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The Forest Products Laboratory Wood Products Production Index

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Abstract

This study presents a single measure of total wood products production, called the Forest Products Laboratory (FPL) Wood Products Production Index. This measure is simple and useful in tracking both volume and value of forest products production. To show the behavior of the index it is compared to several Federal Reserve Board indices of industrial production using graphs and a log-log model: $\log(FPL_t) = B_o + B_1 \log(IP_t)$.

Keywords: Production index, wood products, wood consumption

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The Forest Products Laboratory Wood Products Production Index

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Introduction

Economic activity in the forest products industry can be assessed using a variety of measures. These measures include the levels of wholesale prices, retail sales, inventories, unfilled orders, shipments, commodity production, housing starts, the value of products shipped, and the prices for lumber futures. The ability to measure economic changes in the forest products sector is needed for economic analysis and forecasting. Often the use of one economic indicator alone does not adequately cover the spectrum of activity in any industry. We therefore propose a composite of several variables as a barometer to measure the performance of the forest products industry, just as the Dow Jones industrial stock average does stock prices. Simple to compute, it provides an approximate measure of both volume and value of wood products production. The proposed index was conceived by Robert N. Stone and analyzed by James L. Howard and Kenneth E. Skog who named it the Forest Products Laboratory (FPL) Wood Products Production Index. It is computed weekly to allow persons in industry and government to follow trends in wood products production. This paper shows how the FPL index is computed and how it compares to Federal Reserve Board (FRB) production indices.

We compare the FPL index to FRB industrial production indices to answer questions we think important if the index is to be used along with other production indices for the U.S. economy.

The basic questions are:
- To what degree does variation in the FPL index match variation in selected FRB indices?
- Do changes in the FPL index precede, follow, or match monthly changes in selected FRB indices?
- What average change occurs in the FPL index with given changes in selected FRB indices?

How the Index is Prepared

The FPL index, computed for each week, adds together production of four major commodities-paper, paperboard, plywood, and softwood lumber-covering both fiber and structural products. The index is calculated by adding together the four weekly production estimates and dividing by the weekly average for 1967. Dissimilar units of production are summed directly without conversion to common volume or value units. The following units are used:
- paper - 1,000 tons
- paperboard - 1,000 tons
- plywood - 1,000,000 square feet, 3/8-inch basis
- lumber - 1,000,000 board feet

Weekly production of paper, paperboard, lumber, and plywood, for the week beginning April 7 in 1967 and in 1984 were as follows:

Commodity	Weekly production 1967	Weekly production 1984
Paper (1,000 tons)	402.8	685.0
Paperboard (1,000 tons)	438.8	667.0
Lumber (M fbm)	357.5	454.0
Plywood (M ft^2, 3/8-in. basis)	283.8	460.0
Total	1,482.9	2,267.1
FPL index value	100	153

How the Index Reflects Both Volume and Value of Production

The index roughly reflects the volume of roundwood consumed to make wood products to the extent that one ton of paper or paperboard takes as much roundwood to make as 1,000 square feet of plywood or 1,000 board feet of lumber:

119 cubic feet for 1 ton of paper or paperboard
70 cubic feet for 1,000 square feet of plywood (3/8-in. basis)
156 cubic feet for 1,000 board feet of softwood lumber.

The index also roughly reflects the value of products produced to the extent that the same dissimilar quantities of products have roughly the same wholesale prices. Prices for various wood products in 1984 were as follows:

$300-600 for 1 ton of paper or paperboard
$200 for 1,000 square feet of plywood
$200 for 1,000 board feet of softwood lumber.
See table 1 for prices from 1982, 1983, and 1984.

We compared the FPL index to an index constructed explicitly to measure cubic foot volume needed to produce forest products. The FPL index is within 5 to 10 percent of the volume index between 1972 and 1984 (fig. 1). The percentage difference was greater during recessions (fig. 2). The mix of consumption of industrial roundwood for the four components of the index has changed since 1967. The percentage of industrial roundwood attributed to lumber has declined 5 percent since 1967. The percentage attributed to pulp products has increased 6 percent since 1967. The decline in lumber consumption is reflected in the expanded markets for composite board products such as oriented strandboard. Plywood and veneer products, although declining in actual cubic footage since 1967, remained stable at 10 percent of total industrial roundwood consumption.

Table 1.—Wholesale prices for selected wood products, 1982-1984

Commodity/units	1982	1983	1984
Paper ($/short ton)			
Newsprint, east	[1]425	[1]454	[1]485
Uncoated groundwood paper (standard rate news)	505	505	[2]520
Coated groundwood papers (34-lb rate paper)	760	730	830
Coated free-sheet papers (70-lb. No. 1 sheets)	1,148	1,225	—
Uncoated printing/writing (No. 3 offset 45-lb sheets)	878	840	—
Unbleached kraft paper (70-lb grocery sack)	240	280	[3]360
Linerboard, east (42-lb liner)	250	—	—
Corrugating medium, east (26-lb semi-chemical medium)	240	280	310
Bleached paperboard (15-pt coated SBS)	590/625	590/625	600/662
Recycled paperboard (20-pt folding boxboard)	380/425	370/425	370/425
Lumber ($/MBF)	169	222	199
Plywood ($/1,000 feet^2, 3/8-in. basis)	198	219	211

Sources: Random Lengths (1982-1984), Pulp and Paper, 1984 issues.

