Logging Cost Indices

First Quarterly Report to the
Wood Supply Research Institute

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Table of Contents

List of Figures

1. Introduction

The fundamental objective of the Wood Supply Research Institute (WSRI) is to enhance pro-competitive awareness of factors that affect the efficiency, stability, and economic viability of the industrial wood supply system. Thus, the members of WSRI believe that the industry needs some continuous, long-term, credible, index of trends related to the cost of producing wood and the financial health of the system. The long term cost and productivity study at Mississippi State originated within the Industrial Forestry Operations Research Coop at Virginia Tech in 1990. The study has been supported by the Forestry and Wildlife Research Center at MSU since 1999. The objectives of this study have been to monitor the effects of changes in the wood supply system on logging business performance, to monitor the effects of externalities such as weather, tax law, fuel prices, labor legislation on business structures, and gather information and insights that could lead to the development of better understanding of, and management tools for, the wood supply system. This research project, funded, in part, by WSRI is designed to expand the current work being done at Mississippi State and to enhance the dissemination of this index to a broader audience.

2. Indices

Developing indices is a relatively simple process; it just involves dividing one number by another. All indices are abstractions, attempts to reduce the complexity of reality into a numerical form that can be used in planning and decision making. Developing an accurate, useful, and robust index is not simple. It requires a careful assessment of the phenomena being measured, the planned use of the index and the quality of the data used in the development and maintenance of the index. The value of an index lies in how closely the abstraction reflects the behaviors of the process or system being monitored.

That reflection is a function of whether the responses are reflexive or cognitive. Reflexive responses occur in a predictable fashion, such as jerking a hand away from a hot pan. Cognitive responses may not, such as the choice between waiting in a traffic jam or taking a longer route, the choice depends on the individual.

"Hard sciences"- physics, chemistry, mathematics, biology, - search for reflexive responses that can be reduced to indices and then used for prediction. A weight, dropped from a tall building, will accelerate at the rate of 32 ft./sec./sec., one BTU of heat will raise one pound of water one degree F. The indices then serve as the base for applied fields such as engineering, medicine, and forestry.

Site index has proven to be a credible measurement of forest productivity, a useful summary of the complex of factors (fertility, drainage, rainfall, etc.) that determine tree growth. The population in a stand is large enough and the time frame long enough that short term and local variation in a single tree or single factor is smoothed. While trees are not reflexive in the usual sense, the response to inputs is largely fixed, the fate of any particular plant is of little concern, and the performance of the population is important.

"Soft sciences"- those dealing with things of human creation - economics, business, sociology, psychology- recognize the cognitive nature of their field and then attempt to develop indices for monitoring the state of the humanly constructed systems at any particular time. There are theories, but these are usually accompanied by a caveat- "normally", "a rational man", "a perfect market", or "*ceteris paribus"* (all other things being equal) - and used for explanation rather than prediction.

Indices for cognitive systems are more complex because the systems and responses are more complex. The Dow Jones Industrial Average, an index of a cognitive system is not a predictor, but simply a reflection of the "mood" of the investment community.

Traditional analyses of logging systems approached them as being mechanical, or at best biological, responding to a stimulus in a reflexive or predictable fashion. Perhaps they were in the days of men, mules, and cross-cut saws; a large number of men, mules and individual enterprises were available and variation

within the population tended to smooth the variation of the population as a whole. This changed as capital investment increased, the number of firms decreased, and the legal and business environment became increasingly complex. The responses of the surviving firms are in fact cognitive. The response is not fixed or predictable, but rather the result of the thought processes of the entrepreneur relative to current options and their assessment of the future.

The following is an assessment of behaviors of a set of logging cost indices developed from the performance of the same 25 logging firms from the coastal plain and piedmont regions of the South that demonstrate the response to the factors affecting the logging industry across the period of 1998 through 2001. These indices are also compared with a subset of national and regional indices developed by the Bureau of Labor Statistics, Dept. of Energy and other governmental organizations.

3. The Population

Continuous and consistent data from 25 firms located in nine of the Eastern United States were available for the years 1995 through 2001 (Table 1). No claim is being made that the sample is "representative" of the total population of logging firms in the region. A deliberate effort has been made to include firms across the spectrum of size, procurement system (dealer vs. direct), harvest type (clear cut vs. thinning), species mix (pine vs. hardwood) and geographic distribution. *For more information concerning the characteristics and the operating environments of the firms, see Jackson, 2003*.

Table 1. Participation by state.

State	Number of Firms
Alabama	4
Georgia	4
Louisiana	1
Michigan	1
Mississippi	5
New York	1
North Carolina	1
South Carolina	3
Virginia	5
Total	25

The analyses are based on the fiscal years used by the study participants, so the reported year 1998, for example, includes data for all of those firms with a business year ending between 7/1/1998 and 6/30/1999. Few firms have fiscal years ending between July 1 and December 30.

Annual production for these firms ranged from 20,500 to 245,000 tons per year in 1995 and from 2,650 to 290,000 in 2001 (Figure 1). Arithmetic averages, which indices essentially are, reflect wood volumes not enterprises and would weight the data from the largest contractor in 2001 by 100 times that of the smallest. The wood supply system, on the other hand likely has many more small to mid-sized contractors than large firms. Given the range of operations it was thought useful to split the population by annual production to determine if operations of different size responded differently over time.

For this preliminary analysis, the population was split into approximate thirds with the eight smallest and largest firms in the first and third groups, and nine firms in the middle group. This method of partitioning is perhaps not the optimal for this population but was considered the most objective treatment for a preliminary analysis. The eight large contractors accounted for 52% of the total volume in 1995 and 61% in 2002. The break points between the groups and year to year changes are shown in Figure 1, with blue designating the small firms, gold the mid sized and green the larger firms. The white bars indicate regions with no representation.

This and all subsequent analyses will set out the parameter for the whole population followed by the parameters for the individual groups.

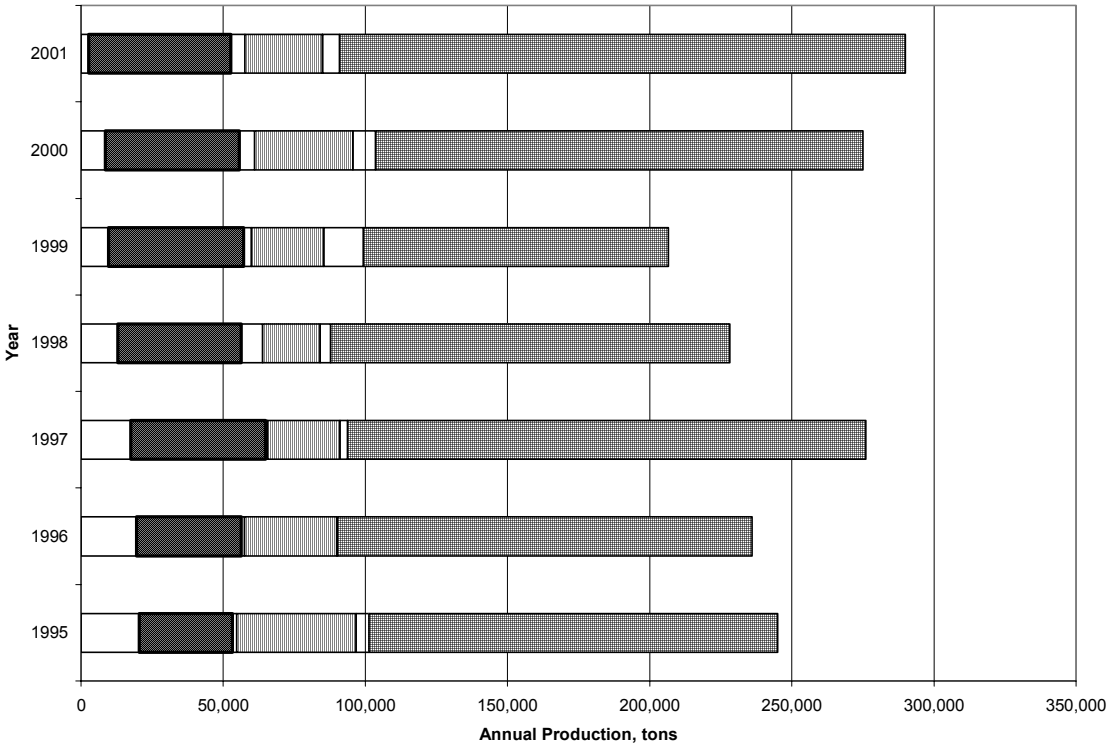

Figure 1. Production range by year.

The approach to partitioning the firms resulted in firms moving between groups across years, especially between the second and third groups. The boundary between the first and second remained relatively constant over the period, ranging between 53,000 and 57,000 tons going above 60,000 tons only twice, in 1997 and 1998. The break between second and third was more fluid ranging from 84,000 to 103,000.

One firm moved among all three groups over the period, starting in the large, moving through the mid-sized to the small and then back up to the mid-sized. Only one that started in the small group ended in the mid-sized, and three of the larger firms moved down to mid-sized.

