of all of the sub-industries boomed during the next five year period, 2001-2006. During this time period, logging and furniture products manufacturing industries showed the largest increase in output level. The output of the logging industry increased 70%, and the output of the furniture products manufacturing industry increased by 57%. Over the same period, paper and wood products manufacturing industries also increased their output level by 13% and 16%, respectively. Increases in output of the forest products industries of Alabama between 2001 and 2006 show that the losses in the number of establishments and the number of employees during the same period did not necessarily translate into similar trends among volume production because of

increasing capital usage in the industry, curtailments, consolidation, and survival of more productive facilities. In contrast to the booming period between 2001 and 2006, almost all the sub-industries experienced a dramatic decrease in their output level between 2006 and 2012. During this period, the most significant decline occurred in the logging industry and wood products manufacturing industry, in which output declined by 70% and 38%, respectively. The furniture products manufacturing industry also lost over 30% of its output over the same period. Only the paper products manufacturing industry increased output, but only by 3% during this period (see Figure 1.5).

Figure 1.6 presents changes in the number of establishments in the forest products industry of Alabama for each time period we examined. Changes in the number of establishments in the industry varied by type of sector, but generally numbers have declined since the mid 1990's due to closing companies, mergers or acquisitions. The number of establishments in wood products manufacturing (NAICS 321) dropped most dramatically between 1996 and 2001, falling from 700 in 1996 to 462 in 2001 (34 percent). Over the same period, the number of establishments in the logging industry (NAICS 113) decreased from 1,090 to 877 (20 percent). Furniture products manufacturing (NAICS 337) also experienced a loss of 14% in the total number of establishments in this period. In addition, 9 mills (10 percent) closed in the pulp, paper, and paperboard manufacturing industry (NAICS 322) during this period. Overall, the forest products industry of Alabama lost more than 500 (22 percent) operating establishments between 1996 and 2001. In the next five year period, 2001-2016, the decline in the number of establishments in the forest products industry of Alabama continued, but was not as severe as the decline during the previous period. Except for the furniture product manufacturing industry, all of the sub-industries lost a few operating establishments. Overall, the

forest industry lost 137 (7 percent) of various size establishments in this period. The period between 2006 and 2012, saw a collapse in the forest products industry of Alabama in terms of the total number of establishments present in the industry. One in every four establishments was closed during this period (overall 423 establishments were closed). The furniture products manufacturing industry showed the largest loss, with 35% (152 establishments) of establishments closing during this time period. The logging industry lost 22% (168 establishments) of its total number of establishments in this period, as well, while the number of establishments in wood and paper products manufacturing decreased by 20% and 17%, respectively.

5. Regional Variations in the Decline

Similar downward trends in the forest products industry of Alabama can be seen in the nation's forest sector and in other southern states. The forest products industries across the United States and especially in the southern region of the country have also experienced a downturn in the last two decades in terms of production, employment, and number of establishments. Figure 1.7 shows changes in the number of establishments and employment level in the forest products industries as a whole and in major sub-industries in the United States between 1996 and 2012. Figure 1.8 through Figure 1.11 show the same changes as Figure 1.7, but for Georgia, Florida, Mississippi, and Louisiana, which neighbor Alabama. Between 1996 and 2012, approximately 800,000 (41 percent) jobs have been lost in the forest products industry of the United States (US Census Bureau, County Business Patterns). The sub-industries (logging, wood products manufacturing, paper products manufacturing, and furniture products manufacturing) lost 36,947 (42 percent), 303,605 (47 percent), 269,421 (43 percent), and 157,319 (31 percent) jobs respectively. Over the same period, 6,112 enerprises were closed in the logging industry, 9,338 in wood products manufacturing, and 2,011 operating facilities in paper

products manufacturing, for a total of 17,471 (31 percent) of the operating enterprises of various size having closed their doors in the United States. Only the number of establishments in the furniture and related products manufacturing industry (NAICS 337) grew during the same period, increasing by 25%.

Neighboring Florida, Georgia, Mississippi, and Louisiana also experienced similar downward trends between 1996 and 2012. For example, employment decreased by 47%, 42%, 46%, and 42% in the forest products industry of Florida, Georgia, Mississippi, and Louisiana, respectively, during this time. The logging industry (NAICS 113) lost 1,165, 2,153, 2,684, and 1,564 jobs in Florida, Georgia, Mississippi, and Louisiana, respectively. Wood products manufacturing (NAICS 321) lost 11,079 jobs in Florida, 18,619 jobs in Georgia, 13,821 jobs in Mississippi, and 6,117 jobs in Louisiana. Between 1996 and 2012, paper and related products manufacturing (NAICS 322) also lost jobs in Florida, Georgia, Mississippi, and Louisiana decreasing the number of positions in the sector by 7,732, 14,135, 5,688, and 6,225 jobs, respectively. The number of employees in the furniture and related products manufacturing (NAICS 337) decreased from 14,335 to 8,981, from 12,199 to 10,995, and from 28,193 to 19,593 in Florida, Georgia, and Mississippi respectively, but increased from 880 to 1,384 in Louisiana between 1996 and 2012.

On the other hand, the forest products industry of Florida, Georgia, Mississippi, and Louisiana lost a net 494 (22 percent), 520 (25 percent), 592 (38 percent), and 258 (29 percent) operating mills, respectively, between 1996 and 2012. Except for the furniture product manufacturing industry, all of the other primary sub-industries in these states experienced a decline in their number of establishments. Between 1996 and 2012, the number of establishments in the furniture products manufacturing industry increased from approximately 25% to 200% in

the southern states, while the number of establishments in logging, wood products manufacturing, and paper products manufacturing decreased from 35% to 46%, from 33% to 55%, and from 14% to 33%, respectively.

6. Economic Impact Analysis

6.1. Alabama (as a whole)

The goal of this section is to determine how the contribution of the forest products industry on the economy of Alabama has changed during the time periods considered in this study (time period of 1996-2001, 2001-2006, 2006-2012, and 1996-2012). Using input-output analysis, three measures including employment, labor income, value-added, and output are evaluated to determine the changes in the industry's contribution on the state's economy. Between 1996 and 2012, the forest products industry of Alabama as a whole and the sub-industries logging (NAICS: 113), wood products manufacturing (NAICS: 321), pulp and paper products manufacturing (NAICS: 322), and furniture products manufacturing (NAICS: 337) have experienced a general downturn in terms of the economic contribution of these industries to the economy of the state. In 1996, for example, the forest products industry of Alabama as a whole had a total economic value of production estimated at approximately $19 billion. By 2012, the industry's total contribution to the state's economy had decreased by 26% to $14 billion (in terms of real US dollars with 1996 as a base year). The total contribution of the industry to the economy of the state slightly decreased during the period between 1996 and 2001, but in the next five-year period, its contribution increased by 10% in 2006 from $18.4 billion to $20.2 billion. However, the total contribution of the forest products industry significantly decreased by 30%, or $6 billion, during the period between 2006 and 2012. Similar to the total contribution of the forest products industry, the industry's direct contribution to the economy of the state has also

declined over the same period. The direct economic impact of the forest products industry, for example, decreased by 5% in the first time period (1996-2001) and 27% during the third time period (2006-2012), but it increased 11% in the second time period (2001-2006). Overall, the value of the industry's direct contribution to the state's economy decreased by 22% over the period between 1996 and 2012 (IMPLAN data, LLC).

Over the same time period, the entire forest products industry's total contribution in terms of labor income (i.e., proprietor income, wages, salaries and other benefits) to the state's economy also decreased dramatically. Labor income, for example, fell constantly from $4.8 billion to $3.2 billion during the period between 1996 and 2012, which was a 33 percent decline in the sector's total contribution of labor income to the economy of the state. Similar to the total contribution of the industry, the industry's direct contribution of labor income to the state's economy decreased by 40%, or over $1 billion, during the period between 1996 and 2012. During the economic recession years between 2006 and 2012, both the industry's total and direct contribution of labor income to the state's economy declined dramatically by 28% and 35%, respectively.

The contribution of the sub-industries within the forest products industry of Alabama to the economy of the state has changed in various ways during the time periods we considered. Wood products manufacturing (NAICS 321), for example, had a total economic value of production estimated at $6.5 billion in 1996. By 2012, the value of this particular industry's total contribution to the state's economy decreased by 32%, or over $2 billion. Over the same period, the value of the wood products industry's direct contribution to the state's economy also decreased from $3.8 billion to $2.4 billion (33 percent). During the economic recession years between 2006 and 2012, the total and direct contribution of the wood products manufacturing

industries to the economy of the state showed the greatest decline, falling by 41% and 39%, respectively. Over the same time period, the wood products manufacturing industry's total and direct contribution of labor income to the economy of the state decreased from $1.5 billion to $1 billion, and $750 million to $500 million, respectively.

The economic contribution of the logging industry (NAICS 113) to the state's economy, via production and labor income, had also declined over the same time period. The industry's direct contribution to the state's economy, via production, decreased by 50%, or $565 million, while the total effect fell by 35%, or $500 million, between 1996 and 2012. However, the direct and the total contribution of the logging industry to the state's economy, via production, declined even more dramatically during the economic recession years between 2006 and 2012, falling 70% and 65%, respectively. Between 1996 and 2012; however, the industry's contribution of wages and salaries to the economy of the state slightly increased by 7%, or $13 million. Increasing labor income paid by the logging industry, while production decreases, may be due to the fact that the industry pays more to find employees who work in the wood.

Similar to the wood and logging industries, the total economic value of the production of furniture products manufacturing industry (NAICS 337) increased from $1.4 billion in 1996 to $2 billion (42 percent increase) in 2006, but decreased to $1.2 billion (40 percent decrease) in 2012 due to the 2007-2009 economic recession. Between 1996 and 2012, the furniture industry's total contribution to employee compensation decreased by 18%, or $72 million. However, more recently, between 2006 and 2012, the furniture industry's total contribution of wages and salaries fell by 45%, or $266 million.

During the time period we studied here, paper products manufacturing (NAICS 322) slightly increased their contribution to the economy of Alabama in terms of the value of production. For example, the total economic value of the production in the paper products manufacturing industry decreased from $9.7 billion in 1996 to $9 billion in 2001, then increased to $10.3 billion in 2006, and finally decreased to $10 billion in 2012, corresponding to the three time periods considered in this study. Overall, the total effect of the industry's growth on the state's economy is estimated to be a $286 million (2 percent) gain in the economic value of the production. However, the paper products manufacturing industry's total contribution of wages and salaries to the economy of the state steadily decreased by 26%, or more than $600 million, between 1996 and 2012. This was primarily due to increases in capital over labor, and the closing of inefficient mills resulting in increases in productivity.

6.2. Western Alabama

The goal of this section is to evaluate how the contribution of the forest products industries, including logging, wood, paper and furniture products manufacturing, to the economy of western Alabama has changed during the study periods considered here. The economy of the region is not diverse and is highly dependent on the forest products industry. The impact of changes in the industry can be more dramatic in this region compared to more urbanized regions of the state. Therefore, special attention must be given to this region to determine how the economic impact of closing a mill differs between forest-dependent and non-forest dependent regions in the state of Alabama. Three measures of economic contribution, including total value-added, labor income (within total value-added), and total industrial output are discussed for each industry in effort to determine these industries' contribution to the economy of this particular region.

6.2.1. Logging (NAICS: 113)

In 1996, the logging industry created new wealth in west Alabama via value-added for an amount of $138.5 million in 1996. Of this total, the supply chain accounted for $17.6 million. Purchases made by the employees in logging and supply chain industries induced another $11 million into the economy of the region. Approximately 2,600 people were employed in 115 sectors and paid nearly $63 million in labor income as a result of logging activities in western Alabama. Of this total labor income, $48 million was directly paid by the logging industry, $9 million was indirectly paid by the industries that are in the supply chain of the logging industry, and $6 million was induced in other industries by local spending of employees in logging industry and supply chain industries.

The economic value of the logging industry's output was $289.5 million in 1996. However, the total impact of the industry's output on the economy of the region was much greater when the direct, indirect, and induced impacts of the industry on other industries were taken into account. The total value of the logging industry's output within the region's economy was $347.6 million in 1996. The industries within the supply chain of the logging industry contributed $40 million to the economy of west Alabama, coming primarily from logging camps and logging contractors, motor freight transport and warehousing, banking, wholesale trade, and sawmills and planning mills. The induced impact of industrial output was $17.7 million, coming primarily from owner-occupied dwellings, banking, doctors and dentists, eating and drinking establishments, and automotive dealers and service stations.

In 1996, the primary industries indirectly impacted by the activities of the logging industry, included logging camps and logging contractors, motor freight transport and warehousing, wholesale trade, maintenance and repair facilities, and banking. The primary

industries induced by the local spending of the logging industry and its supply chain industries, included doctors and dentists, miscellaneous retail, automotive dealers and service stations, grocery stores, eating and drinking industries, banking, and owner-occupied dwellings (i.e., cost of homeownership)[11].

As of 2012, new wealth creation in west Alabama, via value-added of the logging industry, had declined by 11% (i.e., $123.7 million) compared to 1996. Of this total, the supply chain industries accounted for $16.6 million and local spending by the employees in the logging industries, and supply chain industries, induced $27.6 in new wealth for the economy of west Alabama. Interestingly, the induced impact of local purchasing goods and services by these employees were increased by 155% between 1996 and 2012. The logging industry's contribution to the region's economy in terms of labor income increased 88%. The total number of jobs created by the logging industry activities was 2421 in 132 sectors and the total labor income paid as a result of logging activities was $132.9 million in west Alabama. Of this total, the supply chain industries created $15.7 million worth of labor income and local spending by the employees in the logging industry, and the supply chain industries induced another $11.8 million worth of labor income in other industries in west Alabama.

The total economic value of the output produced by the logging industry was $233.7 million in 2012 (i.e., a 33 percent decrease since 1996), with approximately $155 million coming directly from within the industry. The indirect impact of industrial output was $33.7 (i.e., a 17% decrease since 1996) million and the induced impact of industrial output was $44.2 million (i.e., a 97% increase since 1996). Between 2006 and 2012, the logging industry's contribution to the

[11] For the name of the industries, we used the terminology found in IMPLAN software.

region's economy decreased dramatically due to unfavorable economic conditions resulting from the economic crisis between 2007 and 2009. For example, the total contribution of logging industry, via output, to the economy of west Alabama decreased, falling 62%, from $619.3 million in 2006 to $233.7 million in 2012. Table 1.1 provides details on the changes in the contribution of the logging industry to the economy of west Alabama. Increases in the economic contribution of the logging industry, via labor income, and decreases in the contribution, via output (i.e., the economic value of the production), was due to the price of timber declining during the study time period[12].

In 2012, the primary industries within the supply chain of the logging industry were commercial logging, support activities for agriculture and forestry, forestry - forest products - timber tract production, wholesale trade businesses, transport by truck, and monetary authorities and depository credit intermediation activities. The primary industries induced by activities in the logging industry and its supply chain industries, included nursing and residential care facilities, offices of physicians, dentists, and other health practitioners, food services and drinking places, monetary authorities and depository credit intermediation activities, retail stores - food and beverage, imputed rental activity for owner-occupied dwellings (i.e., costs of homeownership), and wholesale trade businesses.

6.2.2. Wood Products Manufacturing (NAICS: 321)

Similar to the logging industry, the contribution of the wood products manufacturing industries to the economy of west Alabama also decreased between 1996 and 2012. Except for

[12] See Data and Methods section for direct, indirect, induced, and total impacts of the industries to the local economic.

wood container and pallet manufacturing (32192), all of the sub-industries considered here including, sawmills and wood preservation (3211), veneer and plywood manufacturing (32121), and reconstituted wood products manufacturing (321219) experienced a general decline in their contribution to the economy of west Alabama (see Table 1.2).

In 1996, Wood products manufacturing industries in west Alabama added a total of $319.5 million in economic value (e.g., employee compensation, taxes etc.) on the raw materials used in their production process. The industries in the supply chain of the wood products manufacturing industry generated $102.6 million in new wealth, via value-added, by supplying inputs to the wood manufacturing industry. Local purchases by the employees in these industries induced another $34.3 million in new wealth into the economy of the region. Sawmills and wood preservation, as well as veneer and plywood manufacturing industries were the major sub-industries creating new wealth via value-added in the region. In 1996, 6,670 people were employed in 138 sectors and approximately $200 million worth of labor income was paid by the activities in the wood products manufacturing industry, with $126.6 million coming directly from within the industry. Of this total labor income, the industries in the supply chain of wood products manufacturing paid $54 million to their employees. Spending by the employees in the wood products manufacturing and supply chain industries generated an additional $18.6 million in labor income in the induced industries. Among the sub-industries related to wood products manufacturing, the largest amount of labor income, $72.7 million, was paid by the activities in the sub-industry sawmills and wood preservation. Veneer and plywood manufacturing followed sawmills and wood preservation industries by contributing $46.3 million worth of labor income to the region’s economy.

Activities in the wood products manufacturing industries generated over $800 million in total industrial output, with over $500 million coming directly from within the industry. Industries that are in the supply chain of wood products manufacturing contributed of $242.2 million to the region's economy. An additional $56 million worth of products were generated in the region by other industries to meet the demand of the employees in the wood products manufacturing and the supply chain industries. Among other sub-industries within wood products manufacturing, the largest contribution to the region's economy was made by sawmills and wood preservation industries (i.e., $335.4 million worth of products).

In 1996, the primary industries within the supply chain of the logging industry (i.e., indirectly impacted the region's economy) were logging camps and logging contractors, sawmills and planning mills- general, motor freight transport and warehousing, veneer and plywood, wholesale trade, and electric services. The primary industries induced by the activities in the logging industry and its supply chain industries were doctors and dentists, miscellaneous retail, automotive dealers and service stations, food stores, eating and drinking, owner-occupied dwellings (i.e., costs of homeownership), and banking.

By 2012, the contribution of the wood products manufacturing industries to the economy of west Alabama via labor income, value-added, and output declined significantly. The total number of people employed in the region as a result of the activities in wood products manufacturing, decreased to 3,752 (i.e., 44 percent) in 2012. New wealth created in the region via value-added of wood products manufacturing industries decreased 28% to $227.2 million. The total contribution of the industry to the region's economy, via labor income, also decreased, falling by 20% (i.e., $160 million) between 1996 and 2012. The economic value of production in the wood products industries also decreased, falling by 24%, or $190 million. As a result of the

decline in the contribution of wood products manufacturing industry to the region's economy, the indirect and induced impacts of the industry on the region's economy also fell significantly during the same period. The total contribution of the sub-industries, including sawmills - wood preservation and reconstituted wood products manufacturing industries, to the region's economy, with respect to production, dropped significantly, falling by 27% and 55%, respectively, between 1996 and 2012. However, over the same period, the contribution of veneer and plywood manufacturing to the region's economy, with respect to production, increased from $157.9 million to $162.1 million (3 percent). Interestingly, the economic contribution of wood container and pallet manufacturing to west Alabama increased significantly from $0.7 million to $20.4 million during this time period. Major declines in the contribution of the wood products manufacturing industries to the economy of west Alabama occurred between 2006 and 2012 due to economic recession of 2007-2009 (see Table 1.2 for details).

The primary industries in the supply chain of the wood products manufacturing industry, and the induced industries in 2012 are similar to the primary industries in 1996.

6.2.3. Paper Products Manufacturing (NAICS: 322)

The contribution of the paper products manufacturing industry (as a whole) to the economy of west Alabama decreased in terms of creating labor income and value-added between 1996 and 2012; however, the contribution, with respect to production in the industry, increased over the same time period. For example, the contribution of the paper products manufacturing to the economy of west Alabama via value-added slightly decreased from $1.06 billion in 1996 to $1.03 billion in 2012. New wealth creation in the region via value-added of the industries in the supply chain of the paper products manufacturing decreased by 33% over the same time period. New wealth created via value-added of other industries (i.e., induced industries) also decreased

by 7% due to reductions in local spending by the employees in paper products manufacturing and the supply chain industries. Within total value-added, total labor income paid by the paper products industry to local people also decreased during the same time period. In 1996, for example, 13,905 people were employed in 115 sectors and $568.6 million in total labor income was paid as a result of economic activities in paper products manufacturing. Of this total labor income, $167.8 million were paid within the supply chain industries and an additional $53.1 million was paid in other industries due to local expenses by the employees working in paper products manufacturing and the supply chain industries. However, as of 2012, 9,651 people were employed in 125 sectors in west Alabama as a result of economic activities in the paper products manufacturing industry, resulting in a total income earned of $438.6 million, which was a 23% decrease from 1996. Total labor income earned by the employees in the supply chain industries and induced industries decreased by 21% and 29%, respectively, between 1996 and 2012.

The total contribution of the paper products manufacturing industry to the economy of west Alabama, via production, slightly increased from $2.7 billion in 1996 to $2.8 billion in 2012. Over the same time period, the industry's direct impact (i.e., the value of products produced directly by paper products manufacturing) on the region's economy increased by 17% while the indirect and the induced impacts (i.e., value of production in the supply chain industries and induced industries) on the region's economy decreased by 30% and 10%, respectively.

Among the primary sub-industries within the paper products manufacturing industry classification, paper and paperboard mills made the largest contribution to the region's economy during the study time period. The economic value of the paper and paperboard mills' production increased from approximately$1 billion in 1996 to $1.5 billion in 2012. Their new wealth

creation in the region, via value-added, also increased from $400 million to $570 million during the same time period. However, total labor income paid to employees in this region as a result of activities in paper and paperboard mills decreased by 18% between 1996 and 2012. Conversely, the contribution of sub-industry pulp mills to the region's economy significantly decreased during the study time period. Pulp mills' contribution to the region's economy via labor income, value-added, and production decreased by 30%, 33%, and 27%, respectively (see Table 1.3 for more details).

Primary suppliers of the paper products manufacturing industries, include commercial logging, sawmills – wood preservation, wholesale trade businesses, electric power generation – transmission – distribution, and transport by truck. The primary industries induced by the spending of employees in these industries include owner-occupied dwellings, banking, doctors and dentists, eating and drinking, automotive dealers and service stations, miscellaneous retail, and wholesale trade businesses.

6.2.4. Furniture Products Manufacturing (NAICS: 337)

The smallest contribution to the economy of west Alabama came from the furniture products manufacturing industries located within the region. For example, the industry's new wealth creation, via value-added, decreased from $21.3 million in 1996 to $9.2 million in 2012. Within total value-added, in 1996, the industry's activities generated a total labor income of $15 million in the region, including nearly $10 million paid directly to the employees within the industry. The industry's contribution to the region's economy, via total paid labor income, decreased dramatically to only $5 million in 2012. The total economic value of the industry's production also dramatically decreased, falling by 65%, or the equivalent of $40 million worth of products.

Over the same period, only wood kitchen cabinet and countertop manufacturing, among other sub-industries, showed an increase in their contribution to the region's economy. Other sub-industries including household furniture manufacturing and institutional furniture manufacturing, experienced a significant decline in their contribution to the economy of west Alabama, via labor income, value-added, and production (see Table 1.4).

As the direct contribution of furniture products manufacturing to the economy of west Alabama decreased, the contribution of their suppliers, and other industries induced by the local spending of employees in the furniture industry, and the supply chain industries, also decreased between 1996 and 2012. The primary suppliers of the furniture industry consist of sawmills and wood preservation, wholesale trade businesses, commercial logging, banking, transport by track, electric services and telecommunications, and veneer and plywood manufacturing. Primary industries induced by activities in the furniture products manufacturing industries, and its supply chain industries, include owner-occupied dwellings, banking, eating and drinking, wholesale trade businesses, doctors and dentists, nursing and residential care facilities, miscellaneous retail, and automotive dealers and service stations.

7. Factors behind the Decline in the Forest Products Industry

There are many factors behind the decline in employment, production, and the number of establishments in the forest products industry of Alabama. Since there are huge amount of timber resources in the state available for production, and the forest products industry plays important role in the economy in providing revenue and jobs to the state, understanding these factors will be crucial to stemming the decline in the industry. Previous studies have isolated factors that have likely contributed to the decline, such as lack of global competitiveness, economic

recessions, consolidation in the industry, decreasing demand for forest products, production cost, timberland acres and ownership, and timber prices, etc.

7.1. Economic Recessions

Economic recessions factor heavily in the decline of the forest products industry of Alabama. In the first decade of the 20th century, the U.S. experienced two economic recessions, first in 2001, and then again 2007 and 2009[13]. Also, the United States economy was affected negatively by the global energy crisis of 2003. Reports indicated that, similar to other industries, losses in production, employment, and mill numbers *etc.*, in the forest products industry of Alabama increased substantially during these country-wide economic recessions (Hodges *et al.* 2011; Woodall *et al.* 2011).

During the economic recession period between 2007 and 2009 and the following a few years, the U.S. economy experienced dramatic declines. For example, real GDP decreased by 6.4%, unemployment rate increased by 9.5%, and the Down Jones Industrial Average index declined by almost 55% (Holt 2009) Previous studies have emphasized that the credit crisis that resulted from the bursting of the housing bubble was the primary cause of the recession. Specifically, studies found that increased debt to income ratio (Gwartney *et al.* 2008), the inflow of foreign savings in to the U.S. mortgage market (Bernanke 2009), the federal government's low short-term interest rate policy (Gwartney *et al.* 2009), deterioration of the quality of subprime loans during the six consecutive years before the recession (Demyank and Hemert, 2008; Mian and Sufi, 2008), and relaxed mortgage lending standards by the government

[13] Economic recessions are determined by The National Bureau of Economic Research, US Business Cycle Expansions and Contractions. For detail, see: http://www.nber.org/cycles.html.

(Liebowitz, 2008; Sowell, 2009; Zandi, 2009) were the main factors leading to the recession. The collapse of the U.S. housing construction industry was the most devastating event of the 2007-2009 economic recession for the forest sector, causing a huge decline in the industry, especially for those sub-industries that are closely tied to housing construction. Between 2004 and 2010, for example, the number of employees in sawmills and wood preservation industries (NAICS 3211) fell from 6,650 to 4,650 (a 30 percent decrease). In addition, the plywood and engineered wood products industry (NAICS 3212) and millwork (NAICS 3219), which are both highly dependent on housing construction, lost approximately 45% and 55% of their employees, respectively, during the recession period. Over the same period, estimated output (i.e., economic value of production) of sawmills/wood preservation industries, plywood/engineered wood products industries, and millwork decreased by 40%, 52%, and 33%, respectively. By comparison, paper mills (NAICS 3222), which are not dependent on the housing industry, only lost 12% of their total employees and 14% of their total output over the same period. The notion that housing-dependent industries were heavily impacted by the recession is further supported by examining the effects of the recession on other industries in Alabama that were not directly related to housing construction industry. For example, the number of employees in the automobile manufacturing industry (NAICS 3361) declined by only 11%, from 7,950 in 2006 to 7,000 in 2010. This shows that the most drastic effects of the 2007-2009 economic recession were seen in the industries that were closely related to the housing construction industry ((BLS and IMPLAN; see Figure 1.12 and Figure 1.13).

7.2. Decreasing Demand

Demand for wood products is one of the most important drivers of investment in the forest sector (FAO, 2009). The per capita consumption of all forest products (in round wood

equivalents) as an indicator of demand for wood products has gradually decreased in the United States since about the mid-1990s. In 1996, for example, per capita consumption (in round wood equivalents) of all wood products averaged 70.4 ft^3. Per capita consumption has continued to steadily decrease since then, falling to 41 ft^3 in 2011. Since 1996, per capita consumption of pulp-based products (e.g., paper, paperboard, etc.) fell from 22.3 ft^3 to 14.2 ft^3 in 2011. Over the same period, per capita lumber consumption declined from 34.5 ft^3 to 19.1 ft^3 and per capita consumption of plywood and veneer products fell from 4.8 ft^3 to 2.4 ft^3 in 2011 (Howard and Westby, 2013).

Previous authors indicated a decrease in demand as one of the most important factors behind the decline in the forest products industry (Collins *et al.* 2008). Due to low population growth, urbanization, more efficient wood processing facilities, usage of products that are substitutes for wood products, and waste paper recycling, demand for forest products has shifted from the developed world to developing parts of the world, such as Africa, Asia, Eastern Europe, and Latin America, etc. (NCSSF 2005). These factors have caused a decline in production, employment, and number of facilities etc., in the forest products industries in the United States. According to relevant literature, another factor behind declining demand is technological achievements, but this has been questioned. While some studies (Woodall *et al.* 2011) argued that the rise of electronic media has caused a decrease in demand for forest products (e.g., paper), others suggested people demand more forest products (e.g., paper and packaging) today due to increasing numbers of printers in houses, offices, etc., and increasing numbers of packages resulting from more consumers choosing to shop online.

Since 2005, the decline in housing starts also negatively affected demand for wood products in the U.S., especially lumber and panel wood products. The housing construction

industry accounts for more than a third of the consumption of softwood and hardwood products in the United States (Howard and Westby, 2013). In 1996, there were approximately 1.5 million housing starts (single and multi-family); a number that increased to a peak of over 2 million starts. Single and multi-family housing starts declined dramatically, falling 74% and 69%, respectively, following the historical peak in 2005 (U.S. Census Bureau, Bureau of New Residential Construction). Figure 1.14 shows changes in sawtimber demand in the U.S. South.

The forest products industry of Alabama has been influenced by these demand shifts in the last two to three decades. While some establishments in the industry have simply discontinued their operations, others have decided to move their facilities to different parts of the world, resulting in dramatic changes in the number of establishments, employment, and production in Alabama's forest products industry.

7.3. Globalization

Global competition in the forest products market is reported in the literature as another critical factor contributing to the decline of the forest products industries (Woodall *et al.* 2011; Collins *et al.* 2008; Ince *et al.* 2007; Bael and Sedjo 2006). In today's global marketplace, capital can easily move across borders to where markets grow quickly and production costs are low. Technological innovations, reduced cost of transportation, and greater mobility of labor and capital *etc.*, have pushed businesses to compete more aggressively in the global marketplace, and they can easily change production locations. In the last decade, for example, production of the forest products (e.g., industrial round wood) has decreased in developed countries, such as Canada, United States, European Union (especially western Europe), and Finland *etc.*, while developing regions of the world including Latin America especially Brazil, New Zealand,

Australia, Asia especially southern Asian countries, such as China, India, Indonesia, increased their production of forest products (see Table 1.5).

The fastest growing markets for major commodities are all overseas and the United States has relatively expensive land and other inputs to production, such as labor, wood fiber, etc. Therefore, the forest products industry is no longer able to compete with its foreign competitors and overseas markets attract investors in the forest products industry away from the US (Collins *et al.* 2008). As a result, the forest products industry has been increasingly buying offshore timberlands (Wilent 2004), and domestic timberlands owned by the industry have been reduced by 50 percent in the last twenty years (Bael and Sedjo 2006).

Import and exports of major forest products in the United States may help understand the global competitiveness of the domestic forest products industries. For example, since the mid-1990s, industrial round wood[14] exports from the United States have decreased gradually by 21%, or over 2.5 million m^3, while, at the same time, imports of industrial round wood into the country have increased by 83%, or a half million m^3. Similarly, plywood exports fell from 1.4 million m^3 in 1996 to 830 thousand m^3 in 2011 (39 percent). However, plywood imports into the United States have increased 1.8 million m^3 to 2.6 million m^3 (41 percent) over the same period. Between 1998 and 2012, pulp and paper products manufacturing industries increased their exports and decreased the total imports. For example, imports of coated paper slightly decreased

[14] According to the definition of the Food and Agriculture Organization of the United States, Forest Products Yearbook, industrial round wood includes all industrial wood in the rough, such as saw logs and veneer logs, pulpwood and other industrial round wood and, in the case of trade, chips and particles and wood residues.

from 1.67 million m^3 to 1.65 million m^3, while exports of this product increased from 0.6 million m^3 to 1.22 million m^3. Moreover, chemical wood pulp imports decreased by 12%, or 0.6 million m^3, while exports of this product increased by 42%, or ~ 2 million m^3 (FAO).

7.4. Timberland Ownership

Changes in timberland ownership are discussed in the literature as another important factor leading to the decline in Alabama's forest products industry. Alabama has the second largest commercial timberland base in the South, and the third largest timberland base in the United States, with 22.9 million acres of timberland (approximately 70% of the state's total land area). The state's commercial timberland area has increased by nearly 20% between 1936 and 2000. Approximately 94 percent of such forestland is privately owned. There are four forestland ownership classes in Alabama. The first and second ownership classes include non-industrial private individuals and corporations, such as real estate, trusts, mining companies, pension funds, and insurance companies. In 2004, 67% of the state's forestland was controlled by an estimated 432,000 family forest owners, and used for different purposes (e.g., recreational, privacy, scenery, hunting, fishing, passing on land to heirs, and economic investments; FIA 2008). Although 6% of Alabama's forestland belongs to either the state or federal government, publicly owned forestlands comprise the third ownership class. There has been a steady increase in publicly owned forestland (up 21% since 1990) due to permanent protection of public lands for conservation purposes. Timberland owned by the forest products industry is the fourth ownership class which has undergone the most significant change in ownership during the last two decades (see Figure 1.15).

Since the 1990's many corporations in the forest products industry have either partially or entirely sold their timberland at a remarkable rate, or they have chosen to restructure their

timberland holdings, resulting in dramatic changes in ownership of timberland in the United States (Binkley *et al.* 1996, Hickman 2007). In the last thirty year period, nearly 26 million acres of commercial timberland were sold by the forest products industry to mostly various institutional investors and other corporate actors (see Table 1.6) – e.g., insurance companies, pension funds, endowments, foundations, Timber Investment Management Organizations (TIMO), and Real Estate Investment Trusts (REIT; Bailey *et al.* 2011, Hickman 2007). Eighteen million acres of this sell - off occurred in the southern United States where the impact has been the greatest (Clutter *et al.*, 2005). This divestiture has particularly affected Alabama's timberland, as the forest products industry of Alabama has sold more than 3 million acres of commercial timberland, accounting for 16 percent of the state's 23 million acres of timberland and 26 percent of the state's total timber harvest (Hartsell and Brown 2002, Bailey *et al.* 2011). As a result of this divestiture, working timberlands formerly owned by the forest products industry have become financial assets instead of purely production resources, resulting in dramatic changes in the forest sector and the nature of timberland ownership in Alabama.

There are numerous social and economic factors that have influenced the forest products industry's decision to sell their timberland holdings. For example, the Federal Employee Retirement Income Security Act of 1974 (ERISA) initiated such changes in timberland ownership since the act encouraged institutional investors holding pension plans to diversify from their traditional reliance on fixed income investments (e.g., government bonds) to other assets like commercial real estate or timberland (Binkley *et al.* 1996). The Tax Reform Act of 1986 is another impetus for the timberland transactions between the forest products industry and various institutional investors because the act raised income taxes from timber sales considerably for the owners of private timberland. The reform nearly doubled the effective tax rate for

corporate timberland owners including individuals, investment partnerships, pension plans, and Real Estate Investment Trusts (Bettinger and Haney 1989). Hence, some corporations in the forest products industry elected to restructure themselves as more efficient tax entity structures, such as subchapter S corporations or Real Estate Investment Trusts (Hickman 2007, Clutter *et al.* 2005, and Hagan *et al.* 2005). One of the primary factors that corporations in the industry cite for selling their timberland base is the growing perception during the 1990s that the stock market undervalued the timberland assets of the forest products industry (Zinkhan 1988). In the past, corporations in the forest products industry owned mills and needed a timberland base to keep their mills constantly supplied with fiber (Hickman 2007, Hagan *et al.* 2005). After these corporations recognized that their raw material, timber, was readily available in the markets for use in their mills, the companies converted their undervalued asset (i.e., timberland holdings) into cash by making long-term timber supply contracts with the buyers (Zinkhan 1988). Another factor is that low cost timber suppliers and forest products manufacturers in Asia and Latin America have increased competition in the global timber markets over the last two decades. In response to this competition, many domestic forest products industries have experienced a period of substantial vertical restructuring (i.e., consolidation), which has generated significant debt to finance this restructuring. Hence, selling timberland holdings appeared an easy way to pay this debt off for the industry (Hickman 2007, AFC 2010, Franklin and Johnson 2004).

Previous studies argued that changes in timberland ownership have influenced the forest products industry (Bliss *et al.* 2010; Shaffer 1997; Mendell 2007; Bailey *et al.* 2011). However, there are conflicting findings in the literature concerning the effects of this change on the forest products industry. Some social scientists suggested that changes in ownership caused declines in the industry because new institutional owners may either continue to produce timber or they may

choose to manage the land for highest and best uses, such as residential development, industrial development, suburban, exurban, recreational, or ecological conservation, resulting in timberland being removed from timber production (Bailey *et al.* 2011). According to Martin (2011), if new owners reduce the volume of timber harvested after their initial short-run investment period, it will increase the price of timber and all other wood products, resulting in mill closures and the loss of employment in the industry (Martin 2011, Bailey *et al.* 2011). Moreover, if the volume of timber harvested is reduced by 10 percent by all of the timberland owners in Alabama, the economy of the state will lose $250 million per year (Martin 2011). Other studies suggested that new land uses may have positive effects on wildlife and fisheries and result in expanded employment in these sectors (Mendell 2007, Bailey *et al.* 2011). On the other hand, ownership may have little or no influence at all on employment in the forest products sector.

In addition to these factors associated with the decline in the forest products industry of Alabama discussed in the literature, we analyze the relationship between some internal factors (internal to the corporations and presumably within their control, such as cost of production, labor productivity etc.) and the decline in the industry in the following chapter.

8. Conclusion

The forest products industry of Alabama, which historically has a dominant role in the state's economy, has experienced a recession since the mid-1990s. Although the contribution of the industry to the state's economy, in terms of employment, production *etc.*, has changed over time, no study to date has analyzed and compared its contribution over more than one time period.

