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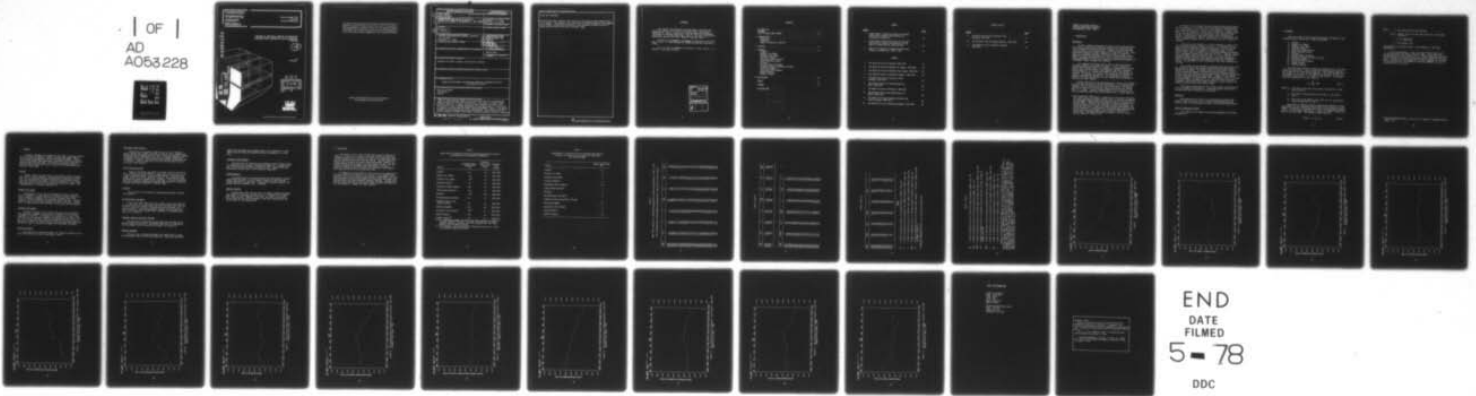
CONSTRUCTION ENGINEERING RESEARCH LAB (ARMY) CHAMPAI--ETC F/G 13/3
TRENDS IN THE REAL PRICES OF SELECTED CONSTRUCTION PRODUCTS AND--ETC(U)
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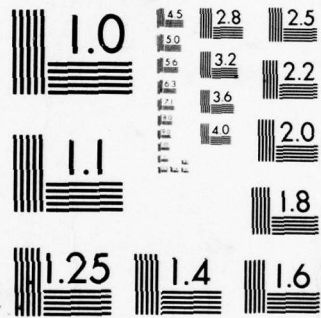
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SPECIAL REPORT D-84
March 1978
Material Shortages Model

TRENDS IN THE REAL PRICES OF SELECTED
CONSTRUCTION PRODUCTS AND MATERIALS,
1946-1976

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B.S.

by
R. Ramsson

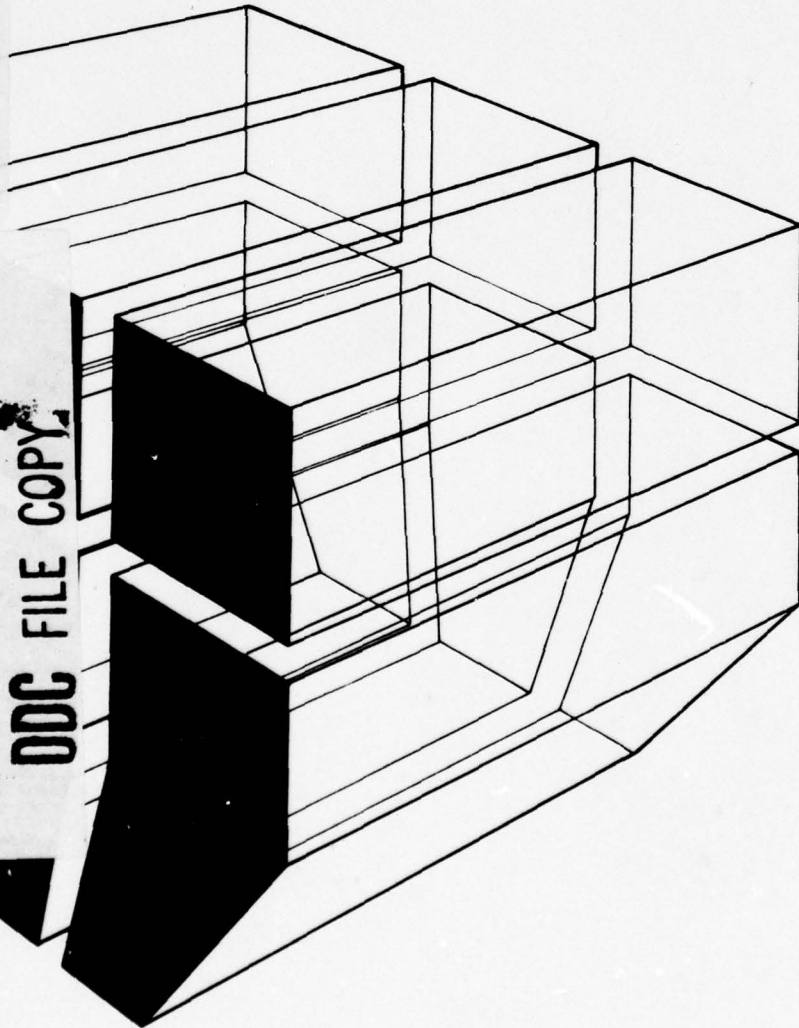
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) ➔ This study measured trends in the relative prices of 13 construction goods and materials from 1946 through 1976. The prices of three of these products--Douglas Fir lumber, structural steel products, and steel reinforcing bars-- have increased substantially since World War II. The prices of plywood, building paper and board, heating equipment, asphalt, and gypsum products have declined during the post-War period. The prices of the remaining products--Southern Pine lumber, concrete products, millwork, plumbing		

Block 20. continued.

fixtures and brass fittings, and structural clay products--have shown little or no change. The pattern of the real prices of these products in 1976 suggests that savings in construction materials can be obtained by substituting for those products whose prices have increased. ←

FOREWORD

This project was performed for Directorate of Military Construction, Office of the Chief of Engineers (OCE) under Project 4A762731AT41, "Design, Construction, and Operation and Maintenance Technology for Military Facilities"; Task T7, "Military Construction Materials"; and Work Unit 005, "Material Shortages Model."

The work was performed by the Energy and Habitability Division (EH) of the U. S. Army Construction Engineering Research Laboratory (CERL).

COL J. E. Hays is Commander and Director of CERL, and DR. L. R. Shaffer is Technical Director.

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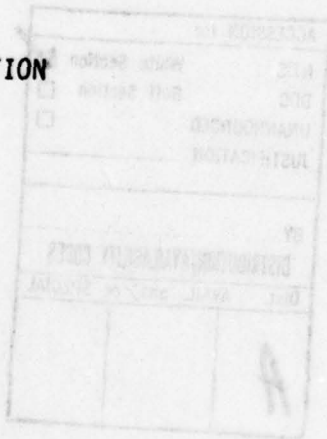
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TRENDS IN THE REAL PRICES OF SELECTED CONSTRUCTION PRODUCTS AND MATERIALS, 1946 - 1976

1 INTRODUCTION

Background

In 1973, temporary shortages of various construction materials and products occurred which were caused mainly by a sustained high level of demand for new construction. Demand for housing had been stimulated by the low interest rates in 1972 and much of 1973. Also, before the shortages occurred (1966-1973), growth of productive capacity in materials-processing industries (such as steel, cement, paper, and board) was unusually low. This is explained partly by various government policies that created an uncertain environment for investment,¹ which included price controls.

In a competitive economy such as that of the United States, shortages generally cause price increases. A price increase (1) rations the available supply of a product to consumers who want the product most, and (2) attracts new producers (and thus increases total production) if increase and windfall profits are expected to continue. Of course, if a price is not allowed to rise because of controls, the shortage may persist. In the absence of controls, however, shortages are unlikely to last, except while the market is adjusting to excess demand.

Certain difficulties are associated with a policy that attempts to avoid repercussions of a product shortage by (1) forecasting the shortage, and (2) planning for the use of substitutes. An obvious problem is inaccuracy of forecasts, especially for periods of more than 1 or 2 years. Careful, constant monitoring of industries can provide reasonably good short-term forecasts, but is quite expensive.

¹ "One reason [for slow growth in capacity] was that those industries were still working off excess capacity built up (partly in response to government-created incentives) from the end of the Korean war to the mid 1960's. Reasons that investment in capacity expansion remained unattractive up to 1973 included an over-valued dollar, uncertainty about how to comply with newly enacted environmental and safety legislation, and uncertainty surrounding both the imposition of price controls and changes in price control regulations." Donald Rice, "Shortages and Economic Planning," *The Wall Street Journal* (March 14, 1977), p 16.

One goal of the shortage forecasting/substitution policy would be the avoidance of increased construction costs by substituting for the product predicted to be scarce or more expensive. However, this goal is not very feasible, since a price increase for a product tends to increase the demand for its substitutes, thus increasing their prices. Therefore, even with substitution, cost increases will usually be unavoidable. However, substitution can be profitable when fairly permanent changes occur in the *relative*, or *real*, prices of products.