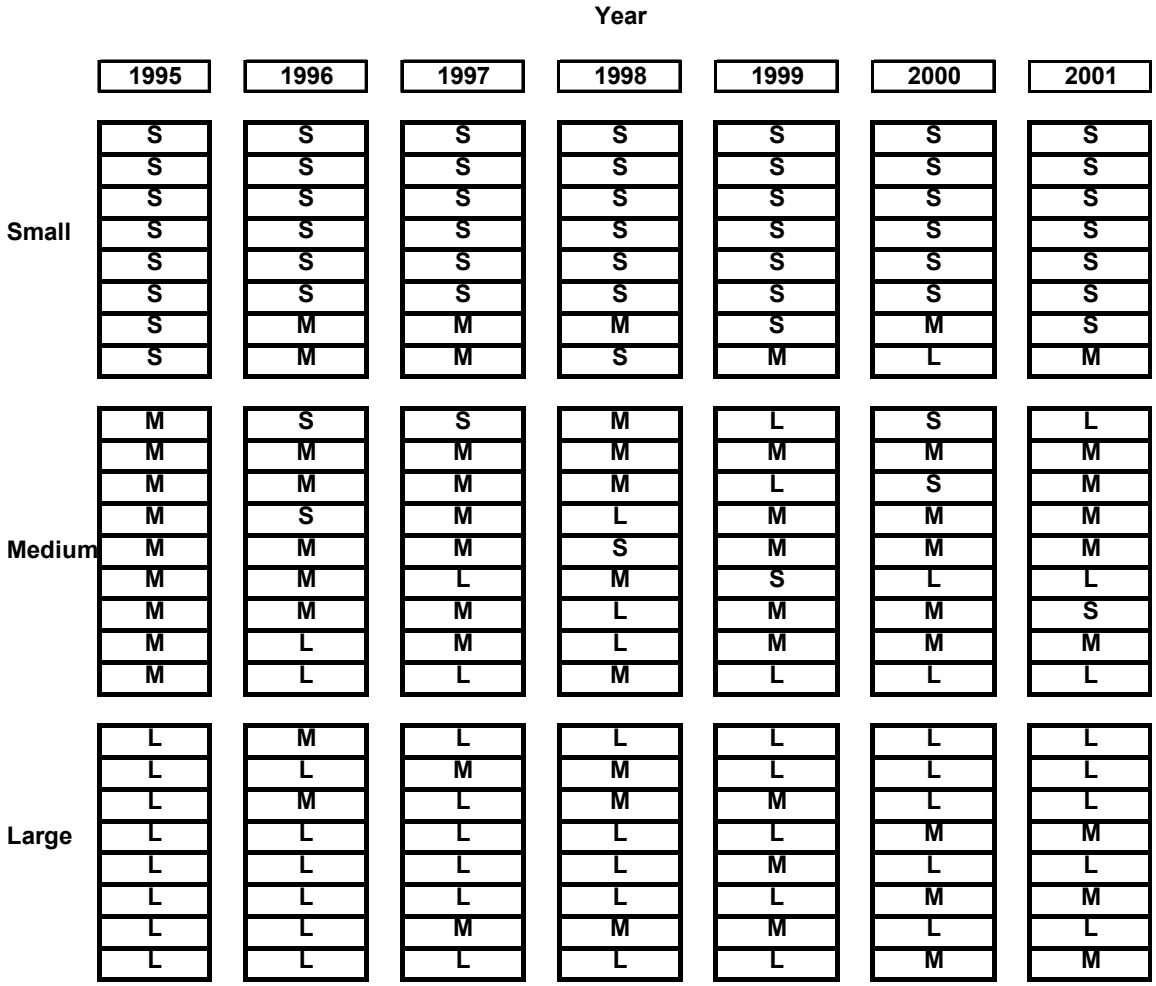

Figure 2. Movement between production groups.

4. Production Indices

Production indices developed by averaging the production per firm within the whole sample and then within groups and using 1995 production as a base, are shown in Figures 3 and 4. Production of the entire sample was up by 6.6% over the seven years, but the pattern of gain was one of two advances and four retreats, ending on a downward slope between 2000 and 2001. (Note: This and all but two of the following charts will have the y axis truncated at a minimum value of 80 and upper value allowed to range as appropriate for the index presented.)

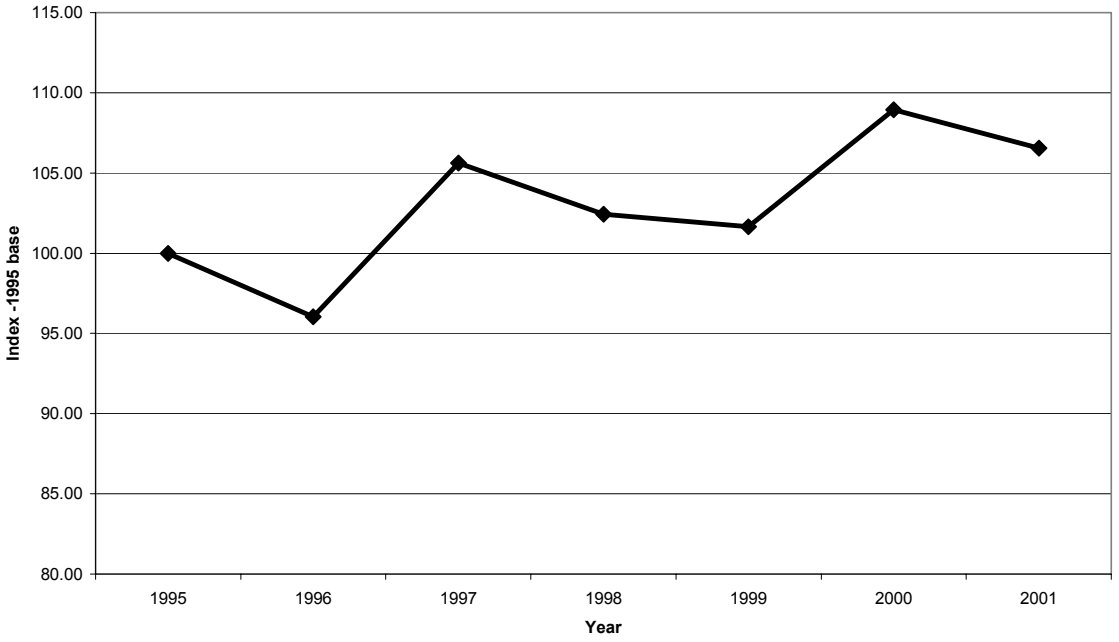

Figure 3. Production index for the total sample.

Production changes were not consistent across firm size. The gain from 1997 on was from the larger firms, with both the medium and smaller firms lagging behind 1995 production levels.

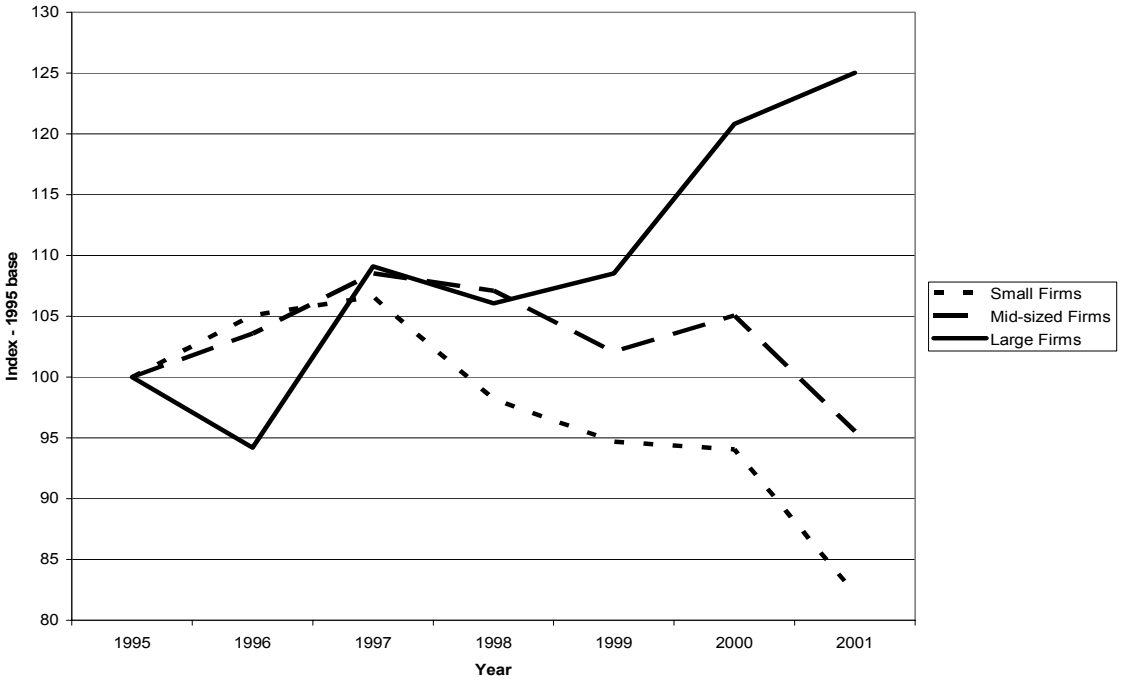

Figure 4. Production indices by firm size.

5. Cost Indices

The following indices are based on unadjusted costs taken from the loggers' books or accountant.