Using a county level dataset spanning the years between 1996 and 2012, we track and analyze changes in production, employment, and number of operating establishments in the forest products industries of Alabama as a whole, and within four primary sub-industries including logging (NAICS: 113), wood products manufacturing (NAICS: 321), pulp and paper products manufacturing (NAICS: 322), and furniture products manufacturing (NAICS: 337). We also employ input- output methods to analyze how the contribution of these industries to the state's economy in terms of labor income, value-added, and output have changed over the same period. We apply these input-output analyses on both the state as a whole and the western region of the state in which the economy is highly dependent to these industries. Finally, we discuss the possible factors behind the decline in the forest products industry of Alabama. We analyze these changes in the industry for three time periods separately: (1) the period between 1996 and 2001, (2) the period between 2001 and 2006, which included two economic crises, and (3) the period between 2006 and 2012, which included the great U.S. economic recession of 2007-2009.

Our analyses show that the forest products industry of Alabama has experienced a general downturn in terms of production, employment, and number of establishments between 1996 and 2012. Moreover, our analyses indicate that many older, smaller, and less efficient mills have closed in the last two decades. Also, capital substitution for labor occurred in the forest product industries between 1996 and 2012. Over the time period considered, the number of employees in the industry steadily decreased, while the industry's production level slightly decreased between 1996 and 2001, significantly increased between 2001 and 2006, and significantly decreased between 2006 and 2012. Among other primary sub-industries, the wood products manufacturing industry in Alabama showed the greatest loss (over 50%) in their number of employees. Between 1996 and 2012, the logging and wood products manufacturing

industries decreased their production level, while paper and furniture products manufacturing industries slightly increased their production in Alabama.

Closing mills, losing employees, and decreasing production in the forest products industry of Alabama resulted significant declines in the contribution of the industry to the economy of the state. Input-output analyses in this study show that contribution of each forest products industry to both the economy of Alabama as a whole and the economy of West Alabama in terms of creating new wealth via labor income, value-added, or production have declined significantly between 1996 and 2012. For example, contribution[15] of logging and furniture manufacturing industries to the state's economy has declined by 50%. Moreover, paper products manufacturing industry's contribution declined by 21% and wood products manufacturing industry's contribution declined by 48% between 1996 and 2012. Over the same period, the industry's contribution to the economy of western Alabama has also declined significantly; however, this decline was not as great as the decline seen at the state level. For example, the region has experienced a 36% and a 24% economic losses due to decline in production of the logging and wood products manufacturing industries, respectively. However, the contribution of paper products manufacturing to the region's economy has increased during this time period. Specifically, the contribution of paper and paperboards to the region's economy has increased by 44%; however, pulp mills' contribution to the economy has decreased by 29%.

The study suggests that increases in the competitiveness of global forest products market, decreases in paper consumption, and decreases in housing demand were the main contributors to the general downturn in the forest products industry in Alabama.

[15] Contribution to the state's gross regional products via production.

Studying and documenting the changes in the economic contributions of the forest products industry to the economy of the state of Alabama, over a broad time period, provides useful information to policymakers and industry leaders. This information is critical for the development of beneficial tax policies and restrictions (i.e., tariffs or duties), and to improve the industry's competitiveness in domestic and global markets.

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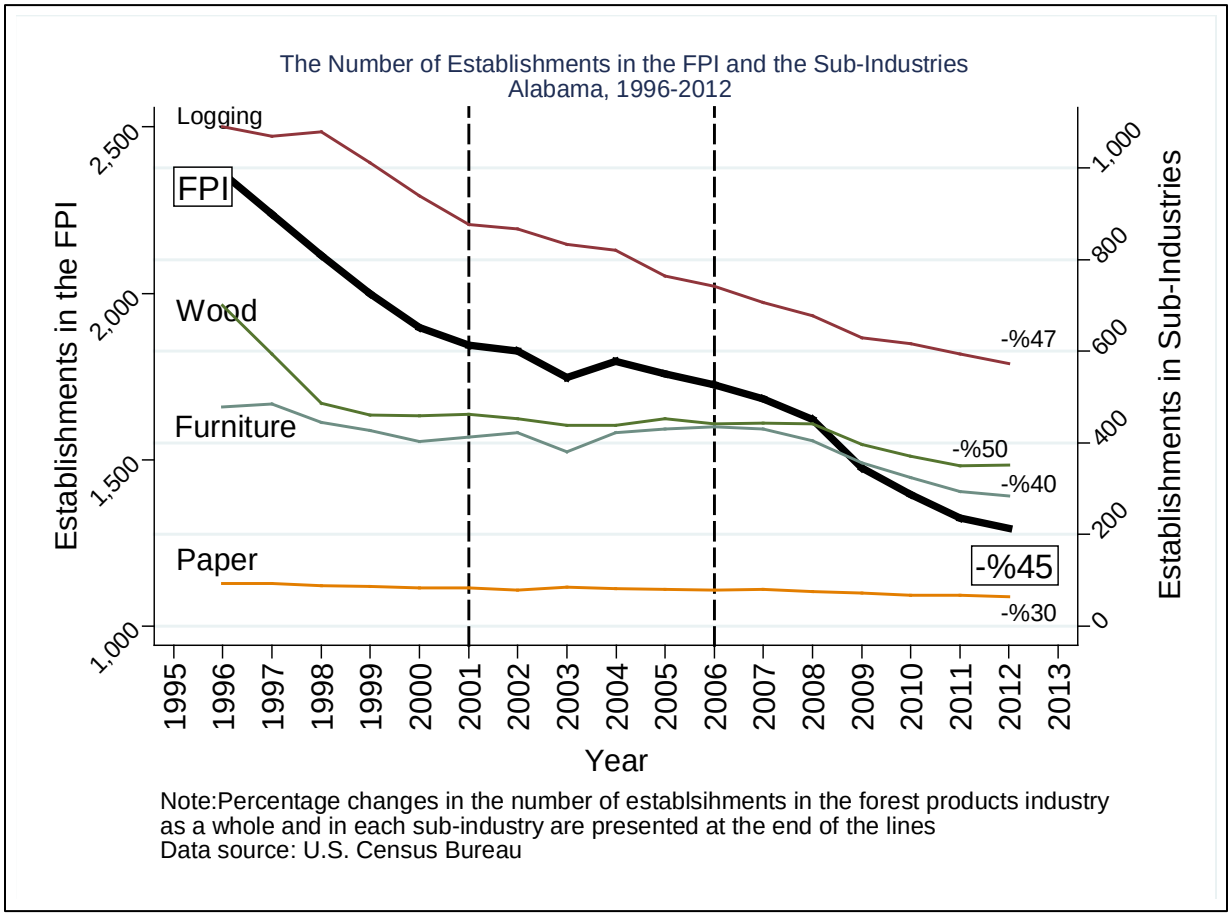
Figures and Tables

Figure 1.1: The number of Establishments in the Forest Products Industry and the Sub-Industries



Note:Percentage changes in the number of establsihments in the forest products industry as a whole and in each sub-industry are presented at the end of the lines
Data source: U.S. Census Bureau

Figure 1.2: Employment in the Forest Products Industry and the Sub-Industries

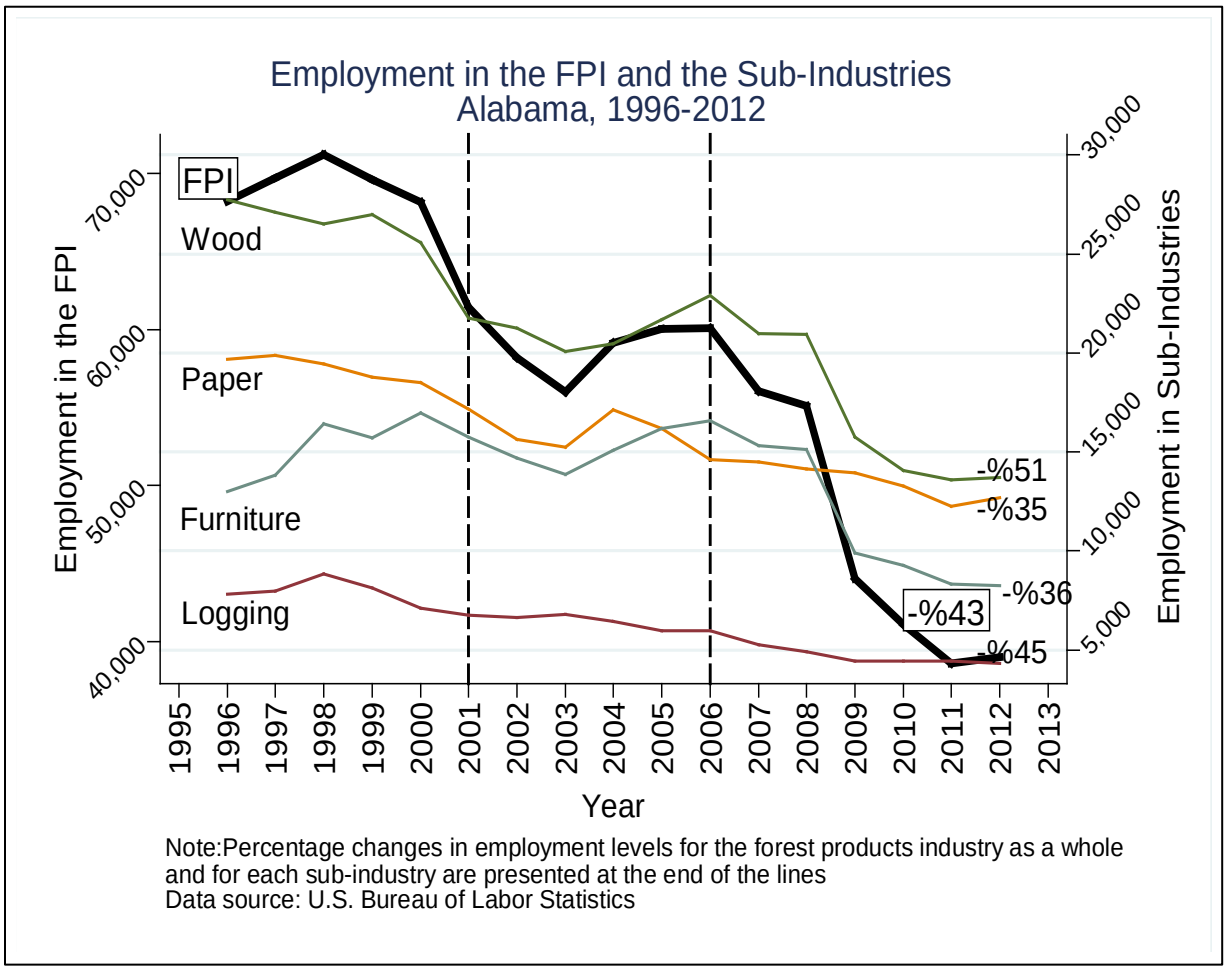
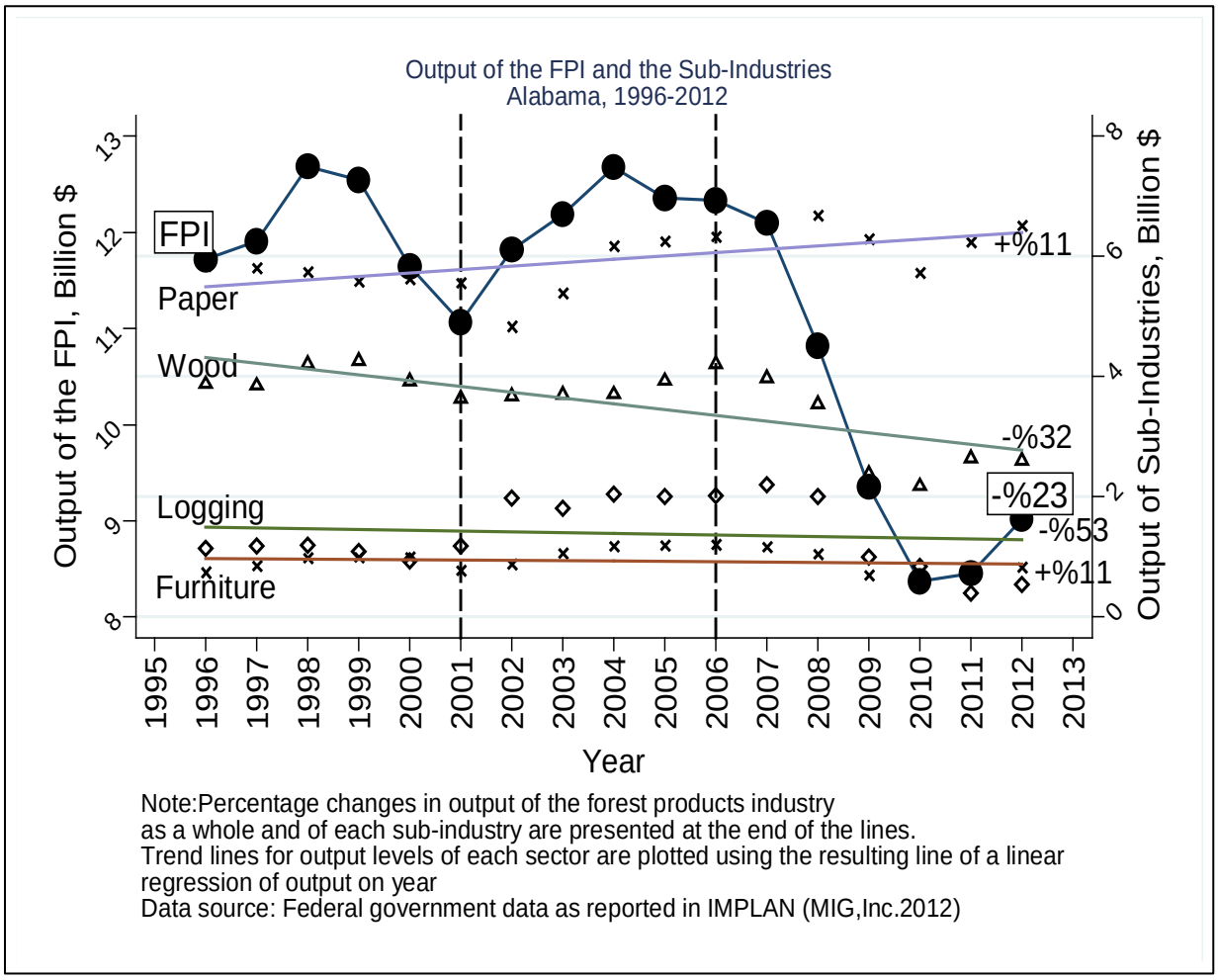
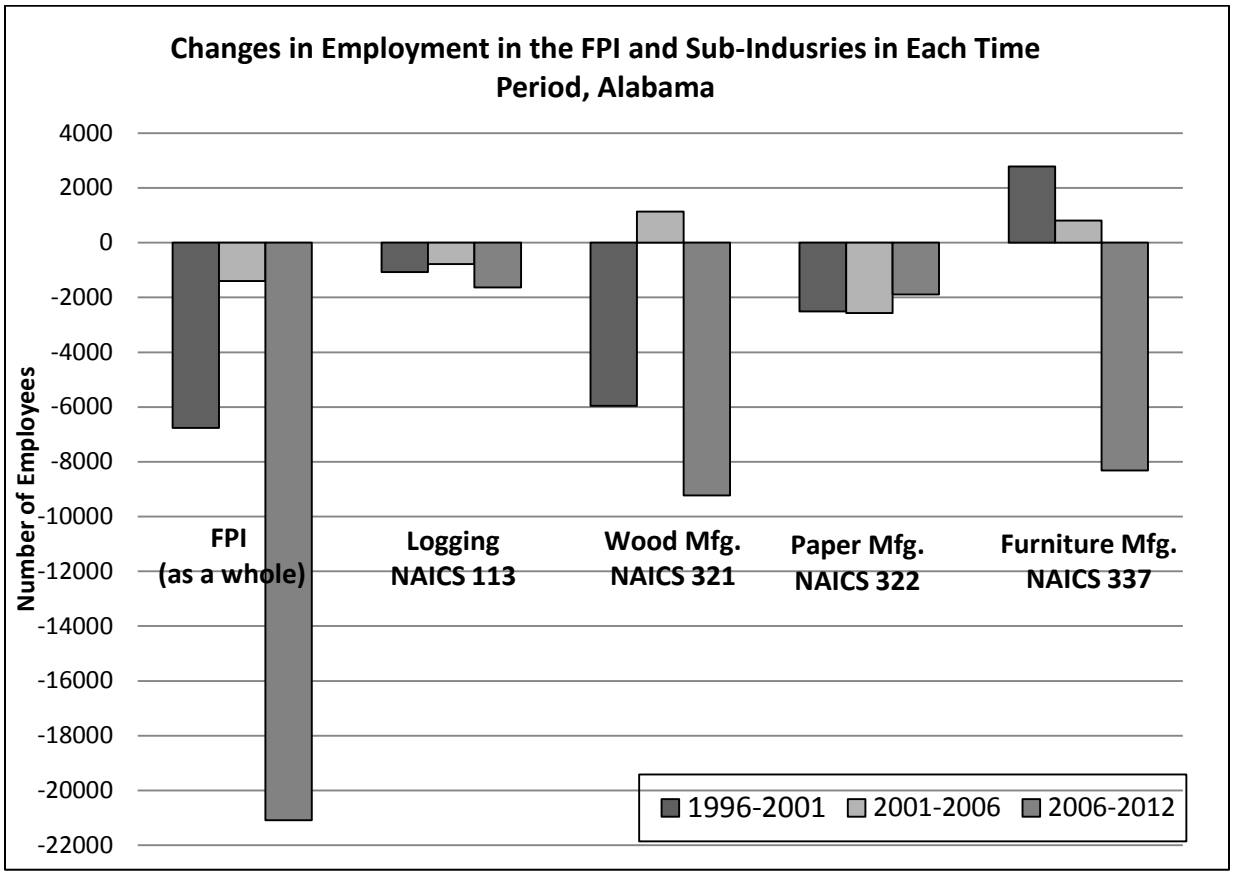


Figure 1.3: Production (output) of the Forest Products Industry and the Sub-Industries



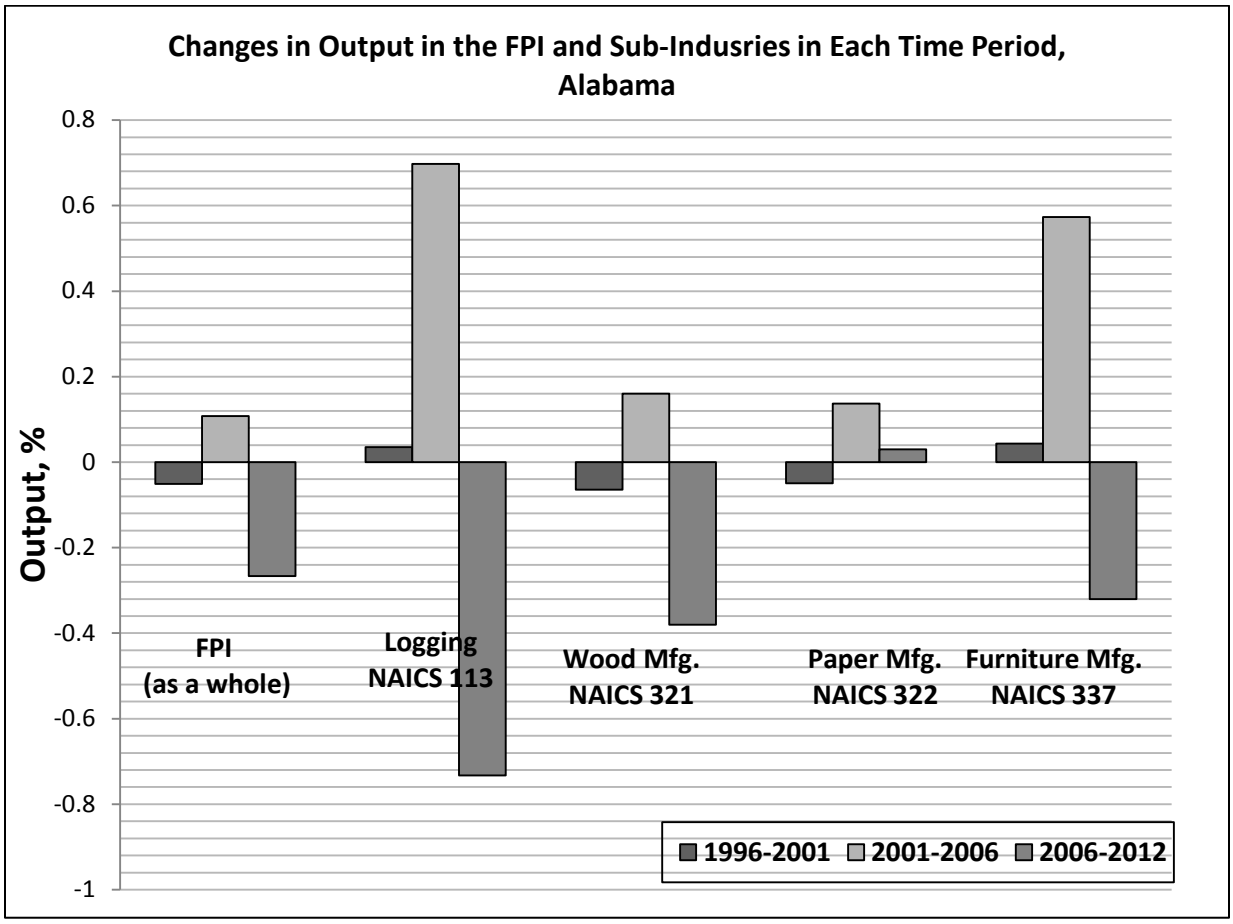
Note:Percentage changes in output of the forest products industry as a whole and of each sub-industry are presented at the end of the lines.
Trend lines for output levels of each sector are plotted using the resulting line of a linear regression of output on year
Data source: Federal government data as reported in IMPLAN (MIG,Inc.2012)

Figure 1.4: Changes in Employment in each Time period



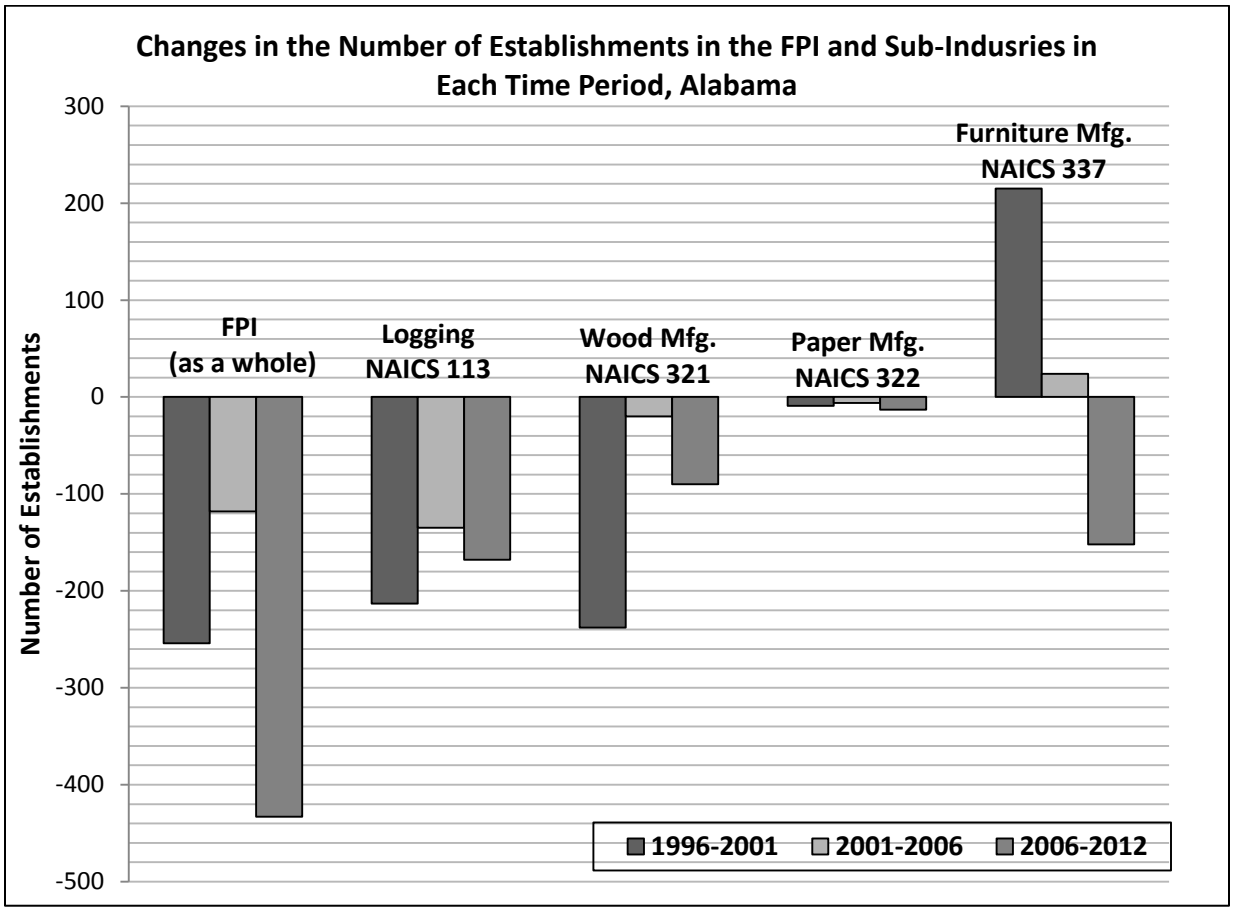
Note: Changes in the number of employees in the Forest products industry of Alabama are presented in the graph using the datasets from US Census Bureau, county business statistics. Sub-Industries, logging, wood products manufacturing, paper products manufacturing, and furniture products manufacturing are classified based on North America Industry Classification System (NAICS) codes.

Figure 1.5: Changes in Output in each Time period



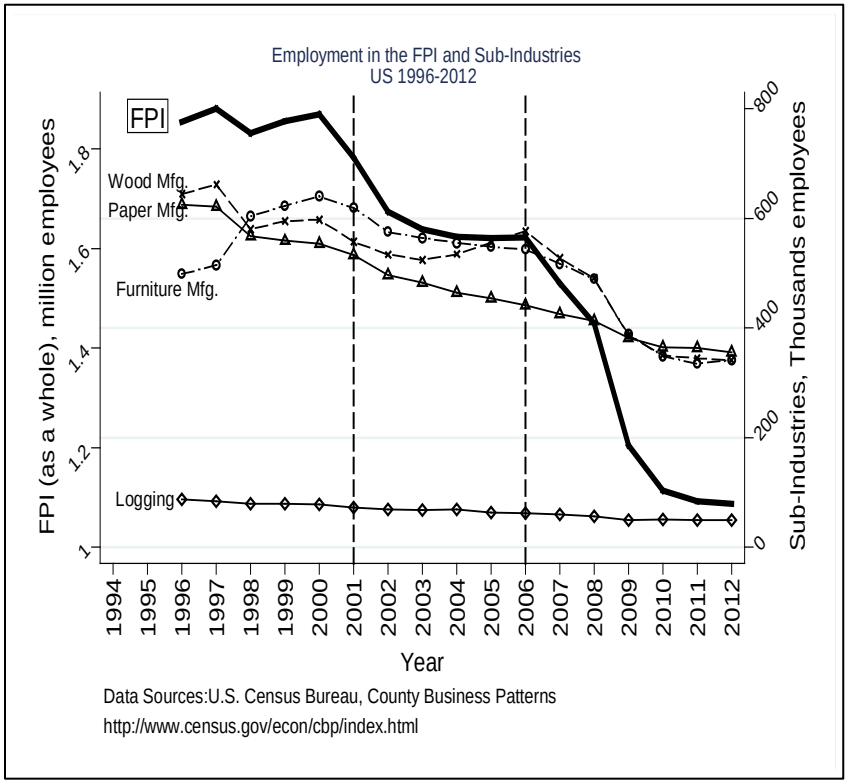
Note: Data source is IMPLAN data, LLC, System and data, www.implan.com

Figure 1.6: Changes in the Number of Establishments in each Time period



Note: Data source is US Census Bureau, county business statistics

Figure 1.7: Number of Establishments and Employees in All Forest Sector and Sub-Industries, US.



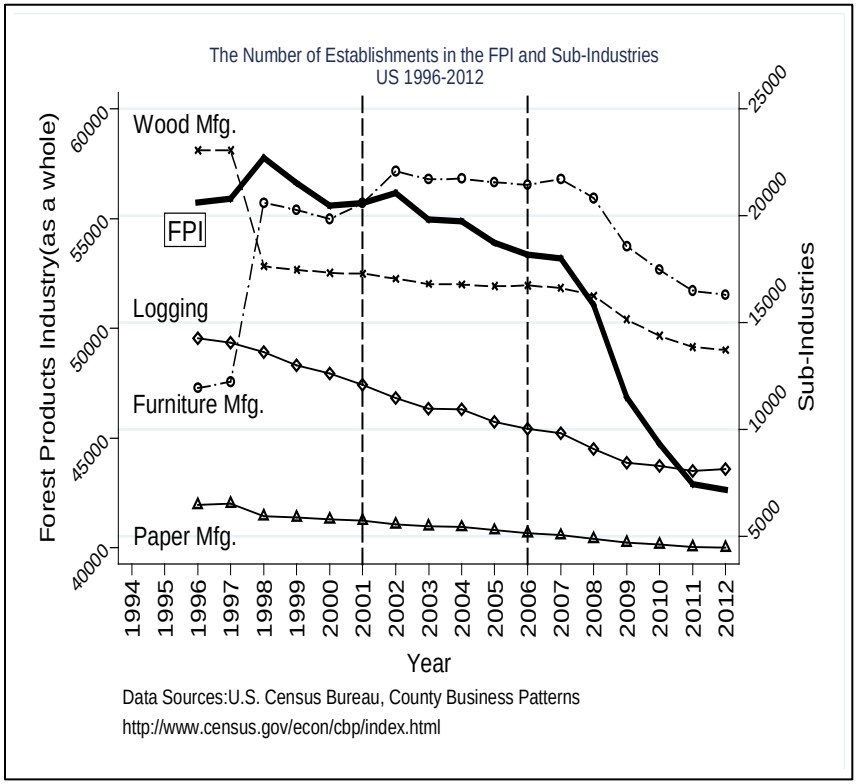
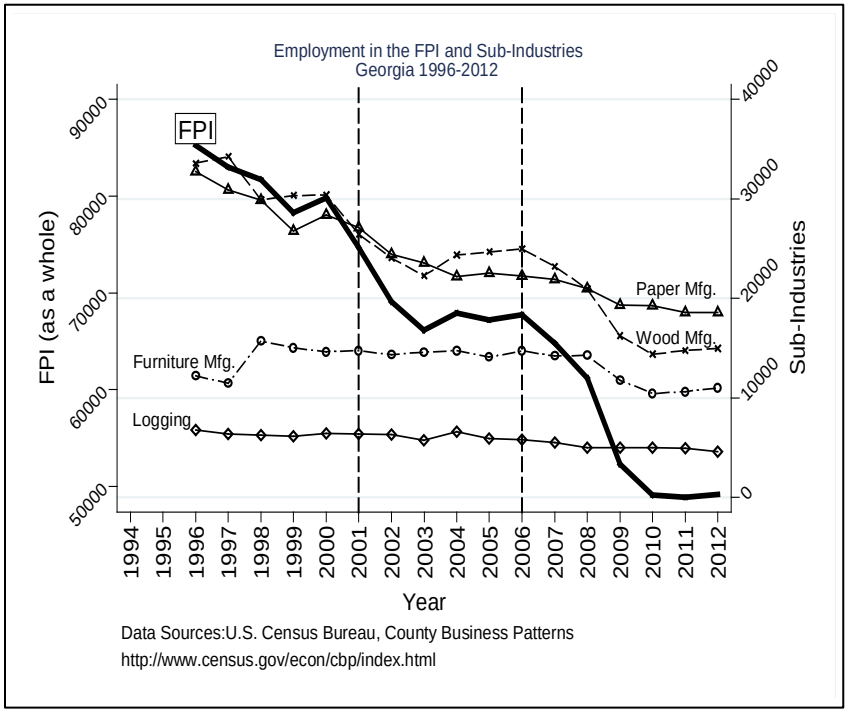


Figure 1.8: Number of Establishments and Employees in All Forest Sector and Sub-Industries, Georgia.



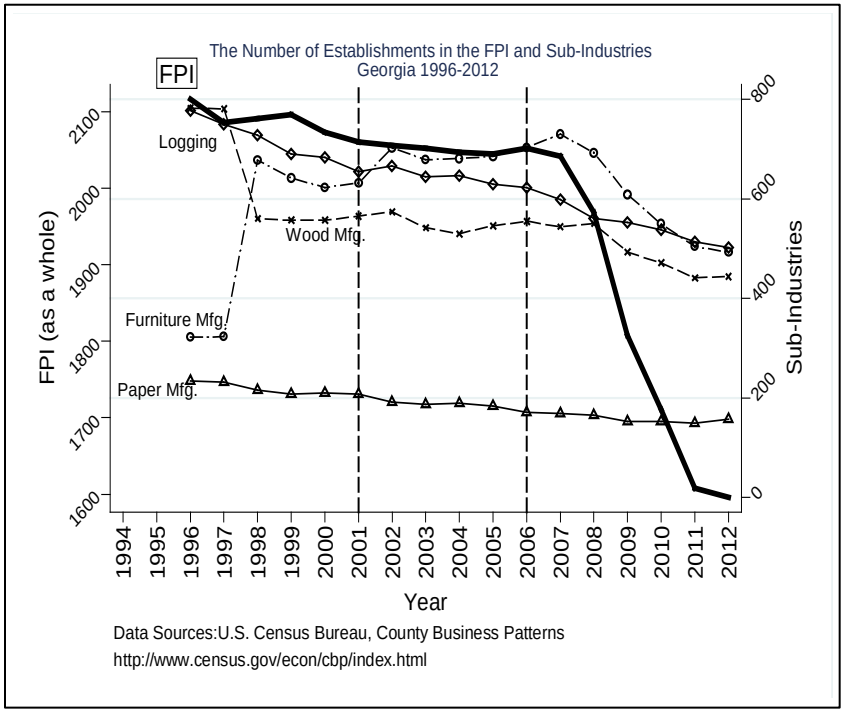
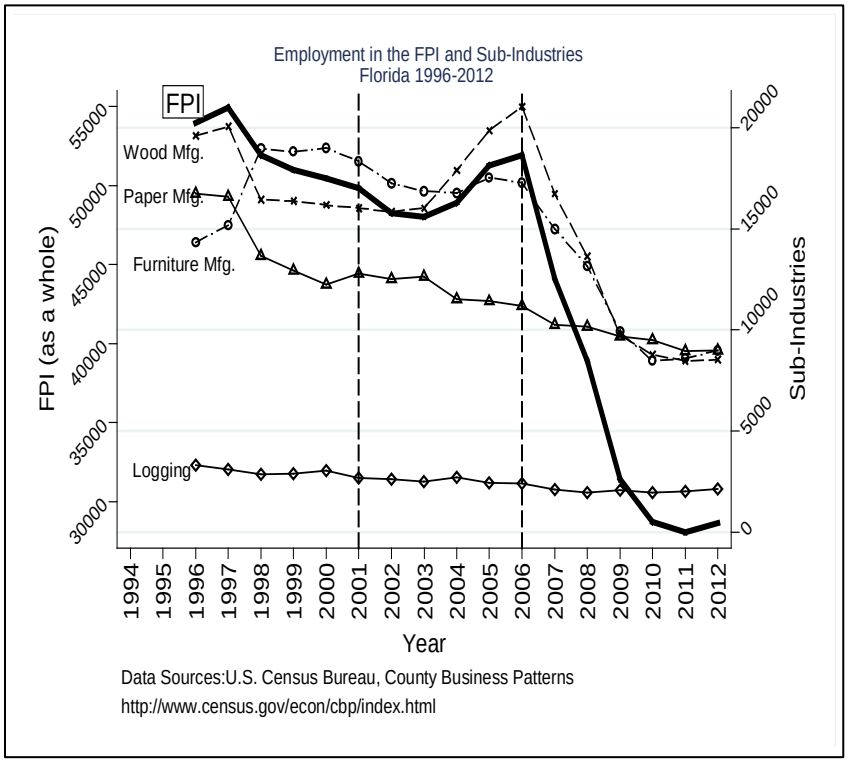


Figure 1.9: Number of Establishments and Employees in All Forest Sector and Sub-Industries, Florida.



