New York State Forest Sector

An Economic Overview & Comparative Analysis – 2001-2021

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Executive Summary

Based on the 2021 population census, about 19,857,492 people reside in New York State (NYS), of which approximately 8,467,513 (43%) of the State's population resides in New York City, leaving the majority of land area to the remaining 11.4 million residents (https://www.census.gov/quickfacts/NY, last accessed 12/23/2022). In 2021, NYS's gross domestic product (GDP) was about $1.9 trillion (all dollar amounts in this document are in 2021-United States dollars) and provided job opportunities for about 11.8 million people [1]. Among the 30.2 million acres of total area, about 61% of the State land area, or approximately 18.6 million acres, is classified as forest land (https://www.dec.ny.gov/lands/309.html, last accessed 12/23/2022), whereas about 20% or nearly 7 million acres is classified as farmland or agricultural land (https://agriculture.ny.gov/land-and-water/farmland-protection, last accessed 01/19/2023). NYS's forest land and forest-related industries provide numerous tangible and intangible benefits for the residents of New York and its many annual visitors. This study employs IMPLAN data [1] to conduct an economic base contribution analysis for the years 2001-2021 [2], in order to provide an economic overview and a comparative analysis of the economic contribution of the Forest Sector to the NYS during this 21-year period.

The Forest Sector comprises four industries: Forestry and Logging, Solid Wood Products, Pulp and Paper, and Wood Furniture. The respective businesses contained within each industry are listed in Appendix 1, following IMPLAN's industrial descriptions. To provide a comparison, we have also included the results for the Agriculture Sector over the same 21-year time period.

Over this 21 years period, on average, the Forest Sector has made an economic contribution to NYS of $18,175 million per year of total base output, $6,696 million per year of total base value added, $5,023 million per year of total base labor income. This Sector has also been responsible for generating an average total base contribution of 62,043 jobs per year. Out of the four forest industries, in terms of total base output, base employment, base value-added, and base labor income, NYS has received the largest contribution from the Pulp and Paper industry, while the Forestry and Logging industry has consistently had the lowest contribution in the state. About 69.96% of the average total base output was attributable to the production activities of the Pulp and Paper industry ($12,716 million per year), 17.28% to the Wood Furniture industry ($3,140 million per year), 11.22% to the Solid Wood Products industry ($2,039 million per year) and about 1.54% to the Forestry and Logging industry ($280 million per year). Given the Forest Sector contribution, the Pulp and Paper contributed 64.46% of the average total base value added ($4,316 million per year), 62.77% of the average total labor income ($3,153 million per year), and was responsible for contributing, on average, more than half (55.83% or 34,641 jobs per year) of the total base employment in the state. The Forestry and Logging industry generated, on average, 2.45% ($164 million per year) of the total value added, 2.79% of the total base labor income ($140 million per year), and about 3.79% of the total base employment (2,351 jobs per year). Among the four NYS Forest industries, the Wood Furniture industry, on average, had the second largest base

contribution to the state's economy in terms of value added (20.90% or $1,400 million per year), labor income (21.91% or $1,101 million per year), and employment (25.81% or 16,015 jobs per year). The Solid Wood Products industry generated 12.19% of the value added ($816 million per year), 12.53% of the labor income ($629 million per year), and about 14.56% of the base employment (9,036 jobs per year) (Exhibit 1 and 2).

Industry	Output	Value Added	Labor Income	Employment
Forestry and Logging	$280.12	$164.19	$140.14	2,351
Solid Wood Products	$2,038.95	$815.89	$629.22	9,036
Wood Furniture	$3,139.99	$1,399.51	$1,100.55	16,015
Pulp and Paper	$12,715.77	$4,316.06	$3,153.05	34,641
Total Forest Sector	$18,174.82	$6,695.65	$5,022.95	62,043
Agriculture	$15,638.91	$5,789.79	$3,926.55	70,466

Exhibit 1: The average economic base contribution of the NYS Forest Sector between 2001 to 2021. Output, labor income, and value added are measured in millions of 2021 dollars and employment is measured in the number of jobs.

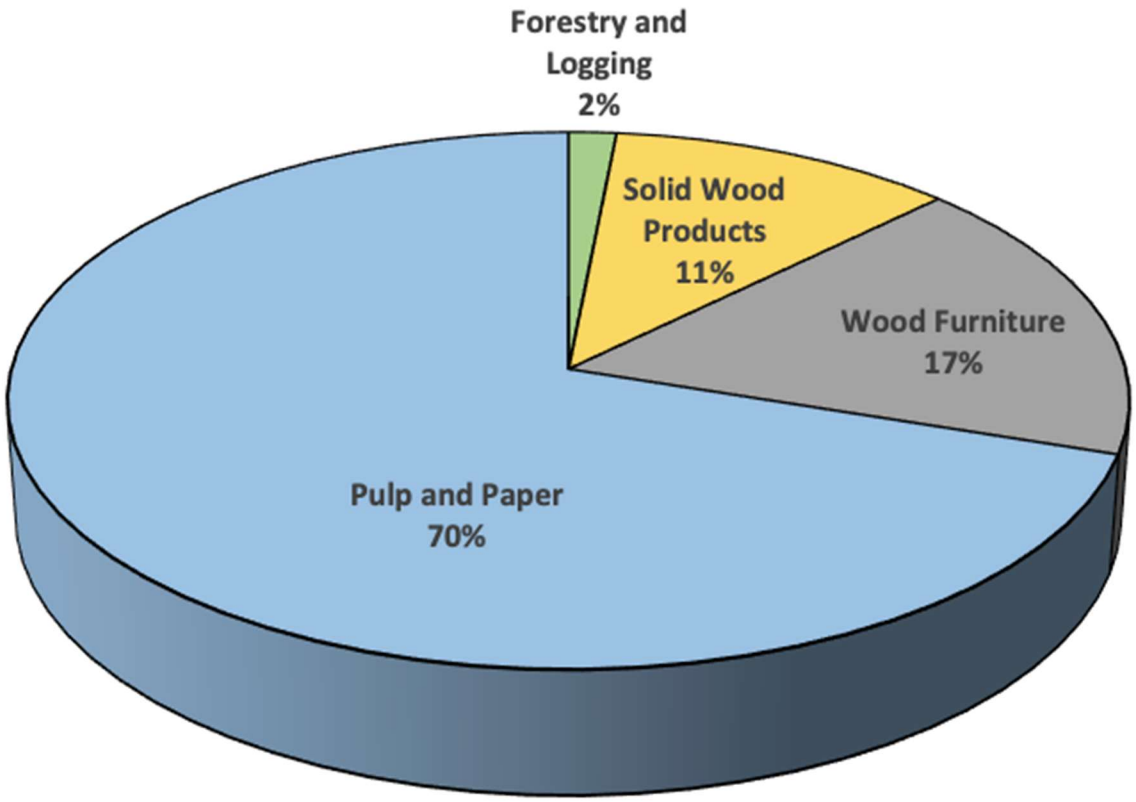

Exhibit 2: Average total base output for the four industries of NYS Forest Sector 2001-2021.

During 2001 to 2021, on average, NYS's Forest Sector outperformed the Agriculture Sector in terms of producing more total base output worth $2,536 million, contributing $906 million more in total base value-added, and generating $1,096 million more of total labor income. However, the Agriculture Sector had more base employment, with 70,466 jobs per year on average, compared to 62,043 jobs per year on average in the Forest Sector (Exhibit 1). Despite this, the jobs created by the Forest Sector during this 21-year period throughout the NYS economy were more lucrative, as the average labor income per worker per year was $80,959 compared to $55,722 in the Agriculture Sector.

The contribution of the NYS Forest Sector has declined significantly over the last 2 decades (2001-2021). In 2001, the base output of the sector was $21,689 million, but this dropped by 38.37% to $14,706 million in 2021. A decline was also observed across base employment, labor income, and value-added, as these components decreased by 47.95%, 37.77%, and 13.65%, respectively. The drop in contribution was more pronounced during the first decade (2001-2011) than the second one (2011-2021). The Forest Sector's total base output, employment, labor income, and value-added decreased by 35.95%, 35.08%, 34.93%, and 22.57%, respectively, during the period of 2001-2011. Similarly, during 2011-2021, the base output, employment, and the labor income decreased by 2.51%, 13.43%, 2.94%, respectively, whereas the base value-added increased by 8.98%.

The data reveals that the decline in the Forest Sector's contribution during the first decade was not as serious for the first six years (2001-2007) as it was during the next four years (2007-2011). For example, during the period of 2001-2007, the base output decreased only by 9.39%, whereas it decreased by 26.79% during the period of 2007-2011. This steep decrease was due to the great recession of 2007-2009 and its aftermath.

Following the shock created by the great recession, the NYS Forest Sector started to recover gradually. For instance, the Forest Sector's total base output increased by 23.63% during the period of 2011-2015 from $15,080 million in 2011 to $19,122 million in 2015. Base labor income, value-added, and base employment also increased by 9.99%, 21.19%, and 15.93%, respectively, during this period. However, the Forest Sector's recovery was short-lived, as it started to decline again after the 2016 mini-recession. In 2016, growth slowed down worldwide. This slowed the economic growth of the US and impacted several sectors, including NYS Forest Sector. All other components, except the base output started to decline after 2015. The base output, however, increased by 0.97% during 2015-2016, and started to decline sharply after that. For instance, during the period of 2016-2019, the base output of the NYS Forest Sector decreased by 11.06% with corresponding decreases in base employment by 10.43%, labor income by 11.24%, and value-added by 7.31%. The decline was further aggravated by the COVID-19 pandemic, which caused a reduction of base output by 16.12% for the years 2019-2021, bringing the Forest Sector's base output down to $14,706 million in 2021.

1. INTRODUCTION

Based on the 2021 population census, about 19,857,492 people reside in New York State (NYS), of which approximately 8,467,513 (43%) of the State's population resides in New York City, leaving the majority of land area to the remaining 11.4 million residents (https://www.census.gov/quickfacts/NY, last accessed 12/23/2022). In 2021, NYS's gross domestic product (GDP) was about $1.9 trillion (all dollar amounts in this document are in 2021-United States dollars) and provided job opportunities for about 11.8 million people [1]. Among the 30.2 million acres of total area, about 61% of the State land area, or approximately 18.6 million acres, is classified as forest land (https://www.dec.ny.gov/lands/309.html, last accessed 12/23/2022), whereas about 20% or nearly 7 million acres is classified as farmland or agricultural land (https://agriculture.ny.gov/land-and-water/farmland-protection, last accessed 01/19/2023). NYS's forest land and forest-related industries provide numerous tangible and intangible benefits for the residents of New York and its many annual visitors. This study employs IMPLAN data [1] to conduct an economic base contribution analysis for the years 2001-2021 [2], to provide an economic overview and a comparative analysis of the economic contribution of the Forest Sector to the NYS during this 21-year period.

The Forest Sector comprises four industries: Forestry and Logging, Solid Wood Products, Pulp and Paper, and Wood Furniture. The respective businesses contained within each industry are listed in Appendix 1, following IMPLAN's industrial descriptions. To provide a comparison, we have also included the contribution analysis results for the Agriculture Sector over the same 2001-2021 period.

The Forest Sector contributes to NYS's economy in terms of 1) base contribution or its supply chain, which measures a sector's expenditures on goods and services from other sectors. An economy's base output is a quantitative indicator of the amount of money a sector brings into the local economy [2], and 2) gross contribution, which measures a sector's ability to keep money in the region by producing and selling goods and services to local industries and households. This document focuses on the supply-chain (base) contribution that the Forest Sector made to the state and has been organized into two main parts: 1) a short description of the main difference between contribution analysis and impact analysis as well as related definitions, 2) Time series analysis of the Forest Sector's base contribution to NYS.

