

AN INQUIRY INTO THE BEHAVIOR  
OF SOFTWOOD PLYWOOD PRICE

by

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AN INQUIRY INTO THE BEHAVIOR  
OF SOFTWOOD PLYWOOD PRICE

DISTRIBUTION OF PLYWOOD

The small size of the average plywood mill, and the wide spread of markets, has fostered the growth of independent wholesalers, or jobbers, as the main distribution channel for softwood plywood. Jobbers buy directly from mills, or indirectly through sales agents representing mills, and in turn sell to retail outlets.

Since World War II, there has been large growth in the number of jobbers. In 1951, jobbers handled 79.4 per cent of the total output of the plywood industry. Of the remaining 20.6 per cent, 3.1 per cent was handled by sales branches, and 17.5 per cent was sold either through brokers, or directly to commercial outlets by mills. (3, p. 7)

There are only a small number of sales branches which are operated by large producing organizations. Sales branches maintain warehouses and a sales force to handle sales to retail outlets, and act basically as the wholesaler for those mills so represented.

Brokers play a minor role in distribution, and are most active during periods of short supply. Brokers do not warehouse, but work rather, as contact men between buyers and sellers. The majority of

brokers do not maintain constant relationships with any single mill, but deal where contacts can be made.

Growth in the number of wholesalers has lead to increased price and non-price competition. Non-price competition has taken the form of broader services to the customer, and has caused the increased necessity of warehousing on the part of the jobber (6). A study conducted in 1953 revealed that 29 per cent of jobbers sales were made by direct mill shipment, while 71 per cent were made from jobbers inventories (3, p. 9).

A survey of 900 jobbers, completed in 1955, found that typical full-service jobber carried a 50 day inventory of plywood on hand (3, p. 11). This inventory reduces the necessity of warehousing on the part of the producer and retailer, and plays a role in stabilization of seasonal fluctuation in both price and production of softwood plywood.

## SEASONALITY

## Price

Monthly adjusted wholesale price indices were calculated for the period 1952 to 1957, with the exclusion of 1954 (Table 1). The year 1954 was omitted due to the abnormal influences of an extended labor dispute and strike taking place in the summer of that year.

The method used in computing adjusted indices from unadjusted data is similar to that used by Buskirk (1, p. 184) in his study of price fluctuations in Douglas fir plywood for the period 1951 to 1953. Monthly unadjusted wholesale price indices were compiled from The Handbook of Basic Economic Statistics (4). From the unadjusted monthly index figures, an average monthly figure for the year was calculated. This average monthly figure, in turn, was divided into the unadjusted monthly index number. The result of each division yielded the adjusted monthly index. Adjustment was made for the five year period. Monthly means for the five year period were computed, and then divided by the mean of the monthly means or grand mean (Table 1).

Seasonally adjusted monthly figures for the five year period were plotted on Chart 1. Chart 2, shows seasonally adjusted monthly figures for a four year period, 1952 to 1957 with 1954 and 1956 extracted (Table 2). Due to the onset of recession, 1956 showed unusual price fluctuations.



TABLE 1. Index of Wholesale Softwood Plywood Prices by Months, 1952-1957 (Less 1954)

| Wholesale Softwood Plywood |       |       |       |       |       |       |       |       |       |       |       |       |                  |
|----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------------------|
| Price Index<br>(4, p. 127) | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEPT  | OCT   | NOV   | DEC   | AVERAGE<br>TOTAL |
| 1952 Monthly               |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 104.2 | 104.8 | 105.6 | 105.6 | 105.6 | 105.7 | 105.8 | 106.0 | 106.0 | 106.1 | 102.3 | 102.3 | 105.0            |
| Adjusted                   |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 99.2  | 99.8  | 100.6 | 100.6 | 100.6 | 100.7 | 100.8 | 100.9 | 100.9 | 101.0 | 97.4  | 97.4  | 100.0            |
| 1953 Monthly               |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 108.5 | 110.9 | 112.0 | 112.0 | 112.4 | 112.4 | 112.7 | 112.4 | 106.8 | 104.7 | 105.6 | 105.6 | 109.7            |
| Adjusted                   |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 98.9  | 101.1 | 102.1 | 102.1 | 102.5 | 102.5 | 102.7 | 102.5 | 97.4  | 95.4  | 96.3  | 96.3  | 100.0            |
| 1955 Monthly               |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 104.7 | 104.8 | 104.8 | 104.8 | 105.6 | 105.6 | 105.7 | 105.7 | 106.1 | 106.1 | 105.9 | 105.7 | 105.5            |
| Adjusted                   |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 99.2  | 99.3  | 99.3  | 99.3  | 100.1 | 100.1 | 100.2 | 100.2 | 100.6 | 100.6 | 100.4 | 100.2 | 100.0            |
| 1956 Monthly               |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 107.5 | 107.5 | 107.5 | 106.9 | 102.7 | 101.0 | 103.3 | 99.2  | 99.2  | 96.1  | 94.8  | 94.6  | 101.7            |
| Adjusted                   |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 105.7 | 105.7 | 105.7 | 105.1 | 100.9 | 99.3  | 101.6 | 97.5  | 97.5  | 94.5  | 93.2  | 93.0  | 100.0            |
| 1957 Monthly               |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 97.1  | 96.4  | 96.2  | 96.7  | 96.8  | 97.7  | 96.9  | 95.2  | 94.7  | 96.9  | 96.4  | 95.6  | 96.4             |
| Adjusted                   |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 100.7 | 100.0 | 99.8  | 100.3 | 100.4 | 101.3 | 100.5 | 98.8  | 98.2  | 100.5 | 100.0 | 99.2  | 100.0            |
| Total Monthly              |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 104.4 | 104.9 | 105.2 | 105.2 | 104.6 | 104.9 | 104.9 | 103.7 | 102.6 | 102.0 | 101.0 | 100.8 | 103.4            |
| Total                      |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Adjusted                   |       |       |       |       |       |       |       |       |       |       |       |       |                  |
| Index                      | 100.1 | 101.5 | 101.7 | 101.7 | 101.2 | 101.5 | 101.5 | 100.3 | 99.2  | 98.6  | 97.7  | 96.5  | 100.0            |