[1]Year end.

[2]Third quarter.

[3]Mid-year, with discounting.

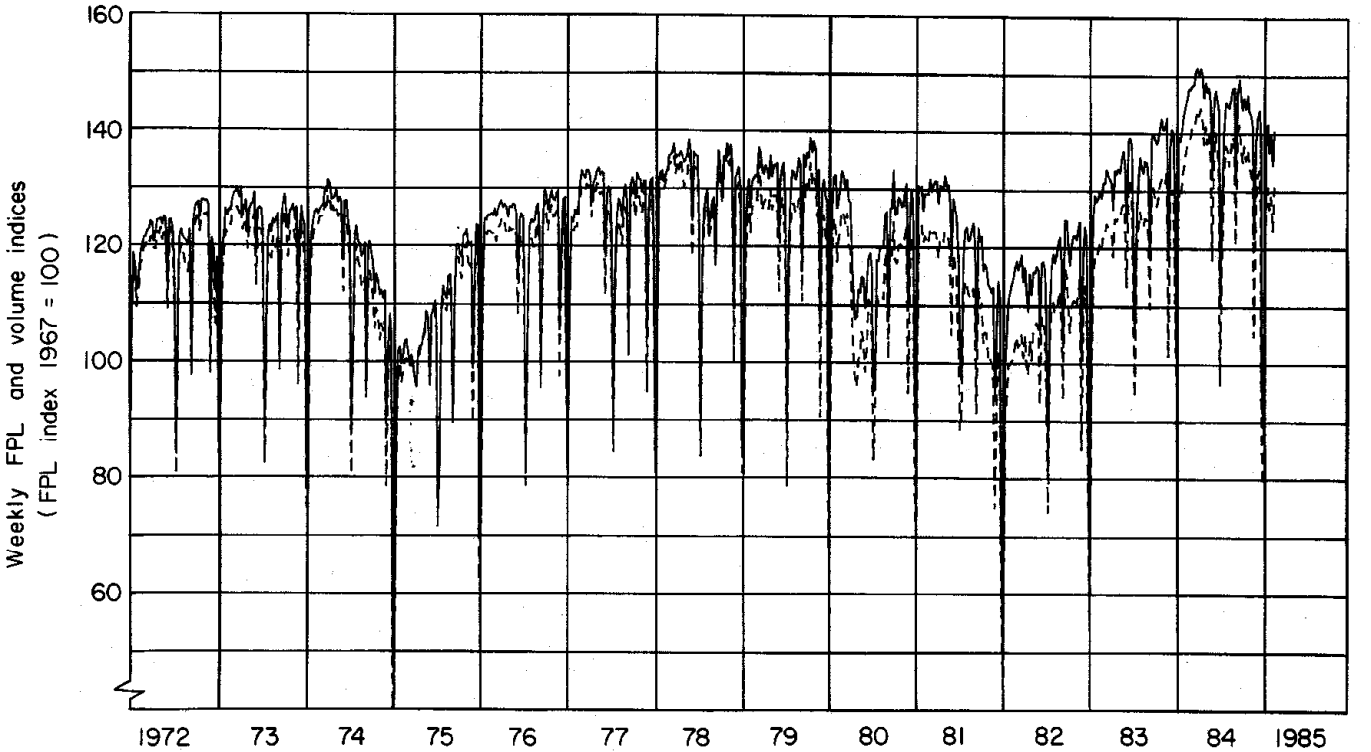

Figure 1.—The FPL index (continuous line) and an unadjusted roundwood volume *requirements index (broken line), 1972 to 1984. (ML85 5537)*

