



Forest and Wildlife Research Center

Research Bulletin

Economic Choice for Hardwood Sawmill Operations

by

Philip H. Steele

Philip A. Araman

Craig Boden

The Forest and Wildlife Research Center at Mississippi State University was established by the Mississippi Legislature with the passage of the Renewable Natural Resources Act of 1994. The mission of the center is to conduct research and technical assistance programs relevant to the efficient management and utilization of the forest, wildlife, and fisheries of the state and region, and the protection and enhancement of the natural environment associated with these resources. The FWRC scientists conduct this research in laboratory and forests administered by the University and cooperating agencies and industries throughout the country. Research results are made available to potential users through the University's educational program and through Center publications such as this, which are directed as appropriate to forest landowners and managers, manufacturers and users of forest products, leaders of government and industry, the scientific community and the general public. Dr. G. Sam Foster is director of the Forest and Wildlife Research Center.

Authors

Philip H. Steele is a professor in the Department of Forest Products at Mississippi State University. His primary research interest is automated wood processing systems. Philip Araman is a project leader for the Southern Research Station, USDA Forest Service. Craig Boden is a Research Associate in the Forest Products Laboratory.

Acknowledgements

Development of this software was funded by cooperative agreements with the Southern Research Station and the Northeastern Forest Experiment Station, USDA Forest Service.

Disclaimer

This software provides preliminary lumber yield and investment feasibility estimates that the authors believe to be accurate. These estimates should be confirmed with more detailed analyses. The authors are not responsible for specific estimates or decisions made on the basis of these estimates made by users of this software.

To Order Copies

Copies of this and other Forest and Wildlife Research Center publications are available from:

Publications Office
Forest and Wildlife Research Center
Box 9680
Mississippi State, MS 39762

Please indicate author(s), title, and publication number if known.

Publications can also be found on our web site at <http://www.cfr.msstate.edu>.

Citation

Steele, P.H., P.A. Araman, C. Boden. 2002. Economic choice for hardwood sawmill operations (ECHO). Forest and Wildlife Research Center, Bulletin FP252, Mississippi State University. 21 pp.





Economic Choice for Hardwood Sawmill Operations (ECHO)

**A program to determine the investment feasibility of
installing reduced-kerf and higher-accuracy sawing
machines in hardwood sawmills.**

by
Philip H. Steele
Philip A. Araman
Craig Boden

Forest and Wildlife Research Center
Mississippi State University

Table of Contents

1.	Introduction	1
2.	Background	1
3.	The Alternative Investment Rate, Inflation and Measures of Investment Feasibility	1
4.	Sensitivity Analysis	2
5.	System Requirements	2
6.	Installing ECHO	2
7.	File Management	2
8.	ECHO Data Worksheet	3
9.	Running ECHO	3
10.	ECHO Keyboard Controls	3
11.	ECHO Tutorial	4
11.1	ECHO TITLE SCREEN	5
11.2	MAIN MENU	5
11.3	SAWMILL IDENTIFICATION	5
11.4	ESTIMATED INCREASED REVENUE OPTION	5
11.5	VARIABLE INPUT	6
11.6	CHANGE RESAW KERF OPTION	6
11.7	CHANGE ROUGH GREEN SIZE OPTION	6
11.8	PRODUCTION PERCENTAGES	7
11.9	ROUGH GREEN SIZE	7
11.10	CENTER CANT SPECIFICATION	7
11.11	COMPUTER/VIEW SUMMARY	8
11.12	INCREASED PRODUCTION DISTRIBUTION OPTION	9
11.13	LUMBER PRODUCTION DATA	9
11.14	ESTIMATED INCREASED REVENUE RESULTS	10
11.15	CAPITAL COSTS	10
11.16	VARIABLE COSTS	11
11.17	INVESTMENT RATES	12
11.18	CASH FLOW ANALYSIS RESULTS	12
11.19	ANALYSIS SUMMARY	13
11.20	SAVE	13
	Appendix A	15
I.	Conversion Data	16
II.	Capital Costs Data	17
III.	Variable Costs Data	18
IV.	Investment Rates Data	18
	Literature Cited	21

1. INTRODUCTION

Reductions in sawkerf on headrigs and resaws can dramatically increase lumber recovery. Research has also shown that lumber target size reductions are even more important than kerf reductions in providing increased lumber recovery. Decreases in either sawkerf or lumber size, however, always come at some cost in both capital and variable costs. Determining whether the financial benefits from increased lumber yield outweigh the incurred costs can be a difficult task.

The Economic Choice for Hardwood Sawmill Operations (ECHO) is a software package developed to help analyze the economic benefit of installing thinner-kerf and higher-accuracy sawing machines. Replacement of headrigs and resaws with reduced kerfs and increased sawing accuracy can be tested.

ECHO will assist in the estimation of the increased lumber recovery and the resultant increased revenue from reducing kerf or lumber sizes on headrigs and resaws. As an alternative, users may make their own increased revenue estimate. Users must also determine the estimated increased costs expected from equipment changes. Based on the estimated increased revenues and costs, a discounted cash flow analysis is performed by ECHO. The investment feasibility measures of present net value, rate of return, and payback period are provided. The software also addresses federal tax implications.

2. BACKGROUND

Circular headrigs can consume 0.131 inch more wood fiber in sawkerf and sawing variation per sawline than band headrigs. This increased loss of wood fiber by circular headrigs translates into a 10 to 12 percent loss in lumber yield for the volume of lumber sawn by the circular headrig. This magnitude of loss indicates that sawmillers with circular saws should carefully consider installing a band headrig.