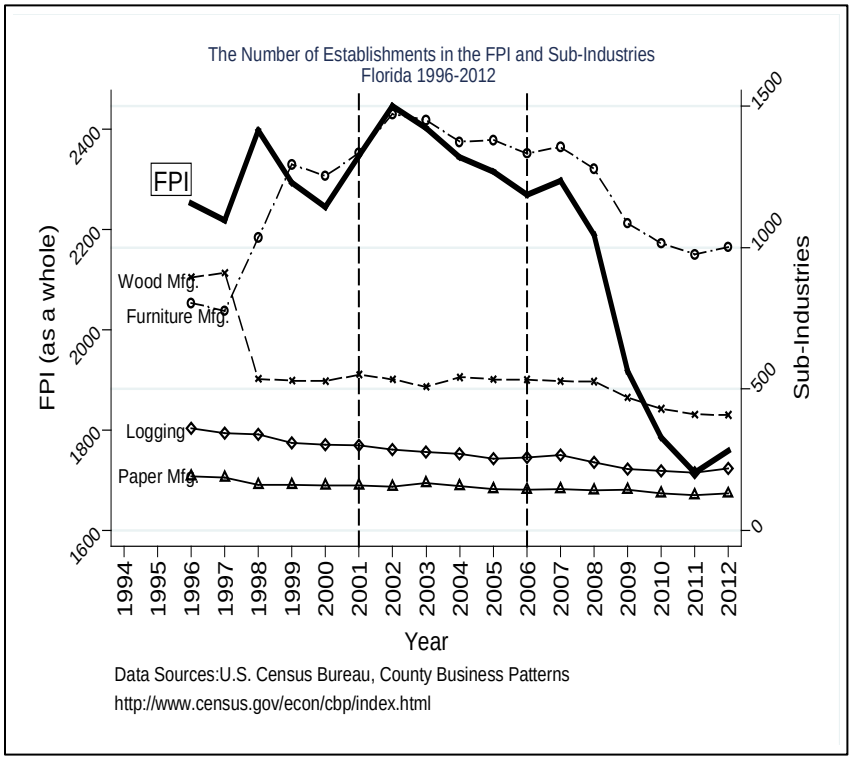
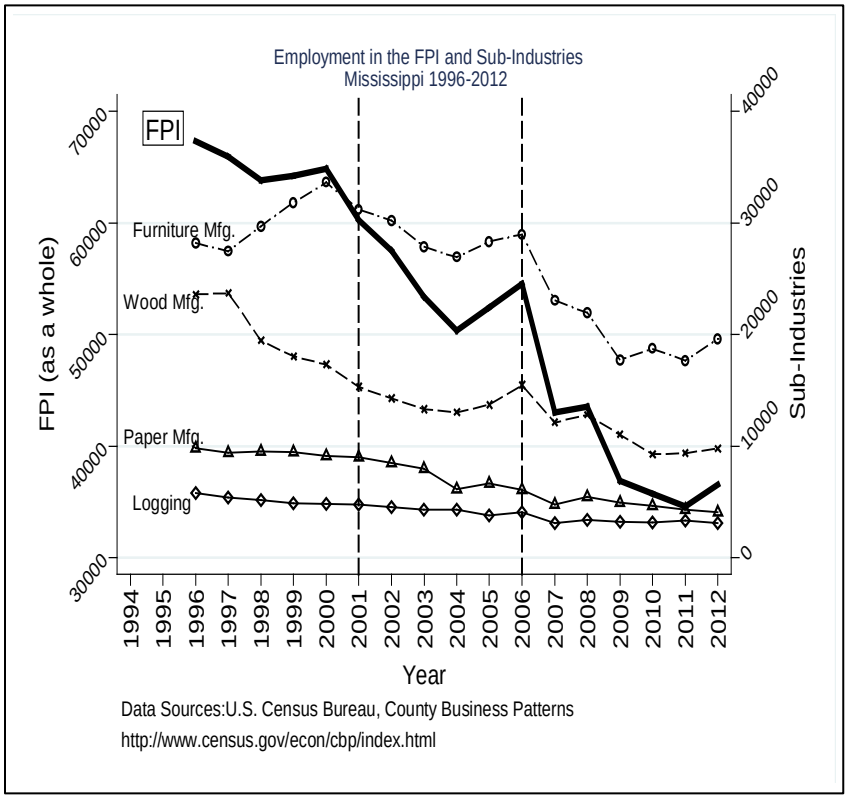


Figure 1.10: Number of Establishments and Employees in All Forest Sector and Sub-Industries, Mississippi.



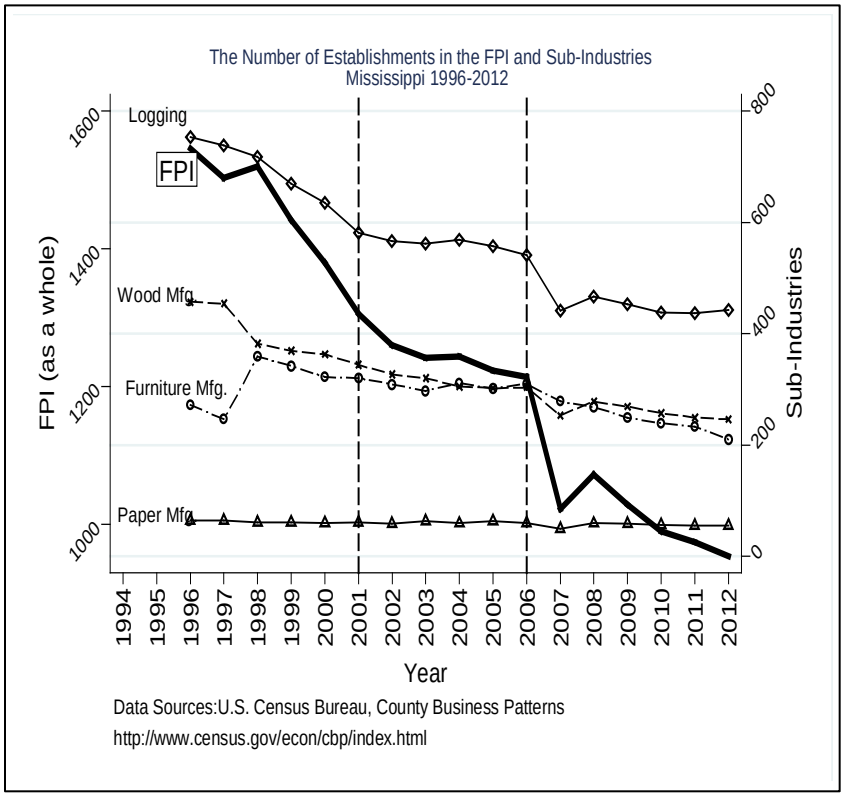
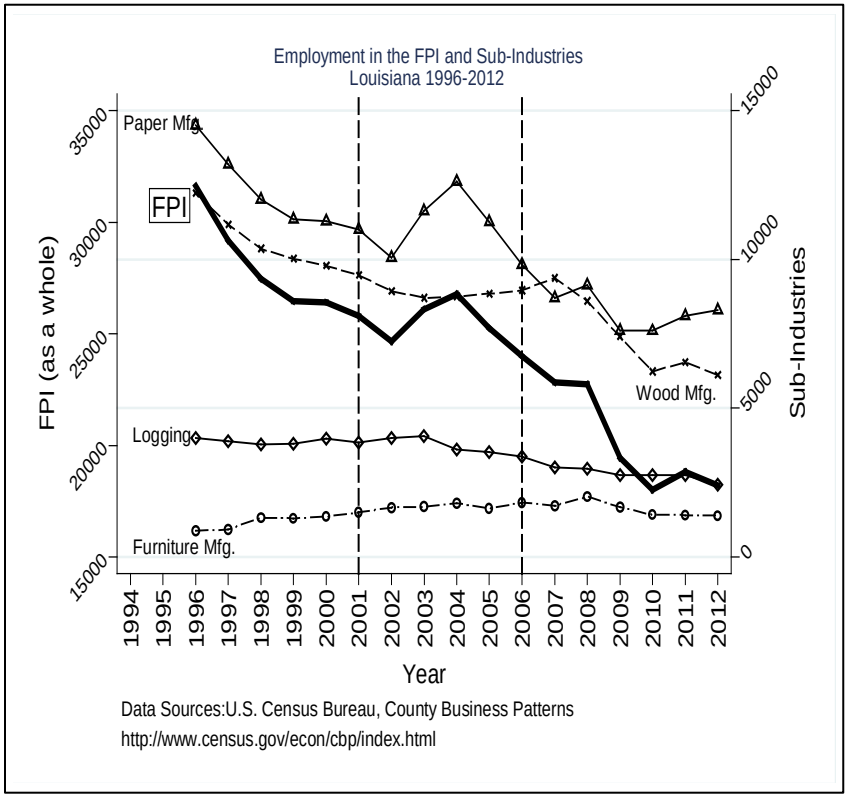


Figure 1.11: Number of Establishments and Employees in All Forest Sector and Sub-Industries, Louisiana.



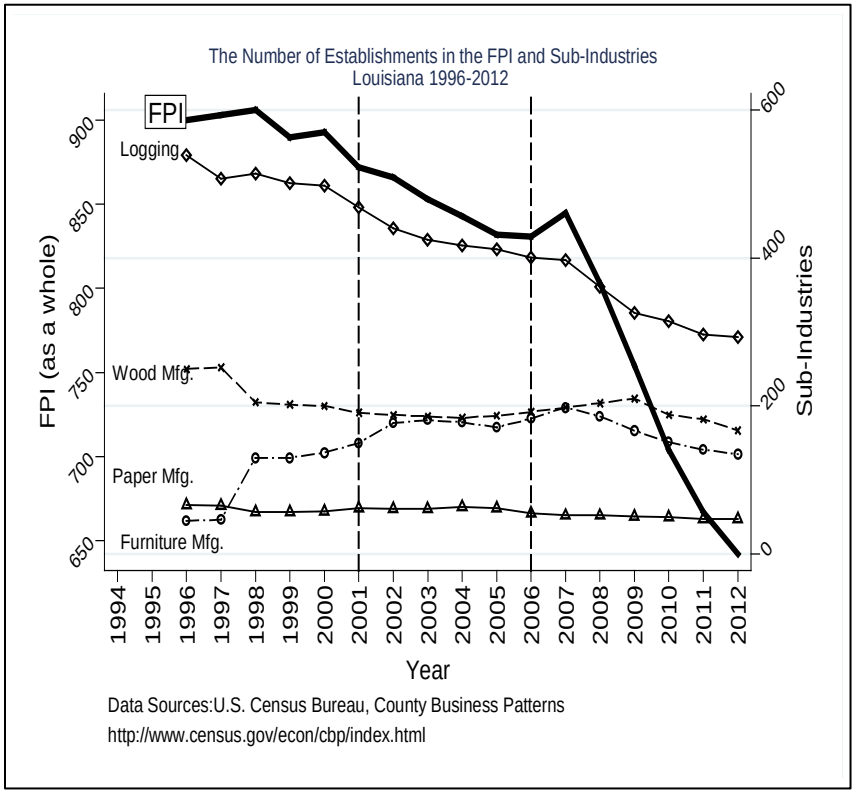


Table 1.1: Economic Impact of the Selected Forest Products Industries on West Alabama, (in million $)

		Labor Income				Value-Added				Output				
Sectors	Year	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	GDP share %
Logging NAICS:113	**1996**	47.9	9.1	5.9	62.9	110.1	17.6	10.8	138.5	289.5	40.4	17.7	**347.6**	**0.107**
	2001	75.8	17.8	9.5	103.1	158.9	29.0	19.4	207.3	305.8	53.1	33.9	**392.8**	**0.127**
	2006	77.8	30.8	10.9	119.6	123.5	44.1	25.7	193.3	454.5	123.7	41.1	**619.3**	**0.152**
	2012	106.0	15.3	11.5	132.9	79.5	16.6	27.6	123.7	155.8	33.7	44.2	**233.7**	**0.048**
Wood Mfg. NAICS:321	**1996**	126.7	54.1	18.6	199.4	182.6	102.7	34.3	319.5	509.3	242.2	56.2	**807.7**	**0.249**
	2001	128.1	75.1	20.0	223.3	167.4	134.3	41.1	342.7	587.3	289.5	71.6	**948.4**	**0.307**
	2006	112.3	58.6	16.9	187.8	191.3	94.6	39.7	325.6	572.3	278.3	63.5	**914.1**	**0.224**
	2012	91.7	54.7	13.8	160.3	129.6	64.8	32.9	227.3	421.6	142.7	52.8	**617.1**	**0.128**
Paper Mfg. NAICS:322	**1996**	347.7	167.8	53.1	568.6	659.0	309.0	97.8	1,065	1,881	664.5	160.1	**2,706**	**0.835**
	2001	282.7	109.8	38.7	431.2	541.6	195.7	79.3	816.6	1,621	426.1	138.3	**2,185**	**0.708**
	2006	372.1	143.7	51.1	566.9	710.8	245.5	120.0	1,076	2,085	623.4	191.8	**2,901**	**0.711**
	2012	267.8	133.0	37.8	438.6	742.6	206.5	90.2	1,039	2,200	467.5	144.8	**2,812**	**0.582**
Furniture Mfg. NAICS:337	**1996**	9.7	3.9	1.4	15.0	12.5	6.2	2.6	21.3	44.2	13.4	4.2	**61.9**	**0.019**
	2001	6.8	1.9	0.9	9.6	9.0	3.0	1.7	13.8	22.9	7.7	3	**33.6**	**0.011**
	2006	6.0	1.2	0.7	7.9	8.7	2.2	1.7	12.6	20	5.2	2.7	**27.8**	**0.007**
	2012	3.8	0.8	0.4	5.0	6.7	1.4	1.0	9.2	16.7	3.1	1.7	**21.5**	**0.004**

Note: The analysis presented in this table includes the following sectors with corresponding NAICS codes: Logging 113, Wood products manufacturing 321, Paper products manufacturing 322, Furniture products manufacturing 337. Nominal dollar values are transformed into real dollar values using appropriate producing price index for each industry considered here and the results reported are in 1996 US dollars. The entries for labor income, value-added, and output are in million dollars. The economic impact results shown in the table are for 10 West Alabama counties including, Clarke, Choctaw, Greene, Hale, Marengo, Monroe, Perry, Sumter, Washington, Wilcox. The last column in the Table shows the proportion of the industries' total output within the state's GDP (column15 = column 14/AL GDP).

Table 1.2: Economic Impact of the Wood Products Manufacturing Industries (NAICS: 321) on West Alabama, (in million $)

		Labor Income				Value-Added				Output				
Sectors	**Year**	**Direct Effect ($)**	**Indirect Effect ($)**	**Induced Effect ($)**	**Total Effect ($)**	**Direct Effect ($)**	**Indirect Effect ($)**	**Induced Effect ($)**	**Total Effect ($)**	**Direct Effect ($)**	**Indirect Effect ($)**	**Induced Effect ($)**	**Total Effect ($)**	**GDP share %**
Wood Mfg. as a whole	**1996**	126.6	54.1	18.6	199.4	182.5	102.6	34.3	319.5	509.2	242.2	56.18	**807.6**	**0.249**
	2001	128.1	75.1	20.0	223.2	167.3	134.2	41	342.7	587.3	289.4	71.61	**948.4**	**0.307**
	2006	112.3	58.5	16.9	187.8	191.3	94.6	39.7	325.6	572.2	278.2	63.52	**914.0**	**0.224**
	2012	91.7	54.7	13.7	160.2	129.5	64.8	32.9	227.2	421.6	142.7	52.80	**617.1**	**0.128**
Reconstituted wood products Mfg.	**1996**	7.00	1.56	0.00	8.56	14.47	3.2	0.01	17.7	33.21	7.39	0.01	**40.6**	**0.013**
	2001	6.96	0.75	0.00	7.70	13.06	1.4	0.01	94.1	38.40	4.12	0.02	**42.5**	**0.014**
	2006	10.7	0.70	0.00	11.4	39.68	2.6	0.01	42.2	73.15	4.79	0.01	**77.9**	**0.019**
	2012	5.39	0.34	0.00	5.73	6.61	0.4	0	7.02	17.16	1.07	0.00	**18.2**	**0.004**
Sawmills and wood preserve	**1996**	65.2	7.48	0.02	72.7	96.02	11.1	0.02	107.1	299.7	35.6	0.07	**335.4**	**0.104**
	2001	63.2	7.46	0.02	70.7	84.2	9.9	0.03	342.6	322.2	37.5	0.11	**359.9**	**0.117**
	2006	50.2	5.49	0.01	55.7	90.58	9.9	0.02	100.5	287.7	31.6	0.05	**319.3**	**0.078**
	2012	43.7	4.30	0.01	48.0	54.61	5.3	0.01	59.9	221.5	21.7	0.04	**243.2**	**0.050**
Veneer and plywood Mfg.	**1996**	41.5	4.84	0.01	46.3	54.58	6.3	0.01	60.9	141.4	16.5	0.02	**157.9**	**0.049**
	2001	45.4	5.38	0.01	50.8	53.41	6.3	0.01	59.7	180.8	21.3	0.03	**202.2**	**0.066**
	2006	42.5	3.81	0.00	46.3	49.89	4.4	0.01	54.3	179.6	16.1	0.02	**195.7**	**0.048**
	2012	34.3	2.13	0.00	36.4	56.45	3.5	0	59.9	152.6	9.46	0.01	**162.1**	**0.034**
Wood container and pallet Mfg.	**1996**	0.21	0.01	0.00	0.22	0.2	0.01	0	0.27	0.7	0.02	0.00	**0.7**	**0.0002**
	2001	0.05	0.00	0.00	0.06	0.06	0.01	0	0.07	0.1	0.02	0.00	**0.2**	**0.0001**
	2006	8.84	0.09	0.01	8.93	11.1	0.1	0.01	11.2	31.6	0.32	0.02	**32.1**	**0.008**
	2012	5.62	0.03	0.00	5.65	7.75	0.05	0	7.8	20.3	0.13	0.01	**20.4**	**0.004**

Note: The analysis presented in this table includes the wood products manufacturing (NAICS 321) with corresponding NAICS codes and the following sub-sectors: Reconstituted wood products manufacturing 321219, Sawmills and wood preservation 3211, Veneer and plywood manufacturing 32121, Wood container and pallet manufacturing 32192. Nominal dollar values are transformed into real dollar values using appropriate producing price index for each industry considered here and the results reported are in 1996 US dollars. The entries for Labor income, Value-Added, and Output are in million dollars. The economic impact results shown in the table are for 10 West Alabama counties including, Clarke, Choctaw, Greene, Hale, Marengo, Monroe, Perry, Sumter, Washington, Wilcox. The last column in the Table shows the proportion of the industries' total output within the state's GDP (column15 = column 14/AL GDP).

Table 1.3: Economic Impact of the Paper Products Manufacturing Industries (NAICS: 322) on West Alabama, (in million $)

		Labor Income				Value-Added				Output				
Sectors	Year	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	GDP share %
Paper Mfg. as a whole	**1996**	347.7	167.8	53.1	568.6	659.0	309.0	97.8	1,065.8	1,881.5	664.5	160.1	**2,706**	**0.835**
	2001	282.7	109.8	38.7	431.2	541.6	195.7	79.3	816.6	1,621.5	426.1	138.3	**2,185**	**0.708**
	2006	372.1	143.7	51.1	566.9	710.8	245.5	120.0	1,076.3	2,085.7	623.4	191.8	**2,901**	**0.711**
	2012	267.8	133.0	37.8	438.6	742.6	206.5	90.2	1,039.3	2,200.2	467.5	144.8	**2,812**	**0.582**
Paper & Paperboard mills	**1996**	227.2	0.8	0.01	228.0	398.1	1.5	0.01	399.6	1,070.8	4.0	0.03	**1,074**	**0.331**
	2001	249.7	1.4	0.05	251.1	498.1	2.8	0.10	501.0	1,430.3	8.0	0.28	**1,438**	**0.466**
	2006	277.7	0.7	0.01	278.3	575.4	1.4	0.01	576.8	1,593.8	3.8	0.04	**1,597**	**0.392**
	2012	184.3	2.1	0.03	186.4	563.7	6.1	0.11	569.9	1,572.4	17.2	0.29	**1,589**	**0.329**
Paperboard container Mfg.	**1996**	12.6	1.2	0.06	13.8	16.0	1.5	0.08	17.6	72.7	6.8	0.35	**79.9**	**0.025**
	2001	9.6	1.7	0.04	11.3	11.9	2.2	0.04	14.1	64.9	11.8	0.24	**76.9**	**0.025**
	2006	14.0	0.1	0.01	14.1	15.7	0.1	0.01	15.8	77.7	0.3	0.07	**78.1**	**0.019**
	2012	15.1	0.7	0.01	15.8	26.0	1.2	0.02	27.2	124.6	5.6	0.07	**130.2**	**0.027**
Pulp mills	**1996**	100.1	1.0	0.00	101.1	231.8	2.3	0.01	234.1	694.5	6.9	0.02	**701.4**	**0.216**
	2001	23.5	0.2	0.00	23.8	31.6	0.3	0.00	31.9	126.3	1.3	0.00	**127.6**	**0.041**
	2006	79.0	2.4	0.00	81.4	117.5	3.6	0.00	121.2	408.6	12.6	0.01	**421.2**	**0.103**
	2012	67.8	2.1	0.00	69.9	151.5	4.8	0.00	156.3	497.7	15.8	0.00	**513.5**	**0.106**

Note: The analysis presented in this table includes the paper products manufacturing (NAICS 322) with corresponding NAICS codes and the following sub-sectors: Paper and paperboard mills 32212-13, Paperboard container manufacturing 32221, and Pulp mills 32211. Nominal dollar values are transformed into real dollar values using appropriate producing price index for each industry considered here and the results reported are in 1996 US dollars. The entries for Labor income, Value-Added, and Output are in million dollars. The economic impact results shown in the table are for 10 West Alabama counties including, Clarke, Choctaw, Greene, Hale, Marengo, Monroe, Perry, Sumter, Washington, Wilcox. The last column in the Table shows the proportion of the industries' total output within the state's GDP (column15 = column 14/AL GDP).

Table 1.4: Economic Impact of the Furniture Products Manufacturing Industries (NAICS: 337) on West AL, (in million $)

		Labor Income				Value-Added				Output				
Sectors	Year	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	Direct Effect ($)	Indirect Effect ($)	Induced Effect ($)	Total Effect ($)	GDP share %
Furniture Mfg. as a whole	1996	9.7	3.9	1.4	15.0	12.5	6.2	2.6	21.3	44.2	13.4	4.2	**61.9**	**0.019**
	2001	6.8	1.9	0.9	9.6	9.0	3.0	1.7	13.8	22.9	7.7	3.1	**33.6**	**0.011**
	2006	6.0	1.2	0.7	7.9	8.7	2.2	1.7	12.6	20.0	5.2	2.7	**27.8**	**0.007**
	2012	3.8	0.8	0.4	5.0	6.7	1.4	1.0	9.2	16.7	3.1	1.7	**21.5**	**0.004**
Institutional Furniture Mfg.	1996	4.1	0.1	0.0	4.2	5.6	0.1	0.0	5.6	23.4	0.4	0.0	**23.8**	**0.007**
	2001	0.3	0.0	0.0	0.3	0.6	0.0	0.0	0.6	1.7	0.0	0.0	**1.7**	**0.001**
	2006	2.0	0.0	0.0	2.0	3.1	0.0	0.0	3.2	7.0	0.1	0.0	**7.0**	**0.002**
	2012	1.0	0.0	0.0	1.0	3.4	0.0	0.0	3.4	7.6	0.0	0.0	**7.6**	**0.002**
Household Furniture Mfg.	1996	5.4	0.0	0.0	5.4	6.7	0.0	0.0	6.7	20.1	0.1	0.0	**20.2**	**0.006**
	2001	2.2	0.0	0.0	2.2	3.0	0.0	0.0	3.0	10.3	0.0	0.0	**10.3**	**0.003**
	2006	0.9	0.0	0.0	0.9	1.4	0.0	0.0	1.4	3.4	0.1	0.0	**3.4**	**0.001**
	2012	0.4	0.0	0.0	0.4	0.7	0.0	0.0	0.7	1.4	0.0	0.0	**1.4**	**0.0003**
Wood cabinet & countertop Mfg.	1996	1.6	0.0	0.0	1.6	2.0	0.0	0.0	2.1	4.2	0.0	0.0	**4.3**	**0.001**
	2001	4.3	0.0	0.0	4.3	5.4	0.0	0.0	5.5	10.9	0.0	0.0	**11.0**	**0.004**
	2006	2.9	0.0	0.0	2.9	3.9	0.0	0.0	3.9	9.0	0.1	0.0	**9.0**	**0.002**
	2012	2.4	0.0	0.0	2.4	2.5	0.0	0.0	2.5	7.7	0.0	0.0	**7.7**	**0.002**

Note: The analysis presented in this table includes the furniture products manufacturing (NAICS 337) with corresponding NAICS codes and the following sub-sectors: Institutional furniture manufacturing 337122, Nonupholstered wood household furniture manufacturing 337127, and Wood kitchen cabinet and countertop manufacturing 33711. Nominal dollar values are transformed into real dollar values using appropriate producing price index for each industry considered here and the results reported are in 1996 US dollars. The entries for Labor income, Value-Added, and Output are in million dollars. The economic impact results shown in the table are for 10 West Alabama counties including, Clarke, Choctaw, Greene, Hale, Marengo, Monroe, Perry, Sumter, Washington, Wilcox. The last column in the Table shows the proportion of the industries' total output within the state's GDP (column15 = column 14/AL GDP).

Figure 1.12: Change in Output of the Forest Products Industries of AL during 2007-2009 Economic Recession

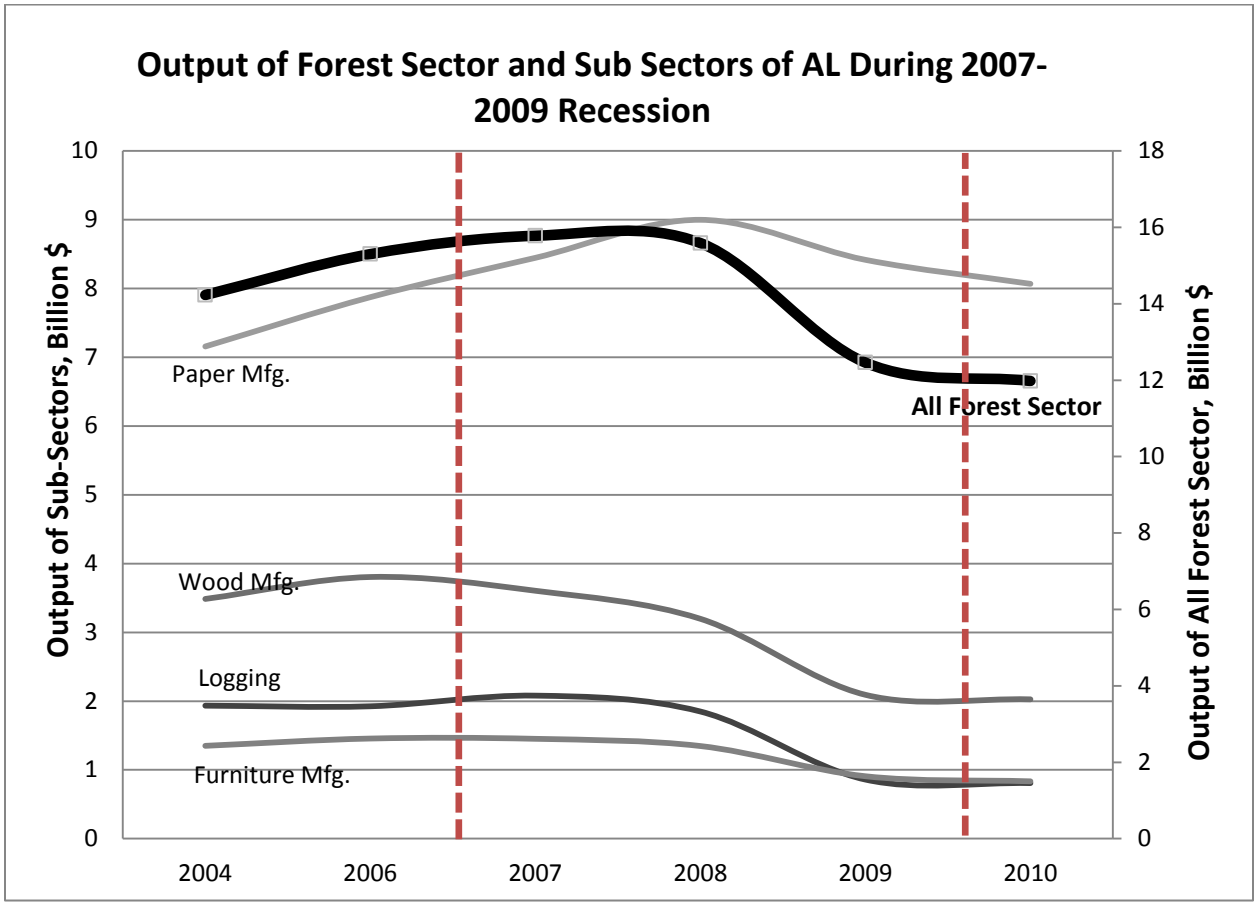


Figure 1.13: Changes in Employment and Number of Establishments in the Forest Products Industry of Alabama during 2007-2009 Economic Recession

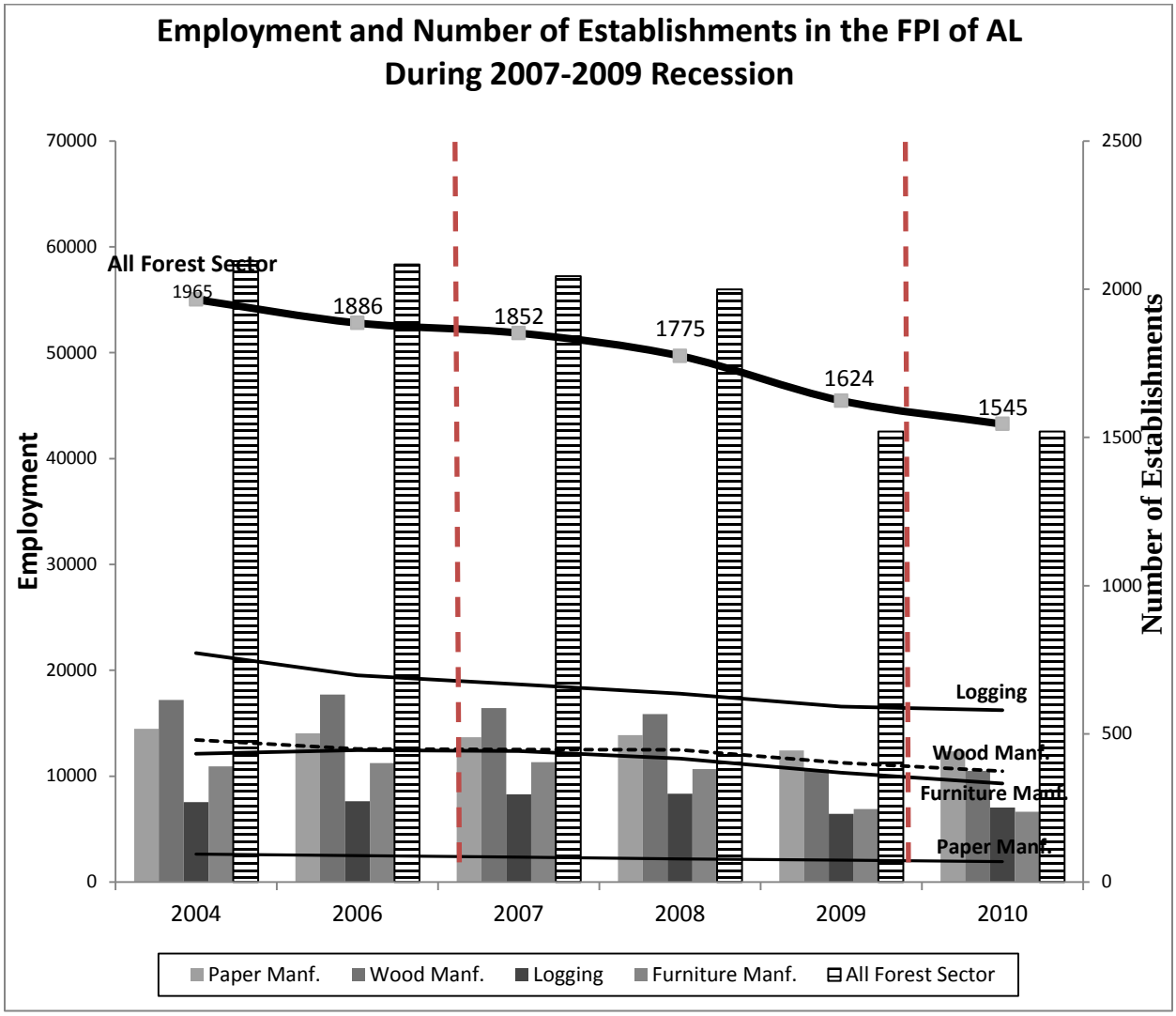
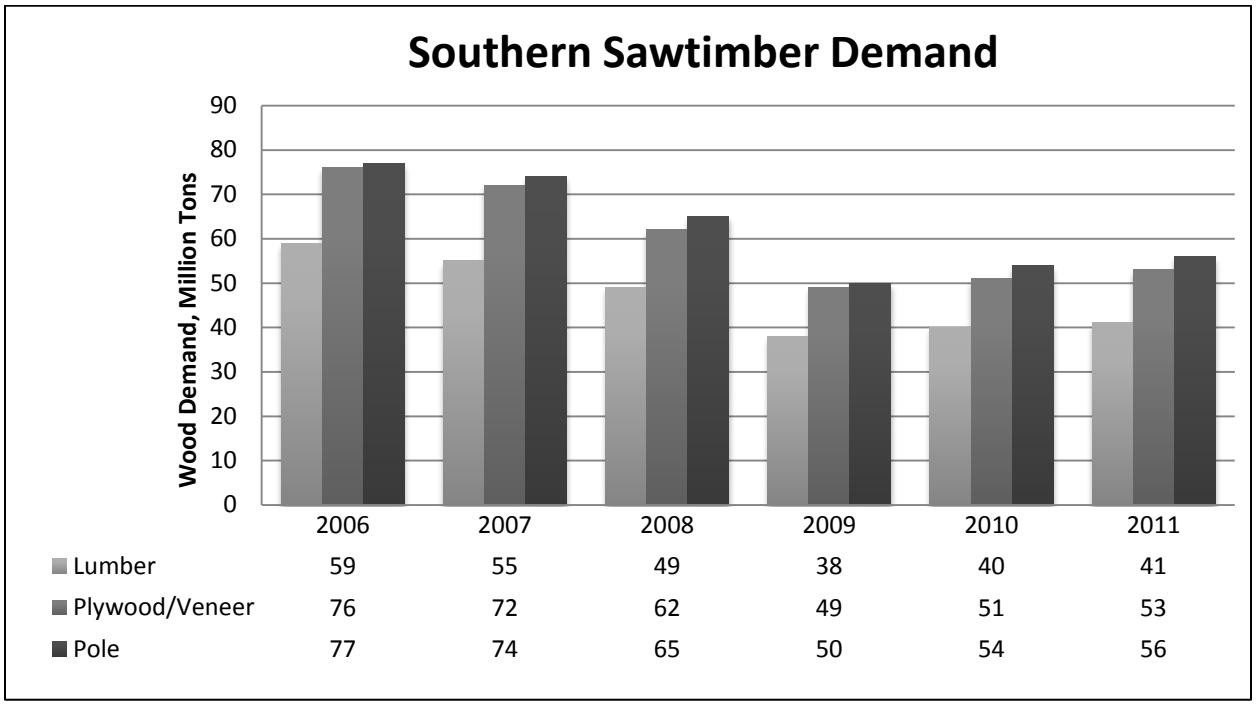


Figure 1.14: Sawtimber Demand the Southern United States



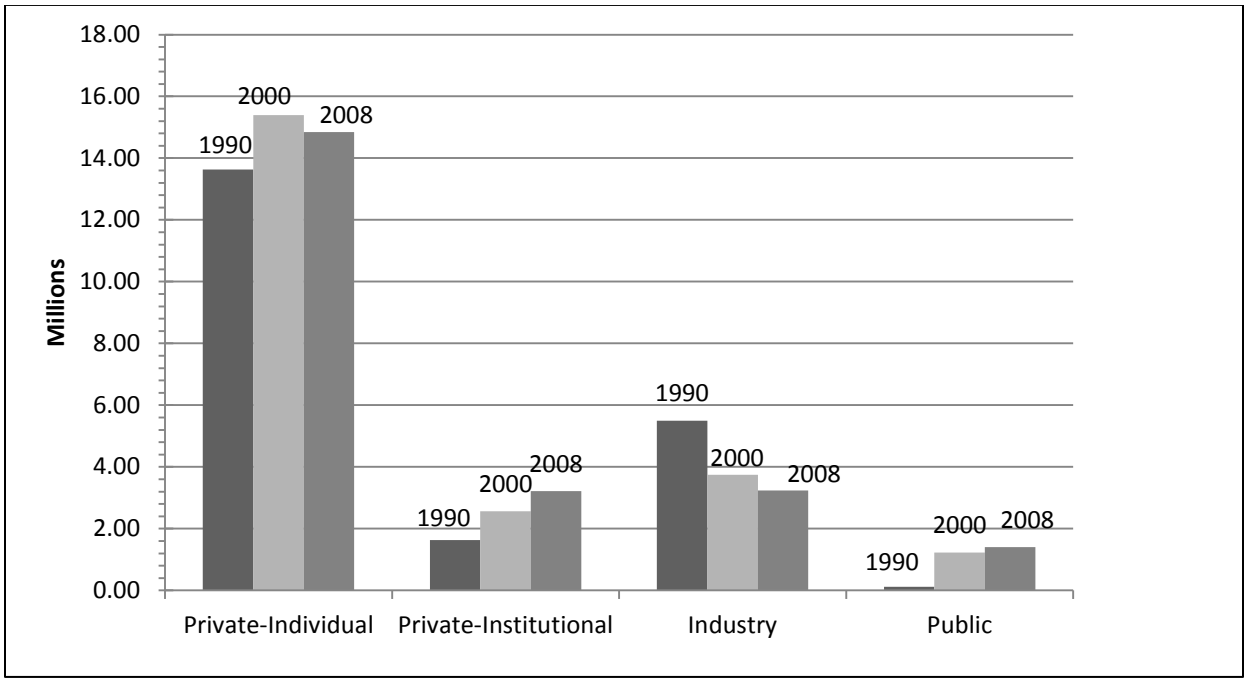
Data Sources: FORISK Consulting, http://www.forisk.com/products/ and Wood Demand Report, http://www.ugacfb.com/wp-content/uploads/2012/10/CFB_WDReport_Q2-2012.pdf

Table 1.5: Industrial Round Wood Production in the World, in million m^3.