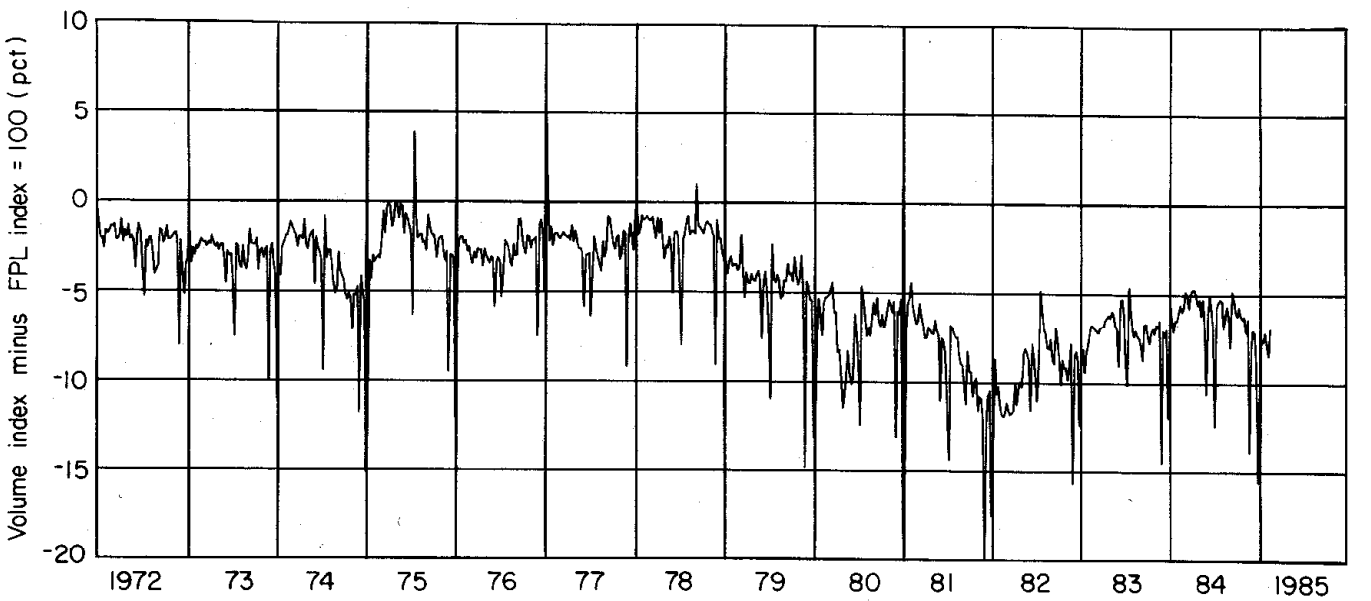

Figure 2.—The percentage difference between the FPL index and a roundwood volume requirements index, 1972 to 1984. (ML85 5538)

Data Sources

The four data components of the index cover most primary wood products production and can be obtained from weekly business and trade publications. The addresses of the sources are listed at the end of this paper. These data are available within 2 to 3 weeks after the actual workweek. Paper and paperboard weekly production, which accounts for nearly 100 percent of national output, is released each week by the American Paper Institute and published in Business Week and *Barrons.* Weekly plywood production, which represents over 90 percent of U.S. plywood production, is compiled by the American Plywood Association and reported in *Random Lengths* and Crows. Weekly lumber production, estimated by the Southern Forest Products Association and the Western Wood Products Association, is from an 800-mill sample of sawmills and accounts for approximately 92 percent of US. lumber produced. The weekly lumber production data are published in *Business Week.*

Advantages of the FPL Index

A key advantage of our index is that it is easy to calculate weekly from readily available data. Second, it is an index which allows easy comparison of current weekly production to production in 1967. An index level of 153 shows an increase of 53 points since 1967. Changes over shorter periods, such as 1 year, 1 month, or 1 week, are just as easy to determine.

Computing an index at weekly rather than monthly intervals allows firms to recognize changes in the national production and possibly take action before monthly data would be available.

Merits of a Weekly Index Versus a Monthly Index

The weekly index avoids difficulties that occur with a monthly index because of the varying number of workdays per month. The number of days in the month may vary from 28 to 31. Monthly production increases or decreases as a result, not necessarily because of changes in productivity per workday. The number of workdays per month may also vary by 3 days depending on which day of the week is the first day of the month. If a 30-day month starts on a Monday, Tuesday, Wednesday, or Thursday, it has 22 weekdays and 8 weekend days but if the month starts on a Friday or a Sunday it has 21 weekdays. A Saturday start results in 20 weekdays. For industries operating on a 5-day workweek, a change in the arrangement of calendar days can explain changes up to 10 percent of monthly production.

Holidays can change the number of workdays in a month or in a week. The merit of a weekly index is that it isolates holiday-related production declines within a single week instead of spreading the effect over a month. For example, effect of the Labor Day holiday on production is reflected in only 1 week's output, assuming the mills resume normal production in the following week.

The Influence of Variation in Length of Workweeks

Plant production schedules vary among industries whose output is measured by the index components. The paper and paperboard plants normally operate 7 days a week, 3 shifts per day, for 320 or more days a year. Lumber and plywood mills usually operate 5 days a week, 1 or 2 shifts per day, for 260 days a year. The production week is from Sunday to Saturday midnight.

Time for maintenance is usually taken during holidays or periods when many employees are on vacation. Time taken for maintenance causes weekly output to drop in weeks having holidays (fig. 3).

Index Comparisons by Equation

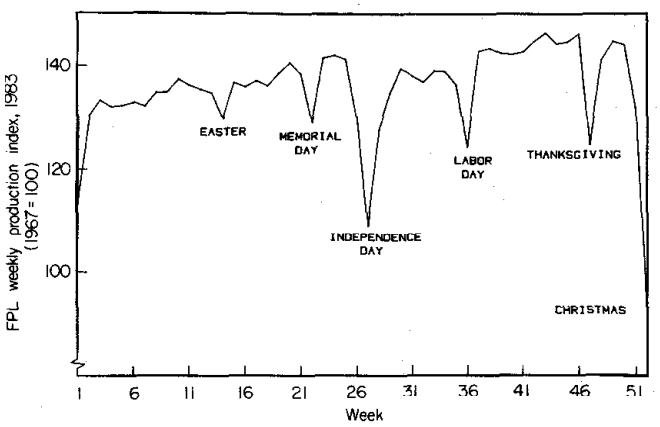

Figure 3.—The weekly FPL index for 1983 showing normal seasonal variations. (ML85 5539)