Circular headrigs reduce overhead costs for hardwood sawmills. Band headrigs require more cap-

ital on installation and require more maintenance and saw filing. Circular headrigs with inserted teeth can be maintained by the sawyer or other sawmill personnel with a few minutes maintenance each day. Insertion of teeth and sharpening can be performed while the saw remains on the arbor. Maintenance of bandsaw blades, however, requires that they be removed from the saw for sharpening. A full-time filer and capital investment in a filing room and specialized filing equipment are usually required.

Some hardwood sawmills will benefit financially from circular headrigs. Operations that saw a high percentage of cants or ties may lose only a small amount of wood fiber from a circular saw compared to a thinner-kerf band saw. Some sawmills may be too small to support the increased per-unit costs required for a band headrig.

Modern resaws are able to saw with substantially thinner kerfs and lower sawing variation than those available even a decade ago. However, a significant capital outlay for this new technology and increased maintenance costs should be expected.

3. THE ALTERNATIVE INVESTMENT RATE, INFLATION, AND MEASURES OF INVESTMENT FEASIBILITY

ECHO provides 3 measures of investment feasibility: payback period, internal rate-of-return, and present net worth. It is assumed that program users are generally familiar with these investment feasibility measures, but for convenience a brief definition of each is given below.

Payback period: The length of time in years required to repay the initial investment expense with the net revenues resulting from the investment. Traditional industry practice is to not discount the cash flows in computing payback period and ECHO has adopted this practice. A payback period shorter than the payback period required by company policy indicates that the investment should be undertaken.

Internal rate-of-return: The rate-of-return earned by an investment. Technically it is the interest rate that discounts the after-tax cash flows to zero. An internal rate-of-return higher than the rate required to be earned by company policy indicates that the investment should be undertaken.

Present net worth: The summed value of all cash flows after being discounted to year zero at the alternative investment rate. A positive value means that the alternative investment rate has been earned and indicates that the investment should be undertaken.

ECHO does not account for monetary inflation over time. For that reason the measures of investment feasibility are given in real dollars and should be compared only to competing investments that are also stated in real dollars (Bullard and Straka 1998). This also means that the alternative investment rate used in discounting should be in real terms.

ECHO computes internal rate-of-return and present net worth based on discounting after-tax cash flows. Therefore, comparisons to other present net worth values or rates-of-return for comparing investments are only appropriate if these investments are given in both real and after-tax terms (Bullard and Straka 1998). Comparison of the ECHO internal rate-of-return should only be compared to bank-rate returns if these bank rates are adjusted downward to an after-tax rate. For example, a company with a 25-percent tax rate that earns a nominal 8-percent rate of interest from a bank before taxes actually earns a 6 percent after-tax rate.

4. SENSITIVITY ANALYSIS

A properly performed investment analysis should include a sensitivity analysis. This involves repeating ECHO runs while varying those cost and benefit estimates to which some uncertainty may be attached. For example, if current lumber prices are at a historically high rate when an investment analysis is made, it would be unwise to be satisfied with the

results of an ECHO run based only on such lumber prices. Rerunning the analysis with lumber prices at the lower levels that may be expected over the next 10 years would be a prudent exercise. The same holds true for other cost or benefit estimates that may be expected to change over time such as interest rates, log costs, etc.

5. SYSTEM REQUIREMENTS

The minimum system requirements needed to run ECHO are:

- IBM® compatible PC
- Microsoft® Windows® 95/98/2000/NT/ME, XP
- Monochrome, Color, or VGA Adapter
- One 3.5" Floppy Drive and a Hard Disk Drive

ECHO is written in Microsoft® Visual Basic® Programming System for MS-DOS®, Version 1.00 (Microsoft Corp. 1992).

6. INSTALLING ECHO

To install ECHO on your hard drive, follow these steps:

1. Begin at the Windows desktop.
2. Insert **ECHO disk 1** into your floppy drive.
3. Click the **Start** button on the taskbar and choose **Run...**
4. Type **A:\SETUP** in the line labeled **Open**. (If your floppy drive is designated by a letter other than **A**, substitute that letter for **A**.)
5. Click the **Ok** button and follow the on-screen instructions to install ECHO.

7. FILE MANAGEMENT

ECHO uses predetermined file extensions for

storing and retrieving data. All input data files have an **.ECO** file extension and all output files have an **.OUT** file extension. For convenience, it is recommended that all data files be kept in the same directory and that similar file names be used for input and output.

8. ECHO DATA WORKSHEET

Before running ECHO, it may be convenient to summarize the required input data on the input data worksheet shown in **Appendix A**. This will help insure that all necessary data are available before running the program. The input data worksheet is also stored as a Microsoft® Word for Windows® document (**Worksheet.doc**) in the ECHO directory on your hard drive.

9. RUNNING ECHO

To run ECHO, follow these steps:

1. Begin at the Windows desktop.
2. Click the **Start** button and then point to **Programs**.
3. Click the **ECHO98** menu item to start the program.

Note: When the program begins, it may appear as a window on your desktop. To switch to the full-screen mode, press and hold the **Alt** key and then press the **Enter** key.

10. ECHO KEYBOARD CONTROLS

ECHO is a menu-driven application requiring user input on various screens. The ECHO screens consist of *data input fields*, *option buttons*, and *command buttons*. The keyboard or the mouse can be used to traverse through these three entities, to enter data in a data input field, or to select an option button or a command button.