Table 2. Index of Wholesale Softwood Plywood Prices by Months, 1952-1957 (Less 1954 and 1956)

| Wholesale Softwood<br>Plywood<br>Price Index<br>(4, p. 127) | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEPT  | OCT   | NOV   | DEC   | AVERAGE<br>TOTAL |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------------------|
| 1952 Monthly<br>Index                                       | 104.2 | 104.8 | 105.6 | 105.6 | 105.6 | 105.7 | 105.8 | 106.0 | 106.0 | 106.1 | 102.3 | 102.3 | 105.0            |
| Adjusted<br>Index   | 99.2  | 99.8  | 100.6 | 100.6 | 100.6 | 100.7 | 100.8 | 100.9 | 100.9 | 101.0 | 97.4  | 97.4  | 100.0            |
| 1953 Monthly<br>Index                                       | 108.5 | 110.9 | 112.0 | 112.0 | 112.4 | 112.4 | 112.7 | 112.4 | 106.8 | 104.7 | 105.6 | 105.6 | 109.7            |
| Adjusted<br>Index   | 98.9  | 101.1 | 102.1 | 102.1 | 102.5 | 102.5 | 102.7 | 102.5 | 97.4  | 95.4  | 96.3  | 96.3  | 100.0            |
| 1955 Monthly<br>Index                                       | 104.7 | 104.8 | 104.8 | 104.8 | 105.6 | 105.6 | 105.7 | 105.7 | 106.1 | 106.1 | 105.9 | 105.7 | 105.5            |
| Adjusted<br>Index   | 99.2  | 99.3  | 99.3  | 99.3  | 100.1 | 100.1 | 100.2 | 100.2 | 100.6 | 100.6 | 100.4 | 100.2 | 100.0            |
| 1957 Monthly<br>Index                                       | 97.1  | 96.4  | 96.2  | 96.7  | 96.8  | 97.7  | 96.9  | 95.2  | 94.7  | 96.9  | 96.4  | 95.6  | 96.4             |
| Adjusted<br>Index   | 100.7 | 100.0 | 99.8  | 100.3 | 100.4 | 101.3 | 100.5 | 98.8  | 98.2  | 100.5 | 100.0 | 99.2  | 100.0            |
| Total Monthly<br>Index                                      | 103.6 | 104.2 | 104.7 | 104.8 | 105.1 | 105.4 | 105.3 | 104.8 | 103.4 | 103.5 | 102.6 | 102.3 | 104.1            |
| Total Adjusted<br>Index                                     | 99.5  | 100.1 | 100.6 | 100.7 | 101.0 | 101.2 | 101.1 | 100.7 | 99.3  | 99.4  | 98.6  | 98.3  | 100.0            |

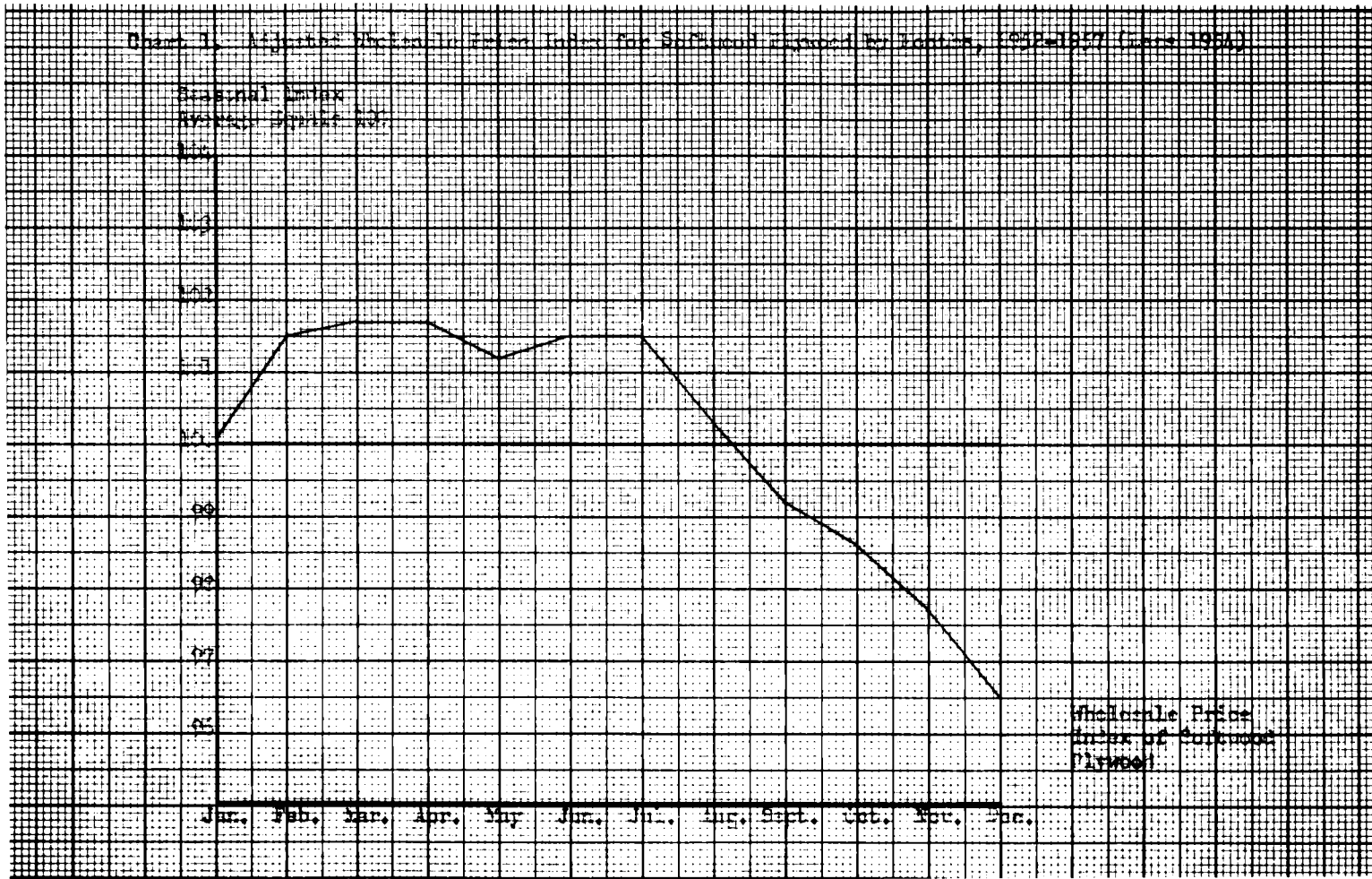


Chart 1. Adjusted Wholesale Price Index for Softwood Plywood by Months, 1952-1957 (Less 1954)