The FPL index was compared to 14 monthly Federal Reserve Board (FRB) production indices using a log-log model:

$$\log(FPL_t) = B_o + B_1 \log(IP_t)$$

where FPL_t is the FPL index averaged over the weeks in month t and IP_t is an FRB index for month t. For this model the elasticity of the FPL index, E(FPL), with respect to IP indices is constant.

$$E(FPL) = \frac{dFPL}{dIP} \times \frac{IP}{FPL} = B_1$$

The FRB indices come in seasonally adjusted and unadjusted forms. They measure physical output weighted by value added per unit output for the nation's factories, mines, and electric and gas utilities. Aggregate indices' are formed by grouping industries into (1) market groups (e.g. consumer goods, equipment, or intermediate products) or (2) industry groups (e.g. standard industrial classification 2-digit industries). The first 12 FRB indices used in tables 2-3 are for market groups and the final 2 are for industry groups. In order to compare our FPL index to seasonally adjusted FRB indices we formed a seasonally adjusted FPL index using the procedure used to adjust the FRB indices, namely, the X-11 procedure prepared by the U.S. Department of Commerce.[2]

The X-11 procedure is a "ratio-to-moving-average" method with which one may choose between the additive and multiplicative versions and between the full seasonal-adjustment routine and one limited to the calculation of summary measures computed from seasonally adjusted data obtained from other sources. In this paper we used the multiplicative version and the full seasonal-adjustment routine.

We used the log-log model (1) to determine the percentage of variation in the FPL index that is matched by variation in various FRB indices (R^2) and (2) to determine the average percentage movement in FPL production index with a 1 percent change in various FRB indices (E(FPL) with respect to IP). Regressions were made on monthly data from 1967 to 1984. First, we regressed the unadjusted FPL index on the seasonally adjusted and unadjusted FRB indices. Second, we regressed the unadjusted FPL index on adjusted and unadjusted FRB indices where the FRB indices were lagged 1 to 4 months. This lagging shows if general economic trends appear in the FPL index before FRB indices. Third, we regressed the unadjusted FPL index on FRB indices where the FPL index was lagged 1 to 4 months to determine if trends appear in certain FRB indices before the FPL index. Fourth, we regressed a seasonally adjusted FPL index on the seasonally adjusted FRB indices, and the unadjusted FRB indices.

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[1]Federal Reserve Board Statistical Release. February 15, 1984. p. 20.

[2]Shiskin, Julius; Young, Allan H.; Musgrave, John C. The X-11 variant of the census method II seasonally adjustment program. Tech. Pap. No. 15. U.S. Department of Commerce, Bureau of Economic Analysis, Washington, DC; February 1967.

Table 2—Lagged-time correlations between the monthly FPL index and unadjusted Federal Reserve Board (FRB) production indices

FRB index and Index groups	Months of lag or lead of the FRB index with respect to the FPL Index[1]								
	-4	-3	-2	-1	0	1	2	3	4
Total Index	0.42	0.40	0.38	0.43	0.46	0.34	0.28	0.22	0.21
Market Groups									
Total products	.39	.34	.36	.39	.42	.32	.26	.20	.21
Final products	—	—	—	—	—	—	—	—	—
Consumer goods	.41	.38	.35	.44	.51	.39	.32	.24	.26
Durables	.34	.34	.40	.60	.67	.41	.28	.21	.38
Nondurables	.37	.33	.28	.31	.38	.32	.28	.21	.21
Total equipment	.25	.23	.20	.22	.20	.15	.12	.10	.09
Intermediate products	—	—	—	—	—	—	—	—	—
Construction supplies	.50	.49	.52	.60	.62	.46	.39	.32	.26
Business supplies	.36	.34	.32	.34	.36	.29	.26	.22	.21
Total materials	.45	.45	.44	.47	.50	.35	.29	.22	.21
Durable goods materials	.45	.45	.44	.47	.46	.30	.23	.17	.15
Nondurable goods materials	.38	.40	.42	.46	.53	.39	.32	.26	.27
Energy materials	.34	.31	.23	.18	.24	.24	.24	.24	.22
Industry Groups									
Manufacturing									
Durables	.43	.41	.40	.47	.46	.31	.23	.17	.16
Nondurables	.38	.37	.36	.41	.46	.35	.29	.24	.24

[1]Negative numbers indicate the number of months the FRB index leads the FPL index with which it is correlated; e.g. -1 indicates FRB_{May} is paired with FPL_{June}. Positive numbers indicate the number of months by which FRB index lags the FPL index, e.g. 1 indicates that FRB_{July} is paired with FPL_{June}.