5.1 Average Total Cost per Ton Indices

The average cost per ton index increased by 15 percent for the population as a whole over the period (Figure 5) It is presented with two Bureau of Labor Statistics (BLS) indices for comparison. The Producer Price Index for logging and logging camps is developed to reflect what purchasers of logging services reported as having paid. The Consumer Price Index, also prepared by BLS, is a general measure of inflation over the period.

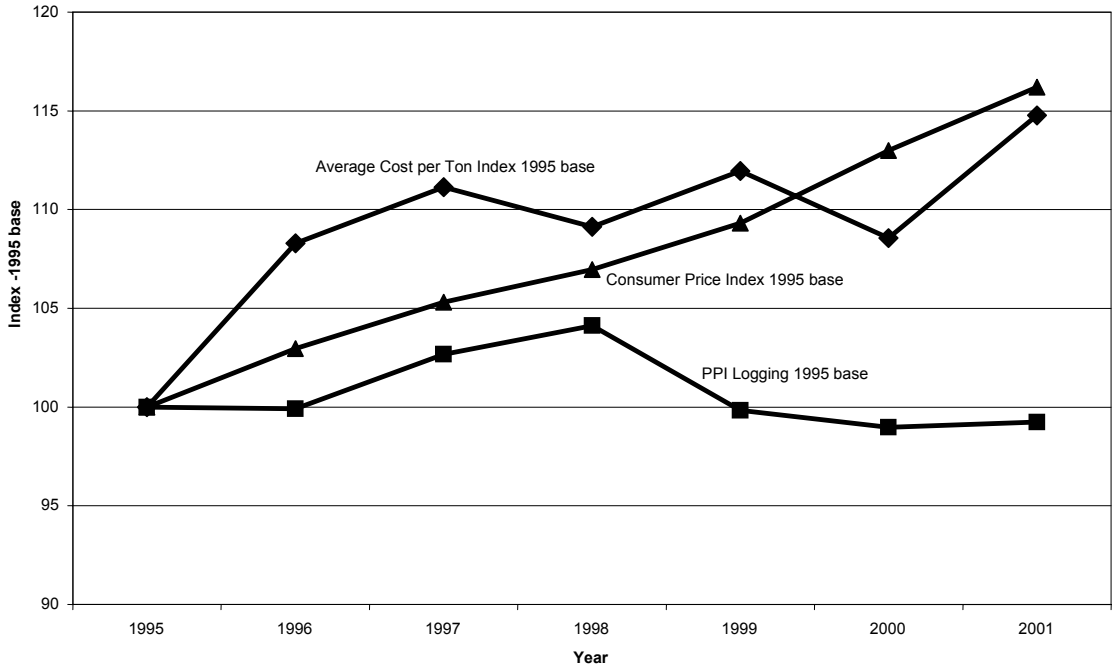

Figure 5. Average total cost per ton index for the total sample.

The timing and magnitude of change was not consistent across firm sizes (Figure 6), with costs for the larger firms rising more rapidly in the early years then falling back. The costs for the smaller firms rose in the period 1996 to 1999, dipped in 2000 and rose again in 2001. The costs of the mid-sized firms moved up in a stepwise fashion. Two of the larger firms added chipping operations during the 1996-1997 period, one by including a chipping operation with a conventional operation that had been part of the study, the second by starting up a new operation. Several smaller firms also changed their operations to meet the challenges of an altered procurement environment, some by moving to producing grade saw-logs, others to thinning, both of which resulted in higher production costs.

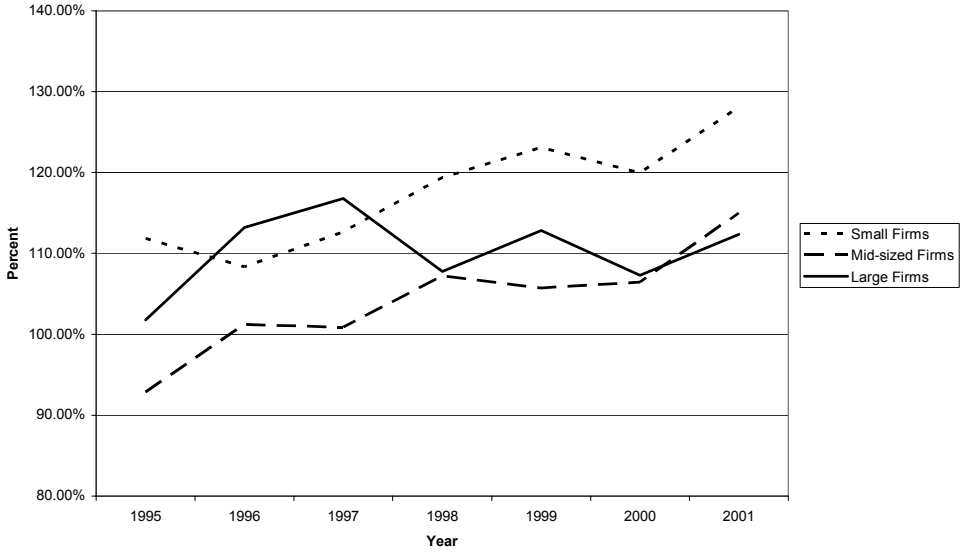

Figure 6. **Average total cost per ton indices by firm size.**

The change in index without a common reference can be misleading. The average annual total cost for each of the three groups was calculated as a percentage of the 1995 average cost for the entire sample for use as a reference. This shows both the change within groups and the relationship between groups (Figure 7). It also supports Lebel's (1996) finding that firms in the 1,500 ton per week range were the most economically efficient overall The costs for the mid-sized firms were lowest for all years but 2001. This has to be tempered with the understanding that some of the small firms specialize in other than "conventional" types of harvest such as thinning small to medium sized tracts, cutting small private tracts and mixed pine/hardwood stands. Some of the large firms likewise have taken on different "unconventional" characteristics such as wet site operation, chipping, and other specialized harvests that may also result in higher production costs.

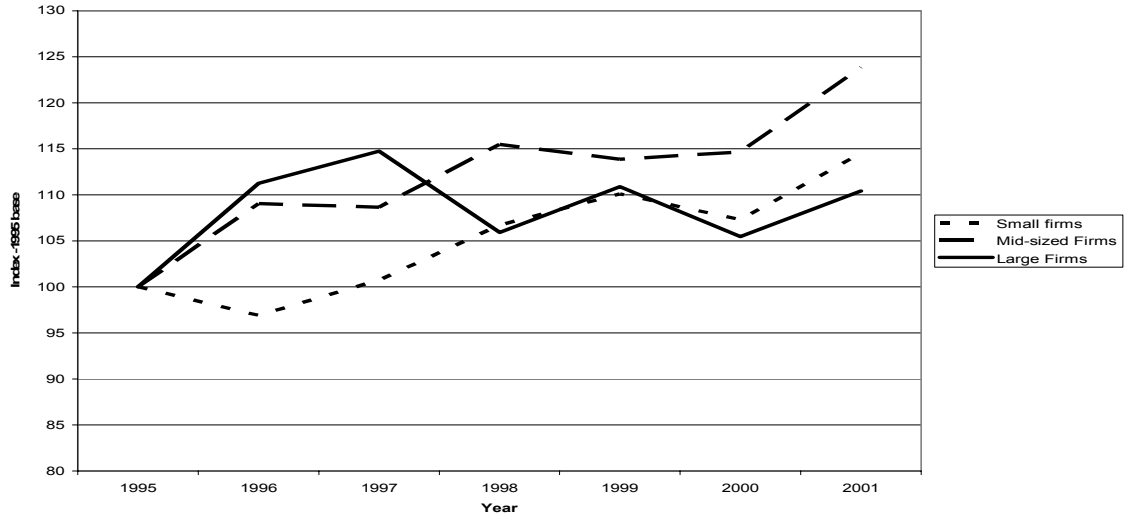

Figure 7. Average total cost per ton indexed to the 1995 total sample average cost per ton.

5.2 Component Cost Indices

The costs were split into six component categories for further analyses:

Equipment-depreciation and interest of equipment loans,
Consumable supplies- the cost of maintenance/repair and all supplies that were expansible in the given year,
Labor – including all fringe benefits and workers compensation insurance,
Contract services - primarily trucking but also including road and BMP work,
Insurance – property and casualty, vehicle liability and all other insurance except that tied directly to labor,
Administrative overheads - office expenses (including salaries and wages), costs of maintaining and operating shops, advertising, contributions, etc.

The contribution of each component to the total cost per ton for the entire sample is shown in Figure 8. Labor was the largest component across the years. Contracted services outlays are equal to or greater than those for equipment. Insurance and administrative overheads costs are relatively small but combined are roughly one-third of the outlay for equipment.