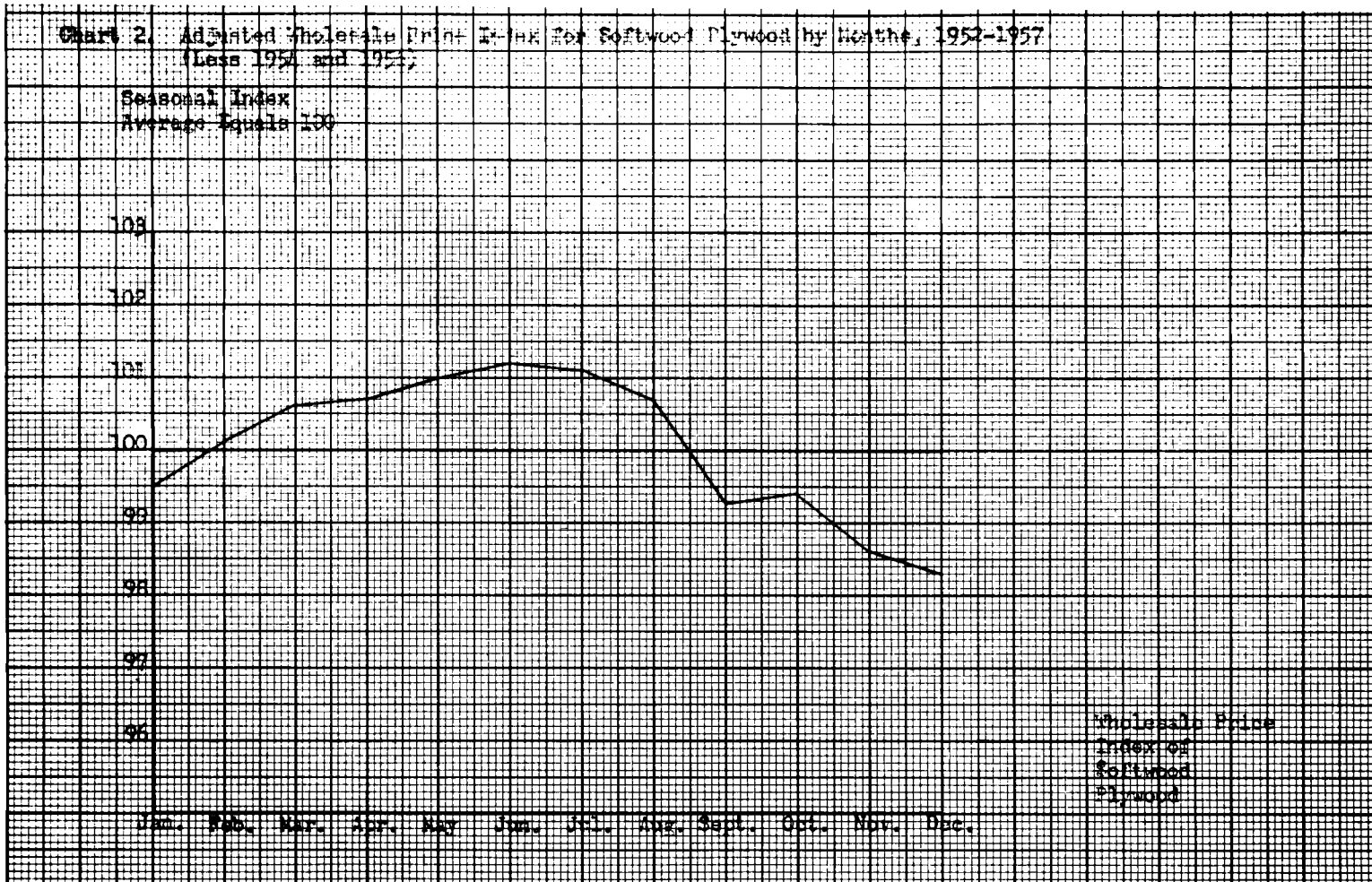


Chart 2. Adjusted Wholesale Price Index for Softwood Plywood by Months, 1952-1957  
(Less 1954 and 1956)

## Production

Some 80 per cent of all softwood plywood is used for construction purposes, for example: on-site building, construction components, maintenance, remodeling, etc. (6, p. 127). Because of the large percentage of softwood plywood used in construction, plywood production was plotted against total construction expenditures to gain insight on production seasonality (Chart 3).

Monthly softwood plywood production figures in millions of square feet, 3/8 inch basis, were compiled for the period 1951 to 1957. Data for 1954 were not included due to the prolonged labor dispute in that year. Unadjusted monthly figures were then seasonally adjusted in the manner previously described for adjustment of price data (Table 3).

Monthly total construction expenditures in millions of dollars were tabulated for the period 1951 to 1957. These unadjusted figures were then seasonally adjusted in a manner similar to that mentioned above. Monthly construction expenditure figures after adjustment are presented in Table 4. Data pertaining to 1954 was not excluded, due to lack of information on yearly happenings in the construction industry.

## Conclusions

The year 1956, with its unusual price behaviour, has caused an atypical fluctuation in the five year adjusted averages (Chart 1). Typically, wholesale plywood prices start an upward climb in January.