Table 3.—Elasticity of the FPL index with respect to unadjusted Federal Reserve Board (FRB) production indices based on lagged-time regressions

FRB index and index groups	Months of lag or lead of the FRB index with respect to the FPL index[1]								
	- 4	- 3	- 2	- 1	0	1	2	3	4
Total Index	0.48	0.47	0.46	0.49	0.51	0.43	0.39	0.35	0.35
Market Groups									
Total products	.46	.44	.42	.46	.48	.41	.37	.33	.34
Final products									
Consumer goods	.48	.43	.44	.49	.53	.46	.41	.36	.38
Durables	.39	.39	.43	.53	.56	.43	.36	.31	.36
Nondurables	.43	.40	.37	.39	.43	.39	.37	.32	.32
Total equipment	.32	.31	.29	.31	.30	.25	.23	.21	.20
Intermediate									
Products									
Construction supplies	.61	.61	.60	.59	.61	.54	.50	.46	.41
Business supplies	.37	.35	.34	.35	.36	.33	.31	.28	.28
Total materials									
Durable goods materials	.45	.45	.45	.47	.46	.37	.32	.28	.26
Nondurable goods materials	.36	.36	.37	.39	.42	.36	.33	.30	.30
Energy materials	.89	.85	.73	.65	.74	.75	.84	.78	.65
Industry Groups									
Manufacturing									
Durables	.51	.50	.50	.54	.54	.44	.38	.33	.32
Nondurables	.38	.37	.37	.39	.42	.36	.33	.30	.30

[1]Negative numbers indicate the number of months the FRB index leads the FPL index with which it is correlated: e.g. -1 indicates FRB_{May} is paired with FPL_{June}. Positive numbers indicate the number of months by which FRB index lags the FPL index, e.g. 1 indicates that FRB_{July} is paired with FPL_{June}.

Index Comparisons by Graph

Our log-log regressions show:

- Variation-in the unadjusted FPL index was matched most closely by variation in the unadjusted FRB indices (table 2) and, conversely, variation in the adjusted FPL index was matched most closely by variation in the adjusted FRB indices (not shown).
- Variation in the FPL index is most closely matched by variation in the construction supplies index (which includes lumber production) and by variation in the durable consumer goods index (table 2).
- Movements in FRB's energy materials and total equipment indices tend to precede movements in the FPL index by 4 months or more; that is, the FPL index is more highly correlated with these indices 4 months earlier than with their values in the current period (table 2).
- Paradoxically, movements in the FPL index tend, also, to precede movements in the FRB energy materials index by 2 to 3 months (table 2). The fact that movements in the energy materials index both precede and follow movement in the FPL index may result from cycles in the energy index rather than any influence forest industries have on energy materials production.
- Among the FRB indices tested, the average movement in the FPL index, E(FPL), is largest in "response" to movement in the energy materials index 4 months or more earlier. A 1 percent change in the energy materials index is followed by a 1 percent change in the same direction in the FPL index 4 months later (table 3).
- The average movement in the FPL index is next largest in "response" to movement in the construction supplies index during the current period (table 3).
- A 1 percent change in the nondurable manufacturing index (which includes paper) is, on average, matched by only a 0.4 percent change in the FPL index in the same period.

By following the FPL index we trace a substantial portion of the U.S. economy. In 1972, the wood industry, from activities in timber management, harvesting, primary manufacturing, secondary manufacturing, construction, transportation, and marketing, contributed $48 billion to the gross national product (GNP).[3] In addition, the wood industry employed 4 percent of the U.S. workforce.[4] By following the FPL index we trace rises and declines in wood products production that have significant effects on the U.S. economy.

The FPL index, through direct connections with other industries such as shipping, construction, or employment, to a limited degree reflects overall performance of the domestic economy. Figure 4 shows that the contractions in the U.S. economy, most obvious during 1974 and 1980, became apparent in the FPL index in about the same month as the contraction in the FRB total industrial production index.

Graphical comparison shows that the FPL index registers the depth and duration of recessions as do the FRB indices. The graphs of the FPL weekly and seasonally adjusted monthly production index (figs. 4 and 5) show that in mid-1974 a major contraction occurred in the U.S. economy as a result of the Arab oil embargo. Wood products production declined drastically. The rebound did not occur until the beginning of 1976. The next major decline occurred in 1979 and lasted until 1983. This particular contraction was a result of inflation-fighting policy of the Reagan Administration. Interest rates increased substantially and the economy and wood products production went into the longest decline in history. Softwood lumber and plywood were produced at all-time lows (figs. 6 and 7), while paper and paperboard were produced at continued high levels (figs. 8 and 9).

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[3]GNP is the total value, at current prices, of the goods and services produced in a country during a given period (generally 1 year) plus net exports.

[4]Howard, James. Wood. In: Encyclopedia of chemical technology. Wiley and Sons, Inc., New York, NY; 1983. p. 604-607.