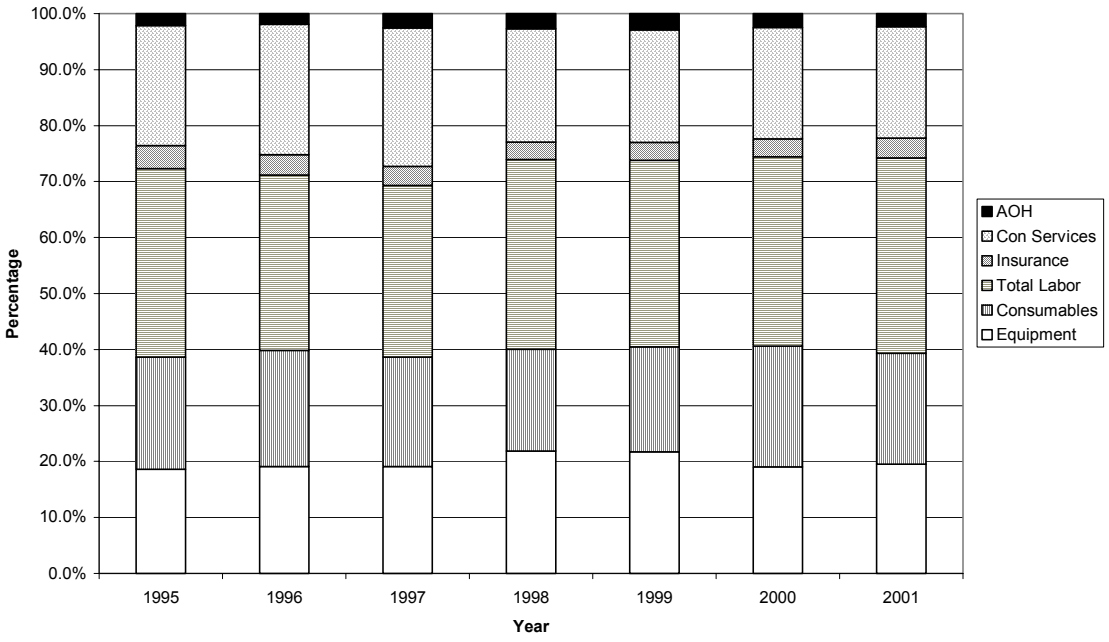

Figure 8. Cost per ton components as a percentage of total cost for the total sample.

The distribution of cost across component differs with firm size. Equipment costs were a greater share of total costs for the smaller firms than for the sample as a whole through 2000 (Figure 9).

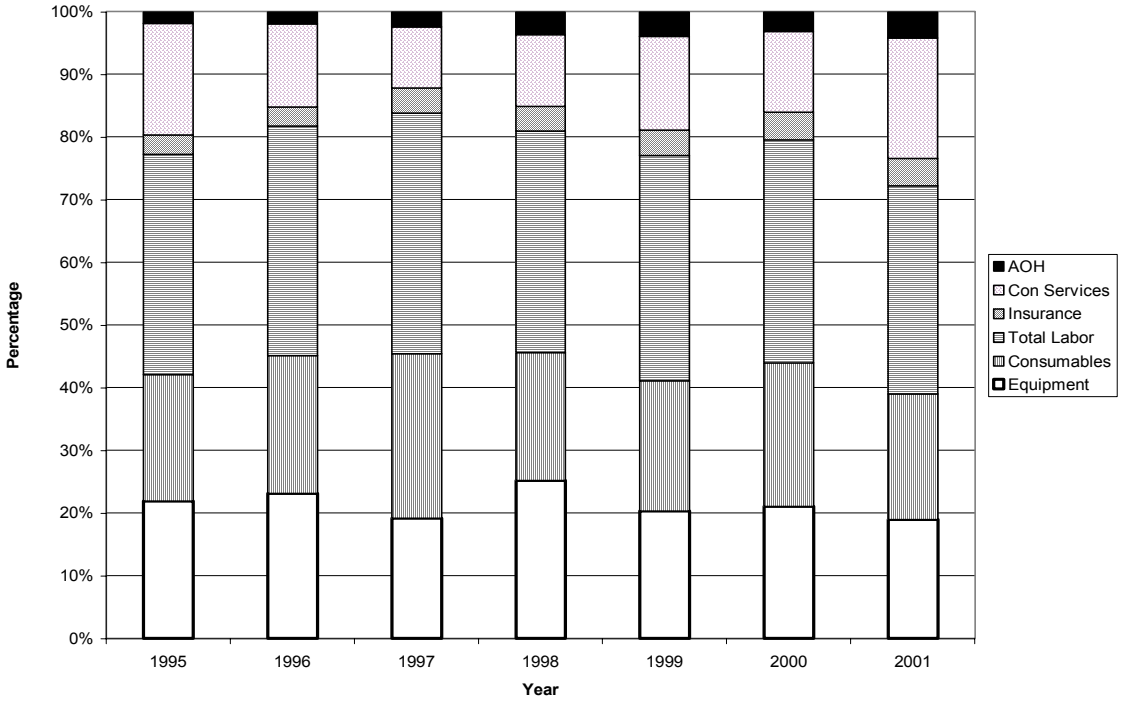

Figure 9. Cost per ton components as a percentage of total cost for the smaller firms.

Mid-sized firms had the most volatility in cost allocation between the "big three" – equipment, supplies and labor - and contracted services (Figure 10).

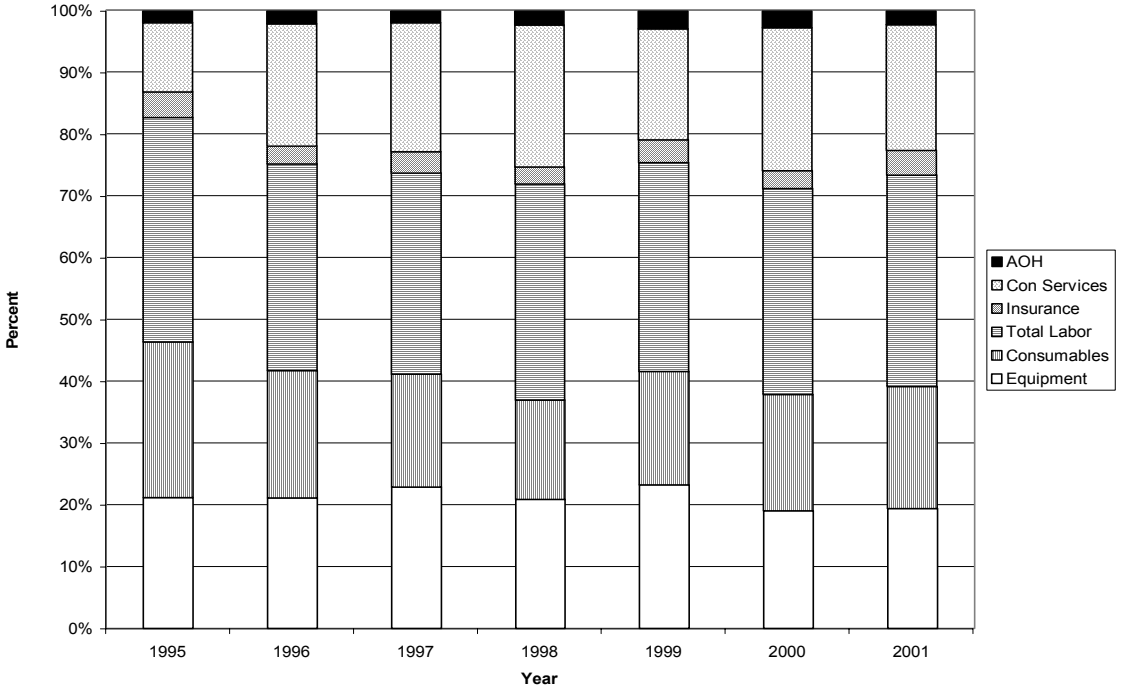

Figure 10. Cost per ton components as a percentage of total cost for the mid-sized firms.

The large firms were spending less per ton on equipment than the other two groups during the first three years, the gap narrowed from then on (Figure 11). There is a linkage between equipment and contracted service expenditures that will be discussed later. Labor cost were lower in the earlier years, but ending very near those for the other groups at 35% versus 34% for the mid-sized and 33% for the smaller firms.

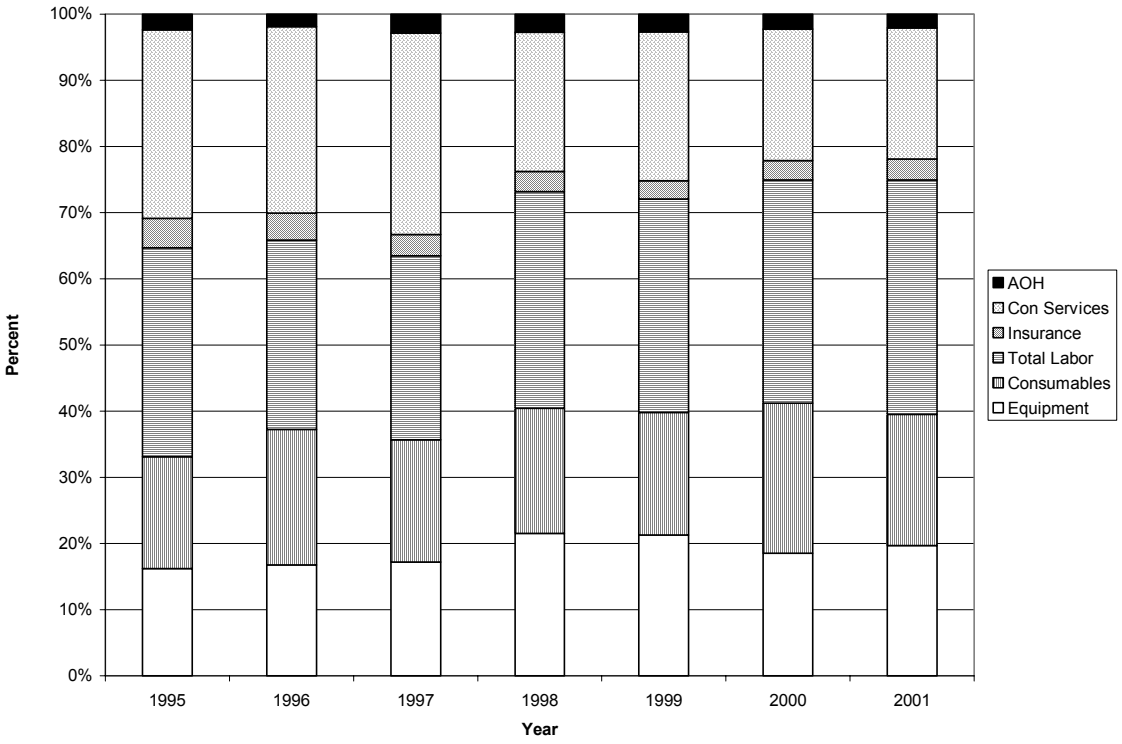

Figure 11. Cost per ton components as a percentage of total cost for the large firms.