TABLE 3. Index of Softwood Plywood Production by Months, 1951-1957 (Less 1954)

| Softwood Plywood<br>Production in<br>thousand sq. feet.<br>(10;11,p.S32) |       |       |       |       |       |       |      |       |       |       |       |       | AVERAGE |
|--|-------|-------|-------|-------|-------|-------|------|-------|-------|-------|-------|-------|---------|
| JAN  | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG  | SEPT  | OCT   | NOV   | DEC   |       |         |
| 1951 Monthly   |       |       |       |       |       |       |      |       |       |       |       |       |         |
| Production   | 272   | 252   | 284   | 266   | 285   | 281   | 194  | 284   | 243   | 269   | 187   | 176   | 250     |
| Index  | 108.8 | 100.8 | 113.6 | 106.4 | 114.0 | 112.4 | 77.6 | 113.1 | 97.2  | 107.6 | 74.8  | 70.4  | 100.0   |
| 1952 Monthly   |       |       |       |       |       |       |      |       |       |       |       |       |         |
| Production   | 244   | 253   | 270   | 283   | 231   | 269   | 225  | 281   | 292   | 204   | 235   | 267   | 263     |
| Index  | 92.8  | 96.2  | 102.7 | 107.6 | 87.8  | 102.3 | 85.6 | 106.8 | 111.0 | 115.6 | 89.4  | 101.5 | 100.0   |
| 1953 Monthly   |       |       |       |       |       |       |      |       |       |       |       |       |         |
| Production   | 290   | 304   | 340   | 353   | 335   | 346   | 282  | 312   | 356   | 318   | 306   | 297   | 320     |
| Index  | 90.6  | 95.0  | 106.3 | 110.3 | 104.7 | 108.1 | 88.1 | 97.5  | 111.3 | 99.4  | 95.6  | 92.8  | 100.0   |
| 1955 Monthly   |       |       |       |       |       |       |      |       |       |       |       |       |         |
| Production   | 393   | 389   | 444   | 413   | 419   | 416   | 321  | 415   | 422   | 428   | 423   | 413   | 408     |
| Index  | 96.3  | 98.3  | 108.8 | 101.2 | 102.7 | 102.0 | 78.7 | 101.7 | 103.4 | 104.9 | 103.7 | 101.2 | 100.0   |
| 1956 Monthly   |       |       |       |       |       |       |      |       |       |       |       |       |         |
| Production   | 448   | 443   | 470   | 447   | 432   | 372   | 355  | 476   | 412   | 494   | 445   | 506   | 442     |
| Index  | 101.4 | 100.2 | 106.3 | 101.1 | 97.7  | 84.2  | 80.3 | 107.7 | 93.2  | 111.8 | 100.7 | 114.5 | 100.0   |
| 1957 Monthly   |       |       |       |       |       |       |      |       |       |       |       |       |         |
| Production   | 440   | 405   | 404   | 473   | 505   | 467   | 413  | 468   | 451   | 512   | 447   | 435   | 452     |
| Index  | 97.3  | 89.6  | 89.4  | 104.6 | 111.7 | 103.3 | 91.4 | 103.5 | 99.8  | 113.3 | 98.9  | 96.2  | 100.0   |
| Average Total  |       |       |       |       |       |       |      |       |       |       |       |       |         |
| Monthly<br>Production  | 303   | 341   | 369   | 373   | 368   | 359   | 298  | 373   | 363   | 370   | 341   | 349   | 351     |
| Index  | 86.3  | 97.2  | 105.1 | 106.3 | 104.8 | 102.3 | 84.9 | 106.3 | 103.4 | 105.4 | 97.2  | 99.4  | 100.0   |

TABLE 4. Index of Total Construction Expenditures by Months, 1951-1957

| Total Construction Expenditures in Millions of Dollars |       |       |       |       |       |       |       |       |       |       |       |       |         |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| (11, p. S11)   | JAN   | FEB   | MAR   | APR   | MAY   | JUN   | JUL   | AUG   | SEPT  | OCT   | NOV   | DEC   | AVERAGE |
| 1951 Monthly   |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 2,161 | 2,034 | 2,257 | 2,448 | 2,649 | 2,807 | 2,870 | 2,927 | 2,901 | 2,849 | 2,624 | 2,366 | 2,514   |
| Index  | 84.0  | 79.0  | 87.7  | 95.1  | 102.9 | 109.1 | 111.5 | 113.7 | 112.7 | 110.7 | 105.6 | 91.9  | 100.0   |
| 1952 Monthly   |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 2,174 | 2,088 | 2,332 | 2,516 | 2,743 | 2,945 | 3,027 | 3,095 | 3,098 | 3,011 | 2,787 | 2,513 | 2,694   |
| Index  | 80.7  | 77.5  | 86.6  | 93.4  | 101.8 | 109.3 | 112.4 | 114.9 | 115.0 | 111.8 | 103.5 | 93.3  | 100.0   |
| 1953 Monthly   |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 2,361 | 2,787 | 2,527 | 2,758 | 2,947 | 3,209 | 3,282 | 3,317 | 3,295 | 3,211 | 2,988 | 2,717 | 2,949   |
| Index  | 80.1  | 94.5  | 85.7  | 93.5  | 99.9  | 108.8 | 111.3 | 112.5 | 111.7 | 108.9 | 101.3 | 92.0  | 100.0   |
| 1954 Monthly   |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 2,454 | 2,358 | 2,579 | 2,814 | 3,140 | 3,385 | 3,556 | 3,693 | 3,674 | 3,503 | 3,329 | 3,092 | 3,131   |
| Index  | 78.4  | 75.3  | 82.4  | 89.9  | 100.3 | 108.1 | 113.6 | 117.9 | 117.3 | 111.9 | 106.3 | 98.8  | 100.0   |
| 1955 Monthly   |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 2,962 | 2,833 | 3,121 | 3,480 | 3,843 | 4,119 | 4,249 | 4,335 | 4,291 | 4,155 | 3,821 | 3,372 | 3,715   |
| Index  | 79.7  | 76.3  | 84.0  | 93.7  | 103.4 | 110.9 | 114.4 | 116.7 | 115.5 | 111.8 | 102.9 | 90.8  | 100.0   |
| 1956 Monthly   |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 3,028 | 2,918 | 3,179 | 3,556 | 3,962 | 4,288 | 4,420 | 4,474 | 4,425 | 4,302 | 3,964 | 3,544 | 3,838   |
| Index  | 78.9  | 76.0  | 82.8  | 92.6  | 103.2 | 111.7 | 115.2 | 116.6 | 115.3 | 112.1 | 103.3 | 92.3  | 100.0   |
| 1957 Monthly   |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 3,198 | 3,007 | 3,295 | 3,657 | 4,025 | 4,308 | 4,477 | 4,667 | 4,682 | 4,409 | 4,208 | 3,791 | 3,977   |
| Index  | 80.4  | 75.6  | 82.8  | 91.9  | 101.2 | 108.3 | 112.6 | 117.3 | 117.7 | 110.9 | 105.8 | 95.3  | 100.0   |
| Total Average Monthly                                  |       |       |       |       |       |       |       |       |       |       |       |       |         |
| Expenditures   | 2,620 | 2,575 | 2,756 | 3,033 | 3,330 | 3,580 | 3,697 | 3,787 | 3,767 | 3,634 | 3,389 | 3,047 | 3,260   |
| Index  | 80.4  | 79.0  | 84.5  | 93.4  | 100.2 | 109.8 | 113.4 | 116.2 | 115.6 | 111.5 | 104.0 | 93.5  | 100.0   |

