

Employment and Labor Income Direct Response Coefficients for the U.S. Forest Products Industry

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The objective of this analysis is to develop state or regional estimates of annual direct private sector employment and labor income associated with harvesting and processing timber throughout the United States. Employment is expressed as number of workers per unit volume of timber processed, labor income is expressed in thousands of dollars per job, and both are referred to as “Direct Response Coefficients” (DRCs). DRCs have been developed for the following forest industry sectors:

- Forestry and logging
- Support activities for forestry
- Softwood and hardwood sawmills
- Softwood and hardwood plywood/veneer plants
- Oriented strand board and other composite board manufacturers using roundwood
- Pulp mills processing roundwood pulpwood
- Other timber processors including manufacturers of house logs, log homes, posts and poles, cedar products, log furniture, utility poles, pilings, etc.
- Facilities processing wood fiber (mill) residue from sawmills and plywood plants

Methods

The calculation of DRCs requires data on the volume of timber harvested, the volume of that timber processed by various sectors of the forest products industry, the use of mill residue generated in processing timber, and associated employment and worker

earnings. Publicly available federal employment and timber output data bases provided this information for logging and forest management sectors. To estimate employment for the sectors that process timber and mill residue, a combination of internal and publicly available data sources were used.

Data Sources

The most comprehensive source of information on timber harvest and use by the various manufacturing sectors is the Forest Inventory and Analysis (FIA) Resources Planning Act/Timber Product Output (RPA/TPO) data base (http://ncrs2.fs.fed.us/4801/fiadb/rpa_tpo/wc_rpa_tpo.ASP). The data base contains timber harvest volume by product type as well as mill residue volume and use. The data are developed from periodic censuses/surveys of the forest products industry and are recorded at the county level for each state.

Wage and salary workers and the self-employed are included in employment, and several data sources were used to estimate employment for the various sectors. Three federal data bases used in this analysis offer annual employment by industry sector with varying levels of detail:

- Regional Economic Information System (REIS) maintained by the U.S. Department of Commerce, Bureau of Economic Analysis (<http://www.bea.gov/regional/reis/>)
- County Business Patterns (CBP) from the U.S. Census Bureau (<http://censtats.census.gov/cbpnaic/cbpnaic.shtml>)
- Quarterly Census of Employment and Wages (QCEW) from the U.S. Department of Labor, Bureau of Labor Statistics (<http://www.bls.gov/data/>)

REIS provides data on employment and worker earnings including the self-employed. However, REIS often does not provide sufficient detail to estimate employment by all of the various timber-processing sectors in this analysis. CBP and QCEW offer substantially more sector level detail but include only wage and salary employees; CBP also reports employment on a specific date--March 12th. CBP and QCEW are good benchmarks for the timber-processing sectors that rely almost entirely on wage and

salary workers but are less accurate for the logging and forestry sectors, which have considerable seasonality and rely on the self-employed to a much greater degree.

Calculation of Employment DRCs in Logging and Forest Management

REIS provides an annual estimate of employment at the state level for “forestry and logging”. This category includes logging, activities related to selling timber, and the long term management of forest property for timber production. Examination of the detailed employment information in CBP and QCEW indicates that over 90 percent of the employment in this category is in managing and harvesting timber. Much of the employment in transporting timber to mills is classified in trucking which is not included in the DRCs reported in this paper.

“Support activities for forestry” are not detailed in REIS but rather are reported combined with “agricultural support activities”. Wage and salary employment from QCEW does detail support activities for forestry. The percentage of private sector agriculture support activities that are private sector forestry support activities was calculated from QCEW data for each state, then the percentage was applied to the total REIS employment estimate in the more general agriculture and forestry category in order to estimate the total employment in support activities for forestry.

A separate employment figure was calculated for forestry and logging and then forestry support for the most recent year that harvest data were available for each state. Employment in each category was then divided by the harvest volume in million cubic feet (MMCF) for each state to yield DRCs for forestry and logging and forestry support.