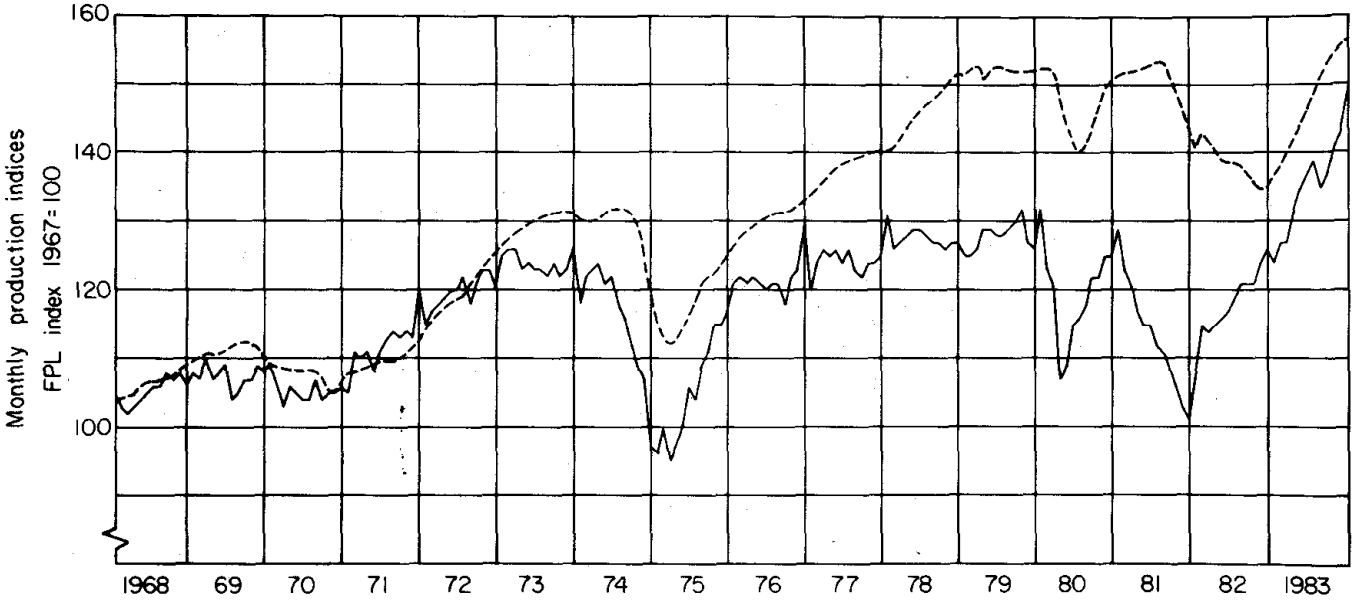

Figure 4.—The monthly seasonally adjusted FPL index (continuous line) and the seasonally adjusted Federal Reserve Board total industrial production index (broken line), 1968 to 1983. (ML85 5540)

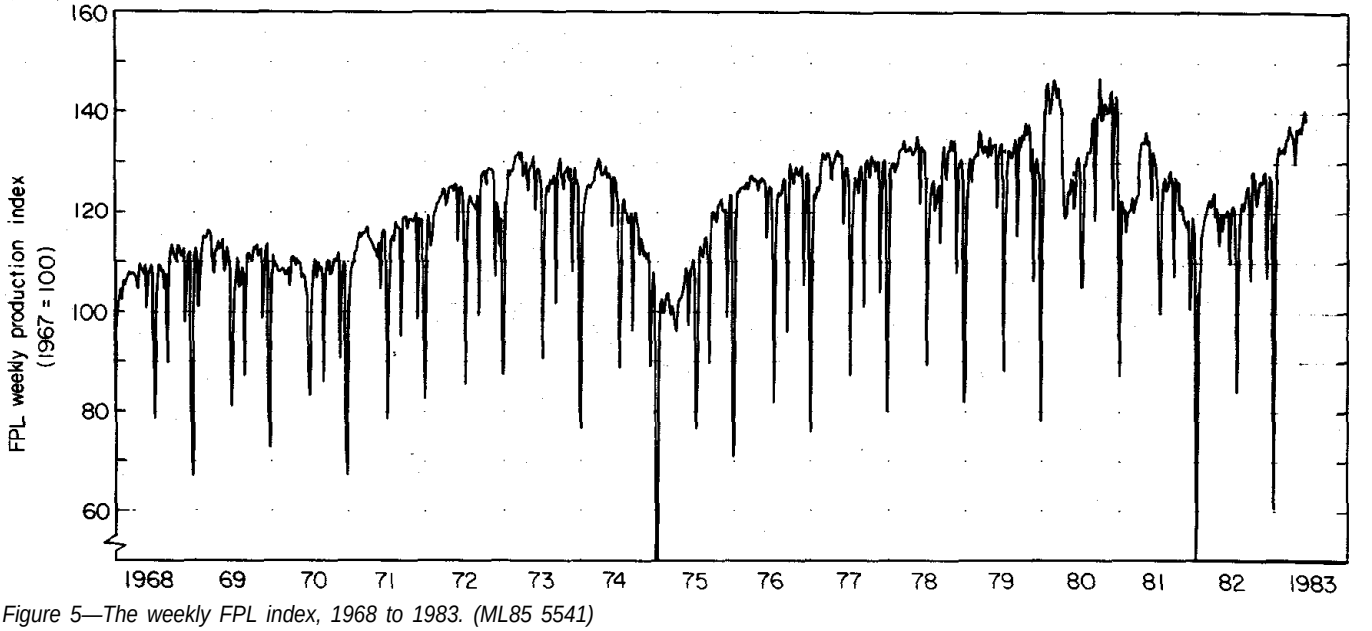

Figure 5—The weekly FPL index, 1968 to 1983. (ML85 5541)