2. CONTRIBUTION VS IMPACT ANALYSIS

Economic contribution and impact analysis (also called multiplier analysis) have often been used to measure the economic activity of a region or a country. While economic contribution and impact are two separate concepts, they are often used interchangeably, leading to confusion [2,3,4]. A contribution analysis provides evidence of how relatively large a sector is in the existing economy and how much economic activity is being cycled through the economy by a given sector [4]. It measures the relative importance of an existing sector to a regional economy [2,3,4] or looks at how a sector supports other industries in the regional economy [5]. An economic impact analysis estimates the net changes to a regional economy to be attributed to an industry, event, or policy that would otherwise not exist [4]. In other words, it creates a hypothetical scenario of what would

happen to the economy if there were a possible entry or exit of a particular firm within a sector or if there would be a change in the exogenous final demand for a specific sector.

Whether conducting a contribution or impact analysis, the first step is to determine the region's endogenous and exogenous sectors. Endogenous sectors refer to the sectors of the economy that are inside the system being analyzed and contribute to the overall production of goods and services. The links between endogenous sectors occur when the outputs from one sector become the inputs to other sectors, creating a supply chain. Households are often included as part of the endogenous sectors as their spending is the largest component of final demand. This spending is linked to production directly as the amount of labor needed to increase production will lead to a change in household income and, therefore, in the spending on local goods and services [6]. Exogenous sector refers to the sectors of the economy that are outside the system being analyzed but have a direct impact on the economy. Exogenous sectors are more external to a region's industries. They are more disconnected from the input-to-output relationships of a supply chain.

The mathematics of contribution analysis and impact analysis are very similar such that the same economic multipliers can be derived from both analyses. Multipliers are a measure of the predicted total production requirements for every unit of production sold to an exogenous change in final demand [2,4,6,7]. Furthermore, multipliers and contribution analysis effects can be constructed for output as well as all the other components, such as value-added, labor income, and employment [2,4,6,7]. Multipliers are commonly calculated with respect to output to measure the impacts of a change in final demand for the output of an initial industry on i) regional output (output/output multipliers), ii) value added (value added/output multipliers), iii) employment (employment/output multipliers), or iv) labor income (labor income/output multipliers).

Contribution and impact analysis illustrate the economic linkages within industries and households of a given region. However, if multipliers are used to estimate an industry's economic contribution, this creates a problem of 'double counting' by making its direct, indirect, or induced effects appear responsible for a larger share of the economy than the observed data can support. That is, the sum of gross and base output across all industries would be greater than what is actually observed. Economic base contribution analysis eliminates this double-counting problem by requiring the sum of gross and base output, employment, income, and value added to add to those actually observed in the region [2].

Finally, contribution and impact analysis results should be interpreted with caution. Normally, industries are defined according to the North American Industrial Classification Scheme (NAICS). For this study, the relevant businesses of the Forest Sector have been aggregated in four industries as described in Appendix 1, while all other sectors are aggregated using a 2-digit NAICS aggregation scheme. For example, the manufacturing sector comprises over 200 industry classifications. Aggregating industries into broader categories may skew the analyses and is termed "aggregation bias." The aggregated sector is a weighted average of all the aggregated businesses' production activity; those businesses with the greatest output levels have the greatest influence. Thus, the analysis may not truly represent an individual business within the aggregated industry [1,2,7].

2.1 Impact or Multiplier Analysis of the NYS Forest Sector for the Years 2001-2021

The NYS's Forest Sector business multipliers for the years 2001, 2011, and 2021 are presented in Table 1.[1] These multipliers were based on a closed model[2]; therefore, they include direct, indirect, and induced effects within the NYS economy. The multipliers are used to answer the what-if question or the forecasted economic impact if there is an exogenous change in the final demand for a sector's outputs.

The Forest Sector business multipliers were very similar over the past 21 years, implying that the impact created by the Forest Sector in the NYS economy has been consistent over the last two decades. For 2001 and 2021, the industries with the largest forecasted economic output impact were the Forestry and Logging industry (1.81 and 1.74), followed by the Solid Wood Products industry (1.76 and 1.73). For 2011, the industry with the largest forecasted economic output impact was the Solid Wood Products (1.78), followed by the Forestry and Logging industry (1.76). The output multiplier in 2001, for example, for Forestry and Logging, implies that for every $1.00 of an exogenous change in the final demand, the total predicted regional economic impact was expected to be $1.81 ($1.76 and $1.74 for 2011 and 2021 respectively). In other words, a $100 increase in final demand for the Forestry and Logging industry in 2001 would result in an additional increase of $81 in production for a total impact of $181 in 2001 (and $176 and $174 in 2011 and 2021 respectively) within the state economy. A larger output multiplier implies that the industry has stronger ties with other regional industries. On the other hand, a smaller output multiplier -- 1.62, 1.62, and 1.65 for 2001, 2011, and 2021, respectively, for Pulp and Paper Industry -- implies that the industry has weaker ties with other local industries, and more of the inputs required for that industry are imported. Although the Pulp and Paper industry had the smallest output multiplier for 2001, 2011, and 2021, it is the largest Forest industry within the state in terms of employment (2.40, 2.63, and 2.66) and value-added (2.61, 2.85, and 2.34) multipliers. For 2021, this implies that 100 jobs in the Pulp and Paper industry were responsible for generating 166 additional jobs in the NYS economy, and $100 of value-added in the Pulp and Paper industry increased the state-wide value added by an additional $134. In terms of the labor income multiplier, the largest industry in 2001 as well as in 2021 was Solid Wood Products, followed by the Pulp and Paper industry. In 2011, the largest industry was the Pulp and Paper industry, followed by the Solid Wood Products industry. A labor income multiplier of 2.13 for Solid Wood Products in 2021 implies that an additional $100 of labor income paid to labor in this industry was responsible for generating $113 extra labor income statewide. The Forestry and Logging industry has the largest output multiplier for 2001 and 2021 and the second largest for 2011, however, it has the smallest employment, labor income, and value-added multipliers for the three years.

[1] A business multiplier focuses only on the endogenous industries of a given region.

[2] A closed model includes transactions among regional industries, the components of value-added (employee compensation, proprietor income, other property type income, and taxes on production and imports), and household purchases of locally produced goods and services. The logic of a closed model is to capture the effects of production, income from production distributed to households, and household spending this income to consume locally produced goods and services.

Table 1. Business Multipliers for the four industries of New York State's Forest Sector in 2001, 2011 and 2021‡

Industries	Output			Employment			Labor Income			Value Added		
	2001	2011	2021	2001	2011	2021	2001	2011	2021	2001	2011	2021
Forestry and Logging	1.81	1.76	1.74	1.47	1.40	1.38	1.56	1.55	1.49	1.83	1.83	1.72
Wood Products	1.76	1.78	1.73	1.94	1.87	1.92	2.30	2.19	2.13	2.58	2.54	2.33
Wood Furniture	1.69	1.76	1.71	1.63	1.66	1.53	1.89	1.84	1.74	2.09	2.33	2.20
Pulp and Paper	1.62	1.62	1.65	2.40	2.63	2.66	2.22	2.34	2.09	2.61	2.85	2.34

‡*The Business multipliers are defined as output/output, value added/value added, employment/employment, labor income/labor income.*

2.2 Contribution Analysis

An economic contribution analysis is carried out by parsing the conventional Input-Output accounts into a sector's expenditures on other goods and services, or supply-chain contributions, and its receipts from selling goods and services to industries and household, or gross contributions. While the multipliers from Table 1 help answer the "what if" question, the results from the contribution analysis presented in this section answer the "what is" question.

Between 2001-2021 the base economic contribution of the Forest Sector to NYS declined in terms of output by 38.37%, value added by 13.65%, labor income by 37.77% and employment by 47.95%. Examining Figures 1, 2, 3 and 4 we can see that the drop was more pronounced in the first decade (2001-2011) as compared to the second (2011-2021). During the years 2001-2011, the Forest Sector's total base output, base labor income, base value-added, and base employment decreased by 35.95%, 34.93%, 22.57%, and 35.08%, respectively[3]. Between 2011-2021, the Forest Sector experienced both periods of growth and decline. For example, between 2011-2016, the total base output increased by 24.59%, but it started to decrease gradually thereafter. Similarly, base labor income, value-added, and base employment also increased between 2011-2015 but started to decrease onwards. Between 2011-2021, the NYS Forest Sector experienced a decrease in base output of 2.51%, a decrease in base labor income of 2.94%, and a decrease in base employment of 13.43%. The base value added, however, increased by 8.98% between the years 2011-2021. In contrast to the first decade analyzed in this document, these periods of growth and decline during the last decade have resulted in a relatively constant average contribution of the Forest sector to the state, however, the contribution for the year 2021 is 38.37% lower than that of 2001, but the 2021 contribution is very similar to the 2011 contribution.

[3] The percentage changes presented in this document were calculated using the midpoint method described by Mankiw, 2021. Mankiw, Principles of Microeconomics 9th edition. ISBN: 978-0-357-13348-4.

Over a 21-year period, the Forest Sector in New York State contributed, on average, $18,175 million per year in total base output to the state's economy, with $21,689 million in 2001 and $14,706 million in 2021 (Figure 1). This translates to $6,696 million per year in total base value-added, with $7,267 million in 2001 and $6,338 million in 2021, and $5,023 million per year in total base labor income, $6,170 million in 2001 and $4,210 million in 2021. The Forest Sector was also responsible for generating an average base contribution of 62,043 jobs per year, with 78,575 jobs in 2001 and 48,186 jobs in 2021.

Figure 1 shows that the Forest Sector base output increased by 1.59% from 2001-2002, reaching $22,037 million, but declined by 10.98% from 2002-2007 to $19,744 million. During the period of the Great Recession of 2007-2009, the Forest Sector experienced a significant decline in its economic contribution to NYS. Specifically, from 2007-2011, the Forest Sector's total base output declined by 26.79% from $19,744 million to $15,080 million.

During the period between 2011-2016, the Forest Sector made progress toward recovery from the recession, with an increase in its base output by 11.04% to $16,842 million between 2011-2014 and a further increase of 13.64% to $19,308 million from 2014-2016. Between 2016-2019 the Forest Sector experienced a decline in its base output by 11.06% to $17,285 million. This decline was further aggravated by the COVID-19 pandemic, which caused an average reduction of 16.12% for the years 2019-2021, bringing the Forest Sector's base output down to $14,706 million in 2021. This indicates that the Forest Sector's recovery from the recession was short-lived, as it started to decline again in 2016, and the COVID-19 pandemic caused significant damage to its base output.