A real price of a product is a price expressed in terms of the prices of other products instead of dollars. It indicates not how many dollars are required to purchase the product, but how much of another good or some set of goods is required in trade. At any specific time, there is essentially no difference between the nominal price (expressed in money units) and the real price. However, nominal prices of goods change at different rates. It is not possible to determine whether the price of a good has increased or decreased in relation to other goods by simply examining the trend in nominal prices. The advantage of real price data is that such information is provided.

Cost savings can be obtained by examining goods whose real price has decreased, rather than products whose real price has remained constant or increased. If nominal prices of both product X and all other construction products increased 50 percent during a period of 2 years, then the relative price of product X has remained constant and savings from substitution are negligible. However, if the nominal price of product X increased faster than the nominal prices of all construction products and materials (i.e., the real price of product X increased), then substitution (where feasible) of other products for product X would provide significant savings.

This paper presents data on the relative prices of selected construction products and materials. These data suggest obvious cost savings which may be achieved by substitution.

Objective

The purpose of this study is to illustrate and measure past trends in the relative prices of selected construction goods and materials and to indicate possible areas for profitable substitution.

Mode of Technology Transfer

This study will not impact any existing Department of the Army documentation.

2 APPROACH

The real prices of the following 13 products and materials were examined for the time period of 1946 through 1976.

1. Plywood
2. Douglas Fir lumber
3. Southern Pine lumber
4. Concrete products
5. Structural steel products
6. Steel reinforcing bars
7. Millwork
8. Building paper and board
9. Plumbing fixtures and brass fittings
10. Heating equipment
11. Structural clay products
12. Gypsum products
13. Asphalt products.

Data were then compiled on indices of wholesale prices for these products and materials. These indices were normalized by a general price index for all construction materials. The resulting data series are indices of the prices of the products and materials *relative* to the general price index, i.e., indices of real prices. In algebraic terms the computation of a real index is:

$$P_t = \frac{W_t}{G_t} \times 100 \quad [\text{Eq 1}]$$

where P_t = the value of the real price index calculated for a given good for year t

W_t = the value of the wholesale price index for the good at year t

G_t = the value of the general price index for all construction goods and materials at year t.

Each series of computed data for products and materials on hand was graphed for the time period 1946 through 1976 to examine the price trends. In addition, two methods were used to estimate annual growth rates in the individual data series. In the first method, regressions were fit to the trends. The regression model used was

$$\ln(P_t) = \alpha + \beta_t + \epsilon_t \quad [\text{Eq 2}]$$

where α = the coefficient of the intercept

$\ln(P_t)$ = natural log of the real price index for a given good,
for year t

t = 1-31 (1946-1976)

ϵ_t = disturbance term.

The estimate of the growth rate is the estimate of β , the slope coefficient.

In the second method, 2 years near the beginning and the end of the time series were chosen (1953 and 1969). These years also represented peaks in the business cycle.² Growth rates were calculated for this series on the basis of the values of the indices for the base years. The object of this method was to remove somewhat the influence of the business cycle (and demand) on prices by comparing 2 years at similar points in the cycle.

² *Long Term Economic Growth, 1860-1970* (U.S. Bureau of Economic Analysis, 1973), p 44.

3 FINDINGS

Figures 1 through 13 are graphs of the trends in the real prices of the 13 products examined. Table 1 provides the growth rates in these trends as estimated by fitting the regression model. Table 2 provides the growth rates obtained by using real price index data for the base years 1953 and 1969. The following paragraphs provide a brief discussion about the trend in real price for each product and material listed above.

Plywood

Figure 1 shows that the trend in the relative price of plywood from 1947 to 1976 was downward, although some fluctuations occurred. Thus, as the technology of producing plywood was perfected, production costs apparently decreased. Fitting a regression to this trend shows that the real price of plywood has declined at an annual rate of approximately 1.8 percent (see Table 1).

Douglas Fir Lumber

From Figure 2, it is hard to distinguish a trend in the real price of Douglas Fir lumber because of substantial year-to-year variation, although it appears that real price increased after 1970. Using the regression method, the estimated growth rate was .7 percent annually; using the base years method, the growth rate was 1 percent. Thus, it seems definite that the trend in this real price was upward.

Southern Pine Lumber

As shown in Figure 3, the trend in the real price of Southern Pine lumber was somewhat like the trend in Douglas Fir real prices, although less volatile. Furthermore, the growth rate in this trend, regardless of the estimation method, was negligible (see Tables 1 and 2). Thus, while there was a definite increase in the real price of Douglas Fir lumber, the average real price of Southern Pine lumber did not exhibit such an increase, although there was annual variation.

Concrete Products

The real price of concrete products has remained essentially constant since 1946 (see Figure 4 and Tables 1 and 2).

Structural Steel Products

Despite such technological advances as the use of numerical control methods and automatic welding, structural steel products have become more costly between 1947 and 1976. Using the regression method, the growth rate in the trend of real price for these products was estimated as 2 percent; using the base years method, the estimate was 1.6 percent. Figure 5 shows the rising trend in the real price of structural steel products.

Steel Reinforcing Bars

Figure 6 illustrates the trend in the real price of reinforcing bars. Clearly, the trend exhibits a great deal of volatility, and a slightly increased growth. The base years method of estimating the growth rate of this trend showed no increase. The regression method estimated the positive growth to be .8 percent. Thus, the conclusion that price increased significantly between 1947 and 1976 is justified although growth was negligible in 1953 and 1969.

Millwork

The real price of millwork has remained approximately constant (see Figure 7).

Building Paper and Board

Since about 1960, there has been a steady, substantial decrease in the real price of building paper and board products (see Figure 8). Using the base years method, the growth rate was estimated to be -.7 percent annually. Using the regression method, which includes the whole time period (1947 through 1976), provided an estimated growth rate of -1.1 percent.

Plumbing Fixtures and Brass Fittings

The real price of plumbing fixtures and brass fittings has remained essentially constant. Estimated growth rates are negligible, and the graphed trend is basically horizontal (see Figure 9).

Heating Equipment

The real price of heating equipment has demonstrated a steady decline between 1947 and 1976 (see Figure 10). Using the regression

method, the estimated annual growth rate in this trend was -1.3 percent; using the base years method provided an estimate of -1.4 percent.

Structural Clay Products

The real price of structural clay products, which include bricks, has remained fairly constant, although from Figure 11 it appears that real price has fallen slightly since about 1967. However, the estimated annual growth rates in this trend are negligible.

Gypsum Products

The relative price of gypsum products was approximately constant between 1947 and 1967. But, as shown in Figure 12, the price has fallen substantially since 1967. Using either estimation method, the growth rate was estimated to be -.7 percent.

Asphalt Products

Through about 1970, the real price of asphalt products decreased (see Figure 13), showing a growth rate of -1.3 percent for the base years 1953 and 1969. However, since 1970, the trend in real price has reversed and by 1976 had reached a level that characterized the initial years of the study period.

4 CONCLUSIONS

The results of this study indicate that prices of Douglas Fir lumber, structural steel products, and steel reinforcing bars have increased substantially relative to prices of all construction products and materials during the post-war period. The real prices of plywood, building paper and board, heating equipment, asphalt, and Gypsum products have declined during the post-war period. The real prices of Southern Pine lumber, concrete products, millwork, plumbing fixtures and brass fittings, and structural clay products have shown negligible or no change since 1946.

In comparison to the pattern of real prices at the beginning of the study period, the pattern of real prices in 1976 suggests that savings in the costs of construction materials and products could have been obtained by substituting plywood, building paper and board, and gypsum products for other materials wherever feasible. Savings could also have been obtained by substituting other products and materials for both Douglas Fir lumber and steel products.

Table 1

Growth Rates in Relative Prices of Selected Construction Products
and Materials as Estimated by Regression

Product	Estimated Annual Growth Rate (%)	Standard Error of the Estimate (%)	Relevant Time Period
Plywood	-1.77	.13	1947-1976
Douglas Fir Lumber	.68	.24	1947-1976
Southern Pine Lumber	.07**	.18	1947-1976
Concrete Products	- .21	.07	1946-1976
Structural Steel Products	1.98	.16	1947-1976
Steel Reinforcing Bars	.82	.24	1947-1976
Millwork	.12**	.08	1946-1976
Building Paper and Board	-1.12	.21	1947-1976
Plumbing Fixtures and Brass Fittings	- .22	.07	1946-1976
Heating Equipment	-1.30	.06	1947-1976
Structural Clay Products	- .01**	.11	1947-1976
Gypsum Products	- .59	.13	1947-1975
Asphalt Products*	- .55	.19	1946-1976

* For 1946 through 1970, the real price index applies for asphalt products generally; however, from 1971 through 1976, the index applies just to asphalt roofing.

** The estimate is not significantly different from zero at a level of 10 percent (two-tailed test).

Table 2

Growth Rates in Relative Prices of Selected Construction
Products and Materials on the Basis of Index Data
for 1953 and 1969

Product	Annual Growth Rate (%)
Plywood	-1.7
Douglas Fir Lumber	1.0
Southern Pine Lumber	.2
Concrete Products	- .3
Structural Steel Products	1.6
Steel Reinforcing Bars	--
Millwork	.1
Building Paper and Board	- .7
Plumbing Fixtures and Brass Fittings	.1
Heating Equipment	-1.4
Structural Clay Products	.2
Gypsum Products	- .7
Asphalt Products	- 1.3

Table 3

Real Price Indices for Selected Construction Products and Materials (1967 = 100)

(For explanation of table heading abbreviations, see notes at end of table.)