This rise continues until a peak and downward turning point is reached in June. Prices then start into a decline and reach their low in December.

Cause of this seasonal variation may be traced to activity in the construction industry. In January, jobbers start building up inventories in expectation of increased construction activity in spring. Through spring and into summer, there is a constant demand for plywood due to construction, but starting in July, jobbers start curtailing their buying. Curtailment of buying is caused by the impending slowdown in construction activity which occurs in fall and winter.

Wholesale plywood price indices for 1956 show variation and reversals of the seasonal trend. Prices remained stable from January through May. A turning point appeared in May and prices fell rapidly until an upturn was recorded in June. Prices rose slightly in July, and then fell, reaching their lowest point in December.

Although plywood production is heavily dependent on construction activity, the construction industry has a greater seasonal variation than that encountered in softwood plywood production (Chart 3). Slowdown of building activity during winter, and the upsurge of activity in spring, give the seasonal building activity cycle a much greater amplitude than is found in softwood plywood production.

Seasonal fluctuations in softwood plywood production although less pronounced than those found in construction activity are of the same basic pattern. The large decrease in softwood plywood production during the month of July is not attributable to construction activity,



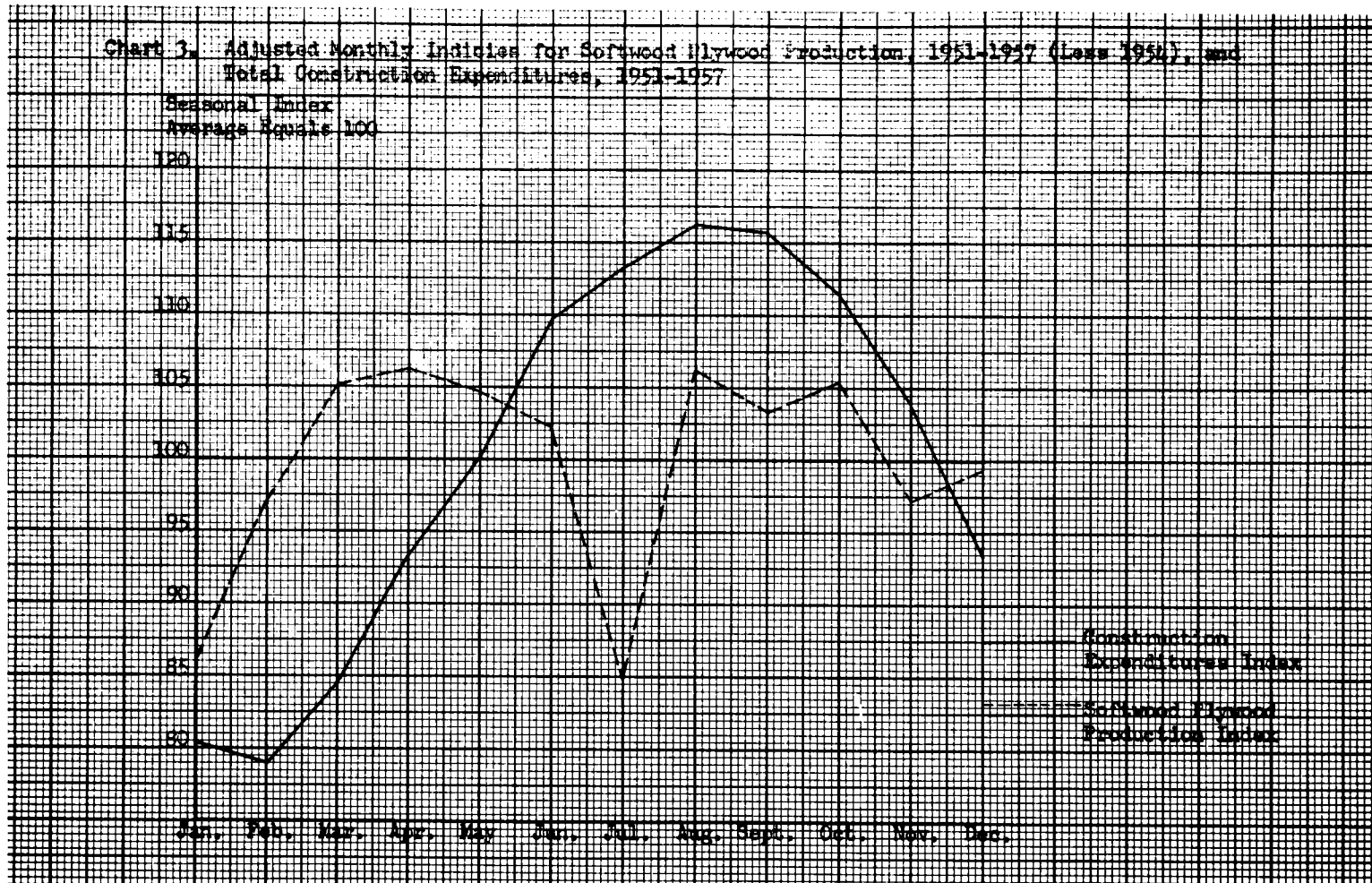


Chart 3. Adjusted Monthly Indices for Softwood Plywood Production, 1951-1957 (Less 1954); and Total Construction Expenditures, 1951-1957

but rather, stems from industry vacation policy. It is common practice in the industry to suspend operation of the mill for a two week period, usually during the first half of July. This practice is evident in decreased production figures for July.