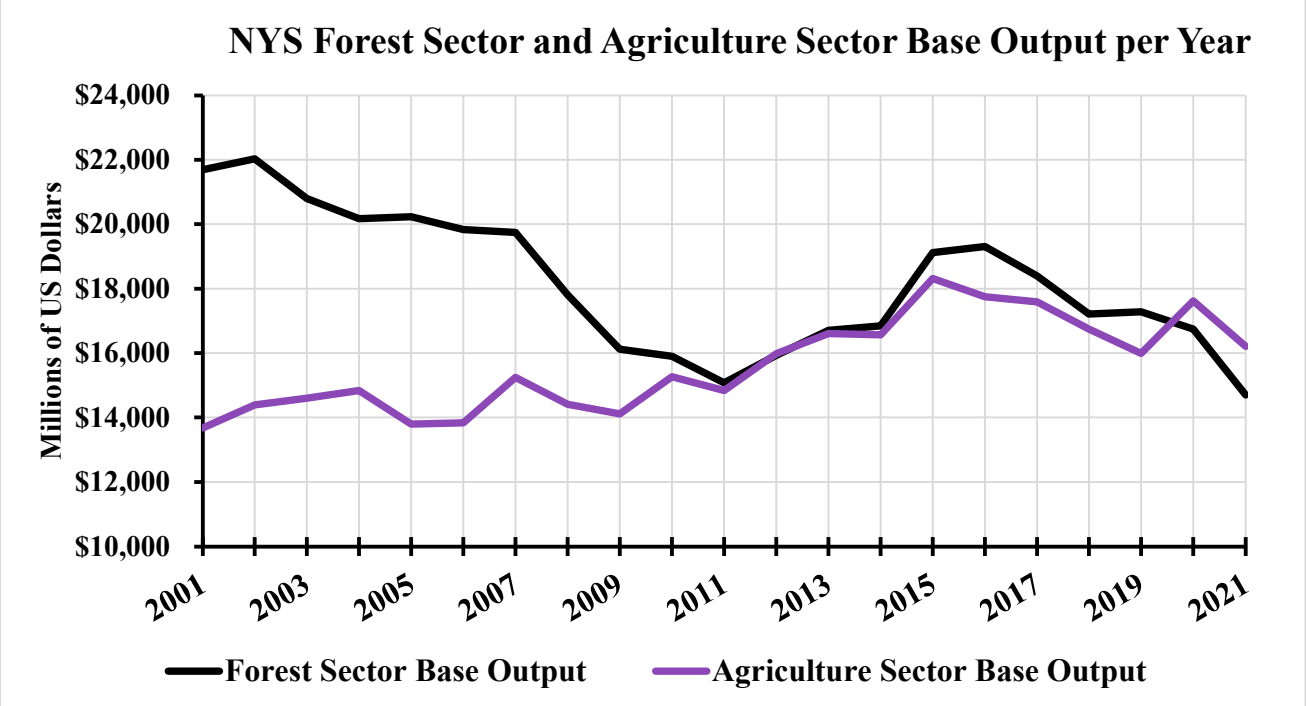

Figure 1. Base Output of the Forest Sector and Agriculture Sector for the State of New York for the period between 2001-2021.

The NYS Forest Sector's job creation has decreased significantly over the years, with the biggest decline occurring during the 2007-2009 recession period (Figure 2). There was a recovery from 2010-2015 which was followed by another decline from 2015-2019. This decline was further worsened by the pandemic in 2020-2021. Figure 2 shows that the NYS's Forest Sector was responsible for generating 78,575 total base employment in 2001, but only 48,186 of total base employment in 2021. This represents an average reduction of 47.95% over the 21-year period. The number of jobs created by the sector decreased from 2001-2007 by 12.91% to 75,003 jobs, with an even more dramatic decrease during the years close to the 2007–2009 recession. From 2007-2011 the number of jobs decreased by 22.42% to 55,125 jobs. From 2011–2015, the Forest Sector showed a recovery in total base employment of 9.99% to 60,921 jobs. However, similar to base output, the number of jobs generated by the Forest Sector started to decline from 2015-2019 with a reduction of 11.27% to 54,420 jobs of total base employment and a further reduction of 12.15% during the Covid-19 pandemic period of 2019-2021.

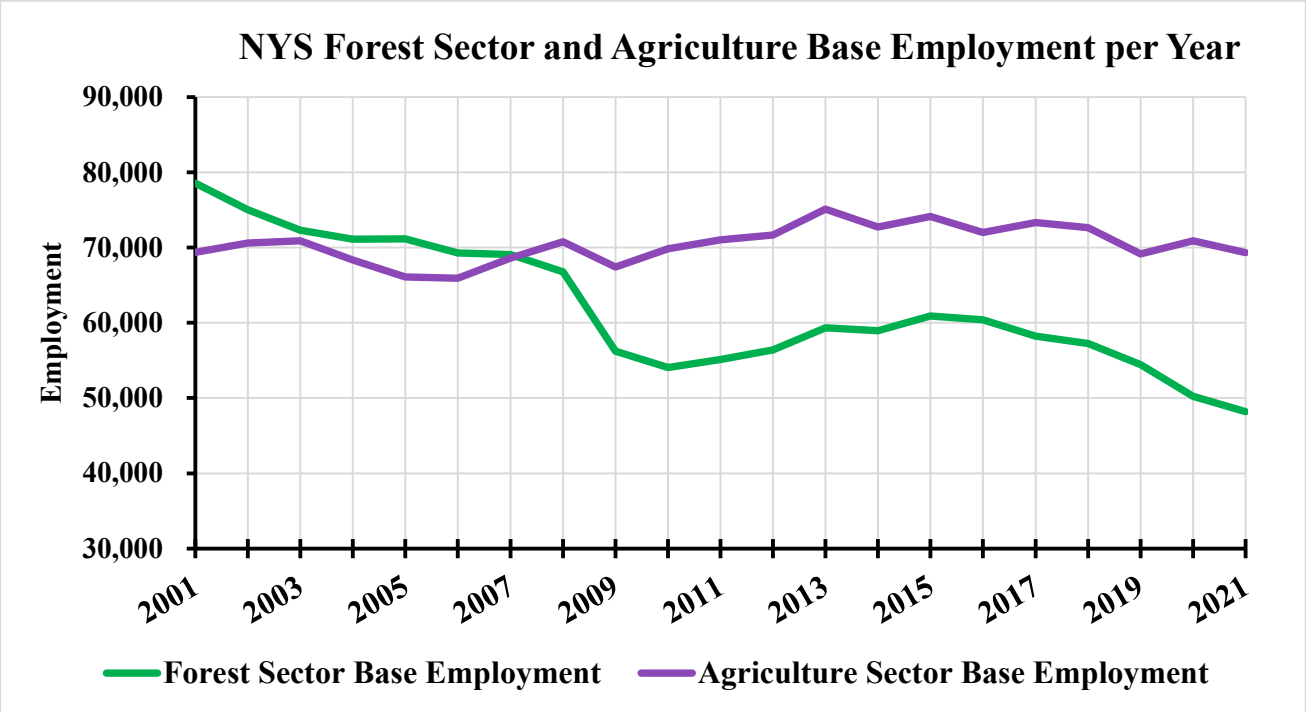

Figure 2. Base Employment of the Forest Sector and Agriculture Sector for the State of New York for the period between 2001-2021.

Figure 3 shows that the total base value added has remained relatively stable over the years, in contrast to the total base output. The Forest Sector's total base value-added contribution declined marginally by 2.61% from $7,267 million to $7,080 million between 2001–2007. However, this was followed by a more accentuated decrease of 19.99% to $5,793 million from 2007-2011. Subsequently, the base value-added contribution displayed an average increase of 21.19% to $7,166 million between 2011-2015 and a reduction of 4.05% to $6,338 million between 2015-2021. These results suggest that the NYS Forest Sector's contribution to the state's economy has been reasonably steady, with fluctuations observed in certain periods. These data also indicates

that while the Forest Sector's value-added contribution experienced a decline during the recession period, it has since rebounded and demonstrated an overall increasing trend.

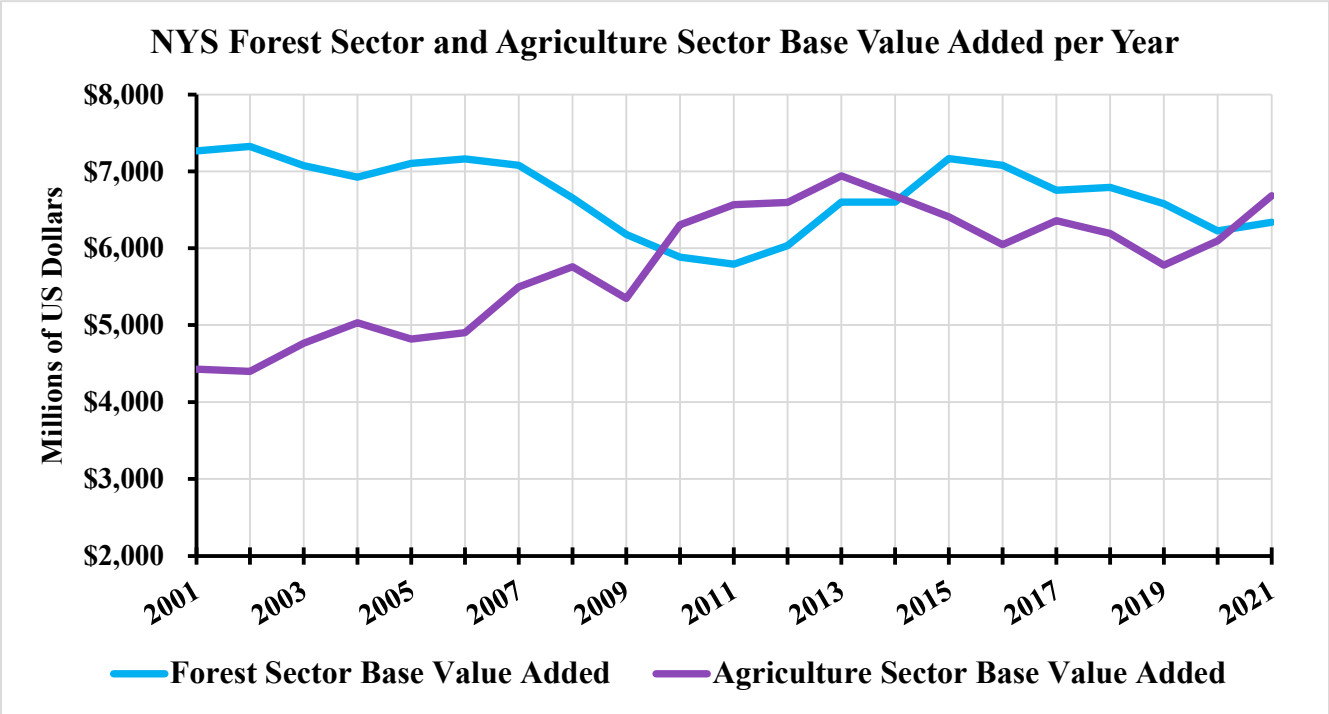

Figure 3. Base Value Added of the Forest Sector and Agriculture Sector for the State of New York for the period between 2001-2021.

Figure 4 shows the 21-year trend of the Forest Sector's total base labor income which exhibits a similar trend as that of base output and base employment. From 2001-2006 labor income declined by 10.27% from $6,170 million to $5,567 million. However, it increased the following year by 3.95% to $5,792 million in 2007. Subsequently, between 2007-2010, NYS Forest Sector experienced a significant decrease of base labor income by 32.64% to $4,166 million. In the following years, from 2010 – 2016 the Forest Sector base labor income increased by 18.91% to $5,037 million, but during the Covid-19 pandemic reverted to the same level of 2010. From 2016-2021, total base labor income declined by 17.88% to $4,210 million. This trend in the Forest Sector's total base labor income can be attributed to various factors, including changes in technology, competition, government policies, and economic conditions. The decline in labor income from 2007-2010 can be associated with the global financial crisis, which had a significant impact on the forest industry's demand and profitability. Conversely, the increase in labor income from 2010-2016 can be attributed to a rebound in demand for forest products as the economy improved.