YEAR	PLY	F	P	CON	ST	RE	MILL
1946	--	--	--	117.	--	--	93.
1947.	162.	105.	117.	105.	58.	71.	88.
1948.	166.	109.	116.	100.	64.	74.	96.
1949.	148.	97.	107.	104.	72.	84.	100.
1950.	154.	111.	112.	99.	72.	81.	99.
1951.	152.	111.	110.	97.	70.	79.	103.
1952.	141.	112.	112.	98.	72.	82.	102.
1953.	144.	101.	110.	99.	75.	90.	104.
1954.	136.	103.	105.	101.	78.	98.	103.
1955.	133.	108.	104.	97.	79.	97.	97.
1956.	123.	103.	104.	97.	81.	100.	94.
1957.	117.	93.	100.	99.	93.	108.	93.
1958.	118.	91.	98.	101.	97.	112.	93.
1959.	119.	101.	98.	99.	96.	111.	95.
1960.	115.	94.	98.	102.	98.	112.	97.
1961.	115.	91.	96.	104.	100.	112.	97.
1962.	111.	94.	96.	104.	100.	107.	97.
1963.	112.	98.	96.	103.	101.	96.	99.
1964.	109.	98.	95.	101.	102.	97.	102.
1965.	108.	96.	95.	101.	100.	104.	100.
1966.	105.	98.	101.	99.	101.	102.	99.
1967.	100.	100.	100.	100.	100.	100.	100.
1968.	110.	114.	108.	97.	96.	94.	100.
1969.	110.	118.	113.	95.	97.	90.	106.
1970.	96.	97.	102.	100.	102.	98.	103.
1971.	96.	115.	112.	101.	106.	98.	101.
1972.	103.	127.	120.	99.	106.	91.	101.

Table 3 (con't)

YEAR	PLY	F	P	CON	ST	RE	MILL
1973.	112.	151.	136.	95.	102.	90.	104.
1974.	100.	133.	115.	94.	111.	125.	98.
1975.	93.	122.	101.	98.	124.	115.	92.
1976.	99.	133.	116.	96.	121.	97.	94.

YEAR	PAPR	PLU	HEAT	C	GYP	A
1946.	--	113.	--	--	--	151.
1947.	104.	99.	125.	92.	104.	126.
1948.	104.	97.	120.	89.	102.	125.
1949.	107.	99.	125.	94.	104.	127.
1950.	103.	97.	119.	91.	99.	117.
1951.	106.	100.	118.	90.	101.	110.
1952.	103.	98.	119.	91.	103.	110.
1953.	106.	95.	118.	92.	104.	113.
1954.	112.	97.	118.	93.	105.	109.
1955.	110.	98.	113.	93.	101.	107.
1956.	110.	101.	113.	94.	101.	108.
1957.	114.	98.	115.	95.	101.	118.
1958.	115.	93.	114.	96.	104.	109.
1959.	114.	95.	111.	95.	102.	109.
1960.	115.	98.	111.	98.	104.	102.
1961.	117.	100.	109.	101.	108.	112.
1962.	113.	97.	108.	102.	109.	108.
1963.	112.	97.	107.	102.	110.	102.
1964.	108.	96.	105.	101.	111.	100.

Table 3 (con't)

YEAR	PAPR	PLU	HEAT	C	GYP	A
1965.	105.	97.	103.	101.	106.	103.
1966.	102.	99.	101.	99.	101.	103.
1967.	100.	100.	100.	100.	100.	100.
1968.	96.	98.	97.	97.	98.	98.
1969.	95.	96.	94.	95.	93.	92.
1970.	90.	100.	98.	98.	89.	91.
1971.	86.	97.	97.	96.	89.	106.
1972.	84.	95.	93.	93.	91.	105.
1973.	81.	91.	87.	89.	87.	100.
1974.	77.	93.	84.	84.	86.	118.
1975.	73.	93.	87.	87.	83.	125.
1976.	74.	93.	84.	87.	--	124.

Notes

- PLY = (index of wholesale prices of plywood divided by INDEX*) times 100
- F = (index of wholesale price of Douglas Fir Lumber divided by INDEX) times 100
- P = (index of wholesale price of Southern Pine Lumber divided by INDEX) times 100
- CON = (index of wholesale prices of concrete products divided by INDEX) times 100
- ST = (index of wholesale prices of finished steel products - structural shapes divided by INDEX) times 100

* Index of wholesale prices of all construction materials.

Table 3 (con't)

RE	= (index of wholesale price of reinforcing bars divided by INDEX) times 100
MILL	= (index of wholesale prices of millwork divided by INDEX) times 100
PAPR	= (index of wholesale prices of building paper and board divided by INDEX) times 100
PLU	= (index of wholesale prices of plumbing fixtures and brass fittings divided by INDEX) times 100
HEAT	= (index of wholesale prices of heating equipment divided by INDEX) times 100
C	= (index of wholesale prices of structural clay products divided by INDEX) times 100
GYP	= (index of wholesale prices of gypsum products divided by INDEX) times 100
A	= (index of wholesale prices of asphalt products divided by INDEX) times 100

20

Sources of the wholesale price data are (1) *Historical Statistics of the United States, Colonial Times to 1970*, Bicentennial Edition, Part 1, Series N 140-155 (U.S. Bureau of the Census) (for data through 1970); (2) *Construction Review*, Table E-2 (U.S. Department of Commerce, December 1976) (for data from 1971 to 1976); (3) *Construction Review*, Table E-2 (U.S. Department of Commerce, December 1975) (for data on gypsum products from 1971 to 1975). The data for 1976 is the average of the monthly indices for January through November. The wholesale price data for 1946 through 1970 used to compute "A" apply to asphalt products generally. From 1971 to 1976, these data are for asphalt roofing only.

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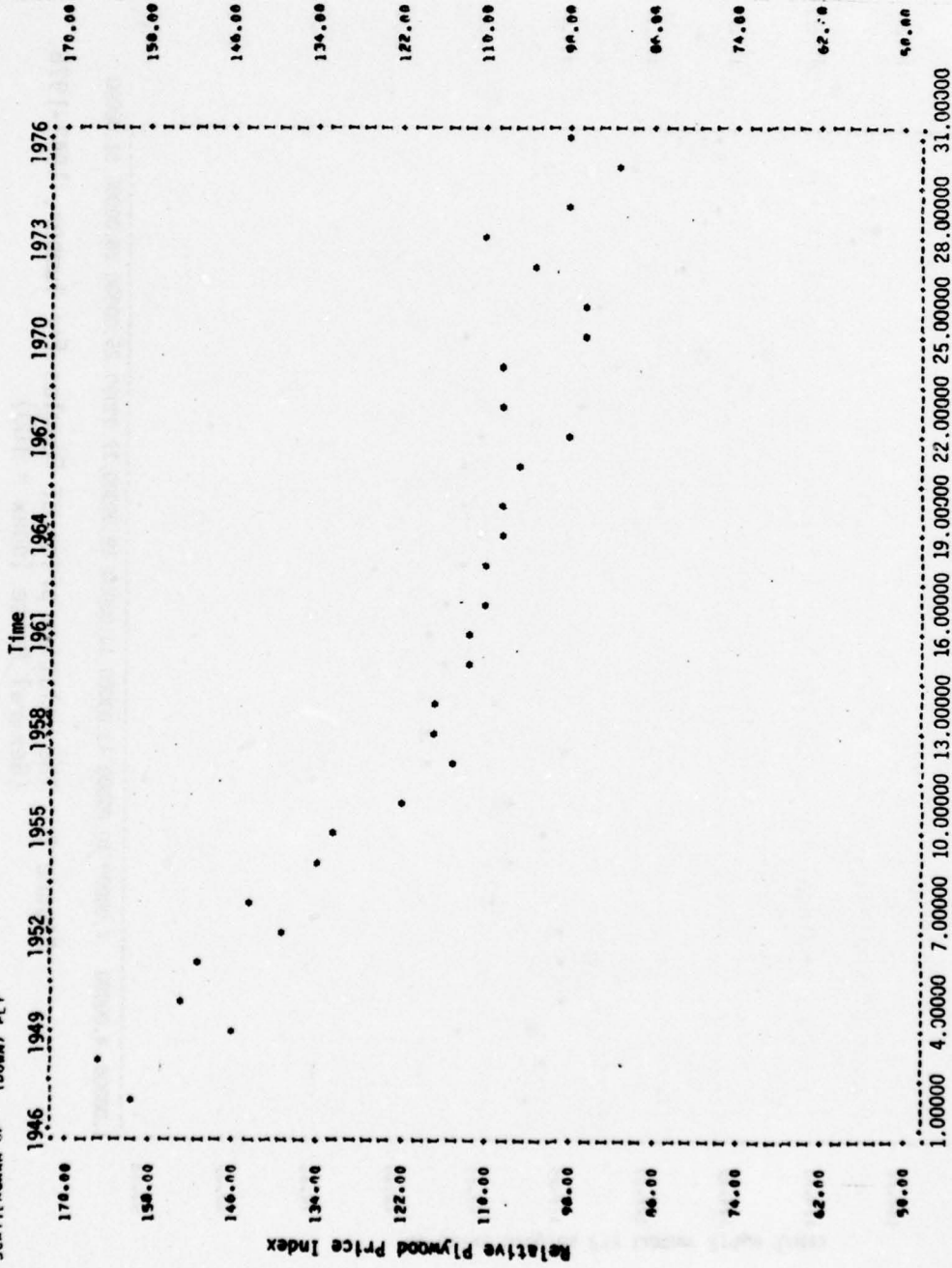


Figure 1. The relative price of plywood, 1947-1976.
 (General Price Index = 100)