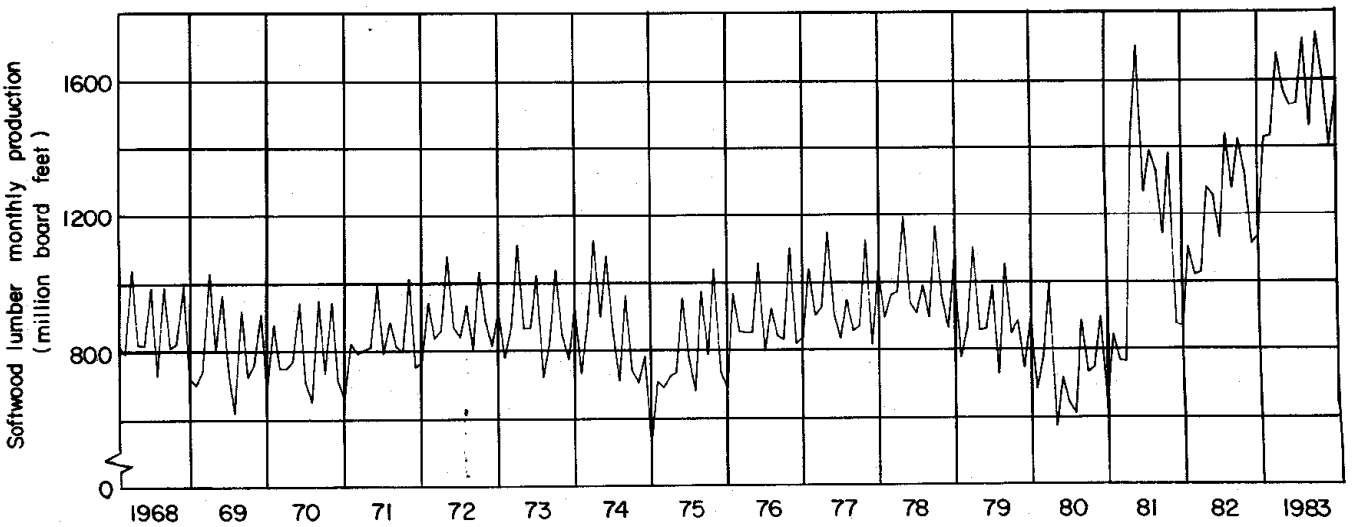

Figure 6.—Monthly production of softwood lumber, 1968 to 1983. (ML85 5542)

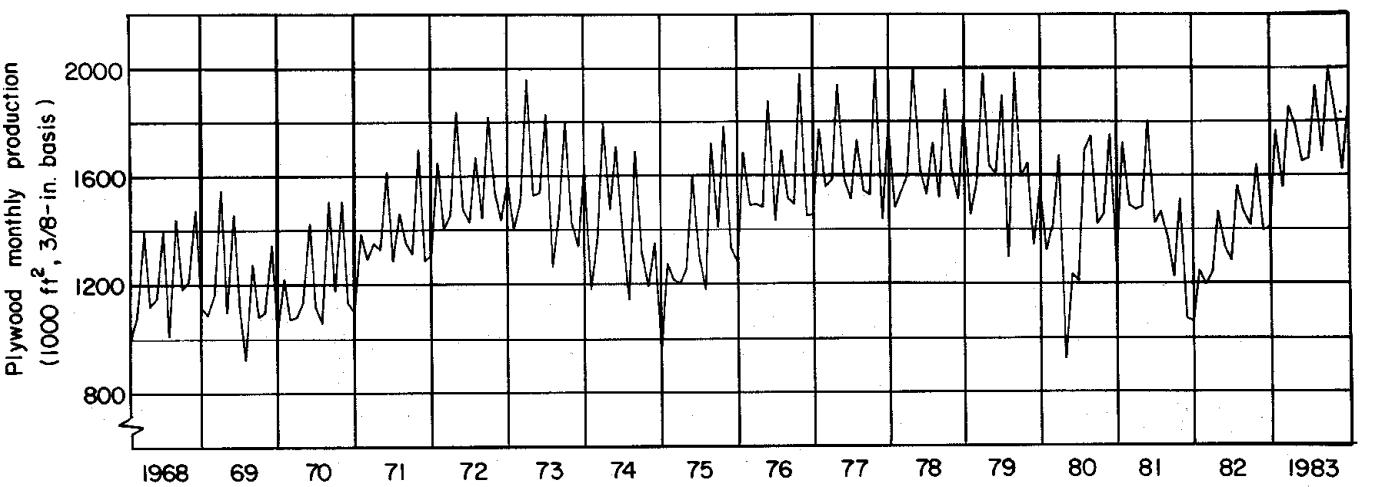

Figure 7.—Monthly production of softwood plywood, 1968 to 1983. (ML85 5543)