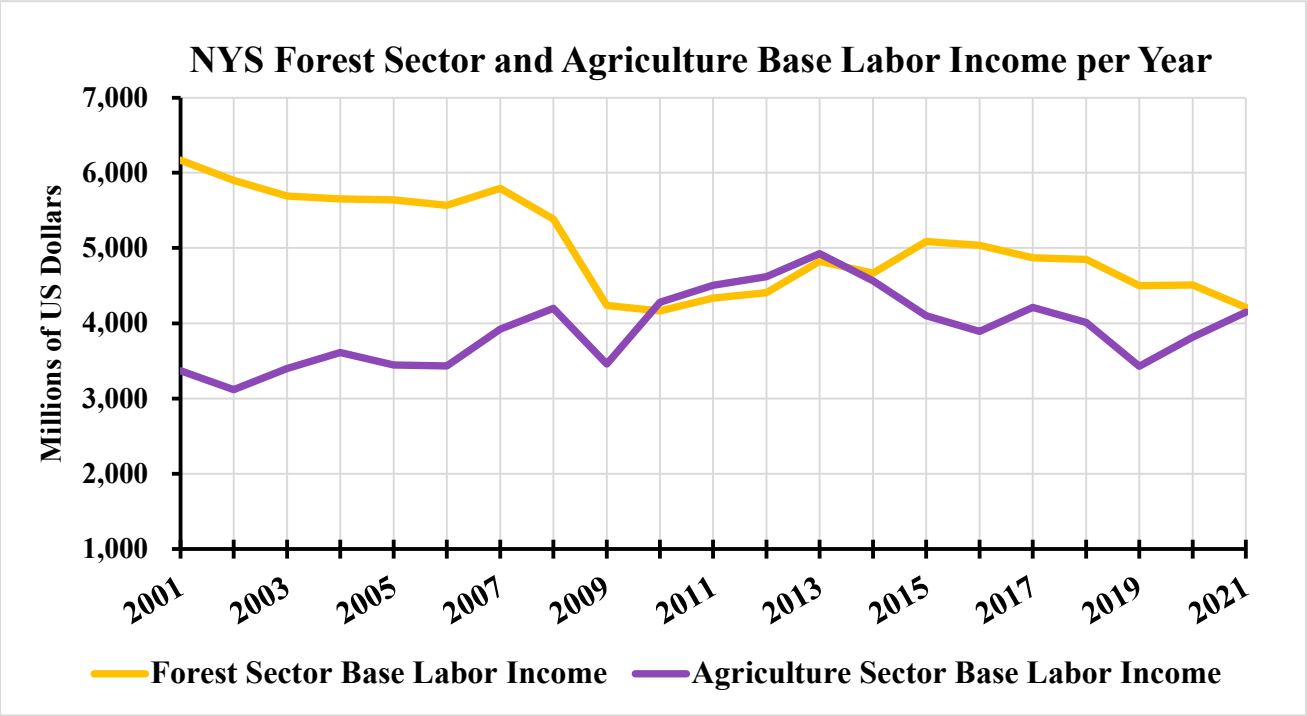

Figure 4. Base Labor Income of the Forest Sector and Agriculture Sector for the State of New York for the period between 2001-2021.

The data presented in Figures 1 to 4 highlights a comparison between the Forest and Agriculture Sectors in NYS. Overall, the Forest Sector has contributed significantly to the economy of NYS, with higher levels of base output, base value-added, and labor income than the Agriculture Sector. However, the Agriculture Sector has sustained higher levels of base employment over the years. On average, NYS's Forest Sector has produced about $2,536 million more per year in base output and contributed $906 million per year more in base value added and $1,096 million per year more in labor income than the Agriculture Sector. However, on average, the Agriculture Sector had a larger level of base employment, generating 70,466 jobs per years compared to the Forest Sector's 62,043 jobs per year. When comparing the average labor income per worker, the Forest Sector has been larger, with an average of $80,959 per worker per year compared to $55,722 per worker per year in the Agriculture Sector. This implies that, on average, the jobs generated by the Forest Sector in the NYS economy have been more lucrative than those created by the Agriculture Sector for the period 2001-2021.

Table 2 shows NYS's Forest Sector was behind the Agriculture Sector only in employment, but it was above it in output, labor income and value added. Table 2 and Figures 5 to 10 indicate that the Pulp and Paper industry has made the largest contribution to NYS in terms of total base output, base employment, base value-added, and base labor income generating more than two thirds of the economic activity in the Forest Sector. Meanwhile, the Forestry and Logging industry has consistently had the lowest contribution in the state. 69.96% of the average total base output or $12,716 million per year is attributable to the production activities of the Pulp and Paper industry, 17.28/% or $3,140 million per year to the Wood Furniture industry, 11.22% or $2.039 million per

year to the Solid Wood Products industry. The Forestry and Logging industry contributed only about 1.54%, which is $280 million per year.

Table 2. Average Total Base Economic Activity of the Forest Sector in NYS‡

Industry	Output	Value Added	Labor Income	Employment
Forestry and Logging	$280.12	$164.19	$140.14	2,351
Solid Wood Products	$2,038.95	$815.89	$629.22	9,036
Wood Furniture	$3,139.99	$1,399.51	$1,100.55	16,015
Pulp and Paper	$12,715.77	$4,316.06	$3,153.05	34,641
Total Forest Sector	$18,174.82	$6,695.65	$5,022.95	62,043
Agriculture	$15,638.91	$5,789.79	$3,926.55	70,466

‡*The average base economic activity for the NYS Forest Sector. Output, labor income, and value added are measured in millions of 2021 dollars and employment is measured in jobs.*

The Pulp and Paper industry contributed 64.46% of the average total base value added of $4,316 million per year, and 62.77% or $3,153 million per year of the average total labor income. Furthermore, the Pulp and Paper industry was responsible for generating, on average, more than half, 55.83% or 34,641 jobs per year, of the total base employment of NYS's Forest Sector.

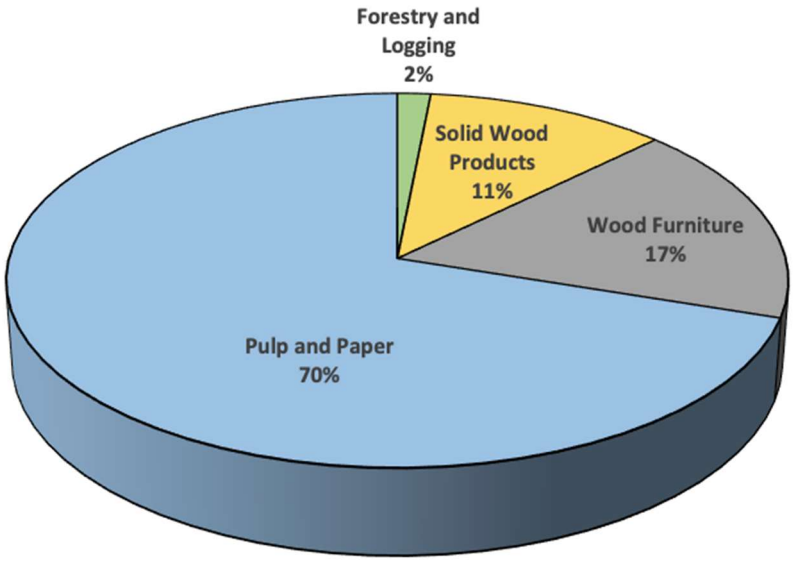

Figure 5: Average Total base output for the four industries of NYS's Forest Sector between2001-2021.

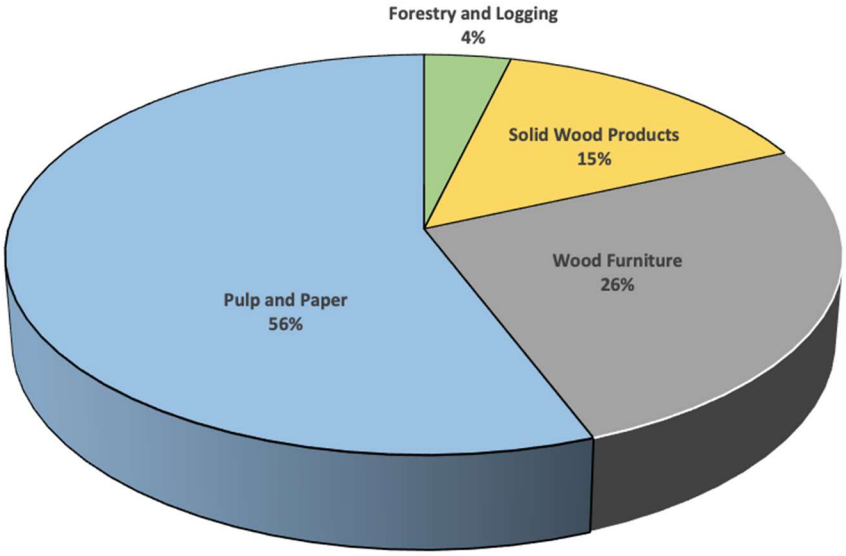

Figure 6: Average Total base employment for the four industries of NYS's Forest Sector 2001-2021.

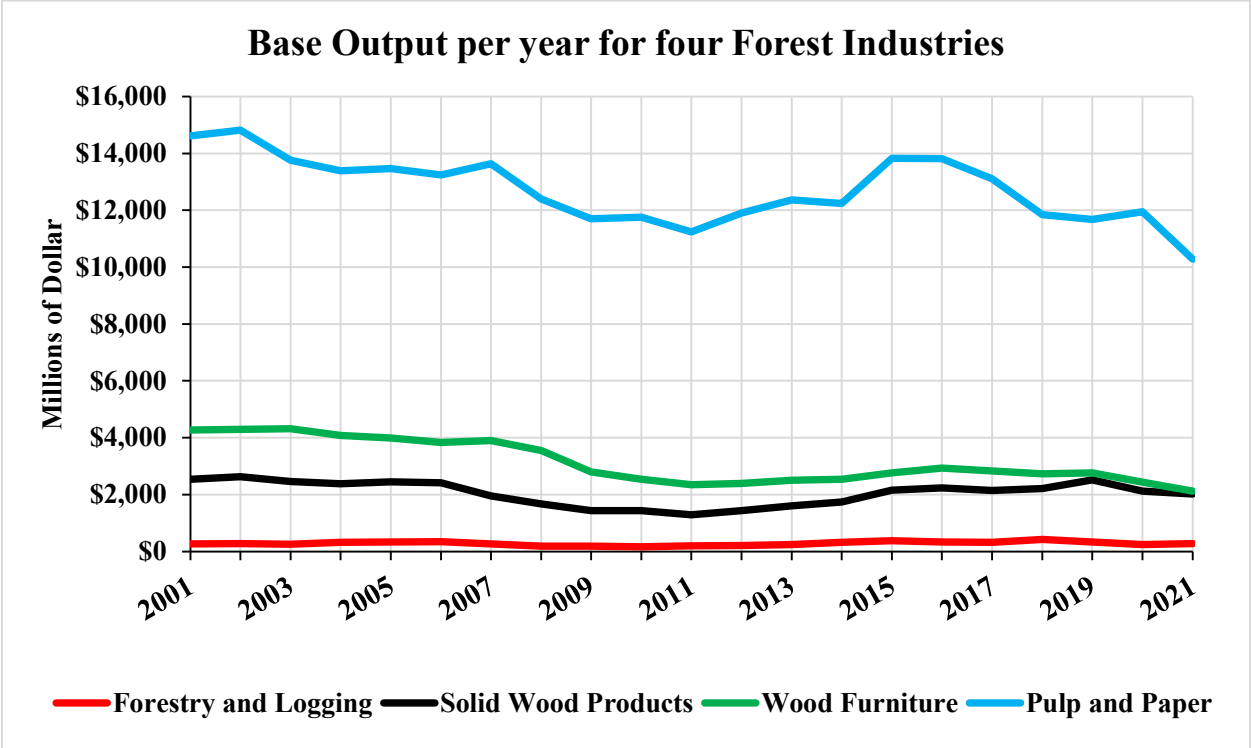

Figure 7. Base Output per NYS's Individual Forest Industries between 2001-2021.