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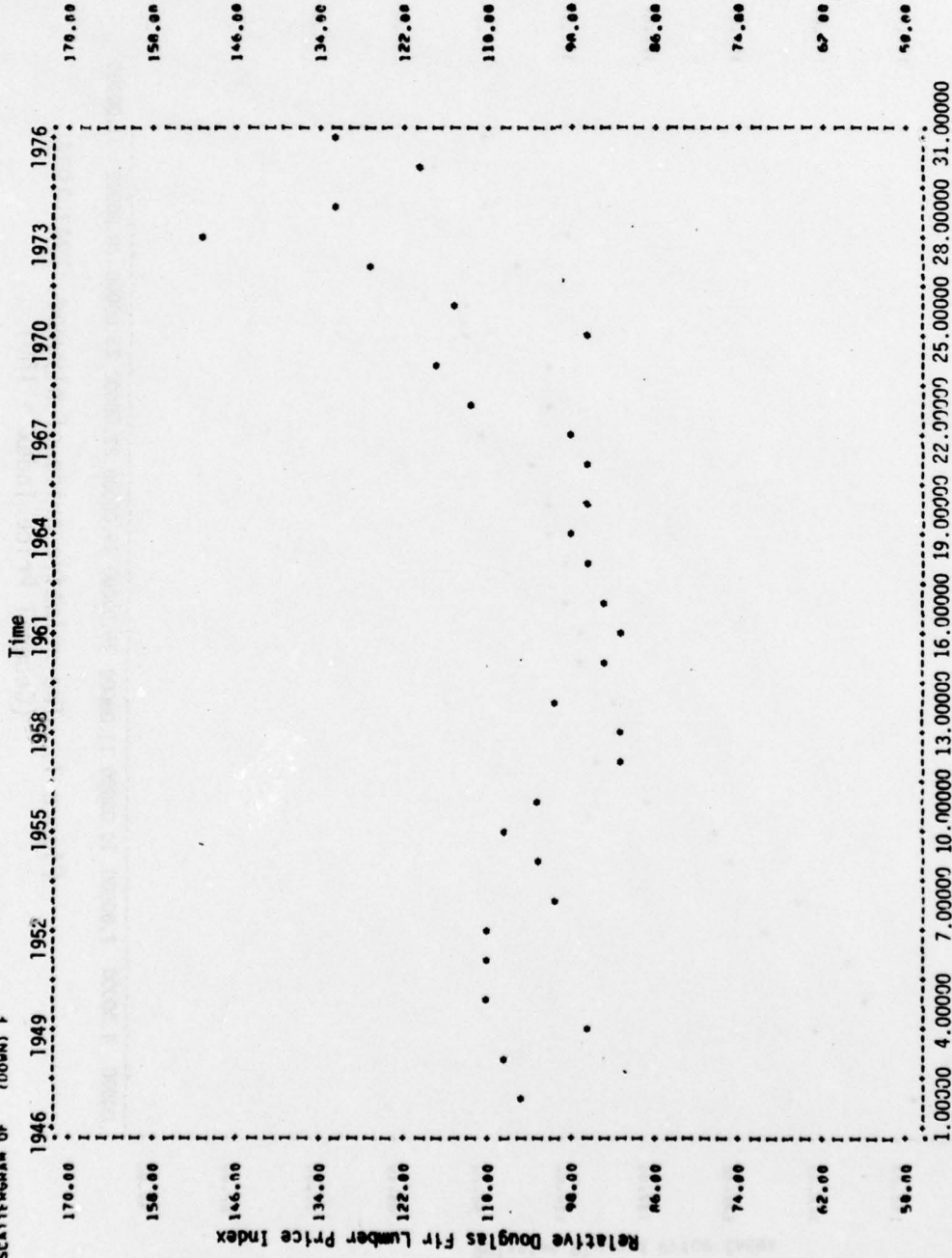


Figure 2. The relative price of Douglas Fir Lumber, 1947-1976.
 (General Price Index = 100)

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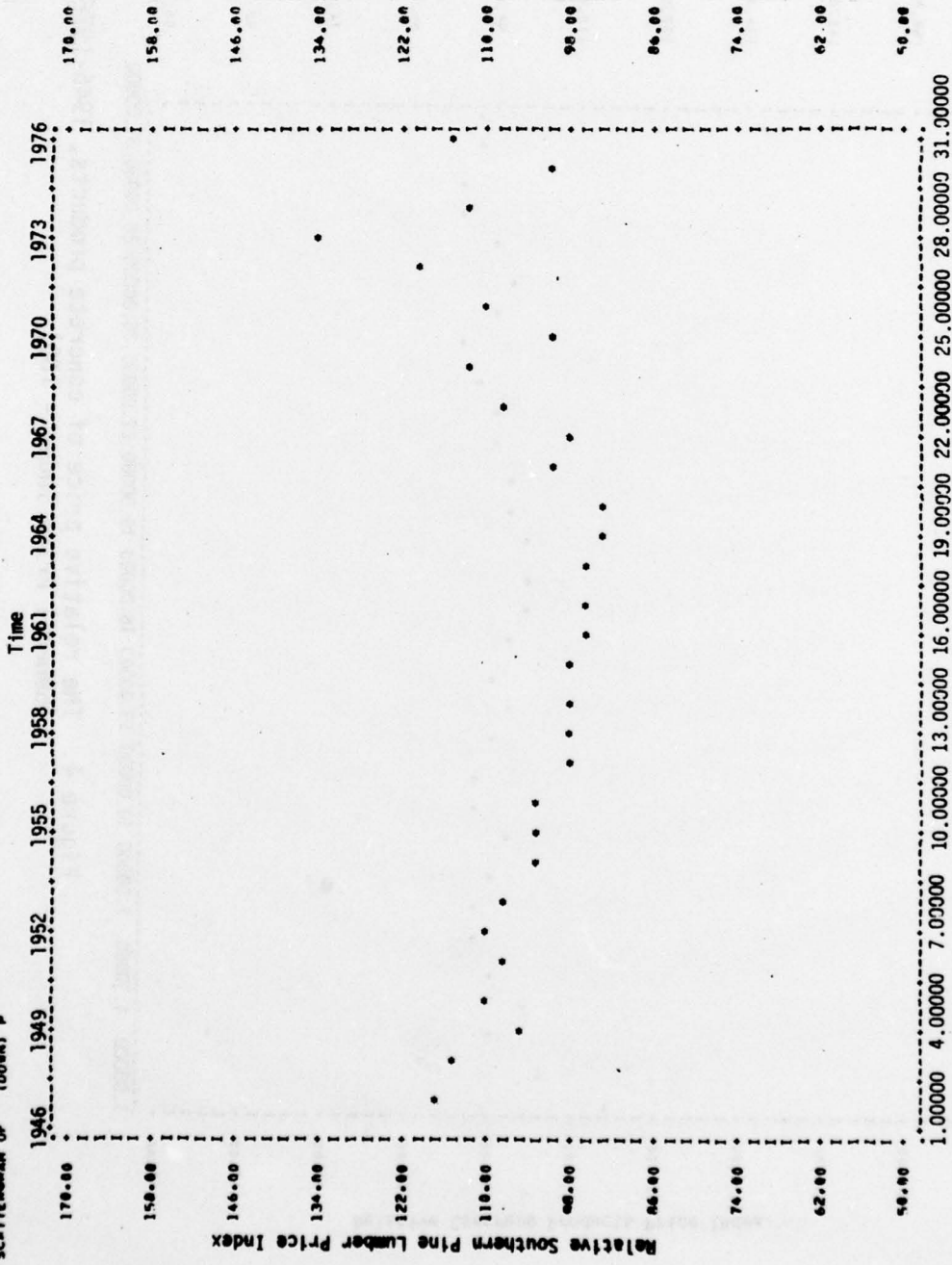


Figure 3. The relative price of Southern Pine Lumber, 1947-1976.
 (General Price Index = 100)