To traverse through the data input fields, the option buttons, and the command buttons within a

screen, use one of the following methods:

- Press the **Tab** key. The **Tab** key moves the cursor to the next entity.
- Press the **Shift-Tab** key combination. The **Shift-Tab** key combination moves the cursor to the previous entity.
- Press the up- or down-arrow key.
- Press the **Enter** key after entering a data value in a data input field. This will advance the cursor to the next entity.
- Move the mouse pointer over a data input field and click the left mouse button. This will move the cursor to the data input field.

To enter a value in a data input field:

1. Move the cursor to the data input field and type the value from the keyboard. The **Backspace** key or the **Delete** key can delete the value.
2. Once the data value has been typed, move the cursor to the next input field or select an option button or a command button.

Each ECHO screen consists of a group of three or more command buttons located at the bottom of the screen. These command buttons include:

Previous	Returns ECHO to the previous screen.
Next	Advances ECHO to the next screen.
Help	Brings up a help window for the current screen.
Exit	Terminates the ECHO program.
Save	Brings up a dialog box from which the input or output data can be saved to a text file.
Edit	Brings up a dialog box from which the MACRS depreciation rates can be changed.

To select an option button or a command button, use one of the following methods:

- Move the mouse pointer over the button and click the left mouse button.
- Move the cursor over the button using the **Tab** key, the **Shift-Tab** key combination, or the up- or down-arrow key and then press **Enter**.
- Press and hold the **Alt** key and then press the highlighted letter in the name appearing on the command button. For example, to select the **N**ext button, press and hold the **Alt** key and then press the letter **N**.

Each ECHO screen contains a pop-up **Help** window that displays a brief description of the screen, including a description of the input data solicited by the screen. To access the **Help** window within a screen, select the **Help** command button.

11. ECHO TUTORIAL

The ECHO tutorial is intended to guide users

through an ECHO analysis with test values. While the values have been selected to make sense they do not represent values from an actual sawmill and are not intended to be used in subsequent analyses. Only values that users know to be accurate for their situation should be used for an actual analysis.

ECHO consists of various screens that solicit input data and display the resulting output data. This section shows the steps for entering data and obtaining results by presenting a hypothetical tutorial run. The tutorial data is based on an assumed reduction in headrig kerf from 0.280 inch to 0.165 inch and in rough green size from 1.125 to 1.11 inch for 4/4 lumber and 1.375 to 1.36 inch for 5/4 lumber. Other machine and raw material data are not changed for this example. Monetary data are based on an initial saw cost of \$120,000, an installation cost of \$15,000, a saw brake cost of \$5,000, an additional filing room building cost of \$40,000, and an additional filing room equipment cost of \$25,000. Variable costs include an increase in filer wages of \$39,000, an annual saw replacement cost of \$5,000, a maintenance cost of \$2,000, and a grinding wheel resurfacing cost of \$1,000. Corporate, property, and insurance taxes of 28%, 3%, and 1%, respectively, are assumed in addi-

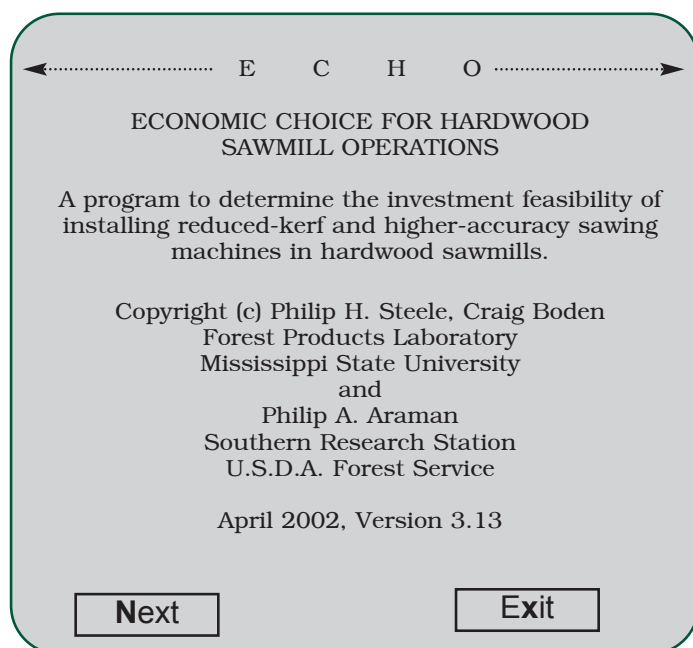


Figure 1. ECHO title screen

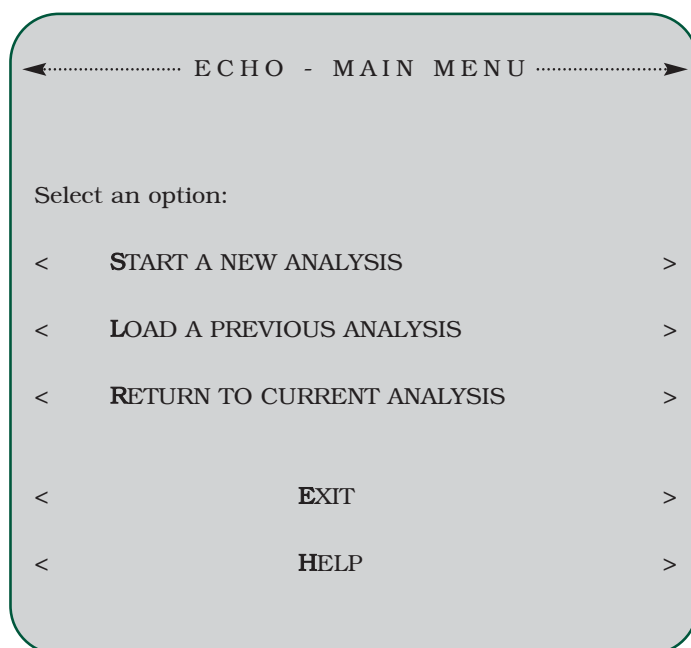


Figure 2. MAIN MENU screen

tion to an alternative investment rate of 12.5%. The straight-line depreciation method is assumed for this tutorial. To begin the tutorial, start the ECHO program as described in Section 9.