The lower seasonal variation in plywood production, as compared to construction activity, may be traced to two major causes. These are non-construction markets and sales to full-service jobbers.

Although non-construction markets for softwood plywood amount to only 20 per cent of its total market, and is in itself heavily influenced by construction activity, this market plays a role in price stabilization. Sales to the non-construction markets during slack periods in construction activity tend to counteract a portion of the seasonal decrease in demand for softwood plywood.

Plywood production increases from January until April. A downward turning point is reached in April and production starts into a decline, reaching a low in July. From July to August there is a rapid rise in production to a point slightly above that attained in May. A decline occurs in September with recoup in October and a decline and slight recovery in November and December. From the data computed, it must be concluded that softwood plywood production is at its minimum point in January. A closer examination of the data presented in Table 3 reveals, that in every case but one, January production has been higher than the preceeding month of December. From this information, and from personal inquiry, it is concluded, that industry production of plywood reaches its yearly low during the month of November.

By building up inventories in anticipation of an increase in construction activity, the full-service wholesalers aid in stabilization of softwood plywood production. Jobbers start building up stocks during January and February in planning for spring building. If expectations are met, repeat orders are forth coming. This action allows the producers to increase production at an earlier period than if warehousing facilities were/<sup>not</sup>available. Jobbers also purchase stocks of material when prices are low, counting on an increase in price in the near future. Warehousing facilities enable the wholesalers to engage in this type of speculation. Through this type of speculative activity, demand is leveled out over the year, and a certain amount of stabilization of fluctuations in both price and production is accorded.

## DETERMINATION OF PRICE LEVEL

Examination of seasonality does not reveal enough information to allow determination of the level of softwood plywood prices. To better arrive at level of price, it is necessary to examine conditions of supply and demand. "The short-run market price of softwood plywood is established by the interaction of a large number of buyers and sellers... The industry's output is predominantly homogenous, at any moment of time there is a recognized market price for each type of panel. This price is established as the level where the market is cleared (i.e. where market supply and demand curves intersect."  
(6, p. 128)

## Demand

An examination of the uses of softwood plywood gives an indication of the demand for plywood. Since 80 per cent of all softwood plywood is used in construction, a strong relationship between softwood plywood production and construction activity should be expected.

Correlations of softwood plywood production to both total construction expenditures and total residential construction expenditures were calculated. It was desired to determine the existence of significance for these factors. (Appendix) The results of these computations are shown below.

| Softwood Plywood Production and:            | Correlation Coefficient (r) |
|---|-----------------------------|
| Total construction expenditures             | .924                        |
| Total residential construction expenditures | .808                        |

It can be seen that a highly significant correlation exists.

### Residential Construction

The use of plywood in residential construction has increased from 48 million square feet (3/8 inch basis) in 1920 to 1,400 million square feet in 1953 (7, p. 349). A study published in 1954 (7) reported that 40 per cent of the plywood used in residential construction was for roof sheathing, 25 per cent for sheathing and facing exterior walls, and 18 per cent for floor underlayment.

The higher cost of plywood in relation to some substitute materials is one to the more important factors limiting the use of plywood in construction. (7, p. 388) Lumber is the most serious single competitor of softwood plywood. A survey made of building contractors in 1951 to determine the materials used in place of plywood, reported 48 per cent of the contractors used lumber. This made lumber the largest single competitor, but the sum total of contractors using board materials in place of plywood was 76 per cent. Board materials noted were; fiberboards 23 per cent, plasterboards 22 per cent, and hardboards 31 per cent (1, p. 86). The increase in composition board production in recent years may have displaced a significant portion of the plywood market.

### Nonresidential Construction

America's Demand for Wood (7, p. 350) states that in 1951, 148 million square feet of softwood plywood was used in nonresidential

construction, including 11 million square feet for farm construction. It is also indicated that the rise in the rate of plywood consumption in nonresidential construction has been rapid.

#### Maintenance and Repair

In 1954, some 15 per cent of the plywood consumption was for maintenance and repair. Indications are that this market will expand as a resultant of the do-it-yourself trend. In 1951 a reported 509 million square feet of softwood plywood were consumed for all maintenance and repair. (7, p. 325)

#### Industrial Markets

Manufacturers who use plywood as a raw material or for plant equipment, maintenance and repair, make up the industrial market for softwood plywood. (1, p. 100) The more important industrial users of softwood plywood are prefabricated home manufacturers, boxcar and truck trailer builders, home trailer manufacturers, and boat and furniture makers.

#### Supply

"The supply of plywood at any given time is determined by three factors: (a) the capacity of the industry, (b) the price of plywood, and (c) the variable costs of plywood production" (1, p. 202).

### Industry Capacity

Historical evidence indicates that in periods of high demand, industry capacity increases rapidly. In the intermediate-run, firm capacity, and hence industry capacity, is increased by the extension of the work week to seven days and the addition of extra shifts. Long-run reaction to high demand, is both expansion of existing facilities, and construction of new.

Petit (7) has stated that there is no significant relationship between productive efficiency and scale or size of operations. Lack of economies of scale is based on the fact that a relatively fixed input-output relationship between labor and capital in the production process exists. "Large plywood mills are essentially additions of several small mills under a single roof" (6, p. 125). Regardless of size of plant, if there is not full utilization of equipment, diseconomies result.