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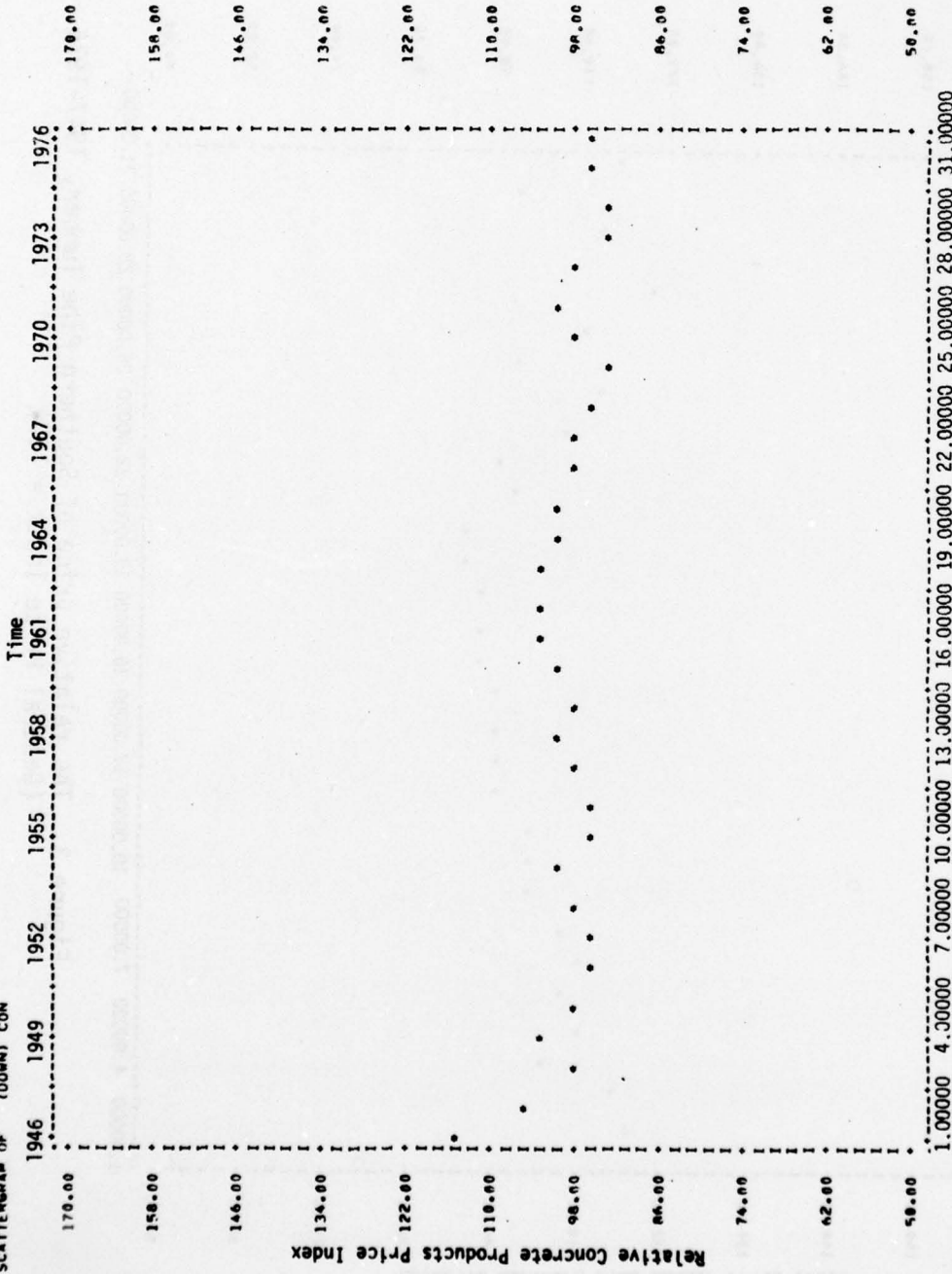


Figure 4. The relative price of concrete products, 1946-1976.
 (General Price Index = 100)

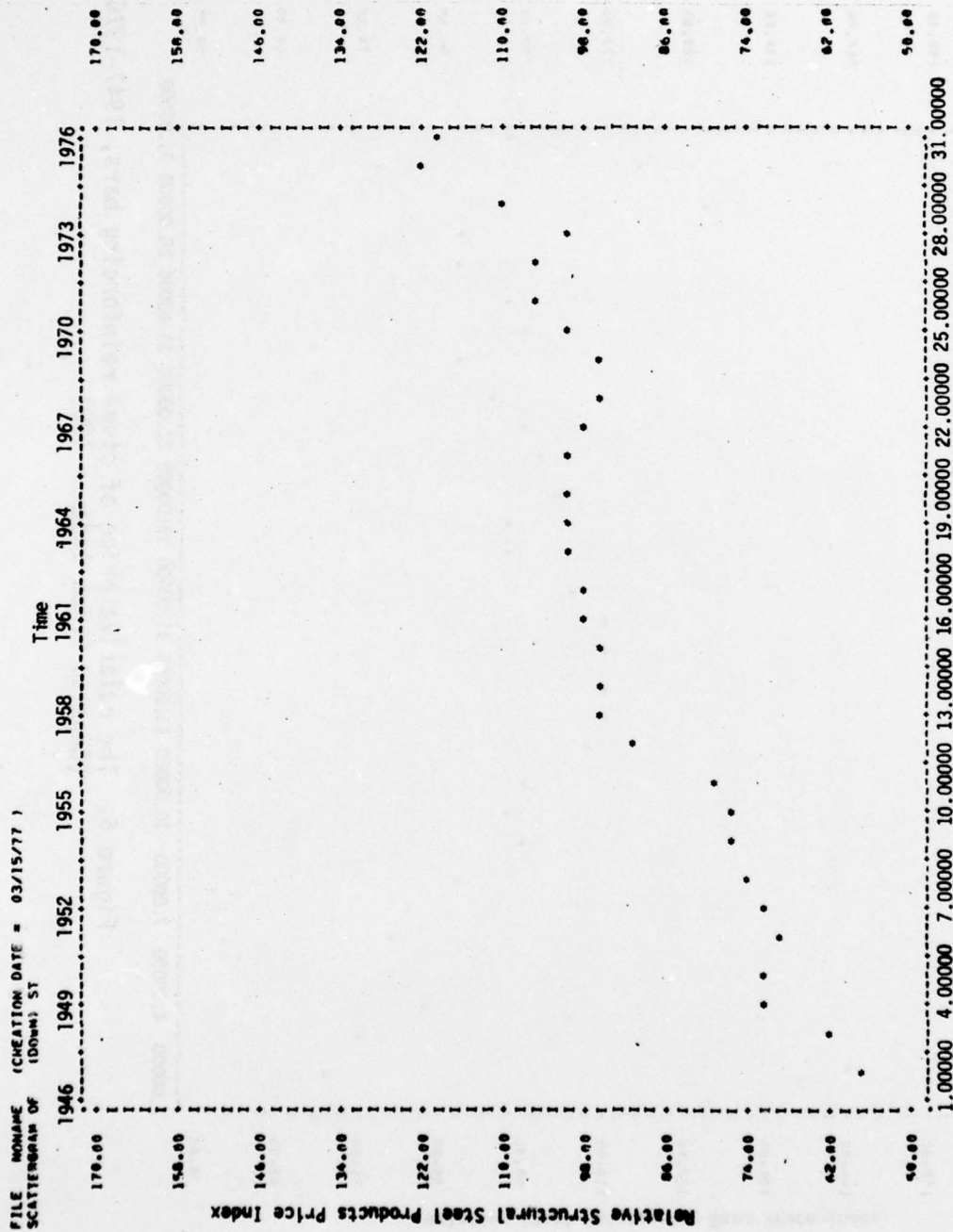


Figure 5. The relative price of structural steel products, 1947-1976.
 (General Price Index = 100)

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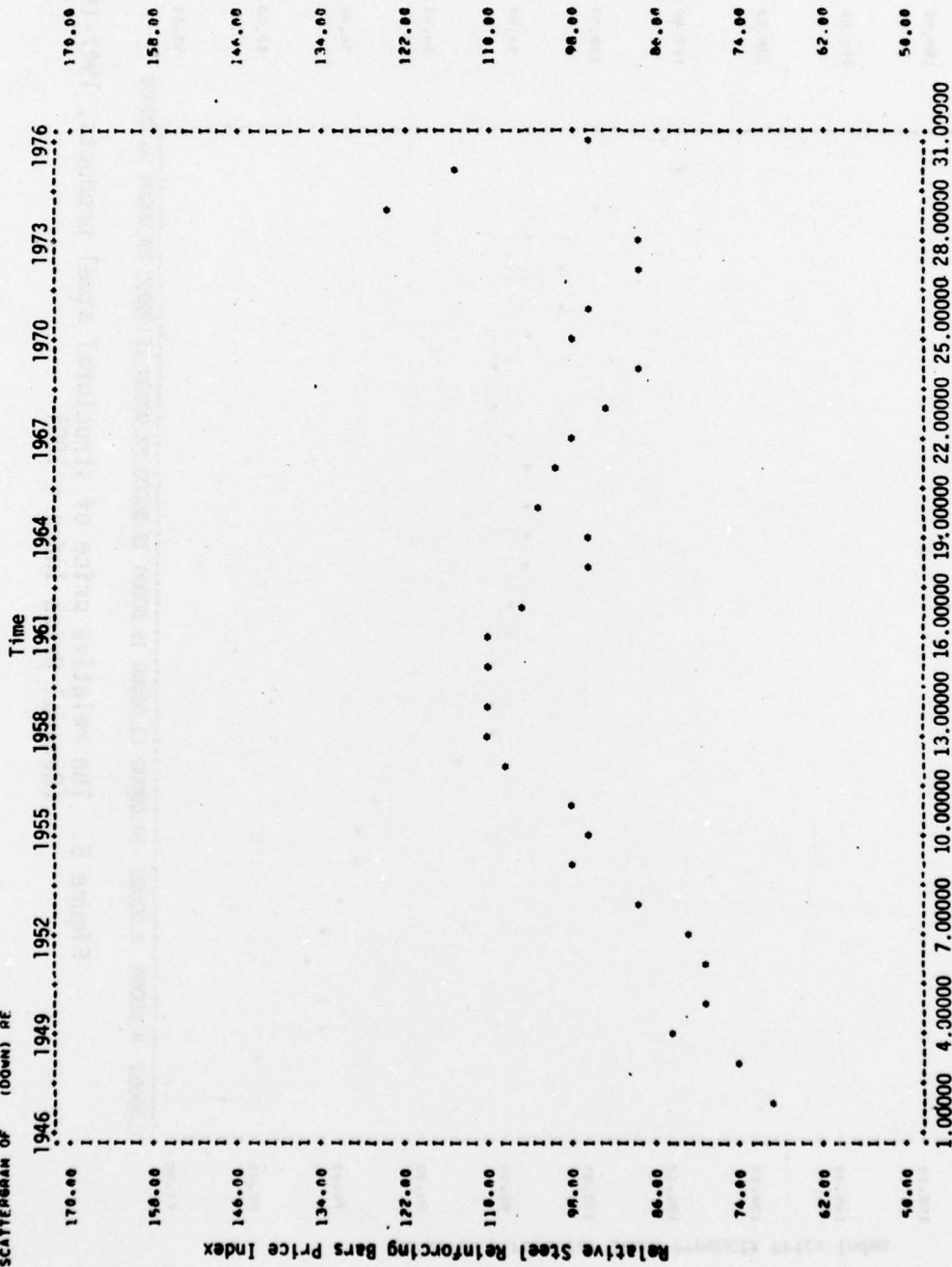