Calculation of Employment DRCs in Timber- and Mill Residue-processing

The challenge of matching timber and mill residue use with employment was substantially more difficult for the processing/manufacturing sectors than for the logging and forestry sectors. Employment DRCs were estimated for eight processing/manufacturing sectors. With the exception of lumber and plywood/veneer, the employment data bases did not always provide sufficient detail to match

employment with timber processed by each sector. Consequently, other data sources were a key part of the development of employment DRCs for these processing sectors.

The University of Montana's Bureau of Business and Economic Research (BBER) develops the RPA/TPO data for the West (Alaska, Arizona, California, Colorado Nevada, Oregon, Idaho, Montana, New Mexico, Utah, and Wyoming) through a series of ongoing censuses of the forest products industry. These censuses are cooperative efforts involving the BBER, USDA, Forest Service, Forest Inventory and Analysis Units in the Rocky Mountain and Pacific Northwest research stations. The cooperators have developed a system to collect, compile, and make available state and county level information on the operations of the forest products industry--the Forest Industries Data Collection System (FIDACS). In addition to the volume of timber and mill residue processed, FIDACS collects information on employment for the individual facilities processing wood fiber. Employment DRCs for the individual western states were calculated using the FIDACS system. States were grouped and the DRCs were volume-weighted by each state's proportion of harvest volume by timber product type to allow release of sector level information.

For all other states with softwood sawmills and softwood veneer and plywood plants, estimates were based on timber use by these sectors from the RPA/TPO data base and state level sector employment as reported in CBP. DRCs for these sectors are also grouped, volume-weighted, and presented at the regional level.

A number of other sources were used to develop employment for other industry sectors and to corroborate the estimates derived from CBP. These sources include QCEW data and publications on various sectors of the wood products industry (Spelter and Alderman 2005; Spelter and others 1996 and 2006) trade journals, news reports, and discussions with forest industry representatives.

Calculation of Labor Income DRCs

Annual labor income per employee by timber processing sector was derived from the REIS data. Since this data series is reported in considerably broader industry categories than the ten sectors specified for this analysis, the finer detail presented in CBP and QCEW was used to apportion labor income among sectors. Even using CBP and QCEW, it was not possible to reach a level of detail comparable to that for employment in each sector and state. Not wishing to imply more precision than the data warrant, labor income DRCs are rounded to the nearest \$5,000. Labor income DRCs reported in this analysis represent annual labor income per worker for Calendar Year 2006.

Results and Discussion

Employment DRCs

Employment DRCs (i.e., workers per MMCF of timber) are presented in Table 1. There are substantial differences among the regions and among industry sectors.

Table 1: Employment Direct Response Coefficients by Industry Sector and State Group
(number of workers per MMCF of timber)

Industry Sector	Idaho & Montana	Central & Southern Rockies	California & Nevada	Oregon & Washington	Alaska	Southeast States	Northeast States	Hardwood States	North Central States	Plains States
Forestry & logging	13	23	16	12	15	8	20	19	13	24
Forestry support	7	14	6	8	7	3	4	2	2	2
Lumber	12	32	15	10	19	12	18	28	21	16
Plywood/veneer soft	41	x	12	28	x	20	21	x	50	23
Plywood/veneer hard	x	x	x	x	x	25-100	25-100	25-100	25-100	25-100
OSB	x	x	x	x	x	7	7	7	7	7
Roundwood pulpwood	9	x	9	9	x	9	9	9	9	9
Other timber products	54	86	10	27	118	10-70	10-70	10-70	10-70	10-70
Residue (Sawmills)	5	6	3	5	x	4	4	4	4	4
Residue (ply/veneer)	4	x	4	4	x	4	4	4	4	4
States in each group	Idaho Montana	Arizona Colorado New Mexico Utah Wyoming	California Nevada	Oregon Washington	Alaska	Alabama Arkansas Florida Georgia Louisiana Mississippi North Carolina South Carolina Tennessee Texas Virginia	Connecticut Delaware Maine Massachusetts New Hampshire New Jersey New York Rhode Island Vermont	Illinois Indiana Kentucky Maryland Missouri Ohio Pennsylvania West Virginia	Michigan Minnesota Wisconsin	Iowa Kansas Nebraska North Dakota Oklahoma South Dakota