### Plywood Price

At fluctuating price levels for plywood, differing amounts will be placed on the market. If a supply schedule were constructed for softwood plywood, at a given time, it would be found that as price rises, so does the quantity of plywood offered for sale. Conversely, as prices decline, the amount of plywood placed on the market declines.

### Variable Costs of Production

The previously mentioned factors are common to all firms, and are industry wide. The factor of total variable cost of production causes variations between firms to exist. A survey conducted in 1952, by the Douglas Fir Plywood Association showed that for 52 plants representing over three-quarters of the industry's capacity, veneer costs were 55.9 per cent of variable costs, direct and indirect labor was 36.5 per cent, and glue cost was 7.6 per cent. Break-even point in the industry is commonly considered to be between \$70 and \$80 per thousand square feet (7, p. 125). The break-even point varies with individual firms, according to log, glue, and labor costs.

Log costs: The open market for logs results in all firms having approximately the same economic cost of logs. Profits arising from using logs purchased at more advantageous times are log profits since those profits could have been realized by selling the logs on the open market (1, p. 203).

This situation applies to firms owning their own timber. The usual practice in this type of situation is for the logging department to sell the logs to the plywood plant at a price equal to that which the logging department could receive on the open market for the logs, plus transportation costs.

Labor costs: Log and glue costs appear highly uniform throughout the softwood plywood industry. Differences in variable cost must then be



to the remaining factor, labor costs. Labor costs can be broken down into two factors for analysis; (a) wage rate, and (b) labor productivity.

(a) Wage rates: Due to the large amount of unionization throughout the softwood plywood industry, there exists a fairly standard wage rate between mills. Major differences in wage rates do exist, but these are between owner-operated mills, and non-owner-operated mills. Worker-owners have been paid consistently higher wages than those received by non-owner-operators. The justification for these higher wage ranges is based on the belief that the worker-owner is more productive than a regular employee. There appears to be doubt regarding the issue of greater productivity, and Buskirk (1, p. 204) has shown where greater productivity does exist, it is not of sufficient magnitude to justify the high differential rates of pay received.

(b) Labor productivity: The method of illustration of labor productivity is that discussed by Buskirk (1, p. 204) but is presented in greater detail.

In 1946 the United States Department of Labor completed a study on man-hour requirements in the production of softwood plywood. This study was conducted in nine mills producing 43 per cent of the total softwood plywood production at that time. It was found that man-hour requirements per 1000 square feet of plywood produced (3/8 inch basis) ran from 9.7 man-hours to 15.1 man-hours, with an industry average of 12.4 man-hours. The breakdown of man-hour requirements by department is shown below (12, p. 69-70).

|                                | Man-hour requirements/1000 Sq.<br>Ft. of plywood (3/8 inch basis) |                 |
|--------------------------------|---|-----------------|
|                                | Average   | Range           |
| Total, all departments         | <u>12.4</u>   | <u>9.7-15.1</u> |
| Production departments         | 10.5  | 8.5-13.1        |
| Green end                      | 1.6   |                 |
| Drying                         | 1.6   |                 |
| Assembly (including finishing) | 6.5   | 4.1-8.0         |
| Shipping                       | .8  |                 |
| Nonproduction departments      | 1.9   | 1.2-2.9         |
| Plant burden                   | 1.3   |                 |
| Administration and selling     | .6  |                 |

Further breakdown was made of the assembly process:

|   | Man-hour requirements/1000 Sq.<br>Ft. of plywood (3/8 inch basis) |         |
|---|---|---------|
|   | Average   | Range   |
| Assembly, all processes                         | 6.5   | 4.1-8.0 |
| Veneer preparation (Patching,<br>tapping, etc.) | 2.1   |         |
| Bonding (Lay-up)                                | 2.5   |         |
| Finishing                                       | 1.9   |         |

Results of a man-hour requirement survey made of the softwood plywood industry in 1935 were compared with the 1946 study. This comparison showed that total average man-hour requirements had decreased 25 per cent over the eleven year period. Average man-hour requirements decreased from 16.6 man-hours in 1935 to 12.4 man-hours in 1946. The Department of Labor attributes this decrease to new equipment discoveries, and to better layout and material handling techniques. (12, p. 71)

Assuming an average labor cost of \$2.25 per hour, it can be shown that the difference in variable labor cost between the most efficient

and inefficient mill is \$12.15 per 1000 square feet of plywood (3/8 inch basis). The difference between the average mill and the extremes is \$6.08 on the same basis. It is assumed by the author that a majority of the existing plywood mills operate within the extremes of man-hour requirements. Also, there have been a large number of improvements in plywood plant machinery and design since the study in 1946 and it is felt that in many cases productivity has further increased over the 1946 figures. Based upon these assumptions, it is concluded that the variable labor cost differential between mills is of slight consequence.

Conclusions regarding variable costs of production: It has been shown that there is little difference in variable costs between plywood firms. As plywood prices decline, the majority of mills are able to stay in direct competition with each other, until the break-even point of \$80 is reached. As the price goes below \$80 the more inefficient mills are forced to curtail or cease production. Eventually a point is reached where only the most efficient mills are able to operate, and this point becomes a minimum figure for prices.

Firms will continue to operate below the break-even point in the short-run before adjustments can be made. In the intermediate-run firms will produce below the break-even point only if they anticipate an increase in price within a short time. If the price decline is taken to be of a permanent nature by producers, they will cease production and liquidate holdings.

## CONCLUSIONS

Seasonal fluctuation in softwood plywood price and production may be traced directly to the industry's strong dependence upon construction activity. Full-service jobbers play an important roll in reducing plywood price and production fluctuations. Speculative behaviour on the part of the wholesalers tend to decrease the severity of the seasonal variations. Non-construction markets aid in stabilizing seasonal fluctuation by providing markets during the slack seasons in building activity.

Softwood plywood price is basically a market determined price, and subject to the laws of supply and demand. When supply is greater than demand, severe competition develops among mills, and price is driven down, often through the actions of jobbers. The maximum limit of softwood plywood price is set by competing materials, since price will not exceed the point at which it will be more profitable to use other materials. The lower price limit of softwood plywood is determined by the point at which average variable costs of the mills are covered. When prices fall below the break-even point, firms may act in a number of different ways. Future price outlook will determine the action taken by the firms.