Figure 6. The relative price of steel reinforcing bars, 1947-1976.
 (General Price Index = 100)

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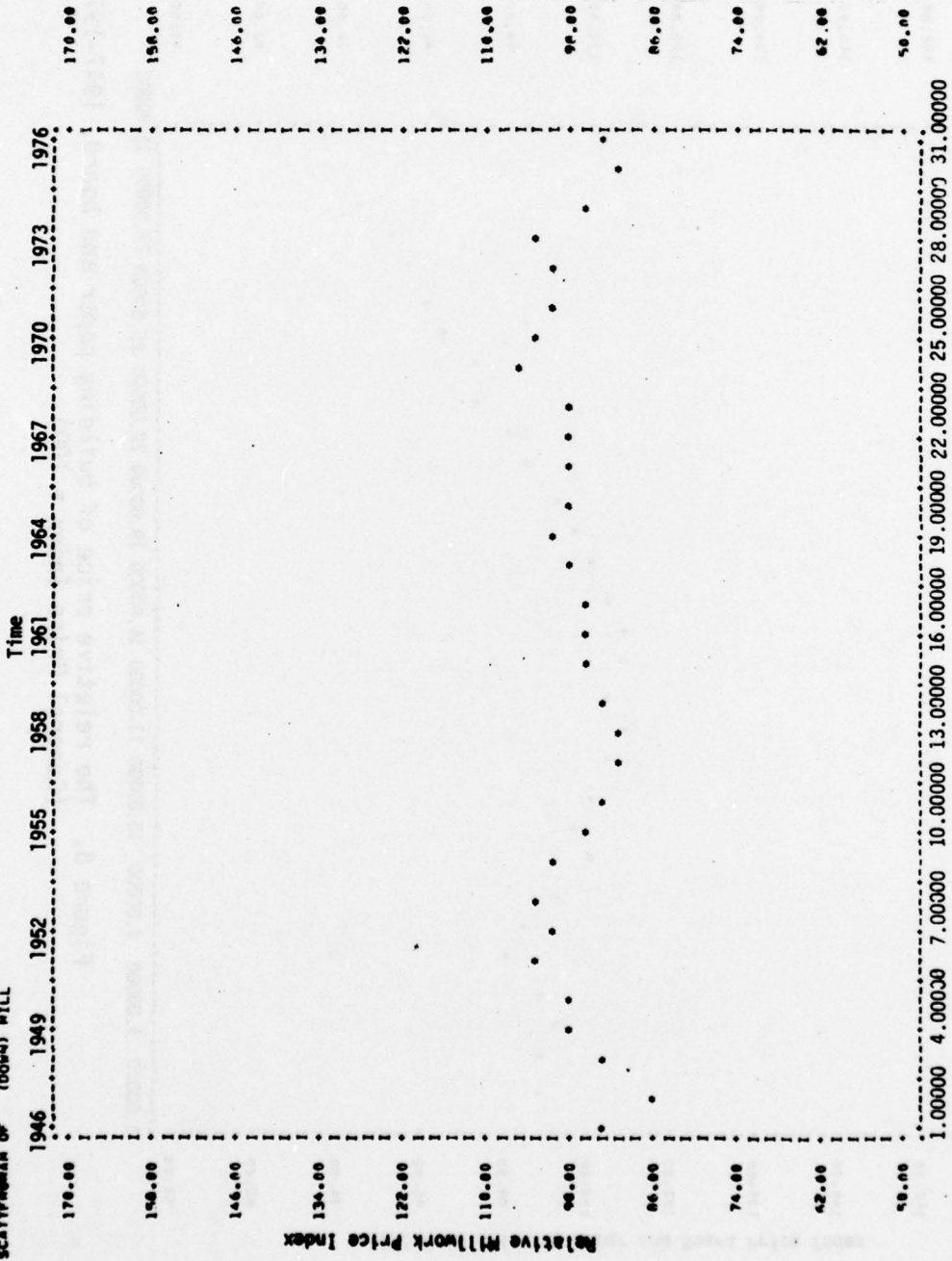


Figure 7. The relative price of millwork, 1946-1976.
 (General Price Index = 100)

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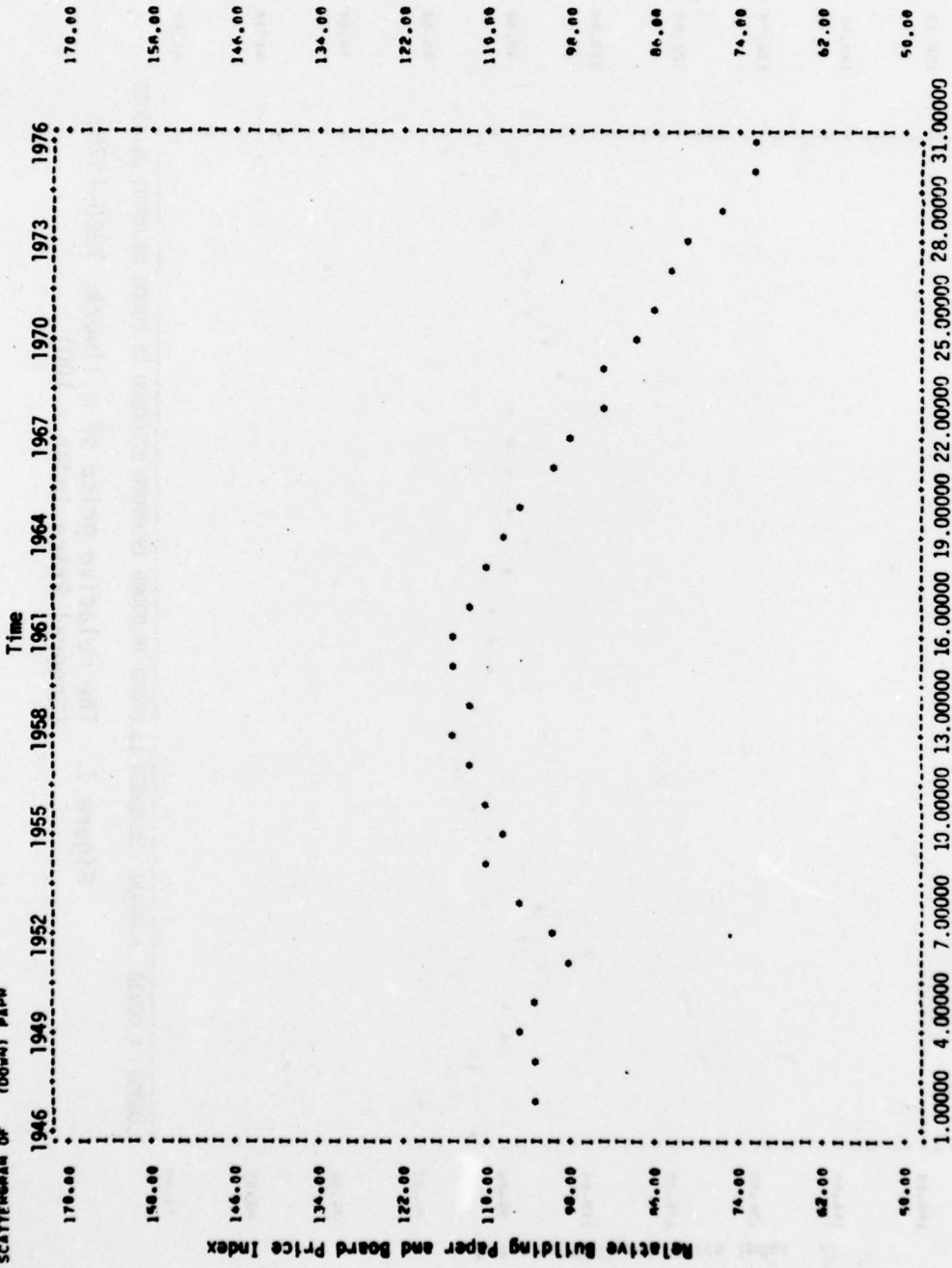


Figure 8. The relative price of building paper and board, 1947-1976.
 (General Price Index = 100)