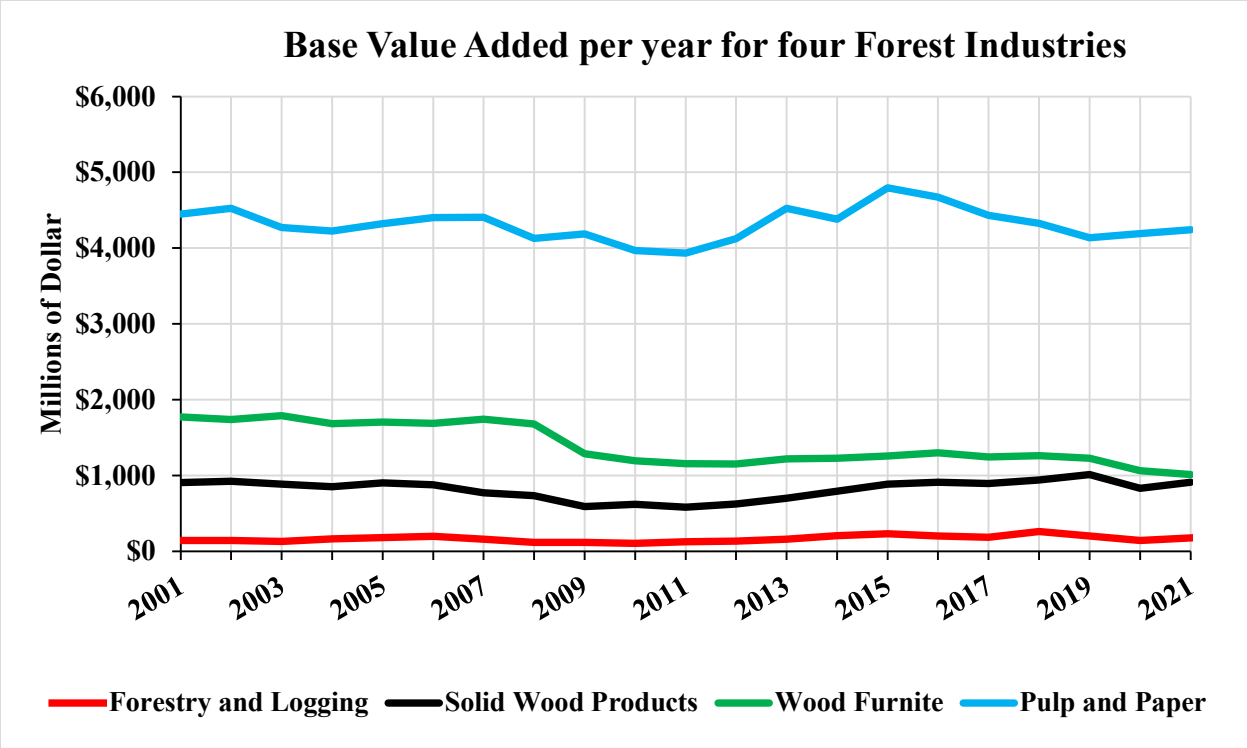

Figure 8. Base Value Added per NYS's Individual Forest Industry between 2001-2021.

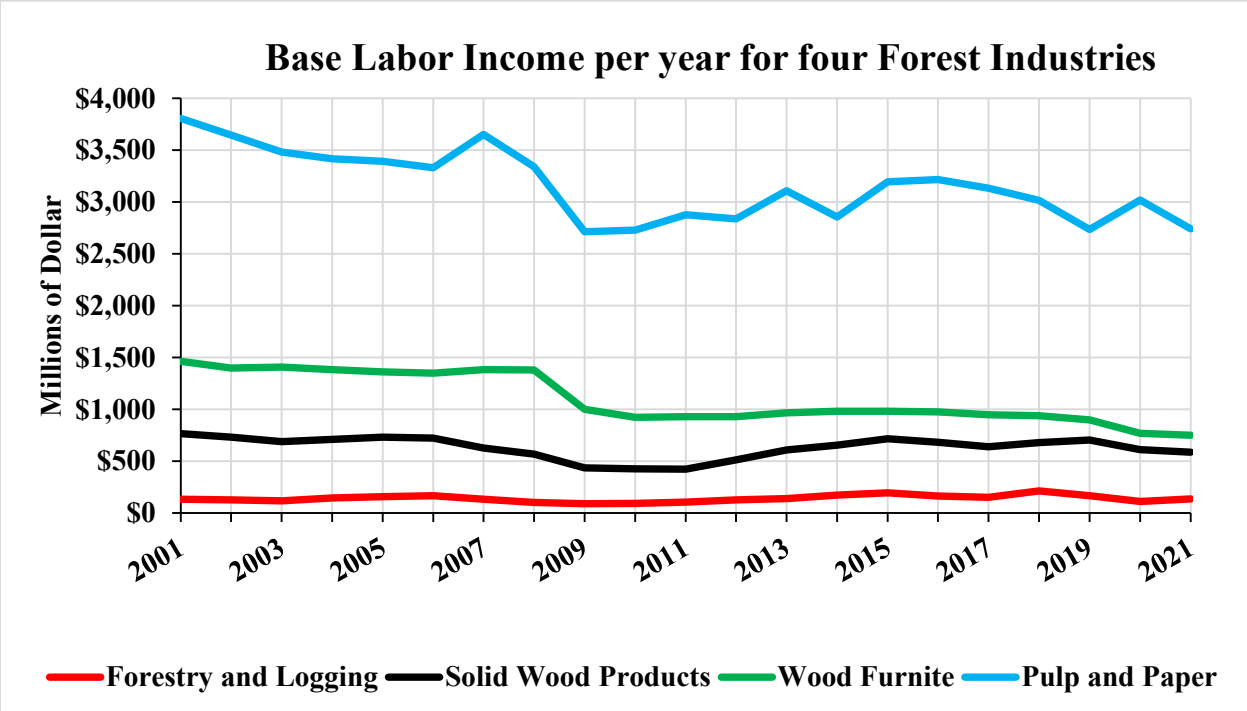

Figure 9. Base Labor Income per NYS's Individual Forest Industry between 2001-2021.

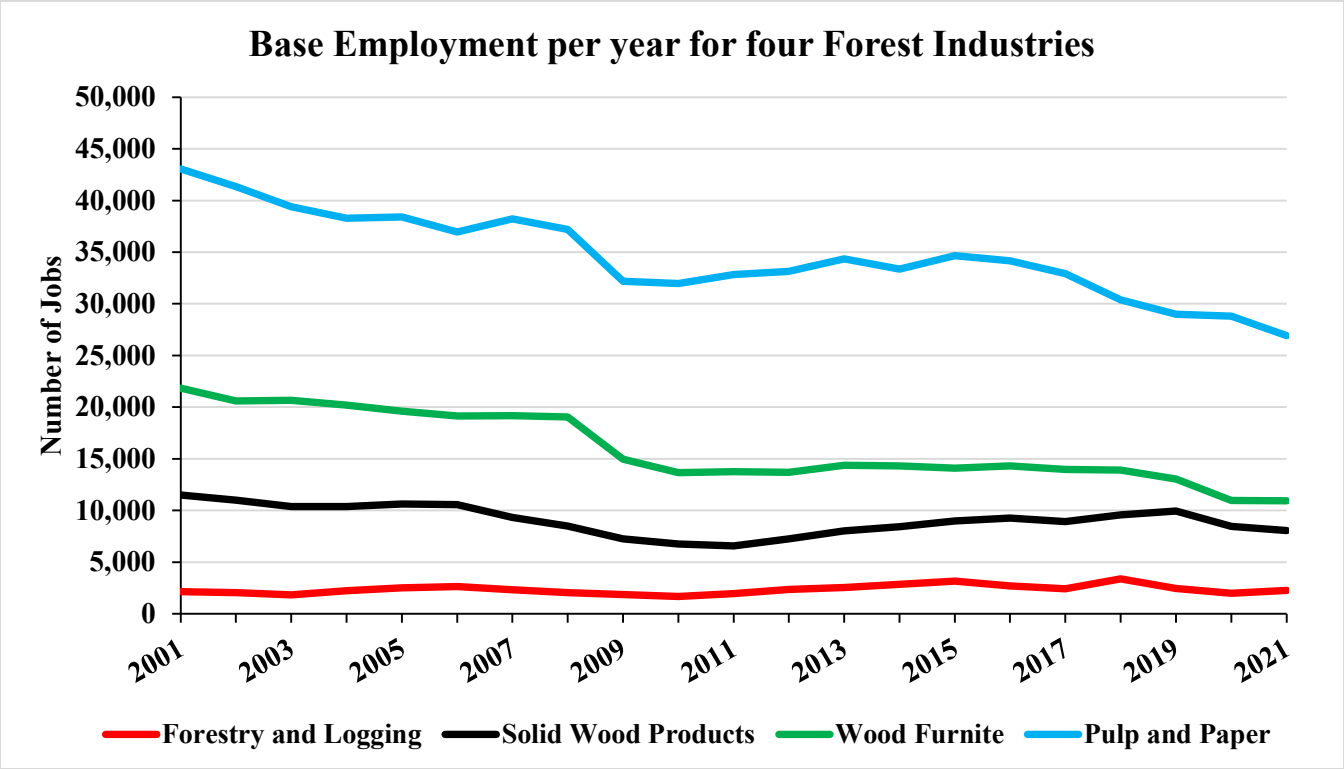

Figure 10. Base Employment per NYS's Individual Forest Industry between 2001-2021.

The Forestry and Logging industry generated, on average, 2.54% or $164 million per year of the total value added, 2.79% or $140 million per year of the total base labor income, and about 3.79% or 2,351 jobs per year of the total base employment of NYS's Forest Sector. The Wood Furniture industry had the second largest base contribution to NYS's Forest Sector, accounting for 20.90% or $1,400 million per year in terms of total value added, 21.91% or $1,101 million per year of the total base labor income, and about 25.81% or 16,015 jobs per years of the total base employment. The Solid Wood Products industry generated 1219% or $816 million of the value added, 12.53% or $629 million of the labor income, and about 14.56% or 9,036 jobs of the base employment within NY's Forest Sector (Table 2).

Examining Figures 5 to 14, all four Forest industries exhibited variability. However, focusing on Figures 5 to 10 the Pulp and Paper industry seems to have the largest variability, with more pronounced increases and declines during the period 2001–2021. The Pulp and Paper industry's comparative volatility was due to the fact that this industry has the highest level of contribution compared with the other three, and when put together, those changes are more noticeable.

A closer look at Figures 11 to 14 shows that the Forestry and Logging industry was the only industry with a higher base contribution in 2021 than in 2001 in terms of total base output, value added, labor income, and employment. All the other forest industries had lower contributions in 2021 than in 2001, except for the Solid Wood Products value added and the Wood Furniture labor income. The Tables summarizing these data are presented in Appendix 3.