Year	Brazil	Asia	Canada	China	Euro. Union	Finland	India	Indonesia	Japan	New Zealand	Australia	USA	W. Europe	S. Asia
1990	74	268	156	91	293	40	35	38	29	13	34	427	137	42
2000	103	269	199	96	342	50	41	49	18	19	47	421	114	49
2001	90	256	183	93	313	48	42	44	16	21	48	403	90	50
2002	96	264	195	93	322	49	43	52	15	22	50	405	87	50
2003	120	278	177	95	336	49	43	52	15	21	51	406	96	51
2004	107	283	205	95	341	49	44	52	16	20	50	418	99	52
2005	118	282	200	95	371	47	45	50	16	19	50	423	101	53
2006	119	280	181	95	341	46	46	47	17	19	51	412	107	53
2007	122	293	161	102	382	51	46	47	18	20	52	379	124	55
2008	115	323	136	125	338	46	47	54	18	19	53	337	100	55
2009	122	337	113	148	304	37	48	48	17	21	51	292	88	56
2010	128	360	139	162	339	46	49	54	17	24	57	336	97	57
2011	140	368	147	161	340	46	50	61	18	26	60	355	96	57
2012	147	373	147	160	330	45	50	63	18	27	58	347	89	57
since 2000	44	104	-52	64	-12	-6	8	14	0	8	11	-74	-25	8
% Change	42.5%	38.7%	-26.2%	66.2%	-3.4%	-11.0%	20.3%	28.2%	2.7%	42.2%	22.9%	-17.5%	-21.9%	16.1%
1990-2000	29	0	43	5	49	10	6	10	-11	6	13	-7	-24	7
% Change	38.7%	0.1%	27.5%	5.3%	16.6%	24.6%	17.5%	27.3%	-38.6%	46.9%	39.3%	-1.5%	-17.3%	17.7%

Data Source: Food and Agriculture Organization of the United Nations, Statistics Division. http://faostat3.fao.org/browse/F/*/E

Figure 1.15: Timberland Acres by Ownership in Alabama, 1990-2008, in Million Acres



Data Source: FIA, 2008.

Table 1.6: Estimated U. S. Timberland Sales Grouped by Seller (Sales over 100,000 acres)

Seller	Buyers	States	Acres
Boise Cascade	Hancock; Madison Dearborn Partners; Forest Capital Partners	Louisiana, Washington, Oregon, Idaho, Alabama, Minnesota	4,579,000
Bowater Inc.	State of Tennessee; Hancock	Tennessee, South Carolina, North Carolina	131,200
Campbell Group	Sierra Pacific Industries	Washington, Oregon	183,000
Corrigan Timb.	RMK Timberland Group	Texas	115,000
Domtar	Chateaugay;Nature Cons.	New York	104,400
Escanaba Timber LLC	Plum Creek Timber Company, Inc.	Michigan	650,000
Finch Paper LLC	The Nature Conservancy	New York	161,000
Georgia-Pacific	Plum Creek	Various	4,700,000
GMO Renewable Resources	Rayonier	New York, Texas, Oklahoma, Arkansas, Alabama, LA	174,000
Great Eastern Timber Co.	Plum Creek; Rayonier	Arkansas, New Hampshire, South Carolina, Alabama	222,000
Harvard Management Co.	Hancock	Texas, Pennsylvania, New York, Washington	915,000
International Paper	Hancock; Nature Conservancy; Resource Mgt. Service; 6 others	Alabama, Michigan, Texas, Louisiana, Arkansas, New York, Maine, New Hampshire, Georgia, Virginia, South Carolina	9,706,530
MeadWestvaco Corporation	Penn Virginia; Wells Timberland; Forestland Group; Wagner Forest	Alabama, Georgia, Ohio, West Virginia, Maine, New Hampshire	1,030,000
Menasha Forest p.	The Campbell Group	Washington, Oregon	135,500
State Teachers Retirement System of Ohio	The Campbell Group, Inc.	Oregon, Washington, California, Alabama, Arkansas, Florida, Mississippi, Tennessee	430,000
Stora Enso	Plum Creek Timber	Michigan, Wisconsin	309,000
TC and I Timber	Molpus Woodlands	Alabama	165,000
Temple-Inland Inc.	The Campbell Group, Inc. affiliate	Texas, Lousiana, Georgia, Alabama	1,550,000
Trust for Public Land	Connecticut Lakes Timber Co.	New Hampshire	146,400
Western Pacific	Potlatch Co.	Idaho	179,900
Weyerhaeuser	Hancock	Washington	324,000
Total			25,910,930

Source: Corporate websites, news releases, and trade journals.

CHAPTER II - Impact of Variable Costs, Demand, and Labor Productivity on Changes in the Forest Products Industry of Alabama, 1996-2012

Abstract: The forest products industry (FPI) in Alabama, the second largest manufacturing sector of the state, has been experiencing a recession since the mid-1990s. This study investigates the determinants of this decline in the industry, using a county level panel data set that spans the period between 1996 and 2012. Four sub-sectors are analyzed separately, including the logging, wood, paper, and furniture manufacturing sectors. Results suggest that increases in average variable cost, rather than decreases in demand, are more strongly associated with the recession as measured by the number of operating establishments. Decomposition analysis indicates that the cost of materials, rather than labor, contribute more to the decline in the number of forest sector establishments in the state. This could be because increases in labor costs, such as wage increases, are accompanied by increases in labor productivity.

Keywords: Demand, Cost, Labor Productivity, Decline, Forest Products Industry.

1. Introduction

As previously discussed, the forest products industry in Alabama has been experiencing a general downturn in the number of establishments, employment, and production since the 1990's (AFC 2010; Bentley et al. 2008; Bentley et al. 2013; Hartsell and Cooper, 2013). For example, the total number of establishments in the forest products industry has decreased by 46% (1087 various sizes of production facilities) in the last two decades. The industry's output in real dollar values has fallen from $11.7 billion to $9 billion since the mid 1990's .The industry has lost 42% of its employees in the last two decades1. This decline in the industry is not limited to Alabama, the forest product industries throughout the United States have also experienced this decline in the last two decades (Bentley et al. 2013; Collins et al. 2008; Hartsell and Cooper, 2013; Johnson et al. 2011). Figures 2.2 through 2.8 show changes in the number of establishments and employees in Alabama, neighboring states Georgia and Mississippi as well as in the Nation as a whole since the mid-1990s. This study analyzes the factors affecting the decline in the forest products industry of Alabama. The main focus of the current study is on Alabama, but the findings of this study have implications for other states in the southern United States which share similar industry structures and resource endowments.

Relevant literature suggests there are many factors affected the decline in the industry, such as a 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 (i.e., mergers and acquisitions, Conrad et al. 2010), taxes and regulations, as well as firm-based (i.e., internal) factors, such as cost and

labor productivity. Given the importance of the industry in providing revenue and jobs to Alabama, understanding the factors behind the decline is critical.

Despite its importance, only a handful of studies in the literature have examined the perceived factors behind the decline in the forest products industries of Alabama. Collins et al. (2008), for example, discussed several factors affecting the decline, such as international currency exchange rates and global cost-competitiveness. Bael and Sedjo (2006) examined the impact of globalization on production place and patterns (e.g., natural or planted forestland) of the forest products industry. Woodall et al. (2011) reported on changes in employment and mill numbers 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 on the forest industry of the Southern US. Ince (2002) discussed longer-term implications of the 2000-2001 recessions on the forest sector of the Southern US. Conrad et al. (2010) investigated the effect of forest ownership and forest industry structure on mill closures and the wood supply chain in the southern US. Keegan et al. (2004) provided a description changes in the structure, capacity, and condition of Idaho's primary forest products industry following the recession in 2007-2009.

None of the before mentioned studies controlled for the entire sets of possible determinants of the decline in the forest sector. Consequently, the analyses presented in these papers may have biased estimates due to the omission of important determinants of the decline (i.e., bias caused by omission of relevant variables)[16]. For example, Hodges et al. (2011)

[16] For omitted variable bias, see Chapter 8 in Greene (2002).

explained 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 costs. The econometric analyses in the current study control for many possible determinants of the decline in the forest products industry. In addition, the above studies only considered external factors (i.e., external to the establishments and beyond their control such as economic crisis, demand etc.) and ignored internal factors (i.e., internal to the establishments and presumably within their control such as cost of production, labor productivity etc.) that may affect the decline in the industry. However, some studies suggested that internal factors were 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 internal factors along with external factors.

Using a panel dataset of Alabama counties spanning the period between 1996 and 2012, this article employs econometric analyses[17] to estimate the determinants of the general downturn in the forest products industry[18]. Four major sectors in the industry are analyzed separately, including the logging, wood, paper, and furniture manufacturing sectors. The analyses are

[17] The current study is the first study in the literature that employs econometric analyses for the determinants of the decline the forest products industry.

[18] In this study, the decline in the number of establishments represents the decline in the forest products industry of Alabama. However, changes in production level or employment in the industry can be also used as a proxy for the decline in the industry. Due to the data available at the county level, and the methods used in the analyses, the number of establishments is the only available proxy for measuring the decline in the industry.

applied to three different study regions, Alabama as a whole, rural counties within the state, where many of the production activities are likely to take place, and the Black Belt-West Alabama region, characterized by an abundance of forest industry establishments and timber resources (see Map 1 in Appendices). The analyses in the current study control for demand for forest products, variable costs of production, business cycle, economic recessions, technological developments, and some county characteristics, such as population density and average age level to investigate the changes in the number of establishments in the industry. Specifically, changes in the number of establishments are linked to changes in two important factors, average variable cost of production and demand for forest products. Based on economic theory, demand and average variable cost are two crucial factors in a firm's decision to shut down (see Figure 2.1) because a firm will decide to shut down production if the price of the goods produced (i.e., the revenue received from the sale of the goods) is lower than average variable cost (i.e., cannot even cover the variable costs of production).

Within average variable cost, the effect of material and labor costs on the number of establishments is estimated. Then, within labor cost, the effect of wages and labor productivity on the number of establishments is also estimated. The results of these analyses should then be useful to decide which factors (e.g., demand, material-labor costs, wages, or labor productivity) the leaders in the industry or government[19] should aim to control or improve in order to enhance the existence and competitiveness of the industry in local and global markets.

The main findings are that: (1) changes in the average variable costs of production impact the decline in the number of establishments much more than changes in demand for forest

[19] The government can improve the industry by enacting better tax or trade policies.

products; (2) the impacts of changes in material costs on the decline are crucial in manufacturing industries; (3) improvements in labor productivity compensating for increases in wages, may lead to an increase in the number of establishments, other things being equal.

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

2. Empirical Framework

2.1. Data

As discussed above, we employ econometric estimations to investigate the effect of demand and average variable costs on the number of establishments in the forest products industry of Alabama. Our county level panel dataset spanning the years between 1996 and 2012 includes data for the number of establishments, production, value-added, and labor income in the forest products industry of the state. All data for demand and average variable costs are in nominal dollar values and are obtained from a single data source which will be explained below.

The results of the estimations are presented for the following industries in the forest products industries of Alabama with their North America Industry Classification System (NAICS) codes: logging (NAICS: 113), wood products manufacturing (NAICS: 321), pulp and paper products manufacturing (NAICS: 322), and furniture products manufacturing (NAICS: 337). These industries are included to ensure good coverage of the forest products industry within the state. Table A 1 in the Appendices lists the aggregated and disaggregated forest based industry classifications analyzed in this study.

All data for the sub-industries in Table A 1 in the Appendices is aggregated, leading readily to the data for the industries used in the current study. In other words, these industries are obtained by clustering the sub-industries that produce similar products. For example, the industry "Wood Products Manufacturing, NAICS:321" is generated by combining several sub-industries such as sawmills and wood preserving, veneer and plywood mills, reconstituted wood products, millwork, planning mills, and flooring mills. Detailed information about what manufacturing sectors are operating in each industry, their NAICS codes and commodity types is provided in Table A 1 in the Appendices.

The data for the dependent variable, the number of establishments in the forest products industry, is obtained from the County Business Patterns (CBP) databases 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. CBP includes data on the size of establishments in terms of their number of employees. Only establishments with fewer than 50 employees (e.g., ~75% of establishments in Alabama) are included in the study in effort to prevent the dependent variable (i.e., the number of establishments) from being skewed by the inclusion of very large establishments (i.e., 1,000 or more employees). Another potential problem with the CBP data is that database includes establishments that have fallen out of production resulting in zero output for a given year in the data. Therefore, establishments with zero output for a given year are excluded from the analyses in this study.

Data for demand and average variable costs are 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 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. It is valuable to use data from a single source because this ensures homogeneity of definitions and consistency in data collection method. This also allows the data for the various sub-industries to be combined in order to represent all of the forest products industries as one group.

Table 2.1 shows the yearly data series used to calculate demand and average variable cost for the model. As the data set did not contain any variables that could be used to model "demand" for forest products, it is necessary to use a demand proxy. Therefore, we use "sales" of the industry as a demand proxy in this study. Sales data provides the quantity sold of a forest product for a given time period, and the quantity sold represents the demand for that particular forest product (Conrad 1976). This means if x units of a product were sold in a time period, then the demand for that product in the same time period was x units, under no stock out assumption (Wecker 1978). Since all the variables in the IMPLAN datasets are provided in nominal United States dollars, we transform the nominal values of the variables, including sales, variable costs, wages, and output per worker into the real dollars using the producer price index for each study industry, with 1996 as a base year. The results then are all expressed in US dollars at the purchasing power of 1996.

Our dataset also includes data for concerning the economic and social characteristics of each county that are likely to impact demand for forest products, cost of production, and the decline in the industry. For example, population density (i.e., number of people per square mile) and average age level in the counties of Alabama are control variables in the models. They are available in the database of the Census Bureau. Another control variable is the unemployment rate, which are obtained from the databases in the Bureau of Labor Statistics.

2.2. Model

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

Following the guidelines described above, we estimate the models depicted below:

(1) $$E^{i}_{c,t} = \beta_0 + \beta_1 S^{i}_{c,t-1} + \beta_2 AVC^{i}_{c,t} + \beta_3 X_{c,t} + d_{07\text{-}09} + \lambda_t + \varepsilon_{c,t}$$

(2) $$E^{i}_{c,t} = \beta_0 + \beta_1 S^{i}_{c,t-1} + \beta_{21} AMC^{i}_{c,t} + \beta_{22} ALC^{i}_{c,t} + \beta_3 X_{c,t} + d_{07\text{-}09} + \lambda_t + \varepsilon_{c,t}$$

(3) $$E^{i}_{c,t} = \beta_0 + \beta_1 S^{i}_{c,t-1} + \beta_{21} AMC^{i}_{c,t} + \beta_{221} W^{i}_{c,t} + \beta_{232} LP^{i}_{c,t} + \beta_3 X_{c,t} + d_{07\text{-}09} + \lambda_t + \varepsilon_{c,t}$$

, where $E^{i}_{c,t\,t}$ stands for the number of establishments in the industry i, in county c in year t. $S^{i}_{c,t-1}$ represents the sales of the industry i in county c and in year t-1, $AVC^{i}_{c,t}$ represents average variable costs per dollar of output, $AMC^{i}_{c,t}$ shows average material cost, $ALC^{i}_{c,t}$ denotes labor cost, $W^{i}_{c,t}$ represents wages per worker, $LP^{i}_{c,t}$ stands for labor productivity in industry i in county

c in year t. $X_{c,t}$ appears in each model to represent control variables. $d_{07\text{-}09}$ denotes a dummy variable for a time period of 2007-2009. λ_t represents year fixed effects. $\beta_{\#}$'s are the coefficients of the independent variables. $\varepsilon_{c,t}$ represents error terms which are assumed to be independently and identically distributed across industries and counties.

In order to control for changes in demand for forest products, all of the models include $S^i_{c,t-1}$, the sales of the industry, as a demand proxy. It represents demand for the forest products industry in county c in year t. In order to eliminate the possibility of an endogeneity problem between $S^i_{c,t}$ and the number of establishments, we use sales data from the previous year (i.e., $S^i_{c,t-1}$) in the estimations. We expect that a high level of sales is associated with a high demand for forest products and higher number of establishments in the industry[20], so the expected sign of $S^i_{c,t-1}$ will be positive in all models. This proposition has been supported by numerous studies on the relationship between sales, demand, and price expectations on industry prices (Broussard and Pilotte 2004; Wecker 1978; Mulligan 1997).

In Model (1), average variable cost per dollar of output, $AVC^i_{c,t}$, is included in the model to indicate the impact of variable cost of production on the number of establishments in the forest industry i, in county c, and in year t. The model includes average variable cost because it is the most important indicator for the shutdown decision of establishments (Varian 1984; Neilson and Winter 1998; Browning and Zupan 2004). Higher variable costs render businesses less profitable, therefore companies invest less and fewer workers will be employed (Israel 2015; Hoppe 2004). Due to increasing variable costs and decreasing profits, establishments will more

[20] Increasing demand for forest products is more likely to be related to new firms entering the market.

likely be in shutdown condition (see Figure 2.1). Therefore, we expect that, in general, increasing average variable costs leads to a decreasing number of establishments in the industry, other things are held constant.

The major components of variable cost include material and labor costs. Thus, the change in the number of establishments due to the change in $AVC^{i}_{c,t}$ can be decomposed further to analyze the impact of material cost, $AMC^{i}_{c,t}$, and labor cost, $ALC^{i}_{c,t}$. Model (2) includes average material cost per dollar of output, $AMC^{i}_{c,t}$, and average labor cost per dollar of output, $ALC^{i}_{c,t}$ to show how components of $AVC^{i}_{c,t}$ impact the number of establishments in the industry separately. Similar to $AVC^{i}_{c,t}$, we expect average material and labor costs will also negatively affect the number of establishments in the forest products industry.

A final decomposition is that of the average labor cost, $LC^{i}_{c,t}$, into a wage (i.e., wages per worker in a year) effect, $W_{c,t}$, and a labor productivity (i.e., production per worker in a year) effect, $LP^{i}_{c,t}$, which is achieved in Model (3). Average labor cost per dollar of output is calculated by multiplying wage rates ($W^{i}_{c,t}$) with number of employees (N) and dividing by the output (Q) in each industry ($ALC^{i}_{c,t} = W^{i}_{c,t} * N/Q$). In this calculation, N/Q shows the inverse labor productivity ($1/ LP^{i}_{c,t} = (N/Q)$) in each industry. In Model (3), we expect that wage rates, $W^{i}_{c,t}$, are negatively correlated with the number of establishments due to increasing costs. However, we expect that labor productivity $LP^{i}_{c,t}$ is positively correlated with the number of establishments in the industry due to decreasing costs in the production process. These decomposition analyses can be used to determine the importance of each component of variable costs in changes 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), Hoekstra and Bergh (2002) and Fuss and Waverman (2006).

$X_{c,t}$ in models 1-3 consists of the unemployment rate, population density, and average age level in the counties of Alabama as control variables. The unemployment rate is one of the most common proxies in the literature to capture the effect of the business cycle on the economies of the regions (Domowitz et al. 1986a, b; Israel 2015; Stock and Watson 1999). Since the forest products industry is one of the primary employers in the counties included in the study, there may be an endogeneity problem between the unemployment rate and the dependent variable. In order to eliminate this problem, we use unemployment rates from the previous year in our analyses. Since a higher unemployment rate is indicative of unfavorable economic conditions in general, we expect there to be a negative relationship between the unemployment rate and the number of establishments in the forest products industry. To capture the impact of the economic recession that occurred between 2007 and 2009 on the forest product industry, we include a dummy variable, $d_{07\text{-}09}$, for these recession years in each model we considered in the analysis.

Except for the dummy variable for the economic recession years, logarithmic transformations of all the variables are used in each estimation model. Also, all the independent variables except the control variables are in real United States dollars based on the producer price index (PPI 1996 = 100). Since the data used in this study is not seasonally adjusted, we add λ_t, yearly dummies, to each model to control for annual business cycle factors. Including yearly dummies also controls for technological developments, such as more usage of electronic media or developments in the bioenergy sector. Description and the summary statistics of all the variables of the models are reported in Table 2.1 and Table 2.2, respectively.

3. Results

Models 1-3 are estimated by fixed effects regression method for three different study regions: (1) all counties in Alabama (N = 1139); (2) rural counties within the state (N = 952), where many of the production activities are likely to take place; and (3) counties within the Black Belt-West Alabama region (N = 357), characterized by abundant of the forest industry and timber resources (see Map 1 in the Appendices). The regression results are presented for each region and industry in Table 2.3 through Table 2.5. The industries covered in the analyses of this study and their NAICS codes (North America Industry Classification System) are logging (113), wood products manufacturing (321), paper products manufacturing (322), and furniture products manufacturing (337). The tables present the results from the specification where the number of establishments in the forest products industries of Alabama is the dependent variable. Each column presents the output of the regressions as elasticities for each industry and model listed at the top of the columns. Standard errors are clustered at the county level and reported in the parentheses in each table of results.

Table 2.3 reports the estimation results for Alabama as a whole (number of counties = 67, number of obs. =1139). Model 1 in Table 2.3 is a baseline model and reports the estimation results for the impact of previous year's demand for forest products (i.e., previous year's sales, Sic,t-1) and average variable cost per dollar of output (AVCic,t) on the number of establishments (Eic,t) in each forest products industry of Alabama. The coefficients of demand have the expected positive sign in all the models and the industries. However, the correlation between the last year's demand for the forest products and the total number of establishments in the logging industry is small. For example, column one in Table 2.3 suggests that a one percent increase in the last year's sales (i.e., the last year's demand for forest products) is correlated with a 0.013%

increase in the total number of establishments in the logging sector per county. This effect does not significantly change after the decomposition analyses (see columns 2 and 3). Elasticity estimates of the number of establishments in each industry with respect to previous year's sales range from 0.002 to 0.02, depends on the industry. As a result, these numbers indicate that demand for forest products in the previous year is positively correlated with an increase in the current year's total number of establishments in the forest products industry; however, the magnitude of the correlation is not large.

Except for the wood products manufacturing, the coefficients for average variable cost (see Table 2.3, Model 1 for each industry) are negative, as expected, and these coefficients are statistically significant at conventional level. Elasticities of the number of establishments with respect to average variable cost per dollar of output are -0.12, -0.42 and -0.28 in the logging, paper and furniture products manufacturing sectors, respectively. This implies, for example, a 10% increase in the average variable cost per dollar of output, is correlated with a 4% decrease in the logging sector in a county. The results of Model 1 suggest that the impact of the average variable cost per dollar of output on the decline in the number of establishments in the industry is greater compared to the impact of demand on the number of establishments in each industry. In other words, the impact of demand (i.e., external factor) on the decline in the number of establishments is much smaller compared to the impact of the production cost (i.e., internal factor) in the forest products industries. These results are not consistent with the literature, which suggests the number of establishments in the industry have been declining due mostly to decreasing demand (NCSSF 2005; Sample and Wallinger 2006; Collins et al. 2008; Woodall et al. 2011).

Models 2 and 3 in Table 2.3 report estimation results based on the decomposition of the average variable cost and labor cost. Model 2 includes average material cost and average labor cost per dollar of output instead of average variable cost and the model reports the estimation results for the impact of demand, average material and labor costs on the number of establishments in the forest industries. In paper and furniture products manufacturing industries, a larger part of the decline in the number of establishments can be attributed to changes in the average cost of materials rather than to changes in average labor costs. For example, a 10% percent increase in average material cost is correlated with a 2% decrease in total number of establishments in these industries per county. However, per county, same increase in average labor cost is associated with an ~ 0.8% decrease in total number of establishments in paper and furniture products manufacturing industries (see columns 8 and 11). This could be in part because material cost has a much larger share in the production process compared to other variable costs. This is not true for the logging industry as it is more labor intense industry than the other sub-industries included in the analysis. For example, a 10% increase in average labor cost is correlated with a decrease of an ~ 1% in total number of establishments in the industry, while the same increase in average material cost is related to an ~ 0.3% decrease in total number of establishments in the logging industry per county. However, because the coefficient for average material cost is not significantly different from zero, the effect of material and labor costs on the number of establishments in the logging industry cannot be adequately compared (see column 2).

The results of the last decomposition analysis are presented in model 3 in Table 2.3. Model 3 includes wage rate per worker and labor productivity (i.e., output per worker in a year), instead of average labor cost, and the model reports estimation results for the impact of demand,

average material cost, wage rates, labor productivity on the number of establishments in the forest products industries. The coefficients for wage rate per worker are statistically significant in all models and each coefficient is negatively related to the number of establishments in each industry, as expected. In wood and furniture products industries, for example, a 10% percent increase in wage rates is correlated with an ~ 0.7% decrease in total number of establishments per county (see columns 6 and 12). In logging and paper products industry, on the other hand, a 10% increase in wage rates is associated with a 0.4% decrease in total number of establishments per county (see columns 3 and 9). The coefficients for labor productivity in Table 2.3 are also statistically significant and are positively associated with the number of establishments in each industry, as expected. A 10% increase in labor productivity is correlated with 0.5% increase in total number of establishments in the logging and paper products industries. Furthermore, the same increase in labor productivity in the wood and furniture products industries is associated with 0.8% increase in total number of establishments in these industries per county. Results of model 3 indicate that, in all of the industries, improvements in labor productivity compensate for increases in wage rates, so that observable increases in wages do not contribute to the general decline in the number of establishments in each industry.

All models in Table 2.3 include average age level and population density in the counties, as well as the unemployment rates as control variables. In addition, these models include a dummy variable to control for the effect of the economic recession that occurred between 2007 and 2009 on the number of establishments in the forest products industry of Alabama. The estimation results reveal that the unemployment rate has a negative correlation with the number of establishments in wood and paper products manufacturing, but has a positive impact on logging and furniture products manufacturing. Average age level in the counties is positively

correlated with the number of establishments in all industries. According to the results in Table 2.3, an increase in population density is related to an increase in the number of establishments in the wood and paper products industries, and a decrease in the number of establishments in the logging and furniture products industries. Results also show that the dummy variable, which accounts for the economic recession years, is negatively correlated with the number of establishments in all of the industries, with the exception of the furniture products industries. This suggests that, during the recession years (i.e., 2007 through 2009), the total number of establishments significantly decreased in the logging and wood products industries, and significantly increased in the furniture products industries. This may be due to the fact that these industries are highly dependent on the construction of new housing, which significantly declined during the economic recession years.

Table 2.4 presents the estimation results for Rural Alabama, where most of the forest production activities are likely to take place. The reason for excluding the metro counties from estimation is that the economy in these areas is more diverse, which means that many other factors in these areas could affect both the number of establishments in the industry and their demand and cost structures. Therefore, the impact of a change in the forest products industry can be more dramatic in rural regions compared to urban regions within the state.

Model 1 in Table 2.4 reports estimation results for the relationship between demand, average variable cost, and the number of establishments in each forest industry. As expected, the impacts of both demand and average variable cost on the number of establishments in rural Alabama are mostly significant where demand is positively associated and cost is negatively associated with the number of establishments, respectively. Model 2 presents estimation results

for the decomposition of average variable cost into average material and labor costs. Average material cost has a significant negative relationship with the number of establishments in paper and furniture industries, and has a positive, but statistically insignificant, relationship with the number of establishments in logging and wood products industries. Model 3 shows estimation results for the decomposition of average labor cost into wage rates and labor productivity. As expected, wage rates and labor productivity are negatively and positively related to number of establishments in all industries, respectively. Most of these coefficients are statistically significant. Estimation results for the rural counties of Alabama are generally similar to the results for Alabama as a whole. Some differences are seen in the estimation results for paper products manufacturing (see columns 7-9); for example, the impact of demand on the number of establishments is significantly smaller in the rural counties of Alabama versus the state as a whole. Also, the correlation between average variable cost, material cost, and number of establishments in paper products industries is smaller in rural counties. Similar estimation results between the rural counties and the state as a whole indicate that extraction of metropolitan counties from the study did not significantly change estimation results.

We apply the same estimation methods for the Black Belt and West Alabama regions because these regions of the state host a large portion of businesses in the forest products industry and contain vast timber resources. Also, there has been persistent unemployment and low income and educational attainment levels within these regions. Therefore, the forest products industries in this region may show a different pattern compared to the other parts of the state.

Estimation results for the Black Belt- West Alabama Region are reported in Table 2.5. The coefficients for the variables in these models have mostly expected signs; however, they are not all statistically significant in some regressions. This could be due to the small number of observations available for each industry in this region. Estimations for this region are also similar to the results of estimations for the other regions of the state; however, the impacts of wage rates and labor productivity on the number of establishments in logging and paper products industries differ in some respects. For example, in Model 3 of Table 2.5, wage rates and labor productivity have a greater impact on the number of establishments in these industries in the Black Belt-West Alabama region compared to their impacts for Alabama as a whole.

4. Conclusion

The forest products industry in Alabama, the second largest manufacturing sector of the state, has been experiencing a recession since mid-1990s. In this paper, we investigate the determinants of this decline in the industry, using a panel data set of Alabama counties spanning from 1996 to 2012. Specifically, we focus on changes in the number of establishments in the following sub-industries: logging (NAICS code: 113), wood products manufacturing (NAICS code: 321), paper products manufacturing (NAICS code: 322), and furniture products manufacturing (NAICS code: 337).

Our results suggest that increases in average variable cost, rather than decreases in demand, have a major influence in the determination of the number of operating establishments in the forest products industry in the state, other things are held constant. Specifically, we show that, depending on the sector, a 10% increase in the previous year's demand for forest products is related to an increase of 0.02% to 0.2% in the current year's total number of establishments in a

county. On the other hand, the same increase in average variable costs is related to a decrease of 1% to 4% in total number of establishments per county, other things being equal. These findings do contradict the results reported by the NCSSF (2005), or Sample and Wallinger (2006), Collins et al. (2008), and Woodall et al. (2011). This may be due to the fact that these studies only considered external factors, such as demand, and ignore internal factors, such as cost of production, labor productivity etc., that can significantly affect the decline in the industry (more information about how internal factors are among the main causes of business failures can be found in Peterson et al. 1983; Everett and Watson 1998; Headd 2001; Collins et al. 2008; Ames 2013).

Our decomposition analysis indicates that the number of establishments in the paper and furniture products manufacturing industries is more sensitive to changes in the cost of materials rather than labor costs. For example, in the furniture products manufacturing sector, a 10% increase in average material cost is associated with a 2% decrease, while the same increase in average labor cost is associated with a 0.7% decrease in total number of establishments per county. This could be because increases in labor costs, such as wage increases, are often accompanied by increases in labor productivity. In other words, increases in labor productivity compensate for increases in wage rates, so that observable increases in wages do not contribute to the general decline in the number of establishments in wood and paper products manufacturing. We provide evidence in the paper for this possibility.

We replicate these analyzes separately for only rural counties of Alabama and for the Black Belt-West Alabama region where the industry is intensely located. The results for these regions are qualitatively the same as the results obtained from the whole sample (Alabama as a

whole) with few exceptions. For example, the impact of demand on the number of establishments is significantly smaller in the rural counties of Alabama versus the state as a whole, and wage rates and labor productivity have a greater impact on the number of establishments in logging and paper products industries in the Black Belt-West Alabama region compared to their impacts for Alabama as a whole. Similar estimation results between the rural counties, counties in the Black Belt- West Alabama region, and all counties in the state indicate that the extraction of the metropolitan counties from the study or focusing on only a specific forest dependent region does not significantly change the estimation results.

The evidence provided in the paper underlines the importance of reducing cost of material and improving labor productivity in order to improve the competitiveness of the industry in domestic and global markets. This is because, establishments in the forest products industries are more sensitive to the changes in material costs compared to other factors, such as demand for forest products. Moreover, a program that trains the forest products industry for reducing costs (i.e., optimizing raw material efficiency or trained more productive labor force) or increasing productivity may be the most effective policy in reducing the recession in the industry.

Findings of this study are likely to be valid for the forest products industries of the other southern states because the industry structures, demand for the products of these industries, and the cost structures of the industries are similar and related to each other.

Future studies may include more variable costs, such as energy, and 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 in the total number of establishments in the forest-

based industries. In addition, future studies may estimate the economic impact of closing one establishment in the industry on the forest-dependent communities in Alabama.

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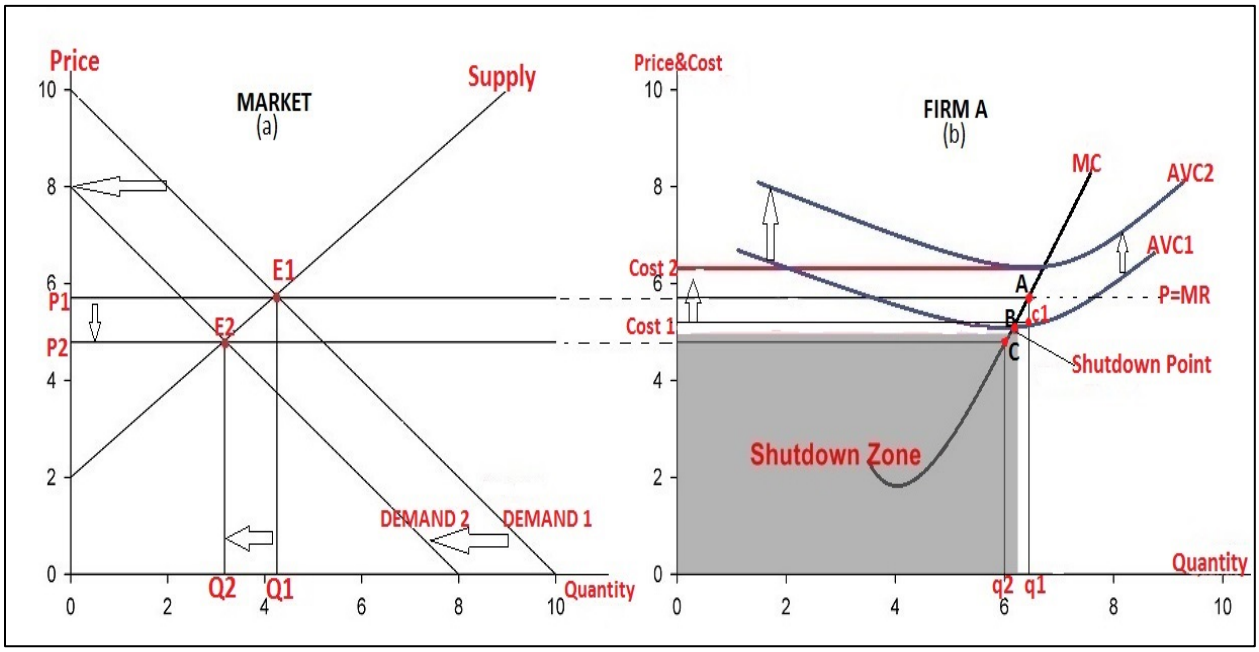
Figures and Tables

Figure 2.1: Shutdown Decision of Establishments and Changes in Supply, Demand and Average Variable Costs.



Note: This figure shows perfectly competitive market equilibrium for a normal good in panel (a) and firm A's produce or shutdown decision in panel (b) due to changes in market demand and average variable cost. In panel (a), the market is in the equilibrium condition at E1. The market price is P1 and at this price, firms in the market produce Q1 units of production. When the market demand reduces from DEMAND1 to DEMAND2 in panel (a), the market price for the product moves to P2 and the quantity produced reduced to Q2 and the market comes to the equilibrium again at the point E2 (panel a). The panel (b) shows changes in firm A's production levels and the average variable costs (AVC) as a response to the changes in the market. Based on the economic theory, firm A should continue to produce if the market price for this particular product is above the firm A's average variable cost curve at that quantity, and the firm A should shut down if the market price is below the firm's average variable costs curve at that quantity. Also the theory suggests, if a competitive firm produces, it should set output to make marginal cost equal to the price. This is output level q1, cost level Cost1 with AVC1 in panel (b), where the marginal cost curve crosses the price line at the point A. This output level also maximizes the profits for the firm A in the short-run. At the price of P1, the quantity produced by firm A is q1and its average variable cost equals AVC1 which is less than the market price. When the demand decreases, the new market price will be P2 (panel a). By selling the products from the price of P2, firm A cannot cover its variable costs by producing at point C, or at q2. Therefore, the firm will be better off shutting down. On the other hand, firm A stops producing due to increasing average variable costs although the market demand does not change. This can be seen in panel (b). Average variable costs increases from AVC1 to AVC2. Producing q1 unit of production at the point A is not profitable anymore to firm A even the market demand does not increase. Therefore, market demand and average variable costs of production are the two most important factors for the firms' shut down or continue to produce decision.

Table 2.1: Description of Datasets

Variable Names, Calculations, (Unit)	Description
O, ($)	Output; the nominal US dollar value of industry production including sales and inventory.
INV, ($)	Inventory; stocks of goods held by the establishment over a period of time. (in nominal US $)
PPI	Producer Price Index (1996=100) for sub-industries and all the forest products industry[1].
$Q=S/PPI_{sector}$, ($)	Real output in each sub-industry and all forest products industry. (in real US $)
VA ($)	Value added; the difference between an industry's total output and the cost of its intermediate inputs. (in nominal US $)
N	Number of Employment; the annual average of monthly jobs include all full-time, part time, and temporary positions. 1 job lasting 12 months=2 jobs lasting 6 months each=3 jobs lasting 4 months each.
# of Estab.	**Dependent variable: Number of establishments in the FPI[2].**
S=O-INV, ($)	**Total sales (in real million US $).**
AMC=(O-VA)/O, (¢)	Average material cost of production per $ of output. (unit=cent)
ALC=(W*N)/O, (¢)	Average labor cost; total payroll cost of the employee paid by the employer per $ of output. (unit=cent)
AVC=AMC+ALC,($)	**Average variable cost per $ of output.(unit=cent)**
W=LC/N, ($)	Wages earned per worker during a year. (unit= US$)
LP=O/N, ($)	Labor Productivity. Output per worker in a year. (unit=US$)
Unemp. Rate	Unemployment rate.
Avg. Age	Average age.
Pop. Density	Population density. Number of people per square mile.
Dummy E.R.	Dummy variable for economic recession years between 2007 - 2009.

[1] U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Indexes, http://www.bls.gov/ppi/data.htm

[2] U.S. Census Bureau; County Business Patterns, http://www.census.gov/econ/cbp/index.html

Note: The variables used in the estimations are bolded in the table. Other variables reported in the table are used to calculate the study variables. All data series except number of establishments, producer price index, and control variables are purchased from IMPLAN Group LLC, IMPLAN System (data and software), www.implan.com. The variables in nominal US$ values reported in the table are transformed into the real US$ values using appropriate producer price indexes (PPI = 1996) for each forest products industry. The results reported in the estimation tables are in 1996 US dollars.