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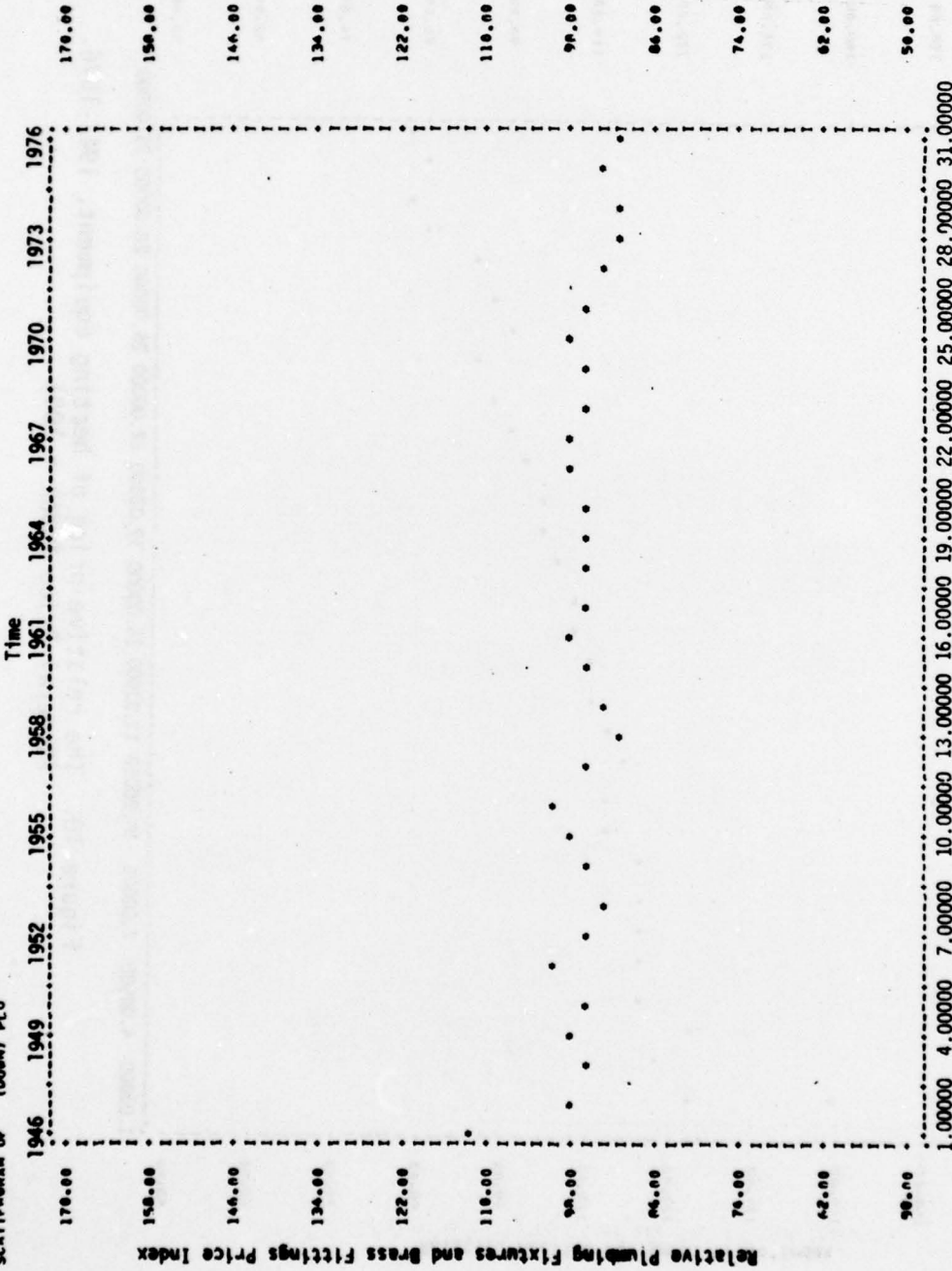


Figure 9. The relative price of plumbing fixtures and brass fittings, 1946-1976. (General Price Index = 100)

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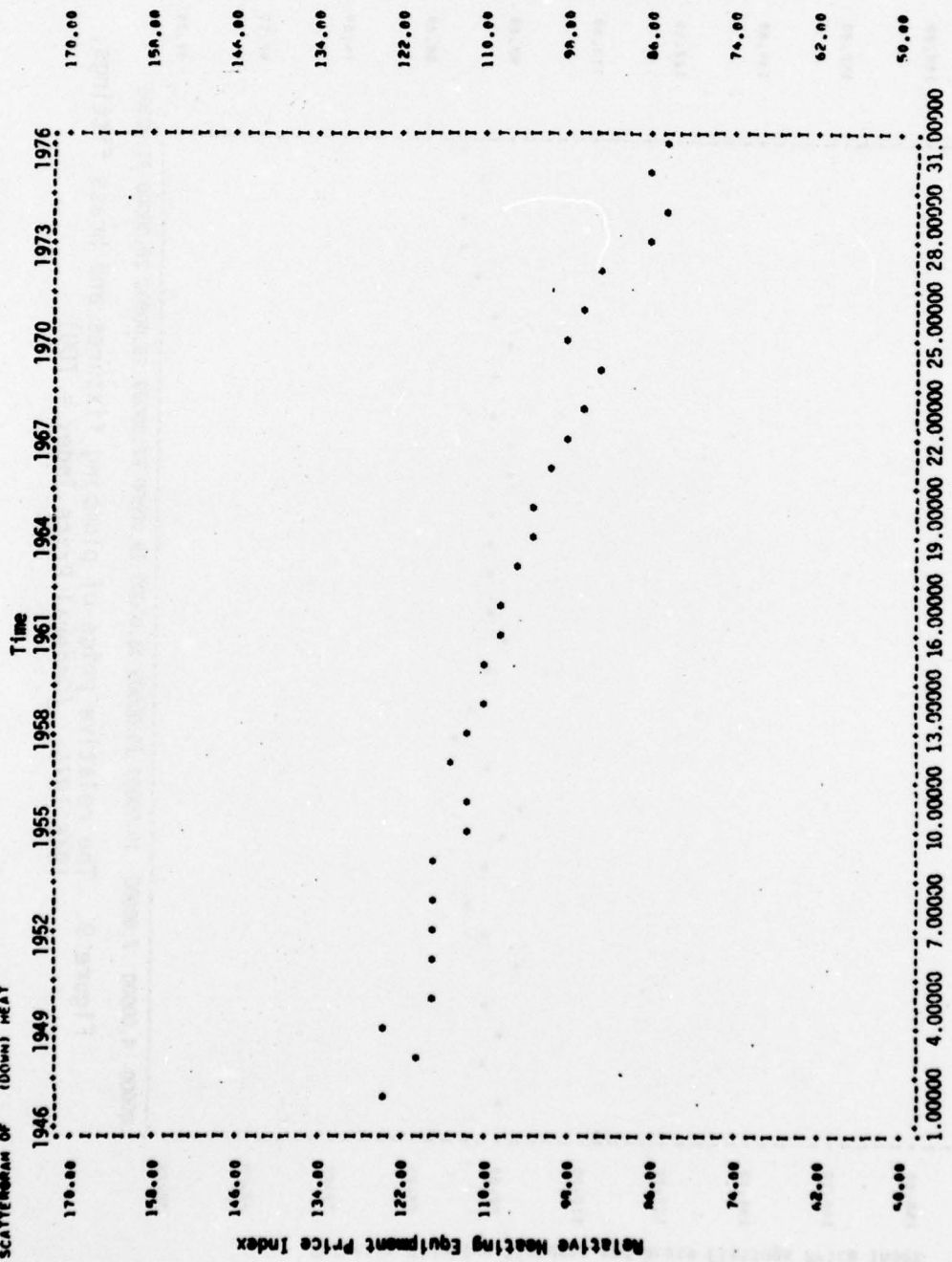


Figure 10. The relative price of heating equipment, 1947-1976.
 (General Price Index = 100)

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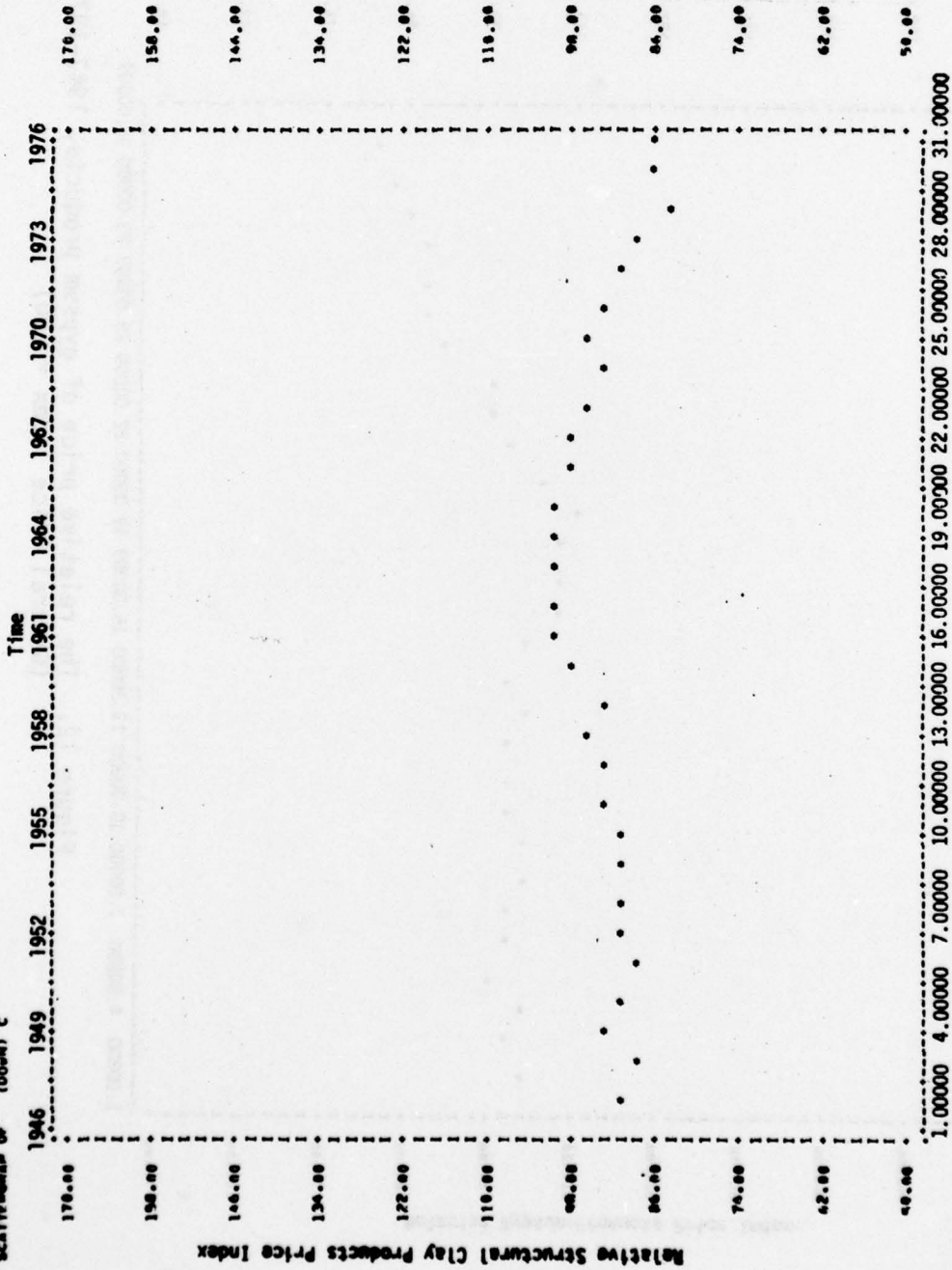