11.1 ECHO title screen. When ECHO begins, the first screen to appear is the ECHO title screen (Figure 1). This screen displays the title of the program and other relevant information. To continue, press any key and ECHO will advance to the MAIN MENU screen.

11.2 MAIN MENU. The MAIN MENU (Figure 2) consists of three options:

1. *Start a New Analysis*
2. *Load a Previous Analysis*
3. *Return to Current Analysis*

The first option allows you to enter data for a new analysis, the second option allows you to load a previously-saved input data file, while the third option allows you to return to the current analysis. At this point in the tutorial, you may choose either of the first two options. Choosing the first option will require that

you manually enter the input data throughout the ECHO program. Choosing the second option allows you to load the data file **TUTORIAL.ECO**. This file resides in the ECHO directory and contains the input data for this tutorial. If the second option is chosen, the LOAD ANALYSIS dialog box will appear. To load the file **TUTORIAL.ECO** from this dialog box, select the file from the file list box and press the **Ok** command button.

After an option is selected from the MAIN MENU, ECHO will advance to the SAWMILL IDENTIFICATION screen.

11.3 SAWMILL IDENTIFICATION. The SAWMILL IDENTIFICATION screen (Figure 3) allows you to enter information that identifies the sawmill. This information is not required, but is recommended to facilitate future file storage and retrieval. For this tutorial, enter the data shown in Figure 3. Press **Next** and ECHO will advance to the ESTIMATED INCREASED REVENUE OPTION screen.

11.4 ESTIMATED INCREASED REVENUE OPTION. The ESTIMATED INCREASED REVENUE OPTION screen (Figure 4) consists of two options:

Sawmill Name:	Forest Products Laboratory
Sawmill Address:	Box 9820
City:	Mississippi State
State:	MS 39762-9820

Previous Next Exit Help

Figure 3. SAWMILL IDENTIFICATION screen

● Compute increased revenue from conversion improvement

() Enter your estimated increased revenue

Previous Next Exit Help

Figure 4. ESTIMATED INCREASED REVENUE OPTION screen

1. *Compute increased revenue from conversion improvement*
2. *Enter your estimated increased revenue*

The first option allows ECHO to compute the estimated increased revenue based on conversion improvement data that will be entered in subsequent screens. The second option allows you to enter your own estimated value of the increased revenue. For this tutorial, select the first option. Press **Next** and ECHO will advance to the VARIABLE INPUT screen.

11.5 VARIABLE INPUT. The VARIABLE INPUT screen (Figure 5) prompts you to enter both the current and new values of the *headrig kerf*, the current value of the *average log diameter*, and the current value of the *average log length*. The headrig kerf is measured in inches. The average log diameter is measured in inches at the log's small end. The average log length is measured in feet. For each variable, enter the data shown in Figure 5. After the data have been entered, press **Next** and ECHO will advance to the CHANGE RESAW KERF OPTION screen.

	Current	New
1) Headrig kerf (0.10 - 0.35 inch):	0.28	0.165
2) Average log diameter (8 - 24 inches):	16	
3) Average log length (8 - 18 feet):	12	

Figure 5. VARIABLE INPUT screen

11.6 CHANGE RESAW KERF OPTION. The CHANGE RESAW KERF OPTION screen (Figure 6) consists of two options, *Yes* and *No*, that allow you to specify whether or not the current resaw kerf will be changed. If *Yes* is selected, ECHO will advance to the RESAW KERF screen. If *No* is selected, ECHO will advance to the CHANGE ROUGH GREEN SIZE OPTION screen. For this tutorial, select *No* and press **Next**.

11.7 CHANGE ROUGH GREEN SIZE OPTION. The CHANGE ROUGH GREEN SIZE OPTION screen (Figure 7) consists of four options for changing the current rough green size:

1. *Change current rough green size for resaw only*
2. *Change current rough green size for headrig only*
3. *Change current rough green size for resaw and headrig*
4. *Do not change current rough green size*

The first option allows you to change the current

Figure 6. CHANGE RESAW KERF OPTION screen

←..... ECHO - CHANGE ROUGH GREEN SIZE OPTION→

() Change current rough green size for resaw only

(●) Change current rough green size for headrig only

() Change current rough green size for resaw and headrig

() Do not change current rough green size

Previous Next Exit Help

Figure 7. CHANGE ROUGH GREEN SIZE OPTION screen

rough green size only for the resaw. The second option allows you to change the current rough green size only for the headrig. The third option allows you to change the current rough green size for both the resaw and the headrig. The fourth option should be chosen if you do not wish to change the current rough green size.

For this tutorial, select the second option. Press **Next** and ECHO will advance to the PRODUCTION PERCENTAGES screen.