Table 2.2: Summary Statistics for Each Study Area and Each Industry

	Study Areas:	Alabama, N=1139		Rural Alabama, N=952		Black Belts-West Alabama, N=357	
	Variables:	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Logging	# of Estab.	12.13	8.91	12.79	9.06	14.84	11.06
	S	20,700,000	21,000,000	22,300,000	21,800,000	27,900,000	27,600,000
	AVC	0.795	0.217	0.799	0.211	0.805	0.204
	AMC	0.592	0.155	0.596	0.151	0.600	0.146
	ALC	0.203	0.128	0.203	0.127	0.205	0.129
	W	60,406	91,260	57,895	89,974	47,862	37,804
	LP	184,248	150,690	180,391	109,995	182,797	144,090
Wood Prod. Mfg.	# of Estab.	5.17	5.14	4.00	3.49	3.64	4.25
	S	51,800,000	64,500,000	47,600,000	66,300,000	50,800,000	54,700,000
	AVC	0.792	0.278	0.774	0.300	0.718	0.357
	AMC	0.619	0.224	0.608	0.243	0.570	0.289
	ALC	0.173	0.078	0.166	0.081	0.148	0.088
	W	37,563	49,485	38,222	53,864	31,262	44,032
	LP	553,965	610,545	475,462	313,864	428,673	330,754
Paper Prod. Mfg.	# of Estab.	0.53	1.09	0.35	0.71	0.23	0.60
	S	39,000,000	125,000,000	31,300,000	98,000,000	43,200,000	127,000,000
	AVC	0.262	0.414	0.226	0.394	0.144	0.328
	AMC	0.208	0.331	0.180	0.316	0.120	0.275
	ALC	0.054	0.091	0.046	0.085	0.024	0.056
	W	34,197	301,474	36,056	329,422	8,982	24,386
	LP	207,356	1,138,421	127,709	311,335	101,544	248,355
Furniture Mfg.	# of Estab.	4.79	6.18	3.09	3.74	1.56	3.56
	S	13,300,000	26,100,000	11,200,000	26,300,000	3,153,438	8,643,875
	AVC	0.677	0.275	0.629	0.475	0.496	0.365
	AMC	0.475	0.299	0.444	0.315	0.279	0.332
	ALC	0.202	0.136	0.185	0.140	0.117	0.146
	W	21,934	38,509	20,422	40,758	12,226	20,230
	LP	138,476	162,617	112,570	112,909	55,630	84,887
Control Vars.	Unemp. Rate	0.067	0.032	0.071	0.032	0.086	0.035
	Avg. Age	47.232	1.367	47.512	1.202	47.450	1.191
	Pop. Density	0.026	0.020	0.030	0.019	0.044	0.018

Note: Mean and standard deviations of average cost variables are provided for per dollar of output. Nominal dollar values are transformed into real dollar values using appropriate producing price index for each industry and the results reported are in 1996 US dollars. Wages show average wages per worker in a year. Labor productivity shows economic value of total production per worker in a year.

Table 2.3: Fixed Effect Regression Results for Alabama, 1996-2012.

Dependent Variable is the Number of Establishments in each Industry												
Industries:	**Logging (113)**			**Wood Products Mfg. (321)**			**Paper Products Mfg. (322)**			**Furniture Products Mfg. (337)**		
Variables\Models	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Columns:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
S (t-1)	**0.013*** **	**0.013*** **	**0.014*** **	**0.017*** **	**0.013*** **	**0.007***	**0.002***	**0.001**	**0.003***	**0.018*** **	**0.009*** **	**0.008** **
	(0.004)	**(0.004)**	**(0.005)**	**(0.004)**	**(0.004)**	**(0.004)**	**(0.001)**	**(0.002)**	**(0.002)**	**(0.003)**	**(0.003)**	**(0.003)**
AVC	**-0.121*** **			**0.451** **			**-0.423** **			**-0.279***		
	(0.033)			**(0.216)**			**(0.176)**			**(0.169)**		
AMC		**-0.026**	**-0.009**		**0.011**	**0.143**		**-0.202** **	**0.078**		**-0.207*** **	**-0.082**
		(0.067)	**(0.083)**		**(0.113)**	**(0.137)**		**(0.085)**	**(0.115)**		**(0.074)**	**(0.093)**
ALC		**-0.121*** **			**-0.035**			**-0.018**			**-0.073** **	
		(0.033)			**(0.030)**			**(0.020)**			**(0.033)**	
W			**-0.039*** **			**-0.070*** **			**-0.037*** **			**-0.068*** **
			(0.011)			**(0.017)**			**(0.013)**			**(0.016)**
LP			**0.048*** **			**0.078*** **			**0.045*** **			**0.075*** **
			(0.011)			**(0.014)**			**(0.011)**			**(0.014)**
Unemp.Rate(t-1)	0.060	0.059	0.068	-0.269***	-0.282***	-0.250***	-0.050	-0.044	-0.046	0.064	0.138**	0.128*
	(0.054)	(0.054)	(0.053)	(0.073)	(0.074)	(0.073)	(0.040)	(0.040)	(0.037)	(0.065)	(0.070)	(0.069)
Avg. Age	0.043	0.022	0.177	6.793***	6.625***	6.262***	0.647	0.622	-0.126	4.322***	3.421**	3.119**
	(1.119)	(1.121)	(1.119)	(1.521)	(1.527)	(1.508)	(0.841)	(0.839)	(0.643)	(1.302)	(1.461)	(1.443)
Pop. Density	-0.087	-0.090	-0.172	0.105	0.104	0.066	0.394***	0.391***	-0.082***	-0.845***	-0.179	-0.139
	(0.164)	(0.164)	(0.165)	(0.222)	(0.222)	(0.219)	(0.123)	(0.123)	(0.024)	(0.065)	(0.215)	(0.213)
Dummy E.R.	-0.517***	-0.518***	-0.535***	-0.645***	-0.680***	-0.633***	-0.010	-0.004	0.004	0.313***	0.366***	0.357***
	(0.057)	(0.057)	(0.056)	(0.080)	(0.076)	(0.076)	(0.042)	(0.042)	(0.039)	(0.071)	(0.074)	(0.073)
Constant	1.722	1.785	0.921	-24.99***	-24.41***	-23.21***	-0.969	-0.883	0.073	-19.34***	-13.051**	-11.795**
	(4.559)	(4.563)	(4.560)	(6.187)	(6.208)	(6.133)	(3.425)	(3.413)	(2.524)	(5.120)	(5.946)	(5.875)
Observations	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072
Counties	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and *, **, and *** indicate P-values, *** p<0.01, ** p<0.05, * p<0.1. Yearly dummies are included in all models but the constant and the coefficients of the dummies are not reported. Logarithmic values of all of the variables are used in all models.

Table 2.4: Fixed Effect Regression Results for Rural Alabama, 1996-2012.

Dependent Variable is the Number of Establishments in each Industry												
Industries:	**Logging(113)**			**Wood Products Mfg.(321)**			**Paper Products Mfg.(322)**			**Furniture Products Mfg.(337)**		
Variables/Models	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Columns:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
S (t-1)	**0.008**	**0.010***	**0.014****	**0.017*****	**0.013*****	**0.007**	**0.000**	**0.000**	**0.003***	**0.018*****	**0.008****	**0.006***
	(0.005)	**(0.005)**	**(0.006)**	**(0.004)**	**(0.004)**	**(0.004)**	**(0.001)**	**(0.001)**	**(0.001)**	**(0.003)**	**(0.003)**	**(0.003)**
AVC	**-0.095****			**0.518****			**-0.335****			**-0.305**		
	(0.038)			**(0.239)**			**(0.152)**			**(0.191)**		
AMC		**0.091**	**0.068**		**0.077**	**0.263***		**-0.186****	**0.087**		**-0.222*****	**-0.032**
		(0.082)	**(0.099)**		**(0.122)**	**(0.150)**		**(0.072)**	**(0.095)**		**(0.078)**	**(0.101)**
ALC		**-0.092****			**-0.054***			**0.013**			**-0.099*****	
		(0.038)			**(0.031)**			**(0.017)**			**(0.034)**	
W			**-0.043*****			**-0.077*****			**0.004**			**-0.034***
			(0.014)			**(0.018)**			**(0.011)**			**(0.018)**
LP			**0.041*****			**0.089*****			**0.007**			**0.051*****
			(0.013)			**(0.015)**			**(0.010)**			**(0.015)**
Unemp. Rate(t-1)	0.141**	0.142**	0.146**	-0.269***	-0.274***	-0.237***	0.020	0.020	-0.019	0.039	0.106	0.091
	(0.057)	(0.057)	(0.057)	(0.081)	(0.082)	(0.081)	(0.033)	(0.033)	(0.030)	(0.072)	(0.076)	(0.075)
Avg. Age	-1.460	-1.380	-1.233	5.438***	5.052***	4.597***	-0.717	-0.659	-0.369	5.824***	4.666***	4.639***
	(1.217)	(1.219)	(1.220)	(1.708)	(1.715)	(1.683)	(0.687)	(0.688)	(0.511)	(1.451)	(1.608)	(1.596)
Pop. Density	0.117	0.132	0.057	0.313	0.330	0.294	0.352***	0.360***	-0.010	-0.75***	0.004	-0.001
	(0.185)	(0.186)	(0.188)	(0.260)	(0.261)	(0.255)	(0.105)	(0.105)	(0.023)	(0.090)	(0.246)	(0.244)
Dummy E.R.	-0.366***	-0.333***	-0.314***	-0.544***	-0.583***	-0.516***	0.068**	0.070**	0.047	0.169**	0.382***	0.210**
	(0.065)	(0.071)	(0.072)	(0.088)	(0.086)	(0.085)	(0.035)	(0.035)	(0.032)	(0.079)	(0.087)	(0.082)
Constant	8.708*	8.464*	7.679	-19.29***	-17.783**	-16.195**	4.146	3.947	1.335	-24.7***	-17.386***	-17.365***
	(4.990)	(4.994)	(5.004)	(6.994)	(7.020)	(6.894)	(2.815)	(2.818)	(2.000)	(5.706)	(6.586)	(6.536)
Observations	896	896	896	896	896	896	896	896	896	896	896	896
Counties	56	56	56	56	56	56	56	56	56	56	56	56

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and *, **, and *** indicate P-values, *** p<0.01, ** p<0.05, * p<0.1. Yearly dummies are included in all models but the constant and the coefficients of the dummies are not reported. Logarithmic values of all of the variables are used in all models.

Table 2.5: Fixed Effect Regression Results for the Black Belt - West Alabama Region, 1996-2012.

Dependent Variable is the Number of Establishments in each Industry												
Sub-Industry:	**Logging(113)**			**Wood Products Mfg.(321)**			**Paper Products Mfg.(322)**			**Furniture Products Mfg.(337)**		
Models:	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Columns:	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
S (t-1)	**-0.017**	**-0.019**	**0.014**	**0.020*** **	**0.016** **	**0.009**	**0.001**	**0.001**	**0.004** **	**0.016*** **	**0.008***	**0.007***
	(0.011)	**(0.012)**	**(0.015)**	**(0.006)**	**(0.007)**	**(0.007)**	**(0.002)**	**(0.002)**	**(0.002)**	**(0.004)**	**(0.004)**	**(0.004)**
AVC	**-0.235*** **			**0.712**			**-0.561** **			**-0.648***		
	(0.066)			**(0.497)**			**(0.222)**			**(0.376)**		
AMC		**-0.035**	**0.021**		**-0.035**	**0.045**		**0.558*** **	**1.566*** **		**-0.284*** **	**-0.186**
		(0.142)	**(0.135)**		**(0.224)**	**(0.301)**		**(0.210)**	**(0.267)**		**(0.106)**	**(0.142)**
ALC		**-0.241*** **			**-0.010**			**-0.135*** **			**-0.054**	
		(0.071)			**(0.049)**			**(0.038)**			**(0.043)**	
W			**-0.132*** **			**-0.064***			**-0.145*** **			**-0.048**
			(0.026)			**(0.037)**			**(0.039)**			**(0.031)**
LP			**0.104*** **			**0.067** **			**0.166*** **			**0.053** **
			(0.024)			**(0.028)**			**(0.030)**			**(0.026)**
Unemp. Rate(t-1)	0.244***	0.243***	0.240***	-0.090	-0.096	-0.109	-0.033	-0.018	-0.043	0.043	0.019	0.010
	(0.082)	(0.082)	(0.080)	(0.131)	(0.133)	(0.132)	(0.050)	(0.050)	(0.038)	(0.100)	(0.097)	(0.098)
Avg. Age	-1.975	-1.995	-1.744	8.923***	8.600***	8.395***	0.414	0.346	-0.585	5.455***	3.635**	3.570**
	(1.441)	(1.445)	(1.415)	(2.332)	(2.352)	(2.356)	(0.875)	(0.867)	(0.518)	(1.642)	(1.716)	(1.712)
Pop. Density	-0.066	-0.070	-0.019	0.241	0.320	0.348	0.281	0.205	0.048**	-0.784***	1.026**	0.931**
	(0.360)	(0.360)	(0.350)	(0.579)	(0.582)	(0.578)	(0.220)	(0.219)	(0.020)	(0.104)	(0.433)	(0.437)
Dummy E.R.	-0.279***	-0.277***	-0.316***	-0.454***	-0.490***	-0.447***	0.006	-0.002	0.010	-0.045	-0.081	0.020
	(0.079)	(0.080)	(0.076)	(0.129)	(0.128)	(0.138)	(0.048)	(0.047)	(0.048)	(0.101)	(0.095)	(0.103)
Constant	10.481*	10.542*	9.776	-32.816***	-31.345***	-30.549***	-0.696	-0.641	2.344	-23.342***	-10.424	-10.521
	(6.172)	(6.187)	(6.050)	(9.950)	(10.030)	(10.040)	(3.740)	(3.705)	(2.017)	(6.436)	(7.325)	(7.286)
Observations	336	336	336	336	336	336	336	336	336	336	336	336
Counties	21	21	21	21	21	21	21	21	21	21	21	21

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and *, **, and *** indicate P-values, *** p<0.01, ** p<0.05, * p<0.1. Yearly dummies are included in all models but the constant and the coefficients of the dummies are not reported. Logarithmic values of all of the variables are used in all models.

CHAPTER III - The Relationship between Forest Sector Dependence and Economic Well-Being in Alabama

Abstract. Using a county level panel dataset, we estimate the impact of forest sector dependence on economic well-being in the counties of Alabama. We use per capita income and poverty rates as indicators of economic well-being. We use three indicators to measure forest sector dependence: (1) the number of operating establishments in each county; (2) the proportion of county employment in the forest sector; and (3) the proportion of total county production in the forest sector. We also employ the location quotient technique to measure forest sector dependency. We apply the analyses to three different study regions: (1) Alabama as a whole; (2) rural counties only; and (3) the Black Belt's-West Alabama region. In order to further analyze the relationship between forest sector dependence and economic well-being, we use complementary analyses. Our results suggest that forest sector dependence is significantly associated with a decrease in per capita income due to the forest sector's negative impact on average wages and average schooling level within the counties. Moreover, the results show that increase in forest sector dependence of the counties is positively related to the number of low income families and negatively related to the number of high income families. Furthermore, the results suggest that forest sector dependence is associated with a decrease in poverty rates within the counties of Alabama.

Keywords: Economic well-being, per capita income, poverty rates

1. Introduction

The concept that resource dependence is strongly related to the economic and social well-being of rural areas has been commonly discussed in regional development policy debates (Deavers and Brown, 1985; Lawrie *et al.,* 2011; Fisher, 2001). Dependence on forests, as natural resources, and the forest sector, as a resource sector, also plays an important role in determining the economic well-being of rural areas (Leake *et al.* 2006; Steadman *et al.* 2005; Parkins *et al.* 2003; Overdevest and Green 1995; Fortmann *et al.* 1991). The findings of previous literature on the relationship between forest dependence and economic well-being are inconsistent. While some of these studies (Parkins *et al.* 2003; Overdevest and Green 1995) found that the forest sector has positive impacts on the economic well-being of rural regions, others, such as Bliss and Bailey (2005), Howze *et al.* (2003), and Norton *et al.* (2003) showed that the sector generates weaker economic performance within these regions. In this study, we examine the relationship between forest sector dependence and economic well-being in Alabama.

As stated in the previous chapters, Alabama has the second largest amount of commercial timberland in the southern U.S. with 22.9 million acres of commercial timberland, which covers approximately 70% of the state's total land area (FIA 2012). Such an abundance of timberland in Alabama has resulted in the forest sector being the second largest manufacturing sector in the state (following the automotive manufacturing sector) and accounts for an estimated 9% of Alabama's total GDP (FIA 2012). However, the forest sector in Alabama has been experiencing a notable decline in the number of establishments, employment and production since the 1990s (AFC 2010; Bentley et al. 2008; Bentley et al. 2013; Hartsell and Cooper, 2013). Clearly, this decline in the forest sector has significantly impacted forest dependency levels of communities and their economic well-being in Alabama.

Figure 3.1 and Figure 3.2 show the general trends in economic well-being and forest dependency in Alabama over the last two decades. Specifically, Figure 3.1 shows changes in average income per capita and poverty rates, which are used as the indicators of economic well-being of Alabamians in this study. Figure 3.2 presents changes in the number of establishments, employment share, and output share of the forest sector in Alabama, which are indicators of forest sector dependency in the current study.

In contrast to the important economic role of the forest sector and its impact on the economic activities within the counties, only a few studies have addressed the issue, particularly the relationship between forest sector dependence and economic well-being in Alabama. Using county level panel datasets and econometric methods, we intimately assess the relationship between forest sector dependence and economic well-being in Alabama. Based on the preponderance of evidence from the literature, we hypothesize that there is a negative relationship between forest sector dependence and economic well-being.

In order to analyze the relationship between forest sector dependence and economic well-being, previous studies have compared the economic well-being of forest-dependent counties to non-forest dependent counties. In these studies, researchers defined forest dependent counties as those where 20% or more of the county labor force are employed in the forest sector. Conversely, these studies have considered counties non-forest dependent where 7.5% or less of total county labor force were employed in the forest sector (Bliss and Bailey 2005; Howze *et al.* 2003; Norton *et al.* 2003; Bliss *et al.* 1998; Bliss *et al.* 1994). In this study, we take a similar approach to Leake *et al.* (2006), Stedman *et al.* (2005), Overdevest and Green (1995), Fortmann *et al.* (1991), in that rather than defining forest-dependent counties and non-forest dependent counties based on the proportion of total county employment or income in the forest sector, we

examine the relationship between economic well-being and proportion of county employment or production in the forest sector on a continuous scale. For example, for every 1% increase in total county employment in the forest sector, we would expect to see an increase of some magnitude in forest sector dependency and also some magnitude of decrease in economic well-being.

We use three indicators to measure forest sector dependence: (1) number of operating establishments in the forest sector; (2) forest sector employment as a proportion of total labor force in a county; and (3) changes in the forest sector production as a proportion of total county production over all sectors. In addition to these indicators of forest sector dependence, we also utilize a technique known as "the location quotient" to measure the forest sector dependence of the counties in Alabama.

We employ two indicators in our models to measure the economic well-being of Alabamians. The primary measure of economic well-being in the models is per capita income. The incidence of poverty in private households, which indicates the proportion of people below the low income cutoff, is our second measure of economic well-being. Per capita income and poverty rates are among the best measures of economic well-being and the most common indicators have been used in many studies to test the hypothesis that different levels of forest dependency affect economic well-being differently (Steadman *et al.* 2005; Howze at al. 2003; Parkins *et al.* 2003; Overdevest and Green 1995) even though these two indicators of economic well-being do not capture other non-economic dimension of well-being, such as infant mortality rates, educational attainment level, environmental quality etc.

One of the inadequacies in the literature on the relationship between forest or forest sector dependence and economic well-being is the indicators or methods used to measure forest

dependency level. Some of the most common methods used to measure forest sector dependency are percent of county employment in the forest sector (Parkins *et al.* 2003) and percent of employment income obtained from the forest sector in a county (Leake *et al.* 2006)[21]. Previous studies usually include only one of the above mentioned methods in their analysis. Because of this, their conclusions on the impact of forest sector dependence on economic well-being are based on what method they chose. For example, in Steadman *et al.* (2005), the authors concluded that the forest sector had negative impacts on economic well-being, based only on the proportion of employment in the forest products industries of Canada as an indicator of forest sector reliance. In our analyses, we use multiple indicators to measure the forest dependence level in the counties of Alabama.

Another inadequacy in the literature is that previous studies only speculate on their results and have not provide complementary analyses to further assess the validity of their results pertaining to the linkages or mechanisms between forest reliance and economic well-being. For example, Leake *et al.* (2006) found the forest sector dependence is positively related to unemployment rate, but they do not employ further analyses to explain why communities dependent on the forest sector appear to be worse in terms of unemployment and poverty. In the current article, we employ complementary analyses to further assess what we found concerning the relationship between forest sector dependence and economic well-being.

[21] There are also other metrics that assess the forest sector's proportion in the economies of the communities, such as % of county land in timberlands, concentration of timberland ownership within communities, number of jobs provided by the forest sector, counties with certain mills like pulp and paper, timber production per capita and number of mills.

Previous studies have employed different analysis methods, such as input-output analysis (Bailey *et al.* 2011), path analysis (Fortmann *et al.* 1991) or the like to analyze the impact of resource or resource based sector on the economic basis of a community. However, the most common and popular analysis method in the literature is econometric approaches, such as linear regressions, structural equation models *etc.*. Leake *et al.* (2006), for example, assess the question of whether dependency on the forest sector causes stronger or weaker economic performance within rural communities of Canada using econometric techniques. Parkins *et al.* (2003) also used econometric methods to examine how the reliance on the forest sector affects the economic well-being of rural communities.

In this study, we use an econometric approach to examine the relationship between economic well-being and forest sector dependence in Alabama. We employ various econometric methods and use a panel dataset of Alabama counties spanning the time period between 1996 and 2012. Specifically, we use methods from economic segmentation theory to estimate the relationship between dependence on each core (e.g., paper products manufacturing) and periphery (e.g., logging, wood and furniture products manufacturing) industries in the forest sector and economic well-being (see Appendices for the details about the economic segmentation theory). We also estimate the relationship between dependence to the forest sector as a whole and the economic well-being in the counties of Alabama.

The analyses are applied to three different study regions; (1) Alabama as a whole; (2) rural counties only, where many of the forest production activities are likely to take place; and (3) the Black Belt's-West Alabama region, which is characterized by the production of an abundance of forest products industry and timber resources (see Map 1 in the Appendices).

Our results, which are mainly consistent with previous literature on economic well-being and forest dependence, suggest that increasing forest sector dependence is associated with lower levels of economic well-being in Alabama. The main findings are that: (1) other things being equal, higher dependency on the forest sector of Alabama is associated with a decrease in per capita income and poverty rates; (2) there is a negative association between average wage levels in the counties and forest sector dependence; (3) an increase in forest sector dependence within counties is related to a decrease in the ratio of high school graduates attending a college; and (4) forest sector dependence is positively related to the number of low income families and negatively related to the number of high income families in Alabama.

The rest of the study is organized as follows: (1) literature on forest dependency and economic well-being is presented; (2) the data and empirical framework used in the paper are described; (3) the results; and (4) discussion and conclusions based on the research.

2. Economic Well-Being and Forest Sector Dependence

Well-being in forest-dependent communities has long been discussed in the literature of regional development and rural sociology. One of the earliest attempts on the study of well-being in forest-dependent communities was carried out by Kaufman (1946). He suggested that maintenance of community stability, which refers to well-being in his work, involves development of a stable timber industry and the practice of sustained forestry. Beckley (1995) also studied community stability and the relationships between economic and social well-being in forest-dependent communities. In his study, he argued that along with natural resources, socio-economic and demographic structures of the communities have considerable influence on well-being. Specifically, he suggested that the quality of work (i.e., are people satisfied and fulfilled by their jobs or livelihoods), social cohesion (i.e., a community with geographical boundaries

possesses community in the sense of shared values, etc.), and local empowerment (i.e., opportunity and capacity to act) have great contributions to well-being in forest-dependent communities. However, Deller *et al.* (2001) suggested that amenity attributes of the region have critical effects on regional economies. They examined the relationship between economic growth of rural areas and amenities that surround them. They hypothesized that the role of amenity attributes was a fundamental factor in the economic growth of rural areas because of its significant impact on quality of life within the region. They proposed five broad based indices of amenity attributes, such as climate, land (including forestland), water, winter recreation, and developed recreational infrastructure. Their results show that rural areas with high levels of key natural resource amenity endowments experience higher economic growth. However, they note that the areas with more traditional agricultural activities experience economic difficulties.

Kusel's (2001) study presents a new conceptual and methodological approach to assessing well-being in communities that are dependent on forestry and other natural resources. In order to highlight the diversity and complexity of approaches to understanding community well-being in natural resource dependent communities, he reviewed studies of well-being in natural resource dependent communities including forest dependent communities, agrarian communities, and boomtown communities undergoing rapid growth. According to the new approach of dependency definition in his study, forest-dependent communities are those immediately adjacent to the biological forest resource, those with a high economic dependence on the forest sector, and those that depend also on the economic and social structures that permit particular uses of the forest resource. Following the approaches in Sen (1984, 1985a, 1985b, 1987, 1993), he also defines well-being as "capabilities and functionings" as an alternative way of evaluating well-being. He suggests that studies of well-being rely only on objective reports,

also called socio-demographic indicators, such as crime, income, employment, and poverty because they are the most detailed measures available for a limited area, are easily gathered, and have more direct policy relevance for governments than other measures. He also suggested that community capacity, such as human capital, social capital, and physical capital, should be used by researchers to assess well-being in forest-dependent communities. He concluded with a discussion of how concepts and approaches interpreted in his paper can be used to develop new methodological approaches to community well-being assessment in ecosystem management studies.

As stated in the previous section, the literature on the relationship between forest dependency and economic well-being is divided into two groups. The first group compared forest-dependent counties to non-forest dependent counties to examine economic well-being in forest-dependent regions. For example, Bliss and Bailey (2005) studied relationships between rural communities, the forests, forest sector, and the social, political, and economic context of communities. For the time period between 1950 and1990, they show rural timber-dependent counties of Alabama (i.e., counties with pulp and paper mills) lagged behind urban and other rural counties that were not timber dependent in all key measures of well-being, such as median family income, households in poverty, educational attainment, and employment. They suggested that, among others, one of the possible reasons behind this lagging was the taxation policies designed to facilitate forestry and industrial recruitment which resulted in inadequate funding of public education and caused under-investment in education, which is crucial for local development. They also argued how healthy and productive forests inevitably lead to healthy and prosperous communities.

Well-being in forest dependent counties of Alabama was well documented in a study of Howze *et al.* (2003). Using historical population, economic, and agricultural census datasets, they compared timber dependent counties and non-timber dependent counties of Alabama to shed light on the development of timber dependency in the state. They used the proportion of employment in the forest sector as an indicator of forest dependency. Using sector employment share data, they defined counties with 25 % or more of their manufacturing employment in forest sector as forest dependent and counties with less than 7.5 % of manufacturing employment in forest sector as non-timber dependent. They used mean scores for a number of socioeconomic measures to compare the two groups of counties. They show that the poorest counties of Alabama were forest dependent and that they suffered from many social and economic ills. Their results indicated that forest dependency was related to declining population, higher unemployment rates, higher proportion of people receiving food stamps, lower levels of education, higher proportions of population below and above the labor age of 18 to 65, higher rates of infant mortality, and lower per student expenditure for public education. They also suggested that large absentee industrial owners of forestlands caused persistence poverty in forest-dependent areas because the land is operated for the benefit of those owners and local elites and lower tax rates were designed to promote industrial development in the state resulting in the under investment in human capital.

Questions related to forest-based employment patterns and socioeconomic correlates of forest dependency were examined by Norton *et al.* (2003). They compared forest dependency and socioeconomic characteristics in forest-dependent counties of the Northwest and the Southwest, including Alabama, to determine whether these two forested regions of the country experienced timber dependency in similar ways. They defined timber dependent counties as

those with 20 % or more of the total county employment in forest-based industries. They found forest-dependent counties in the Southeast region have significantly lower scores on the measures of community well-being than forest-dependent counties in the Northwest. They stated that forest dependence in the Southeast region is associated with negative social and economic indicators of well-being. They suggested that improvement in education through decreases in the tax abatements, which have been given to forest-based industries to encourage them to locate in the South, could lead to improvements in community well-being.

Bliss *et al.* (1998) compared two forest-dependent counties of Alabama to investigate the factors affecting community well-being and prospects for sustainable development. They concluded that a more diversified forest products industry would lead to more economic development. They suggested that simply recruiting forest products industry would impede economic development. Bliss *et al.* (1994) questioned whether a relationship existed between forest-based economic activity and social and economic well-being in Alabama's Black Belt, a 16-county region which is forest dependent, poor, and in which the state's rural African-American population is concentrated. Their results suggested that although there are many factors behind poverty, economic development of these regions in Alabama was not likely to occur without significant involvement of the forest products industry.

The second group of studies in the literature examined the relationship between economic well-being and proportion of county employment or production in the forest sector on a continuous scale. For example, using an econometric approach, Leake at al. (2006) assessed the question of how changes in the economic activity of the forest sector affected measures of economic well-being. They used the share of economic activity in the forest sector as a long-term forest dependency measure instead of using short-term changes in the sector. They considered

median household income, the unemployment rate, poverty rates, and income distribution and equality as measures of economic well-being in forest-dependent communities. As an assessment of the dependence of the communities on forestry, they used the proportion of employment income from the forest sector compared to the total employment income over all industries in the same region. The results from their empirical models indicated that forest dependence was positively and significantly correlated with unemployment rate and the incidence of poverty for people in private households. Their estimation results showed inconsistent correlations between income and forest dependency depending on the econometric models. Forest dependence had a negative but insignificant effect on median household income in one model (i.e., OLS model) and a positive and significant effect on income in another model (i.e., 2SLS model). Their results also indicated inconsistent results for the impact of forest dependence on income distribution and equality.

Stedman *et al.* (2005) investigated variation in the relationship between forest dependence and well-being by forest sector, region, and indicators chosen to represent well-being of rural communities in Canada. They addressed whether the forest sector in Canada was a peripheral industry overall, whether core and peripheral industries varied by region, and finally whether the negative association between forest dependence and economic well-being typically found in the literature was due to the indicators chosen to represent economic well-being. They measured dependence on forestry as the proportion of employment in the forest products industries of Canada. In their study, well-being was measured with poverty rates, median family income, unemployment rate, and educational attainment. They concluded higher rates of forest dependency were significantly correlated with lower educational attainment level, higher poverty rates, and unemployment. According to their results, with the exception of the pulp and paper

sector, all other sectors, including logging, lumber and services, in the forest products industry were associated with decreased median family income. Their results, however, vary a great deal by region because of regional differences in the presence of core-peripheral industries and different dependency levels.

Parkins *et al.* (2003) explored the relationship between forest dependence and community well-being in two Canadian regions, New Brunswick and British Columbia. They used methods in economic segmentation theory to estimate separate impacts of each center and periphery industry in the forest sector. Changes in the forest sector were measured using employment and income in the forestry sector as a proportion of the total employment income from all other sectors within regions. The measures of well-being in their model were median family income, poverty rate, and migration. Using a structural equation model, their estimation results suggested that the relationship between forest dependency and well-being is quite unique in each region of the study. They showed that center industries (e.g., pulp and lumber) in New Brunswick have positive effect on income while periphery industries (e.g., logging and forest services) had no impact on income. In British Columbia, both center and periphery industries were positively correlated with income (because the "only game in town" is forestry) and negatively correlated with poverty. In both regions, the study results indicated that there were negative correlation between forest dependency and in-migration.

Overdevest and Green (1995) examined the relationship between the forest sector and economic well-being in rural Georgia counties. Based on size, payments and concentrated ownerships, they divided the sector in two parts as core forest industries, such as pulp, paper and paperboard, and periphery forest industries, such as logging, sawmills, furniture etc. They used county-level per capita personal income and county poverty rate as indicators of well-being and

percent of county employment in the forest sector as an indicator for the forest dependence. Their regressions of economic well-being on core and periphery forest industries suggested that core pulp and paper mills provided greater per capita income and thus greater economic well-being to the county in which they were located. Their models also indicated that periphery industries generally have no or negative effect on economic-well-being.

Fortmann *et al.* (1991) also examined whether the forest sector affected well-being in all rural and urban counties in northern California. They used poverty rates, median family income, income inequality, level of health (i.e., work injury rates) and social pathology (i.e., crime rates) as well-being indicators in their analyses. They used total timber production per capita and number of mills as controlling variables for changes in the forest sector dependency of the Northern California. They found that the level of forest sector dependence was not significantly related to well-being. They also found that although the forest sector was not correlated with high levels of well-being, the absence of the sector was correlated with low well-being. Their analyses for both urban and non-urban counties showed the results are nearly identical.

Another study by Bloomquist and Summers (1982) reported the impact of the forest sector on income distribution in rural US. Specifically their study demonstrated the possible differential impacts of changes in major industrial sectors including the forest sector on the distribution of income (i.e., family income) among consumption units within all non-metropolitan communities in the United States. Their results showed that concentrated sectors, such as construction, transportation, machinery etc., had equalizing effect on the distribution of income. On the other hand, competitive sectors, such as forest products industries, textile mills, non-durable manufacturing etc., contributed more to changes in the proportion of families at the lower end of the distribution of income.

The term “forest dependency” has been referred to as “forest sector dependency” in most of the studies in the literature that analyzed the effect of forest dependency on well-being. These studies on forest dependence assumed a link among the welfare of forest-dependent communities, changes in characteristics of forests or forest-related markets, and the forest sector. Similarly, we use the term “forest sector dependence” to refer to changes in characteristics of the forest sector in Alabama.

Following the similar studies by Leake *et al.* (2006), Overdevest and Green (1995), and Fortmann *et al.* (1991), we examine the relationship between economic well-being and forest sector dependency in Alabama for the time period between 1996 and 2012. In order to assess the relationship, we utilize different techniques in regression analysis methods, which are discussed in the following section in detail.

3. Empirical Framework

3.1. Data

In our analyses of economic well-being in counties of Alabama, we use annual county level panel datasets. The reason for using the county as the unit of observation in this study is that the county has been the most common and appropriate political, economic, and social unit of analysis in studies of well-being in resource-dependent regions. Moreover, the county is a useful unit of analysis because many socio-economic data are collected at the county level for multiple time periods (Machlis and Force 1988; Lobao 1990; Parkins *et al.* 2003). Since counties are comprised by rural and urban communities, county level data provides broader view of social life than smaller level datasets (e.g., community level data) (Eberts 1979). Our yearly county level dataset covers 67 counties in Alabama for the time period between 1996 and 2012.

The analyses are applied to three different study regions; (1) Alabama as a whole; (2) rural counties only, where many of the forest production activities are likely to take place; and (3) the Black Belt -West Alabama region, which is characterized by the production of an abundance of forest products industry and timber resources (see Map 1 in the Appendices). We determine the rural counties in Alabama based on the urban-rural classification system of the U.S. Census Bureau[22]. The reason for excluding the metro counties from the estimations is that the economy is more diverse and there are many other factors in metropolitan areas affecting both the forest sector and the economic well-being. Therefore, the impact of forest sector dependence on economic well-being can be more dramatic in rural counties compared to urban areas of the state. The counties of Alabama comprising the Black Belt's region of this study are historically considered part of the Black Belt region. We include additional West Alabama counties in the Black Belt's – West Alabama region because these counties of West Alabama have similar characteristics to those in Black Belt's region in terms of forest dependency, economic well-being *etc.*. The reason for applying analyses on only the counties in the Black Belt region is because this region has an abundance of forest products industries and timber resources. Also, there have been persistently high unemployment rates and low income and educational attainment levels in the region historically (Dyer *et al.* 2013; Joshi *et al.* 2000; Duncan and Coles 2000). Therefore, forest sector dependence in this region may have a different influence on economic well-being compared to other parts of the state.

[22] According to the U.S. Census Bureau urban-rural classification system of 2010, rural counties consist of open countryside where the population density is less than 500 people per square mile and cities with less than 2,500 people.

The results of our estimations for the relationship between forest sector dependence and economic well-being are presented for the following industries: logging (NAICS: 113), wood products manufacturing (NAICS: 321), pulp and paper products manufacturing (NAICS: 322), and furniture products manufacturing (NAICS: 337)[23]. These are four major NAICS codes that are related to forestry. These industries ensure a good coverage of the forest sector in Alabama. Table A 1 in the Appendices lists the aggregated and disaggregated forest based industry classifications analyzed in this study. These industries were obtained by clustering the sub-industries that produce similar products. For example, the industry "Wood Products Manufacturing, NAICS:321" was generated by combining several sub-industries such as sawmills and wood preserving, veneer and plywood mills, reconstituted wood products, millwork, planning mills, and flooring mills. Detailed information about what sub-industries are operating under each industry, their NAICS codes and produced commodity types is provided in Table A 1 in the Appendices.

Data for the variables of the models comes from a variety of different data sources. Data for per capita income, one of the dependent variables used as an indicator of well-being in the analyses of this study, is obtained from Local Area Personal Income Datasets of the Bureau of Economic Analysis (BEA) in the United States Department of Commerce for the period between 1996 and 2012. BEA calculates per capita income as the total personal income of the residents of

[23] North American Classification System (NAICS), formerly known as Standard Industrial Classification (SIC) system, is developed by the US Economic Classification Policy Committee to classify business establishments for the purpose of collecting, analyzing, and publishing statistical data of North American countries. For more information about NAICS see the link: http://www.census.gov/eos/www/naics/

a region divided by the population of the region. According to BEA, per capita income is one of the best indicators of economic well-being of a region[24]. Comparing a county's per capita income level with its state's or nation's per capita income level provides insight into the economic well-being of that county.

Poverty rate is the second dependent variable of the analysis to measure economic well-being of the counties in Alabama. Data for this variable comes from the datasets provided by the US Census Bureau, Small Area Income and Poverty Estimates. Poverty rate is defined as the number of people with an income below the poverty line as the proportion of the total population. The Census Bureau uses thresholds, like the poverty line, which vary by family size and composition, to determine the number of families and individuals in poverty[25].