5.21 Equipment

Outlays for equipment reflected the uncertainty of the industry over the period, and this uncertainty was apparently different for different sectors of the population. The overall index moved upward through 1999 and the plummeted, recovering somewhat in 2001. The BLS' Producer Price Index for construction machinery is presented as a measure of the rate of change in new equipment prices.

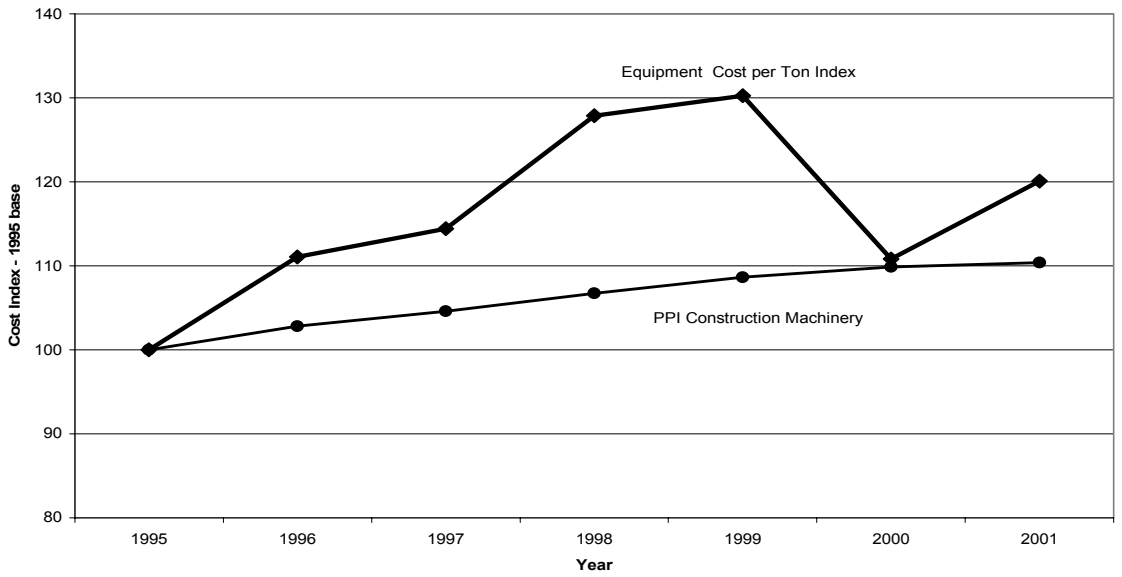

Figure 12. Equipment cost per ton index for the total sample.

The pattern of investment gets even more interesting when split by firm size. The larger firms continued to invest through 1999, the mid-sized firms shifted reinvestment strategy on a year to year basis beginning in 1997. The smaller firms retrenched in 1997, reinvested in 1998, and then retrenched 2000 ending up about where they had started.

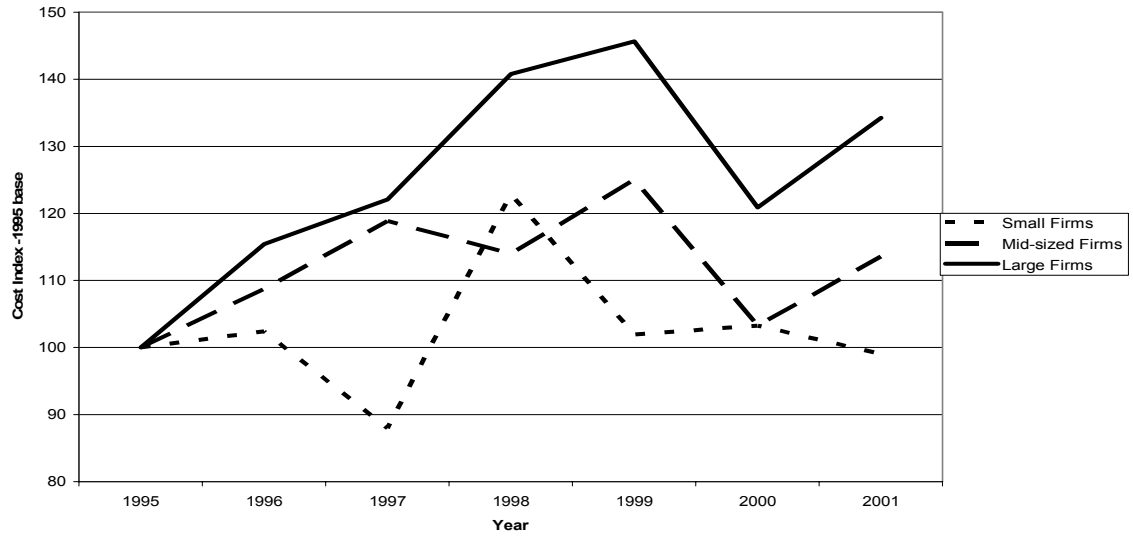

Figure 13. Equipment cost per ton index by firm size.

The pattern of changes among the groups is interesting and could stand further analysis concerning cause and strategy.

5.22 Consumable Supplies

Expenditures for fuel, oil, tires, repair and maintenance and other production related supplies are among the more difficult costs to contain, the user must pay market rates at the time the commodity or service is used. Fuel costs dominate this category and the percentage of supplies cost going for fuel varies with equipment age, equipment spread, amount of in-woods processing, haul distance, and the amount of wood moved by contract truckers. Strategies such as changing operations, delaying some forms of maintenance or doing more repair work "in house" can be employed to affect the amount of that service or commodity used, at least in the short-run. The fact that the 80 point jump in the fuel cost index resulted in increases of six to 12 points in the supplies cost index indicates that coping strategies were put in place (Figure 14). It should also be noted that the strategies that buffer the increases also affected their ability to capture the advantage of falling fuel prices.

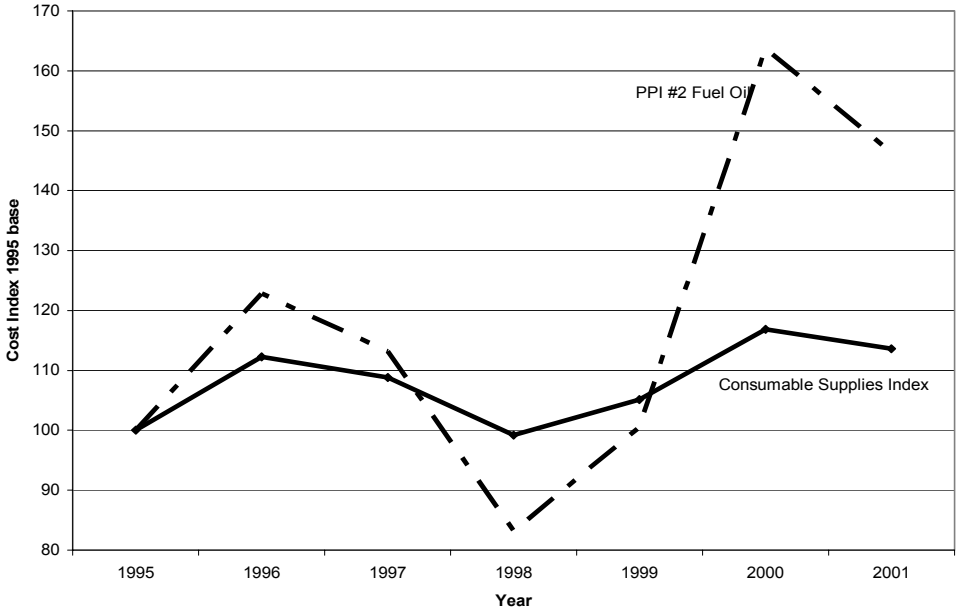

Figure 14. Consumable supplies cost per ton index for the total sample.

The mid-sized firms reduced consumables – fuel, tires, repair and maintenance supplies - through 1998. This is one of the few instances where any cost indices dipped below 80 over the period. This trend could have been linked with the rise in equipment expenditures shown in Figure 9, but the relationship between equipment investment and consumable supplies is relatively weak. (Subsequent discussion of the change in contract services costs may help explain this anomaly.) Patterns for the small and large firms were similar from 1997 on (Figure 15).