11.8 PRODUCTION PERCENTAGES. The PRODUCTION PERCENTAGES screen (Figure 8) prompts you to enter the percentage of the total production made up by each lumber dimension (4/4, 5/4, 6/4, 7/4, and 8/4). The percentages of total production for the lumber thicknesses specified must add to 100. The percentage of the total production of each thickness processed at the headrig must also be entered. For example, the input data given in Figure 8 shows that 50% of the total production will be 4/4 lumber and 70% of the 4/4 lumber processed will be processed at the headrig. The remaining 50% of production is 5/4 lumber, also with 70% processed at the headrig.

For this tutorial, enter the data shown in

←..... ECHO - PRODUCTION PERCENTAGES→

Thickness	Total Production (%)	Percentage Processed at the Headrig (%)
4/4	50	70
5/4	50	70
6/4		
7/4		
8/4		

Previous Next Exit Help

Figure 8. PRODUCTION PERCENTAGES screen

Figure 8 and press **Next**. ECHO will then advance to the ROUGH GREEN SIZE screen.

11.9 ROUGH GREEN SIZE. The ROUGH GREEN SIZE screen (Figure 9) prompts you to enter both the current and new *rough green size* values for each thickness of lumber that will be processed. Those unfamiliar with determining rough green lumber sizes should consult Chapter 9 of "Quality Control in Lumber Manufacturing" by T. D. Brown (1982).

For this tutorial, enter the data shown in Figure 9 and press **Next**. ECHO will then advance to the CENTER CANT SPECIFICATION screen.

11.10 CENTER CANT SPECIFICATION. The CENTER CANT SPECIFICATION screen (Figure 10) prompts you to enter the percentage of the average log volume produced as a center cant that is not subsequently processed at the resaw. For this tutorial, enter **30** and press **Next**. ECHO will then advance to the COMPUTE/VIEW SUMMARY screen.

11.11 COMPUTE/VIEW SUMMARY. The COMPUTE/VIEW SUMMARY screen (Figure 11) consists of two options:

←..... ECHO - ROUGH GREEN SIZE→

Enter the current and new rough green size values for each thickness of lumber that will be processed.

Thickness	Current Rough Green Size (in.)	New Rough Green Size (in.)
4/4	1.125 (0.75 - 1.25)	1.11 (0.75 - 1.25)
5/4	1.375 (1.00 - 1.50)	1.36 (1.00 - 1.50)
6/4	(1.20 - 1.75)	(1.20 - 1.75)
7/4	(1.50 - 2.00)	(1.50 - 2.00)
8/4	(1.75 - 2.25)	(1.75 - 2.25)

Figure 9. ROUGH GREEN SIZE screen

1. *Compute estimated increased revenue*
2. *View summary of changes and conversion efficiency improvement result*

Choosing the first option causes ECHO to advance to

the INCREASED PRODUCTION DISTRIBUTION OPTION screen (Figure 13). Choose this option when you are ready for ECHO to compute the estimated increased revenue and continue with the run analysis. Choosing the second option causes ECHO to advance to the CONVERSION EFFICIENCY IMPROVEMENT RESULT screen (Figure 12). This option allows you to view a summary of the input data that have been entered into the ECHO program up to this point. This gives you the opportunity to verify the accuracy of the input data before ECHO computes the estimated increased revenue. This option also allows you to view the conversion efficiency improvement result. For this tutorial, select the second option. Note that the conversion efficiency improvement result for this tutorial is 4.59%. After verifying the accuracy of the input data, press the **OK** command button from the CONVERSION EFFICIENCY IMPROVEMENT RESULT screen, and ECHO will return to the COMPUTE/VIEW SUMMARY screen.

From the COMPUTE/VIEW SUMMARY screen, select the first option. Press **Next** and ECHO will advance to the INCREASED PRODUCTION DISTRIBUTION OPTION screen.

←..... ECHO - CENTER CANT SPECIFICATION→

Enter the percentage of the average log volume produced as a center cant that is not subsequently processed at the resaw: 30

Figure 10. CENTER CANT SPECIFICATION screen

←..... ECHO - COMPUTE/VIEW SUMMARY→

() Compute estimated increased revenue

(●) View summary of changes and conversion efficiency improvement result

Figure 11. COMPUTE/VIEW SUMMARY screen

11.12 INCREASED PRODUCTION DISTRIBUTION OPTION. The INCREASED PRODUCTION DISTRIBUTION OPTION screen (Figure 13) prompts you to specify the manner in which the increased lumber production will be applied. There are three options:

1. *Increased lumber production only*
2. *Decreased log cost only*
3. *Both increased lumber production and decreased log cost*

The first option should be selected if the resulting conversion efficiency improvement will only increase lumber production. The second option should be selected if the resulting conversion efficiency improvement will only reduce log purchases. The third option should be selected if the resulting conversion efficiency improvement will increase lumber production and reduce log purchases. If you select the third option, ECHO will prompt you to enter the percentage of the lumber production increase that will reduce log purchases.

For this tutorial, select the first option and press **Next**. ECHO will then advance to the LUMBER

PRODUCTION DATA screen.

11.13 LUMBER PRODUCTION DATA. The LUMBER PRODUCTION DATA screen (Figure 14) prompts you to enter data about the sawmill's current lumber production and log purchases. There are a total of five values that you might be required to enter depending on the option selected in the previous screen, INCREASED PRODUCTION DISTRIBUTION OPTION (Section 11.12). These user-input values are:

1. *Current annual lumber production (MBF)*
2. *Current revenue from lumber sales (\$/MBF)*
3. *Reduced overhead on increased production (\$/MBF)*
4. *Current log cost (\$/MBF)*
5. *Current annual log volume purchased (MBF)*

All volume values must be specified per MBF and all monetary values must be specified as dollars per MBF, where MBF denotes 1,000 board feet.