Figures 7 to 14 also show that the Forest Sector and the forest industries experienced the largest decline in base contribution between the years 2001-2009, 2010, or 2011, with some periods of

recovery in the following years and a less pronounced period of decline towards the Covid 19 pandemic years.

Between 2001-2021, the base economic contribution of the Forestry and Logging industry to NYS increased in terms of output by 2.51% from $269 million to $276 million, and value-added increased by 22.56% from $140 million to $176 million, labor income increased by 0.80% from $134 million to $135 million, and employment by 5.80% from 2,148 to 2,351 jobs. During the first 10 years or 2001-2010, the Forestry and Logging industry experienced a decline in terms of output of 43.17% to $173.58 million, value added of 30.22% to $103.38 million, labor income by 36.76% to $92.30 million, and employment by 24.74% to 1,675 jobs. However, between 2010-2021, the Forestry and Logging industry experienced an increase in total base output by 45.5%, base value added by 51.89%, base labor income by 37.53%, and base employment by 30.43%. (See Appendix 3.3)

Upon closer examination of Figure 11 shows that the Forestry and Logging industry's total base output contribution underwent significant fluctuations between 2001-2021. Specifically, there was a 24.00% increase in base output from 2001-2006, followed by a steep decline of 65.48% between 2006-2010. However, the industry experienced a subsequent increase of 84.58% between 2010-2018, which ended with a decrease of 43.18% between 2018-2021. Additionally, the base contribution of value-added, labor income, and employment decreased during 2001-2003 by 7.07%, 13.61%, and 16.52%, respectively. Value-added, labor income, and employment decreased further by 61.23%, 56.95% and 44.94%, respectively between 2006-2010. This downward trend continued during 2015-2017 with a decline of 22.21%, 24.83% and 26.50%, respectively. Finally, a decline of 59.09%, 62.48% and 52.26%, between 2018-2020, respectively. On a positive note, the Forestry and Logging industry experienced four periods of growth in base contribution of value added, labor income, and employment. The first, between 2003-2006 with an increase of 39.36%, 34.67% and 36.98%, respectively. The second, between 2010-2015 with an increase of 75.68%, 71.09% and 61.57%, respectively. The third, between 2017-2018 with an increase of 34.69%, 34.51% and 33.37%, respectively. Finally, between 2020-2021 there was an increase of base value-added, labor income, and employment by 21.55%, 18.33% and 13.48%, respectively.

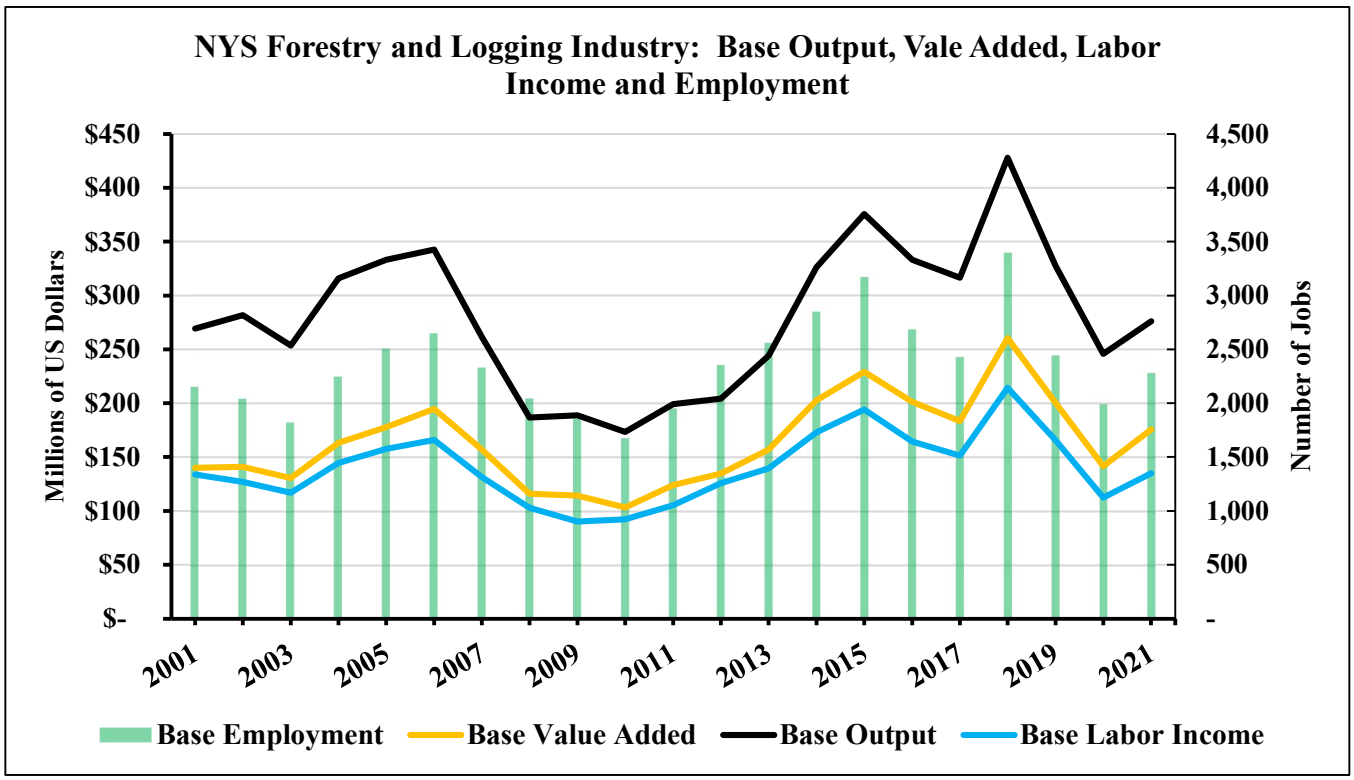

Figure 11. NYS's Forestry and Logging Industry: Base Output, Value Added, Labor Income and Employment between 2001-2021.

Figure 12 shows between 2001–2021, the Pulp and Paper industry's base economic contribution to NYS's economy decreased in terms of output by 34.71% to $10,291 million; value added by 4.76% to $4,240 million; labor income by 32.61% to $2,739 million; and employment by 46.16% to 26,916 jobs. The largest declines in output and value added were between 2001–2011 by 26.09% and 12.33%, respectively. The largest decline for labor income was between 2001-2009 by 33.55%, and for employment between 2001-2010 by 29.63%. From 2011-2021, the base contribution of output declined by 8.82%. Employment decreased by 17.12% from 2010-2021. The base contribution of value added from 2011-2021 increased by 7.48% and the base contribution in labor income also increased from 2009-2021 by 0.97%.

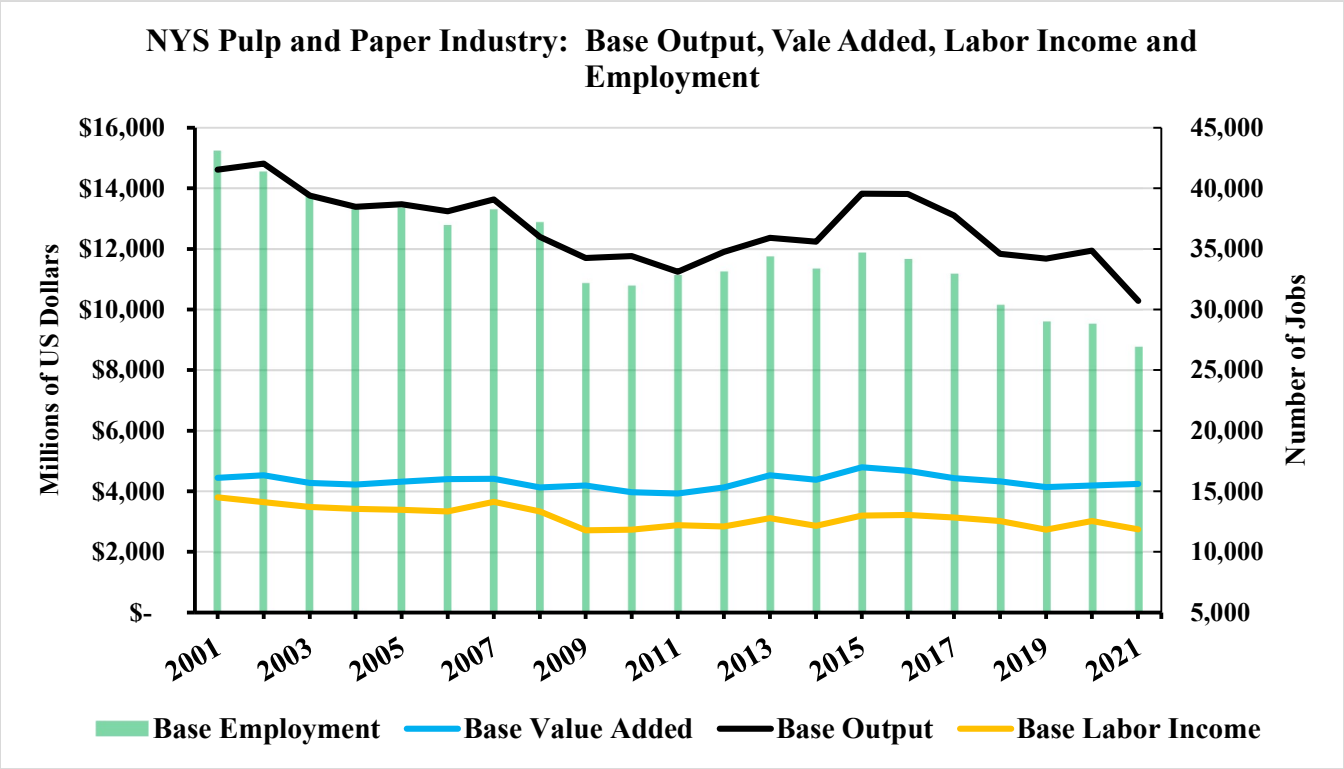

Figure 12. NYS's Pulp and Paper Industry: Base Output, Value Added, Labor Income and Employment between 2001-2021.

Figure 13 shows that between 2001-2021, the Wood Furniture industry's base economic contribution to NYS decreased in terms of output by 67.19% to $2,123 million; value added by 54.52% to $1,013 million; labor income by 64.43% to $750 million; and employment by 66.61% to 10,934 jobs. During 2001-2011, this industry declined in terms of output, value-added, and employment by 58.17%, 42.36%, and 45.46%, respectively. The largest reduction in labor income was between 2001-2010 by 45.47%. The Wood Furniture industry's base contribution also shrank between 2011-2021, but at a lower rate for output by 10.00%, for value added by 12.90%, labor income by 20.46%, and employment by 22.89%.

Taking a closer look, Figure 13 shows that the Wood Furniture industry's total base output contribution decreased by 9.21% between 2001-2007, followed by a steeper decline of 49.62% between 2007-2011. Between 2011-2016 and 2016–2021, its base output contribution declined by 22.14% and 31.96%, respectively. The Wood Furniture industry's base contribution of value added had two noticeable declines of 40.79% and 21.82%, respectively between 2007-2011 and 2018-2021. The base labor income contribution also had two relevant declines of 39.74% and 18.18%, respectively during 2008-2010 and 2019-2021. The base employment contribution was similar to the base output contribution, with three reductions of 13.69%, 32.27%, and 17.59%, respectively in the number of jobs generated between the years 2001-2008, 2008-2011, and 2019-2021.