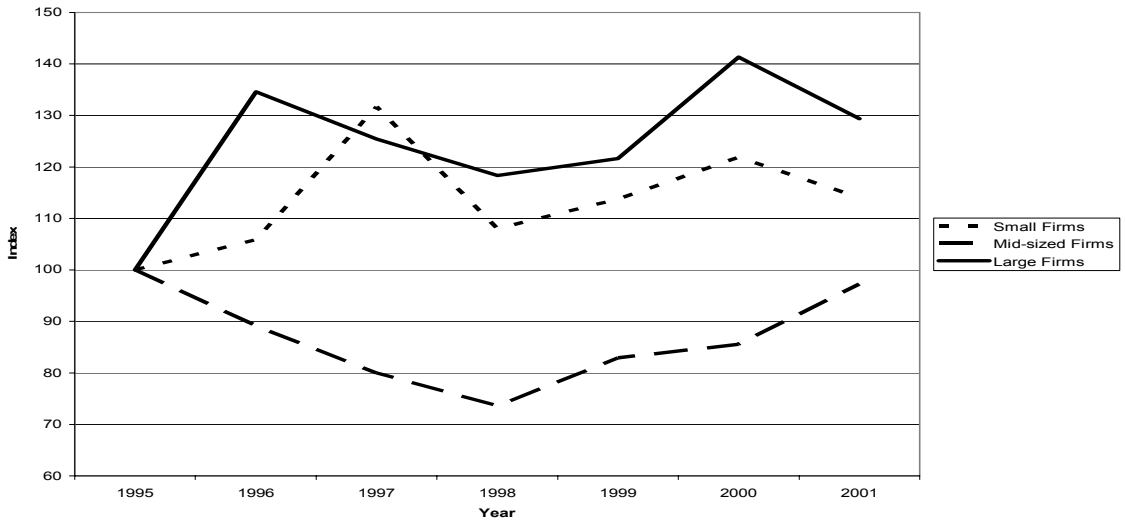

Figure 15. Consumable supplies const per ton index by firm size.

5.23 Labor

Labor costs include wages or salary, benefits and workers compensation insurance. An owner's salary of $20,000 per year plus $0.30 per ton – exclusive of fringes is included when the owner is a working member of the crew or an active supervisor.

The overall trend was a modest increase from 1995 to 1997 with a steep rise in 1998, stable in 1999 with a small decrease in 2000 followed by a sharp increase in 2001 (Figure 16). The step pattern is different from the consistent and continuous rise in hourly wages of production workers reported by the BLS. The pattern indicates that it is possible to control labor costs and maintain crew capability for a year or two, but competitive pressure builds and has to be countered.

Figure 16. Labor cost per ton index for the total sample.

Smaller firms experienced earlier pressure on labor rates than the larger firms, and apparently took compensatory steps earlier – lay offs, reduced benefits and the like, ending with labor costs in 2001 being lower than those of 1997. The large firms resisted until 1998, but ended with a 25% increase paralleling the change reported by BLS for the period. Mid-sized firms also had a significant increase in labor costs in 1998, but were able to compensate, reducing costs in 1999 and 2000 but costs increased by 12 points in 2001.

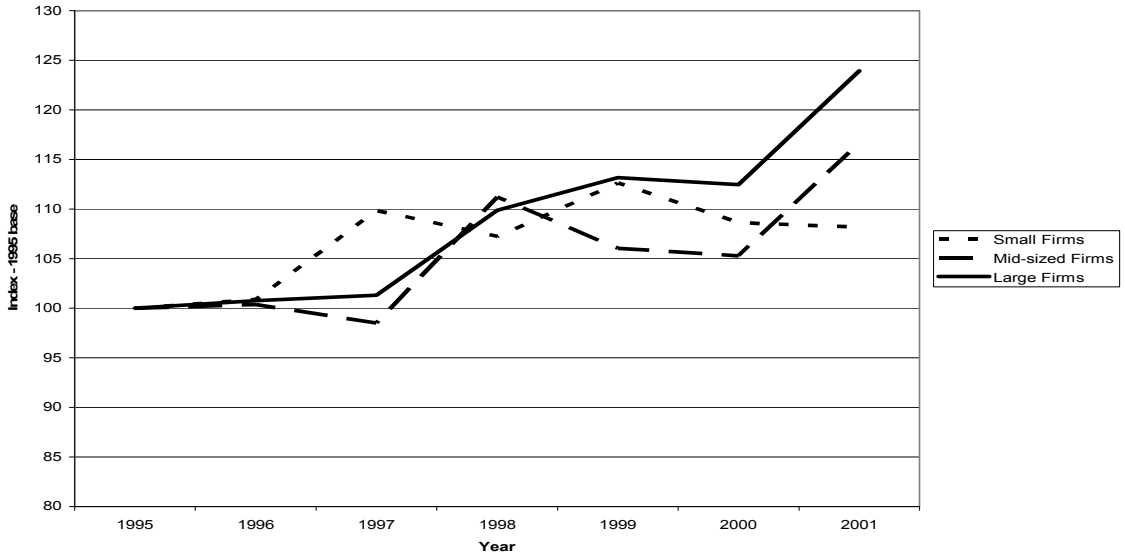

Figure 17. Labor cost per ton index by firm size.

5.24 Contract Services

Contract services, in a few instances included charges for road construction, trucking gravel and BMP work, but contract hauling dominated the category.

Contract services, especially trucking, remain the wild card in logging cost analysis for several reasons. Hauling may be contacted to an external firm on a regular basis, or to maintain productivity on long hauls. Hauling may be contracted to a captive firm serving only one logging business, set up for workers compensation insurance reasons or to reduce overall liability, or to a firm with common ownership serving several crews, or to a firm with common ownership that contracts with other loggers as well as serving the owner's operation. Contracting may also be used as a strategy for postponing equipment reinvestment until the future becomes clearer, as a way to avoid the management complexity of running a logging operation and a transportation business simultaneously, or simply because a contract trucker offers to work for less than it costs to operate one of the firm's trucks. The reasons are rational, but the rationale may change within and between years.

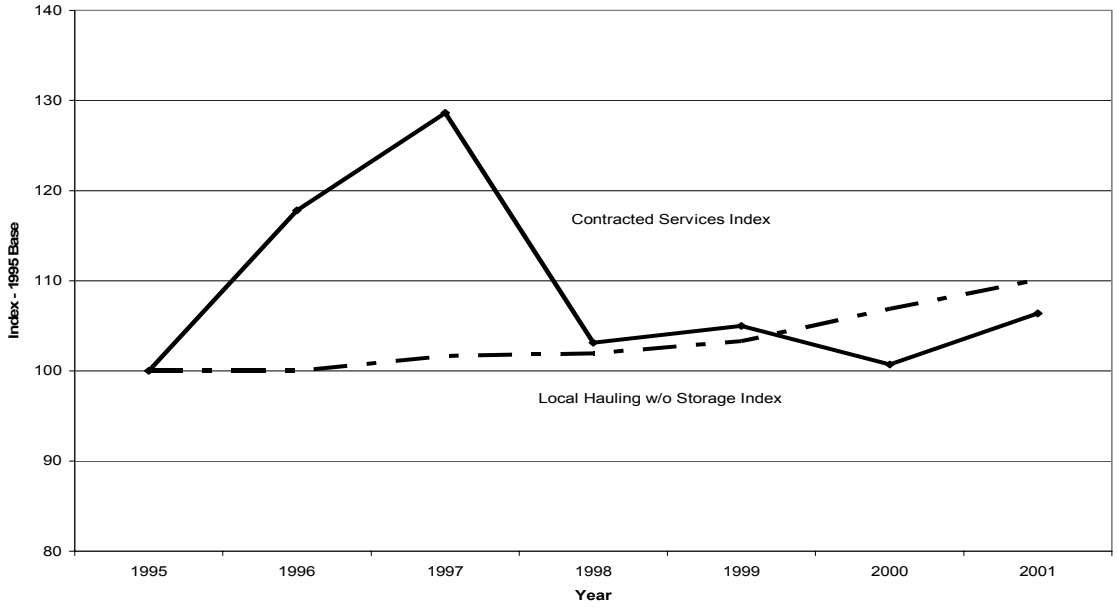

Figure 18. Contracted Services cost per ton index for the total sample.

The index for contracted services cost per ton reflect this volatility (Figure 18). The index rose steeply for 1996 and 1997 as firms worked to accommodate changes, then retrenched and remained relatively stable for the next four years. The pattern reflects more than just direct trucking costs, for this is one area where costs may be moved between businesses. The PPI for local hauling without storage shows a slow continuous rise through 1999 followed by a steeper increase in 2000 and 2001 which likely reflects higher fuel costs.