It is important to provide the average sales

←..... ECHO - CONVERSION EFFICIENCY IMPROVEMENT RESULT→

The changes which are given below will improve conversion efficiency by an estimated 4.59%

Variable	Current	New
Headrig kerf (in.)	0.28	0.165
Resaw kerf (in.)	-----	-----
Rough green size (in.)	4/4 = 1.125	4/4 = 1.11
	5/4 = 1.375	5/4 = 1.36
	6/4 =	6/4 =
	7/4 =	7/4 =
	8/4 =	8/4 =

Ok

Figure 12. CONVERSION EFFICIENCY IMPROVEMENT RESULT screen

←..... ECHO - INCREASED PRODUCTION DISTRIBUTION OPTION→

Select the option to which the increased lumber production will be applied:

☒ Increased lumber production only

☐ Decreased log cost only

☐ Both increased lumber production and decreased log cost

Previous

Next

Exit

Help

Figure 13. INCREASED PRODUCTION DISTRIBUTION OPTION screen

value for only those thicknesses of lumber being considered in the ECHO analysis. Use of a mill-run value that might, for example, contain lower or higher-value products will not reflect the true dollar-value increase from the investment.

If option 1, *Increased lumber production only*, was selected in the INCREASED PRODUCTION DISTRIBUTION OPTION screen (Section 11.12), values will be required only for items 1, 2, and 3 above. If option 2, *Decreased log cost only*, was selected, values will be required only for items 1, 4, and 5 above. If option 3, *Both increased lumber production and decreased log cost*, was selected, values for all five items must be entered.

For this tutorial, enter the data shown in Figure 14. Press **Next** and ECHO will advance to the ESTIMATED INCREASED REVENUE RESULTS screen.

11.14 ESTIMATED INCREASED REVENUE RESULTS. The ESTIMATED INCREASED REVENUE RESULTS screen (Figure 15) displays five numerical values that summarize the estimated increased revenue results:

1. *Total revenue from lumber sales*
2. *Conversion efficiency improvement*
3. *Estimated increased revenue from increased lumber production*
4. *Estimated decreased cost as a result of log purchase reduction*
5. *Net estimated increased revenue*

The ESTIMATED INCREASED REVENUE RESULTS screen also gives you the option of accepting or rejecting the value of the net estimated increased revenue. To accept the value, select **Yes** from the designated prompt. To reject the value, select **No**. If **No** is selected, ECHO will give you the option to either recompute the estimated increased revenue or to enter your own estimated increased revenue value. For this tutorial, select **Yes**. Press **Next** and ECHO will advance to the CAPITAL COSTS screens.

11.15 CAPITAL COSTS. ECHO contains two CAPITAL COSTS screens (Figure 16 and Figure 17) that prompt you to enter various estimated increased capital costs resulting from equipment replacement. The first CAPITAL COSTS screen (Figure 16) prompts you to enter values for:

←.....
ECHO - LUMBER PRODUCTION DATA
.....→

Current annual lumber production (MBF) ----->

Combined current revenue from 4/4 and 5/4 lumber sales (\$/MBF) ----->

Reduced overhead on increased production (\$/MBF) ----->

Current log cost (\$/MBF) ----->

Current annual log volume purchased (MBF) ----->

Previous
Next
Exit
Help

Figure 14. LUMBER PRODUCTION DATA screen

←.....
ECHO - ESTIMATED INCREASED REVENUE RESULTS
.....→

Total revenue from lumber sales ----->
\$5,550,000

Conversion efficiency improvement----->
4.59%

Estimated increased revenue from increased lumber production----->
\$254,745

Estimated decreased cost as a result of log purchase reduction ----->
\$0

Net estimated increased revenue ----->
\$254,745

Use this value for estimated increased revenue?
(●) Yes () No

Previous
Next
Exit
Help

Figure 15. ESTIMATED INCREASED REVENUE RESULTS screen

1. *Initial sawing machine cost*
2. *Initial saw blade cost*
3. *Saw installation cost*
4. *Saw brake cost*
5. *Debarker cost*

For this tutorial, enter the data shown in Figure 16. Press **Next** and ECHO will advance to the second CAPITAL COSTS screen.

The second CAPITAL COSTS screen (Figure 17) prompts you to enter values for:

1. *Filing room building cost*
2. *Total additional filing room equipment cost*
3. *Cost of additional buildings*
4. *Additional equipment cost*

The third cost input should include, if applicable, the construction costs for a pit to house the band headrig. The fourth cost input should include any additional equipment costs other than filing room equipment costs. For this tutorial, enter the data shown in Figure 17. Press **Next** and ECHO will advance to the VARIABLE COSTS screens.

Note: A value of zero (0) should be entered for any capital cost that will not be incurred in your equipment replacement scheme.

11.16 VARIABLE COSTS. ECHO contains two VARIABLE COSTS screens (Figure 18 and Figure 19) that prompt you to enter various estimated increased variable costs resulting from equipment replacement. The first VARIABLE COSTS screen (Figure 18) prompts you to enter values for:

1. *Increase in annual filing room wages*
2. *Increase in annual sawyer wages*

For these cost inputs, only the *increase* in annual wages resulting from the investment should be entered, not the total amount of annual wages. For this tutorial, enter the data shown in Figure 18. Press **Next** and ECHO will advance to the second VARIABLE COSTS screen.