Forestry and logging: The Southeast States, at 8 workers per MMCF have a substantially lower forestry and logging employment DRC than other areas of the country. This is likely a function of relatively short-rotation, even-aged pine plantation silviculture and the prevalence of relatively gentle terrain across much of the South, which allow for highly mechanized logging operations on a large, highly productive, and mostly privately held landbase. The North Central States have a forestry and logging employment DRC of 13 workers per MMCF, also probably related to topography, species mix, ownership, and degree of mechanization. The major timber producing regions in the U.S. West have employment DRCs in forestry and logging that range from 12 to 16 workers per MMCF. Difficult terrain, frequent use of cable yarding and hand-felling, and more publicly-owned timber land in the West are thought to contribute to the higher employment DRCs relative to the South.

The highest employment DRCs for forestry and logging are in the Central and Southern Rockies and Plains States. These higher DRCs are thought to primarily be function of the low level of timber harvest, as well as a logging workforce comprised of more part-time operations. The part-time nature of logging is also reflected in low labor income DRCs for forestry and logging in these regions (Table 2). Part-time logging may also be a factor in the relatively high employment DRCs for the Northeast and Hardwood States. These regions also have a large component of the harvest in hardwood sawlogs and veneer logs, which could be attributable to the more frequent use of hand-felling and merchandising, and a greater degree of handling involved with these relatively high-value hardwood timber products.

Forestry support: The DRCs for forestry support range from approximately 2 workers per MMCF of timber harvested in the Hardwood States, North Central States, and Plains States to 14 workers per MMCF in the in the Central and Southern Rockies. Employment DRCs for forestry support are thought to be higher in the West versus the remainder of the country because this category includes private sector fire fighters, terrain- and species-related factors may make reforestation more labor intensive, and a

higher degree of seasonality and part-time nature of forestry support activities may exist in the West.

Lumber: The major timber-producing regions in the West and the Southeast have the lowest employment DRCs for lumber. The lowest DRC was 10 workers per MMCF in Oregon and Washington. The Southeast States and Idaho and Montana had 12 workers per MMCF. These major lumber-producing regions are dominated by large, highly automated sawmills, many of which have retooled to process smaller logs at high speed. The somewhat higher employment DRC in California--which is typically the third- or fourth-largest lumber-producing state behind Oregon, Washington, and occasionally Georgia--stems from the fact that sawmills in California process relatively large timber (Morgan and Spoelma 2008) more of which is sawn for grade rather than maximum volume recovery. Among the other regions, those regions with low levels of timber harvest, like the Central and Southern Rockies--which tend to have more sawmills that operate on a part-time basis--and regions with hardwood sawmills had higher employment DRCs for lumber.

Plywood and veneer: More workers per MMCF of timber are employed to manufacture softwood plywood and veneer in the West versus the Southeast. This is likely due to a strong emphasis among Western firms on specialty plywood products (Spelter and others 2006, FIDACS 2008). The exception in the West is California, with a low employment DRC of 12 workers per MMCF in plywood and veneer. California has a relatively small veneer industry and no plywood plants. Much of the veneer produced in California is laid up into plywood in Oregon.