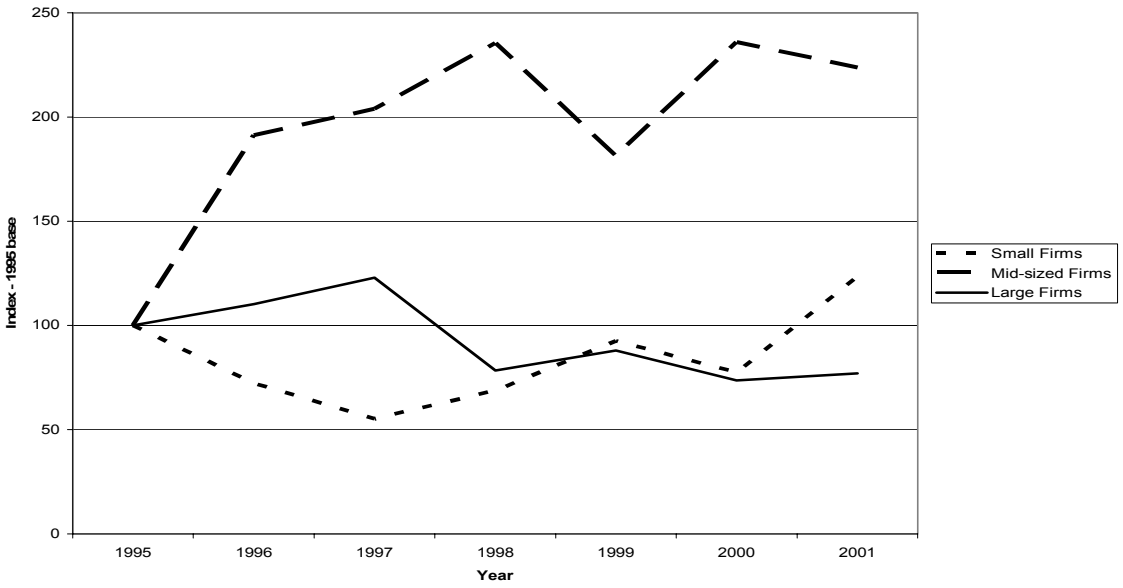

Figure 19. Contracted services cost index by firm size.

Again, patterns differed with firm size. Many of the larger firms had made the transition to contract hauling, often to a firm in common ownership, before 1995. Others made the transition between 1996 and 1988 for insurance and financing reasons. Many of the mid-sized firms outsourced their hauling to avoid reinvestment in trucks; others recognized that a separate trucking firm could help control workers' comp rates and provide a level of protection from personal liability suits. Smaller firms tried moving more of their own wood as an economy move in the 1996-1997 period and then reverted to contract hauling as the business environment became more tenuous.

5.25 Insurance

Insurance, other than workers' compensation, is a critical cost in today's business environment. No firm should be without property and casualty, fire, theft and vandalism on equipment, personal liability for owners, vehicle liability and other insurance. There is an assumed negative correlation between the performance of the investment markets and insurance rates, and the assumption appears to have held true through 1998, but began reversing before the 2000 declines on Wall Street. While the popular conception is that rates began to increase with the decline of the stock market in 2000, upward pressures on insurance cost in the industry started in 1998, partly as a result of purchasers of services demanding that loggers maintain higher liability limits, equipment finance companies requiring more coverage, and a general assessment of logging and round-wood trucking as high risk undertakings. Adaptive strategies were employed, reduced coverage, dropping less critical insurance and increased use of contract trucking.

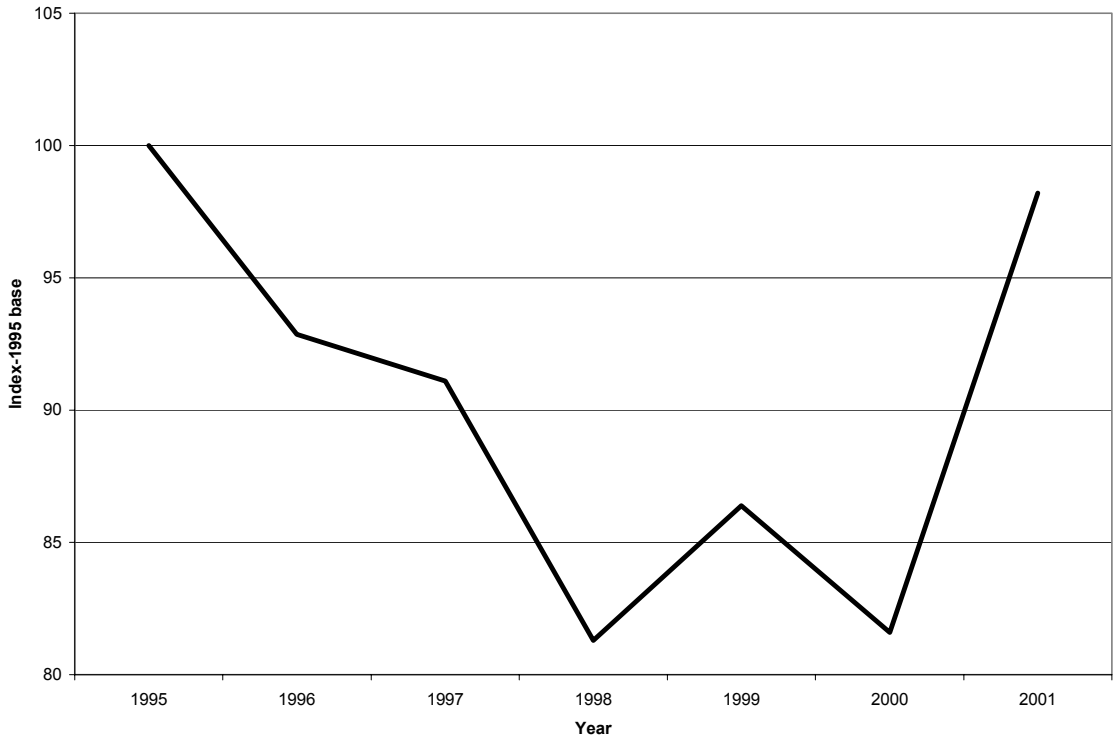

Figure 20. Insurance, other than workers' compensation for the total sample.

The effect of stock market reversals is apparent in the rapid rise in the index in 2001, and expectations are that the 2002 rise will be even greater.

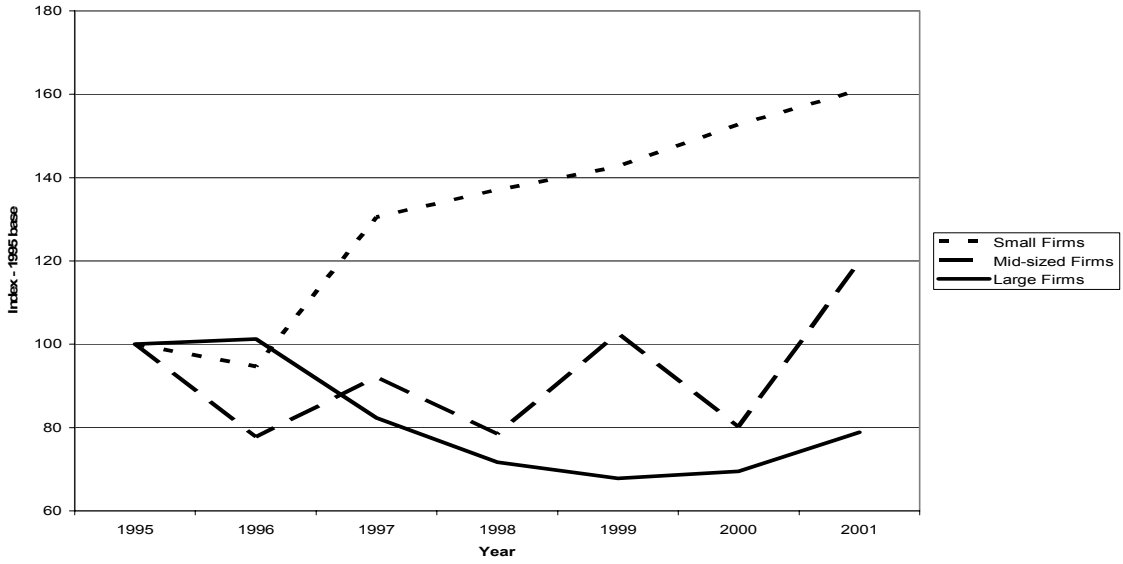

Figure 21. Insurance cost per ton by firm size.

Figure 21 demonstrates the difference in insurance costs among firm sizes. This is one of the few indices that fell below 80, requiring the y axis to be started at 60 to accommodate the reduction in rates afforded the larger firms after 1996. That year also marked the largest increase in insurance costs for the smaller firms. The rate of increase slowed for this group after the 1996 jump but continued upward ending 60 points higher. Costs for the mid-sized group oscillated, but advanced 20 points over the period.

5.26 Administrative Overheads

Administrative overheads include all of the necessary, but not production related, costs of owning and operating a business including office, phone and utilities expenses, office salaries and wages, education and training expenses, professional memberships, subscriptions, and the like. These costs rose rapidly between 1996 and 2000, and were trimmed to offset some of the increased fuel costs, and ended 30% higher than in 1995.