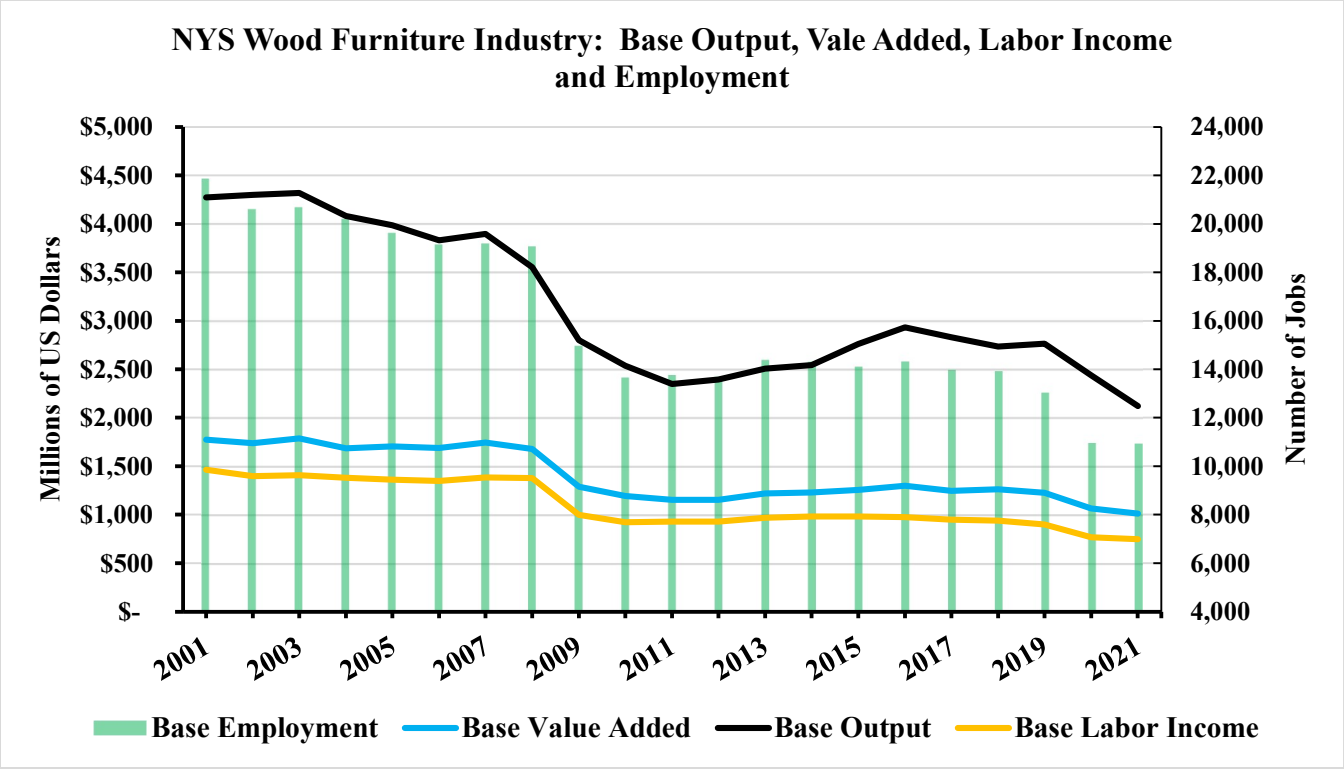

Figure 13. NYS's Wood Furniture Industry: Base Output, Value Added, Labor Income and Employment between 2001-2021.

Figure 14 shows that the Solid Wood Products industry's base economic contribution to NYS's economy for 2001-2021 decreased in terms of output by 22.80% to $2,016 million; of labor income by 26.76% to $586 million; and employment by 35.20% to 8,061 jobs. But showed a small increase in the value-added contribution of 0.21% to $909 million. The biggest decline was between 2001-2011, where the base output decreased by 64.84%, value added by 43.63%, labor income by 57.22%, and employment by 54.26%. However, during the period from 2011-2021, the base contribution increased in terms of output by 43.65%, value added by 43.83%, labor income by 31.68%, and employment by 20.02%.

Figure 14 also shows the Solid Wood Products industry's largest declines were during 2006–2011 in terms of output by 60.54%, value added by 40.40%, labor income by 51.52%, and employment by 46.20%. Between 2011-2019 there were increases in the base contributions of output by 64.29%, value added by 54.15%, and employment by 40.55%. Labor income's contribution increased by 50.96% from 2011-2015 and by 9.63% from 2017-2019, followed by a further decline by 11.62% from 2015-2017. During 2019-2021, the Solid Wood Products industry's base contribution declined by 22.20% for output, 18.12% for labor income, and 20.96% for employment. A decline also occurred in terms of value added by 20.00%, but it lasted only from 2019-2020 which was followed by another increase of 9.08% from 2020-2021.

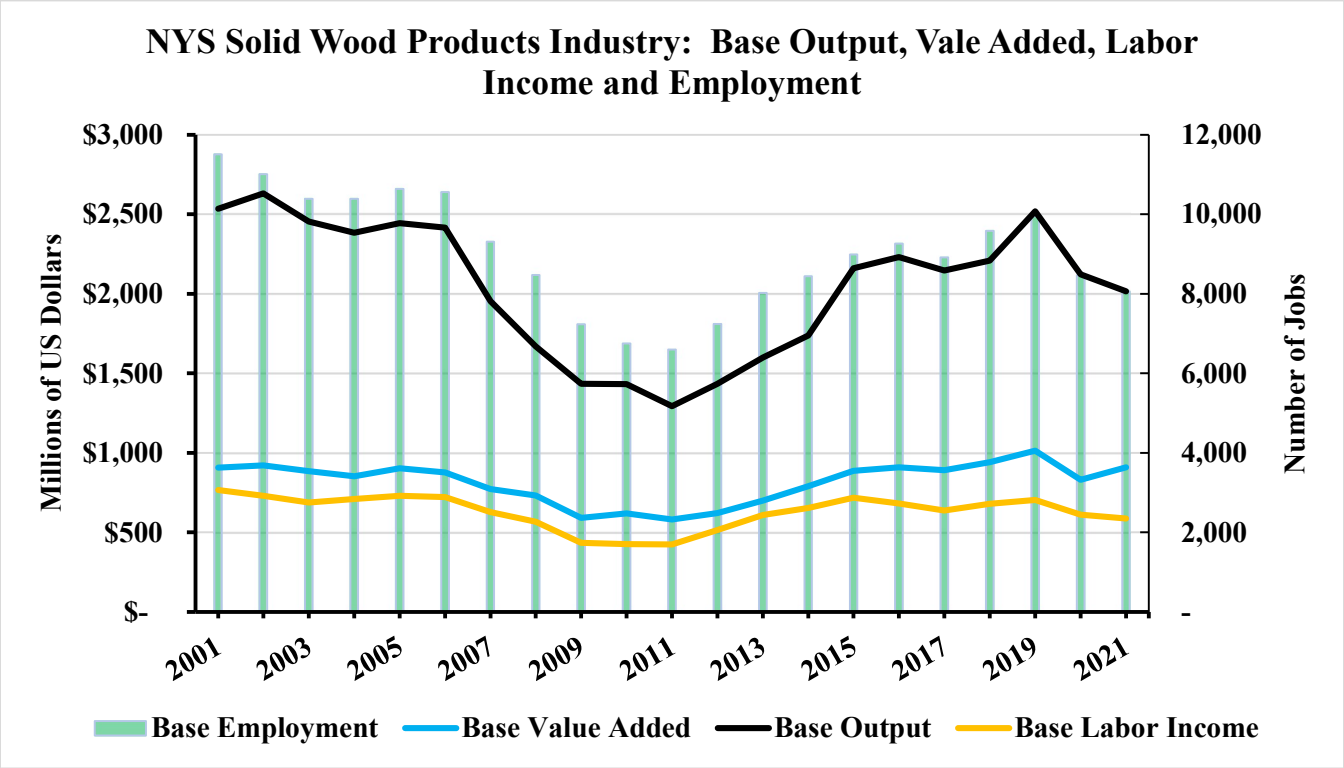

Figure 14. NYS's Solid Wood Products Industry: Base Output, Value Added, Labor Income and Employment between 2001-2021.

Summary

In summary, NYS's Forest Sector has made a significant economic contribution over the past 21 years, with an average annual total base output of $18,175 million, total base value added of $6,696 million, and total base labor income of $5,023 million, and generating an average total base contribution of 62,043 jobs per year. Of the four Forest Sector industries, NYS has received the largest contribution from the Pulp and Paper industry in terms of total base output, base employment, base value added and base labor income. The Forestry and Logging industry has had consistently the lowest contribution in the state. About 69.96% or $12,716 million of the average total base output is attributable to the production activities of the Pulp and Paper industry, 17.28% or $3,140 million to the Wood Furniture industry, 11.22% $2,039 million to the Solid Wood Products industry, and about 1.54% or $280 million to the Forestry and Logging industry.

The Forest Sector's economic contribution to NYS declined significantly between 2001-2021. Particularly in the first decade due to the Great Recession of 2007-2009. Between 2011-2021, the Forest Sector experienced both periods of growth and decline. For instance, there was growth between 2011-2016. However, the Forest Sector's contribution started to decrease gradually after that indicating its recovery from the recession was short-lived. It started to decline again in 2016 and the COVID-19 pandemic caused significant damage to its base output. The decline in the

Forest Sector's base output could be attributed to various factors, including changes in market demand and supply, economic policies, technological advancement and natural disasters. Understanding the reasons behind the decline in the Forest Sector's base output is crucial to formulating effective policies and strategies to promote its recovery and growth.

As mentioned before, of the four Forest Sector industries, the Pulp and Paper industry exhibited the most variability, with increases and declines from year to year without a long period of steady growth or reduction, except for the clear negative change around the years of the 2007-2009 recession and the COVID-19 pandemic. A contributing factor to Pulp and Paper industry's comparative volatility was this industry had the largest contribution compared with the other three and when put together those changes are more noticeable.

References:

[1] IMPLAN Group LLC. 2021. IMPLAN 2021. Available online at IMPLAN.com; last accessed December 27, 2022

[2] Watson, P., Cooke, S., Kay, D., & Alward, G. (2015). A method for improving economic contribution studies for regional analysis. *Journal of Regional Analysis & Policy*, *45*(1), 1-15.

[3] Henderson, J. E., Joshi, O., Tanger, S., Boby, L., Hubbard, W., Pelkki, M., ... & Tappe, P. (2017). Standard procedures and methods for economic impact and contribution analysis in the forest products sector. *Journal of Forestry*, *115*(2), 112-116.

[4] Watson, P., Wilson, J., Thilmany, D., & Winter, S. (2007). Determining Economic Contributions and Impacts: What is the difference and why do we care?. *Journal of Regional Analysis & Policy*, *37*(2), 140-146.

[5] Parajuli, R., Henderson, J. E., Tanger, S., Joshi, O., & Dahal, R. (2018). Economic Contribution Analysis of the Forest-Product Industry: A Comparison of the Two Methods for Multisector Contribution Analysis Using IMPLAN. *Journal of Forestry*, *116*(6), 513-519.

[6] Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge university press.

[7] Martinez de Anguita P, Wagner J., 2012. 'Environmental and Social Accounting Matrices: Theory and Applications'. 1st ed. Routledge.

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Appendix 1: Industry aggregation-the list of the businesses in each industry. Industries are defined according to the North American Industrial Classification Scheme (NAICS).