[24] BEA defines personal income as the sum of wages and salaries obtained from participation in production, supplements, transfer receipts from government and businesses, proprietors' income, capital consumption adjustments, rental income of people, personal dividend income and personal interest income. Personal income includes the residence adjustment representing the net flow of compensation of interstate commuters. For more details about income per capita, see: http://www.bea.gov/regional/index.htm

[25] Earnings, unemployment compensation, social security, supplemental security income, public assistance, veterans' payments, survivor benefits, pension or retirement income, interest, dividends, rents, royalties, income from estates, trusts, educational assistance, alimony and child support income are used to compute poverty status. Noncash benefits like food stamps and capital gains are excluded in the computation of poverty status. For details see: https://www.census.gov/hhes/www/poverty/about/overview/measure.html

In the complementary econometric analyses to illustrate the results of models (1) through (3), we use average wage levels in the counties, the proportion of high school graduates who attend a college, and certain family income quintiles as the dependent variables of these complementary analyses. Data on average wages comes from the Quarterly Census of Employment and Wages datasets of the Bureau of Labor Statistics. Average wage is calculated by dividing a county's total wages by its total employment within that county[26]. The data for the ratio of high school graduates who attend a college to total high school graduates provides information on each high school within Alabama, including the number of high school graduates and the number of those graduates who enrolled in a college. Data for this variable is available for the years between 1998 and 2014 in high school feedback reports from the Alabama Commission on Higher Education. Since the data is available at the school level, we sum the number of students in each high school within the borders of a county to find the total number of high school students in that county[27]. Income quintiles, the third dependent variable in the complementary econometric estimations, demonstrate the number of families in different income groups, such as the number of families with an annual income less than $40,000 or families with an annual income more than $75,000. The data for income quintiles is available for the year 2000

[26] Wages include salaries, hourly wages, bonuses, stock options, severance pay, profit distributions, cash value of meals and lodging, tips and other gratuities and certain employer contributions. See the link for details: http://www.bls.gov/cew/data.htm

[27] Detailed information on higher education in Alabama can be obtained from the link: http://www.ache.state.al.us/Content/StudentDB/SDBArchive.aspx

and for 2008 to 2012 from the American Community Survey datasets of US Census Bureau and 2000 decennial census datasets[28].

To assess the relationship between forest sector dependence and economic well-being, we use three indicators to control forest sector dependence in the counties of Alabama: (1) the number of establishments in the forest sector, (2) proportion of total county employment in the forest sector, and (3) proportion of total county output in the sector. The data for the number of establishments in the forest sector was obtained from the County Business Patterns database of the United States Census Bureau, which is an annual series providing sub-national economic data by industry including the number of establishments, employment, and annual payrolls. The second indicator we use is the number of people employed in the forest sector in a county as proportion of total labor force in that county. Data for employment also comes from the County Business Patterns database of the Census Bureau[29].

The third indicator for the forest sector dependency is the ratio between the sector's output and output produced over all sectors in a county. The information on output of the sectors is available in IMPLAN (IMpact analysis for PLANning) databases. 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

[28] Detailed information for income groups see: https://www.census.gov/programs-surveys/acs/

[29] For more information on the number of establishments and employment by sector see: http://www.census.gov/econ/cbp/index.html

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[30]. Output is defined as the total monetary (US$) value of production by an industry in a calendar year and it includes the value added, taxes, profits, compensation, and intermediate expenditures of the production process between the industries. Since data for output of the forest sector is provided in nominal US dollar values by IMPLAN, in our analyses we transform output of the industry into real US dollar values using the producer price index, with 1996 as the base year.

The dataset we use in the analyses also includes controlled variables for counties' economic and social characteristics that are likely to impact both their economic well-being and forest sector dependence, such as unemployment rate, schooling, race and economic diversity. Unemployment rates for Alabama counties come from the Bureau of Labor Statistics. To control schooling rate, we used the total number of students in 12^{th} grade in high schools as a proportion of total county population between the ages 15 and 19. Data for this variable is publicly available in the enrollment reports of Alabama State Department of Education[31]. Race is another control variable and indicates the ratio of African-American population to total population in the counties. We obtain data for race from the US Census Bureau. The last control variable in the analyses is the Shannon-Weaver economic diversity index, which shows whether the economic activities of a region are distributed among a number of different types of industries. Data for the

[30] www.implan.com

[31] https://www.alsde.edu/#

diversity index is obtained from IMPLAN databases. The description of the variables and availability and sources of the data are presented in the Table A 2 in Appendices. Table 3.1 presents the summary statistics of the variables.

3.2. Models

3.2.1. Forest Sector Dependence, Per Capita Income and Poverty Rates

Following the studies using econometric approaches, we estimate the impact of forest sector dependence on economic well-being for each study region; Alabama as a whole, rural Alabama, and Black Belt's – West Alabama region. We employ separate estimations to show the impact of dependence on each periphery (e.g., logging, wood, and furniture manufacturing) and core (e.g., paper manufacturing) industry on economic well-being in each study region. As explained previously, we hypothesize that there is an inverse relationship between forest sector dependence and economic well-being in Alabama. To explain this inverse relationship, we also employ complementary econometric estimations in the next section. We used fixed effects regression in all estimations to control time-invariant county characteristics. Models (1) through (3) below are the central models of this study. Models (4) through (9) provide further analyses and help explain models (1) through (3).

The following models are estimated to analyze the relationship between the forest sector dependence and economic well-being:

(1) (1.1) $IPC_{c,t} = \beta_{11}Establishments_{i,c,t} + \beta_{12}X_{c,t} + \varepsilon_{c,t}$

(1.2) $PovRate_{c,t} = \lambda_{11}Establishments_{i,c,t} + \lambda_{12}X_{c,t} + \varepsilon_{c,t}$

All models in this study include two indicators for economic well-being: $IPC_{c,t}$ and $PovRate_{c,t}$. $IP_{c,t}$ stands for per capita income in county c in year t. $PovRate_{c,t}$ symbolizes the poverty rates in county c in year t. These two indicators are well-suited to economic well-being and have been used in many studies to measure economic well-being of the regions (Bliss and Bailey 2005; Leake *et al.* 2006).

Equation (1) estimates the correlation between the number of operating establishments in the forest sector and economic well-being in county c in year t. In equation (1), $Establishments_{i,c,t}$ represents the number of establishments in the forest sector as a whole and each periphery (e.g., logging, wood products manufacturing, and furniture product manufacturing) and core (e.g., pulp and paper products manufacturing) industries. The coefficient of $Establishments_{i,c,t}$, β_{11}, shows not only the impact of dependency to the forest sector as a whole on the economic well-being, but also the impact of dependency to each periphery-core industry on economic well-being of Alabamians. Fortmann *et al.* (1991) also used the number of establishments (number of mills) as an indicator to control changes in forest sector dependence.

(2)

$$(2.1) \quad IPC_{c,t} = \beta_{21}\text{Employment Ratio}_{i,c,t} + \beta_{22}X_{c,t} + \varepsilon_{c,t}$$

$$(2.2) \quad PovRate_{c,t} = \lambda_{21}\text{Employment Ratio}_{i,c,t} + \lambda_{22}X_{c,t} + \varepsilon_{c,t}$$

In equation (2), $\text{Employment Ratio}_{i,c,t}$ stands for the proportion of county employment in industry i of county c in year t. The ratio has been used in many studies to measure forest dependence level. For example, holding constant other determinants, more periphery forest industry employment lowers economic well-being (Overdevest and Green 1995; Steadman *et al.* 2005).

(3) (3.1) $IPC_{c,t} = \beta_{31}\text{Output Ratio}_{i,c,t} + \beta_{32}X_{c,t} + \varepsilon_{c,t}$

(3.2) $\text{PovRate}_{c,t} = \lambda_{31}\text{Output Ratio}_{i,c,t} + \lambda_{32}X_{c,t} + \varepsilon_{c,t}$

Output $\text{Ratio}_{i,c,t}$ in equation (3) stands for output of the industry i as a proportion of the total output in county c in year t. Output ratio of the forest sector is used as another indicator for measuring forest sector dependence level. We believe output of the forest sector provides a better representation of the general status of the sector compared to the number of establishments, or ratio of forest sector employment, because it provides a better explanation of consolidation (i.e., mergers and acquisitions) in the sector. Consolidation in the forest sector may result in a decrease in the number of establishments and overall employment, but may also result in an increase in the total output of the sector. Therefore, we also use output of the sector as a proportion of the total county output as an additional indicator of forest sector reliance of the counties in Alabama. Output is defined here as the monetary (US$) value of the production of an industry.

The vector $X_{c,t}$ symbolizes a vector of counties' economic and social characteristics that are likely to impact both economic well-being and forest sector dependence within Alabama. Some characteristics, such as schooling rate in the counties, may impact the economic well-being of counties because of the positive effects of education on people's income (Lipset 1959; Helliwell 1994). Schooling rate is measured as the total number of students in 12^{th} grade in high schools as a proportion of total county population between the ages 15 and 19. Other variables, such as race, may also have an impact on economic well-being. For example, in counties where African-Americans greatly outnumber Caucasians income levels are typically lower (Shapiro and

Kenty-Drane 2005; Sullivan *et al.* 2015). In our analyses, we use African-American population ratio in the counties to measure the impact of race on economic well-being.

$X_{c,t}$ also includes the Shannon-Weaver Index to determine the economic diversity in the counties of Alabama. Literature on the topic suggests that economic diversity promotes higher levels of economic well-being by improving the ability of regions to cushion the adverse effects of economic cycles (Attaran 1986). The existence of many industries with an equal share of economic activity in a region is an indicator of a diverse economy (Shannon and Weaver 1949). Using the Shannon-Weaver entropy function, we derived estimates of economic diversity using employment data[32]. Therefore, the economic diversity index in our analyses indicates how employment is distributed across the industries in a county. For example, if there are 100 different industries in a county and each industry has 10 employees, then the index will be 1, which shows a perfectly diversified economy. The index ranges between 0 (no diversity) and 1 (perfect diversity) and has been used in many studies to show economic diversity of regions (Attaran 1986; Dissart 2003: Davies and Tonts 2010).

The following function shows how we derived the economic diversity **ED** in terms of regional employment:

Eq. (1) $$ED(E_1, E_2, \ldots\ldots E_n) = -\sum_{i=1}^{n}[E_i \times lnE_i]$$

where E denotes the proportion of total employment of a region that is located in the i'th industry and n is the total number of industries in that region.

[32] Economic diversity of regions can also be measured using value added, labor income or production data.

In models (1) through (3), $B_{i,j}$ and $\lambda_{i,j}$ are the parameters to be estimated for model i and sub-model j. We expect negative signs for the coefficients β_{11} through β_{32} and positive signs for the coefficient λ_{11} through λ_{31}. $\varepsilon_{c,t}$ is an idiosyncratic error term. We used logarithmic transformation of all the variables in all models.

3.2.2. Location Quotient

In order to measure the forest sector dependence of the counties in Alabama, we employ an additional technique known as the "Location Quotient" that has been widely used by the studies in economic base and regional economic development literature since the 1930s. The purpose of Location Quotient (LQ) is to quantify how concentrated a particular sector is in a region (e.g., county) as compared to a larger reference region (e.g., state or nation). In other words, the location quotient is a ratio to compare a particular sector in a county to the same sector in a larger geographic area, such as a state or the nation. Due to the data availability, location quotient for an industry is usually calculated based on employment data of the industry in the previous studies. It can also be calculated using employment income, values of industry sales, value added, output, and trade flows *etc*.. The location quotient is measured on a numerical scale. A location quotient of one means the region has proportionately the same number of people employed in a specific sector compared to that of the sector in the larger reference region. A location quotient of greater than one indicates that a region has proportionately more employees than the larger comparison region, and a location quotient of less than one means that the study region's employment level in a sector is less than the reference region. The value of location quotient implies that the study area is producing more or less of a product than is consumed by the area. For example, the paper manufacturing sector accounts for 1% of total manufacturing employment in Jefferson County in the year 1996, whereas the sector accounted

for 4% of total manufacturing employment in Alabama in the same year, then the location quotient in this case is 25% (1% ÷ 4%) for paper manufacturing sector of Jefferson County in 1996. By looking at this location quotient, which is less than one, we can conclude that the paper manufacturing sector was four times less concentrated in Jefferson County than the state average in 1996.

In this study, we calculated location quotients for the forest sector as a whole and for the sub-industries of the sector, such as the logging industry, as well as wood, paper, and furniture products manufacturing in each county of Alabama between the period 1996 and 2012. We created the location quotients using the number of establishments, employment level, and output of the forest sector. To be consistent with the previous models of this study, we employ the same indicators of the forest sector reliance used in the models (1) through (3) to calculate the location quotients.

Following the guidelines described above, we use the state of Alabama as the comparison for a county's base sector to calculate the location quotients with the following equations:

$$Eq.(2) \qquad Est\_LQ_{c,t}^{i} = \left[\frac{(E_{c,t}^{i}/E_{c,t}^{T}}{E_{AL,t}^{i}/E_{AL,t}^{T}}\right],$$

where $Est\_LQ_{c,t}^{i}$ is the location quotient based on the number of establishments in industry i in county c in year t. $E_{c,t}^{i}$ represents county c's total number of establishments for industry i in year t, $E_{c,t}^{T}$ is total number of establishment over all sectors in county c, $E_{AL,t}^{i}$ stands for the number of establishments in industry i in the state of Alabama in year t, and $E_{AL,t}^{T}$ represents total number of establishments over all sectors in Alabama.

$Eq.(3)$ $$Emp\_LQ^{i}_{c,t} = \left[\frac{(L^{i}_{c,t}/L^{T}_{c,t}}{L^{i}_{AL,t}/L^{T}_{AL,t}}\right],$$

where $Emp\_LQ^{i}_{c,t}$ indicates location quotient for industry i in county c in year t based on the number of employment in industry i. $L^{i}_{c,t}$ stands for the number of employment or labor in industry i in county c in year t, $L^{T}_{c,t}$ is for total labor force in county c, $L^{i}_{AL,t}$ represents total employment in industry i in AL, and $L^{T}_{AL,t}$ shows total labor force in AL.

$Eq.(4)$ $$Out\_LQ^{i}_{c,t} = \left[\frac{(O^{i}_{c,t}/O^{T}_{c,t}}{O^{i}_{AL,t}/O^{T}_{AL,t}}\right].$$

$Out\_LQ^{i}_{c,t}$ represents the location quotients based on output of the forest sector. $O^{i}_{c,t}$ stands for total output produced by industry i in county c in year t, $O^{T}_{c,t}$ shows total county output over all industries, $O^{i}_{AL,t}$ is for the output of the forest sector in AL, and $O^{T}_{AL,t}$ indicates total output produced by all the sectors in AL.

Using the equations (2) through (4) we estimate the impact of the forest sector reliance on economic well-being in Alabama with the following models:

(4) (4.1) $IPC_{c,t} = \beta_{41}\, Est\_LQ^{i}_{c,t} + \beta_{42}X_{c,t} + \mathcal{E}_{c,t}$

(4.2) $PovRate_{c,t} = \lambda_{41}\, Est\_LQ^{i}_{c,t} + \lambda_{42}X_{c,t} + \mathcal{E}_{c,t}$

(5) (5.1) $IPC_{c,t} = \beta_{41}\, Emp\_LQ^{i}_{c,t} + \beta_{42}X_{c,t} + \mathcal{E}_{c,t}$

(5.2) $PovRate_{c,t} = \lambda_{41}\, Emp\_LQ^{i}_{c,t} + \lambda_{42}X_{c,t} + \mathcal{E}_{c,t}$

(6) (6.1) $IPC_{c,t} = \beta_{41}\, Out\_LQ^{i}_{c,t} + \beta_{42}X_{c,t} + \mathcal{E}_{c,t}$

$$(6.2) \quad PovRate_{c,t} = \lambda_{41} Out\_LQ^{i}_{c,t} + \lambda_{42} X_{c,t} + \varepsilon_{c,t}$$

All the regressors, outcome variables and coefficients in the models above are defined in the previous section.

3.2.3. Complementary Analyses

We implement complementary analyses to further assess the relationship between forest sector reliance and economic well-being. According to our first hypothesis, we expect a negative correlation between economic well-being and forest sector dependence in models (1) through (3). In other words, we expect forest sector dependence is negatively correlated with per capita income and also negatively correlated with poverty. We suggest this is because average wage levels are lower in the counties where the forest sector dominates. Those counties also have fewer highly educated people, lower incomes, and higher numbers of families in low income groups. Therefore, in the models (7) through (9), we hypothesize that: (1) the forest sector is negatively associated with the average wage levels in the counties, (2) forest sector dependence is negatively associated with the proportion of high school graduates who attend a college, and (3) forest sector dependence is positively associated with number of low income families and negatively associated with number of high income families in the counties of Alabama.

Using the following models we further estimate the relationship between forest sector dependence and economic well-being:

(7)

$$(7.1) \quad AvgW_{c,t} = \beta_{71} \text{ Establishments}_{i,c,t} + \beta_{72} X_{c,t} + \varepsilon_{c,t}$$

$$(7.2) \quad AvgW_{c,t} = \beta_{71} \text{ Employment Ratio}_{i,c,t} + \beta_{72} X_{c,t} + \varepsilon_{c,t}$$

$$(7.3) \quad AvgW_{c,t} = \beta_{71} \text{ Output Ratio}_{i,c,t} + \beta_{72} X_{c,t} + \varepsilon_{c,t}$$

(8) (8.1) $HighEdu_{c,t} = \beta_{81}\ Establishments_{i,c,t} + \beta_{82}X_{c,t} + \varepsilon_{c,t}$

(8.2) $HighEdu_{c,t} = \beta_{81}\ Employment\ Ratio_{i,c,t} + \beta_{82}X_{c,t} + \varepsilon_{c,t}$

(8.3) $HighEdu_{c,t} = \beta_{81}\ Output\ Ratio_{i,c,t} + \beta_{82}X_{c,t} + \varepsilon_{c,t}$

(9) (9.1) $IncGrp_{g,c,t} = \beta_{91}\ Establishments_{i,c,t} + \beta_{92}X_{c,t} + \varepsilon_{c,t}$

(9.2) $IncGrp_{g,c,t} = \beta_{91}\ Employment\ Ratio_{i,c,t} + \beta_{92}X_{c,t} + \varepsilon_{c,t}$

(9.3) $IncGrp_{g,c,t} = \beta_{91}\ Output\ Ratio_{i,c,t} + \beta_{92}X_{c,t} + \varepsilon_{c,t}$

In model (7), $AvgW_{c,t}$ stands for average wage levels in county c in year t. We expect a negative correlation between average wages and the forest sector to be consistent with the hypothesis of the model (1)-(3). In model (8), $HighEdu_{,t}$ demonstrates the proportion of high school graduates attending a college in county c in year t. We expect a negative relationship between forest sector dependence and the proportion of high school graduates attending a college. This is because we believe the existence of the sector in a county is negatively associated with the probability of continuing to a college after graduating from a high school since a high school education is generally sufficient to be employed in the sector. In model (9), $IncGrp_{g,c,t}$ denotes the number of families in certain income groups g in county c in year t. We use the number of families in four different income groups: (1) the number of families whose income is between $20,000 and $25,000; (2) the number of families with income is between $25,000 and $30,000; (3) the number of families with income is between $20,000 and $40,000: (4) the number of families whose income is more than $75,000. The reason we use the first three income groups in our analyses is because people or families in these three income groups are usually considered

impoverished depending on the size and composition of the family[33]. In order to explain the relationship between per capita income, poverty rates and forest sector dependence in the models (1) through (3), we analyze how the sector is correlated with the number of families in the low income groups, such as the families whose annual income is less than $30,000 compared to families whose income exceed $75,000. We expect the sector dependence is positively related to the number of families in low income groups. The model (9) is also used to explain the results of the model (1) and (2). For example, the negative correlation between forest sector dependence and per capita income can be explained if the sector is related to decreased number of high income families and increased number of low income families.

In the models (7) through (9), $X_{c,t}$ stands for variables to control economic and social characteristics of the counties of Alabama, such as race, unemployment rate and economic diversity. In only model (8), $X_{c,t}$ additionally includes the number of establishments, employment level, and output of agriculture and automotive sectors to control their effect on the ratio of high school graduates attending a college since these two sectors are major employers in the state in addition to forest sector. $\varepsilon_{c,t}$ is an idiosyncratic error term and β_0, β_1 and β_2 are the parameters to be estimated.

4. Results

The results, obtained from estimating models (1) through (9) using fixed effect regression, are presented in Table 3.2 through Table 3.8. The entries represent the elasticities, with robust standard errors, clustered at the county level, presented in parentheses. The regression results are presented for each sub-industry (e.g., logging, wood, paper, and furniture

[33] See Data section for the information about the poverty thresholds.

manufacturing industries) and for the forest sector as a whole in each column of the result tables. The estimations in Table 3.2 through Table 3.8 are for Alabama as a whole, including all 67 counties in the state and the number of observations is 1,138. The estimations for the rural counties of Alabama, and for the counties in the Black Belt's-West Alabama region, eliminating metropolitan counties, are presented in Table A 3 through Table A 6 in Appendices.

Table 3.2 and Table 3.3 present the primary results of this study. Other regression tables provided in the Figures and Tables section further explain and analyze the results reported in Table 3.2 and Table 3.3. For example, Table 3.4 and Table 3.5 replicate the estimations from Table 3.2 and Table 3.3 using the location quotient technique to measure the forest sector dependence in a different way. Table 3.6 through Table 3.8 explains the relationship between forest sector dependence and economic well-being shown in Table 3.2 and Table 3.3.

4.1. Forest Sector Dependence, Per Capita Income, and Poverty Rates.

The estimation results of models (1) through (3) are presented in Table 3.2 and Table 3.3. The outcome variables are per capita income in Table 3.2 and poverty rates in Table 3.3. In columns 1 through 5 of Table 3.2, we report estimation results for the relationship between the forest sector dependence and per capita income, based on model (1) (i.e., forest sector dependence is measured by the number of establishments in a county). The results suggest that, other things being equal, forest sector dependence is associated with lower per capita incomes. In column 1 of Table 3.2, for example, a 10% increase in dependence to the logging sector (relative to mean) is related to a 1% decrease in per capita income. Similarly, in column 5, an approximate 1.2% decrease in county per capita income (relative to the mean) is associated with a 10% increase in dependence on the forest sector as a whole. In columns 6 through 10, we report the estimation results for the relationship between forest sector dependence and per capita income

from model (2), which uses proportion of county employment in the forest sector as an indicator of the changes in sector dependence. The results show that an increase in dependence on the forest sector is negatively associated with per capita income in that county. For example, a 10% increase in dependence on the forest sector as a whole is related to a 0.5% decrease in per capita income (see column 10). In columns 11 through 15 of Table 3.2, we report the estimation results for the relationship between forest sector dependence on per capita income based on model (3), which measures forest sector dependency as the sector's output as a proportion of total output in a county. The estimation results for the model (3) also suggest that there is a negative correlation between forest sector dependence and per capita income.

The coefficients for the interest variables, including the number of establishments, employment level and output of the forest sector in Alabama, are statistically significant and all indicate that there is a negative relationship between forest sector dependence and per capita income in each model and industry presented in Table 3.2. This negative relationship between forest sector dependence and economic well-being exists for all the sub-industries and for the entire forest sector. For example, a 10% increase in dependence to sub-industries of the forest sector is associated with a 0.04% (see columns 7 and 11) to a 1% (see column 1) decrease in county per capita income depends on the model and the sub-industry. Similarly, increasing dependence on the forest sector as a whole is related to a 0.3% (see column 15) to a 1.2% (see column 5) decline in per capita income. According to the results, the impact of forest sector dependence on per capita income is greatest with model (1) and similar estimation results with models (2) and (3), respectively. The results in Table 3.2 are consistent with the previous literature that suggests that forest sector dependence is negatively related to economic well-being (Steadman *et al.* 2005; Leake *et al.* 2006). However, our results are not consistent with the

literature concerning economic segmentation theory, in that we found dependence on core and periphery industries both were negatively related to economic well-being, rather than just periphery industries. Specifically, the literature argues that dependence on core industries in the forest sector has positive influences on economic well-being, and dependence on periphery industries is associated with a decrease in the regions' economic well-being (Overdevest and Green 1995; Parkins *et al.* 2003). Conversely, our results showed no difference between dependence on core (e.g., pulp and paper) and dependence on periphery (e.g., logging, wood and furniture manufacturing) industries in terms of their effect on per capita income in the counties of Alabama (see Appendices for the details about the economic segmentation theory).

The coefficients for the control variables in the estimation of models (1) through (3) in Table 3.2 have expected signs and they are mostly significant. For example, 10% increase in schooling rates is associated with approximately 0.6% to 1% increases in per capita income in the counties of Alabama. Also, a 6% to a 9% increases in per capita income is associated with an increase of 10% in economic diversity (i.e., Shannon Weaver index). Moreover, a 10% increase in African-American population ratio (relative to the mean in counties of Alabama) is associated with 0.7% to 1.2% decreases in per capita income.

In Table 3.3, we replicate our regression analyses in Table 3.2 using poverty rates as our outcome variable. Columns 1 through 5 report the estimation results for the relationship between forest sector dependence and poverty rates using changes in the number of establishments in the forest sector as an indicator of forest sector dependence. The results show that increase in dependence on the forest sector is associated with a decrease in poverty rates within the counties of Alabama. In other words, establishing a new establishment in a county is related to a decrease in the ratio of people whose income is under the poverty line in that county. For example, a 10%

increase in dependence to forest sector as a whole is associated with a 0.8% decrease in poverty rates (see column 5). A 10% increase in dependence to each sub-industry, logging, wood, paper and furniture products manufacturing industries, is related to approximately 0.9%, 0.1%, 0.1%, and 0.3% decrease in poverty rates, respectively (columns 1 through 4). The estimation results in columns 6 through 10 are based on model (2), which measures the forest sector reliance as the employment share of the sector in a county. Similar to the results of model (1), the results of model (2) also show that there is a negative correlation between the forest sector reliance and poverty rates. This means increase in the number of employees in the forest sector of a county as a proportion of that county's total employment is associated with a decrease in the ratio of people whose income is under the poverty line. For example, a 0.2% decrease in poverty rates is significantly associated with a 10% increase in dependence to furniture industry in the counties (column 9). Except for the estimations for the forest sector as a whole, the magnitudes of coefficients in the estimations of model (2) are smaller compared to the coefficients in the estimations of model (1). The estimation results of model (3) are presented on the columns 11 through 15 of Table 3.3. The results are consistent with the results of model (1) and model (2) and suggest that there is a negative correlation between forest sector dependence and poverty rates. In other words, when output of a county's forest sector as a proportion of the county's total output increases, the ratio of people whose income is under the poverty line will decrease in the county. In column 15, for example, a 10% increase in dependence to the forest sector as a whole is related to a 0.6% decrease in poverty rates within the counties of Alabama. The results of model (3) are mostly similar to the results of models (2) and (3) in terms of the magnitude of the coefficients, except for the results for wood products manufacturing. For example, a 10% increase in dependence to wood products manufacturing is associated with a 0.1%, 0.04%, and

0.4% decreases in poverty rates in model (1) through model (3), respectively (columns 2, 7 and 12).

The coefficients of the interest variables in Table 3.3 are mostly significant. However, they all have unexpected negative signs. Each 10% increase in dependence to sub-industries of the forest sector is related to a 0.9% to a 0.04% decreases in poverty rates depending on the model and the sub-industry. Also, each percentage increase in dependence on the entire forest sector is associated with a 0.6% to a 0.8% decreases in poverty rates. According to the results, the impact of forest sector dependence on poverty rates is the lowest with the model (2) and similar estimation results with models (1) and (3), respectively. The estimation results in Table 3.3 do not support our hypothesis which predicts that forest sector dependence is associated with an increase in poverty rates in the counties of Alabama. However, the results of Table 3.3 support the findings of some of the previous literature that suggest although forest sector dependence is not correlated with high levels of economic well-being, the absence of the sector is correlated with low economic well-being (Fortmann *et al.* 1991; Bliss *et al.* 1994)[34].

4.2. Results of Location Quotient

The estimation results for models (4) through (6) are presented in Table 3.4 and Table 3.5. Table 3.4 presents the results for the relationship between forest sector dependence and per capita income based on the models (4.1), (5.1) and (6.1). The results in Table 3.4 suggest that forest sector dependence is negatively related to per capita income in the counties of Alabama. For example, a 10% increase in forest sector dependence is associated with a 0.04%, a 0.2% and a 0.1% decreases in per capita income depending on models (4.1), (5.1) and (6.1), respectively

[34] The results of the Table 3 are also discussed in the results of the complementary analyses.

(see columns 5, 10 and 15). However, dependence on the sub-industries has a different relation to per capita income. For example, dependence on paper products manufacturing has a positive association with per capita income in all the models we considered. However, this association is statistically significant only in the estimations using the model (1). The association between dependence on the furniture products manufacturing industry and per capita income is positive in models (4.1) and (5.1), and negative, but insignificant in model (6.1). Dependence on the logging sub-industry has a statistically significant and negative relation with per capita income in models (4.1) and (6.1) and a statistically significant and positive relation with per capita income in model (5.1). Dependence on the wood products manufacturing sector has a generally negative correlation with per capita income throughout the models, but this correlation is not statistically significant in all the models we considered. These results are consistent with the results obtained in Table 3.2, suggesting dependence on the forest sector (as a whole) is related to lower average per capita incomes in the counties of Alabama. However, the estimation results for the sub-industries contradict the results in Table 3.2. The results for the sub-industries in Table 3.4 suggest that dependence on the forest products industries that use advanced technology and more skilled labor, such as paper products manufacturing or furniture products manufacturing is positively associated with the average per capita income in Alabama.

Table 3.5 presents the results obtained from estimating model (4.2), (5.2) and (6.2). The models (4.2) and (5.2) in Table 3.5 suggest that dependence on the forest sector is related to higher poverty rates, but model (6.2) reports an inverse correlation between forest sector dependence and poverty rates within the counties of Alabama. The results of model (6.2) in Table 3.5 are consistent with the results of Table 3.3, but the results of other models in Table 3.5 mostly contradict the results presented in Table 3.3.

4.3. Results of the Complementary Analyses

In order to further analyze the results obtained from estimating models (1) through (3) in Table 3.2 and Table 3.3, we employ complementary analyses in Table 3.6 through Table 3.8. To explain the negative relationship between forest sector dependence and per capita income reported in Table 3.2, we use average wages, ratio of high school graduates attending a college to total high school graduates, and certain income groups, such as people making income less than $30,000 or more than $75,000 annually. In other words, we suggest forest sector dependence is related to lower per capita incomes because: (1) the forest sector decreases average wage levels in the counties, (2) the sector is negatively associated with the ratio of high school graduates who attend a college to total high school graduates, and (3) the sector dependence is associated with a lower number of high income families, and higher number of low income families, resulting in lowered per capita income relative to other counties in Alabama.

To further analyze the results of Table 3.3, which presents a negative correlation between forest sector dependence and poverty rates, we utilize the results of Table 3.8 which shows the relationship between forest sector dependence and different income groups. We detail the relationships among forest sector dependence, average wages, higher education ratio, and certain income groups in the discussion of Table 3.6 through Table 3.8. Table 3.6 reports the results of model (7), which estimates the impact of forest sector dependence on the average wage levels in the counties of Alabama. Except for the furniture products manufacturing sub-industry in model (7.1) and (7.2), forest sector dependence is negatively correlated with average wage levels in all the models and the sub-industries. For example, a decrease of 0.7%, 0.3%, and 0.2% in the average wages is associated with a 10% increase in dependence to forest sector as a whole depending on models (7.1) through (7.3), respectively (see columns 5, 10 and 15). The results of

Table 3.6 are consistent with the results of Table 3.2 and support the hypothesis suggesting forest sector dependence is related to lower per capita income due to its negative relation with average wage levels within the counties of Alabama.

In Table 3.7, we present the estimation results of model (8), which shows the relationship between forest sector dependence and the ratio of high school graduates who attend a college[35]. Each model in Table 3.7 shows a negative correlation between forest sector dependence and the proportion of high school graduates who attend a college. In column 1, for example, a 0.7% decrease in the proportion of high school students that go on to college in a county is related to a 10% increase in forest sector dependence in that county based on the model (8.1). In order to compare the relationship between forest sector dependence and this proportion with other major sectors of the state, we also estimate the relationship between dependence on agriculture and automotive sectors and the proportion of high school graduates who attend a college. The results suggest that dependence on agriculture sector is negatively correlated with the proportion of students who attend a college after graduating from high school, while the automotive sector is positively related to this proportion. The results of Table 3.7 imply that dependence on traditional resource based sectors, such as forestry and agriculture, has a negative association

[35] Unlike the previous estimation tables, Table 3.7 shows the estimation results for only the forest sector as a whole and does not include detailed estimation results for the sub-industries of the sector. This is because we use the relationship between the forest sector dependence and continuing to higher education ratio to answer the question of why the forest sector dependence is negatively correlated with income per capita. The estimation results for the relationship between dependence to the sub-industries and continuing to higher education ratio are presented in Table A 7 in Appendices.

with the decision of high school graduates to attend a college. However, dependence on sectors that use advanced technology and employ more skilled labor, such as the automotive sector, is positively associated with students' decision to pursue higher education. These results support the results of Table 3.2 by revealing the negative relationship between forest sector dependence and the average schooling level within the counties of Alabama.

Table 3.8 presents the relationship between forest sector dependence and the number of families within low and high income groups. Each column in Table 3.8 provides estimates from models (9.1) through (9.3) for high and low income groups[36]. Our results suggest that forest sector dependence is positively correlated with the number of families in the low income groups and negatively correlated with the number of families in high income groups. For example, a 10% increase in forest sector dependence, based on model (9.1), is associated with a 1.5% increase in the number of low income families whose annual income is between $20,000 and $25,000, and a 3.3% decrease in the number of high income families whose annual income is more than $75,000. The results shown in Table 3.8 imply that forest sector dependence is related to lower average per capita income (see the results in Table 3.2) because greater dependence on the sector is associated with a larger ratio of low income population and a smaller ratio of high income families within the counties of Alabama. However, the larger number of families in the low income categories is not consistent with the results reported in Table 3.3 that suggest forest sector dependence is negatively related to poverty rates. One explanation for this conflict

[36] Similar to the representation method of Table 3.7, we only reports the impact of dependence to the forest sector as a whole on the number of families in certain income groups. The impact of dependence to the sub-industries on the number of families in each income group can be found in Table A 8 through Table A 11 in Appendices.

between the results shown in Table 3.3 and Table 3.8 is that the forest sector lowers poverty rates because people employed by the sector earn income, income typically higher than the poverty thresholds; however, because the sector pays low wages, the number of low income families increases.

4.4. Results of the Other Study Regions

The analyses presented in Table 3.2 and Table 3.3 are replicated for the rural counties of Alabama (number of counties=56) and for counties in the Black Belt's-West Alabama region (number of counties=21). The results are presented in Tab through Table A 6 in Appendices. Table A 3, similar to Table 3.2, presents the results for models (1) through (3) concerning the relationship between forest sector dependence and per capita income in rural counties of Alabama. Table A 3 in Appendices has the same econometric analyses and models as those presented in Table 3.2; however, the study area corresponding to Table A 3 covers only the rural counties of Alabama. The reason for excluding the metro counties from the estimations is because the economy is more diverse and there are many other factors in metropolitan areas affecting both the forest sector and economic well-being. Therefore, the relationship between forest sector dependence and economic well-being can be more dramatic in rural counties compared to urban areas of the state. However, the results in Table A 3 in Appendices show that there is not a statistically significant difference between estimates for rural counties and Alabama as a whole. For example, results from model (3.1) show a 10% increase in forest sector dependence is related to a 0.28% decrease in per capita income (see column 15, Table A 3 in Appendices) within rural counties, and a 0.34% decrease in per capita income (see column 15, Table 3.2) in Alabama as a whole. In addition, model (2.1) estimates that a 10% increase in logging sector dependence is associated with a 0.09% and a 0.1% decreases in per capita income

in rural counties and the state as a whole, respectively (see column 6 in Table 3.2 and Table A 3). Similar results for rural counties and the state as a whole indicate that the removal of the metropolitan counties from the analyses does not significantly change estimation results.

Table A 4 in Appendices, similar to Table 3.2, provides results for models (1) through (3) for the counties in the Black Belt's - West Alabama Region. This region has an abundance of forest products industries and timber resources. Also, there have been persistently high unemployment rates and low income and educational attainment levels in the region historically (Dyer *et al.* 2013; Joshi *et al.* 2000; Duncan and Coles 2000). Therefore, forest sector dependence in this region may have different impacts on economic well-being compared to other parts of the state. The results in Table A 4 in Appendices show that there is also a negative correlation between the forest sector dependence and per capita income within this particular region of the state. Compared with our results for the entire state and rural counties only, the impact of forest sector dependence on per capita income is greater within the counties of Black Belt's - West Alabama Region. According to the results from model (1.1), for example, a 10% increase in forest sector dependence is related to a 2% decrease in per capita income in the Black Belt's-West Alabama region (see column 5 in Table A 4), but the same increase in forest sector dependence is related to a 1.2% decrease in per capita income in the rural counties of Alabama as well as the whole state (see column 5 in Table 3.2 and Table A 3). These results were likely due to people in this region of the state being more dependent on the forest sector, resulting in changes in the sector having more influence on these regions' economies compared to the other regions within the state.