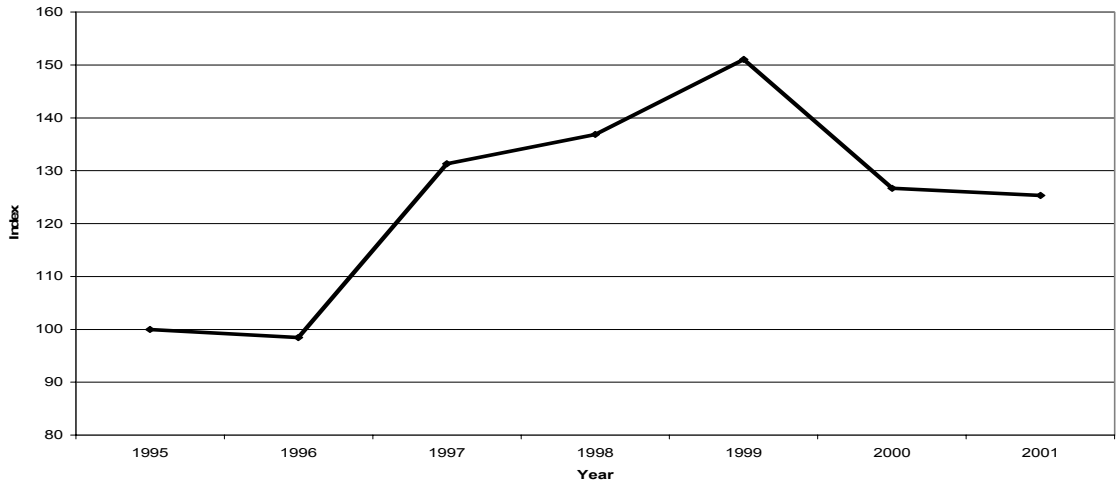

Figure 22. Administrative overheads cost per ton index for the total sample.

The pattern of change are again different among the different sized firms, likely because these costs tend to come in increments – the cost of switching from a tax preparer to a certified accountant for example, which are then distributed across production. Administrative costs began increasing rapidly for the smaller firms in 1996 and continued to rise through 1999. Accommodations were made in 2000, likely to partially offset the effect of higher fuel costs, but costs were forced upward again in 2001. Large firms had a spike in 1997, but production increases from 1998 on tended to moderate the effect. The mid-sized firms had a period of rapid increase between 1997 and 1999, which then moderated.

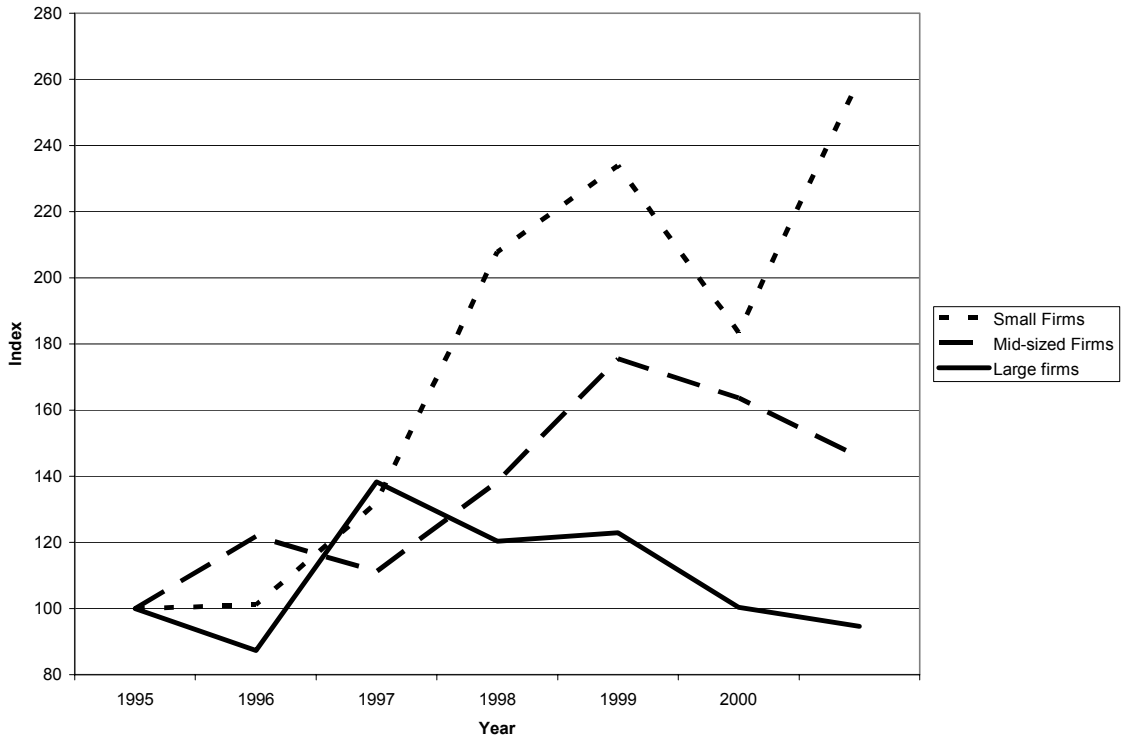

Figure 23. Administrative cost per ton indices by firm size.

6. Discussion

This analysis was conducted to test the complexity of developing indices that measure and document the change and variability in and among logging firms in response to external stimuli, and to check these indices against a set of selected public indices.

Considerable differences were found between firms of different sizes. Each of these firms plays an important role in the overall wood supply system. The firm producing 500 to 1,000 tons a week thinning or harvesting small private tracts is as vital to the sustainability of production forestry as the firm producing 2,500 to 3,000 tons per week from company or TIMO (Timberland Investment Management Organizations) properties. The number of firms is likely to be inversely proportional to size; the number of 500 to 1,000 t/wk firms is much greater than those producing 2,500 tons.

If nothing else, the analysis confirms that logging firms are businesses, humanly constructed and managed according the perceptions of the owner/manager at any point in time. The division into thirds revealed some of the variation masked by the indices for the population as a whole. The variation within thirds, discussed in Jackson's work is equally as large. The businesses react cognitively not reflexively. The same stimulus may trigger reinvestment by one businessman and increased outsourcing, or retraction by another. Each does what he or she considers best for his business, and the behavior of the industry is simply a summation of these decisions.

Any indices developed to monitor the industry must take these differences into consideration by partitioning the population of businesses into representative types and sizes. This analysis lumped all firms together without consideration of special capabilities or market niches. The splitting of the population into

thirds, rather than halves, quartiles or fifths was an arbitrary decision that attempted to get a reasonable number of firms in each group and could be improved upon with a larger sample size.

Information is valuable. Time is money. Information in time is especially valuable. A system for shortening the reporting time for critical subsets of the data must be developed, and can only be developed with the cooperation of the loggers themselves. This cooperation will only be gained if those supplying data are satisfied that their information will not be used to their detriment.

Indices are good for documenting normal variation, but must include provisions for identifying and capturing sources of exceptional variation. Weather can be captured from NOAA records, but periods of quota or mill curtailment, or more particularly procurement strategies employed during periods of quota or curtailment are more difficult to capture.

Context of the index is important. Looking at the Dow Jones over the last two years without being aware of Enron's collapse or 9/11 could lead to inaccurate conjecture. The same is true when looking at these indices without considering forces at work in the industry at the time. For example, the apparent reinvestment by firms in 2000 and 2001 is a promising sign, until one digs deeper, as Jackson did and finds that much of the investment had been in loaders capable of supporting pull-through delimbers and bucking saws, dozers for BMP work, used highway trucks and other equipment with resale potential in fields other than logging. Primary production equipment, feller bunchers and skidders, continued to age.

The index should be supported by a more detailed documentation of what is happening and why, just as the Dow Jones is supported by portfolio analyses and financial disclosure filings. The necessary documentation can come from a variety of sources, loggers, consuming mills, equipment dealerships, trade journals (conventional and on-line), periodic surveys, and trade associations. A system or process for capturing and organizing it should be developed. Even then, as recent experience with the Dow Jones demonstrates, the system can be distorted. But we must begin with an assumption that the development of an accurate, robust index is in the best interest of all parties.

The government indices are useful for comparison, and some, such as the diesel fuel index, as components of an information set. Contract logging, despite its importance to economies of some parts of the country, has not been adequately measured by the systems used to collect the data upon which these indices are based. There is confusion concerning whether logging is a manufacturing or agricultural undertaking, the censuses of the two economic sectors are different and separate. The BLS statistics tend to be weighted toward urban areas, logging is largely rural. The confusion has increased with the change for SIC to NAICS and the transfer of logging from the Manufacturing Census to the Agricultural Census, a change that occurred largely with out the knowledge of those collecting the agricultural census data. A "shadow" set of similar indices for fuel, tires, insurance, labor, etc. should be developed for the logging industry.

Contract services are a significant part of the industry and a parallel effort should be made to develop indices similar to those above for trucking firms, whether independent or in common ownership with logging. This could be especially problematic given the large number of owner/operator contractors in some parts of the country.

Production remains the most difficult variable to capture. Accounting systems, especially those for small firms, are designed to capture and document flows of money, not wood. Settlement records, when available, often record outside sales on the date payment was received rather than when the delivery was made. Data collection is especially difficult when a firm works between procurement systems, as a direct supplier for some products or tracts, through a dealer for others and as a purchase and merchandize operator on others.

As mentioned in the introduction, economics involves theories concerning economic activity, business is the application. Much of the traditional research in harvesting cost analysis has been based on classical economics, forest economics or industrial economy. The sustainability of a vital independent contractor force and a dependable wood supply system will require considering logging and transportation enterprises as businesses and developing the appropriate monitoring tools.

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