Figure 11. The relative price of structural clay products, 1947-1976.
(General Price Index = 100)

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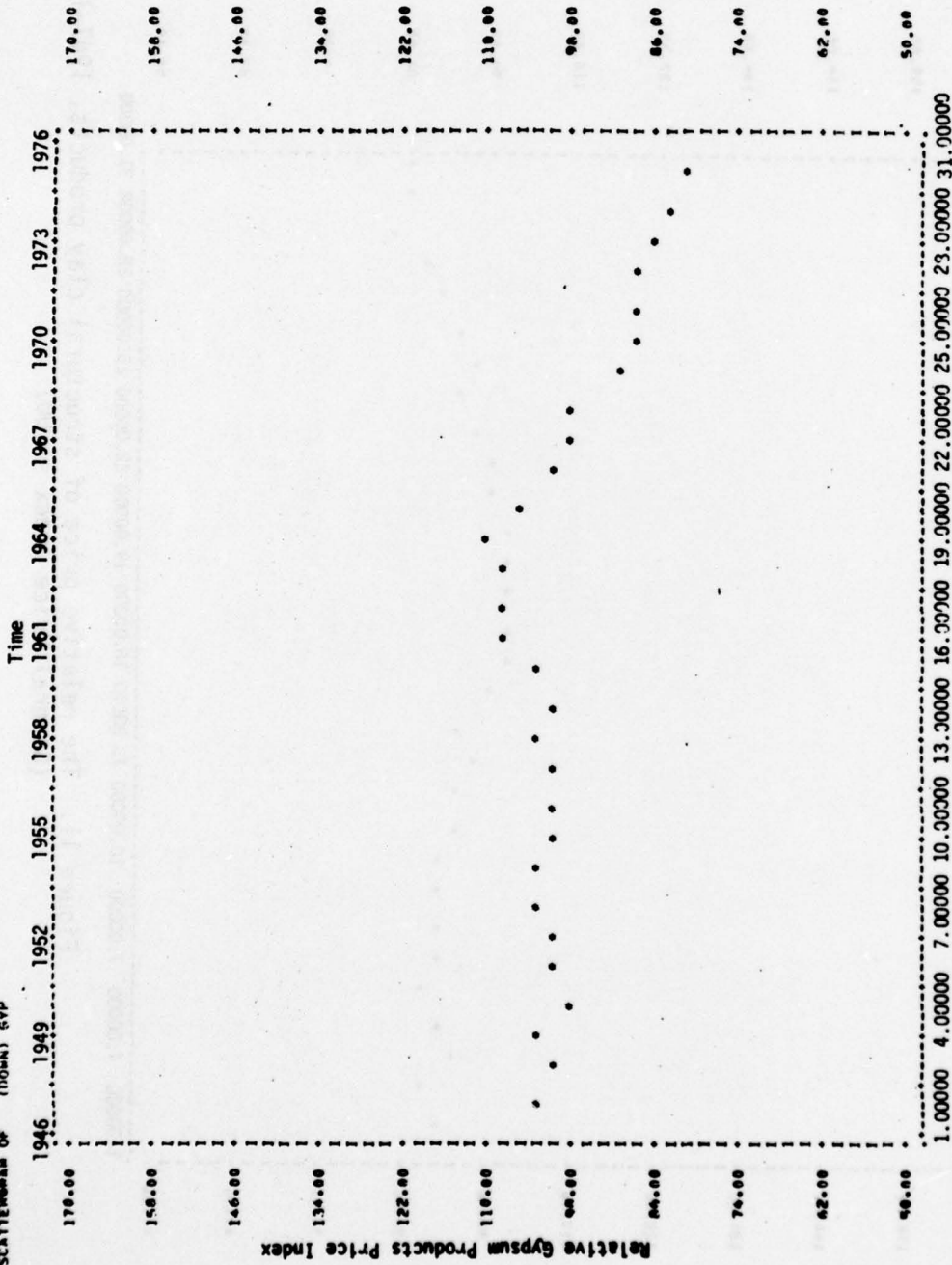


Figure 12. The relative price of gypsum products, 1947-1975.
 (General Price Index = 100)

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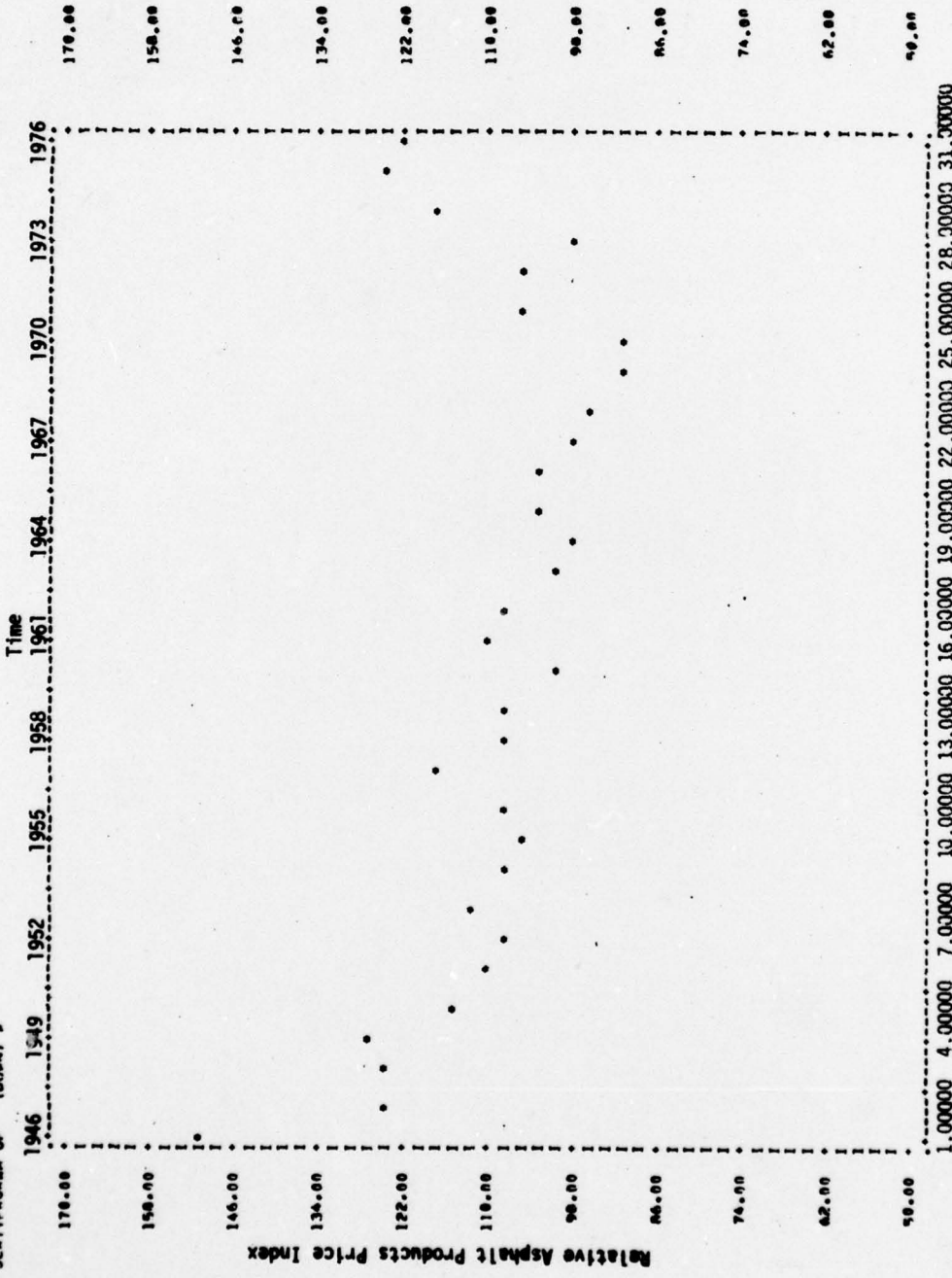


Figure 13. The relative price of asphalt products, 1947-1970.
 (General Price Index = 100)

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