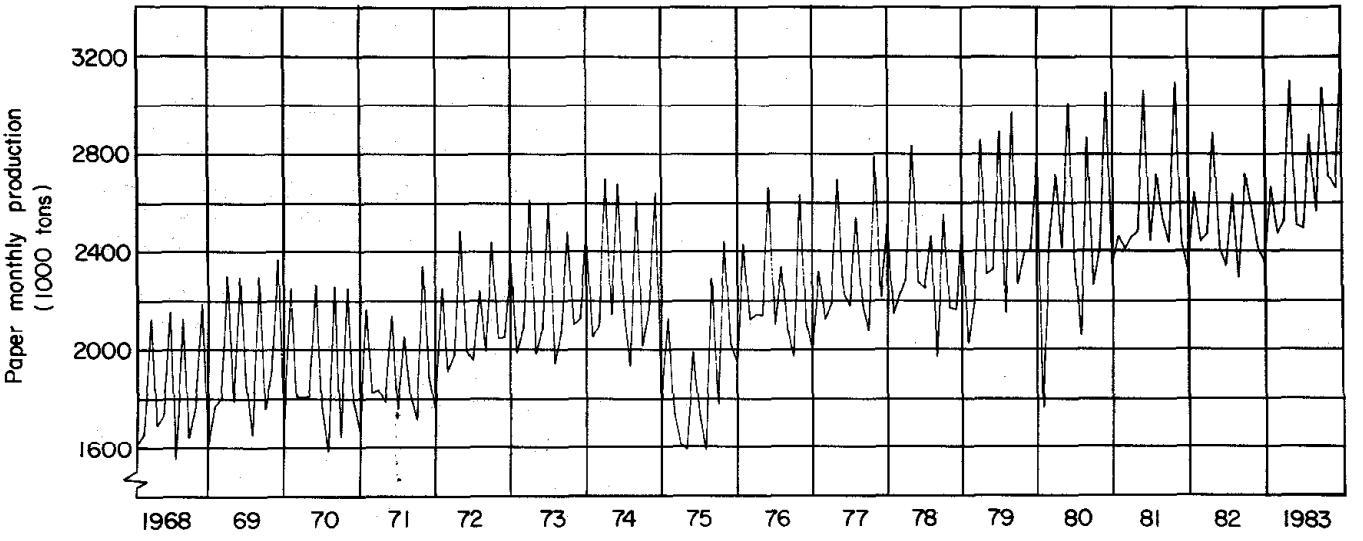

Figure 8.—Monthly production of paper, 1968 to 1983. (ML85 5544)

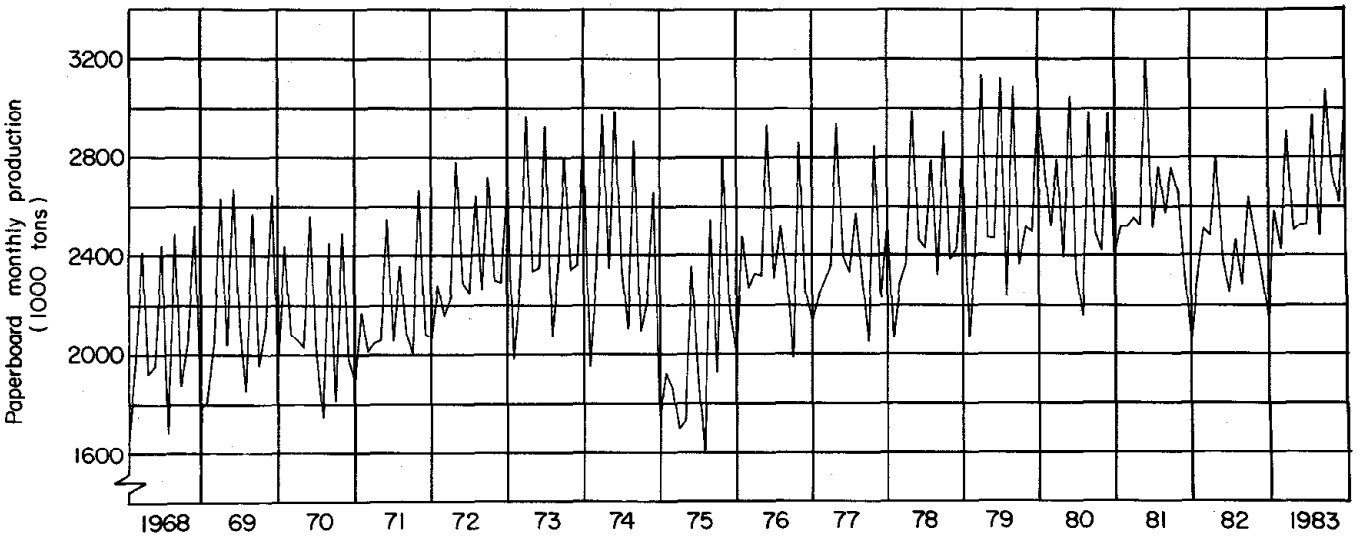

Figure 9.—Monthly production of paperboard, 1968 to 1983. (ML85 5545)

Summary

The four components of the FPL index-paperboard, paper, lumber, and plywood-make up most of primary wood products production. As a single barometer of primary wood products production, the FPL index can be useful to those who monitor general movements in the primary and secondary wood products markets. The FPL index may have to be redesigned as new wood products appear. For example, medium density board may have to be added as it replaces plywood.

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