Industries	Individual Industries
Forestry and Logging	Forestry, forest products, and timber tract production; Commercial logging
Solid Wood Products	Sawmills and wood preservation; Veneer and plywood manufacturing; Engineered wood member and truss manufacturing; Reconstituted wood product manufacturing; Wood windows and doors manufacturing, cut stock, re-sawing lumber and planning, other millwork including flooring, wood container and pallet manufacturing; Manufactured home manufacturing; Prefabricated wood building manufacturing; All other miscellaneous wood product manufacturing and electric power generation-biomass
Pulp and Paper	Pulp mills; Paper mills; Paperboard mills; Paperboard container manufacturing; Paper bags and coated and treated paper manufacturing; Stationery product manufacturing; Sanitary paper product manufacturing; All other converted paper product manufacturing
Wood Furniture	Wood kitchen cabinet and countertop manufacturing; Upholstered household furniture manufacturing; non-upholstered wood household furniture manufacturing; Institutional furniture manufacturing; Wood office furniture manufacturing; Custom architectural woodwork and millwork.
Agriculture	Crop production; Vegetable and melon farming; Fruit and tree nut farming; Greenhouse, nursery, and floriculture production; Animal production and aquaculture; Fishing, hunting, and trapping; Fluid milk manufacturing; Creamery butter manufacturing; Cheese manufacturing; Animal; except poultry; slaughtering; Meat processed from carcasses; Poultry processing; Wineries. Excludes the Forestry and Logging Industry.

Appendix 2: Tables of the Base Economic Activity of the Forest Sector and Individual Forest Industries. All the dollar amounts are in millions of 2021 dollars, while employment amounts are in number of jobs

3.1. Base Economic Activity of the NYS's Forest Sector between 2001-2021

Year	Output	Value Added	Labor Income	Employment
2001	$21,688,812,935	$7,266,794,940	$6,169,956,842	78,575
2002	$22,036,971,615	$7,324,397,900	$5,898,176,806	75,003
2003	$20,793,177,800	$7,075,863,762	$5,691,881,699	72,289
2004	$20,170,414,359	$6,923,266,037	$5,652,855,241	71,103
2005	$20,232,862,890	$7,105,046,741	$5,639,787,120	71,146
2006	$19,833,607,547	$7,160,566,453	$5,567,297,897	69,274
2007	$19,744,191,735	$7,079,681,804	$5,791,824,190	69,047
2008	$17,804,764,508	$6,653,501,620	$5,385,444,146	66,753
2009	$16,124,422,749	$6,180,161,408	$4,235,286,000	56,229
2010	$15,900,573,256	$5,882,986,682	$4,166,481,565	54,041
2011	$15,080,023,827	$5,793,250,333	$4,335,267,155	55,125
2012	$15,933,221,695	$6,032,588,396	$4,405,563,160	56,398
2013	$16,710,291,758	$6,599,596,084	$4,822,287,187	59,322
2014	$16,842,350,420	$6,600,106,990	$4,664,055,812	58,929
2015	$19,121,563,929	$7,166,210,755	$5,085,897,166	60,921
2016	$19,308,701,686	$7,079,057,604	$5,036,508,974	60,410
2017	$18,395,033,072	$6,752,787,269	$4,867,904,660	58,239
2018	$17,211,631,582	$6,789,503,206	$4,847,359,441	57,266
2019	$17,284,787,235	$6,579,752,995	$4,500,347,972	54,420
2020	$16,747,721,053	$6,225,273,051	$4,508,036,090	50,229
2021	$14,706,120,541	$6,338,228,092	$4,209,800,693	48,186

2.2. Base Economic Activity of NYS's Agriculture Sector between 2001-2021

Year	Output	Value Added	Labor Income	Employment
2001	$13,679,222,028	$7,266,794,940	$6,169,956,842	78,575
2002	$14,395,731,462	$7,324,397,900	$5,898,176,806	75,003
2003	$14,598,788,554	$7,075,863,762	$5,691,881,699	72,289
2004	$14,839,780,046	$6,923,266,037	$5,652,855,241	71,103
2005	$13,800,642,168	$7,105,046,741	$5,639,787,120	71,146
2006	$13,839,561,509	$7,160,566,453	$5,567,297,897	69,274
2007	$15,250,572,552	$7,079,681,804	$5,791,824,190	69,047
2008	$14,414,431,896	$6,653,501,620	$5,385,444,146	66,753
2009	$14,117,383,992	$6,180,161,408	$4,235,286,000	56,229
2010	$15,263,679,579	$5,882,986,682	$4,166,481,565	54,041
2011	$14,836,323,240	$5,793,250,333	$4,335,267,155	55,125
2012	$15,983,987,449	$6,032,588,396	$4,405,563,160	56,398
2013	$16,602,432,400	$6,599,596,084	$4,822,287,187	59,322
2014	$16,570,669,191	$6,600,106,990	$4,664,055,812	58,929
2015	$18,318,353,158	$7,166,210,755	$5,085,897,166	60,921
2016	$17,748,792,435	$7,079,057,604	$5,036,508,974	60,410
2017	$17,591,252,989	$6,752,787,269	$4,867,904,660	58,239
2018	$16,749,767,155	$6,789,503,206	$4,847,359,441	57,266
2019	$15,991,030,464	$6,579,752,995	$4,500,347,972	54,420
2020	$17,619,635,505	$6,225,273,051	$4,508,036,090	50,229
2021	$16,205,131,458	$6,338,228,092	$4,209,800,693	48,186

2.3. Total Base Output per NYS's Forest Industry between 2001-2021

Year	Forestry and Logging	Solid Wood Products	Wood Furniture	Pulp and Paper
2001	$269,158,914	$2,534,424,166	$4,271,828,340	$14,613,401,515
2002	$281,727,408	$2,632,728,155	$4,299,219,233	$14,823,296,819
2003	$253,562,863	$2,454,235,752	$4,320,893,523	$13,764,485,661
2004	$315,982,622	$2,383,839,939	$4,081,322,797	$13,389,269,001
2005	$333,105,754	$2,444,028,518	$3,985,136,445	$13,470,592,172
2006	$342,577,861	$2,416,310,336	$3,830,621,489	$13,244,097,861
2007	$261,622,314	$1,953,536,439	$3,895,555,581	$13,633,477,400
2008	$186,668,497	$1,669,935,165	$3,552,191,829	$12,395,969,016
2009	$188,662,615	$1,433,102,376	$2,800,667,504	$11,701,990,254
2010	$173,583,328	$1,431,532,874	$2,537,156,584	$11,758,300,470
2011	$199,288,263	$1,293,423,307	$2,346,904,073	$11,240,408,184
2012	$204,119,087	$1,433,819,726	$2,393,182,642	$11,902,100,241
2013	$243,881,500	$1,598,903,014	$2,505,529,216	$12,361,978,028
2014	$326,166,494	$1,737,887,043	$2,542,663,164	$12,235,633,719
2015	$375,525,304	$2,160,059,723	$2,760,456,868	$13,825,522,033
2016	$333,048,197	$2,230,292,390	$2,931,097,438	$13,814,263,662
2017	$316,618,877	$2,145,193,169	$2,828,753,136	$13,104,467,890
2018	$427,984,883	$2,208,430,393	$2,733,084,829	$11,842,131,477
2019	$327,508,631	$2,518,989,186	$2,763,666,020	$11,674,623,399
2020	$245,705,707	$2,121,502,330	$2,436,334,116	$11,944,178,899
2021	$276,005,602	$2,015,709,340	$2,123,461,602	$10,290,943,997

2.4. Total Base Value Added per NYS's Forest Industry between 2001-2021

Year	Forestry and Logging	Solid Wood Products	Wood Furniture	Pulp and Paper
2001	$140,175,600	$907,342,403	$1,772,746,407	$4,446,530,530
2002	$140,962,378	$920,615,905	$1,736,250,129	$4,526,569,487
2003	$130,607,329	$884,026,002	$1,789,833,139	$4,271,397,293
2004	$163,058,761	$852,952,618	$1,684,260,433	$4,222,994,225
2005	$177,655,128	$902,514,957	$1,703,680,444	$4,321,196,212
2006	$194,601,828	$877,238,342	$1,687,107,891	$4,401,618,392
2007	$156,932,977	$771,596,582	$1,743,807,194	$4,407,345,051
2008	$115,951,314	$732,156,771	$1,678,020,847	$4,127,372,688
2009	$114,206,925	$590,246,808	$1,287,498,495	$4,188,209,180
2010	$103,377,590	$619,863,547	$1,191,391,434	$3,968,354,111
2011	$123,852,834	$582,363,225	$1,153,024,923	$3,934,009,352
2012	$134,820,288	$621,812,077	$1,151,741,356	$4,124,214,676
2013	$156,962,459	$699,465,794	$1,217,878,067	$4,525,289,764
2014	$202,815,042	$790,142,045	$1,227,875,007	$4,379,274,895
2015	$229,244,642	$886,015,987	$1,255,076,611	$4,795,873,515
2016	$201,290,369	$908,049,753	$1,298,703,663	$4,671,013,820
2017	$183,409,706	$891,386,193	$1,245,423,721	$4,432,567,650
2018	$260,391,938	$941,536,442	$1,261,462,771	$4,326,112,056
2019	$200,254,096	$1,014,847,395	$1,227,282,151	$4,137,369,354
2020	$141,616,765	$830,294,721	$1,063,279,960	$4,190,081,605
2021	$175,814,524	$909,263,017	$1,013,269,163	$4,239,881,388

2.4. Total Base Labor Income per NYS's Forest Industry between 2001-2021

Year	Forestry and Logging	Solid Wood Products	Wood Furniture	Pulp and Paper
2001	$134	$767	$1,464	$3,806
2002	$127	$730	$1,397	$3,644
2003	$117	$687	$1,408	$3,480
2004	$145	$710	$1,382	$3,417
2005	$158	$730	$1,362	$3,390
2006	$166	$721	$1,350	$3,331
2007	$131	$627	$1,384	$3,649
2008	$103	$566	$1,378	$3,338
2009	$90	$434	$998	$2,712
2010	$92	$426	$921	$2,727
2011	$105	$426	$929	$2,876
2012	$126	$514	$930	$2,836
2013	$139	$608	$967	$3,108
2014	$173	$654	$982	$2,856
2015	$194	$717	$982	$3,193
2016	$165	$681	$975	$3,216
2017	$151	$638	$948	$3,131
2018	$214	$678	$939	$3,015
2019	$166	$703	$899	$2,733
2020	$112	$610	$767	$3,019
2021	$135	$586	$750	$2,739

2.5. Total Base Employment per NYS's Forest Industry between 2001-2021

Year	Forestry and Logging	Solid Wood Products	Wood Furniture	Pulp and Paper
2001	2,148	11,504	21,854	43,069
2002	2,039	11,009	20,593	41,362
2003	1,820	10,389	20,672	39,407
2004	2,244	10,389	20,188	38,282
2005	2,504	10,634	19,617	38,391
2006	2,645	10,556	19,137	36,936
2007	2,327	9,310	19,178	38,233
2008	2,042	8,472	19,054	37,185
2009	1,855	7,236	14,965	32,172
2010	1,675	6,752	13,659	31,955
2011	1,950	6,594	13,759	32,822
2012	2,351	7,240	13,681	33,126
2013	2,555	8,022	14,385	34,359
2014	2,845	8,437	14,301	33,345
2015	3,164	8,986	14,108	34,664
2016	2,682	9,258	14,316	34,155
2017	2,424	8,917	13,975	32,922
2018	3,395	9,582	13,918	30,371
2019	2,440	9,948	13,042	28,990
2020	1,988	8,465	10,968	28,807
2021	2,276	8,061	10,934	26,916