We also replicate the analyses presented in Table 3.3 for the rural counties of Alabama and for the counties in the Black Belt's - West Alabama region. Results of these analyses appear

in Table A 5 and Table A 6 in Appendices. In general, we found that the results for these regions are very similar to those for Alabama as a whole, suggesting that forest sector dependence is related to decreases in poverty rates within this particular region of the state. For example, Table A 5 in Appendices reports the estimation results for the relationship between forest sector dependence and poverty rates within rural counties of Alabama. According to the results in Table A 5, there is a negative correlation between forest sector dependence and poverty rates in rural counties within the state. Comparing the results obtained in Table 3.3 and Table A 5, one can conclude that the impacts of forest sector dependence on poverty rates in rural counties and on the state as a whole were similar. Moreover, Table A 6 in Appendices shows the estimation results for the impact of forest sector dependence on poverty rates within the counties of the Black Belt's – West Alabama Region. The results indicate that the impact of forest sector dependence on poverty rates is smaller in these specific regions of Alabama compared to the state as a whole. Estimates from model (2), for example, show that a 10% increase in forest sector dependence is associated with a 0.3% decrease in poverty rates (see column 10 in Table A 6) in the region compared to a 0.8% decrease (see column 10 in Table 3.3) in the state as a whole.

5. Conclusion

The forest sector has a dominant role in the economies of Alabama counties. In this study, we estimated the relationship between forest sector dependence and the economic well-being of the counties in Alabama. We used a county level dataset spanning the period between 1996 and 2012. We analyzed data from three different study regions: Alabama as a whole, rural Alabama, and the Black Belt's-West Alabama region. We also estimated the relationship

between dependence on four major sub-industries of the forest sector, including logging, wood, paper, and furniture products manufacturing, and the economic well-being of Alabama.

We used per capita income and poverty rates as indicators of economic well-being within the counties of Alabama. To measure forest sector dependence, we utilized three indicators: (1) the number of operating establishments in the forest sector, (2) proportion of county employment in the forest sector, and (3) proportion of total county output (production) in the forest sector. We further analyzed our findings on the relationship between forest sector dependence and economic well-being using complementary analyses.

The estimated models of this study implied some interesting, and apparently general, results. First, we showed that forest sector dependence is negatively correlated with per capita income in Alabama counties. The complementary analyses indicated the negative relationship between forest sector dependence and per capita income is because: (1) forest sector decreases the average wage levels in the counties of Alabama; (2) forest sector is negatively related to the average schooling level of Alabamians because increases in forest sector dependence are associated with decreases in the ratio of high school graduates attending a college to total high school graduates; and (3) forest sector dependence is positively associated with larger numbers of low income families, and smaller numbers of high income families (i.e., decreasing income inequality), resulting in decreased average per capita income within the counties of Alabama.

These findings contradict results reported by Steadman *et al.* (2005) and Leake *et al.* (2006). However, the estimation results showed no difference between core (e.g., pulp and paper) and periphery (e.g., logging, wood and furniture manufacturing) industry dependence in terms of their effect on per capita income. This is not consistent with the literature on economic

segmentation theory, suggesting that while core industries in the forest sector have positive effects on income, periphery industries negatively affect general income levels (Overdevest and Green 1995; Parkins *et al.* 2003).

Second, results of this study showed forest sector dependence is related to a decrease in poverty rates in the counties of Alabama. The negative association between forest sector dependence and poverty rates conflicts with the previous literature's findings; however, these results support the findings of some of the previous literature that suggest although the forest sector is not correlated with high levels of economic well-being, the absence of the sector is correlated with low economic well-being. Using unemployment insurance, social assistance *etc.*, future studies may clarify the relationships between forest sector dependence and poverty rates.

The estimations also showed that measuring forest sector dependency of the counties using the location quotient technique does not change the negative relationship between forest sector dependence and per capita income. However, estimation results using this technique suggest that an increase in core industries has a positive association with per capita income while the periphery industries generally have a negative or no association with per capita income. The results of the estimations using the location quotient technique indicated that the impact of the forest sector dependence on poverty rates varies depending on the models.

We replicated these analyzes separately for rural counties of Alabama and for the Black Belt-West Alabama region. The results for these regions are qualitatively the same as the results obtained from the whole sample (Alabama as a whole) except for a few minor differences. For example, a 10% increase in forest sector dependence is related to a 2% decrease in per capita income in the Black Belt's-West Alabama region, and the same increase in forest sector

dependence decreases per capita income by about 1.2% in Alabama as a whole as well as rural Alabama. Similar estimation results between rural counties, counties in the Black Belt- West Alabama region, and all counties in the state indicate that the removal of the metropolitan counties from the study, or focusing on only a specific forest dependent region, does not significantly change the estimation results.

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Figures and Tables

Figure 3.1: Changes in per capita Income and Poverty Rates, Alabama 1996-2012.

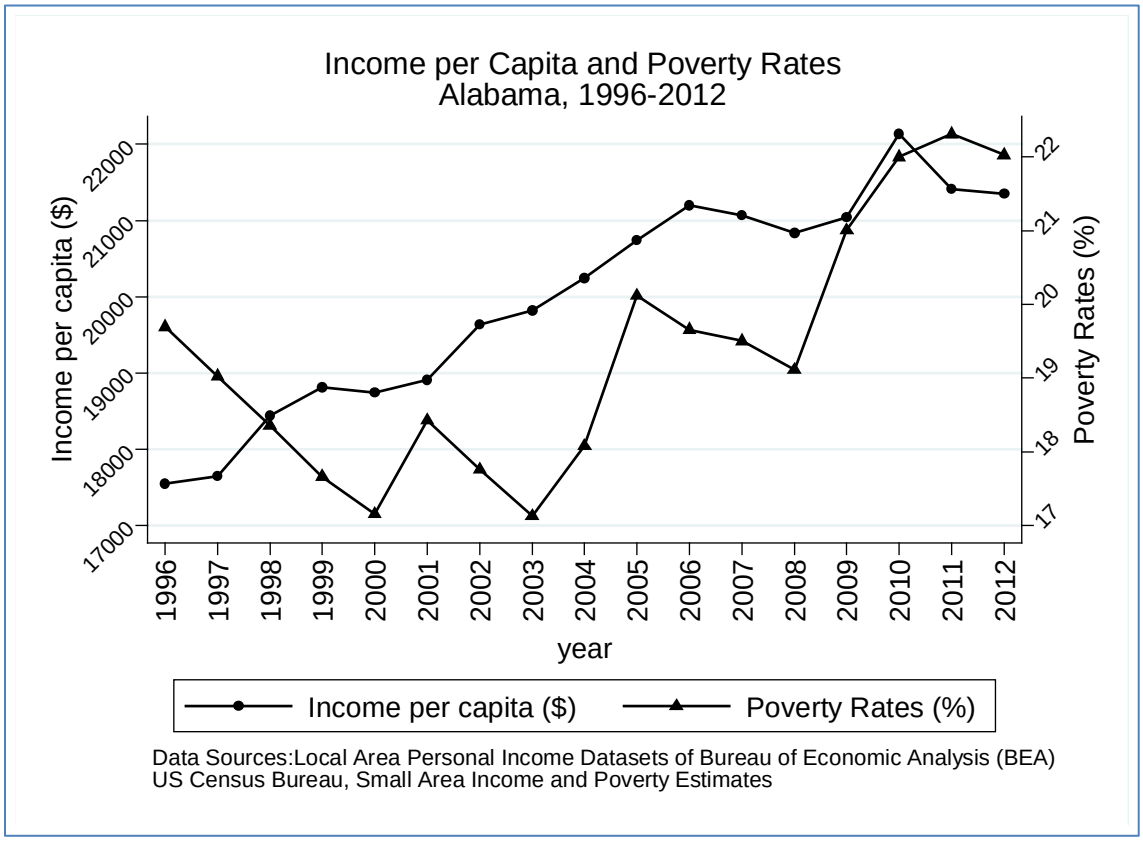


Figure 3.2: The Number of Establishments, Employment and Output Share of the Forest Sector of Alabama, 1996-2012

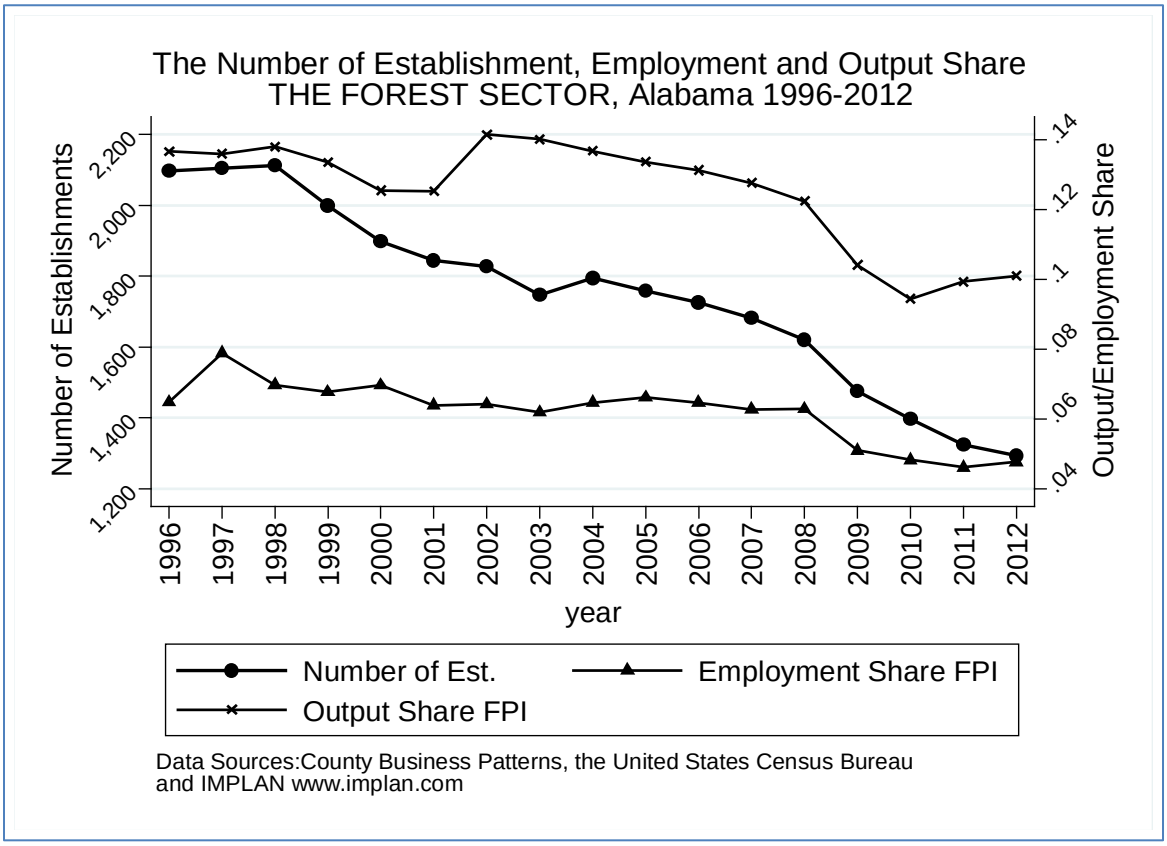


Table 3.1: Summary Statistics

Study Areas:	Alabama				Rural Alabama				West AL and Black-Belt Area			
Variables	**N**	**Mean**	**Min**	**Max**	**N**	**Mean**	**Min**	**Max**	**N**	**Mean**	**Min**	**Max**
Dependent Variables:												
Per capita income($)	1139	19974.8	11919.3	41046.2	952	19145.9	11919.3	27195	425	18878.4	11919.3	29137.4
Poverty	1139	19.4	5.8	39.9	952	20.1	9.7	39.9	425	24.6	9.7	39.9
Wages($)	1139	23844.9	16465	37749.9	952	23199.5	16465	37385.5	425	23904.9	16465	37385.5
Higher Education	1005	0.5	0	0.7	840	0.5	0	0.7	375	0.4	0	0.7
Income Groups:												
$15,000<I<$20,000	402	995.7	99	10091	336	714.8	99	6795	150	808.6	104	6795
I<$20,000	402	3053.2	408	33041	336	2206.5	408	25208	150	2684.1	499	25208
I<$30,000	402	5141.8	837	54919	336	3681.5	837	39067	150	4256.8	845	39067
I>$75,000	402	5755.3	223	64633	336	3502.4	223	33460	150	3658.8	223	33460
# of Establishments:												
Logging	1139	11.5	0	59	952	12.3	0	59	425	14.4	0	59
Wood Mfg.	1139	7.4	0	68	952	6.5	0	68	425	7.3	0	68
Paper Mfg.	1139	1.1	0	13	952	0.8	0	12	425	1.2	0	12
Furniture Mfg.	1139	5.1	0	49	952	3.7	0	33	425	2.9	0	33
Total FS	1139	27	1	126	952	25.1	1	126	425	27.6	1	126
Employment Share:												
Logging	1139	0.01	0	0.1	952	0.01	0	0.1	425	0.01	0	0.1
Wood Mfg.	1139	0.02	0	0.3	952	0.03	0	0.3	425	0.03	0	0.1
Paper Mfg.	1139	0.02	0	0.4	952	0.02	0	0.4	425	0.04	0	0.4
Furniture Mfg.	1139	0.01	0	0.3	952	0.01	0	0.3	425	0.01	0	0
Total FS	1139	0.1	0.001	0.5	952	0.1	0.001	0.5	425	0.1	0	0.5
Output Share:												
Logging	1139	0.02	0	0.2	952	0.03	0	0.2	425	0.03	0	0.2
Wood Mfg.	1139	0.04	0	0.4	952	0.05	0	0.4	425	0.05	0	0.2
Paper Mfg.	1139	0.1	0	0.7	952	0.1	0	0.7	425	0.1	0	0.7
Furniture Mfg.	1139	0.01	0	0.4	952	0.01	0	0.4	425	0	0	0
Total FS	1139	0.1	0.001	0.8	952	0.15	0	0.8	425	0.2	0	0.8
Control Variables:												
Schooling Rate	1138	0.1	0.02	0.3	952	0.1	0.02	0.3	425	0.1	0	0.3
Race	1139	0.3	0.003	0.9	952	0.3	0	0.9	425	0.5	0.1	0.9
Economic Diversity	1139	0.6	0.5	0.7	952	0.6	0.5	0.7	425	0.6	0.5	0.7
Unemployment Rate	1139	0.1	0.01	0.2	952	0.1	0.03	0.2	425	0.1	0	0.2

Table 3.2: Effect of the Forest Sector Dependence on Per capita income in Alabama

Dependent Variable: Real Per capita income (Based on 1996 US dollars)															
Models:	(1.1)					(2.1)					(3.1)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Number of Establish.	**-0.096[a]**	**-0.051[a]**	**-0.028[a]**	**-0.019[a]**	**-0.122[a]**										
	(0.007)	**(0.005)**	**(0.012)**	**(0.006)**	**(0.009)**										
Employment Share						**-0.010[a]**	**-0.004[c]**	**-0.006[b]**	**-0.001**	**-0.052[a]**					
						(0.003)	**(0.002)**	**(0.003)**	**(0.003)**	**(0.007)**					
Output Share											**-0.004[b]**	**-0.019[a]**	**-0.002**	**-0.009[b]**	**-0.034[a]**
											(0.002)	**(0.004)**	**(0.003)**	**(0.004)**	**(0.006)**
Schooling Rate	0.080[a]	0.080[a]	0.097[a]	0.103[a]	0.069[a]	0.097[a]	0.101[a]	0.099[a]	0.101[a]	0.083[a]	0.092[a]	0.090[a]	0.101[a]	0.099[a]	0.078[a]
	(0.021)	(0.021)	(0.022)	(0.022)	(0.020)	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Shannon-Weaver index	0.617[a]	0.797[a]	0.960[a]	0.947[a]	0.626[a]	0.959[a]	0.959[a]	0.973[a]	0.964[a]	0.854[a]	0.985[a]	0.994[a]	0.977[a]	0.965[a]	0.935[a]
	(0.070)	(0.070)	(0.073)	(0.073)	(0.071)	(0.073)	(0.073)	(0.073)	(0.073)	(0.073)	(0.074)	(0.073)	(0.075)	(0.073)	(0.072)
Race (Black Pop)	-0.081[b]	-0.086[b]	-0.115[a]	-0.098[a]	-0.068[b]	-0.103[a]	-0.111[a]	-0.106[a]	-0.114[a]	-0.112[a]	-0.115[a]	-0.112[a]	-0.110[a]	-0.121[a]	-0.107[a]
	(0.034)	(0.034)	(0.036)	(0.036)	(0.033)	(0.036)	(0.036)	(0.036)	(0.036)	(0.035)	(0.036)	(0.036)	(0.036)	(0.036)	(0.035)
Constant	10.439[a]	10.430[a]	10.381[a]	10.395[a]	10.608[a]	10.334[a]	10.371[a]	10.355[a]	10.376[a]	10.112[a]	10.352[a]	10.292[a]	10.386[a]	10.312[a]	10.228[a]
	(0.080)	(0.079)	(0.083)	(0.084)	(0.079)	(0.085)	(0.085)	(0.086)	(0.090)	(0.090)	(0.086)	(0.086)	(0.084)	(0.090)	(0.087)
Observations	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
Counties	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Dependent variable, per capita income, and output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table 3.3: Effect of the Forest Sector Dependence on Poverty Rates in Alabama

Dependent Variable: Poverty Rates (Number of People in Poverty/Population)															
Models:	(1.2)					(2.2)					(3.2)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Number of Establish.	**-0.089[a]**	**-0.013[b]**	**-0.012**	**-0.035[a]**	**-0.078[a]**										
	(0.010)	**(0.006)**	**(0.015)**	**(0.008)**	**(0.012)**										
Employment Share						**-0.011[a]**	**-0.004**	**-0.009[b]**	**-0.021[a]**	**-0.078[a]**					
						(0.003)	**(0.003)**	**(0.004)**	**(0.004)**	**(0.009)**					
Output Share											**-0.010[a]**	**-0.043[a]**	**-0.009[b]**	**-0.028[a]**	**-0.060[a]**
											(0.003)	**(0.005)**	**(0.004)**	**(0.005)**	**(0.007)**
Schooling Rate	0.135[a]	0.149[a]	0.153[a]	0.152[a]	0.134[a]	0.149[a]	0.154[a]	0.152[a]	0.147[a]	0.126[a]	0.132[a]	0.128[a]	0.155[a]	0.148[a]	0.112[a]
	(0.027)	(0.028)	(0.028)	(0.027)	(0.027)	(0.028)	(0.028)	(0.028)	(0.027)	(0.027)	(0.028)	(0.027)	(0.028)	(0.027)	(0.027)
Shannon-Weaver index	0.814[a]	1.093[a]	1.134[a]	1.173[a]	0.921[a]	1.128[a]	1.129[a]	1.145[a]	1.102[a]	0.967[a]	1.180[a]	1.198[a]	1.095[a]	1.130[a]	1.082[a]
	(0.091)	(0.093)	(0.092)	(0.092)	(0.096)	(0.092)	(0.093)	(0.093)	(0.091)	(0.091)	(0.093)	(0.090)	(0.095)	(0.091)	(0.090)
Race (Black Pop)	0.111[b]	0.089[b]	0.081[c]	0.058	0.110[b]	0.091[b]	0.082[c]	0.089[c]	0.041	0.081[c]	0.073	0.079[c]	0.077[c]	0.052	0.089[b]
	(0.044)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.045)	(0.044)	(0.045)	(0.044)	(0.045)	(0.045)	(0.044)
Constant	4.034[a]	3.964[a]	3.941[a]	3.977[a]	4.086[a]	3.888[a]	3.927[a]	3.898[a]	3.711[a]	3.529[a]	3.857[a]	3.725[a]	3.967[a]	3.705[a]	3.662[a]
	(0.104)	(0.106)	(0.106)	(0.105)	(0.106)	(0.107)	(0.107)	(0.108)	(0.111)	(0.113)	(0.108)	(0.106)	(0.106)	(0.113)	(0.108)
Observation	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
County	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] p<0.01, [b] p<0.05, [c] p<0.1. Logarithmic values of all the variables are used in all models. Output share of the forest products industry is transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table 3.4: Location Quotient, Effect of the Forest Sector Dependence on Per capita income in Alabama

Dependent Variable: Real Per capita income (Based on 1996 US dollars)															
Models:	(4.1)					(5.1)					(6.1)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
$Est\_LQ^i_{c,t}$	**-0.014[b]**	**-0.009**	**0.026[a]**	**0.002**	**-0.004**										
	(0.006)	**(0.006)**	**(0.006)**	**(0.008)**	**(0.011)**										
$Emp\_LQ^i_{c,t}$						**0.015[a]**	**-0.001**	**0.004**	**0.008[b]**	**-0.020[a]**					
						(0.004)	**(0.004)**	**(0.003)**	**(0.004)**	**(0.004)**					
$Out\_LQ^i_{c,t}$											**-0.010[a]**	**0.005**	**0.005**	**-0.005**	**-0.014[a]**
											(0.003)	**(0.003)**	**(0.004)**	**(0.003)**	**(0.005)**
Schooling Rate	0.099[a]	0.101[a]	0.097[a]	0.101[a]	0.101[a]	0.102[a]	0.101[a]	0.101[a]	0.103[a]	0.092[a]	0.096[a]	0.102[a]	0.102[a]	0.101[a]	0.095[a]
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Shannon-Weaver index	0.991[a]	0.977[a]	0.937[a]	0.964[a]	0.972[a]	0.911[a]	0.967[a]	0.948[a]	0.949[a]	1.035[a]	1.015[a]	0.940[a]	0.948[a]	0.975[a]	0.978[a]
	(0.074)	(0.074)	(0.073)	(0.074)	(0.075)	(0.074)	(0.074)	(0.075)	(0.074)	(0.074)	(0.075)	(0.076)	(0.074)	(0.073)	(0.073)
Race (Black Pop)	-0.109[a]	-0.112[a]	-0.116[a]	-0.109[a]	-0.111[a]	-0.130[a]	-0.111[a]	-0.113[a]	-0.107[a]	-0.089[b]	-0.111[a]	-0.109[a]	-0.115[a]	-0.113[a]	-0.110[a]
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
Constant	10.405[a]	10.396[a]	10.350[a]	10.393[a]	10.395[a]	10.329[a]	10.391[a]	10.379[a]	10.396[a]	10.435[a]	10.407[a]	10.384[a]	10.377[a]	10.390[a]	10.384[a]
	(0.084)	(0.084)	(0.084)	(0.084)	(0.085)	(0.085)	(0.084)	(0.084)	(0.084)	(0.083)	(0.084)	(0.084)	(0.084)	(0.084)	(0.084)
Observation	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
County	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Dependent variable, per capita income is transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table 3.5: Location Quotient, Effect of the Forest Sector Dependence on Poverty Rates in Alabama

Dependent Variable: Poverty Rates (Number of People in Poverty/ Population)															
Models:	(4.2)					(5.2)					(6.2)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
$Est\_LQ^i_{c,t}$	**-0.004**	**0.010**	**0.022[a]**	**-0.001**	**0.050[a]**										
	(0.007)	**(0.008)**	**(0.008)**	**(0.010)**	**(0.013)**										
$Emp\_LQ^i_{c,t}$						**0.018[a]**	**0.003**	**0.011[b]**	**0.012[b]**	**0.0003**					
						(0.005)	**(0.005)**	**(0.004)**	**(0.005)**	**(0.005)**					
$Out\_LQ^i_{c,t}$											**-0.006**	**-0.015[a]**	**0.005**	**-0.002**	**-0.039[a]**
											(0.004)	**(0.004)**	**(0.005)**	**(0.004)**	**(0.006)**
Schooling Rate	0.154[a]	0.155[a]	0.151[a]	0.154[a]	0.157[a]	0.155[a]	0.154[a]	0.154[a]	0.157[a]	0.155[a]	0.151[a]	0.152[a]	0.155[a]	0.154[a]	0.137[a]
	(0.028)	(0.028)	(0.028)	(0.028)	(0.027)	(0.027)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.027)
Shannon-Weaver index	1.144[a]	1.124[a]	1.112[a]	1.137[a]	1.071[a]	1.066[a]	1.128[a]	1.090[a]	1.109[a]	1.135[a]	1.168[a]	1.220[a]	1.119[a]	1.139[a]	1.168[a]
	(0.094)	(0.093)	(0.093)	(0.093)	(0.094)	(0.094)	(0.094)	(0.094)	(0.093)	(0.094)	(0.095)	(0.095)	(0.094)	(0.093)	(0.091)
Race (Black Pop)	0.083[c]	0.083[c]	0.078[c]	0.081[c]	0.080[c]	0.058	0.085[c]	0.078[c]	0.089[c]	0.082[c]	0.083[c]	0.075[c]	0.079[c]	0.082[c]	0.084[c]
	(0.045)	(0.045)	(0.045)	(0.046)	(0.045)	(0.046)	(0.046)	(0.045)	(0.045)	(0.046)	(0.045)	(0.045)	(0.045)	(0.045)	(0.044)
Constant	3.953[a]	3.942[a]	3.915[a]	3.947[a]	3.895[a]	3.870[a]	3.949[a]	3.917[a]	3.955[a]	3.947[a]	3.958[a]	3.971[a]	3.935[a]	3.948[a]	3.927[a]
	(0.106)	(0.106)	(0.106)	(0.106)	(0.106)	(0.108)	(0.106)	(0.107)	(0.106)	(0.107)	(0.106)	(0.106)	(0.107)	(0.106)	(0.104)
Observation	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
County	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models.

Table 3.6: Complementary Analysis; Effect of the Forest Sector Dependence on Average Wages in Alabama

Dependent Variable: Average Wages (Real values based on 1996 US dollars)															
Models:	(7.1)					(7.2)					(7.3)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Number of Establish.	**-0.047[a]**	**-0.029[a]**	**-0.017[a]**	**0.013[a]**	**-0.066[a]**										
	(0.002)	**(0.002)**	**(0.006)**	**(0.003)**	**(0.005)**										
Employment Share						**-0.007[a]**	**-0.003[a]**	**-0.006[a]**	**0.001**	**-0.029[a]**					
						(0.002)	**(0.001)**	**(0.002)**	**(0.002)**	**(0.004)**					
Output Share											**-0.002[c]**	**-0.006[b]**	**-0.005[a]**	**-0.006[a]**	**-0.020[a]**
											(0.001)	**(0.002)**	**(0.002)**	**(0.002)**	**(0.003)**
Schooling Rate	0.037[a]	0.035[a]	0.045[a]	0.049[a]	0.031[a]	0.044[a]	0.048[a]	0.046[a]	0.048[a]	0.037[a]	0.043[a]	0.044[a]	0.047[a]	0.046[a]	0.034[a]
	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)	(0.013)	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Shannon-Weaver index	0.183[a]	0.256[a]	0.350[a]	0.340[a]	0.171[a]	0.349[a]	0.348[a]	0.360[a]	0.356[a]	0.291[a]	0.363[a]	0.362[a]	0.378[a]	0.353[a]	0.336[a]
	(0.041)	(0.041)	(0.042)	(0.042)	(0.041)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.043)	(0.042)	(0.041)
Race (Black Pop)	-0.066[a]	-0.067[a]	-0.084[a]	-0.072[a]	-0.058[a]	-0.076[a]	-0.082[a]	-0.077[a]	-0.079[a]	-0.082[a]	-0.083[a]	-0.082[a]	-0.078[a]	-0.088[a]	-0.079[a]
	(0.020)	(0.020)	(0.020)	(0.021)	(0.019)	(0.020)	(0.021)	(0.021)	(0.021)	(0.020)	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)
Constant	10.245[a]	10.227[a]	10.202[a]	10.204[a]	10.324[a]	10.166[a]	10.190[a]	10.171[a]	10.220[a]	10.051[a]	10.188[a]	10.178[a]	10.196[a]	10.155[a]	10.111[a]
	(0.047)	(0.046)	(0.048)	(0.048)	(0.046)	(0.048)	(0.048)	(0.049)	(0.051)	(0.052)	(0.049)	(0.050)	(0.048)	(0.052)	(0.050)
Observation	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138
County	67	67	67	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Dependent variable, average wages, and output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table 3.7: Effect of Forestry, Agriculture and Automotive Sector Dependence on the Ratio of High School Graduates Attending to a College

Dependent Variable: The Ratio of High School Graduates Attending to a College			
	(8.1)	(8.2)	(8.3)
VARIABLES	gocollege	gocollege	gocollege
Number of Est.in Forest Products Sector	**-0.069[c]** **(0.041)**		
Number of Est.in Agriculture Sector	-0.238[a] (0.032)		
Number of Est.in Automotive Sector	0.076[a] (0.018)		
Rate of Employment in Forest Sector (Forest Employees/Laborforce)		**-0.067[a]** **(0.020)**	
Rate of Employment in Agriculture Sector (AgricultureEmployees/Laborforce)		-0.082[a] (0.015)	
Rate of Employment in Automotive Sector (Auto. Employees/Laborforce)		0.013[a] (0.004)	
Rate of Output of Forest Sector (Forest Output/ Mfg. Output)			**-0.001** **(0.013)**
Rate of Output of Agriculture Sector (Ag. Output/ Mfg. Output)			-0.087[a] (0.004)
Rate of Output of Automotive Sector (Auto. Output/ Mfg. Output)			0.006[c] (0.003)
Race (Black Pop. Ratio)	-0.259[a] (0.093)	-0.328[a] (0.099)	-0.049 (0.086)
Unemployment Rate	0.017 (0.018)	0.060[a] (0.019)	0.033[b] (0.016)
Constant	-0.392[b] (0.181)	-1.757[a] (0.212)	-1.047[a] (0.158)
Number of Observations	1,004	1,004	1,004
Number of Counties	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] p<0.01, [b] p<0.05, [c] p<0.1.Logarithmic values of all the variables are used in all models. Output share of the industries are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.The number of observations is 1004 because higher education data is available for the years between 1998 and 2012.

Table 3.8: Effect of the Forest Sector Dependence on the Number of Families within Certain Income Groups in Alabama

Dependent Variable: Number of Families in Each Income Groups												
Models:	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)
Variables/ Income Groups	20K<Income<25K			25K<Income<30K			20K<Income<40K			Income>75K		
Number of Establishments	**0.145[a]**			**0.219[a]**			**0.178[a]**			**-0.333[a]**		
	(0.046)			**(0.044)**			**(0.026)**			**(0.044)**		
Employment Share		**0.044**			**0.107[a]**			**0.079[a]**			**-0.212[a]**	
		(0.029)			**(0.028)**			**(0.016)**			**(0.027)**	
Output Share			**0.047[b]**			**0.086[a]**			**0.066[a]**			**-0.139[a]**
			(0.022)			**(0.021)**			**(0.012)**			**(0.021)**
Schooling Rate	-0.032	-0.080	-0.056	0.077	0.023	0.054	-0.049	-0.097[b]	-0.071	0.291[a]	0.352[a]	0.319[a]
	(0.080)	(0.080)	(0.081)	(0.078)	(0.078)	(0.079)	(0.045)	(0.045)	(0.046)	(0.078)	(0.076)	(0.079)
Shannon-Weaver index	-1.708[a]	-2.076[a]	-2.126[a]	-1.453[a]	-1.894[a]	-2.061[a]	-1.654[a]	-2.034[a]	-2.155[a]	4.063[a]	4.599[a]	4.976[a]
	(0.365)	(0.344)	(0.335)	(0.355)	(0.336)	(0.328)	(0.204)	(0.197)	(0.191)	(0.353)	(0.328)	(0.328)
Race (Black Pop)	0.206	0.203	0.197	0.167	0.161	0.151	0.098	0.095	0.087	-0.609[a]	-0.598[a]	-0.584[a]
	(0.135)	(0.137)	(0.136)	(0.132)	(0.133)	(0.133)	(0.076)	(0.078)	(0.078)	(0.131)	(0.130)	(0.133)
Constant	5.595[a]	5.904[a]	5.913[a]	5.644[a]	6.346[a]	6.201[a]	6.656[a]	7.184[a]	7.088[a]	10.255[a]	8.902[a]	9.361[a]
	(0.351)	(0.392)	(0.373)	(0.342)	(0.382)	(0.364)	(0.196)	(0.224)	(0.212)	(0.340)	(0.373)	(0.365)
Observations	402	402	402	402	402	402	402	402	402	402	402	402
Number of County	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Appendices

Economic Segmentation and Dual Economy Theory

Economic segmentation theory postulates the existence of two types of industries within an economy: core and periphery industries (Averitt 1968). According to the theory, core industries generate greater economic well-being, while periphery industries have a negative influence on economic well-being. Core industries are capital intensive and dominate their product market with large-scale establishments, use of advanced technology, labor unionization, bureaucratic organizational structure, and have more factor endowment and market concentration. Workers in core industries generally enjoy benefits, such as higher wages, greater job stability, insurance, vacations, and retirement payments. Conversely, periphery industries are typically small-scale firms that use labor intensive production by employing low-skilled labor. Periphery industries also typically have small profit margins, lack unionization, experience intensive product market competition, and generally exhibit low productivity and pay low wages (Averitt 1968; Bluestone 1970; O'Conner 1973; Oster 1979; Tolbert *et al.*1980).

Overdevest and Green (1995) applied the market segmentation theory on forest products industries of Georgia. They estimated the impact of dependence on core and periphery forest industries on the economic well-being within the rural counties of Georgia. Based on the Standard Industrial Classification (SIC) System, they defined pulp mills, paper mills, and paperboard mills as core industries in the forest sector and their periphery forest industry classification included forestry services (e.g., forestry cruising and estimating timber, fire prevention, forest management, forest nurseries), logging, sawmills, planning mills, hardwood dimension and flooring mills, special products mills, millwork, veneer, plywood and structural

wood members, wood container mills, wood pallet mills, wood preserving, reconstituted wood products, hardboard, particleboard, fiberboard, waferboard, stranboard, furniture manufacturing, paperboard containers, and converted paper products. They found that core industries, such as pulp and paper mills, positively influence economic well-being, while periphery industries are not associated with economic well-being. Similarly, Parkins *et al.* (2003) utilized economic segmentation theory to investigate the impact of core and periphery industries within the forest sector in two provinces of Canada on economic well-being. They used pulp and lumber as the core industry and logging and forest services as periphery industries within the forest sector of Canada. They show that core industries (e.g., pulp and lumber) in New Brunswick province of Canada have positive effect on income while periphery industries (e.g., logging and forest services) have no impact on income. In British Columbia province of Canada, both core and periphery industries are positively correlated with income (because the "only game in town" is forestry) and negatively correlated with poverty.

In a similar fashion, we attempt to link the analyses in this study to the theory of economic segmentation. Following above-mentioned studies, we defined paper products manufacturing as a core industry within the forest sector of Alabama based on the industries numbered code "322" in the North American Industrial Classification System (NAICS). Our periphery classification included logging, wood products manufacturing, and paper products manufacturing industries in the forest sector of Alabama based on NAICS codes 113, 321, and 337, respectively.

Figures and Tables

Table A 1: Sub-Industries and Their Commodities Based on NAICS Codes

NAICS	Sub-Industries	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
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).