The second VARIABLE COSTS screen (Figure 19) prompts you to enter values for:

1. *Annual saw blade replacement cost*
2. *Annual grinding wheels and grinding*

←..... ECHO - CAPITAL COSTS→

Initial sawing machine cost ----->\$ 120000

Initial saw blade cost ----->\$ 5000

Saw installation cost ----->\$ 15000

Saw brake cost ----->\$ 5000

Debarker cost ----->\$ 35000

Previous **Next** **Exit** **Help**

Figure 16. First CAPITAL COSTS screen

←..... ECHO - CAPITAL COSTS→

Filing room building cost ----->\$ 40000

Total additional filing room equipment cost ----->\$ 25000

Cost of additional buildings as a result of the investment (including construction costs for a pit to house the band headrig) ----->\$ 30000

Additional equipment (other than filing room equipment) cost as a result of the investment ----->\$ 7000

Previous **Next** **Exit** **Help**

Figure 17. Second CAPITAL COSTS screen

←..... ECHO - VARIABLE COSTS→

For the two lines below, enter only the amount of the increase in annual wages.

Increase in annual filing room wages----->\$

Increase in annual sawyer wages----->\$

Figure 18. First VARIABLE COSTS screen

←..... ECHO - VARIABLE COSTS→

Annual saw blade replacement cost----->\$

Annual grinding wheels and grinding room maintenance cost----->\$

Annual cost to resurface wheels ----->\$

Other increased annual costs ----->\$

Figure 19. Second VARIABLE COSTS screen

- room maintenance cost
3. Annual cost to resurface wheels
4. Other increased annual costs

For this tutorial, enter the data shown in Figure 19. Press **Next** and ECHO will advance to the INVESTMENT RATES screen.

Note: A value of zero (0) should be entered for any variable cost that will not be incurred in your equipment replacement scheme.

11.17 INVESTMENT RATES. The INVESTMENT RATES screen (Figure 20) prompts you to enter percentage rates for the following:

1. Corporate tax rate
2. Alternative investment rate
3. Property tax rate
4. Insurance rate

This screen also prompts you to select the method of depreciation that will be used in the cash flow analysis. You may select either the *Straight-line* depreciation method or the *Modified Accelerated Cost*

Recovery System (MACRS) depreciation method. If the straight-line method is used, the amortization will take place over a 10-year period; buildings will be depreciated, however, over a 39-year period. For this tutorial, select the straight-line method. Press **Next** and ECHO will advance to the CASH FLOW ANALYSIS RESULTS screen.

11.18 CASH FLOW ANALYSIS RESULTS.

The CASH FLOW ANALYSIS RESULTS screen (Figure 21) displays the results of a discounted cash flow analysis calculated from the input data. Values displayed in tabular form are:

1. Amortization year
2. Net cash flow
3. After-tax profit
4. After-tax cash flow
5. After-tax present worth

The *total net cash flow* and the *total after-tax cash flow* are also displayed. After viewing the results, select **Next** and ECHO will advance to the ANALYSIS SUMMARY screen.

←..... ECHO - INVESTMENT RATES.....→

Years -----> \$

Corporate tax rate [%]-----> \$

Alternative investment rate [%] -----> \$

Property tax rate [%]-----> \$

Insurance rate [%] -----> \$

Method of depreciation
 (●) Straight-line method () MACRS method

Figure 20. INVESTMENT RATES screen

11.19 ANALYSIS SUMMARY. The ANALYSIS SUMMARY screen (Figure 22) displays four values that summarize the sawmill's investment. The values displayed are:

1. *Initial investment*
2. *Payback period*
3. *Internal rate of return*
4. *Present net worth*

This screen allows you to save the input and output data to a text file. You can save the data by selecting the **Save** button. For this tutorial, select the **Save** button. ECHO will then bring up the SAVE dialog box.

11.20 SAVE. The SAVE dialog box (Figure 23) allows you to save the input data or analysis results to a text file. To save the data from the SAVE dialog box, follow these steps:

1. Select either *Input Data* or *Analysis Results* from the *Data* option box.
2. Type the file name in the *File name* textbox. There is no need to specify an extension for your file name; ECHO will automatically attach an extension to the file name that you enter (see Section 7 for an explanation of file extensions used by ECHO).
3. Select the **Save** command button.

←..... ECHO - CASH FLOW ANALYSIS→

RESULTS

Year	Net Cash Flow	After-Tax Profit	After-Tax Cash Flow	After-Tax Present Worth
0	\$ -282,000	\$ 0	\$ -282,000	\$ -282,000
1	\$ 202,825	\$152,473	\$ -129,527	\$ 135,531
2	\$ 202,825	\$152,473	\$ 22,945	\$ 120,472
3	\$ 202,825	\$152,473	\$ 175,418	\$ 107,086
4	\$ 202,825	\$152,473	\$ 327,890	\$ 95,188
5	\$ 202,825	\$152,473	\$ 480,363	\$ 84,611
6	\$ 202,825	\$152,473	\$ 632,835	\$ 75,210
7	\$ 202,825	\$152,473	\$ 785,308	\$ 66,853
8	\$ 202,825	\$152,473	\$ 937,781	\$ 59,425
9	\$ 202,825	\$152,473	\$1,090,253	\$ 52,823
10	\$ 202,825	\$152,473	\$1,242,726	\$ 46,953
Total	\$1,746,250		\$1,242,726	