Employment DRCs for hardwood veneer and plywood were difficult to estimate for a number of reasons. First, the industry sector contains a broad mix of types and sizes of facilities. Facilities that produce only veneer from logs, veneer and plywood from logs, as well as facilities that produce plywood from purchased veneer are included in the employment data. Hardwood plywood also typically has one or more layers or sheets of softwood veneer in the core, confounding a simple DRC calculation using only

hardwood veneer log volume as the denominator. Further, there is considerable log flow and purchase of veneer across state lines (Piva and Gallion 2007, Howell and Wright 2002, Bentley and Lowe 2003). Hardwood veneer logs have historically moved substantial distances, including overseas, making harvest and point of processing difficult to identify, thus making it difficult to match harvest and use (Widmann and others 1998).

State level employment DRCs for hardwood plywood and veneer based on CBP and TPO data ranged from 26 to more than 7,000 workers per MMCF. The range presented in Table 1 for processing timber into hardwood plywood and veneer is 25 to 100 workers per MMCF. This range appears to be a reasonable estimate based on the employment DRCs calculated for the major states harvesting hardwood veneer logs. With hardwood veneer logs in particular, it is important to know the local and regional industry structure and consider where the timber is expected to be processed.

OSB, pulp and paper: Table 1 shows employment DRCs for OSB and pulp and paper reported as national averages. Limited information is available for most states, the number of workers per MMCF appears similar among states, and the data do not provide sufficient detail to refine estimates by region. The lowest employment DRCs among timber-processing sectors are in the use of timber to produce OSB and pulp and paper at 7 and 9 workers per MMCF of logs, respectively. These sectors are dominated by large, highly capital-intensive facilities which tend to employ few workers per unit of input. As discussed in "Labor Income" below, workers in this sector are also among the highest paid in the forest products industry.

Other timber products: Employment DRCs for other timber products show considerable variation due to the mix of other products manufactured in each state and region. It is very difficult to estimate precise values outside of the West, where precise mill-level employment and timber volume data are available to the authors. Data on specific components of the other timber products sector can be provided for many western states on request. In other parts of the country, the types of other producers can be

identified, but detail on volume processed and employment are not available. The employment DRC range presented in Table 1 for regions outside the West is 10 to 70 workers per MMCF.

Mill Residue: Mill residue is a major source of raw material for manufacturers of pulp and paper and reconstituted boards such as particleboard or medium density fiberboard (MDF). It is a source of fuel for major sectors of the wood products industry including facilities like sawmills and plywood plants that generate the residue. Mill residue is a feedstock for producers of electricity, pellets, and presto logs. Other uses include mulch, landscaping material, and animal bedding.

The employment DRCs for mill residue from sawmill and plywood plants indicated in Table 1 represent the employment generated when 1 MMCF of logs are processed at a sawmill or plywood facility and the resulting mill residue is used as raw material or fuel at another facility. The volume of logs processed by a sawmill or plywood plant is calculated inside bark, and no bark volume is included in the log measure. Mill residue, however, does include bark and the employment generated from utilizing bark is included in the employment DRCs for mill residue.

The use of the mill residue from 1 MMCF of logs processed at sawmills typically generates 3 to 6 additional workers (Table 1). The Central and Southern Rockies have the highest employment DRC (i.e., 6 workers per MMCF) for sawmill residue. Residue use in this region is dominated by facilities producing decorative bark and landscape material, which are smaller and more labor intensive than pulp mills and particleboard plants. Relatively high employment DRCs for mill residue in Idaho and Montana and Oregon and Washington are due to a higher percentage of residue being used by the pulp and paper and reconstituted board sectors in these states versus more mill residue being used for energy in the eastern regions and California

(http://ncrs2.fs.fed.us/4801/fiadb/rpa_tpo/wc_rpa_tpo.ASP; Johnson and others 2008).

The use of the mill residue from 1 MMCF of logs processed at plywood plants generates 4 additional worker at other facilities.

Labor Income

Table 2 illustrates labor income DRCs (i.e., annual labor income per worker) during 2006 by industry sector and geographic region.