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APPENDIX

## CORRELATION COEFFICIENTS

The method used for calculation correlation coefficients is that shown in Introduction to Statistical Inference, by Jerome C. R. Li (5, p. 268). The figures used in the calculations were for the period 1935 to 1957 with the period of the second World War (1942 to 1945) omitted. It was felt that the abnormality of the war period would deter from a true indication of a significant relationship.

Symbols used in the calculation of correlation coefficients:

$N$  is the number of observations.

$\Sigma X$  is the sum of the  $X$  observations.

$\bar{X}$  is the average of the  $X$  observations.

$(\Sigma X)^2$  is the sum of the  $X$  observations squared.

$\Sigma X^2$  is the sum of the  $X$  observations squared.

$SS_X$  is the product of  $X^2 - \frac{(\Sigma X)^2}{N}$ .

$S_p$  is the product of  $\frac{(\Sigma X)(\Sigma Y)}{SS_X \cdot SS_Y}$ .

## Calculation of correlation coefficients. (6)

| Year | Total construction expenditures in millions of dollars<br>(10, p. 37; 11, p. 7) | Total Softwood Plywood production in millions Sq. Ft. 3/8 inch basis<br>(8, p. 69; 9, p. 66-70) |
|------|---|---|
| Year | X   | Y   |
| 1935 | 4,232   | 480   |
| 1936 | 6,497   | 700   |
| 1937 | 6,999   | 725   |
| 1938 | 6,980   | 650   |
| 1939 | 8,198   | 950   |
| 1940 | 8,682   | 1,200   |
| 1941 | 11,951  | 1,620   |
| 1946 | 12,000  | 1,395   |
| 1947 | 16,627  | 1,630   |
| 1948 | 21,572  | 1,871   |
| 1949 | 22,584  | 1,889   |
| 1950 | 27,902  | 2,553   |
| 1951 | 30,888  | 2,866   |
| 1952 | 32,328  | 3,049   |
| 1953 | 35,256  | 3,670   |
| 1954 | 37,170  | 3,824   |
| 1955 | 39,601  | 5,075   |
| 1956 | 44,581  | 5,240   |
| 1957 | <u>46,060</u>   | <u>5,450</u>  |

$$N = 19$$

$$(\Sigma X) (\Sigma Y) = 18,836,382,396 \quad \Sigma X = 420,108$$

$$\Sigma Y = 44,837$$

$$\frac{(\Sigma X) (\Sigma Y)}{N} = 991,388,547 \quad \bar{X} = 22,111$$

$$\bar{Y} = 2,359$$

$$\Sigma XY = 1,396,083,059$$

$$(\Sigma X)^2 = 168,928,787,664$$

$$(\Sigma Y)^2 = 2,010,356,569$$

$$S_p = 404,694,512$$

$$\frac{(\Sigma X)^2}{N} = 8,890,988,824$$

$$\frac{(\Sigma Y)^2}{N} = 105,808,404$$

$$\Sigma X^2 = 12,918,595,862$$

$$\Sigma Y^2 = 153,343,578$$

$$SS_X = 4,027,607,038$$

$$SS_Y = 47,535,174$$

Correlation Coefficient (r)

$$r = \frac{S_p}{\sqrt{SS_X \cdot SS_Y}} = \frac{404,694,512}{\sqrt{191,453,001,354,954,612}} = .924$$



Total Residential construction expenditures in millions of dollars (10, p. 32-33; 4, p. 192)

Total spftwood plywood production in millions Sq. Ft. 3/8 inch basis (8, p. 69; 9, p. 66-70)

| Year                                     | X  | Y                                      |
|--|--|--|
| 1935                                     | 1,019  | 480                                    |
| 1936                                     | 1,626  | 700                                    |
| 1937                                     | 1,968  | 725                                    |
| 1938                                     | 2,025  | 650                                    |
| 1939                                     | 2,745  | 950                                    |
| 1940                                     | 3,185  | 1,200                                  |
| 1941                                     | 3,940  | 1,620                                  |
| 1946                                     | 4,389  | 1,395                                  |
| 1947                                     | 6,510  | 1,630                                  |
| 1948                                     | 20,278   | 1,871                                  |
| 1949                                     | 10,001   | 1,889                                  |
| 1950                                     | 14,445   | 2,553                                  |
| 1951                                     | 13,124   | 2,866                                  |
| 1952                                     | 13,496   | 3,049                                  |
| 1953                                     | 27,829   | 3,670                                  |
| 1954                                     | 15,715   | 3,824                                  |
| 1955                                     | 18,971   | 5,075                                  |
| 1956                                     | 17,924   | 5,240                                  |
| 1957                                     | <u>17,081</u>                                  | <u>5,450</u>                           |
| N=19                                     | $(\Sigma X)(\Sigma Y) = 8,800,202,827$         | $\Sigma Y = 44,837$                    |
| $\Sigma X = 196,271$                     | $\frac{(\Sigma X)(\Sigma Y)}{N} = 463,168,622$ | $\bar{Y} = 2,359$                      |
| $\bar{X} = 2,359$                        | $\Sigma XY = 651,907,300$                      | $(\Sigma Y)^2 = 2,010,356,569$         |
| $(\Sigma X)^2 = 38,522,305,441$          | $S_p = 188,738,678$                            | $\frac{(\Sigma Y)^2}{N} = 105,808,404$ |
| $\frac{(\Sigma X)^2}{N} = 2,027,489,760$ |  | $\Sigma Y^2 = 153,343,578$             |
| $\Sigma X^2 = 3,175,102,503$             |  | $SS_Y = 47,535,174$                    |
| $SS_X = 1,147,612,743$                   |  |  |

Correlation Coefficient (r)

$$r = \frac{S_p}{\sqrt{SS_X \cdot SS_Y}} = \frac{188,738,678}{\sqrt{54,551,971,423,122,282}} = .808$$

UNADJUSTED MONTHLY WHOLESALE SOFTWOOD PLYWOOD PRICE INDEXES 1952-1957 (TABLE I)