Figure 21. CASH FLOW ANALYSIS RESULTS screen

←..... ECHO - ANALYSIS SUMMARY→

Initial investment -----> \$282,000

Payback period -----> 1.85 years

Internal rate of return -----> 53.3%

Present net worth -----> \$562,154

Figure 22. ANALYSIS SUMMARY screen

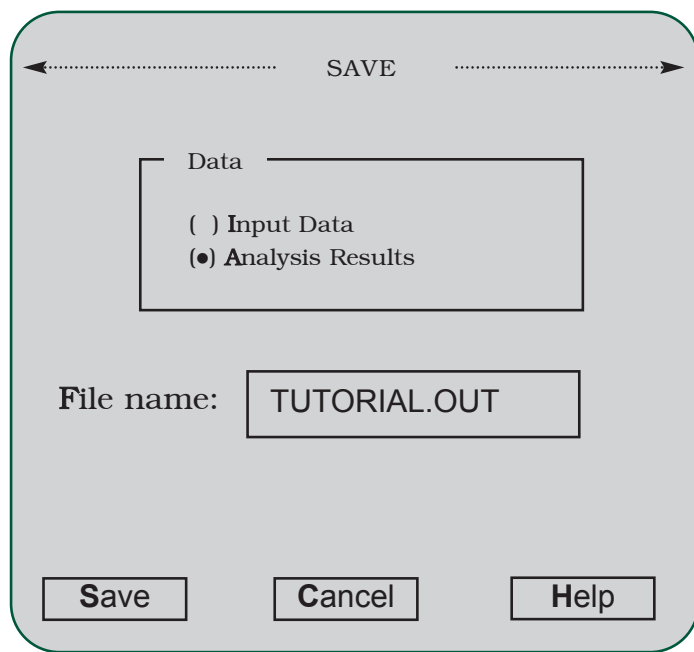


Figure 23. SAVE dialog box

If you choose to save the input data, all input data entered in the ECHO program will be saved to the specified file. If you choose to save the analysis results, the data displayed in the CASH FLOW ANALYSIS RESULTS screen (Section 11.18) and the ANALYSIS SUMMARY screen (Section 11.19) will be saved to the specified file. For this tutorial, you are encouraged to save the input data and the analysis results.

APPENDIX A

ECHO DATA WORKSHEET

I. Conversion Data

Your estimated increased revenue: \$ _____

Variable	Current	New	Valid Range
Headrig kerf (in.)	_____	_____	0.10 - 0.35
Resaw kerf (in.)	_____	_____	0.08 - 0.30
Avg. log diameter (in.)	_____	XXXXXX	8 - 24
Avg. log length (ft.)	_____	XXXXXX	8 - 18
Rough green size (in.)	4/4 = _____	4/4 = _____	0.75 - 1.25
	5/4 = _____	5/4 = _____	1.00 - 1.50
	6/4 = _____	6/4 = _____	1.20 - 1.75
	7/4 = _____	7/4 = _____	1.50 - 2.00
	8/4 = _____	8/4 = _____	1.75 - 2.25

Thickness	Total Production (%)	Valid Range
4/4	_____	0 - 100
5/4	_____	0 - 100
6/4	_____	0 - 100
7/4	_____	0 - 100
8/4	_____	0 - 100

Thickness	Percentage Processed* (%)	Valid Range
4/4	_____	0 - 100
5/4	_____	0 - 100
6/4	_____	0 - 100
7/4	_____	0 - 100
8/4	_____	0 - 100

* Percentage Processed at _____ Headrig _____ Resaw

Percentage of average log volume produced as a center cant that is not subsequently processed at the resaw (0 - 100%): _____

Percentage of lumber production employed to reduce log purchases (0 - 100%) : _____

Current annual lumber production (MBF) : _____

Current revenue from lumber sales (\$/MBF): _____

Reduced overhead on increased production (\$/MBF): _____

Current log cost (\$/MBF): _____

Current annual log volume purchased (MBF): _____

II. Capitol Costs Data

Initial sawing machine cost: \$ _____

Initial saw blade cost: \$ _____

Saw installation cost: \$ _____

Saw brake cost: \$ _____

Debarker cost: \$ _____

Filing room building cost: \$ _____

Total additional filing room equipment cost: \$ _____

Cost of additional buildings: \$ _____

Additional equipment cost: \$ _____

III. Variable Costs Data

Increase in annual filing room wages: \$ _____

Increase in annual sawyer wages: \$ _____

Annual saw blade replacement cost: \$ _____

Annual grinding wheels and grinding
room maintenance cost: \$ _____

Annual cost to resurface wheels: \$ _____

Other increased annual costs: \$ _____

IV. Investment Rates Data

Corporate tax rate: _____ %

Alternative investment rate: _____ %

Property tax rate: _____ %

Insurance rate: _____ %

MACRS depreciation rates year: _____

MACRS depreciation rates:

Year 1: _____ Year 5: _____

Year 2: _____ Year 6: _____

Year 3: _____ Year 7: _____

Year 4: _____ Year 8: _____

LITERATURE CITED

1. Microsoft Corporation. 1992. Microsoft® Visual Basic® Programming System for MS-DOS®, Version 1.00. Redmond, WA.
2. S.H. Bullard and T.J. Straka. 1998. Basic Concepts in Forest Valuation and Investment Analysis, Ed. 2.1. Préceda, LLC. Auburn, AL.
3. T.D. Brown. 1982. Quality Control in Lumber Manufacturing. Miller Freeman Publications, San Francisco, CA.