Table 2: Labor Income Direct Response Coefficients by Industry Sector and State Group
(annual labor income in thousands of 2006 dollars per worker)

Industry Sector	Idaho & Montana	Central & Southern Rockies	California & Nevada	Oregon & Washington	Alaska	Southeast States	Northeast States	Hardwood States	North Central States	Plains States
Forestry & logging	40	20	45	60	50	40	30	25	25	25
Forestry support	25	20	25	25	25	20	20	25	20	
Lumber	45	35	50	55	40	40	40	40	40	35
Plywood/veneer soft	45	x	50	55	x	45	x	x	x	x
Plywood/veneer hard						35	40	40	40	x
OSB	x	x	x	x	x	65	65	65	65	65
Roundwood pulpwood	100	x	80	95	x	80	90	70	70	70
Other timber products	20-50	20-50	20-50	20-50	20-50	20-50	20-50	20-50	20-50	20-50
Residue (Sawmills)	85	20-40	70	85	x	70	70	65	65	65
Residue (ply/veneer)	80	x	70	85	x	70	70	65	65	65
States in each group	Idaho Montana	Arizona Colorado New Mexico Utah Wyoming	California Nevada	Oregon Washington	Alaska	Alabama Arkansas Florida Georgia Louisiana Mississippi North Carolina South Carolina Tennessee Texas Virginia	Connecticut Delaware Maine Massachusetts New Hampshire New Jersey New York Rhode Island Vermont	Illinois Indiana Kentucky Maryland Missouri Ohio Pennsylvania West Virginia	Michigan Minnesota Wisconsin	Iowa Kansas Nebraska North Dakota Oklahoma South Dakota

The highest labor income per worker is found in the roundwood pulpwood, OSB, and residue sectors. The pulp and paper industry is the highest paying major component of the forest products industry, and it is the major user of mill residue through most of the country. Consequently it contributes to high wages in the residue sectors. Also contributing to high wages in the mill residue sectors are reconstituted board plants such as MDF and particleboard producers, which, like OSB plants, reveal annual labor income DRCs of \$65,000 or more.

At \$25,000 or less in all states and regions, the lowest labor income DRCs are in forestry support. The low earnings per worker in this sector appear to be attributable to

both the part-time or seasonal nature of many of the jobs and to relatively low wages per worker.

States and regions along the Pacific Coast tend to have the highest labor income DRCs. The lowest labor income DRCs are found in the Central and Southern Rockies, due in large part to the fact that many of the operations in that region operate on a part-time basis.

Illustrating the Use of Direct Response Coefficients

Users of the DRCs presented should be aquatinted with the structure of the industry and expected log flows in the area being analyzed. To illustrate the use of DRCs an example is provided for Montana (Table 3).

Sector	Workers per MMCF	Labor income per worker	Labor income per MMCF
Forestry & logging	13	\$ 40,000	\$ 520,000
Forestry support	7	\$ 25,000	\$ 175,000
Lumber	12	\$ 45,000	\$ 540,000
Residue (sawmills)	5	\$ 85,000	\$ 425,000
Total	37		\$ 1,660,000

A timber sale of 1 MMCF is offered in Montana with the expectation that the logs will be processed into lumber. Montana contains a pulp and paper mill, an MDF facility, a particleboard plant, and several smaller users of mill residue. The expected annual employment and labor income from the harvesting and processing of those logs is as follows:

- The harvesting of those logs would employ an estimated 13 workers, each earning \$40,000 per year.
- Forestry support services would involve another 7 workers, each earning \$25,000 per year.

- The processing of those logs into lumber at Montana sawmills would employ 12 more workers, each earning \$45,000 per year.
- The use of the sawmill residue at other facilities would employ an additional 5 workers, each earning \$85,000 per year.
- Thus the total direct private sector employment from harvesting and processing 1 MMCF of logs into lumber in Montana would be 37 workers, with total earnings of \$1.66 million per year in 2006 dollars.

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