Table A 1 Continued,

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.
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 and 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.
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,

Table A 1 Continued,

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

Figure A 1: Forest Sector Reliance Indicators, Logging Sector, Alabama 1996-2012

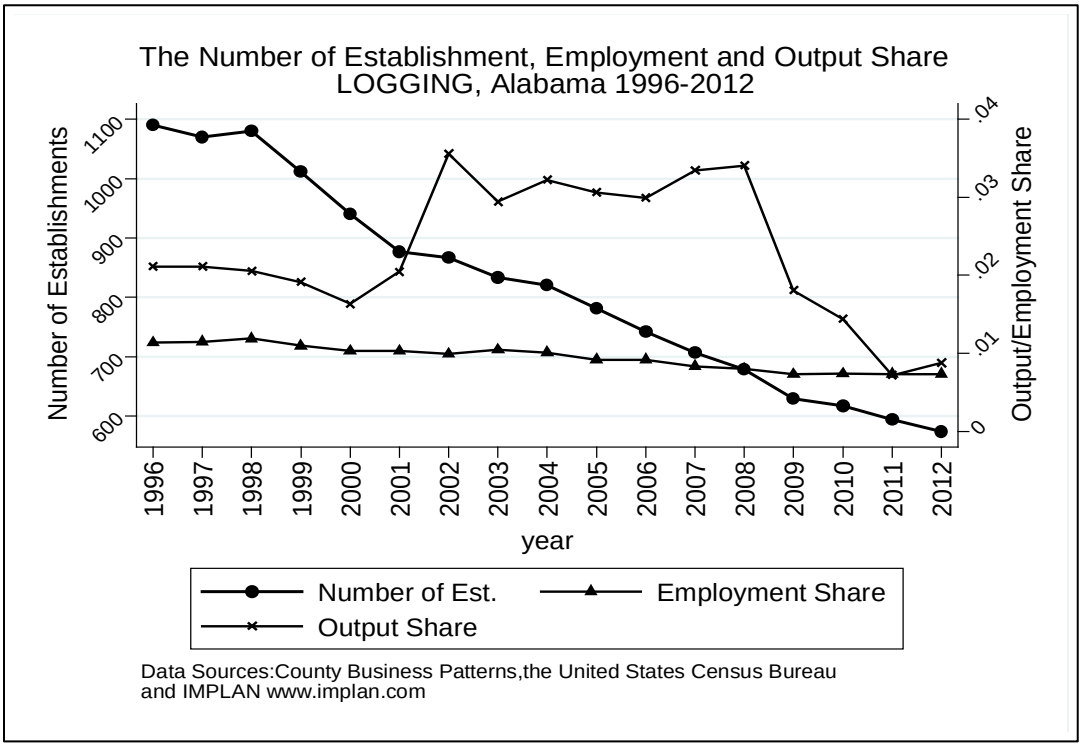


Figure A 2: Forest Sector Reliance Indicators, Wood Products Mfg., Alabama 1996-2012

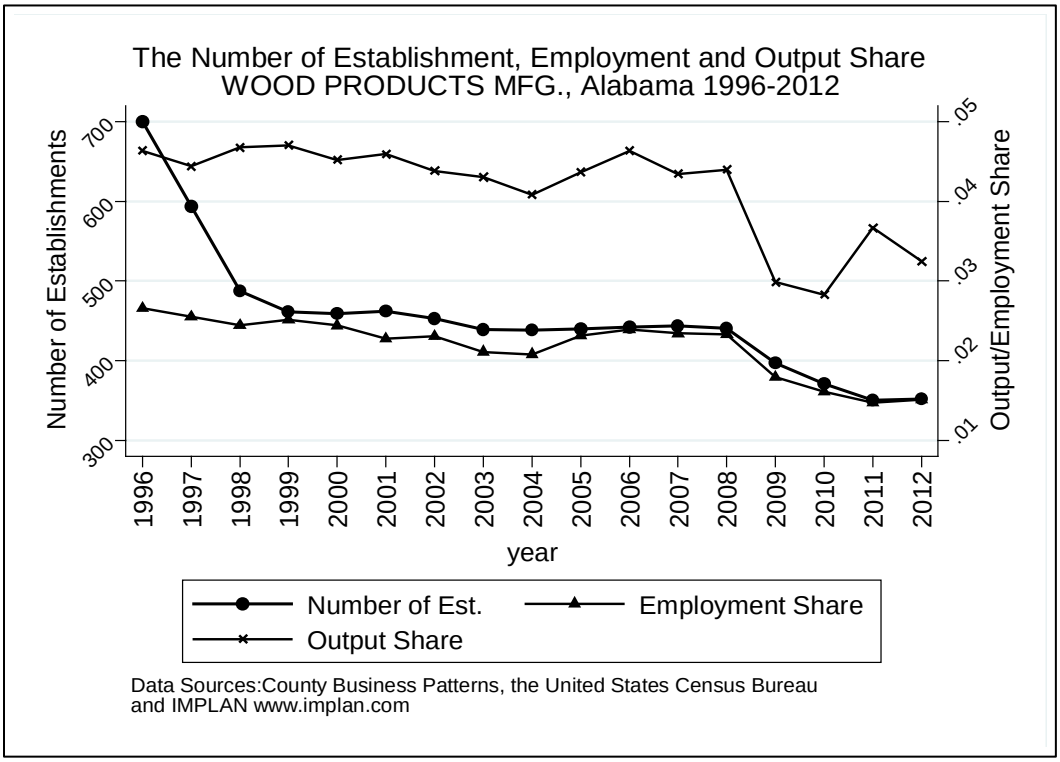


Figure A 3: Forest Sector Reliance Indicators, Paper Products Mfg., Alabama 1996-2012

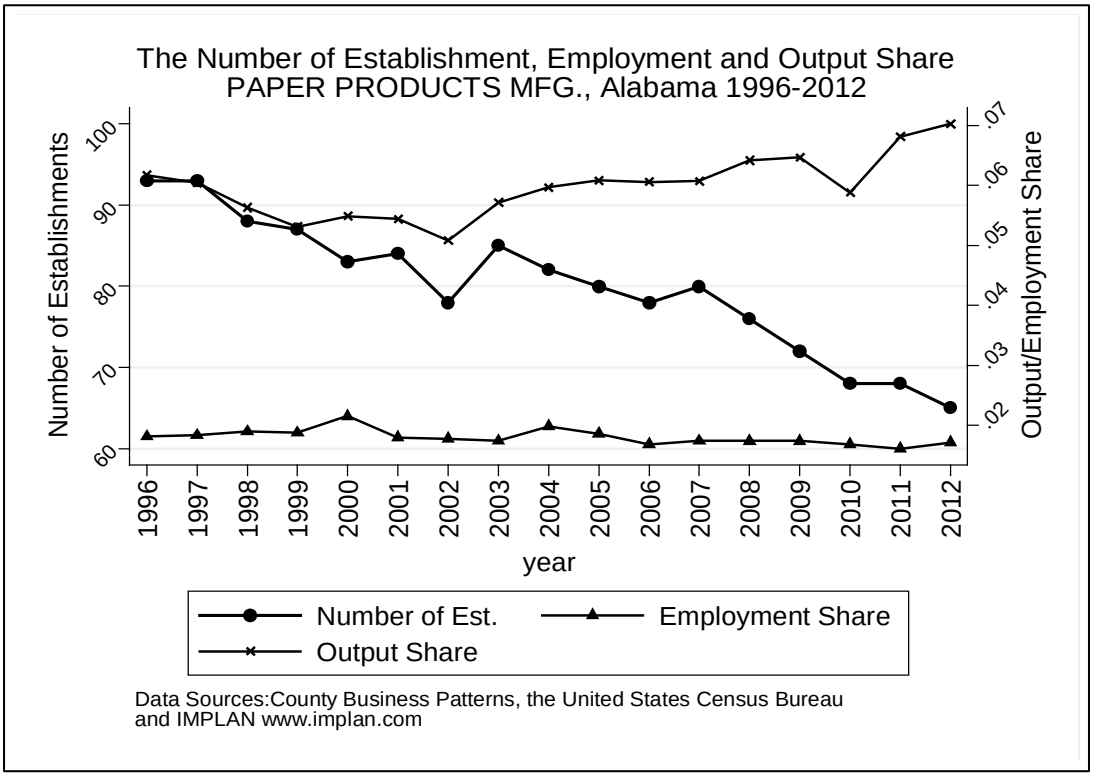


Figure A 4: Forest Sector Reliance Indicators, Furniture Mfg., Alabama 1996-2012

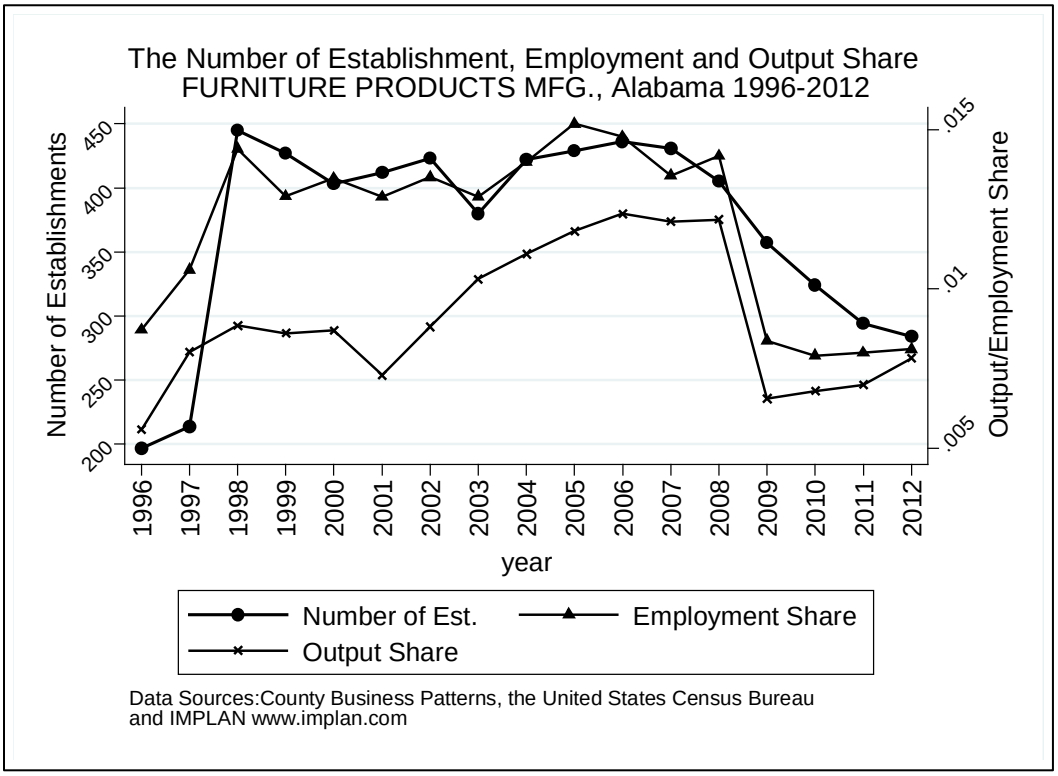


Table A 2: Description, Availability and Sources of the Study Dataset

Variables	Description and Availability	Source
Dependent Variables:		
Per capita income	Total personal income of the residents of an area divided by the population of the area. Data is available for the years:1996-2012	U.S. Bureau of Economic Analysis, www.bea.com
Poverty Rates	The proportion of people below the low income thresholds within a region. Data is available for the years:1996-2012	U.S. Census Bureau, Small Income and Poverty Estimates Datasets http://www.census.gov/did/www/saipe/data/statecounty/data/index.html
Wages	Average annual wages include bonuses, stock options, severance pay, profit distributions, cash value of meals and lodging, tips and other gratuities. Data is available for the years:1996-2012	U.S. Department of Labor, Bureau of Labor Statistics, Quarterly Census of Employment and Wages Datasets http://www.bls.gov/cew/dataguide.htm
Education	The number of high school graduates as proportion of total high school graduates Data is available for the years:1998-2012	Alabama Commission on Higher Education http://www.ache.state.al.us

Table A 2 Continued,

Income Quintiles	The number of families in different income groups. Data is available for the years:2000, 2008-2012	American Community Survey, US Census Bureau. https://www.census.gov/programs-surveys/acs/
Independent Variables: ***1.Interest Variables***		
Number of Establishments	Number of establishments in Logging, Wood Manufacturing, Pulp and Paper Manufacturing, and Furniture Manufacturing.	County Business Patterns, US Census Bureau. http://www.census.gov/econ/cbp/download/
Employment Ratio	Employment in the Forest Sector as proportion of total labor force in a county. Data is available for the years:1996-2012	County Business Patterns, US Census Bureau. http://www.census.gov/econ/cbp/download/
Output Ratio	Proportion of the forest sector output in total manufacturing sector's output. Data is available for the years:1996-2012	IMPLAN Group LLC, IMPLAN System www.IMPLAN.com
2. Control Variables:		
Educational Attainment	Proportion of the number of Students in private and public schools of Alabama in county population. 1996-2012	Alabama State Department of Education. https://www.alsde.edu/#

Table A 2 Continued,

Race	African American Population Ratio Data is available for the years:1996-2012	Population and Housing Unit Estimates, US Census Bureau. https://www.census.gov/popest/index.html
Economic Diversity	The Shannon-Weaver Economic Diversity Index. How employment in a county is distributed among the firms of that county. 0: no diversity, 1: perfect diversity. Data is available for the years:1996-2012	IMPLAN Group LLC, IMPLAN System www.IMPLAN.com
Unemployment Rate	%age of unemployed individuals among all individuals currently in the labor force. Data is available for the years:1996-2012	U.S. Department of Labor, Bureau of Labor Statistics, www.BLS.gov

Table A 3: Effect of the Forest Sector Dependence on Per capita Income in Rural Alabama

Dependent Variable: Real Per capita income (Based on 1996 US dollars)															
Models:	(1.1)					(2.1)					(3.1)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
Number of Establish.	**-0.097[a]**	**-0.047[a]**	**-0.003**	**0.005**	**-0.123[a]**										
	(0.008)	**(0.005)**	**(0.017)**	**(0.007)**	**(0.009)**										
Employment Share						**-0.009[a]**	**-0.003**	**-0.003**	**-0.003**	**-0.052[a]**					
						(0.003)	**(0.002)**	**(0.003)**	**(0.003)**	**(0.008)**					
Output Share											**-0.007[a]**	**-0.015[a]**	**-0.002**	**-0.007[c]**	**-0.028[a]**
											(0.002)	**(0.004)**	**(0.004)**	**(0.004)**	**(0.006)**
Schooling Rate	0.084[a]	0.089[a]	0.108[a]	0.108[a]	0.074[a]	0.104[a]	0.108[a]	0.107[a]	0.107[a]	0.091[a]	0.094[a]	0.100[a]	0.108[a]	0.106[a]	0.090[a]
	(0.023)	(0.023)	(0.024)	(0.024)	(0.022)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.025)	(0.024)	(0.024)	(0.024)	(0.024)
Shannon-Weaver index	0.498[a]	0.682[a]	0.818[a]	0.815[a]	0.498[a]	0.821[a]	0.812[a]	0.822[a]	0.811[a]	0.720[a]	0.845[a]	0.847[a]	0.825[a]	0.819[a]	0.808[a]
	(0.078)	(0.076)	(0.078)	(0.078)	(0.075)	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)	(0.078)	(0.080)	(0.078)	(0.077)
Race (Black Pop)	-0.124[a]	-0.137[a]	-0.172[a]	-0.169[a]	-0.109[a]	-0.161[a]	-0.172[a]	-0.169[a]	-0.178[a]	-0.160[a]	-0.180[a]	-0.167[a]	-0.171[a]	-0.178[a]	-0.159[a]
	(0.036)	(0.037)	(0.039)	(0.039)	(0.036)	(0.039)	(0.039)	(0.039)	(0.039)	(0.038)	(0.039)	(0.038)	(0.039)	(0.039)	(0.038)
Constant	10.284[a]	10.212[a]	10.192[a]	10.193[a]	10.439[a]	10.160[a]	10.179[a]	10.178[a]	10.155[a]	9.958[a]	10.133[a]	10.136[a]	10.190[a]	10.137[a]	10.097[a]
	(0.086)	(0.088)	(0.092)	(0.092)	(0.086)	(0.092)	(0.092)	(0.093)	(0.098)	(0.096)	(0.094)	(0.093)	(0.092)	(0.098)	(0.093)
Observations	952	952	952	952	952	952	952	952	952	952	952	952	952	952	952
Counties	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Dependent variable, per capita income, and output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 4: Effect of the Forest Sector Dependence on Per capita Income in Black Belt-West Alabama Region

Dependent Variable: Real Per capita income (Based on 1996 US dollars)															
Models:	(1.1)					(2.1)					(3.1)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
Number of Establish.	**-0.212[a]**	**-0.074[a]**	**0.024**	**-0.020**	**-0.210[a]**										
	(0.019)	**(0.010)**	**(0.034)**	**(0.020)**	**(0.017)**										
Employment Share						**-0.020[a]**	**-0.002**	**0.006**	**-0.007**	**-0.087[a]**					
						(0.007)	**(0.005)**	**(0.006)**	**(0.005)**	**(0.017)**					
Output Share											**-0.016[b]**	**-0.023[b]**	**0.008**	**-0.013**	**-0.044[a]**
											(0.006)	**(0.010)**	**(0.008)**	**(0.009)**	**(0.013)**
Schooling Rate	0.131[a]	0.092[b]	0.109[a]	0.109[a]	0.095[a]	0.105[b]	0.109[a]	0.108[a]	0.107[b]	0.102[b]	0.078[c]	0.104[b]	0.109[a]	0.103[b]	0.082[b]
	(0.035)	(0.038)	(0.041)	(0.041)	(0.034)	(0.041)	(0.041)	(0.041)	(0.041)	(0.040)	(0.043)	(0.041)	(0.041)	(0.041)	(0.041)
Shannon-Weaver index	0.715[a]	1.200[a]	1.338[a]	1.330[a]	0.714[a]	1.393[a]	1.338[a]	1.339[a]	1.320[a]	1.117[a]	1.367[a]	1.375[a]	1.327[a]	1.315[a]	1.218[a]
	(0.146)	(0.149)	(0.159)	(0.159)	(0.141)	(0.159)	(0.159)	(0.159)	(0.160)	(0.160)	(0.158)	(0.159)	(0.160)	(0.160)	(0.161)
Race (Black Pop)	0.034	0.021	0.041	0.044	0.078	-0.005	0.066	0.071	0.023	0.012	-0.008	-0.032	0.053	-0.021	0.055
	(0.145)	(0.158)	(0.173)	(0.171)	(0.141)	(0.170)	(0.171)	(0.171)	(0.173)	(0.165)	(0.171)	(0.174)	(0.171)	(0.181)	(0.168)
Constant	11.002[a]	10.750[a]	10.763[a]	10.773[a]	11.055[a]	10.670[a]	10.779[a]	10.827[a]	10.688[a]	10.364[a]	10.621[a]	10.641[a]	10.806[a]	10.619[a]	10.556[a]
	(0.144)	(0.156)	(0.170)	(0.169)	(0.141)	(0.171)	(0.169)	(0.174)	(0.182)	(0.183)	(0.179)	(0.178)	(0.170)	(0.206)	(0.179)
Observations	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357
Counties	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Dependent variable, per capita income, and output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 5: Effect of the Forest Sector Dependence on Poverty Rates in Rural Alabama

Dependent Variable: Poverty Rates (Number of People in Poverty/ Population)															
Models:	(1.2)					(2.2)					(3.2)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
Number of Establish.	**-0.083[a]**	**-0.011[c]**	**0.024**	**-0.034[a]**	**-0.066[a]**										
	(0.011)	**(0.006)**	**(0.021)**	**(0.009)**	**(0.012)**										
Employment Share						**-0.010[b]**	**-0.002**	**-0.007[c]**	**-0.020[a]**	**-0.073[a]**					
						(0.004)	**(0.003)**	**(0.004)**	**(0.004)**	**(0.010)**					
Output Share											**-0.017[a]**	**-0.040[a]**	**0.008[c]**	**-0.026[a]**	**-0.055[a]**
											(0.003)	**(0.005)**	**(0.005)**	**(0.005)**	**(0.008)**
Schooling Rate	0.107[a]	0.123[a]	0.129[a]	0.123[a]	0.109[a]	0.123[a]	0.128[a]	0.126[a]	0.120[a]	0.103[a]	0.092[a]	0.106[a]	0.127[a]	0.122[a]	0.093[a]
	(0.029)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.029)	(0.029)	(0.030)	(0.029)	(0.030)	(0.030)	(0.029)
Shannon-Weaver index	0.833[a]	1.075[a]	1.102[a]	1.128[a]	0.934[a]	1.109[a]	1.102[a]	1.118[a]	1.068[a]	0.970[a]	1.176[a]	1.186[a]	1.064[a]	1.111[a]	1.086[a]
	(0.100)	(0.098)	(0.097)	(0.096)	(0.101)	(0.097)	(0.097)	(0.097)	(0.095)	(0.096)	(0.096)	(0.095)	(0.099)	(0.096)	(0.094)
Race (Black Pop)	0.076	0.042	0.034	0.010	0.069	0.047	0.035	0.042	-0.002	0.052	0.014	0.048	0.027	0.015	0.061
	(0.047)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.047)	(0.047)	(0.047)	(0.048)	(0.047)	(0.047)
Constant	3.921[a]	3.846[a]	3.838[a]	3.833[a]	3.975[a]	3.805[a]	3.832[a]	3.806[a]	3.615[a]	3.515[a]	3.690[a]	3.693[a]	3.851[a]	3.642[a]	3.655[a]
	(0.111)	(0.114)	(0.114)	(0.113)	(0.115)	(0.114)	(0.114)	(0.115)	(0.119)	(0.118)	(0.115)	(0.112)	(0.114)	(0.120)	(0.114)
Observation	952	952	952	952	952	952	952	952	952	952	952	952	952	952	952
County	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry is transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 6: Effect of the Forest Sector Dependence on Poverty Rates in Black Belt-West Alabama Region

Dependent Variable: Poverty Rates (Number of People in Poverty/ Population)															
Models:	(1.2)					(2.2)					(3.2)				
Variables/Industries	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS	Logging	Wood Mfg	Paper Mfg	Furn. Mfg	FS
Number of Establish.	**-0.024**	**0.007**	**0.054[c]**	**-0.053[a]**	**-0.016**										
	(0.022)	**(0.011)**	**(0.033)**	**(0.020)**	**(0.020)**										
Employment Share						**-0.006**	**-0.006**	**-0.004**	**-0.015[a]**	**-0.035[c]**					
						(0.007)	**(0.005)**	**(0.006)**	**(0.005)**	**(0.018)**					
Output Share											**-0.019[a]**	**-0.030[a]**	**0.014[c]**	**-0.001**	**-0.029[b]**
											(0.006)	**(0.010)**	**(0.008)**	**(0.009)**	**(0.013)**
Schooling Rate	0.025	0.023	0.026	0.025	0.021	0.021	0.028	0.021	0.020	0.020	-0.014	0.018	0.024	0.022	0.005
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.042)	(0.041)	(0.041)	(0.041)	(0.042)
Shannon-Weaver index	0.752[a]	0.837[a]	0.819[a]	0.796[a]	0.777[a]	0.839[a]	0.818[a]	0.825[a]	0.781[a]	0.735[a]	0.855[a]	0.869[a]	0.801[a]	0.824[a]	0.745[a]
	(0.171)	(0.160)	(0.158)	(0.157)	(0.170)	(0.160)	(0.159)	(0.159)	(0.158)	(0.165)	(0.157)	(0.157)	(0.159)	(0.160)	(0.162)
Race (Black Pop)	0.602[a]	0.610[a]	0.555[a]	0.555[a]	0.607[a]	0.586[a]	0.612[a]	0.601[a]	0.520[a]	0.585[a]	0.519[a]	0.479[a]	0.588[a]	0.605[a]	0.600[a]
	(0.170)	(0.170)	(0.172)	(0.169)	(0.170)	(0.172)	(0.170)	(0.170)	(0.171)	(0.169)	(0.170)	(0.173)	(0.170)	(0.181)	(0.169)
Constant	4.113[a]	4.091[a]	4.046[a]	4.066[a]	4.109[a]	4.056[a]	4.080[a]	4.059[a]	3.891[a]	3.921[a]	3.894[a]	3.902[a]	4.130[a]	4.087[a]	3.942[a]
	(0.169)	(0.168)	(0.169)	(0.166)	(0.170)	(0.173)	(0.168)	(0.174)	(0.180)	(0.188)	(0.177)	(0.176)	(0.169)	(0.206)	(0.180)
Observation	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357
County	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry is transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 7: Effect of the Dependency to Sub-Industries of the Forest Sector on the Ratio of High School Graduates Attending to a College

Dependent Variable: The Ratio of High School Graduates Attending to a College												
Models:	**(5.1)**				**(5.2)**				**(5.3)**			
Variables/Industries	**Logging**	**Wood Mfg.**	**Paper Mfg.**	**Furn. Mfg.**	**Logging**	**Wood Mfg.**	**Paper Mfg.**	**Furn. Mfg.**	**Logging**	**Wood Mfg.**	**Paper Mfg.**	**Furn. Mfg.**
Number of Establish.	**-0.103[a]**	**-0.082[a]**	**-0.038**	**-0.059[a]**								
	(0.009)	**(0.011)**	**(0.025)**	**(0.012)**								
Employment Share					**-0.017[b]**	**-0.003**	**-0.003**	**-0.039[a]**				
					(0.007)	**(0.005)**	**(0.008)**	**(0.008)**				
Output Share									**0.018[a]**	**-0.015**	**0.017[c]**	**0.005**
									(0.005)	**(0.011)**	**(0.009)**	**(0.011)**
Race (Black Pop)	-0.302[a]	-0.379[a]	-0.377[a]	-0.385[a]	-0.367[a]	-0.379[a]	-0.373[a]	-0.430[a]	-0.356[a]	-0.379[a]	-0.380[a]	-0.371[a]
	(0.095)	(0.099)	(0.101)	(0.100)	(0.101)	(0.102)	(0.102)	(0.101)	(0.101)	(0.101)	(0.101)	(0.102)
Unemployment R.	0.121[a]	0.115[a]	0.108[a]	0.114[a]	0.105[a]	0.109[a]	0.109[a]	0.088[a]	0.120[a]	0.103[a]	0.107[a]	0.112[a]
	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.018)	(0.017)	(0.018)
Constant	-0.706[a]	-0.944[a]	-1.063[a]	-1.004[a]	-1.160[a]	-1.087[a]	-1.085[a]	-1.467[a]	-0.923[a]	-1.155[a]	-0.995[a]	-1.020[a]
	(0.169)	(0.174)	(0.178)	(0.177)	(0.182)	(0.182)	(0.185)	(0.196)	(0.182)	(0.190)	(0.182)	(0.202)
Observations	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004	1,004
Number of County	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry is transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 8: Effect of "*the Logging Sector Dependency*" on the Number of Families within Certain Income Groups in Alabama

Dependent Variable: Number of Families in Each Income Groups												
Models:	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)
Variables/ Income Groups	20K<Income<25K			25K<Income<30K			20K<Income<40K			Income>75K		
Number of Establishments	**0.149[a]**			**0.190[a]**			**0.158[a]**			**-0.295[a]**		
	(0.034)			**(0.033)**			**(0.019)**			**(0.032)**		
Employment Share		**0.019[c]**			**0.029[a]**			**0.023[a]**			**-0.045[a]**	
		(0.011)			**(0.011)**			**(0.006)**			**(0.011)**	
Output Share			**0.005**			**0.018[b]**			**0.012[a]**			**-0.023[a]**
			(0.007)			**(0.007)**			**(0.004)**			**(0.007)**
Shannon-Weaver index	-0.045	-0.096	-0.083	0.045	-0.019	0.029	-0.074[c]	-0.127[a]	-0.095[b]	0.337[a]	0.437[a]	0.375[a]
	(0.078)	(0.079)	(0.082)	(0.076)	(0.077)	(0.080)	(0.043)	(0.046)	(0.048)	(0.073)	(0.079)	(0.083)
Race (Black Pop)	-1.492[a]	-2.183[a]	-2.234[a]	-1.293[a]	-2.167[a]	-2.315[a]	-1.505[a]	-2.236[a]	-2.339[a]	3.787[a]	5.149[a]	5.348[a]
	(0.363)	(0.335)	(0.340)	(0.354)	(0.330)	(0.335)	(0.199)	(0.194)	(0.198)	(0.344)	(0.339)	(0.346)
Unemployment R.	0.187	0.196	0.208	0.144	0.151	0.175	0.079	0.086	0.104	-0.573[a]	-0.586[a]	-0.620[a]
	(0.133)	(0.137)	(0.137)	(0.130)	(0.135)	(0.135)	(0.073)	(0.079)	(0.080)	(0.126)	(0.138)	(0.140)
Constant	5.761[a]	5.754[a]	5.700[a]	5.868[a]	5.887[a]	5.889[a]	6.842[a]	6.850[a]	6.835[a]	9.909[a]	9.882[a]	9.916[a]
	(0.347)	(0.359)	(0.362)	(0.338)	(0.354)	(0.356)	(0.190)	(0.208)	(0.211)	(0.329)	(0.363)	(0.368)
Observations	402	402	402	402	402	402	402	402	402	402	402	402
Number of County	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 9: Effect of "*Wood Products Manufacturing Dependency*" on the Number of Families within Certain Income Groups in Alabama

Dependent Variable: Number of Families in Each Income Groups												
Models:	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)
Variables/ Income Groups	20K<Income<25K			25K<Income<30K			20K<Income<40K			Income>75K		
Number of Establishments	**0.077[b]**			**0.110[a]**			**0.076[a]**			**-0.147[a]**		
	(0.033)			**(0.033)**			**(0.019)**			**(0.033)**		
Employment Share		**-0.010**			**0.009**			**0.001**			**-0.002**	
		(0.008)			**(0.008)**			**(0.005)**			**(0.008)**	
Output Share			**0.022**			**0.047[a]**			**0.034[a]**			**-0.071[a]**
			(0.015)			**(0.015)**			**(0.009)**			**(0.015)**
Shannon-Weaver index	-0.061	-0.101	-0.080	0.030	-0.020	0.016	-0.094[b]	-0.130[a]	-0.102[b]	0.371[a]	0.442[a]	0.384[a]
	(0.080)	(0.079)	(0.080)	(0.079)	(0.078)	(0.078)	(0.046)	(0.047)	(0.046)	(0.081)	(0.081)	(0.080)
Race (Black Pop)	-2.097[a]	-2.202[a]	-2.219[a]	-2.047[a]	-2.179[a]	-2.237[a]	-2.154[a]	-2.250[a]	-2.288[a]	4.992[a]	5.177[a]	5.256[a]
	(0.336)	(0.336)	(0.335)	(0.331)	(0.333)	(0.329)	(0.195)	(0.198)	(0.194)	(0.340)	(0.347)	(0.336)
Unemployment R.	0.221	0.196	0.201	0.189	0.176	0.156	0.114	0.099	0.091	-0.639[a]	-0.611[a]	-0.593[a]
	(0.136)	(0.137)	(0.137)	(0.134)	(0.136)	(0.134)	(0.079)	(0.081)	(0.079)	(0.138)	(0.142)	(0.137)
Constant	5.700[a]	5.585[a]	5.774[a]	5.798[a]	5.799[a]	5.987[a]	6.774[a]	6.733[a]	6.915[a]	10.033[a]	10.111[a]	9.737[a]
	(0.354)	(0.360)	(0.364)	(0.349)	(0.358)	(0.358)	(0.205)	(0.213)	(0.210)	(0.358)	(0.372)	(0.365)
Observations	402	402	402	402	402	402	402	402	402	402	402	402
Number of County	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 10: Effect of "*Pulp and Paper Products Manufacturing Dependency*" on the Number of Families within Certain Income Groups in Alabama

Dependent Variable: Number of Families in Each Income Groups												
Models:	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)
Variables/ Income Groups	20K<Income<25K			25K<Income<30K			20K<Income<40K			Income>75K		
Number of Establishments	**0.056**			**0.014**			**0.042**			**-0.144[a]**		
	(0.049)			**(0.049)**			**(0.029)**			**(0.050)**		
Employment Share		**-0.018**			**-0.017**			**0.006**			**-0.068[a]**	
		(0.020)			**(0.020)**			**(0.012)**			**(0.021)**	
Output Share			**-0.025**			**-0.010**			**-0.006**			**-0.001**
			(0.019)			**(0.019)**			**(0.011)**			**(0.019)**
Shannon-Weaver index	-0.089	-0.105	-0.100	-0.020	-0.028	-0.023	-0.123[a]	-0.129[a]	-0.131[a]	0.419[a]	0.420[a]	0.443[a]
	(0.079)	(0.079)	(0.079)	(0.079)	(0.079)	(0.078)	(0.047)	(0.047)	(0.046)	(0.081)	(0.080)	(0.081)
Race (Black Pop)	-2.169[a]	-2.182[a]	-2.054[a]	-2.179[a]	-2.174[a]	-2.130[a]	-2.231[a]	-2.255[a]	-2.218[a]	5.111[a]	5.226[a]	5.182[a]
	(0.336)	(0.336)	(0.351)	(0.335)	(0.334)	(0.350)	(0.198)	(0.198)	(0.208)	(0.344)	(0.342)	(0.364)
Unemployment R.	0.212	0.232[c]	0.211	0.168	0.191	0.169	0.103	0.091	0.100	-0.625[a]	-0.511[a]	-0.609[a]
	(0.137)	(0.140)	(0.137)	(0.136)	(0.139)	(0.136)	(0.081)	(0.083)	(0.081)	(0.140)	(0.143)	(0.142)
Constant	5.680[a]	5.564[a]	5.594[a]	5.738[a]	5.650[a]	5.708[a]	6.748[a]	6.754[a]	6.714[a]	10.053[a]	9.793[a]	10.121[a]
	(0.356)	(0.369)	(0.358)	(0.355)	(0.367)	(0.356)	(0.210)	(0.218)	(0.211)	(0.364)	(0.375)	(0.370)
Observations	402	402	402	402	402	402	402	402	402	402	402	402
Number of County	67	67	67	67	67	67	67	67	67	67	67	67

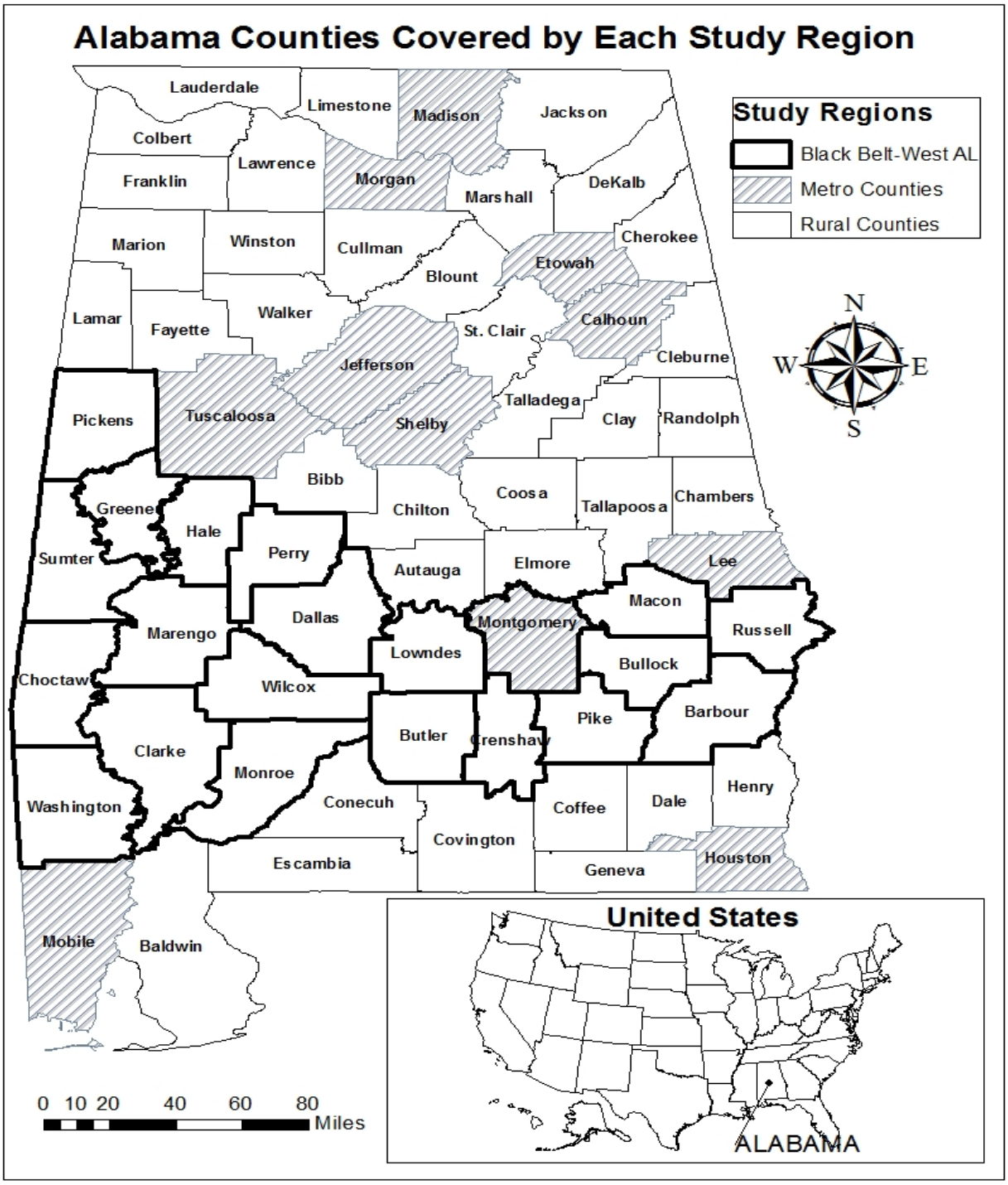
Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Table A 11: Effect of "*Furniture Products Manufacturing Dependency*" on the Number of Families within Certain Income Groups in Alabama

Dependent Variable: Number of Families in Each Income Groups												
Models:	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)	(9.1)	(9.2)	(9.3)
Variables/ Income Groups	20K<Income<25K			25K<Income<30K			20K<Income<40K			Income>75K		
Number of Establishments	**-0.058[c]**			**0.019**			**0.014**			**-0.086[a]**		
	(0.031)			**(0.031)**			**(0.018)**			**(0.032)**		
Employment Share		**0.009**			**0.041[a]**			**0.024[a]**			**-0.045[a]**	
		(0.012)			**(0.012)**			**(0.007)**			**(0.013)**	
Output Share			**0.035[b]**			**0.006**			**0.027[a]**			**-0.062[a]**
			(0.015)			**(0.015)**			**(0.009)**			**(0.015)**
Shannon-Weaver index	-0.123	-0.094	-0.100	-0.014	-0.005	-0.023	-0.124[a]	-0.120[a]	-0.132[a]	0.406[a]	0.423[a]	0.446[a]
	(0.080)	(0.079)	(0.078)	(0.079)	(0.077)	(0.078)	(0.047)	(0.046)	(0.046)	(0.082)	(0.080)	(0.079)
Race (Black Pop)	-2.277[a]	-2.136[a]	-2.146[a]	-2.158[a]	-1.929[a]	-2.177[a]	-2.230[a]	-2.104[a]	-2.213[a]	5.056[a]	4.894[a]	5.091[a]
	(0.337)	(0.345)	(0.334)	(0.337)	(0.337)	(0.335)	(0.200)	(0.200)	(0.196)	(0.346)	(0.349)	(0.339)
Unemployment R.	0.166	0.223	0.221	0.180	0.242[c]	0.169	0.109	0.142[c]	0.110	-0.668[a]	-0.692[a]	-0.636[a]
	(0.138)	(0.139)	(0.136)	(0.138)	(0.136)	(0.136)	(0.082)	(0.081)	(0.080)	(0.142)	(0.141)	(0.138)
Constant	5.561[a]	5.779[a]	5.914[a]	5.762[a]	6.279[a]	5.776[a]	6.751[a]	7.041[a]	6.931[a]	9.985[a]	9.516[a]	9.658[a]
	(0.358)	(0.392)	(0.370)	(0.357)	(0.383)	(0.371)	(0.212)	(0.228)	(0.217)	(0.367)	(0.397)	(0.376)
Observations	402	402	402	402	402	402	402	402	402	402	402	402
Number of County	67	67	67	67	67	67	67	67	67	67	67	67

Note: Elasticities are reported for each variable. Robust standard errors are in parentheses and [a], [b], and [c] indicate P-values, [a] $p<0.01$, [b] $p<0.05$, [c] $p<0.1$. Logarithmic values of all the variables are used in all models. Output share of the forest products industry are transformed into the real dollars using the producer price index, with 1996 as base year. The results then are all expressed in United States dollars at the purchasing power of 1996.

Map 1: Study Regions



Note: The analyses of this study are applied on three different regions of AL. First, Analyses cover all counties in Alabama. Second, metropolitan counties excluded from the analyses. Third, analyses are applied on only the Black Belt-West Alabama region characterized by an abundance of forest resource. The map is created using ArcMap 10.2 software.